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Heterogeneity and Portfolio Choice: Theory and Evidence

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Abstract

In this paper, we summarize and add to the evidence on the large and systematic differences in portfolio composition across individuals with varying characteristics, and evaluate some of the theories that have been proposed in terms of their ability to account for these differences. Variation in background risk exposure -- from sources such as labor and entrepreneurial income or real estate holdings, and from factors such as transactions costs, borrowing constraints, restricted pension investments and life cycle considerations – can explain some but not all aspects of the observed cross-sectional variation in portfolio holdings in a traditional utility maximizing framework. In particular, fixed costs and life cycle considerations appear necessary to explain the lack of stock market participation by young and less affluent households. Remaining challenges for quantitative theories include the apparent lack of diversification in some unconstrained individual portfolios, and non-participation in the stock market by some households with significant financial wealth.

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1. Introduction

Data on households' financial behavior points to considerable heterogeneity in portfolio allocations. The majority of households hold neither common stock nor other risky financial securities. Others invest in stocks almost exclusively. The extent to which risky asset holdings are diversified also varies greatly, ranging from exclusive reliance on diversified index funds to holdings concentrated in a few individual stocks. Employees often have significant holdings in the stock of their employers. To make sense of these observations, it is useful to look for empirical regularities in the way that households with different characteristics invest their savings, and to interpret these regularities using theories of portfolio choice that allow heterogeneity among investors. In this paper, we summarize and add to the evidence on the large and systematic differences in portfolio composition across individuals with varying characteristics, and evaluate some of the theories that have been proposed in terms of their ability to account for these differences.

If heterogeneity in portfolio allocations is to be explained in a traditional utility maximizing framework, it must be accounted for by heterogeneity in preferences, heterogeneity in circumstances, or a combination of the two. The recent literature on portfolio choice has emphasized both of these possibilities. Heterogeneity in circumstances encompasses a wide range of potential explanatory factors including the presence of non-diversifiable background risks, demographics, information asymmetries and transaction costs. Potential sources of non-diversifiable background risks include labor income and proprietary business income (or more broadly human capital), restricted pension investments, and owner-occupied real estate. Demographic factors include age, occupation, inherited wealth and education. Transactions costs include taxes, the fixed and variable costs of trading in securities markets, and also the time or psychic costs of learning about asset markets.

To provide context for the empirical findings, we briefly review some of the extensive theoretical literature on portfolio choice, with an emphasis on calibrated models explicitly designed to quantitatively explain heterogeneity. Early papers by Mossin (1968), Merton (1969), and Samuelson (1969, 1970) were the first to address the dynamic portfolio choice problem in preference based theories. Friend and Blume

(1975) found that, consistent with average asset holdings, calibrated versions of these theoretical portfolio share rules imply a fairly even division of wealth between stocks and bonds, assuming moderate risk aversion. For the next several decades portfolio choice was thought to be a largely solved problem. Recently, however, there has been renewed interest in this area. This can be attributed to the greater availability of data that reveals apparent idiosyncrasies in individual behavior, and also to the increasing interest in the implications of incomplete markets. Both naturally lead to an examination of optimal portfolio behavior in the presence of market frictions that can affect portfolio allocation rules.[1]

Apart from explaining data, understanding portfolio choice can shed light on a variety of broader issues. For one, asset pricing models presume a theory of portfolio choice. Unresolved issues in the asset pricing literature, such as the equity premium puzzle (Mehra and Prescott (1985)), are related to unsettled questions in the portfolio choice literature, such as explaining non-participation in the stock market, or that many portfolios are skewed towards safe assets. For instance, without the existence of a significant differential between the average return on stocks and that on short-term risk-free bonds (the equity premium), it would be quite easy to account for low stock market participation by appealing to moderate transaction costs or background risk using conventional models. Research on portfolio choice may help to explain the behavior of return differentials and asset prices by suggesting the characteristics of the "marginal investor" in asset markets, or by pointing towards a direction in which to modify our models of preferences or beliefs. Second, public policy questions, such as whether investing social security contributions in the stock market would be welfare improving, or whether current tax laws favoring investments in own-company stock should be changed, are also informed by a clearer understanding of the reasons for current asset allocations. Finally, investment advisers need to understand the causes and implications of investor heterogeneity to provide their clients with sound advice.

[1] The issue of background risk generally does not arise in the earlier work on portfolio theory which implicitly assumed that all income is capitalized into wealth. The allocation of wealth between risky stocks and risk-free bonds is therefore unaffected by the statistical properties of background risk.

The remainder of the paper is organized as follows. Section 2 presents summary statistics on heterogeneity in portfolio choice and some of the factors that suggest partial explanations for the cross-sectional variation. Section 3 briefly surveys the theoretical literature on portfolio choice. Section 4 reviews the results of many of the calibrated theoretical models that have been proposed to explain portfolio choice in the presence of market frictions and with uninsurable background risks, and discusses model predictions are often ambiguous. Section 5 reviews the statistical evidence on background income risk and its effect on portfolio allocations, and the some unresolved measurement issues.. Section 6 concludes.

2. Summary Statistics on Stock Market Participation and Portfolio Choice

Market clearing dictates that aggregate portfolio shares match the aggregate supply of stocks, bonds and other financial assets. Hence portfolio theories can only be tested using cross-sectional variation in portfolio composition, or time series data on individuals or households. In fact there is much heterogeneity in portfolio composition to be explained, as documented for the U.S. in a number of papers including Bertaut (1994), Blume and Zeldes (1994), Friend and Blume (1975), Heaton and Lucas (2000b), and Poterba (1993).

