HOUSEHOLD RISKY ASSETS:
SELECTION AND ALLOCATION

DISSERTATION

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ABSTRACT

Investment in high return risky assets is an important factor in households’ future economic well-being, especially in terms of their potential retirement adequacy. However, in discussing the household wealth composition, most previous studies on household portfolio choices focused on the role of risky financial assets in household wealth accumulation, overlooking the importance of risky nonfinancial assets in household asset selection and allocation. Only in the last decade have some researchers begun to examine background income risk associated with households’ risky nonfinancial asset investment and its effect on their financial investment behavior. While theoretical analyses demonstrate that background income risk resulting from risky nonfinancial asset investment can substitute or crowd out a household’s investment in risky financial assets, few empirical analyses have been conducted to examine the extent of this effect and there is not much consensus on the extent of this effect. More importantly, previous studies have not verified the correlation between household risky financial asset investment and risky nonfinancial asset investment empirically, thus the fundamental relationship of household risky asset selection between different categories of risky asset is still vague.

By using the 2004 Survey of Consumer Finances, this study examines whether there is a close linkage between the choices and levels of different types of risky assets owned by American households. It is crucial to take the potential interaction relationship
between risky asset categories into consideration in examining household portfolio choice, as conclusions about the efficiency of household choices depend on the relationship.

Even though some researchers provide evidence of determinants of household investment of self-employed households or entrepreneurs, the effect of a household’s investment in financial market and its associated financial risk on its investment behavior on risky nonfinancial assets has not been fully investigated. The potential impact of household risky financial investment on its alternative investment in risky nonfinancial assets is also examined in this study.

Generally speaking, this research views households’ portfolio choice in terms of the overall composition of risky assets, and explores households’ choices between investment in risky financial assets and investment in risky nonfinancial assets jointly rather than independently. The analysis can be divided into two parts—risky asset selection and asset allocation. These two research issues are integrated throughout the theoretical framework and empirical analyses. First, based on the assumption that households make decisions of portfolio selection and allocation from their overall expectation of investment return, this study estimates the interdependent relationship of household risky asset selection in financial and nonfinancial asset categories by using a Bivariate Probit model, which estimates the determinants of two types of ownership of household risky assets simultaneously on the conditional probability of other risky asset ownership, while other household characteristics are controlled. The significant Rho in the model demonstrates that household asset selections in risky financial and nonfinancial assets are interrelated with each other. Thus, the first hypothesis of the household risky selection is not rejected, which suggests that it is important to examine households’ asset
allocation with considering their investment in each type of risky asset jointly. Based on that result, the research further investigates the determinants of household asset allocation by looking at the shares of each type of risky asset of total assets respectively by utilizing two sets of Tobit analyses, while controlling for the effect of the other alternative risky assets investment on each asset category.

The key findings from the analysis of the household demand of risky financial assets with consideration of household risky nonfinancial asset investment support the proposed hypothesis that background income risk resulting from households’ risky nonfinancial asset investment has substitution effect on household risky financial asset investment. Households with investment in private business or investment real estate invest significantly lower proportions of their assets in stocks, and the more they invest in risky nonfinancial assets, the less that they invest in stocks.

This research extends previous studies in portfolio choices by investigating the potential effect of households’ risky financial investment on alternative risky nonfinancial investment. Using a Tobit model analyzing the determinants of household risky nonfinancial asset investment while controlling household risky financial asset investment status and other household characteristics, the results indicate that household risky financial asset investment crowds out household risky nonfinancial assets. In other words, households with investment in stocks directly and indirectly invest significantly lower proportions of their assets in private business or investment real estate, and the more they invest in stocks, the lower the proportions of assets invested in risky nonfinancial assets. Thus the interdependent relationship of household risky asset portfolio choices exists not only in household risky asset selection but also in household
asset allocation. The result provides evidence that households’ portfolio selection and allocation in particular type of risky asset are strongly influenced by their investment in the other type of risky assets. The significantly correlated relationship and effects on each other’s actual allocation proportion further confirm the importance of viewing households’ investment behavior in terms of overall composition of household investment assets. Hence, understanding the composition of household risky assets is of particular importance to analyze households’ investment behavior in either risky financial assets or risky nonfinancial assets.

This research contributes to the literature in this regard by providing a direct estimation of potential interdependent relationship of household risky asset selections and a comprehensive empirical study to examine the overall determinants of households’ risky financial assets and risky nonfinancial assets. This result has important implications for future research and professional practice as well. The study implies that both financial professionals and policy makers should consider the potential interaction effect between household investment behavior in risky financial assets and risky nonfinancial assets.
Dedicated to my family
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CHAPTER 1

INTRODUCTION

1.1 Background and Motivation

How households select and allocate their portfolios has been an important issue to economic researchers and policy makers. Most literature regarding household asset allocation focuses on the relationship between households’ wealth level with their investment in the financial asset market mostly, rather than the composition of their overall wealth or their portfolio choices of asset allocation among different wealth components (Visser-Jørgensen, 2002). Households face an asset allocation question of risky versus safer assets, but they also face the question of which type of risky assets to select and how the relative proportions of investment affect the demand of each other. How households select and allocate their risky assets within their limited financial resources with the consideration of their alternative investment strategy is important but has not been fully investigated by previous researchers.

Investment in publicly traded stocks is a type of risky asset commonly accepted and discussed in previous literature. The importance of stock investment as a risky financial asset in households’ wealth accumulation has been examined extensively by previous researchers (e.g. Hanna & Chen, 1995; Bertaut & Haliassos, 1995; Bertaut &
Starr-McCluer, 2000) and a large amount of research has been focused on the research of household stock market participation and the problem of the “stock-holding puzzle”, that is, why do most households not hold stock assets. Nevertheless, in addition to stock investment, there are other risky asset investment categories such as real estate and private business investment, and they can also bring similar rates of return to a household and can be treated as an important alternative to household stock investment in terms of building wealth.

In the 1990s, there was an increasing percentage of households holding risky assets in their portfolios in many countries (Guiso, Haliassos & Jappelli, 2002). Given the importance of risky assets in household well-being, many economists have begun to focus on household portfolio choices and their effects on wealth accumulation and distribution. Recently the research on household asset allocation has been extended to a much broader categorization of risky assets instead of concentration on the risky financial assets only. Therefore household risky nonfinancial asset investment behavior, especially private business investment and real estate investment has now received greater attentions.

The interaction of risky nonfinancial assets with risky financial assets is an important issue for exploring the household portfolio choice as they constitute two of the most important components of household wealth in terms of reaching long-run goals such as retirement adequacy. Despite the fact that nonfinancial assets account for a majority of households’ wealth (Bucks, Kennickell, & Moore, 2006), very little work has been done in examining their roles in affecting households’ decision about portfolio allocation or how household characteristics influence household risky nonfinancial asset allocation.
Another reason why risky nonfinancial assets need particular attention is that the risk associated with this type of investment is different from the risk the individuals undertake in financial market. Most studies analyzing household portfolios assume that the decision makers face a single source of risk—financial risk of assets traded in the market. However, in the real world, some important components of wealth are not traded in financial markets, for instance the income from investment in private business or real estate. Under these circumstances, people face uncertain risks from the nonfinancial market as well as financial investment simultaneously. The risk that households bear from uncertain income in the form of investment in real estate and privately held business, in addition to the financial risk from publicly traded stock assets, is predicted to have an impact on household portfolio choice individually and jointly. Although many researchers have noted the importance of this risk, only few very recent studies discuss the impact of households’ uncertain risk on their asset allocation.

Household financial investment behavior in risky financial markets might affect their alternative choice in risky nonfinancial asset investment as well. When exposed to financial risks, the investors might reallocate their risky assets or select a different category of assets in order to reduce their total avoidable risks. Thus, the effect of financial risk on households’ investment in risky nonfinancial markets should also be investigated under this circumstance.

To sum up, this research is intended to provide further empirical evidence of household financial investment behavior under the condition that households hold risky nonfinancial assets. On the other hand, the research also explores how household financial investment behavior influences investment in nonfinancial markets. By
combining the results from these two aspects, the study can better explain how household investment behavior differs in various household asset compositions.

1.2 Research Questions

This research divides households’ total risky assets into two main groups: risky financial assets and risky nonfinancial assets. It is assumed that households decide how to select their risky asset investment between these two types of assets and allocate relative shares of their assets into specific categories based on their future financial goals of maximizing their total expected utility from investment returns with limited household financial resources. It is also assumed that all households have flexibility in choosing either type of risky assets and investing any proportion of their total assets in either type of risky assets. Correspondingly, households have to undertake particular types of risks in investing in either type of these risky assets in order to obtain an expected rate of return.

The main goal of this research therefore is to shed more light on household investment behavior in risky asset markets by examining households’ choice of risky financial asset (stock investment) and risky nonfinancial asset investment (investment in private business and investment in real estate) jointly. Different from previous studies in analyzing household risky asset selection, the model presented in this research treats households’ risky asset selection in those two types of risky assets simultaneously rather than separately. Based on the theoretical framework related to the background income risk and financial risk, this research will provide a comprehensive analysis of household investment behavior in overall risky asset market, with the consideration of the
interdependent relationship between risky financial asset investment and risky nonfinancial asset investment.

To be more specific, the purposes of this study are threefold:

1) to investigate whether household asset selections in different types of risky assets are significantly correlated with each other and ascertain the determinants of asset selections conditional upon the probability of the household holding alternative risky assets;

2) to examine the determinants of household risky financial asset allocation measured by the relative share of stock investment of household total assets, while controlling for household background income risk resulting from their risky nonfinancial asset investment status and holding other household characteristics constant;

3) to explore the determinants of household risky nonfinancial asset allocation measured by the relative share of risky nonfinancial asset investment of households’ total assets, while controlling for household risky financial asset investment status and holding other household characteristics constant.

Investigation on those problems may help us better understand household portfolio choices from both the respects of asset selection and asset allocation. In addition, the study can provide a clearer picture of household investment behavior in both financial and nonfinancial asset market.
1.3 Contributions of Research

With the goal of examining household portfolio choice from both aspects of selection and allocation in both risky financial assets and risky nonfinancial assets, this research has a number of contributions to the literature:

This study includes the two most important aspects of household portfolio choices, asset selection and asset allocation. By exploring both the determinants of households’ decisions in asset selection in risky financial asset and risky nonfinancial asset as well as the determinants of the shares of each investment, the study can explain household investment behavior in risky asset markets more comprehensively rather than emphasize one individual aspect. Moreover, this study, goes beyond previous studies by assuming that the households make decisions on whether to invest in a certain type of risky asset or how much to allocate relative to different portfolio categories conditional upon the status of other investment alternatives. In this empirical study, the households’ selection in stocks and risky nonfinancial assets are treated as two dependent endogenous variables and that they are determined by other household characteristics simultaneously. Thus, the interrelation between these selections can be estimated and the result will be integrated into the second part of the analysis of household risky asset demand.

By controlling household risky asset ownership and the actual amount of investment separately in different risky asset demand models, the study provides a more in-depth examination of household risky asset allocation, with the consideration of the interactions of household asset selection in risky financial assets and risky nonfinancial assets. Therefore, the study includes household risky asset investment behaviors in terms
of both selection and allocation and in the categories of financial and risky nonfinancial assets.

This study also extends previous studies by the investigation of the effect of risky nonfinancial asset investment on households’ financial risk-taking behavior, and by examining the effect of households’ risky financial asset investment on their risky nonfinancial asset allocation. In this way, it further illustrates the interrelationship between household risky asset demand in both risky financial market and risky nonfinancial market.

This research also treats households’ individual risk tolerance as an exogenous factor, which is a constant household characteristic in the whole life cycle. It is assumed that individual risk tolerance will not be increased or decreased by the background income risk resulting from household alternative investment in risky nonfinancial assets. In this way, the study views households’ risk-taking behavior based on the total risks they are undertaking, including both financial risk and background income risk. Compared to previous studies, this adjustment will provide a better explanation of household different investment behaviors in different situations.

1.4 Research Organization

The dissertation is organized as follows. After an introduction of the research background, main research questions and related contributions are presented in Chapter 1. Chapter 2 reviews the most important studies related to both household financial and risky nonfinancial asset investment, especially regarding to the role of risky nonfinancial asset investment in household portfolio choice. Following that, Chapter 3 describes the
theoretical framework for this research based on theories presented in previous literature, and formulates the hypotheses to be tested. Chapter 4 describes the data set utilized in the analysis and the statistical methodologies employed in univariate and multivariate analyses as well as the variables included in this study. The statistical results are reported in Chapter 5 and their linkage with previous literature and hypotheses are discussed as well. In light of statistical findings from this study, Chapter 6 further discusses the importance of those findings based on the comparison with previous empirical analyses. Improvements and extensions made in this research have been summarized and implications for future research, practitioners, financial educators, and policymakers are discussed.
CHAPTER 2

LITERATURE REVIEW

This chapter first briefly reviews and discusses the most important studies related to household portfolio choice, stressing two types of portfolio choices: financial and risky nonfinancial asset investments. The impact of household risky nonfinancial asset investment on the choice of risky financial asset investments is addressed. The importance of considering those two types of investment together rather than separately is highlighted in line with previous studies.

2.1 Household optimal investment and wealth composition

Theoretical analysis of household portfolio choice has been largely limited to the choice between risk-free and risky financial assets since the middle of the last century (Markowitz, 1952; Tobin, 1958). Traditional portfolio theory mostly focuses on understanding financial portfolio selection, with a lack of concentration on the other components of household wealth. More recent analyses have started considering the effects of housing, real estate or entrepreneurship on household risky financial asset allocation, but the impact of household risky financial asset on the alternative risky nonfinancial asset allocation has not been investigated empirically. The following section
is to review the basic history of portfolio theory development and its application in explaining household asset investment behavior.

The earliest portfolio theory can be traced to Markowitz (1952), who presents the famous mean-variance analysis. In that model, the individual makes investment decisions by balancing the expected return (mean) of financial investment and the riskiness (variance) of the return on each asset.

Tobin (1958) further illustrates that risky assets comprise different proportions of a household portfolio, and proposes that the more risk adverse investors should hold a greater proportion of their portfolio in risky assets. Bodie, Merton, and Samuelson (1992) examine an individual’s optimal investment and consumption decisions by employing a life cycle model. They find that wealth composition does influence one’s optimal portfolio choice. They also argue that an individual with flexible labor should invest a greater proportion of his/her financial wealth in the risky assets than a counterpart with fixed labor. The result of their model suggests that labor supply flexibility\textsuperscript{1} can play an important role in household asset allocation. They also propose that at any given age in the life cycle, greater labor flexibility will induce greater risk taking in an individual’s financial investment when all other things are equal. They also propose that at any given age in the life cycle, the riskier an individual’s human capital is, the lower his/her financial investment in risky assets will be.

King and Leape (1987) focus on the household asset allocation. The authors use a survey of 6,010 U.S. asset holding and wealthy households based on the data drawn from the 1978 Survey of Consumer Financial Decisions, with emphasis on the number of

\textsuperscript{1} Flexible labor occupations in their study refer to those that offer opportunities for working extra hours, taking extra jobs, or delaying retirement.
information-intensive assets. They counted as information-intensive assets, stocks, corporate bonds, municipal bonds, savings certificates and saving bonds, treasury bonds, money market funds and instruments, and single-premium annuities. Based on the Probit estimates for the ownership of information-intensive assets, the study shows that the probability of ownership increases with age, even after controlling for change in wealth, marginal tax rate, and household characteristics. They also suggest that optimal portfolio construction may be restricted by lack of exposure to investment information.

Obviously, most previous research has emphasized the discussion of investment or household wealth allocation over stocks, bonds or mutual funds, or simply the investment in financial markets in achieving an expected return under a certain level of financial risk associated with typical financial portfolios. The research overlooks another important component of household wealth in risky assets, risky nonfinancial assets, which include households’ real investments in privately owned business or real estate assets.

Risky nonfinancial assets constitute an important portion of households’ total wealth. Yet most of the previous literature only pays attention to the level of their financial wealth in terms of meeting financial needs. It does not consider the composition of wealth and households’ portfolio choice in other alternative risky assets, thus ignoring the role of risky nonfinancial assets as an important component of risky assets in household portfolio choice. Empirical analysis has been infrequently carried out by previous researchers regarding the determinants of this particular type of risky asset, especially with consideration of household risky financial asset investment.
Embrey and Fox (1997) make an improvement by carrying out a study focused on the gender difference in household risky asset investment, in which they include they include stocks, business and housing. They use the 1995 Survey of Consumer Finances (SCF) for the United States but focus the sample on women living alone and compare them with men living alone. They conduct two separate Tobit analyses, with one analyzing the determinants of household investment in stocks and CDs, and the other examining the determinants of the household investment in houses and businesses. They find that there is little difference between the determinants of investing in stocks and CDs between men and women, whereas there is great difference with the respect to house and business investment. They find that the investment in a business increases more rapidly with net worth for women than for men.

2.2 Determinants of household investment in risky financial assets (stocks)

Using traditional portfolio choice theory, Merton (1969, 1971) and Samuelson (1969), propose that with complete markets, if investors are living off financial income generated from multiple financial assets, all investors should invest some of their household assets in risky assets. However, inspite of the high risk premium of financial investment returns, most American households still choose not to hold stocks. Bertaut and Starr-McCluer (2000) show that over half of all American households do not hold any type of stock investment, a lack of market participation noticed by many previous researchers².

While previous researchers' methods vary in analyzing the distribution of household wealth, there is agreement that the distribution of wealth in the United States is

² The market here and market nonparticipation discussed later refer to financial market, or stock market.
very unequal and that inequality has worsened in recent decades. Keister and Moller (2000) note that participation in stock and real estate investments markets have very important influences on the unequal distribution of wealth. Based on the information of 2004 SCF, a majority of households (nearly 51%) do not have any stock holdings at all (Bucks, et al. 2006). But Campbell and Viceira (2002) suggest that it may be not surprising that low income households with low income avoid the stock market, since they use financial assets as a buffer-stock against shocks to income and desired expenditures. However, they also point out that even though wealthy households are more likely to hold stocks, among households with more financial assets, a substantial fraction of them still hold no stocks at all. Mankiw and Zeldes (1991), for example, report that only 48% of households with liquid assets above $100,000 held stocks in 1984. Obviously, the financial investment in stocks is a problem for all kinds of households at different levels of wealth.

Although a lot of effort has been made to explain this “stockholding puzzle”, most economic and finance literature focuses only on the relationship between an individual’s level of financial wealth and how households make decisions about their portfolio allocation based on their financial condition, rather than the composition of total wealth and the interactions among different asset components. The later section of this part is to present several important reasons that could explain households’ choice of not holding stocks.
2.2.1 Fixed information and transaction costs

The fixed information cost of holding stocks could be tangible, such as brokerage fees or the cost of becoming informed about investing in stocks. Also, whereas opening a checking account is fairly straightforward, it takes time to learn how to invest in other assets and to manage them over time (quarterly statement, tax returns, and etc, Bertaut & Starr-McCluer, 2000).

There have been a number of attempts to analyze the effect of the fixed costs that may discourage stock market participation. Bertaut and Haliassos (1995) and Bertaut (1998) identify the role of information costs in deterring investment in stocks. Vissing-Jørgensen (2002) finds that low income households with tend to avoid the fixed costs because stockholding may not pay for households with little financial assets. Those households may wish to hold their financial assets in a convenient, liquid form. Therefore, it is reasonable for them not to hold any risky assets.