We begin by presenting statistics on portfolio allocations that are consistent with these studies, and that incorporate more recent data. These summary statistics are primarily based on tabulations from the Survey of Consumer Finances (SCF). The SCF is a leading source of information on household portfolio choice in the U.S., and includes detail on the various components of wealth (see, e.g., Aizcorbe et. al. (2003) and references therein). Because the SCF lacks a time series dimension, researchers interested life cycle effects often turn to the Panel Survey of Income Dynamics (PSID). While the PSID tracks households over time, it provides less financial detail than the SCF, and it surveys a much smaller sample of the wealthy households that own a disproportionate share of total financial assets.

Although much of the portfolio choice literature restricts attention to liquid wealth in the form of stocks, bonds and cash, several other types of financial assets comprise a significant portion of wealth, as do non-financial assets such as human capital. This raises the question of what measure of wealth to use in the

denominator when reporting percentage portfolio allocations. In this paper we employ a measure of "total financial wealth." We emphasize this measure because of the quantitative importance of assets such as real estate and privately held businesses, and because these components of financial wealth represent potentially important risk factors that may influence the composition of liquid asset holdings. Table 1 shows the breakdown of financial wealth from the 2001 SCF. For the average household, total financial wealth consists of liquid assets (15.8% stocks, 7.6% bonds, and 24.4% cash), housing (41.3%), other real estate (4.8%), and the market value of private businesses (4.2%). Stocks and bonds in various types of accounts (e.g., retirement accounts, mutual funds, and brokerage accounts) are aggregated in these statistics, although liquidity may be limited in some of these accounts. Other miscellaneous assets such as pensions or trusts that cannot be allocated to an asset class total 1.9%. Notice that liquid assets only average 47.8% of total financial assets. Notice also that leverage, which for many households is in the form of a home mortgage, is not reflected in these statistics.

(Table 1 here)

A significant portion of financial wealth is held in dedicated retirement accounts. Discussions of pension investing often abstract from the broader context of portfolio choice. Conversely, the portfolio choice literature generally ignores the institutional features of pension plans that may help to explain important aspects of portfolio choice. In this paper we emphasize the connections between these literatures. The Investment Company Institute (ICI) estimates that in 2003, the value of the retirement market stood at $10.2 trillion in 2002. Defined contribution (DC) plans (including IRAs, employer sponsored DCs and federal government DCs) have grown from 35% of the market in 1990 to about 45% of the total market in 2002. Over the same period defined benefit (DB) plans, which can be thought of as providing workers with a partially indexed bond, have shrunk from 52% to 44% in 2002. The remaining share is attributable to annuities. Interestingly, over 28% of the retirement market is provided by local, state and federal governments to their employees. Purcell (2002) provides statistics from the US Department of Labor that show defined benefit coverage in terms of numbers of participants shrunk over the 1990 to 1998 period whereas DC plan coverage almost doubled, so that there are now more than twice as many participants in

DC plans than in DB plans (50 million participants versus 22 million respectively). Estimates from the 2001 Survey of Consumer Finances suggest that 52 percent of households participate in some form of defined contribution tax deferred retirement account (21% held employer sponsored DC plans, 18% held IRAs and 13% held both). These retirement account assets comprise 13.4% of the financial assets of US households The median retirement account balance for households who held them was $29,000.

One aspect of portfolio choice that receives considerable attention is the decision by many households to opt out of the stock market entirely, despite the increasing participation rates seen in recent years. As emphasized by many authors (e.g., Bertaut and Haliassos (1995), Mankiw and Zeldes (1991), Saito (1995)), the phenomenon of stock market non-participation poses a challenge to portfolio theory, as well as to representative consumer asset pricing theory. To illustrate the trend in stock market participation rates over the last decade, Table 2 presents summary statistics on the distribution of the share of stocks in financial wealth in each SCF survey from 1989 to 2001. These statistics include all households with positive net worth, adjusted by the survey weights. Consistent with the relative growth of the stock market, mean stock holdings as a percentage of wealth has increased over this period. Participation rates in the stock market increased in the 1990s, although the percentage of non-participants remains strikingly high. Prior to 2001, stock holdings as a fraction of financial wealth were virtually zero in the 50th percentile. In the 75th percentile, this share increases from only 4.7% in 1989 to 26% in 2001. The increase in standard deviation and sharp decrease in skewness over the 12 years further indicates the increasingly wide, but still concentrated, distribution of stockholdings.

(Table 2 here)

These statistics are consistent with the findings in earlier studies. Poterba (1998) reports approximately 69.3 million shareholders in the U.S in 1995, compared to the 61.4 million in 1992 and 52.3 million in 1989. There is also some evidence that people start buying stocks at a younger age than in the past. For example Poterba and Samwick (1997) argue that baby boomers are participating more heavily in the stock market. Further Amerik and Zeldes (2000) show that there may be important cohort effects explaining trends in participation.