2.2.2 Individuals’ relative risk aversion (RRA)

Previous researchers contribute significantly to the examination of how individuals’ relative risk aversion influences the propensity of households to take financial risk corresponding to their investment in a financial market. An interesting question is whether stock holders are more risk tolerant than non-holders. A number of studies have analyzed financial risk tolerance using the risk tolerance question in the Federal Reserve Board’s Survey of Consumer Finances (SCF), a reasonably reliable measure of investment risk tolerance as suggested by Grable and Lytton (2001) and adopted by a great body of research. Some previous studies examine households’
reported willingness to take financial risk and its relationship with the riskiness of their portfolios. Schooley and Worden (1996), for instance, compare households’ reported willingness to take financial risk to the riskiness of their portfolios based on the 1989 SCF. Overall, they find that households do allocate portfolio holdings consistently with their preferred attitudes toward risk-taking to increase investment returns.

Faig and Shum (2002) employ the self-reported measurement of risk tolerance based on the 1995 SCF and they show that a higher self-reported degree of risk aversion is associated with a safer financial portfolio. However, Haliassos and Michaelides (2003) and Gomes and Michaelides (2005) argue that risk averse households have a strong precautionary saving motive, and therefore they tend to accumulate more wealth. So, though most literature agrees that households holding stocks are less risk averse than households not holding stocks, the conclusion about correlation between the level of individuals’ risk aversion and the level of the riskiness of their assets is not consistent.

2.2.3 Risky nonfinancial assets and the associated background income risk

Another important reason provided by previous researchers in explaining the stock holding puzzle is that households own other risky nonfinancial assets. With the uncertain labor income or background income risk resulting from their investment in nonfinancial assets such as privately owned business or real estate, this type of investment status has an effect of discouraging or crowding out households’ investment in risky financial market or stock holdings. Heaton and Lucas (2000a) and Campbell (2006) define this kind of nonfinancial market risk as background income risk or simply

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3 Risky assets in this study is defined to include the value of financial assets that provide an uncertain cash flow, the market value of real estate held for investment purposes, and an estimate of human capital.
background risk, distinguished from the financial risk that investors undertake in the financial market. Following this definition, the background income risk defined in this study refers to the risks resulting from uninsurable household income obtained from real investment in risky nonfinancial assets, including private business and investment real estate.

Wang and Hanna (2007b), using the SCF dataset (2004), show that roughly 25% of households own some risky nonfinancial asset\(^4\), but the average of these assets is almost twice as much as that of risky financial assets ($146,064 vs. $89,218). It is evident that risky nonfinancial assets account for a large part of total household wealth. Whereas, of households having investment in business and real estate, only 77% hold stocks directly and indirectly and more than 23% of this type of household holds no stocks, although they represent a fraction of households with high or extremely high wealth. Based on the household portfolio optimization theory, it should be reasonable for business or real estate owners to substitute at least some amount of their own nonfinancial investment for the investment in the financial market to accumulate wealth so long as they anticipate some similar financial returns in the future. In this regard, their investment behavior is rational and their household portfolio allocation is more efficient with similar or higher returns expected but lower similar risk perceived.

The most relevant study in considering the role of risky nonfinancial asset on household stock market participation is done by Vissing-Jørgensen (2002) (the summary table of literature is attached at the end of this section), who uses data on income and asset holdings from the PSID (Panel Study of Income Dynamic) from the 1983 to 1992,\(^4\) It includes those households who have any investment in private business or real estate. Table 2.2.1 shows the definition of asset allocation in this study.
and other U.S. household level data sets from 1984, 1989 and 1994, supplementing the PSID to analyze reasons for nonparticipation in the stock market from the respect of households’ nonfinancial income. The study provides some empirical evidence to support the evidence of a positive mean effect of nonfinancial income\(^5\) and a negative risk effect on the probability of stock market participation. Overall, the results suggest that participation costs/transaction costs and nonfinancial income contribute substantially to understanding observed heterogeneity in portfolio choices across households and over time.

A number of studies investigating the impact of risky nonfinancial assets on household portfolio choice have used the concept of the background income risk. The potential importance of background income risks in asset allocation is well documented in the theoretical literature, especially in recent studies. Heaton and Lucas contribute significantly to the literature of risks and household investment on the condition of risky nonfinancial asset investment by two important papers they published in 2000. Heaton and Lucas (2000a)\(^6\), using 1989 to 1995 SCF and Tax Model data and concentrating on entrepreneurs, find that proprietary business wealth is important for households with substantial stockholdings, and that proprietary income risk influences portfolio choices. They report evidence that private businesses may crowd out ownership of publicly traded equities in that wealthy households with more variable proprietary income tend to have smaller proportions of equity allocated in their portfolios. In addition, their regression

\(^5\) Nonfinancial income defined in this study is all taxable income plus transfer income of head and spouse, minus income from dividends, interest, trust funds, and royalties.

\(^6\) Heaton and Lucas (2000a) construct a broad measure of financial wealth, including not only marketable financial assets but also proprietary businesses, pension, trusts, and liabilities such as mortgages and consumer loans.
results indicate that households with more private business wealth hold lower amount of stocks relative to other liquid assets. While focusing on labor income risk, Heaton and Lucas (2000a) also include relative real estate holdings\(^7\) in some of their specifications and they find a strong negative relationship between real estate exposure and stock holdings. Whereas, the effect of real estate investment on stock holding is positive, suggesting that this source of risk does not actually discourage stock holding. In their regression model of the share of stock holdings, they find that self-reported risk attitude has a negative effect on stock holding, with more risk-averse households avoiding stocks. To sum up, the empirical evidence of this research however, does indicate a potentially important role of background risks in households’ portfolio selection and allocation decisions. Although this research stresses the importance of entrepreneurial risk from the respect of their income risk on the households’ portfolio choice, its results have important implications in that background risk can explain why households with high and variable proprietary business income hold less wealth in stocks than other similarly wealthy households. Unfortunately, the role of investment in real estate has not been discussed clearly enough. Another limitation of this study is that because SCF is a survey conducted by single years, this study can not compare the risk from the stock market and the risk from risky nonfinancial markets. And also it can not track the change of the degree of household background risk because SCF is not panel data. Since one of the characteristics of background risk is that it is not stationary, which is also a feature of life cycle models, it is hard to compare the magnitude of the background risk across the years.

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\(^7\) Refers to the real estate value relative to households’ financial net worth.
Heaton and Lucas (2000b) improve on their first study by focusing on how the presence of background risk from sources such as labor and entrepreneurial income influences portfolio allocations instead of main income risk of entrepreneurs. This study is probably the most comprehensive empirical research in discussing the role of background risk in household portfolio choices. The results suggest that there is considerable heterogeneity in exposure to background risk, and that households with greater exposure tend to hold a smaller share of stocks in their portfolios. On the basis of Heaton and Lucas (2000a), this paper further explores the effects of background risk on portfolio choices in a calibrated decision-theoretic model. In addition to the statistical results by using 1992 to 1995 SCF data, they use 1979-1990 Panel of Individual Tax Return Data and exploit the panel dimension to calculate, by households, the standard deviations of labor income and business income and the covariance of these two income components with the S&P500 stock return, and track the households’ exposure to the degrees of their background risk over time. These results are used as regressors in a regression with the proportion of financial wealth invested in stocks as the dependent variable. These new calibration results point to an important role for background risk in understanding portfolio decisions taken by households. The result of this study is consistent with Heaton and Lucas (2000a) in that households with significant business holdings or ownership of their employer’s stock tend to hold smaller fractions of their liquid financial assets in the form of stocks.

Due to different characteristics of private business investment and investment real estate, some studies only focus one of two types of risky nonfinancial assets and its individual role in household asset allocation. Although they have not covered household
risky nonfinancial asset investment comprehensively, it is important to review their main findings and contribution to literature at this point. The next part of this section discusses the relevant literature regarding to the two components of risky nonfinancial assets—private business investment and investment real estate separately.

**Portfolio choices with the presence of private business investment**

Campbell (2006) points out that the private business assets can explain much of the nonparticipation in public equity markets for wealthy households. Moskowitz and Vissing-Jørgensen (2002) summarize some important characteristics of households owning private business investments. They find that investment in private equity is extremely concentrated. About 75% of all private equity is owned by households and it constitutes at least half of their total net worth. Furthermore, households with entrepreneurial equity invest on average more than 70% of their private holdings in a single private company in which they have an active management interest. Despite this dramatic lack of diversification, the estimated returns to entrepreneurial investment using the data from SCF and FFA/NIPA (the Flow of Funds Accounts and National Income and Product Accounts) to all private equity are similar to those of the public market equity index. Since entrepreneurs typically own equity in a single private firm, the risk faced by the average entrepreneurs may be higher still. Therefore their study strongly implies that households with risky nonfinancial asset investment in private business should diversify their household portfolio to balance their risk in operating their business.

Gentry and Hubbard (2004) examine the saving and investment decisions of entrepreneurs, and conclude that this group accumulates more wealth than non-
entrepreneurs, perhaps due to a precautionary demand for financing. They first confirm the interdependence between entrepreneurs’ investment and saving decisions and then report that private business owners hold as much as 40% of total net worth even though they comprise less than 10% of the population, implying that these households are particularly important for aggregate asset demands. They also stress the importance of interdependence between entrepreneurs’ investment and saving decisions, a factor that they think will affect the consumption choices and the portfolio allocation of both current and potential entrepreneurs. In this respect, households investing in business should increase their allocation in liquid assets or other financial assets in order to insure against business risk.

Moreover, Faig and Shum (2002), based on their analysis of the 1995 SCF, find that households that are saving to invest in their own homes or in their own businesses have significantly less volatile and safer financial portfolios than those who are saving for retirement, and their portfolio is more vulnerable because they rely on too much on their investment in business. Focusing on risky nonfinancial assets from the aspect of illiquid projects, they discover that a larger housing value, a bigger stake in investment real estate, and a greater business value are all associated with a significantly safer financial portfolio. They also provide some rationality for this phenomenon: because real estate and private businesses are risky assets, there may be a diversification motive for holding safer financial assets, in addition to liquidity needs. Similarly, Gutter and Saleem (2005) analyze the financial vulnerability of small business owners because business owners allocate less of their wealth to retirement assets than non-business owners since asset value of their business comprises the bulk of their wealth.
Portfolio choices with the presence of investment real estate

The largest nonfinancial investment of a typical household is non-residential real estate investment\(^8\) (Kullmann & Siegel, 2003), and the effect of this illiquid housing also plays a larger role in a life cycle savings. Similar to private business investment, previous studies also reveal that this type of investment is typically undiversified, highly leveraged, costly to adjust and but less correlated to stock returns. On the one hand, these characteristics suggest that real estate investment is likely to influence portfolio choices and induce lower levels of household stock holdings; on the other hand, the low correlation of housing returns with the stock market implies that it has some portfolio diversification advantages that could encourage greater amount of stock holdings. For instance, in a continuous-time framework, Cauley, Pavlov and Schwartz (2005) show that because it is not easy to freely adjust housing investment, households substantially change their target holdings of financial assets. In particular, this constraint results in significantly decreased stock holdings for households with large house value to net worth ratios.

The idea that housing affects portfolio choice has empirical support from a variety of data sources. Cocco (2004), by using the data from PSID from the year 1970 to 1992, addresses that investment in housing plays a crucial role in explaining the patterns of cross-sectional variation in the composition of wealth and the level of stockholdings

\(^8\) Unlike some other studies, the primary residence is not included in the calculation of real estate-related assets in this study because the main purpose of this research is to study the current asset allocation of U.S. households and to investigate whether or not household investors can be better off reallocating their investment assets. The primary residence is not a liquid asset and is not easy altered without incurring a lot of cost. In addition, the main purpose of having a primary residence is for consumption and psychological reasons, not the investment return. But, the homeownership status will be also controlled in the study.
observed in the composition data. The effects of nonparticipation in equity markets are also related to the real estate variable. Investors who have high levels of real estate relative to financial net-worth do not participate in equity markets. Therefore, his study provides empirical evidence that housing risk crowds out stockholdings, and this crowding out effect is larger for low financial net-worth households.

However, there is also some evidence of opposite results. In a dynamic consumption model, Yao and Zhang (2005) reveal that in the presence of labor income risk, home owners increase the proportion of stocks in liquid assets because of the diversification benefit, and find some empirical support in the 1998 SCF. They also study the effects of housing on the portfolio allocation of liquid wealth among stocks and bonds. They find that when investors are indifferent between renting and owning a house, they chose substantially different portfolio allocations when owning a house versus when renting. When owning a house, investors substitute home equity for risky stocks, but hold a higher equity proportion in their liquid financial portfolio (bonds and stocks).

Shum and Faig (2006) carry out an empirical study of the determinants of stock holdings using data from the SCF from 1992 to 2001. Different from Heaton and Lucas (2000a), the variable of real estate controlled in this study refers to the relative housing value and investment real estate. The study controls the ownership of real estate using two variables, one is the housing value relative to total net worth, where housing refers to each household’s primary residence. The other is the value of investment real estate relative to total net worth. They use the business value relative to total net worth as a proxy for entrepreneurial risk, the same variable that Heaton and Lucas (2000a) use in their study. Similar to Heaton and Lucas (2000a), they also control the respondent’s risk
tolerance in the analysis. By using a Probit analysis, the study reveals that stock ownership is positively correlated with various measures of wealth, age, retirement savings, and having sought financial advice. It is negatively correlated with holdings of alternative risky investments, such as investments in private businesses, relative business value and also with the willingness to undertake non-financial investment in the future. They also find that the higher the degree of a household’s risk aversion, the less likely that a household would own stocks. Their result also shows a negative, but statistically insignificant relationship between the risk from exposure to real estate and the likelihood of holding stocks. All of these results are consistent with Heaton and Lucas (2000a), but they also provide some possible explanation for this result. Theoretically, this relationship is ambiguous because exposure to real estate affects the financial portfolio in a variety of ways. Not only is real estate a risky investment, but also it has special characteristics such as being illiquid, providing the consumption stream of shelter, and generating regular liquidity needs (e.g., mortgage, property tax, and utility payments, and maintenance costs). Because of all these complexities, the interaction between housing and the financial portfolio is theoretically ambiguous. Following that, the study carries out a Tobit analysis of equity holdings, and the Tobit regression result confirms the result from the conditional linear regression analysis, which explains the equity shares by using pooled data from SCF 1992, 1995, 1998 and 2001.

Kullmann and Siegel (2003) examine household portfolio choices as a function of their exposure to risk from investment in real estate by using PSID data from 1984 to 1999. The study tests predictions of portfolio choice models that account for background risks, and in particular real estate risk. This study controls the variables such as the house
to net worth ratio, mortgage to net worth ratio, other real estate to net worth ratio, business to net worth ratio and other household characteristics. The findings strongly support the hypothesis that real estate risk significantly affects households’ financial portfolio compositions. Asset allocation models, as well as practical investment advice, can be improved upon by accounting for investors’ total risk exposure by taking their real estate holdings situation into consideration, instead of only considering their financial portfolio. The dependent variables included in this study are equity holdings divided by financial wealth or risky financial asset holdings divided by financial wealth. Financial wealth is defined as the sum of riskless asset holdings, equity holdings, and other financial assets. The analyses reveal that after controlling for wealth, income and other-possibly unobserved-household characteristics, real estate exposure reduces relative holdings of stocks and other risky financial assets. Higher mortgage balances, on the other hand, are associated with increased risky financial asset holdings. Although the relative share of risky financial assets is negatively associated with the exposure to real estate, homeowners are more likely to participate in the stock market than renters. However they also find that as the amount of home equity increases households increase the share of risk-free assets in their financial asset portfolio. The evidence from international data is also mixed.

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9 Riskless assets include the self-assessed value of checking and savings accounts, money market funds, certificates of deposit, savings bonds, Treasury bills and riskless assets held in IRAs. Equity holdings reflect the market value less related debt of stock in publicly held corporations, mutual funds or investment trusts, including stocks in IRAs. Risky financial assets are given by the sum of equity holdings and holdings of other financial assets. Other financial assets reflect the net value of other investments in trusts or estates, bond funds, life insurance policies, and special collections.
The advantage of this study is that by using PSID panel data, the author can track households’ income and stock holdings across the time, and by using different model specifications of a variety of econometric techniques, the study provides us with strong empirical supports of the hypothesis that real estate risk is a background risk that significantly affects households’ financial portfolio compositions. Different from the other studies, this study pays a lot of attention to the sample selection problem, and uses a model similar to Heckman (1979). The limitation of this study is that it emphasizes real estate and ignores the importance of investment in private business to a large extent, although the effect of holding a business interest is also discussed. Based on the results of previous studies, both of these two types of investment are equally important in explaining the effect of background risk and its correlation with households’ wealth composition, so there is no reason for us to overlook the importance of business investment.

Although previous literature points out the importance of uncertain income risk and background risk in explaining most households’ portfolio composition, this issue is still rather unexplored for a number of reasons. First, the validity of the interrelationship between household financial investment and nonfinancial investment has not been investigated. Although the risky asset investment from these two types of assets account for a large part of household portfolios, none of the previous studies verify empirically the interdependent relationship in terms of household portfolio selections between them. Obviously, a better empirical model is needed to justify why household investment in risky nonfinancial assets and in risky financial assets should be considered together rather than separately in order to better understand household investment in different situations.
Second, despite the fact that most of those studies achieve consistency about the crowding-out role of private business investments in household risky financial investment, they reach different conclusions on the effect of real estate investment. For instance, Heaton and Lucas (2000a) and Shum and Faig (2006) conclude that the negative effect of relative real estate investment on stock holdings is not significant, whereas Cocco (2004), Curcuru, Heaton, Lucas, and Moore (2006), and Kullmann and Siegel (2003) find the relationship is significant. Because both of these investments are important sources of households’ background risk, there is no reason to ignore or give more weight to either one.

Theoretically, the relationship between investment in real estate and stock investment is more ambiguous because exposure to real estate affects the financial portfolio in a variety of ways. Not only is real estate a risky investment, but also it has special characteristics such as being illiquid, less flexible to adjust the cost, and the demand for regular liquidity needs (e.g., mortgage, property tax, and utility payments, and maintenance costs). Because of all these complexities, the interaction between risky nonfinancial asset investment and the risky financial asset investment needs further exploration.
<table>
<thead>
<tr>
<th>Studies</th>
<th>Data Set</th>
<th>Dependent Variables</th>
<th>Main Controlled Variables</th>
<th>Statistical Models</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heaton and Lucas (2000a)</td>
<td>1989 to 1995 SCF and Tax Model data</td>
<td>Dollar value of stocks, the proportion of stocks relative to liquid, financial or total assets</td>
<td>Total income, net worth, business value, real estate value, relative real estate</td>
<td>Regressions</td>
<td>The income risk from proprietary business influences portfolio choice substantially with private business may crowd out ownership of publicly traded equities. Proprietary business wealth is important for households with substantial stockholdings, and that proprietary income risk influences portfolio choice.</td>
</tr>
<tr>
<td>Heaton and Lucas (2000b)</td>
<td>1992 to 1995 SCF data; 1979-1990 Panel of Individual Tax Returns</td>
<td>Wage income, proprietary income, return to housing</td>
<td>proportion of financial wealth invested in stocks</td>
<td>Simulation</td>
<td>Background risks play an important role in explaining non stock-participation. Background risk depresses the willingness to bear other avoidable risks. When investors are confronted with uninsurable income risk, they reduce their overall exposure to risk by holding a lower proportion of risky assets.</td>
</tr>
<tr>
<td>Kullman and Siegel (2003)</td>
<td>PSID (1984 to 1999)</td>
<td>Financial assets held in the form of risky financial assets</td>
<td>Share of housing, mortgage, other real estate</td>
<td>Heckman selection model</td>
<td>Homeowners are more likely to participate in the stock market than renters.</td>
</tr>
</tbody>
</table>

Table 2.1: Summary of literature on household risky asset demand (Continued)
<table>
<thead>
<tr>
<th>Studies</th>
<th>Data Set</th>
<th>Dependent Variables</th>
<th>Main Controlled Variables</th>
<th>Statistical Models</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>(restricted to the asset, financial assets and total assets)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Shum and Faig (2006)</td>
<td>1992, 1995, 1998 SCF</td>
<td>Decision to hold equity and the share of equity</td>
<td>Financial net worth, relative housing value, relative business value</td>
<td>Probit model and Tobit model</td>
<td>The decision to hold stocks is positively correlated with various measure of wealth. Stock ownership is negatively correlated with holdings of alternative risky investments (real estate and private business), and with the willingness to undertake non-financial investment in the future.</td>
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<tr>
<td>Cocco (2004)</td>
<td>PSID (1989) (restricted to the sample of those who own a house)</td>
<td>stock relative to liquid assets, financial net-worth, real estates over financial net-worth</td>
<td>income, financial net-worth, real estates over financial net-worth</td>
<td>simulation method; Tobit model</td>
<td>Investors with high levels of real estate relative to financial net-worth do not participate in equity market. Investment in housing reduces the benefits of equity market participation and house price risk crowds out stock holdings both for high and low levels of financial net-worth.</td>
</tr>
<tr>
<td>Embrey and Fox (1997)</td>
<td>1995 SCF</td>
<td>Net worth, income(by gender group) business; houses</td>
<td>Stocks ; CDs; business; houses</td>
<td>Tobit model</td>
<td>There are significant gender difference in household investment in business and house.</td>
</tr>
</tbody>
</table>

Table 2.1: Continued
2.3 Factor influencing household investment in risky nonfinancial assets

There are also some important factors associated with households’ investment behavior in risky nonfinancial assets, and the most commonly discussed factor is personal risk attitude from financial risk-taking behavior. For instance, a few recent studies find a strong relationship between risk tolerance and the probability of being self-employed or entrepreneurs, although the studies use different methods of measuring risk tolerance and sampling frame in their studies. An analysis of individuals’ risk tolerance may increase our understanding of the factors that may influence the propensity of households to take appropriate risks to invest in risky ventures (e.g. their own businesses), or invest in other risky assets (e.g. holding stocks) as an alternative (Norton & Moore, 2002). Cramer, Hartog, Jonker and Van Praag (2002) report on a survey of 5,800 school children aged 12 in 1952 and reinterviewed in 1983 and 1993, and conclude that more risk averse individuals are less likely to become entrepreneurs. Segal, Borgia and Schoenfeld (2005) use a comparative advantage approach to analyze the choices between being an employee and being self-employed and conclude that self-employment is a riskier occupational choice than being an employee. They find that an individual’s risk tolerance has a significant influence on the intention to engage in entrepreneurial activity. Ekelund, Johansson, Järvelin and Lichtermann (2005) use psychometric data and find that their measure of risk aversion has a statistically and quantitatively significant and negative effect on an individual’s probability of being self-employed. They also indicate that being male and being a homeowner is positively associated with the chance of being a business owner.
Using 1983 to 1995 SCF data, Carroll (2002) demonstrates that the portfolios of the rich are dramatically riskier\textsuperscript{10} than those of the rest of the population. The rich hold a much smaller proportion of their wealth in home equity and a much larger proportion in business equity and investment real estate. He also shows evidence that the rich are more risk tolerant than the rest based on 1983 SCF’s question about willingness to take risk in order to obtain the correspondent returns and also discusses the efficiency of preference heterogeneity in explaining this observed pattern of facts. He concludes that the rich have much higher propensity to be involved in entrepreneurial activities and to hold much of their net worth in the form of their own entrepreneurial ventures. He concludes that in principle, the household risk-taking preference can indeed explain the large share of business equity in the portfolios of the richest households, under the assumption that private business investments bear the highest risk and the highest returns among the categories of assets available.

However, there are many problems with this assumption. For instance, if the risk preferences of the rich were similar to those of the rest, the extra risk associated with their entrepreneurial wealth should induce them to try to minimize the riskiness of the remainder of their portfolio. If that is the case, the entrepreneurs would be much less likely to hold risky financial assets than those non-entrepreneurs with similar level of wealth. However, this research, similar to those of Heaton and Lucas (2000a and 2000b) treats households risk preference under the presence of risk stemmed from the risky nonfinancial investment as exogenous rather than constant. It is questionable to assume

\textsuperscript{10} The author includes three different kinds of measurement of risky assets: the narrow definition includes direct stock holding only; the broad risky assets include stocks plus the net value of businesses and investment real estate, and this measurement is closest to my definition used in this research; the broadest definition refers to all assets in the broad definition and probably safer assets.
that the households’ investment action in risky nonfinancial asset can reduce or increase the total risk (or the effective risk as described by Heaton & Lucas (2000a)) if we assume that an individual’s risk preference is an endowed attribute.
CHAPTER 3

THEORIES AND CONCEPTUAL THEORETICAL MODEL

This chapter first introduces the definition of risky assets utilized in this study, then it briefly surveys theories that help build up the theoretical framework in this research. It highlights the most important theories in explaining household risky asset selection and allocation in the presence of household background income risk resulting from risky nonfinancial asset investments and financial risk from risky financial asset investments. Based on the theoretical predictions, the conceptual theoretical models are established and the research hypotheses are formulated.

3.1 Definition of risky asset in the study

In order to build upon the foundation of this research, it is necessary to establish the categories of household assets, since there is no common criterion in literature. As shown in Table 3.1, the United State household portfolio is invested in following categories of assets:

1) Low risk financial assets, which include various bank accounts such as savings and checking accounts, certified deposits;

2) Risky financial assets, which mainly include investment in stocks directly and indirectly. The indirectly held stocks include mutual funds, retirement accounts,
IRA/Keoughs invested in stocks, other managed assets, thrift-type retirement accounts invested in stocks, and other financial assets which include loans from households to someone else, future proceeds and royalties.

3) **Personal use nonfinancial assets**, including primary residence, all vehicles not owned by a business, all other type of personal-use vehicles and miscellaneous nonfinancial assets such as artwork, antique, jewelry, furniture and valuable collections, for instance coin, stamp, etc.

4) **Risky nonfinancial assets**, including real investment in private business and real estate. Unlike stock investments, it is difficult to estimate the rate of return and standard deviation of investment in real estate in general, because of the diversity of real estate investments. During the 1972 to 2006 period, equity Real Estate Investment Trusts (REITS) are estimated to have had higher rates of return than large company stocks (the S&P 500 stock index), 14.5% versus 11.4% (Morningstar, 2007, 59). Business ownership might be plausibly assumed to have a higher expected return than stocks of publicly traded small companies, with correspondingly higher risk levels (Lai & Hanna, 2004).

In terms of the categorization of bonds, this study generally follows the definition adopted in Hanna and Wang (2007):

Bond investments are sometimes assumed to be risky investments, based on having higher mean returns and standard deviations than cash equivalent investments. However, based on the much lower inflation-adjusted mean arithmetic return for the period 1926-2006 of long-term corporate bonds, 3.2% versus 9.1% for large company stocks, and much lower standard deviations, 9.6% versus 20.2% for large company stocks
(Morningstar, 2007, 120), it seems reasonable to exclude bond investments from the risky asset category. During the 1926 to 2006 period, bonds were substantially inferior to stock investments for building wealth, as $1 invested as of the beginning of 1926 would by the end of 2006 have turned into an inflation-adjusted value of $273 in a hypothetical large stock fund, $1,414 in a small stock fund, $9 in a corporate bond fund, and $6 in an intermediate government bond fund (Morningstar, 2007, 105).

Similarly, in this study, risky financial assets are restricted to the investment in stocks directly and indirectly, and all other financial assets are treated as low risk financial assets, including government bonds. Even though some non-stock financial assets might be risky, it is not possible to identify which financial assets, such as high yield bonds, in the dataset used. This method of categorization is closest to what Carroll (2002) defines in his analysis.

This research is focused on the two most important components of household assets—risky financial assets and risky nonfinancial assets. The reason of not including risk free assets is that this type of household asset is not an indicator of household risk-taking investment behavior.
### Financially Low Risk Assets
- Liquid accounts (checking or no checking account, saving account, money market deposit accounts, money market mutual funds), call accounts at brokerage;
- Certificate of deposit
- Government bonds or other saving bonds

### Risky Financial Assets
- Stocks (directly held)
- Mutual funds (excluding money market funds)
- Retirement accounts
- IRA/Keoughs invested in stocks
- Other managed assets
- Thrift-type retirement accounts invested in stocks
- Other financial assets (includes loans from households to someone else, future proceeds, royalties)

### Risky Nonfinancial Assets
- Business equity (private owned, with or without management role)
- Investment real estate (second house or other real estate not used for own accommodation)

| Total Risky Assets | = risky financial asset + risky nonfinancial assets |

### Personal Use Nonfinancial Assets
- Primary residence
- Others (include all vehicles not owned by a business, all other type of personal-use vehicles and miscellaneous nonfinancial assets such as artwork, antique, jewelry, furniture and valuable collections (coin, stamp, etc))

| Total Assets | = total risky assets + financially low risk asset + personal use nonfinancial assets |

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Table 3.1: Household asset categorization
3.2 Review of Theories

3.2.1 Life cycle model

Life cycle models traditionally are used to examine the determinants of individual portfolio allocation and wealth accumulation. In general, life cycle models appear to explain many aspects of observed portfolio choices and imply that age does affect portfolio choices in a variety of ways. The traditional life cycle model does not distinguish risky financial assets from the risky nonfinancial assets and is limiting in this respect.

According to Campbell and Viceira (2002), most households who invest should hold at least some risky assets in order to obtain a higher return, and stocks should represent a substantial proportion of household portfolios for many households. Lai and Hanna (2004) conclude that efficient portfolios for most older households should include business investments (proxied by the performance of microcap public stocks).

Young people want to consume, not save, because they anticipate higher incomes in the future, and they are limited by borrowing constraints. Even a relatively small fixed cost of stock market participation is large relative to the gains from investing their limited savings. It is also easier to explain positive bond holdings, even using standard preferences, for older people, who have primarily financial wealth rather than human capital. Gomes and Michaelides (2003) show that in a life cycle model with steeply sloping age income profiles for young workers, it is relatively easy to explain non-participation in the stock market.
In contrast, by using an additive habit model, Polkovnichenko (2007) implies that young investors should hold more conservative portfolios than middle-aged investors. This finding is consistent with what Faig and Shum (2002) find in that people save for illiquid assets, such as houses or private businesses, which introduces extra demand for safer liquid asset earlier in the life cycle.

Cocco, Gomes and Maehout (2005) examine how the portfolio rules vary with the correlation between labor income and risky asset return. Their study shows that nonfinancial income has large effects on the optimal equity portfolio share over the life cycle by using simulation methods as the share invested in equities is roughly decreasing with age. They find middle-aged investors hold portfolios that are more tilted towards equities than do older retired investors, whereas young investors tend to choose somewhat less equity exposure than middle-aged investors.

### 3.2.2 Relative risk aversion and the expected utility theory

Pratt (1964) introduces a measure of risk aversion\(^{11}\). Arrow (1964) and Pratt (1964) develop the concepts of absolute and relative risk aversion. These measures indicate the proportion of wealth that an individual should invest into risky assets.

Under the standard axioms on decision under uncertainty, households will select the portfolio that maximizes the expected utility of their final consumption and participants in risky markets are risk-averse agents who are willing to take risk only if

\[^{11}\text{According to this study, utility functions can be characterized in terms of relative risk aversion. In Pratt (1964)'s model, the relative risk aversion } C \text{ is defined as:}\]

\[ C = W \left[ \frac{(-U'(W) - W)}{U(W)} \right], \]

\[ \text{where } W \text{ is the households' wealth and } U \text{ is the utility function. If investors' risk aversion decreases with the increase of the wealth, then the investors exhibit decreasing relative risk aversion.} \]
they receive appropriate rewards. Usually owning risky assets is compensated by higher expected returns on one’s portfolio, and risk-averse households must determine their best trade-off between risk they have to undertake and the expected returns.

Barsky, Juster, Kimball and Shapiro (1997) use responses to hypothetical lottery games in the 1992 Household Retirement Study (HRS) to construct measures of Arrow-Pratt risk aversion. They find that households differ markedly in their willingness to bear risk. Moreover, risk aversion has considerable predictive power on the actual risk-bearing choices of households. Recent empirical work focuses on the importance of relative risk aversion (RRA) on portfolio choices. Schooley and Worden (1996) compare RRA measures and examine factors that may explain variations across household RRAs calculated from asset allocations based on the 1998 SCF. They conclude that overall household portfolio allocations demonstrate their relative level of risk taking. Gomes (2005) shows that loss-averse individuals will choose not to participate in the equity markets unless the equity-premium is sufficiently large.

3.2.3 Background income risk and the associated substitution effects

Previously economic theory applied to the study of household portfolios has emphasized the decision between consumption and saving much more than household portfolio choices. From the early 1990s, portfolio theory also deals with the way in which uninsurable (uncertain) income risk influences the portfolio share of risky assets.

As pointed out in Campbell (2006), models in the Merton (1969) tradition assume that all wealth is held in a liquid, easily tradable form. However, the largest component of wealth for most households is human capital, which is nontradable and uncertain in terms
of financial return. Usually, uncertain income risk comes from risky labor and this income is distinguished from low risk wage income. Income from risky labor, such as private investment in business or real estate, is more uncertain than income of wage-earners. Previous studies label this risk, distinct from financial risk aversion in financial markets, background (uncertain) income risk.

Only a few studies examine theoretically or empirically the relationship between investors’ financial risk-taking behavior and the uncertain risk or background risk they face from risky nonfinancial investments. Whether the presence of the background risk reduces or increases households’ overall exposure to risks in risky asset markets is a common question now for researchers since this additional risk may lead households to reduce or increase their holdings in risky financial assets. It is plausible that for a household with risky nonfinancial asset investments, its privately owned business or investment real estate might be a substitute for investing in publicly traded stocks in terms of its optimal household portfolio. This effect is a typical substitution effect or crowding out effect mentioned in previous studies.

Gollier (2001), in the first study addressing this issue, discusses individuals’ risk aversion with the presence of background risk and its impact on demand for risky assets. He concludes that the presence of an uninsurable background risk in the wealth of a decision maker affects his behavior towards other independent sources of risk. Although Grolier’s study does not provide any quantitative evaluation of the effect of background risk, it does emphasize the importance of examining household financial positions beyond their investment in marketable securities in order to understand their portfolio allocations. By running simulations from different scenarios, Cocco, Gomes and Maehout
(2005) propose from their model that uncertain income risk will reduce individuals’ financial risk.

Recent empirical research supports the theoretical prediction that households in risky environments tend to tilt their portfolio towards safer assets in order to avoid higher risks. When some income (e.g., labor or private business income or income from investment real estate) is uncertain or relatively uninsured, investors will reevaluate their financial investments by taking into account their uncertain income risk.

Guiso, Jappelli and Terlizzese (1996) use a two-stage decision process based on a cross-section of Italian households to analyze the effect of income risk and borrowing constraints on a household’s portfolio in terms of the demand for risky assets. Their empirical results support the proposition that background risk depresses a household’s willingness to bear other avoidable risks. They also find that when investors are confronted with uninsurable income risk, they reduce their overall exposure to risk by holding a lower proportion of risky assets. In particular, a consumer’s perception of a riskier distribution of (uninsurable) human-capital wealth is negatively related to the proportion of risky assets held in one’s investment portfolio. Guiso et al. suggest that their results indirectly provide a possible explanation for the equity premium puzzle, the lower stockownership rate than would seem reasonable based on the higher return of stock assets.

The other studies also concentrate on the relationship between the personal risk aversion and the uncertain income risk. For instance, Gollier (2001) extends previous risk aversion theory by applying uncertain income risk/background risk under a relative risk aversion theoretical framework. He finds that under decreasing relative risk aversion
wealthier people should invest a larger share of their wealth in risky financial assets, younger investors should invest more in risky financial assets, and investors with riskier human capital or higher degree of background risk should invest less in risky financial assets. Therefore, we can expect some correlations between individuals’ financial risk tolerance and their background risk as well as their risky asset allocation.

A number of papers, for instance, Bertaut and Haliassos (1997), Cocco, Gomes and Maenhout (2005), Heaton and Lucas (1997 and 2000b), and Koo (1998), demonstrate that adding a risky income stream that cannot be capitalized may actually increase tolerance for stock market risk. The reason is that any assumed floor level of exogenous income effectively is a risk-free asset, which is a perfect substitute for risk-free financial holdings. Although non-tradable income is risky, it limits bad outcomes relative to risky income from the financial investment, which significantly reduces effective the risk aversion (Heaton & Lucas, 2000b).

Although there is a relatively wide discussion of the theoretical impact of background income risk, only a few studies carry out an empirical analysis of its relationship with risk aversion or the corresponding risk-taking behaviors of investors. The limited conclusions are controversial as well. For example, Heaton and Lucas (2000b) point out that background risk increases effective risk aversion and leads households to invest more cautiously in financial markets. On the other hand, Bodie et al. (1992) argue that to the extent that some households can increase their labor supply in response to poor investment returns, either by increasing hours worked or by delaying their retirement, this added flexibility increases households’ willingness to take financial risks. Because both of these two types of risks are important for households to make
decisions about their portfolio choice, a more in-depth study needs to be focused on this issue.

3.2.4 Risk from risky financial markets

Hanna and Chen (1995) use a simulation method and demonstrate optimal household investment behaviors in different horizons. They conclude that households in which financial assets represent a small portion of total wealth should choose asset categories with the highest expected returns. Although their study does not test the direct relationship between a household’s financial asset holding and their risky nonfinancial asset investment, it implies that households’ financial asset status is an important factor which should influence portfolio choice or asset allocation.

Xiao (1995) examines the 1989 SCF data and finds that the ownership of one type of financial asset increases the probability of owning another, controlling for socio-economic factors such as income, household size, home ownership, credit card ownership, age, race, gender, education, marital status, and employment status. However, this article considers only financial assets, and ignores the risky nonfinancial assets, an important component of household assets. It is also possible that risky financial assets increase or reduce a household’s possibility of owning risky nonfinancial assets.

Another theory that can explain households’ risky asset investment is the theory of investment in familiarity. The theory of investment in familiarity is related to an individuals’ psychological factor which may affect their investment behavior in a certain circumstance (Huberman, 2001). This theory suggests that under the influence of
individuals’ presumed familiarity or confidence, they might behave differently than traditional portfolio theory suggests.