The trend of increasing participation is consistent with a number of possible explanations including a fall in the costs of participation over time, for instance because of changes in risk attitudes or expected returns, or reductions in background risk. It also coincides with the growth of low-cost mutual funds, and employer sponsored defined contribution (DC) pension plans. The latter can significantly lower the cost of participation through employer contributions or matches, virtually no direct transaction costs, and relatively easy access to information. Based on survey data from the Investment Company Institute (2002), 48 percent of U.S. households owning stock in January 2002 initially bought equities inside employer plans. In fact, the same study finds that the majority of equity investors own equities in employer-sponsored retirement plans in 2002. Data from the SCF, summarized in Table 3, confirms the importance of defined contribution pensions and of mutual funds as the vehicles for increased participation.

(Table 3 here)

Despite increases in participation, wealth and stock holdings in the U.S. remain highly concentrated in dollar terms. For example, in 1989 the top 10% of the wealth distribution held 84 percent of the stock. This dropped slightly to 83 percent in 1995, and further to 76.6 percent in 2001.

In fact, households with stock in their portfolio look considerably different than non-stock holders in many dimensions. In tabulations from the SCF that summarize some of these differences, we include only those households with positive net worth and adjust the results by the survey weights. We designate as "Non-Stockholders" those households with less than $500 in stock, and as "Stockholders" those households with at least $500 in stock. We set this cutoff above zero to avoid classifying households with incidental holdings as stockholders, but the results are not very sensitive to this choice. Based on this classification, Table 4 reports the mean and median of total financial wealth, housing wealth, mortgage debt, other real estate wealth, business wealth, labor income, age, education, self-reported risk tolerance, and the number of households, both in 1992 and in 2001, for each group. Not surprisingly, the data reveal that stockholders are considerably wealthier, with larger holdings in all asset categories, better educated, and describe themselves as less risk-averse (risk tolerance of 1=willing to take substantial financial risks, 4=not willing to take financial risks). These differences are all greater in 2001 than in 1992.

(Table 4 here)

The very limited wealth of many non-participants suggests they may have little incentive to optimize their portfolios, or that they may be discouraged from doing so by fairly small fixed costs. Calibrated theoretical papers that investigate this are discussed in Section 4.

Among stockholders, there is considerable heterogeneity in the share of wealth held in stocks. Conditioning on those households who have more than $500 in stock, Table 5 illustrates that for this group, in the 2001 SCF the average stock share in financial wealth is 26.9%, and ranges from 7.0% at the 25th percentile to 40.5% at the 75th percentile. These statistics suggest that heterogeneity is important, but not necessarily that any of these investors are making mistakes when differences in preferences and circumstances are accounted for.

(Table 5 here)

Some of the variation in portfolio share appears to be related to age and net worth, although these two factors only explain a small portion of the cross-sectional variance. Table 6 shows the relative shares of various assets in financial wealth across age and net worth brackets, where net worth is defined as financial wealth net of all personal debt, based on the 2001 SCF. Within each demographic category there is also significant variation, and holdings are often highly skewed in individual portfolios. Owner-occupied housing is the largest component of wealth for all but the wealthiest households, and private business wealth is an important component for the wealthy, particularly those under 45.

Previous studies on stock holding over the life cycle are largely consistent with the findings in Table 6. King and Leape (1987) emphasize the increase in stock holdings until retirement, and attribute it to the increase over time in knowledge when financial information is costly. Others emphasize the decline in stock holdings among the very old. Poterba and Samwick (1997) analyze the relationship between age and portfolio structure, with a focus on distinguishing between age effects and cohort effects. They find evidence of both age and cohort effects. Heaton and Lucas (2000b) suggest that the age effect on stock holding is sensitive to whether wealth is broadly or narrowly defined, with a smaller negative effect of age when wealth is broadly defined.

(Table 6 here)

The relation between stock market participation and portfolio shares and various household characteristics can be summarized using regression analysis. Tables 7 and 8 show the results of probit and OLS regressions of stock ownership on household characteristics using the 2001 SCF, with an emphasis on how various measures of housing affect these choices. Households with a net worth greater than $10,000 are included, and the survey weights are used. Table 7 shows that, controlling for wealth, the probability of stock ownership is decreasing with age and home equity/net worth, and home value and mortgage scaled by total financial wealth[2]. Participation in a defined benefit plan slightly decreases the probability of stock market participation, while participation in a defined contribution plan (which usually includes stock) significantly increases the probability. The fraction of liquid financial assets[3] invested in stock has a similar relationship with these real estate measures, as shown in Table 8. The negative relation between stock holdings and real estate is consistent with a substitution effect – for a given level of wealth, households that choose to spend more on housing have less to invest in other assets. If fixed costs are associated with stock investments, this would imply lower participation rates. The negative relation could also result from a reduced willingness to take on stock market risk when leveraged real estate represents a significant background risk.

(Tables 7 and 8 here)

Perhaps the aspect of data on portfolio choice that is most challenging to traditional theories is the apparent lack of diversification in the stock holdings of a significant number of households. Table 9 presents tabulations from the SCF, indicating the prevalence of investments in individual stocks, and also of investments in own-company stock. While the SCF does not allow a precise measure of diversification (for instance, the number of stocks in defined contribution pension accounts are not reported), we define undiversified households as those with more than 50 percent of their equity holdings in brokerage accounts

[2] In Table 5 the dependent variable =1 if the stockholdings are greater than $500.

[3] Liquid financial assets are defined as the sum of stocks, bonds, and cash.

with fewer than 10 stocks. By this measure, diversification has increased since the early 1990s, when more than 30 percent of households with equity fell into this category. In 2001 this percentage had fallen to 13.7 percent. Undiversified households were older by about 5 years, but wealth differences varied over the 5 surveys with diversified households slightly wealthier on average in 2001. Diversified and undiversified households hold similar average shares of real estate and private businesses.