Heath and Tversky (1991) find that people prefer to stay in a context where they consider themselves knowledgeable or competent than in a context where they feel ignorant or uninformed. And they conclude that the competence might also help explain why investors are sometimes willing to give up the advantage of diversification and concentrate on a small number of companies with which they are presumably familiar.

Huberman (2001) introduces the concept of “familiarity” and finds that it increases investment and that familiarity bias exists in portfolio diversification. Based on this theory, his study supports that investors do not optimize objective risk-return tradeoffs. In contrast, individuals are more likely to invest in a known company, which will lead most people to shy away from foreign stocks and to concentrate on stocks they know, such as the stock of their company. It could be reasonable that business owners have superior information about the business they own so they invest most of their assets into their private business rather than in financial markets to diversify their portfolio. Therefore, the theory of investment in the familiar complements the traditional portfolio theory of diversification and provides important implications to practitioners in business owning households and other similar areas.

Investments in the familiar can also explain the decision between investing in stocks and risky nonfinancial assets in private business or investment real estate. Stock owners, especially those households with substantial stock holdings can be presumed to be more familiar with financial markets than otherwise similar households without substantial holdings. Transferring to investment in private business assets or real estate
not only requires additional financial resources, but also more knowledge in the field. It might not be possible to obtain this knowledge in a short period of time. It is much easier to be exposed to information on financial markets than to gain the necessary information of starting up a business or investing in real estate. Therefore, it is reasonable to assume stock holders are already familiar with trading in risky financial markets and the more they hold in stocks, the more confident they are in obtaining an acceptable rate of return from this type of investment. Hence, they will be less likely to invest, or will invest less, in risky nonfinancial assets that they are relatively less familiar with.

It is also likely that households with knowledge about nonfinancial assets invest less in stocks than in their private business or real estate. Such investments might be more reasonable for family business owners or business managers with previous working experience in the same field. Once they accumulate enough knowledge through practice or observation, they become more confident in the future return of their own investments than in financial investments.

### 3.3 Conceptual Models and Research Hypotheses

Figure 3.1 and Figure 3.2 depict the structure of the conceptual theoretical models developed in this research. As shown in Figure 3.1, which explains the problems of household portfolio choice in risky assets, the framework of this research is built upon two parts. The first part analyzes household asset selection. The second part focuses on asset allocation. The implications of the first part are integrated into the second part. Thus (as discussed more specifically in the next section) the first hypothesis regarding the relationship of household risky asset choices between risky financial and nonfinancial
assets is proposed, with the prediction that the correlation between the disturbances is significant and not equal to zero.

While the risky asset selection analysis is focused on the determinants of the probabilities of a household owning each type of risky asset, the second part is to further analyze the determinants of relative shares of each type of risky asset holdings by taking their alternative risky asset investment choice into consideration. Built upon the theories of background income risk and financial risk, the hypotheses that each type of risky asset has significant substitution effects on the other are proposed. The result of this part will further support the interdependent relationship of household risky asset selection found in the first part.
Figure 3.1: Theoretical Framework of the Research
Figure 3.2: Model of Household Risky Asset Selection and Allocation
Households with similar demographic and financial resources might behave quite differently in the allocation of investment portfolios both in financial and nonfinancial asset markets. It is important to analyze whether individual household characteristics will affect investors’ risky asset selection and allocation, even after controlling the others. Figure 3.2 depicts the selected exploratory variables based on household characteristics that could affect household risk asset selection and allocation.

Based on the life cycle model discussed previously, age should be an important factor influencing household portfolio choice, with an expectation that the older investors will be less likely to choose and allocate less proportion of their assets to either type of risky assets. A more recent study, Wang and Hanna (1997), using a Tobit analysis, reports monotonically increasing age effects on the proportion of net wealth invested in risky assets by using 1983-1989 panel data of the SCF. The risky asset they define in the study are assets that provide households with an uncertain nominal cash flow, which includes the market value of all real estate held for investment purposes, the total value of business assets, the market value of mutual funds, corporate stocks, and precious metals. They also find risk tolerance to be positively related to risky asset proportion of net worth. In addition to risk attitude, being married, higher education levels, and being in a racial/ethnic group other than Black are also positively and significantly related to the share of risky assets.

As discussed in the literature review, studies reveal the strong relationship between risk tolerance or individuals’ relative risk aversion with their investment behavior. Unlike previous research (Heaton & Lucas, 2000a; 2000b), risk tolerance defined in this research is assume to be constant in a household’s lifecycle. Thus it will
not change by a household’s exposure to background income risk. Based on the theory of relative risk aversion, this study controls risk tolerance as an exogenous factor, and the higher risk tolerance level is projected to be associated with a greater willingness to invest in either type of risky assets and invest a larger share of risky assets of total assets.

As many previous studies have shown, such as Gutter, Fox and Montalto (1999), Gutter and Fontes (2006) and Yao, Hanna and Gutter (2005), racial/ethnic group is related to household decision making in risky asset investment. This research also includes racial/ethnic status as a factor predicted to influence household risky portfolio choices. Wang and Hanna (1997) also point out that the expectation of future inheritance increases the level of household wealth invested in risky assets, and it could be expected that this factor is related to household risky asset investments as well. Wang and Hanna (2006) report that even after controlling for risk tolerance levels and other variables, Blacks and Hispanics are less likely to directly or indirectly hold stock investments than Whites.

Gender is also strongly associated to household portfolio choice. Jianakoplos and Bernasek (1998) conclude that compared with single women, single men have more aggressive portfolio allocation strategies by using 1998 SCF. Coleman (2003) also concludes that men tend to allocate higher proportions of their portfolio to risky assets than women. Bajtelsmit, Bernasek and Jianakoplos (1999) use 1989 SCF and discover some gender differences in household asset allocation in defined contribution plans. They show that men significantly contribute more into defined contribution plans compared with married men, but single women significantly contribute less to that asset than married women. That means when examining household asset allocation, it is important
to take a look at their marital status. Xiao (1996) has similar findings. After examining the determinants of household financial asset investment, he reveals the significant effect of marital status on holding stocks, when household income and net worth are controlled. Lyons and Yilmazer (2004) focus on the relationship of marital status and women’s decision in participating defined contribution plans by using 1995 to 2001 SCF. They find that married households with younger and more educated wives compared with their husbands, are less likely to invest in risky assets. This study further implies the strong effect of marital status on household portfolio choice. Therefore, household composition is included as an explanatory factor in influencing household risky choice.

With regarding to household wealth and its relationship with household investment in risky assets, Coleman (2003) shows that the assets invested in equity increase with household net worth. In addition, Zhong and Xiao (1995) conclude that the proportion of household assets allocated into risky portfolio increases with household income. In this sense, the research can expect that there is a significant relationship between household income and its risky asset selection and allocation. Guiso, Jappelli and Terlizzese (1996) reveal that Italian households’ demand for risky assets increases as income level increases. However, Bertaut (1998) shows that income is not significant in estimating the probability of households’ stock holdings in either year 1983 or year 1989.

Household educational background is also a widely discussed variable in the study of asset allocation decisions. A consumer’s access to information and related services in financial markets might also affect its investment behavior. If a consumer can obtain more information and service for financial investment, he or she probably will be more willing to participate in financial markets. For example, more educated households
may be more willing to participate in financial market than less educated people. Haurin and Morrow-Jones (2006) conclude that differences in knowledge of markets might contribute to lower homeownership rates of Black households, so it is plausible that similar factors may contribute to lower risky asset ownership rates. Xiao (1996) finds that there is a positive relationship between education levels and the likelihood of asset ownership.

Whether household has a child aged under 19 also impacts household economic well-being and its investment decision-making. Gutter, Fox and Montalto (1999) find some different effects of change of presence of children on risky asset ownership between different racial groups. For households with White respondents, the presence of children does not affect risky asset ownership significantly, but for Black households, if the households have any children living with them, they are more likely to hold risky assets.

Primary residence or home owned by households is one of the most important assets for most households and homeowners might behave different in their investment decision-making from renters. Sung and Hanna (1996), using the 1992 SCF, find that homeownership has a significant effect on a household’s risk tolerance, with homeowners without a mortgage being more risk tolerant than otherwise similar households with who rent or have an outstanding balance on their home mortgage.
3.3.1 Correlation between risky financial asset and risky nonfinancial asset selection

Based on the expected utility theory, investors tend to determine what to invest and how much to invest in risky assets based on the prediction of the expected returns and the corresponding risks. Based on the theory of uncertain income risk, when faced with more uncertain income risk, which refers to any risks other than those directly associated with the risky securities (for example, due to more labor income risk, or housing/mortgage risk) investors will invest a smaller fraction of their financial wealth in risky financial assets. For this reason, including uncertain income risk can help explain a household’s holding low levels of stock assets. With additional risk from risky nonfinancial investments and assumed constant personal financial risk tolerance, a household is willing to reduce its stock holdings to reduce total risks.

So, the first hypothesis of risky asset selection is proposed as:

**H1: Household portfolio selections between risky financial assets and risky nonfinancial assets are not independent choices but correlated with each other when other household characteristics are controlled.**

In terms of household asset selections, the study also expects that household financial and demographic characteristics such as income, age, and education will influence household portfolio choices in stocks and in risky nonfinancial asset investments.

3.3.2 Risky financial asset allocation in the presence of background income risk

Based on the theoretical framework, it might be expected that all else equal, people with greater income risk would be less likely to hold stocks and hold a lower share
of wealth in stocks, if they anticipate a similar or higher return from their private business or real estate investment in risky nonfinancial assets (see Figure 3.1 for this framework). On the other hand, households with an investment in private business or real estate are presumed to be more familiar with this type of risky nonfinancial asset investment than with risky financial investments. It is rational for households to hold more of familiar assets.

Therefore, the second hypothesis is:

**H2:** Households’ risky nonfinancial asset investment status will significantly impact the household risky financial asset allocation, when controlling for the other household characteristics.

Based on the theoretical model and previous literature, it can be expected that if a household investor’s perceived return from a risky nonfinancial asset is relatively similar to the return from the stock market, and the stability of that asset is highly correlated with the return from the stock market, it will be rational for to have a lower share of total assets in the stock market for diversification reasons since other assets invested in private business or real estate can substitute the stock investment.

Based on this expectation, two separate hypotheses (H2a and H2b) are formulated to test the impact of risky nonfinancial asset investment on risky financial asset investment from the respect of risky nonfinancial asset ownership and actual invested value separately.

**H2a:** If a household holds any risky nonfinancial assets, it will invest a significantly lower proportion of wealth in risky financial assets, when holding everything else constant.
**H2b:** The more a household invests in risky nonfinancial assets, the lower the proportions of its wealth is invested in risky financial assets, while holding everything else constant.

### 3.3.3 Risky nonfinancial asset allocation in the presence of financial risk

Based on the theory of relative risk aversion theory and the theory of investment in familiarity, it is likely for stock owners to be less likely to invest a higher value of assets in risky nonfinancial assets. The higher value of stocks the household holds, the more the households is familiar with the financial market. Therefore, it is expected that the amount of stocks held is negatively related to the relative share of assets invested in risky nonfinancial assets. So, the following hypotheses about the effect of risky financial behavior on risky nonfinancial asset investment are formulated:

**H3:** A household’s risky financial asset investment status will significantly affect its risky nonfinancial asset allocation.

Treating the effect of ownership and actual value invested in financial risk assets separately, the following two hypotheses (H3a and H3b) are proposed regarding the influence of risky financial asset investment on risky nonfinancial asset investment.

**H3a:** If a household holds any risky financial assets (stocks), then it will invest a significantly lower proportions of its wealth in risky nonfinancial assets (private business or real estate), holding everything else constant.

**H3b:** The more a households invests in risky financial assets (stocks), the lower the proportion of wealth invested in risky nonfinancial assets (private business or real estate), holding everything else constant.
CHAPTER 4

DATA AND METHODOLOGY

This chapter first summarizes the main characteristics of the data set used in this study. The advantage and disadvantage of using this dataset are illustrated and the reasons for utilizing this dataset in the research are demonstrated accordingly. Following that, the second section discusses the main statistical methodologies implemented in this study. Then the variables selected in this research are explained in detail.

4.1 SCF Dataset

Most work on household portfolio choice relies on particular surveys. The U.S. survey with the best data on financial wealth is generally thought to be the Survey of Consumer Finances (SCF). SCF data have been collected by the National Opinion Research Center at the University of Chicago (NORC) since 1992.\(^\text{12}\).

The SCF provides a rich source of information on the financial characteristics of U.S. households. According to the official website for the survey, it is the only fully-representative source of information on the broad financial circumstances of U.S. households. In addition to the core data on assets, liabilities, and their key characteristics, the survey also collects information on employment history and pension, income, and

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\(^{12}\) See: [http://www.norc.org/projects/scf/about.htm](http://www.norc.org/projects/scf/about.htm)
demographic characteristics to support analysis of the core data. The SCF not only includes detailed information about the assets and liabilities of families, but also their work history, use of financial institutions, attitudes and expectations, and a variety of demographic characteristics. Based on this information, this research is able to measure comprehensive household financial wealth (checking, savings and money market accounts, certificates of deposit, saving bonds, other types of bond, mutual funds, hedge funds, stocks, annuities, managed investment accounts, trusts, the cash value of life insurance, retirement accounts, and miscellaneous financial assets) and nonfinancial wealth (principal residences, other residential real estate, businesses, vehicles, and miscellaneous nonfinancial assets).

Since wealth in the U.S. is relatively concentrated, the SCF supplements a general random sample with a random sample that is more likely to have wealthy households than the general population, a unique feature of the SCF. Since it was designed primarily as a wealth survey, SCF provides the most detailed measurement of household wealth available from a household survey and contains literally hundreds of questions on household wealth holdings. Many of the balances that are combined in the other surveys (such as checking, saving and money market accounts) are probed separately in the SCF. Detailed information is collected on household assets and liabilities, as well as accompanying household characteristics such as demographics, labor force activities, income, etc. More importantly, the SCF covers all aspects of wealth including both liquid and illiquid assets. The most recent edition of the survey that is currently available, the 2004 SCF, is employed in this study.
The SCF sample is not an equal-probability design; therefore, weights play a critical role in interpreting the survey data. The main data set contains the final nonresponse-adjusted sampling weights. These weights are intended to compensate for unequal probabilities of selection in the original design and for unit non-response (failure to obtain an interview) (Kennickell, 2003). Although it is necessary to weight descriptive analyses to make the results representative of U.S. households, as suggested by (Lindamood, Hanna & Bi, 2007), the weighted method and un-weighted method have similar results for multivariate analyses.

Multiple imputation techniques are used in the SCF to address nonresponses. Missing data are imputed five times by drawing from the estimated conditional distribution of the variable; each of these estimates (and associated weight) is contained in one of five replicate records for each observation in the SCF data. Multiple imputation allows the survey to be analyzed as a complete data set but requires greater effort (Rubin, 1987). Additionally, some of the values may vary slightly from one implicate to the others. Averaging the results of the five implicates will produce unbiased estimates of effects, but will tend to underestimate the variance of the estimates. Montalto and Sung (1996) describe the repeated-imputation inference (RII) technique, which is designed to remedy the potential underestimation of the variances.

However the SCF is less satisfactory in three other respects. There are different types of stocks and bonds, such as small stocks, large stocks, intermediate government bonds, or corporate bonds, and the performance of these securities are quite different. From the SCF, we can get information about whether and how much the households own stocks directly or indirectly, but lacking information about the components of those
stocks such as large or small stocks, we can not compare the riskiness of their investment in terms of financial returns. Especially, for households owning both financial and risky nonfinancial asset, it is important to examine whether the financial assets owned by households with background risk are less risky in terms of future market returns than those owned by households without background risk.

Another problem with the data set is that in the SCF, families’ financial assets include transaction accounts, certificates of deposit, saving bonds, bonds, stocks, mutual funds, retirement accounts, life insurance, other managed assets and other financial assets, which are vaguely categorized. In order to study the portfolio allocations of U.S. households, it is important to know the percentages households invest in cash equivalent assets, stock related assets, bond related assets, real estate related assets, and business related assets. All five of these categories have different risk and return patterns and will affect the households’ net worth differently. However, in the SCF, some types of financial assets also belong to the other assets. For example, for retirement accounts and other management assets, the SCF includes more detailed information about how the money in these assets is invested among stocks, mutual fund, bonds, real estate, or mixed etc.

Finally, since 1989 the SCF has not followed households over time; rather, it interviewed a fresh sample of households every three years. It is not panel data, so we can not track the time trend of households’ asset holdings. Instead, we can only focus that situation in a particular period of time. Because of this limitation, continuous time discrete models can not be applied to address this problem.
Despite these limitations, the SCF is still the best choice for this study compared with the other available data sets. The analysis based on this rich data set can complement the existing literature in the following ways. First, the most recently available survey of 2004 provides an interesting look at household stock holdings after the bull market years of the late 1990s and the subsequent bear market. Second, we have information on the overall portfolios held by households that are representative of the US population. Third, this data set allows a more comprehensive set of explanatory variables to be included than in previous studies because the SCF contains information on many household characteristics in addition to the most important information about both financial and nonfinancial investments in risky assets (e.g., investment real estate, private business).

4.2 Statistical Methodologies

Both univariate and multivariate analyses are used in this study. Univariate analysis is utilized to examine the composition of household asset allocation and its patterns along with different household characteristics. Unlike multivariate analysis, univariate analysis does not control for any other factors constant while examining specific variables and it is used to present the general distribution patterns. So differences due to one factor detected under univariate analysis could actually come from other confounding factors. By using multivariate analysis, these factors could be largely controlled. The two main multivariate analysis methodologies adopted in this research are Bivariate probit model and Tobit model. Their main functions and advantages in application are discussed in the following section.
Multivariate analyses are based on the implicate one of the 2004 SCF data rather than the combination of five implicates using RII technique because RII techniques are not available for Bivariate probit and Tobit model. According to Lindamood, Hanna and Bi (2007), this method should have little effect on the significance levels of the coefficients, although it might be appropriate to use a more conservative threshold, for instance, 0.01 rather than the usual 0.05 level. Also following the suggestion of Lindamood, Hanna and Bi (2007), all multivariate analyses in this research are unweighted.

4.2.1 Bivariate probit model

As predicted from the theoretical framework, the background income risk from the risky nonfinancial asset investment might substitute for household risky financial investment. On the other hand, the financial risk from the financial market might impact household risky nonfinancial asset investment. Therefore, in order to test the first hypothesis, the interdependence between household portfolio choices between stock investment and risky nonfinancial asset has to be tested. The Bivariate probit model is adopted to estimate portfolio selections for the two types of risky asset jointly. The advantage of using this model is that it enables an easy and straightforward comparison of the impact of each variable across two types of risky asset selections, while calculating the correlation between the two decisions directly. In this way, the interrelation between household asset selection in risky financial assets and risky nonfinancial assets can be captured; in contrast to the two separate logit or probit models which ignore the potential correlations between the two decisions.
The Bivariate probit model was introduced by Greene (1984) as an extension of traditional probit model. Since then, it has been widely used in economic research. For instance, Bertaut (1998) uses this model in estimating the stockholding behavior of U.S. households. In the Bertaut’s study, the Bivariate probit model makes it possible for the author to consider the probabilities of stock ownership both in 1983 and in 1989 and their correlations. Bertaut finds the probabilities of stock ownership during those two periods to be highly correlated. Using the panel data of SCF, he shows that most U.S. households demonstrate considerable persistence in their portfolio investments.

Based on the theoretical framework established in Chapter 3, households are supposed to have two options for risky asset investment: investment in risky financial assets (stocks) or investment in risky nonfinancial assets. Since each option has two binary outcomes: having investment or not having, there are four different possibilities in this portfolio selection situation, with each choice based on the condition of the other alternative investment selection. These four categories of portfolio choices can be described as:

$$\begin{align*}
\Rightarrow \\
&\{ \\
&\text{Stock investment} = 0 \text{ and nonfinancial risky asset investment} = 0; \\
&\text{Stock investment} = 0 \text{ and nonfinancial risky asset investment} = 1; \\
&\text{Stock investment} = 1 \text{ and nonfinancial risky asset investment} = 0; \\
&\text{Stock investment} = 1 \text{ and nonfinancial risky asset investment} = 1; \\
\}
\end{align*}$$

Following these four different possibilities, two equations relating to household investment choices are formulated by applying bivariate probit model:

$$having \text{ stock investment}^* = \beta_1 \times \chi_{i1} + \varepsilon_{i1} \quad (1)$$

$$having \text{ nonfinancial risky asset investment}^* = \beta_2 \times \chi_{i2} + \varepsilon_{i2} \quad (2)$$
Where $\chi_{i1}$ and $\chi_{i2}$ are vectors of risk tolerance, household financial and demographic characteristics;

Having stock investment $= 1$ if having stock investment $> 0$, 0 otherwise;

Having risky nonfinancial investment $= 1$ if having risky nonfinancial investment $> 0$, 0 otherwise.

The two equations can be estimated separately by single equation probit models. But, there is a problem in that the separate estimation ignores the correlation between the disturbances. Bivariate probit model is advantageous over the two single probit models in that it takes the correlation of two disturbances in each equation into consideration, without assuming that the two probabilities are independent from each other.

In the bivariate probit model, equations (1) and (2) are simultaneously estimated using maximum likelihood of two dependent variables, thus it produces unbiased estimates of parameter coefficients $\beta$ and $\rho$, where $\rho$ is the estimate of the interaction of two predictors. The random error terms, $\varepsilon_{i1}$ and $\varepsilon_{i2}$, are assumed to be dependent and normally distributed, such that $E[\varepsilon_{i1}] = E[\varepsilon_{i2}] = 0$, $\text{var}[\varepsilon_{i1}] = \text{var}[\varepsilon_{i2}] = 1$ and $\text{cov}[\varepsilon_{i1} + \varepsilon_{i2}] = \rho$. If a Wald Test shows that $\rho$ is insignificant, then no endogeneity bias is present and the two models can be estimated separately as two single binomial probits. In the special case where $\rho$ equals 0, the zero correlation implies that there is no dependence of household asset selections between risky financial assets and risky nonfinancial assets. Then the two equation estimates work exactly the same as standard univariate probit model. If $\rho$ is significant and not equal to zero, then variables in one of the probit models have an indirect effect on the other probit model. For instance in this
study, it means household choices to have stock investment and risky nonfinancial asset investment are endogenous processes and that they affect each other. Therefore two choices should be considered jointly rather than separately.

4.2.2 Tobit model

The univariate result shows that only about 49% of households have some stock investment and only 25% of households own any kind of risky nonfinancial assets. Thus, in the multivariate analysis, the dependent variables of the relative share of risky financial assets and risky nonfinancial assets are significantly limited in their range. In order to test the second and third hypotheses, the problem of sampling bias has to be considered in this study.

Selection problems occur in a wide range of applications in econometrics. However, the Ordinary Least Square (OLS) model is less powerful in analyzing continuous outcomes with potential selection bias included in the model. In the multivariate analysis of predicting probability of ownership, the stock ownership is coded to be 1 if they have some investment in stocks, otherwise, it is coded to be 0. However, in the OLS model, the dependent variable is the stocks that households own, so it is limited to households who have at least some stock holdings. The result is that simple OLS regression will lead to downward-biased estimates, because the subsample used in this model can not represent the whole population. Technically, only when it is reasonable to assume that the decision of participating in financial market is uncorrelated with the level of asset holdings, can we use pooled OLS on the subsample of households with positive risky asset holdings to obtain consistent coefficient estimates. Otherwise, other estimation
methods that adjust for this selection bias during the process of OLS regression has to be used.

Normally, there are two ways of dealing with this issue, one is the Tobit model and the other one is the Heckman two-stage model. Both of these methods are commonly utilized in the previous literature in discussing households’ asset demand or allocation issues. Each method has its own strength and weakness in solving the selection bias problem. In the Tobit model, all individuals (or a sample) are observed, but only some observations can be made on the dependent variables (Dubin & Rivers, 1990). In this study, all households are observed, but only households with positive financial or risky nonfinancial assets are used on the dependent variables. Whereas, the Heckman selection model is more efficient in dealing with those unobserved variables. For instance in Heckman’s study of wages, the wages are not observable for people who are not employed. In addition to that, Heckman model has a number of limitations in solving similar econometric issues. For instance, in solving the omitted variable problem, the Heckman procedure introduces a measurement error problem and it assumes that the measurement error is always normally distributed. It is hard to identify the underlying reason for choosing two different sets of variables that influence the probability and the amount in the first and second stages separately. Therefore, in this research on financial or risky nonfinancial asset investment, with all households’ asset levels observed but the dependent variables “censored” because of zero value, it is more appropriate to utilize the Tobit estimation method.

In order to analyze the relationship between household income and household luxury expenditures with some households having zero expenditure, Tobin (1958)
introduces the Tobit model. In his study, Tobin finds that the more income a household gains the more they will spend on luxury goods with a large concentration of households who spend exactly zero dollars on luxury goods. He thinks that the concentration of observations at zero should be taken into account when testing hypotheses about the relationship between household income and expenditure because an explanatory variable is expected to influence both the probability of whether a household spent zero dollars on luxury items and how much they actually spent, given that they spent something.

The advantage of the Tobit model is that it is more efficient to estimate the decision to hold equity or risky nonfinancial assets and the share of those assets in the portfolio jointly in one step. According to the methodologies adopted by previous literature, Agnew, Balduzzi and Sunden (2003) and Poterba and Samwick (2002) favor the Tobit specification for censored dependent variables. McDonald and Moffitt (1980) point out in their study that the Tobit model can be used to determine both changes in the probability of being above limit and changes in the value of dependent variable if it is already above the limit.

However, this approach has its own limitation. The factors that influence the two choices may be different because strong parametric assumptions are used in the Tobit model. Suppose we are estimating an equation explaining desired risky asset allocation but that whenever it is negative we observe zero risky asset holdings. McDonald and Moffitt (1980) discuss the similar problem for analysis of expenditures.

Facing a similar selection problem with limited equity holdings among U.S. population, Faig and Shum (2006) employ a Tobit model to analyze the determinants of stock holdings by predicting the share of financial wealth invested in stocks for
households who hold positive amounts of equities. In their study, they compare the result of equity shares estimated by both the methods of conditional linear regression and the Tobit model. They also clarify the reasons why the Tobit model can explain equity shares much better than the conditional linear regressions. They conclude that in the context of truncated regressions (in their study, the sample is truncated at equity share equal to zero) the least squares method produces biased estimates.

Therefore, following the same methods used by Coleman (2003), Wang and Hanna (1997) and Embrey and Fox (1997) in discussing household risk assets, this research builds its demand of each type of risky assets on the Tobit estimates. The first Tobit model examines the share of household assets allocated in risky financial assets, and it is formulated as:

\[
\left( \frac{stock_{investment}}{total_{assets}} \right)^* = \begin{cases} 
\beta_i \times \chi_{i3} + \varepsilon_{i3} & \text{if } \beta_i \times \chi_{i3} + \varepsilon_{i3} > 0 \\
0 & \text{if } \beta_i \times \chi_{i3} + \varepsilon_{i3} \leq 0
\end{cases}
\] (3)

Where \((stock_{investment}/total_{assets})^*\) is the households' desired proportion of assets invested in stocks, \(\chi_{i3}\) is a vector of risk tolerance, household financial and demographic characteristics, and household status of risky nonfinancial asset investment. The log likelihood function of the Tobit consists of both parts of this equation.

In this model, the status of risky nonfinancial asset investment is measured by two different sets of variables: the ownership of risky nonfinancial assets and the amount of risky nonfinancial asset holdings. In order to avoid the potential problem of multicollinearity, two separate Tobit analyses are conducted with each variable controlled separately.
The second Tobit model examines the share of household assets allocated in risky nonfinancial assets, and it is formulated as:

\[
\left( \frac{\text{nonfinancial risky assets}}{\text{total assets}} \right)^* = \begin{cases} 
\beta_i \times \chi_{i4} + \varepsilon_{i4} & \text{if } \beta_i \times \chi_{i4} + \varepsilon_{i4} > 0 \\
0 & \text{if } \beta_i \times \chi_{i4} + \varepsilon_{i4} \leq 0
\end{cases}
\] (4)

Where (risky nonfinancial asset investment/ total assets)* is the households’ desired proportion of assets invested in private business or real estate, and \( \chi_{i4} \) is a vector of risk tolerance, household financial and demographic characteristics, and the household status of risky financial asset investment.

In this model, the status of risky financial asset investment is measured by two different variables: the ownership of stocks and the actual amount of stock holdings. Similar to the first model, two separate Tobit analyses are conducted with each analysis only controlling one of those two variables, in order to avoid the multicollinearity problem in the regressions.

4.3 Selected Variables

This study focuses on the composition of household risky assets from the aspects of selection and allocation. The main objective is to study what factors influence the ownership and relative share of each type of risky asset invested of households’ total assets. Therefore, the dependent variables examined in this study are:

1. household stock ownership;
2. household risky nonfinancial asset ownership;
3. the proportion of total assets invested in stocks;
4. the proportion of total assets invested in risky nonfinancial assets.
The stock ownership is an indicator of the household's actual risk-taking behavior in risky financial market, and is based on whether a household owns stocks directly and/or indirectly based the answer to the SCF survey question. If the households’ total value of direct and indirect investment in stocks is positive, then the households are referred to as risky financial asset owners or stock owners, otherwise they are not risky financial asset (stock) owners.

Investment in risky nonfinancial assets is defined by the households’ investment in private business and/or real estate other than their primary residence. Once households hold either of these assets and their value is larger than zero, they are defined as risky nonfinancial asset owners; otherwise they are nonowners of risky nonfinancial assets.

The proportion of stock investment in total assets is the equity share of household portfolios. It is calculated as the ratio of the value of stocks divided by the household total assets. This ratio indicates the relative importance of equity asset as a component in household portfolio composition. The higher the ratio, the more important the role of the stock equity in the household’s total wealth.

The proportion of risky nonfinancial asset investment in total assets is the share of risky nonfinancial assets of household portfolio. It is calculated as the ratio of the sum value of household private business value and investment real estate value divided by the household’s total assets. This ratio represents the relative contribution of risky nonfinancial asset in household wealth constitution. A higher ratio means risky nonfinancial assets account for a higher fraction of household total assets or greater importance in household wealth accumulation.
As discussed in the Chapter 1, one goal of this study is to examine the effect of background income risk in household financial investment selection and allocation. The background income risk defined in this research is the risk resulting from household investment in risky nonfinancial market, including whether they own any type of this investment, and/or the actually amount of assets they invest in this type of risky assets. Therefore the variables indicating background income risk include:

1. the ownership of business investment;
2. the ownership of investment real estate;
3. the net value of business investment;
4. the net value of investment real estate.

In the SCF, respondents are asked whether they owned and managed any business. If the answer is “yes” and the values of businesses they owned and managed are positive, then they are business owners. The SCF also asks whether respondents have real estate other than their primary residence. If the answer is “yes” and the net value of real estate investment is positive then they are defined as investment real estate owners. The reason for selecting them as background income risk variables is that they all bring household uncertain income with additional risks from nonfinancial market, both of which belong to risky nonfinancial assets. In order to avoid the effect of extreme values in the model, the nature logs of business investment and investment real estate are employed instead of actual amount. (The explanatory variables are listed in Appendix)

Most studies demonstrate that household portfolios differ by household wealth, and various household characteristics such as the age, education background, marital status. The controlled variables in this study include household risk attitude, age,
education background, race/ethnicity, marital status, gender of the respondent, and whether there is a child under 19 is living at home. This set of household demographic variables can be treated as household information cost in stock market participation (Bertaut, 1998). The other economic characteristics such as household annual income, home ownership, expectance of future inheritance and liquidity constraint can also play an important role in influencing household choices of their asset allocations.

Age is a factor reflecting household life cycle and investment horizon, so it is highly associated with household investment decision making. In order to allow for nonlinear effects of age on investment choices, both age and age squared are included as independent variables. It is predicted that there is a bell-shaped relationship between investors’ age and their demand of any type of risky assets.

Risk tolerance should influence portfolio decisions, and age should have an effect based on life cycle savings considerations, e.g., young households might not have any savings, and the investment horizon may initially increase after short-term goals have been reached, and decrease as retirement approaches. Households’ financial risk tolerance level is measured by the question asked in the survey about the types of risk they are willing to take in order to obtain the correspondent financial returns. This variable is categorized into four levels: no-risk taking (if answered “not willing to take any financial risks”); average risk taking (if answered “take average financial risks expecting to earn average returns”), above average risk taking (if answered “take above average financial risks expecting to earn above average returns”) and substantial risk taking (if answered “take substantial financial risks expecting to earn substantial returns”).

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Education may have an impact on the financial knowledge of the households, and therefore their choices on risky asset investment. So in this study, dummy variables for respondents’ actual educational level will be controlled too. In this study, the level of educational attainment is measured with four categorical dummy variables. They are less than high school, high school graduate, some college, bachelor’s degree or higher degree.

Race/ethnicity of the respondent of household is classified as four dummy variables: White, Black, Hispanic, and Other. The “other” category includes Asian, American Indian, Alaska Native, Native Hawaiian, and others. Based on Census reports, a majority of respondents in “other category” are Asians.

Household composition is another important factor in explaining different household investment behaviors. In this study, the marital status of the household is classified into three categories: married couple, partners which refer to those living together but not married, and single head household. Married couples may make different choices than unmarried persons, and generally have more potential resources than single people. So the households’ marital status will also be taken into concern in this study. The SCF attempts to have the more financially knowledgeable partner be the respondent in couple households (Lindamood & Hanna, 2005). Therefore, the gender of the respondent can be male or female in both couple households and non-couple households, and it will also likely affect households’ portfolio choices.

Household income is directly related to household portfolio decision since it is the main source of their investment. Lower income households may decide not to save much for retirement because of the higher replacement rate for Social Security pensions. So the information cost for entering risky financial or nonfinancial asset market is relatively too
high to make them participate in risky asset markets. On the other hand, households with high income might have enough financial resources to spread their assets widely across various investment categories, such as stocks, private business, etc. The natural log of household income is used in this study to reduce possible effects of heteroskedascity.

The liquidity constraint is a useful tool for studying household emergency funds and it reflects whether a household has enough liquid assets to cover emergent financial needs. If a household’s current liquid asset is larger than its monthly income, then it is assessed that it has an adequate emergent fund or no liquidity constraint, otherwise, it faces certain level of liquidity constraint. This factor is particularly important for households who operate their own business or have some real estate investment since typically those households hold a significant amount of their wealth in risky nonfinancial assets and they need a certain amount of liquid assets to maintain their business operation or real estate investment.

Although household primary residence is not included as risky nonfinancial assets in this study, homeownership is controlled in the statistical analysis given its high importance in contributing to household total assets. If the respondent in SCF said the household owns a home but is not a renter, the household is considered as a homeowner household.

If households expect substantial wealth inheritance, their wealth or total assets will change significantly after that inheritance. Consequently, it is very likely that they will alter their investment strategy given this added large amount of wealth. Therefore, the variable of inheritance is also controlled in this research in order to identify whether it will affect household portfolio choices. According to SCF, if the respondent said he or
she expects to receive substantial inheritance, then the expectation of inheritance is coded as 1, otherwise it is coded as 0.
CHAPTER 5

RESULTS AND DISCUSSION

This chapter presents statistical results from empirical models, along with the discussions of the predictions from the theoretical models and comparisons from previous literature. Descriptive results are presented in the first section, including the detailed description of household portfolio composition and its relationship with household characteristics. Multivariate results are presented in the later sections, which include the Probit estimation regarding to household portfolio selection issue and Tobit estimation regarding to the problem of household relative risky asset allocation. All the results are based on the 2004 Survey of Consumer Finances, with the univariate analyses weighted and multivariate analyses unweighted.

5.1 Descriptive Results

5.1.1 Overall composition of household portfolio

This section begins with a comprehensive examination of the household portfolio distribution using the Survey of Consumer Finances of the year 2004. The primary goal of this part is to provide an overall view of how household portfolio is diversified in terms of different types of risky assets, or how the components of household risky assets are distributed.
Base on the 2004 SCF, 4,519 households are observed in this analysis, and Table 5.1 shows the average ownerships of each type of risky asset of U.S. households based on the 2004 SCF, as well as the mean and median values for each category of risky assets. In this study, direct and indirect stock investment is utilized as an indicator of risky financial assets. The result shows that only 48.6% of households own stock investments, and that is consistent with the puzzling stockholding phenomenon pointed out by lots of previous and current researchers that most households do not hold stocks. The result also reveals that almost 24.8% of households own at least one type of financial low risk investment, with 11.5% owning some business assets and 18.1% having investment real estate other than the primary residence. Combining two types of risky assets, the univariate result shows that almost 56.0% of households own at least one type of risky assets. The median values for each category are zero, and even the median for the total amount of risky assets is only $2,000, reflecting the fact that less than half of households own any particular category of risky assets. The mean value of risky nonfinancial assets, $146,064, is substantially higher than the mean value of risky financial assets.
<table>
<thead>
<tr>
<th>Types of risky assets</th>
<th>proportion</th>
<th>Mean ($)</th>
<th>Median ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Risky financial investments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stocks directly and indirectly</td>
<td>48.58%</td>
<td>89,031</td>
<td>0</td>
</tr>
<tr>
<td>2. Risky nonfinancial Investments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business investments</td>
<td>11.47%</td>
<td>87,383</td>
<td>0</td>
</tr>
<tr>
<td>Real estate investments other than primary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>residence</td>
<td>18.10%</td>
<td>58,681</td>
<td>0</td>
</tr>
<tr>
<td>Total of risky nonfinancial assets</td>
<td>24.83%</td>
<td>146,064</td>
<td>0</td>
</tr>
<tr>
<td>Total risky assets</td>
<td>55.96%</td>
<td>235,283</td>
<td>2,000</td>
</tr>
</tbody>
</table>

Table 5.1: Mean values of household risky assets and the proportion owing assets
Weighted analysis of 2004 Survey of Consumer Finances, all 5 implicates.
Figure 5.1 depicts the United States household average asset composition based on a weighted analysis of the 2004 SCF. Based on this graph, it is obvious that on average almost half of households’ assets are allocated into low risk assets, with 18.8% of aggregate assets in risk-free financial assets, including liquid accounts, certificate of deposits and government bonds, and 36.6% in low risk nonfinancial assets or personal use nonfinancial assets, which include primary residence house, vehicles and other individual collections. The rest of household assets are distributed between risky financial assets and risky nonfinancial assets, with stocks accounting for 16.9% of total household assets, private business accounting for 15.6% of total assets and real estate accounting for 11.1% of household assets. This result shows that on average the household risky assets represent almost 44.6% of household total assets, with 35.7% of total assets allocated in risky financial assets and 27.7% allocated in risky nonfinancial assets. Therefore, it is evident that both risky financial assets and risky nonfinancial assets play important roles in household asset composition.
Figure 5.1: Aggregate household asset composition
Weighted analysis of 2004 Survey of Consumer Finances, all 5 implicates.
Figure 5.2 demonstrates the composition of U.S. household aggregate risky assets. Stock investment accounts for 37.9% of overall risky assets, the proportion which is slightly higher than that of private business investment in total risky assets (37.2%). Investment real estate also constitutes a significant proportion of household total assets (24.9%), though the share is less than that of the stocks or private business investment. By combining private business and investment real estate, risky nonfinancial assets account for 62.1% of total risky assets, a fraction much higher than that of risky financial assets (37.9%).