For undiversified households, own company stock is a significant factor in all survey years, comprising 35.0 percent of total stock in 1989, and 28.4 percent in 2001. Holdings of own company stock are particularly difficult to explain from a diversification perspective, since returns are correlated with labor income risk. Undiversified households invested in own company stock and households invested in other stocks appear to be quite distinct groups (less than 20 percent of undiversified households held both own company stock and other stocks in all years).

Despite the apparent fall in undiversified households directly invested into single securities captured by the SCF, over the same period own company stock investments have grown rapidly in retirement accounts. Some of the decline in-own company stock holding may be the result of a corporate shift away from stock option, bonus and purchase plans, toward stock based compensation in more tax favored retirement plans. According to the Investment Company Institute (2003), 8.8 million households owned individual stock inside employer-sponsored retirement plans, with 51 percent owning exclusively employer stock. The role of employer incentives to hold own company stock in defined contribution pension plans via ESOPs, as discussed in Section 3.4, is likely one reason for this phenomenon. Further evidence on the role of employer stock is discussed in Section 5.3.

(Table 9 here)

3. Theories of Portfolio Choice

This section provides a brief overview of the main strands of the traditional literature on portfolio choice, which has been surveyed more extensively elsewhere.[4] A common feature of many of the earlier theories is that wealth from all income sources is implicitly assumed to be capitalized, and to be held in financial assets that can be freely traded. One can think of these theories as implicitly applying to a complete markets setting. We also survey the more recent theoretical literature that relaxes the assumption that all income is capitalized, complicating the portfolio choice problem but potentially explaining some of the heterogeneity observed in the data. A simple algebraic framework that embeds many of these models is described in section 3.7.

3.1 The Classics

Early and enduring contributions include Merton (1969, 1971), and Samuelson (1969). Merton (1969, 1971) considers a dynamic portfolio optimization problem in which investors maximize expected utility through their choice of risky and risk-free investments, subject to a wealth constraint. Conditions for optimal portfolio shares under a variety of assumptions about the returns process and utility specification are derived using dynamic programming. Closed form solutions obtain when returns are generated by a Brownian motion process, and for HARA utility functions, a class that includes constant relative risk aversion (CRRA) and constant absolute risk aversion (CARA).

One important result that emerges from Merton's analysis is a two-fund separation theorem. It states that given n assets with log-normally distributed prices, there exists a unique pair of "mutual funds" consisting of a linear combination of the assets, such that independent of preferences, wealth distribution, or time horizon, investors will be indifferent between choosing from a linear combination of these two funds or a linear combination of the original n assets. This reduces the analysis of many assets to a two-asset case.

With CRRA utility, and one risky and one risk-free asset representing the two funds, the theory has the testable property that the share invested in the risky asset is affected neither by the level of wealth nor by

[4] See for example, Heaton and Lucas (2000a).

the consumption decision. For CARA utility, the total dollar value of wealth invested in the risky asset is constant regardless of wealth. This implies, somewhat counter-intuitively and contrary to the empirical evidence, that as an investor becomes wealthier a decreasing fraction of his wealth is invested in the risky asset. Nevertheless, this functional form is often chosen for convenience in continuous time models since it can be integrated against a normal distribution.

3.1 Generalized Preferences

Recent results in the asset pricing literature emphasize the importance of relaxing the restrictive assumptions of time-separable CRRA utility. In models with habit persistence current consumption is evaluated relative to a weighted average of past consumption. Work by Constantinides (1990), Campbell and Cochrane (1999), Heaton (1995), and others, demonstrates that this modification to the representative consumer model can help to explain the equity premium puzzle along with observed time variation in expected returns. Another successful class of models builds on the recursive utility specification of Kreps and Porteus (1978) and allows for separate parameters governing the elasticity of intertemporal substitution and risk aversion. This added flexibility has proven useful in simultaneously understanding observed risk premia and risk-free rates (see, for example, Epstein and Zin (1989) and Weil (1990)).

Evaluation of decision theoretic models with these alternative preference assumptions opens additional avenues for understanding portfolio choice. First the predicted level of savings is altered, especially under standard models of habit persistence. The first-order effect is to increase savings in reaction to an increased aversion to variation in consumption over time (Heaton and Lucas (1997)). Second under both habit persistence and the recursive utility models that build on the Kreps-Porteus specifcation, the individual investor chooses portfolios to hedge against variation in future consumption. This additional hedging demand can be significant, especially in the context of time varying investment opportunities as considered by Campbell and Viciera (1998), and Skiadas and Schroder (1998), for example. Even without time varying investment opportunities, there can be important variation in the optimal investment in risky assets when an investor is faced with variation in non-traded risks, again especially in models with habit

persistence. This occurs because of the variation in risk aversion induced by the model. The result is substantial trading that may be counterfactual (Heaton and Lucas (1997)). The predicted dynamics of trading does allow the model's predictions to be compared to observed trading patterns, however.

3.2 Time Variation in Returns

Barberis (2000), Campbell and Viciera (1999), Kandel and Stambaugh (1996), Nielsen and Vassalou (2002), Wachter (2002), and Xia (2001), among others, study dynamic models of optimal portfolio choice in the face of time variation in the distribution of asset returns. Typically, expected returns are assumed to move with aggregate information such as price-dividend ratios and interest rates. Calibrations of these models predict considerable variation in portfolios shares because variation in expected returns is assumed not to be simultaneously accompanied by changes in risk.

Campbell and Viceira (2001, 2002) tackle the application of time variation in real and nominal interest rates in a model with a long lived agent motivated by the desire to smooth their stream of real consumption. They show that the relative magnitude of real and inflationary components of interest rate volatility drives the demand for short and long term bonds. In low inflation regimes, nominal bonds are an adequate substitute for inflation indexed bonds, and thus provide an effective hedge against real interest rate movements. Hence, a policy of inflation stabilization would appear to provide a motive for long horizon investors to hold long term nominal bonds. Brennan and Xia (2001) provide closed form results on inflation hedging with long and short nominal bonds.

Campbell and Viciera (1997) and Lynch (2001) use a partial equilibrium analysis to show that the cost of ignoring return predictability through lost market timing opportunities can be significant. Since the variation in investment opportunities considered in these papers is due to aggregate information, these analyses cannot address the heterogeneity in portfolio holdings that is the subject of this paper. A further issue is that in equilibrium, the average investor cannot arbitrarily adjust their portfolio shares. For this reason these decision theoretic analyses are unable to address the fundamental question of whether the time

variation reflects changes in preferences or other risk factors that diminish the apparent advantages of market timing.

3.3 Trading Frictions

A number of authors maintain the assumption that all wealth is held in financial assets, but incorporate some type of trading friction. Examples of theoretical models with exclusively financial assets and trading frictions include He and Pearson (1991), Karatzas, Lehoczky, Shreve and Xu (1991), and Xu and Shreve (1992). These authors analytically examine the case where the payoffs to financial securities do not span all of the uncertainty in the economy, and there are short sales restrictions.

Constantinides (1986) and Davis and Norman (1990) consider the effect of proportional transactions costs on trades of risky securities. In these papers, the only reason to trade is to rebalance one's portfolio between the risk-free and risky assets. Constantinides (1986) finds that such transactions costs do not discourage stock holding -- target portfolio allocations are similar to those in a frictionless environment. Rather, the effect of the costs is to discourage frequent trading, so that portfolio shares fluctuate more than in a frictionless environment. Interestingly, this finding contrasts with the implications of calibrated models with risky labor income, where the primary reason to trade is consumption smoothing rather than portfolio rebalancing, and the demand for trading is relatively inelastic. In that case, Heaton and Lucas (1997) find that transactions costs can influence portfolio shares, causing agents to tilt their portfolio towards assets with lower trading costs. More generally, trading frictions are often incorporated into models with non-tradable income risk and non-participation, but a detailed discussion of their effects in more complicated environments is postponed until Section 4.

Some types of taxes, such as those levied on capital gains, are theoretically analogous to proportional transactions costs. These taxes, by analogy, can be expected to discourage portfolio rebalancing but to have less effect on consumption smoothing. Relative taxes on different sources of capital income may also affect portfolio allocations. For instance, Black (1980) and Tepper (1981), and more recently Shoven and Sialm (2002) and Damon, Spatt and Zhang (2004) consider the optimal division of portfolio holdings

between tax favored and taxable accounts. These studies generally reach the intuitive conclusion that placing relatively highly taxed investments in tax protected accounts is optimal. Empirical evidence, however, suggests that many people ignore this logic, holding highly taxed investments in taxable accounts. Amromin (2002) summarizes this evidence, and suggests that liquidity considerations may partially explain this behavior.

The tax treatment and regulations governing defined contribution pension plans are another friction with potentially important implications for portfolio choice. Specifically, the interaction between tax law and pension regulations may help to account for the prevalence of concentrated investments in employer stock, despite the diversification losses for employees. Where employer stock is provided via employer contributions, it is common to provide it through an Employee Stock Ownership Plan (ESOP). From an employer perspective, an ESOP is the most cost-effective vehicle for compensating employees with employer stock. Under a typical combination arrangement involving an ESOP and a 401(k) plan, the employee's voluntary salary deferrals to their 401(k) are matched by the employer with an allocation of employer stock to the employee's ESOP account. Generally each participant's ESOP account balance is invested almost exclusively in the stock of the employer. Historically ESOPs have been used as a merger defense by trying to place the equity of a company in friendly employee hands. They have also been used as part of corporate restructurings where employees take a long term equity stake in exchange for lower wages.

Taxation of ESOPs is much the same as for 401(k)s and other profit sharing plans in that there are no taxes on contributions made by the employer and employee until distribution. In addition, dividends paid on shares in the ESOP are tax deductible to the employer if they are paid in cash to employees or if they are rolled over into new stock within the ESOP. Leveraging the ESOP increases the fraction of payroll that can be distributed in a tax-preferred form. To qualify for these tax advantages, an ESOP must comply with many of the regulatory requirements of a 401(k) plan, including the rules that mandate non-discrimination and that limit the share of benefits going to highly compensated employees. This may be responsible for

companies providing stocks to lower paid workers, even if in the absence of tax incentives and regulations they would choose to target stock distributions more narrowly.