5.1.2 Household characteristics and risky asset investment

Table 5.2 shows that both financial and risky nonfinancial assets increase continuously with respondents’ age until the age above 65. Mean values for both financial and risky nonfinancial assets are the highest among the respondents who are aged between 55 and 64. The trend is reasonable since most households can accumulate their largest amount of wealth during their late fifties and early sixties and then their wealth declines after they reach their retirement ages.

Table 5.3 shows that mean levels of risky assets increase consistently with income, and only households with incomes over $50,000 per year have median levels of risky assets over zero. Households having income higher than $100,000 hold over six times the mean levels of financial and nonfinancial assets as households with incomes between income between $50,000 and $100,000.
Figure 5.2: Aggregate composition of household risky assets
Weighted analysis of 2004 Survey of Consumer Finances, all 5 implicants.
<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Risky financial assets</th>
<th>Risky nonfinancial assets</th>
<th>All risky assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>age&lt;35</td>
<td>7,456</td>
<td>29,074</td>
<td>36,530</td>
</tr>
<tr>
<td>35-44</td>
<td>52,384</td>
<td>116,908</td>
<td>169,292</td>
</tr>
<tr>
<td>45-54</td>
<td>103,419</td>
<td>205,312</td>
<td>308,731</td>
</tr>
<tr>
<td>55-64</td>
<td>187,282</td>
<td>290,757</td>
<td>478,038</td>
</tr>
<tr>
<td>age&gt;=65</td>
<td>133,612</td>
<td>140,919</td>
<td>274,531</td>
</tr>
</tbody>
</table>

Table 5.2: Mean values of household risky assets across different age groups
Weighted analysis of 2004 Survey of Consumer Finances, all 5 implicates.
Risky financial assets | Risky nonfinancial assets | Total of risky assets
---|---|---
income<25,000 | 8,305 | 0 | 20,762 | 0 | 29,068 | 0
25,000=<income<50,000 | 22,938 | 0 | 32,287 | 0 | 55,225 | 28
50,000=<income<100,000 | 64,081 | 5,300 | 80,310 | 0 | 144,391 | 18,000
income>=100,000 | 398,632 | 69,250 | 689,905 | 0 | 1,088,538 | 175,940

Table 5.3: Mean values of risky assets among groups of different income levels
Weighted analysis of 2004 Survey of Consumer Finances, all 5 implicates.
Table 5.4 and Figure 5.3 demonstrate the patterns of households’ financial and risky nonfinancial asset ownership based on the percentiles of households net worth. It is evident that compared with stock ownership, the risky nonfinancial asset ownership is extremely low among the households with net worth percentile lower than 75% (14.2%). But as the households’ net worth increases, they are more likely to own risky nonfinancial asset, with a majority of households with top 10% of net worth owning some kind of risky nonfinancial assets, and about 90% owning stock assets. Among households with net worth among top 1%, almost all of them own risky assets, with 93.3% owning stock assets and 93.9% owning risky nonfinancial assets. This pattern further demonstrates that the ownership of risky nonfinancial asset is of particular importance to those relatively wealthier or extremely wealthy households.

Based on Figure 5.3, it is clear that the proportions of household wealth invested in risky assets keep increasing along with the percentiles of household net worth. The richer the household is, the higher fraction of the household’s total asset is invested in risky assets. For households ranking in the top 1% of net worth percentile, risky nonfinancial assets account for almost 45% of their total assets, a percentage of more than double of that of stock investment. It seems that risky assets become more and more important in household portfolio composition as households’ wealth increases. It is noteworthy that for households among the top 1% of net worth, the role of risky nonfinancial assets is much greater than that of risky financial assets in terms of their household wealth constitution.
<table>
<thead>
<tr>
<th>Percentile of household net worth</th>
<th>Risky financial asset ownership (average)</th>
<th>Risky nonfinancial assets ownership (average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-75%</td>
<td>36.21%</td>
<td>14.20%</td>
</tr>
<tr>
<td>75%-90%</td>
<td>82.23%</td>
<td>46.57%</td>
</tr>
<tr>
<td>90%-95%</td>
<td>88.64%</td>
<td>64.08%</td>
</tr>
<tr>
<td>95%-99%</td>
<td>93.11%</td>
<td>76.41%</td>
</tr>
<tr>
<td>99%-100%</td>
<td>93.25%</td>
<td>93.85%</td>
</tr>
</tbody>
</table>

Table 5.4: Household risky financial and nonfinancial asset ownership by percentiles of net worth
Weighted analysis of 2004 Survey of Consumer Finances, all 5 implicates.
Figure 5.3: Household risky asset allocation by net worth percentile. Weighted analysis of 2004 Survey of Consumer Finances, all 5 implicates.
This result is consistent with a few important characteristics of household holding investment in business or real estate as stressed by previous literature (Gentry & Hubbard, 2004; Carroll, 2002): first, households having investment in private business or real estate typically own a substantial amount of household wealth and income; second, the portfolios of those households, even wealthy ones, are very undiversified, with bulk of assets held within active business or real estate or housing investment. Therefore, for those types of households, their portfolio allocation problem is more complex than the rest of similar wealthy households.

Figure 5.4 demonstrates that high proportions of households in the top 1% of net worth own investment business (almost 80%) and privately owned business assets (about 70%). For households in the 90th to 95th percentile of net worth, ownership of investment real estate is almost twice as likely as ownership of business assets (48% versus 25%).

To sum up, the univariate analysis presents the most important characteristics of household risky asset distribution. Based the broader definition of risky asset utilized in this study, the results shows that a slightly more than half of all households hold any risky assets in their portfolio, and diversification across different categories of risky assets is limited, even for the richest households. The results indicate that both stocks and risky nonfinancial assets are important for household wealth. And the risky nonfinancial assets contribute to household wealth even more than what risky financial assets (stocks) do in terms of relative values. The distribution pattern shows that stocks, business, and investment real estate are extremely disproportionately held by the wealthiest families.
Figure 5.4: Household business ownership rates and investment real estate ownership rates by household net worth percentile. Weighted analysis of 2004 Survey of Consumer Finances, all 5 implicates.
Household portfolio selection in stocks is highly associated with household financial and demographic characteristics. Stock owning households differ from non-stock holding households in both financial and demographic characteristics. A univariate analysis is carried out based on the 2004 SCF data set to compare the differences between stock holding households and non-stock holding households.

Table 5.5 demonstrates the differences of household characteristics in terms of households’ stock holding status, with stock-holding households compared with households without any direct or indirect stock ownership. Compared with households without stock assets, stock owners have substantially higher levels of net worth ($797,934 vs. $122,415) and total assets ($917,633 vs. $164,825), including risky nonfinancial assets ($260,131 vs. $39,924). Also higher proportion of stock owners own risky nonfinancial assets than do non-stock owners (35.9% vs. 14.9%). Stock owners roughly put 15.6% of their total assets in stocks, but they invest 10.3% of their total assets into risky nonfinancial assets, including 4.3% in private business and 6.0% in real estate investment. For households who do not own any stocks, they allocate 5.7% of their total asset into risky nonfinancial investment, including 2.7% in their private business and 3.0% in real estate investment. The average ages of the respondent in both two types of households are pretty much close to 49.
<table>
<thead>
<tr>
<th></th>
<th>Own stocks</th>
<th>Do not own stocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net worth (means)</td>
<td>797,934 ($)</td>
<td>122,415 ($)</td>
</tr>
<tr>
<td>Total assets (means)</td>
<td>917,633 ($)</td>
<td>164,825 ($)</td>
</tr>
<tr>
<td>Stock investment (means)</td>
<td>183,284 ($)</td>
<td>0 ($)</td>
</tr>
<tr>
<td>Nonfinancial risky asset investment (means)</td>
<td>260,131 ($)</td>
<td>39,924 ($)</td>
</tr>
<tr>
<td>Having Nonfinancial risky asset investment</td>
<td>35.93%</td>
<td>14.94%</td>
</tr>
<tr>
<td>Stock investment/total assets</td>
<td>15.55%</td>
<td>0</td>
</tr>
<tr>
<td>Risky nonfinancial assets/total assets</td>
<td>10.29%</td>
<td>5.74%</td>
</tr>
<tr>
<td>Business investment/total assets</td>
<td>4.30%</td>
<td>2.71%</td>
</tr>
<tr>
<td>Real estate investment/total assets</td>
<td>5.99%</td>
<td>3.03%</td>
</tr>
<tr>
<td>Expect to receive substantial inheritance</td>
<td>19.29%</td>
<td>9.25%</td>
</tr>
<tr>
<td>Homeowner</td>
<td>83.99%</td>
<td>57.25%</td>
</tr>
<tr>
<td>Having liquidity constraint</td>
<td>37.97%</td>
<td>66.79%</td>
</tr>
<tr>
<td>Take no risk</td>
<td>18.86%</td>
<td>63.50%</td>
</tr>
<tr>
<td>Take average risk</td>
<td>52.03%</td>
<td>26.27%</td>
</tr>
<tr>
<td>Take above average risk</td>
<td>24.84%</td>
<td>7.67%</td>
</tr>
<tr>
<td>Take substantial risk</td>
<td>4.27%</td>
<td>2.57%</td>
</tr>
<tr>
<td>Mean age of respondent</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>White</td>
<td>85.89%</td>
<td>63.53%</td>
</tr>
<tr>
<td>Black</td>
<td>7.12%</td>
<td>18.52%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3.52%</td>
<td>14.01%</td>
</tr>
<tr>
<td>Asian and others</td>
<td>3.47%</td>
<td>3.94%</td>
</tr>
<tr>
<td>No high school diploma</td>
<td>3.08%</td>
<td>21.98%</td>
</tr>
<tr>
<td>High school diploma</td>
<td>22.36%</td>
<td>35.57%</td>
</tr>
<tr>
<td>college degree</td>
<td>19.11%</td>
<td>21.53%</td>
</tr>
<tr>
<td>Bachelor’s degree and above</td>
<td>55.45%</td>
<td>20.92%</td>
</tr>
<tr>
<td>Related child&lt;19 at home</td>
<td>43.75%</td>
<td>43.75%</td>
</tr>
<tr>
<td>Married couple households</td>
<td>62.48%</td>
<td>40.32%</td>
</tr>
<tr>
<td>Partner households</td>
<td>5.81%</td>
<td>8.73%</td>
</tr>
<tr>
<td>Single head households</td>
<td>31.72%</td>
<td>50.95%</td>
</tr>
<tr>
<td>Female respondents</td>
<td>48.40%</td>
<td>49.09%</td>
</tr>
</tbody>
</table>

Table 5.5: Household characteristics by households’ stock ownership
Analysis is weighted based on 2004 SCF, all 5 implicates.
The results also show that 19.3% of stock owners expect some substantial inheritance, compared to only 9.3% of non-stock owners who have similar expectation. In addition, higher proportions of stock owners are homeowners compared with those of non-stock owners (84.0% vs. 57.3%). Only 40.0% of stock owners face liquidity constraint, whereas 66.8% of non-stock owners confront with that situation.

With regarding to the difference in risk-taking attitude, more stock owners seem to be willing to take risk than non-stock owners consistently in three different risk tolerance levels, that is average risk tolerance (52.0% of stock owners vs. 26.3% of non-stock owners), above average risk tolerance (24.8% of stock owners vs. 7.7% of non-stock owners) and substantial risk tolerance (4.3% of stock owners vs. 2.6% of non-stock owners). That means that on average more stock owners are willing to take risks, whatever the level of the risk is. As for other differences among demographic characteristics, stock owners are more likely to from Whites rather than from minority ethnicities, and also more of them have bachelor or higher degree instead of college or lower degree than non-stock owners.

In order to further understand what kinds of households are more likely to have risky nonfinancial asset investment in general, the univariate analysis of household characteristics in term of their risky nonfinancial asset ownership is conducted (results shown in Table 5.6).
<table>
<thead>
<tr>
<th></th>
<th>Own some type of risky nonfinancial assets</th>
<th>Do not own any type of risky nonfinancial assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net worth (means)</td>
<td>1,267,824 ($)</td>
<td>177,243 ($)</td>
</tr>
<tr>
<td>Total assets (means)</td>
<td>1,414,305 ($)</td>
<td>234,067 ($)</td>
</tr>
<tr>
<td>Stock investment (means)</td>
<td>234,515 ($)</td>
<td>40,980 ($)</td>
</tr>
<tr>
<td>Having stock investment</td>
<td>70.30%</td>
<td>41.40%</td>
</tr>
<tr>
<td>Stock investment/total assets</td>
<td>9.71%</td>
<td>6.85%</td>
</tr>
<tr>
<td>Risky nonfinancial assets/total assets</td>
<td>31.55%</td>
<td>0</td>
</tr>
<tr>
<td>Business investment/total assets</td>
<td>13.80%</td>
<td>0</td>
</tr>
<tr>
<td>Real estate investment/total assets</td>
<td>17.74%</td>
<td>0</td>
</tr>
<tr>
<td>Expect to receive substantial inheritance</td>
<td>17.19%</td>
<td>12.89%</td>
</tr>
<tr>
<td>Homeowner</td>
<td>87.15%</td>
<td>63.08%</td>
</tr>
<tr>
<td>Having liquidity constraint</td>
<td>35.14%</td>
<td>59.39%</td>
</tr>
<tr>
<td>Take no risk</td>
<td>22.06%</td>
<td>48.99%</td>
</tr>
<tr>
<td>Take average risk</td>
<td>49.76%</td>
<td>34.69%</td>
</tr>
<tr>
<td>Take above average risk</td>
<td>22.94%</td>
<td>13.55%</td>
</tr>
<tr>
<td>Take substantial risk</td>
<td>5.24%</td>
<td>2.75%</td>
</tr>
<tr>
<td>Mean age of respondent</td>
<td>51.85</td>
<td>48.03</td>
</tr>
<tr>
<td>White</td>
<td>81.69%</td>
<td>70.93%</td>
</tr>
<tr>
<td>Black</td>
<td>8.56%</td>
<td>15.21%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>5.35%</td>
<td>10.44%</td>
</tr>
<tr>
<td>Asian and others</td>
<td>4.40%</td>
<td>3.42%</td>
</tr>
<tr>
<td>No high school diploma</td>
<td>5.46%</td>
<td>16.35%</td>
</tr>
<tr>
<td>High school diploma</td>
<td>22.55%</td>
<td>31.09%</td>
</tr>
<tr>
<td>college degree</td>
<td>18.98%</td>
<td>20.45%</td>
</tr>
<tr>
<td>Bachelor’s degree and above</td>
<td>53.01%</td>
<td>20.45%</td>
</tr>
<tr>
<td>Related child&lt;19 at home</td>
<td>42.46%</td>
<td>44.20%</td>
</tr>
<tr>
<td>Married couple households</td>
<td>67.12%</td>
<td>44.99%</td>
</tr>
<tr>
<td>Partner households</td>
<td>5.63%</td>
<td>8.09%</td>
</tr>
<tr>
<td>Single head households</td>
<td>27.25%</td>
<td>46.92%</td>
</tr>
<tr>
<td>Female respondents</td>
<td>42.85%</td>
<td>58.91%</td>
</tr>
</tbody>
</table>

Table 5.6: Households’ characteristics by households’ risky nonfinancial asset ownership  
Analysis is weighted based on 2004 SCF, all 5 implicates
Table 5.6 presents most important demographic and economic characteristics of households who own at least some kind of risky nonfinancial asset, as well as comparisons with households who do not own any kind of risky nonfinancial asset. It is evident that households who own some type of risky nonfinancial assets are on average much richer than households who do not own any type of risky nonfinancial assets, since they have higher levels of net worth mean values ($1,267,824 vs. $177,243) and total assets mean values (1,414,305 vs. $234,067). On the other hand, compared with households who own nothing in risky nonfinancial asset, higher proportion of households who own some risky nonfinancial assets hold stocks directly or indirectly (70.3% vs. 41.4%) and they also hold higher value of assets in stocks ($234,515 vs. $40,980). Households who own some risky nonfinancial assets have an average level of 9.7% of total assets invested in stocks, and this percentage is slightly higher than that of households who own nothing in risky nonfinancial assets (6.9%). For those who have some type of risky nonfinancial assets, on average 31.6% of their total assets are invested in risky nonfinancial assets, with 13.8% in private business investment and 17.7% in real estate investment, respectively.

The result also shows that households who own some risky nonfinancial asset investment, 17.2% of them expect substantial inheritance, compared with 12.9% of those who do not own any risky nonfinancial assets. About 87.2% of those risky nonfinancial assets owners are homeowners, compared with 63.1% of counterpart households. And 35.1% of risky nonfinancial asset owners face liquidity constraint, whereas 59.4% of households without risky nonfinancial assets face that constraint.
The univariate analysis also shows that risky nonfinancial asset owners are consistently willing to take higher risks at each risk tolerance level than households without risky nonfinancial assets. For instance, 49.8% of risky nonfinancial asset owners are willing to take average risk compared with 34.7% of those households which do not own any risky nonfinancial assets.

Among other demographic characteristics, Whites are over-represented in risky nonfinancial asset owners and other racial/ethnic groups are over-represented among those who do not own any risky nonfinancial assets. As for the household educational background, more than half of risky nonfinancial asset owners are holding a bachelor or higher degree, compared to only 20.5% of households without risky nonfinancial assets holding the same degree. In terms of household composition, it is obvious that most risky nonfinancial asset owners are married, compared with the fact that only 50.0% of those households not owning any risky nonfinancial assets are married. Fewer respondents from risky nonfinancial asset owning households are female than those from households who do not own any risky nonfinancial assets (42.9% vs. 58.9%).
5.2 Multivariate analysis

The objectives of this study are focused on household risky asset choices, which include the issues of the risky asset selection and the relative share of assets allocated in each type of risky assets. Therefore, two separate sets of empirical analyses are carried out to test them individually. A bivariate probit model is conducted to analyze household portfolio selections. Following that, Tobit models are conducted to examine the determinants of household risky assets, including the relative proportions of assets invested in risky financial asset and risky nonfinancial assets.