Because employees are restricted from diversifying ESOP holdings, they are a source of background risk that can be expected to affect other aspects of portfolio choice. Interestingly, ESOP participants have a legal right to partially diversify their ESOP holdings once they have attained age 55 and have 10 years of service with the firm (the employer may impose less stringent rules. Under these rules each participant may diversify up to 25% of their ESOP shares in the 5 years following eligibility and this fraction increases to 50% in the sixth year after becoming eligible. The remaining balance of shares is held in the ESOP until the employee leaves the firm. These rules create natural experiments to determine the extent that employees voluntarily maintain large exposures to the idiosyncratic risk of their company.

3.4 Uninsurable Background Risk

When some income (e.g., labor or private business income) cannot be capitalized, investors must evaluate their financial investments taking into account this background risk. Undiversified investments in risky assets such as housing also generate background risk. The earlier analyses relevant to these types of complications consider the effect of constraints on portfolio weights (e.g., Mayers (1973), Anderson and Danthine (1981), Cvitani'c and Karatzas (1992). In these analyses, it is assumed that a subset of risky assets must be held in fixed amounts. Under fairly standard assumptions, this produces an additional hedging term that depends on the covariance between the constrained asset and freely traded assets, but not on risk preferences. Notice that these analyses imply that heterogeneity resulting from uninsurable risk invalidates the convenient two-fund separation theorems of Merton (1971). If background risks vary across individuals in their co-variation with individual stocks, holding a combination of a diversified market portfolio and risk-free securities no longer is optimal. Rather, portfolio optimization requires underweighting or shorting stocks that hedge the non-traded component of income risk.

More recently, a number of authors have derived some analytical results on portfolio choice in the present of background risk (quantitative results from related calibrated theories are discussed at length in

Section 4 below). For example, Cuoco (1997), Duffie et. al. (1997), He and Pag'es (1993), Svensson and Werner (1993), and Vila and Zariphopoulou (1997) present existence results and some characteristics of the solution to the continuous-time portfolio choice problem with non-tradable stochastic labor income and borrowing constraints. Gollier (2001) provides slightly more general results (in terms of the utility and distributional assumptions required) on portfolio choices with background risk in the context of two period and discrete time models.

3.5 Non-participation

There are two, not necessarily mutually exclusive, ways to motivate stock market non-participation in standard models. One is that some people are limited by a short-sales constraint. The second is that fixed costs discourage participation. This fixed cost could be tangible, such as brokerage fees or the cost of becoming informed about investing in stocks. Alternatively the cost could be some type of psychic cost of putting savings at risk that is not captured by the standard preference assumptions. Because of the difficulty of obtaining closed form solutions when these factors are considered, there are few analytical results, although an exception is Basak and Cuocco (1998). (See Section 4.4 for a discussion of calibrated theories of non-participation.)

An interesting but indirect implication of analyses with uninsurable background risk is that non-participation in the stock market cannot be explained by background risk alone -- other market frictions such as short sales constraints or fixed costs of market participation must also be present. The reason is that while background risk changes the target ratio of stocks to other liquid assets, and may even motivate a short position when stock returns are highly correlated with large background risks, the probability that the demand for stocks is exactly zero is negligible. This fact, together with the observation that many households hold no stock, is one motivation for routinely imposing short sales constraints in these analyses.

3.6 Life Cycle Effects

An important question for portfolio theory is whether the share of wealth invested in risky assets should vary with age? A well-known, if unintuitive, result due to Samuelson (1969) is that under normally assumed preference specifications, there is no age variation in portfolio shares when capital income is a person's only source of income. This contradicts the common view of many financial advisors (Bodie and Crane (1997)), who counsel that older people should reduce the share held in stocks. Bodie, Merton and Saumuelson (1992) provide some theoretical underpinnings for the popular view. They show that if the ability to smooth income shocks by adjusting labor supply is greater for younger workers, then older people should hold less stock in their portfolios. Jagannathan and Kocherlakota (1996), and Cocco, Gomes and Maenhout (1998) also discuss reasons for changing portfolio investments over the lifecycle.

3.7 A General Analytic Framework

Most of the models discussed above share a basic analytic framework, a representative version of which is developed here. We assume that period utility is of the CRRA form, since it is the most commonly used specification, and it allows the derivation of some closed form results. The analyses of the alternative utility specifications described in section 3.1 proceed similarly, but replace CRRA utility with other functional forms. The analysis is also simplified by assuming a single risky financial asset, a "stock," and one-period bonds.

Assume that an investor maximizes expected utility over a horizon T:

$$U_t = E_t\left[\sum_{x=0}^{T}\left(c_{t+x}^{1-\gamma}-1\right)/(1-\gamma)\right] \tag{1}$$

The agent chooses to invest s_{t+1} in stocks, b_{t+1} in bonds and consume c_t at time t. The consumption and saving choice is subject to the flow wealth constraint:

$$c_t + s_{t+1} + b_{t+1} \le s_t(1+r_t^s) + b_t(1+r_t^b) + y_t, \tag{2}$$

where r_t^s is the return on stocks at time t, and r_t^b is the return on bonds at time t, and y_t is risky non-tradable income.

For an unconstrained investor j, the resulting Euler equation is:

$$E_t\left\{\left(c_{t+1}^j / c_t^j\right)^{-\gamma}\left(r_{t+1}^s - r_{t+1}^b\right) = 0\right\}. \tag{3}$$

Under the assumption that consumption growth and returns are lognormally distributed conditional on information at time t, (3) can be written as:

$$\mu_t^s = \mu_t^b - \frac{1}{2}\mathrm{var}_t(r_{t+1}^s) + \gamma\,\mathrm{cov}_t[\log(c_{t+1}^j / c_t^j), r_{t+1}^s] \tag{4}$$

where μ denotes a mean return. When there is no non-tradable income ($y_t \equiv 0$) and the consumption process equals the returns process on financial assets, (4) implies the classic Merton result, that the portfolio share of the risky asset in wealth, ω, is given by:

$$\omega = \frac{\mu^s - r}{\mathrm{var}(r^s)\gamma} \tag{5}$$

Notice that in the absence of borrowing or short sales constraints, (3) and (4) hold not only when all income comes from financial investments, but also for investors with a non-treaded income stream y_t. This income could come from a variety of sources, including wages, restricted pension holdings, housing rents, and private businesses. The background income process does affect portfolio composition, but only indirectly, through its affect on the variability of consumption and its correlation with financial returns.

Many authors have found that with standard preferences, agents generally accumulate more wealth when a non-tradable income source is considered than in similar models with only financial assets, since a "buffer stock" of savings is used to partially self-insure against the risk from non-tradable income. In finite horizon versions of the model, the life-cycle pattern of background income often creates an additional

retirement motive for saving starting in middle age. A bequest motive also can influence the level of and allocation of savings.

It is often assumed that investors can borrow at most a limited amount in the bond market, and cannot go short in stocks. When a short sales constraint is binding, the equality in (3) is replaced by an inequality, and the constant share rule (5) need not hold. Perhaps the most important implication of these constraints is for asset pricing theory, since they imply that the marginal investor might not have a consumption pattern proportional to aggregate consumption.

As noted earlier, incorporating non-participation in the stock market requires either the possibility of a binding short sales constraint or a fixed cost of entering the stock market. Mathematically, the situation where the agent does not participate in either the stock or the bond market and is thus against both the borrowing and short-sale constraints requires that the following inequalities are satisfied:

$$\beta E_t[(y_{t+1}/y_t)^{-\gamma}(1+r_{t+1}^s)] \leq 1 \tag{6}$$

and

$$\beta E_t[(y_{t+1}/y_t)^{-\gamma}(1+r_{t+1}^b)] \leq 1 \tag{7}$$

An empirical difficulty with this formulation, as emphasized by Heaton and Lucas (1997), is finding plausible parameters where people choose to hold risk-free assets but do not hold stocks; where (6) holds but (7) does not. For instance, when background income risk is uncorrelated with the market, and even assuming an equity premium significantly below its historical average, standard parameterizations of this model counterfactually predict that agents with low levels of wealth will put all of their savings in stocks. Only at higher levels of financial wealth does the risk of stocks start to dominate the attraction of the equity premium, leading to limited investment in stocks. When stock returns are strongly positively correlated with shocks to non-traded income, the model can generate policy rules that include risk-free securities at lower wealth levels. Alternatively, a fixed cost of stock market participation can discourage stock holdings at low wealth levels.

3.8 Theoretical Complications

The theoretical literature establishes that non-tradable background risk can affect the desired level and composition of liquid asset holdings. When combined with fixed participation costs, it is also possible to justify non-participation in the stock market by households with low wealth levels or short horizons. Unfortunately, a number of theoretical complications make it difficult, if not impossible, to tease out sharp empirical predictions from these models. These caveats may help to explain the mixed success of empirical attempts to explain cross-sectional variation in portfolio holdings with variation in background risk and moderate participation costs, which are surveyed in Section 4 below.

Intuitively, one might expect theory to predict that the fraction of investments held in risky stocks would be inversely related to the correlation between stock returns and the background risk source, since positive correlation magnifies total consumption risk. Further, one might expect that all else equal, people exposed to higher variance background risk would be expected to hold less wealth in stocks, since they would have a reduced tolerance for risk. Theoretically, however, it is easy to construct counterexamples to this intuition due to the following considerations:

1. Only utility functions exhibiting "proper risk aversion" have the property that increased background risk induces higher effective risk aversion.
2. More importantly, the addition of a risky income stream that is bounded below can reduce overall consumption risk, increasing effective risk tolerance even with proper risk aversion.
3. Portfolio composition and savings decisions are intertwined. With CRRA preferences, this interaction can result in stock market participation rates that rise with the assumed coefficient of risk aversion.

Pratt and Zeckhauser (1987) characterize utility functions with "proper risk aversion," which is defined by the property that an undesirable lottery can never be made desirable by the presence of an independent, undesirable lottery. They show that this is a feature of exponential, power, and logarithmic utility functions, so it holds for all of the most commonly used utility specifications. Gollier and Kimball (1994) further examine the relation between utility functions and background risk.

A number of papers (e.g., Bertaut and Haliassos (1997), Cocco, Gomes and Maenhout (1998), Heaton and Lucas (1997and 2000b), Koo (1995) and Viciera (1997)) demonstrate that adding a risky income stream that cannot be capitalized (i.e., labor income) 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 bond holdings. Although non-tradable income is risky, it limits bad outcomes relative to investment income, which significantly reduces effective risk aversion. For this reason, including background income risk can make it more difficult to explain non-participation in the stock market, or low levels of stock holdings. More generally, these models suggest that quantitative predictions of calibrated models are highly sensitive to the assumed stochastic processes, an implication explored further in Section 5.