5.2.1 Bivariate probit analysis of risky asset selection

Bivariate probit model is utilized to examine the determinants of the likelihood of household choices between two types of risky asset investment—risky financial assets which are indicated by household stock ownership and risky nonfinancial assets which include household private business investment and real estate investment. Table 5.7 presents the parameter estimates from household risky asset allocation based on Bivariate probit estimate equations formulated in the Chapter 3.
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Coefficient</th>
<th>p-value</th>
<th>Coefficient</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-4.161427</td>
<td>&lt;.0001</td>
<td>-5.506048</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

**Risk attitude**

| Average risk                   | 0.784966    | <.0001  | 0.384772    | <.0001  |
| Above average risk             | 1.008938    | <.0001  | 0.552543    | <.0001  |
| Substantial risk               | 0.823378    | <.0001  | 0.937708    | <.0001  |

**Demographic Characteristics**

| Age of respondent              | 0.050196    | <.0001  | 0.069493    | <.0001  |
| Age square of respondent       | -0.000456   | <.0001  | -0.000531   | <.0001  |
| Racial/ethnic group of respondent: reference category = White |
| Black                          | -0.385337   | <.0001  | -0.098540   | 0.0104  |
| Hispanic                       | -0.530063   | <.0001  | 0.013338    | 0.7621  |
| Other groups                   | -0.333552   | <.0001  | 0.096818    | 0.0550  |
| Education of respondent: reference category = less than high school diploma |
| High school diploma            | 0.447767    | <.0001  | 0.147100    | 0.0013  |
| Some college                   | 0.572399    | <.0001  | 0.334896    | <.0001  |
| Bachelor degree or above       | 0.962538    | <.0001  | 0.380779    | <.0001  |
| Household composition: reference category = married couples |
| Partners                       | -0.033974   | 0.4459  | -0.076764   | 0.0854  |
| Single-head                    | -0.140709   | <.0001  | -0.263933   | <.0001  |
| Presence of related child < 19 | -0.078829   | 0.0013  | -0.040736   | 0.0791  |
| Female respondent              | -0.005814   | 0.7942  | -0.286730   | <.0001  |

**Financial Characteristics**

| Liquid assets < monthly income | -0.483420   | <.0001  | -0.305586   | <.0001  |
| Log (household annual income)  | 0.184292    | <.0001  | 0.239330    | <.0001  |
| Homeowners: reference category=renters |
| Expectation of Inheritance     | 0.179225    | 0.0168  | 0.066594    | 0.0168  |
| Rho (ρ)                        | 0.104050    | <.0001  | 0.0        | <.0001  |
| Log likelihood                 | -19440      |         |             |         |

Table 5.7: Bivariate probit model of household risky asset selection
(Stock ownership and risky nonfinancial asset ownership are the two dependent endogenous dichotomous variables)
* Rho is the disturbance correlation of the two Probit estimation equations. Unweighted analysis, based on 2004 SCF.
Correlations of portfolio selections between two types of risky assets

The result of Bivariate probit analysis based on two-equation estimates shows that the correlation between the disturbances from the household choice in stock investment probit and the risky nonfinancial asset invest probit is statistically significant, since the Rho (0.10) is different from zero at a significance level of less than 0.0001. Therefore endogenous dependent variables should be jointly estimated in two Probit regressions rather than in separate univariate probit models. Hypothesis 1 is not rejected. Household ownership of stocks and risky nonfinancial assets are significantly dependent on each other, even after controlling other household characteristics, indicating that this relationship should be incorporated in the examination of household risky asset allocation to be discussed in the later sections.

Determinants of stock ownership and risky nonfinancial asset ownership

It is evident that there are some similar patterns of the determinants on the types of ownership. In both Probit estimates, the parameter estimates for risk attitude at each single level, from average risk tolerance level to substantial risk tolerance level are significantly and positively related to households’ ownership in risky financial assets or risky nonfinancial assets, therefore the individuals’ risk tolerance is a powerful determinant for household asset selection in risky financial and nonfinancial assets investment. Controlling for other variables, respondents who are more willing to take risks at any level are significantly more likely to hold stocks and have risky nonfinancial asset investments than respondents who are not willing to take any risks at all. Households with respondents willing to take above average risk are the most likely to
hold stocks. However, those willing to take substantial risk in order to obtain a substantial return are the most likely to have investment in risky nonfinancial assets. The result also shows that the likelihood of having risky nonfinancial investments increases consistently with the levels of individuals’ risk tolerance. The result is consistent with that from Norton and Moore (2002) and Segal, Borgia and Schoenfeld (2005).

Age is a significant determinant in both estimates as well, with the age by itself is positively related to both stock ownership and risky nonfinancial asset ownership and age squared is negatively and significantly related with households’ risky asset selection in either stocks or risky nonfinancial assets. The result is consistent with what Shum and Faig (2006) find in their Probit estimate of stock holdings by using pooled SCF data from 1992 to 2001. The result also demonstrates a pattern of increasing likelihood of risky asset ownership at a decreasing rate with the respondent’s age. The likelihood of stock ownership increases at a decreasing rate and then decreases after the respondent’s age reaches 55. Whereas, for household risky nonfinancial asset ownership, the likelihood keeps increasing until the respondent’s age reaches 65, then decreases with age.

There are some evident racial/ethnic differences in household risky asset allocation as shown in Table 5.7. Compared with Whites, the other groups are all significantly less likely to own stocks. It is clear that race/ethnicity has a significant impact on household stock ownership and Whites are significantly different from the other groups in terms of their likelihood of investing in stocks. However, there is a slightly different pattern in terms of risky nonfinancial asset ownership. Comparing households with White respondents to those with respondents choosing another category, only Blacks are significantly less likely to own risky nonfinancial assets than Whites.
Households with respondents in the other racial/ethnic category are slightly more likely to own risky nonfinancial assets than households with White respondents, although the significance level is at 0.055, not meeting the conventional 5% level. Racial/ethnic status has a less substantial effect on risky nonfinancial asset ownership than on stock ownership.

Educational background seems to be a powerful determinant in household portfolio choice in either type of risky asset selection. Compared with respondents with lower education degree than high school diploma, households who hold any higher level of degree are significantly more likely to invest in either stocks or in risky nonfinancial assets.

Marital status also plays an important role in influencing the likelihood of household portfolio choices. Compared with married couples, single head households are significantly less likely to invest either in stocks or in other risky nonfinancial assets. Partners are not found to be significantly different from married couples in their risky asset investment choices.

Households with female respondents are significantly less likely than households with male respondents to own any risky nonfinancial asset investment, but there is no difference in stock ownership. Whether there is a child aged under 19 living at home does not make a significant difference in risky nonfinancial asset ownership, but it is negatively related to stock ownership.

Whether households face a liquidity constraint has a great impact on household portfolio choices. Households with financial assets less than what they need to cover their
monthly income are significantly less likely to invest in either stocks or in risky nonfinancial assets.

The coefficients of log of household income are positive and significant in both estimates. The predicted probability of having either type of risky asset increases with income.

Homeowners are significantly more likely to invest in each type of risky assets than renters. The result is consistent with Wang and Hanna’s (2007a) finding that homeownership is significantly and positively related to stockownership, and also consistent with Wang and Hanna’s (2006) finding that homeowners are significantly more likely to be business owners than renters.

If the respondent expects to receive a substantial inheritance, he or she is more likely to hold risky nonfinancial assets than if there is no expectation of a substantial inheritance. This result is consistent with Wang and Hanna (2006) in that the expectation of inheritance positively relates to the likelihood of being a business owner.
5.2.2 Tobit analysis of the determinants of household risky financial asset allocation

The following section is based on the Tobit models discussed in Chapter 3 in analyzing households’ demand for risky assets. In order to examine the specific differences between the potential factors that are associated with two types of risky asset investment, the determinants of risky financial asset allocation and risky nonfinancial asset allocation are investigated separately by conducting two sets of Tobit analyses.

Results of Tobit analysis on the determinants of the share of stock holdings are displayed in Table 5.8. Model I is identical to model II except that model I controls household risky nonfinancial asset ownership but model II controls household actual level of risky nonfinancial asset holdings. The result from model I shows that household share of stock holdings of total assets is negatively and significantly related to households’ ownership of risky nonfinancial assets (coefficient is -0.3731). Therefore, while controlling for other variables in the Tobit, if households hold any assets in private business or investment real estate, they invest significantly lower proportion of their assets into stocks. So the hypothesis 2a is not rejected.
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Coefficient</th>
<th>p-value</th>
<th>Coefficient</th>
<th>p-value</th>
</tr>
</thead>
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<tr>
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<td>-4.2780</td>
<td>&lt;.0001</td>
<td>-4.8324</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

*Risky nonfinancial asset investment status*

- Having investment in risky nonfinancial asset: -0.3731 | <.0001 |
- Log of Business investment: -0.0280 | <.0001 |
- Log of Real estate investment: -0.0115 | <.0001 |

*Attitudes*

Risk tolerance level of respondent: reference category = not willing to take any risk

- Average risk: 0.3737 | <.0001 |
- Above average risk: 0.5525 | <.0001 |
- Substantial risk: 0.5012 | <.0001 |

*Demographic Characteristics*

- Age of respondent: 0.0587 | <.0001 |
- Age squared: -0.0003 | <.0001 |
- Racial/ethnic group of respondent: reference category = White
  - Black: -0.3644 | <.0001 |
  - Hispanic: -0.2037 | 0.0014 |
  - Other groups: -0.1191 | 0.0373 |
- Education of respondent: reference category = less than high school diploma
  - High school diploma: 0.1646 | 0.0312 |
  - Some college: 0.3488 | <.0001 |
  - Bachelor degree or above: 0.5468 | <.0001 |
- Household composition: reference category = married couples
  - Partners: -0.2453 | <.0001 |
  - Single-head: -0.0532 | 0.0620 |
  - Presence of related child < 19: -0.1145 | <.0001 |
  - Female respondent: -0.1236 | <.0001 |

*Financial Characteristics*

- Liquid assets < monthly income: -0.1095 | <.0001 |
- Log (Annual household income): 0.0497 | <.0001 |
- Homeowners: reference category=renters: -0.9544 | <.0001 |
- Expectation of Inheritance: 0.0673 | 0.0121 |
- Log likelihood: -23767 | <.0001 |

Table 5.8: Tobit analysis of the relative share of stocks of total assets
(The dependent variable is the amount of stock investment divided by the amount of households’ total assets)
Unweighted analysis, based on 2004 SCF.

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Model II controls the log amount of risky nonfinancial asset holdings by controlling the log of the total value of private business assets and also the log of the total value of investment real estate assets. The result shows that both of these two variables significantly impact the share of household stock holdings of total assets (the coefficients are -0.0280 for the log of private business value and -0.0115 for investment real estate value respectively). That implies that the more the households invest in their risky nonfinancial assets in terms of privately owned business or investment real estate, the lower proportion of household assets invested in stocks, therefore the hypothesis 2b is not rejected.

Combining the results of these two models, the Tobit results show that households’ risky nonfinancial asset investment status strongly impacts household asset allocation in risky financial assets, suggesting that Hypothesis 2 is not rejected. This result supports findings from previous literature in that background income risk has a substitution effect in households’ equity asset holdings (Heaton & Lucas, 2000a; Heaton & Lucas, 2000b; Guiso, Jappelli & Terrlizzese, 1996; Cocco, 2004; Kullman & Siegel, 2003).

Respondents’ risk attitude also strongly influences the fraction of households’ stock holdings. In both models, the factors of risk tolerance at all levels are significantly and positively correlated with the relative share of household stock holdings. The monotonic pattern of the coefficient estimates of risk tolerance levels shows that the higher the respondents’ risk tolerance level is, the larger share of household assets is invested in stocks.
Age is positively and significantly related with the share of stock holdings but the age squared is negatively and significantly related with the share of stock holdings. The result shows that the ratio of stock assets to total assets increases to age 99, and the ratio of risky nonfinancial assets to total assets increases to age 81, then decreases.

The racial/ethnic group chosen by the respondent is another significant factor that influences the faction of stock holdings in household total assets. Households with a Black respondent have a significantly lower proportion of their assets in stocks than those with a White respondent in both models. Households with a Hispanic respondent and those with a respondent choosing another category have a significantly lower proportion of their assets in stocks than those with a White respondent.

Household educational background makes a significant difference in household stock allocation level as well. Although respondents with high school diploma are not significantly different from those without a high school diploma, the respondents holding some college degree or higher degrees are significantly more likely to hold higher value of stocks.

Marital status and having a child at home also affect household stock investment level. Compared with married couples, partner households invest significantly lower shares of assets in stocks. Single headed households are found to invest lower proportion of their assets in stocks than married couples in model II but not in model I. Households with a child aged under 19 living at home invest significantly lower proportion of their assets in stocks.
Gender also plays an important role in determining the level of household stock investment. Households with female respondents have lower shares of assets in stocks than households with male respondents.

All household financial characteristics controlled in these Tobit models seem to have a significant impact on the household asset allocation in stocks. Having a liquidity constraint restricts households from investing higher proportion of wealth in stocks since the coefficient of the estimate is significant and negative. That means if households face the situation of holding liquid assets less than their monthly income, then they hold significantly lower share of their assets in stocks. Not surprisingly, the coefficient for the log of income is significant and positive. Therefore the higher income the households have, the higher proportions of their wealth are invested in stocks.

Homeowner households have significantly lower ratios of stocks to total assets than do renter households. The result is reasonable given that the value of a home is part of total assets. Households that expect a substantial inheritance have a higher fraction of assets invested in stocks than do not expect a substantial inheritance.

5.2.3 Tobit analysis of the determinants of household risky nonfinancial asset allocation

In order to examine the effect of the financial risk resulting from households’ investment in financial asset market on their investment in nonfinancial asset market, another Tobit analysis is conducted. The purpose of this Tobit analysis is to investigate the determinants of the relative share of household risky nonfinancial assets in private
business or investment real estate, while controlling household risky financial investment status and other household characteristics.

As shown in Table 5.9, this Tobit analysis is similar to the first Tobit analysis in that this analysis also contains two separate models, with model I controlling for stock ownership and other household characteristics, and model II controlling for the amount of stock holding and the other household characteristics which are the same with what are controlled in the first Tobit analysis.
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Coefficient</th>
<th>p-value</th>
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<td><strong>risky financial asset investment status</strong></td>
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<td></td>
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</tr>
<tr>
<td>Having investment in risky financial asset (stocks)</td>
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</tr>
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<td>Log of financial risk asset investment (stocks)</td>
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<td></td>
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<td><strong>Attitudes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk tolerance level of respondent: reference category = not willing to take any risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average risk</td>
<td>0.0419</td>
<td>0.1149</td>
<td>0.0556</td>
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<td>Above average risk</td>
<td>0.1255</td>
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<td>0.1473</td>
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<td>Substantial risk</td>
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<td>&lt;.0001</td>
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<tr>
<td><strong>Demographic Characteristics</strong></td>
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</tr>
<tr>
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<td>0.2548</td>
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<td>&lt;.0001</td>
</tr>
<tr>
<td>Racial/ethnic group of respondent: reference category = White</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>-0.0650</td>
<td>0.1503</td>
<td>-0.0652</td>
<td>0.1495</td>
</tr>
<tr>
<td>Hispanic</td>
<td>-0.0451</td>
<td>0.3138</td>
<td>-0.0583</td>
<td>0.1936</td>
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<tr>
<td>Other groups</td>
<td>0.1232</td>
<td>0.0049</td>
<td>0.1133</td>
<td>0.0097</td>
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<tr>
<td>Education of respondent: reference category = less than high school diploma</td>
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<tr>
<td>High school diploma</td>
<td>-0.0962</td>
<td>0.0806</td>
<td>-0.0898</td>
<td>0.1027</td>
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<tr>
<td>Some college</td>
<td>-0.1056</td>
<td>0.0565</td>
<td>-0.0926</td>
<td>0.0949</td>
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<tr>
<td>Bachelor degree or above</td>
<td>-0.1217</td>
<td>0.0218</td>
<td>-0.0989</td>
<td>0.0632</td>
</tr>
<tr>
<td>Household composition: reference category = married couples</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partners</td>
<td>-0.0120</td>
<td>0.7864</td>
<td>-0.0196</td>
<td>0.6570</td>
</tr>
<tr>
<td>Single-head</td>
<td>-0.0174</td>
<td>0.4616</td>
<td>-0.0262</td>
<td>0.2675</td>
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<tr>
<td>Presence of related child &lt; 19</td>
<td>0.0029</td>
<td>0.8839</td>
<td>0.0025</td>
<td>0.8989</td>
</tr>
<tr>
<td>Female respondent</td>
<td>-0.1162</td>
<td>&lt;.0001</td>
<td>-0.1207</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td><strong>Financial Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid assets &lt; monthly income</td>
<td>0.0694</td>
<td>&lt;.0001</td>
<td>0.0658</td>
<td>0.0003</td>
</tr>
<tr>
<td>Log (Annual household income)</td>
<td>0.0501</td>
<td>&lt;.0001</td>
<td>0.0540</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Homeowners: reference category=renters</td>
<td>-0.4126</td>
<td>&lt;.0001</td>
<td>-0.4031</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Expectation of Inheritance</td>
<td>0.0013</td>
<td>0.9526</td>
<td>0.0040</td>
<td>0.8575</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-13716</td>
<td>&lt;.0001</td>
<td>-13702</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Table 5.9: Tobit analysis of the relative share of risky nonfinancial assets of total assets (The dependent variable is the amount of household risky nonfinancial asset divided by the amount of household total assets) Unweighted analysis, based on 2004 SCF.
Both model I and model II show that the household risky financial asset investment is a powerful determinant of household risky nonfinancial asset allocation. The result from model I, which controls the households’ stock ownership and other household characteristics, shows that if the households are stock owners, they invest significantly lower proportions of their assets in private business or real estate investment, thus the hypothesis H3a is not rejected. Model II controls the amount of households’ actual stock holding instead of ownership, the result shows that the coefficient of log amount of stock holdings is significant and negative (coefficient is -0.0130), the result is consistent with the predicts based on conceptual theoretical framework in that if households hold more assets in stocks they invest significantly lower proportion of their assets in risky nonfinancial assets. Therefore, the hypothesis H3b is not rejected.

Taking the testing results of hypothesis H3a and H3b together, it is clear that household risky financial asset investment plays an important role in determining household risky nonfinancial asset investment. Thus the hypothesis H3 is not rejected. That implies that financial risks that households undertake from their investment in risky financial asset market impacts or substitutes their alternative investment choice in risky nonfinancial asset markets.

Risk tolerance also affects the proportion of households’ assets invested in risky nonfinancial assets. The results from both of the two models show that the higher the respondent’s risk tolerance level is, the higher proportion of household assets the household invests in private business or real estate investment. And the respondents who are willing to take above average risk or substantial risk invest significantly higher share
of their assets in risky nonfinancial assets than respondents who are not willing to take any risks.

Age is not found to be a significant factor in model I but is a significant factor in model II. The age coefficient in model II is positive and significant but the age square is significant and negative. The combined effect of age and age squared implies that controlling for other variables in the Tobit, the share of risky nonfinancial assets of total assets decreases after age 23.

Surprisingly, in this estimate, both two models show that Blacks and Hispanics are not significantly different from Whites in terms of their asset allocation in risky nonfinancial assets. However, other racial groups, mostly Asians, allocate a significantly higher proportion of their assets in risky nonfinancial assets (private business and real estate) than Whites.

Similar to the Tobit estimate of household risky financial asset investment, this estimate also shows that gender is an important factor in influencing households’ relative proportion of assets allocated in risky nonfinancial assets, while controlling household financial investment status and other household characteristics constant. Compared to households with male respondents, those with female respondents invest significantly lower proportions of their assets in private business or real estate investment. This result is consistent with Embrey and Fox (1997) in that the difference of allocation of total assets in housing and businesses is at least partially determined by gender.

Not surprisingly, the effects of household financial resource status on their risky nonfinancial asset allocation are very strong as well. Both model I and model II show that if households are confronted with liquidity constraints, they invest significantly higher
proportion of their wealth in risky nonfinancial assets. And the higher the household income is, the higher proportion of household wealth is invested in private business or real estate.

Similar to the results of household risky financial asset determinants, both models reveal the homeowners invest significantly lower proportion of their wealth in risky nonfinancial assets than renters (with coefficient of -0.4126 and -0.4031 respectively). Although Wang and Hanna (2006) find that homeowners are significantly more likely to be business owners, this result shows that homeownership negatively affects a household’s relative share of risky nonfinancial assets. The result is reasonable in that household’s primary residence accounts for a large proportion of household nonfinancial assets, which are mostly illiquid. For home-owning households, their total illiquid asset will be increased if they invest higher proportion of their asset in private business or real estate. Instead, if they invest in risky financial asset, they could balance their asset compositions in illiquid and liquid assets.

Tobit estimates from model I and model II also show that whether households expect substantial inheritance does not impact significantly their risky nonfinancial asset allocation, a result different from that of the determinants of equity asset holdings.

5.3 Summary of the determinants of household risky asset allocation

This section summarizes the determinants of household risk assets allocation on the whole. Obviously, there are some common factors that are associated with asset allocation in both risky financial and nonfinancial assets. Risk tolerance is one of those common determinants in that the above average and substantial risk tolerance are
significantly and positively correlated with the relative shares of both financial and risky nonfinancial assets of total assets. The results suggest that the personal risk attitude impacts households’ any type of risky asset allocation, even after controlling their background income risk from nonfinancial market and financial risk from their financial market.

Another factor that plays a consistently important role in household risky asset allocation is gender, with households with female respondents shown to allocate significantly lower shares of financial or risky nonfinancial assets in total assets than households with male respondents. Not surprisingly, income is significantly and positively associated with demand for risky assets in either of two risky asset components. If households have higher income, they invest significantly higher proportion of their assets in either stocks, or private business and investment real estate.

Compared with renters, homeowners hold significantly lower level of any risky assets. This result is consistent with Kullmand and Siegel (2003) in that households’ house value relative to its net worth negatively affects the relative share of risky financial assets in households’ financial portfolio.
H1: Household portfolio selections between risky financial assets and risky nonfinancial assets are not independent choices but correlated with each other while controlling for other household characteristics.

Bivariate probit results: not rejected

H2a: If a household holds any risky nonfinancial assets, it will invest a significantly lower proportion of its wealth in risky financial assets, while holding everything else constant.

Tobit result: not rejected

H2b: The more a household invests in risky nonfinancial assets, the lower proportions of its wealth in risky financial assets, while holding everything else constant.

Tobit result: not rejected

H3a: If a household holds any risky financial assets (stocks), then it will invest a significantly lower proportion of its wealth in risky nonfinancial assets (private business or real estate), holding everything else constant.

Tobit result: not rejected

H3b: The more a household invests in risky financial assets (stocks), the lower proportion of wealth invested in risky nonfinancial assets (private business or real estate), everything else is held constant.

Tobit result: not rejected

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H1</strong>: Household portfolio selections between risky financial assets and</td>
<td>Bivariate probit results: not rejected</td>
</tr>
<tr>
<td>risky nonfinancial assets are not independent choices but correlated with</td>
<td></td>
</tr>
<tr>
<td>each other while controlling for other household characteristics.</td>
<td></td>
</tr>
<tr>
<td><strong>H2a</strong>: If a household holds any risky nonfinancial assets, it will</td>
<td>Tobit result: not rejected</td>
</tr>
<tr>
<td>invest a significantly lower proportion of its wealth in risky financial</td>
<td></td>
</tr>
<tr>
<td>assets, while holding everything else constant.</td>
<td></td>
</tr>
<tr>
<td><strong>H2b</strong>: The more a household invests in risky nonfinancial assets, the</td>
<td>Tobit result: not rejected</td>
</tr>
<tr>
<td>lower proportions of its wealth in risky financial assets, while holding</td>
<td></td>
</tr>
<tr>
<td>everything else constant.</td>
<td></td>
</tr>
<tr>
<td><strong>H3a</strong>: If a household holds any risky financial assets (stocks), then it</td>
<td>Tobit result: not rejected</td>
</tr>
<tr>
<td>invest a significantly lower proportion of its wealth in risky nonfinancial</td>
<td></td>
</tr>
<tr>
<td>assets (private business or real estate), holding everything else constant.</td>
<td></td>
</tr>
<tr>
<td><strong>H3b</strong>: The more a household invests in risky financial assets (stocks),</td>
<td>Tobit result: not rejected</td>
</tr>
<tr>
<td>the lower proportion of wealth invested in risky nonfinancial assets (</td>
<td></td>
</tr>
<tr>
<td>private business or real estate), everything else is held constant.</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.10: Summary Table of Hypothesis Testing
CHAPTER 6

CONCLUSION AND IMPLICATION

6.1 Conclusions

This research uses the 2004 SCF dataset, the most recent survey available at the time of this research to explore households’ investment behavior in both financial and risky nonfinancial asset market. In general, the result demonstrates that in order to understand households’ portfolio choice, it is important to examine their investment both in risky financial assets and risky nonfinancial assets, rather than emphasize only one type of asset category. Previous literature acknowledges the importance of risky financial assets in household portfolios, and factors influencing household choices in risky financial assets have been examined comprehensively, however, household investment behavior in risky nonfinancial assets has not been given enough attention. This research not only tests the interdependent relationship of household risky asset selections between risky financial assets and risky nonfinancial assets, but also investigates how they influence each other in term of asset selection and allocation conditional upon the status of alternative choices.

This study aims to examine household investment behavior based on the composition of the household portfolio in terms of different categories of risky assets. It assumes that households’ investment in either type of risky assets might be strongly
correlated with their investment in other risky assets, and there are some common factors or household characteristics associated with their risky asset selection. In order to test this relationship, the study uses a Bivariate Probit model by controlling household risky financial asset ownership and risky nonfinancial asset ownership as two dependent endogenous variables simultaneously. With the correlation coefficient shown to be not equal to zero and statistically significant, the Bivariate probit estimate confirms that households’ portfolio selections between financial and risky nonfinancial assets are highly related to each other and there are mutually affected by some similar household demographic and socioeconomic characteristics.

It is crucial to address this relationship when examining household portfolio selection in understanding household decision-making of either type of risky asset investment. While it is shown that the correlation between the error terms for household risky asset choices is statistically significant, the empirical evidence also implies that the background income risk from risky nonfinancial market will affect household participation in stock market. Thus households with private real investment in business or real estates will rethink their status of being stock holders at the same time.

On the other hand, the financial risk from the investment in financial market will also affect households’ likelihood of investment in nonfinancial markets, while controlling for other factors. This result indicates that the households’ status of being stock owners is associated with their status of becoming business owners or real estate investors. Households make decisions of whether invest in risky nonfinancial assets by taking their stock holding situation into account.
Examining only the selection of household risky asset choice will not provide enough evidence of how household risky assets are comprised of or diversified across different components, thus Tobit analyses of the determinants of household nonfinancial and risky financial asset allocation are conducted. The results from Tobit models further confirm that all background income variables have significant impact on household investment behavior on financial market. Households holding some investment in private business or investment real estate invest significantly lower proportion of their wealth in stocks than those without any risky nonfinancial asset investment. This means that the households’ risky nonfinancial asset investment is an important predictor for their investment behavior in financial market. Therefore, while background income risk from risky nonfinancial asset investment will influence households’ participation in stock market, it also discourages households from investing higher shares of their wealth in stocks.

By controlling the actual value of risky nonfinancial asset investment in the Tobit model, the study shows that the households who invest more in private business or real estate tend to invest significantly lower proportion of their wealth in stocks. In other words, the more a household has in private business or real estate investment assets, the lower proportion of total assets that are stock assets. These findings are consistent with the predictions from the hypotheses established in this research in that exposure to additional risks reduces a household’s relative holdings in other type of risky asset—stocks. Results from the first Tobit analysis (Tobit 5.8) suggest that investment in risky nonfinancial assets can substitute for household investment in stock market. These results are consistent with Heaton and Lucas (2000a and 2000b) and Cocco (2004) in that house
price risk crowds out stock holdings, and this crowd out effect is important for explaining the level of stockholdings commonly observed across different datasets.

In order to comprehensively understand the demand of household risky asset, the second Tobit estimates (Table 5.9) examining the determinants of household risky nonfinancial assets are conducted, while household risky financial asset investment status is controlled. The result shows that household relative share of assets allocated in risky nonfinancial assets is reduced if they have financial risk from holding stocks. This result provides additional evidence that it is crucial to separately consider risky nonfinancial assets in analyzing household portfolio composition.

While the result of this study supports the most important findings from previous related studies of household risky assets (e.g. Heaton & Lucas, 2000a and 2000b), it also improves and extends them by examining both the effect of background income risk and effect of financial risk and their individual impact on household portfolio choice. This research addresses the following issues in analyzing household investment in risky assets:

1. This study treats household portfolio selection and allocation separately by employing a Bivariate probit model. Based on the Bivariate probit results, this study concludes that the ownership of either type of risky will affect the ownership of the alternative risky assets.

2. The study examines the overall risks that households are undertaking from investing in risky assets. While the study further supports previous literature’s findings in the effect of background income risk, the substitution effect of household stock investment on risky nonfinancial asset investment is also investigated. Our results show that there is some significant substitution effect of household risky financial asset
investment on households’ asset allocation on risky nonfinancial assets. Households which hold stocks hold significantly lower proportion of their assets in private business or investment real estate. On the other hand, households with higher amount of wealth in stocks are likely to have lower shares of their assets in risky nonfinancial asset investment. This result suggests that both of these two types of risky assets have substitution effect on each other in terms of the relative share of asset holdings. The study contributes to the literature uniquely by exploring the effect of risky financial investment on households’ investment behavior on risky nonfinancial market.

In addition, unlike Heaton and Lucas (2000a and 2000b) and Gollier (2001), this study treats individuals’ relative risk tolerance as a constant factor, thus it will not be changed with household investment status in risky nonfinancial assets. Rather, this study includes background income risk and financial risk as households’ total risk they have in explaining households’ relative allocation in risky assets in either category.

6.2 Implications

This study stresses the importance of examining household investment behavior from their overall risky asset composition, thus it implies that for professional financial advisors and researchers that the portfolio selection and allocation should be an integral component of household wealth management. Based on the particular investment risk and return rate across different types of risky assets, and households’ financial goal of selecting a particular asset portfolio which can maximize their expected utility, professional educators should provide best advice of their household portfolio selection and allocation strategy. For professional financial educators, it would be helpful to
understand the composition of household risky assets, or the extent that risky assets have been diversified before they give household appropriate investment suggestions. In addition to that, financial advisors should recognize the specific characteristics of particular households’ wealth distribution style. Then they should use all of this information to develop educational strategies that are most suitable for various portfolio selection strategies.

6.2.1 Implication for future research

This research proposes that the interaction relationship of households’ portfolio selections between risky financial assets and risky nonfinancial assets should be taken into consideration in the analysis of risky asset allocation. However, the traditional Tobit model can only treat the analysis of the determinants of shares of risky assets separately. Although the alternative investment behavior is controlled separately in the models, this method can not treat the two endogenous variables in this estimate, risky financial asset and risky nonfinancial asset allocation simultaneously like the way that household risky asset selection is discussed. It is important to analyze whether certain share of each type of risky asset holdings will affect the alternative risky asset allocation, while controlling other household characteristics simultaneous. Future research should use a more advanced technique to allow for endogeneity of the risky investment share variables.

Given the significant impact of each type of risky asset investment on its alternative investment choice, it is important for future researchers to pay attention to the structure of household risky portfolio. Since the results suggest that it is better to understand households’ investment behavior from the overall composition of risky assets,
future research should make more efforts on investigating how the components of risky assets affect each other in some specific type of household portfolio construction. This study examines risky nonfinancial assets generally, without dividing them into separate groups. Future researchers should divide risky nonfinancial asset investment into more specific groups, for instance private business investment and real estate investment, so it is possible to compare them separately with the risky assets invested in stocks.

One limitation of the SCF is that contains relatively little information about the characteristics of private businesses the households own and manage. This research considers private businesses generally rather than treat each business type and its characteristics in detail due to this limitation. The diversity of those business types might have different impacts on the levels of background income risk that the households face in terms of risky nonfinancial asset investment. Future research can pay more attention to the relative levels of this background income risk by investigating the characteristics of private business and investment real estate.

On the other hand, the occupations of householders are also diversified in terms of their risk contributing to household income. However, users of the SCF public dataset cannot distinguish respondents’ fields of employment with enough detail to identify the differences in income variability, thus the income variance of employed household cannot be examined directly. As Guiso, Haliassos and Jappelli (1996) illustrate in their study, this income risk has a great impact on household demand of risky asset even without considering the income from self-employment and investment in real estate. It is important for future researchers to examine the income risk from specific employment section and its effect on household portfolio choice.
Another limitation of SCF data is that it is not a panel data and it is a main obstacle for researchers to track households’ risky asset allocation change across years. If future researchers can use panel data from recent datasets to examine households’ entry and exit in real estate investment given expected future returns in this nonfinancial market, and how it affects their investment behavior in financial market, additional insights might be obtained.

6.2.2 Implications for policymakers

A better understanding of household portfolio choice in the presence of each type of risky assets and the related risks is also important to policymakers and practitioners for a number of reasons. If financial professionals can recognize investors’ overall exposure to financial and nonfinancial (background income) risks, it is more likely that better recommendations can be made, with a result of more appropriate asset allocation strategies for their investors. Financial planners dealing with clients with lots of risky nonfinancial assets can give them better advice if they are more knowledgeable about nonfinancial assets and household risky asset composition.

One important aspect associated with this issue is taxation. Gentry and Hubbard (2004), after measuring the role of entrepreneurs in aggregate wealth accumulation, examine implications for portfolio allocation and asset pricing and the consequences of tax policy toward entrepreneurial saving and investment. They stress that tax policy has potentially large effects on entrepreneurial saving and investment and high “success tax rates” can discourage entrepreneurial entry, saving and investment. Since entrepreneurs are typically richer households with large financial wealth, this effect might significantly
influence their investment behavior. Based on the predicted consequence and based on the substitution effect drawn from this research, this tax policy may alter household portfolio composition by attracting more business investor to invest more in risky financial market.

Any policy provided by government or similar institutions or advice from professionals without considering the information of households’ investment in their private business or real estate might result in unexpected resource transfer across financial and nonfinancial market. For instance, if the policy in taxation or insurance system is changed towards income from self-employment, the associated background income risk predicted by household investors would change correspondently, and they will adjust their investment strategy based on the new information, hence the investment in this nonfinancial market would be highly influenced. Based on the substitution effect discovered from this research, it is likely that the investment in risky nonfinancial assets will be transferred into risky financial assets. On the other hand, if the policy was changed to be more favorable for investors in private business or real estate market, it is likely for some stock holders to withdraw some money from financial market to invest in risky nonfinancial assets. Therefore, investors will evaluate the benefits or welfare they can obtain from the policy change, and make decision on their new portfolio selection and allocation. Therefore policies with respect to tax rules and social welfare system might affect household portfolio selection and allocation as these policies might alter householders’ undertaking risks. Policymaker needs to take this potential impact into consideration when making new policies either related to financial investment or nonfinancial investments.
BIBLIOGRAPHY


## APPENDIX

### Description of Explanatory Variables

<table>
<thead>
<tr>
<th>Variables</th>
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<td><strong>Demographic variables</strong></td>
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<td>Age</td>
<td>Age of respondent</td>
</tr>
<tr>
<td>Age-squared</td>
<td>Squared age of respondent</td>
</tr>
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<td><strong>Racial/ethnic self-identification of the respondent (based on variable X6809)</strong></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1 if respondent said he/she is White, 0 otherwise</td>
</tr>
<tr>
<td>Black</td>
<td>1 if respondent said he/she is Black, 0 otherwise</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1 if respondent said he/she is Hispanic, 0 otherwise</td>
</tr>
<tr>
<td>Other (including Asian)</td>
<td>1 if respondent said he/she belongs to other group, 0 otherwise</td>
</tr>
<tr>
<td><strong>Respondent’s education</strong></td>
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</tr>
<tr>
<td>Less than high school</td>
<td>1 if years of education &lt; 12, 0 otherwise</td>
</tr>
<tr>
<td>High school</td>
<td>1 if years of education = 12, 0 otherwise</td>
</tr>
<tr>
<td>Some college degree</td>
<td>1 if get some college degree, 0 otherwise</td>
</tr>
<tr>
<td>Bachelor or above</td>
<td>1 if get a bachelor or above degree, 0 otherwise</td>
</tr>
<tr>
<td><strong>Respondent’s investment risk tolerance</strong></td>
<td></td>
</tr>
<tr>
<td>Not willing</td>
<td>1 if not willing to take any risk, 0 otherwise</td>
</tr>
<tr>
<td>Average risk tolerance</td>
<td>1 if not willing to take average risk, 0 otherwise</td>
</tr>
<tr>
<td>Above average risk tolerance</td>
<td>1 if not willing to take above average risk, 0 otherwise</td>
</tr>
<tr>
<td>Substantial risk tolerance</td>
<td>1 if not willing to take substantial risk, 0 otherwise</td>
</tr>
<tr>
<td><strong>Risky nonfinancial asset ownership</strong></td>
<td>1 if the value of household investment business and/or real estate is larger than 0, 0 otherwise</td>
</tr>
<tr>
<td><strong>Log of risky nonfinancial asset investment</strong></td>
<td>Log of household wealth invested in business and Log of household wealth invested in real estate</td>
</tr>
<tr>
<td><strong>Risky financial asset ownership</strong></td>
<td>1 if the value of household investment in stocks directly and indirectly is larger than 0, 0 otherwise</td>
</tr>
<tr>
<td><strong>Log of risky financial asset investment</strong></td>
<td>Log of household wealth invested in stocks directly and indirectly</td>
</tr>
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<td><strong>Home ownership</strong></td>
<td>1 if the respondent said the household owned home, 0 otherwise</td>
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<td><strong>Household composition</strong></td>
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<tr>
<td>Married couple</td>
<td>1 if the respondent is married to household member, 0 otherwise</td>
</tr>
<tr>
<td>Partners</td>
<td>1 if the respondent is living together with household member but not married, 0 otherwise</td>
</tr>
<tr>
<td>Single-headed</td>
<td>1 if the respondent is single-headed, 0 otherwise</td>
</tr>
<tr>
<td><strong>Female respondent</strong></td>
<td>1 if the sex of the respondent is female, 0 otherwise</td>
</tr>
<tr>
<td>Presence of child aged under 19</td>
<td>1 if there is a child aged under 19 living in the household, 0 otherwise</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Log of income</td>
<td>Log of household’s annual income (if income ≤ 0, use ln (0.01))</td>
</tr>
<tr>
<td>Inheritance</td>
<td>1 if respondent said he or she is expecting substantial inheritance</td>
</tr>
<tr>
<td>Liquidity</td>
<td>1 if household liquid asset is less than monthly income, 0 otherwise</td>
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</table>