The confounding effect of higher risk aversion on stock market participation in the presence of fixed participation costs is due to the connection between risk aversion and the intertemporal elasticity of substitution with CRRA preferences. With CRRA preferences, risk aversion is the inverse of the intertemporal elasticity of substitution. This implies that as agents become more risk averse, they simultaneously become more intolerant of intertemporal variation in consumption. Consequently, higher risk aversion results in higher predicted levels of savings. The importance of the equity premium relative to the fixed participation cost increases with the level of savings. For some parameters, more risk-averse agents are therefore more likely to participate in the stock market. This mechanism is explored in Gakidis (1997) and Gomes and Michaelides (2003). These types of analyses suggest that separating the coefficient of relative risk aversion from the elasticity of intertemporal substitution improves the ability to generate predictions consistent with intuition and observed behavior.

4. Quantitative Analyses

The cross-sectional data presented in Section 2 suggests that many households manage their financial wealth in a way that is inconsistent with frictionless markets. Once the assumptions of frictionless markets and a representative agent are relaxed, however, there are many possible avenues to explore. We

begin by describing the results of several of the first studies to reinterpret traditional theories to take into account heterogeneity and its empirical implications. We then turn to calibrated theories exploring heterogeneity arising from uninsurable background risks -- from sources such as labor income, private business or employer stock holdings, restrictions on pension investments, and concentrated real estate holdings – which can create considerable heterogeneity in optimal portfolio allocations. Recall that the reason for the effect on portfolio choice is that these risks affect the consumption process, and hence the tolerance for tradable financial risks. Researchers have concentrated on these particular background risks because of their quantitative importance for many households (see Table 4), and the apparent difficulty of avoiding or insuring against them. These analyses provide some support for the idea that differential background risk systematically influences portfolio choice, but overall account for only a limited amount of the observed cross-sectional variation.

4.1 The Consumption of Stockholders and Non Stockholders

A counterfactual empirical implication of calibrating (3) with aggregate consumption data, the historical equity premium, and standard values of the risk aversion coefficient is that the representative consumer would invest all wealth in the stock market, or even takes a levered position in stocks. This is because aggregate consumption is neither very risky nor highly correlated with the stock market, and because of the high equity premium. The difficulty of explaining low or even moderate levels of stock holdings in a model calibrated with aggregate consumption is the partial equilibrium counterpart of the equity premium puzzle proposed by Mehra and Prescott (1985).

The simplest way to incorporate heterogeneity as a potential solution to this empirical failure to predict portfolio shares with aggregate consumption is to calibrate (3) using consumption data for individuals who actually hold stocks. If markets are relatively complete for stock market participants, then the covariance of stock returns with total stock holder consumption, not aggregate consumption, is the relevant predictor of risky asset holdings.

Mankiw and Zeldes (1991) were the first to propose and test this idea, using data on food consumption in the PSID. They find that the consumption of stockholders has a higher variance and is more highly correlated with stock returns. A number of studies have repeated this type of analysis using broader measures of consumption from the Consumer Expenditure Survey (see, for example, Brav et. al. (1999), Parker (2001), and Vissing-Jorgensen (2002)) and the UK Family Expenditure Survey (Attanasio et. al. (1998)). Similar to the results of Mankiw and Zeldes (1991), these studies report that the consumption of identified stockholders is more consistent with the predictions of (3) for moderate levels of risk aversion than is the consumption of non-stockholders. In addition, Ait-Sahalia et. al. (2001) find that the consumption of wealthy individuals, as represented by the consumption of luxury goods, covaries more highly with stock returns than does aggregate consumptions. To the extent that wealthier individuals are stockholders, this is also consistent with the idea that stockholders hold riskier consumption bundles.

Collectively, these studies show that model performance is improved by focusing on the consumption of market participants. Assuming moderate risk aversion, these models still predict far larger investments in stocks than observed in practice. However, these studies continue to impose significant aggregation by imposing that all stockholders experience the same consumption growth process. The models described in the rest of this section take heterogeneity further, by assuming that even stockholders have limited opportunities for consumption smoothing.

4.2 Calibrated Models with Background Risk

In the last decade, a number of authors have used numerical methods to examine the quantitative implications of background risk for portfolio choice in theoretical models. Many of these studies also assume other types of trading frictions, such as borrowing and short sale constraints, or fixed or variable trading costs. For convenience, we classify these analyses under the broad heading of background risk, even though the trading frictions are often essential elements of the story.

Labor Income. Labor income, because of its importance for most households, and the difficulty of insuring it, is a natural source of background risk to consider. Koo (1995) studies a decision-theoretic model

of portfolio choice in which infinitely lived investors with time and state separable preferences face uninsurable labor income risk. Heaton and Lucas (1997) consider a similar structure that also allows for transactions costs and habit formation. Bertaut and Haliassos (1997), Cocco, Gomes and Maenhout (1998), and Viciera (1997) analyze similar environments with finitely-lived agents.

All analyses using infinite horizon models and standard preferences find that despite high levels of assumed background risk, savings are held mostly or entirely in the stock market. In fact, for reasonable parameter values agents often want to take a leveraged position in stocks. This is because the assumed floor on labor income tends to reduce overall risk exposure, thereby increasing risk tolerance. Further, labor income has a low correlation with stock returns, at least over the annual horizons that most of these studies focus on. These factors, in combination with a sizable equity premium, imply that stock holdings tend to dominate bond holdings.

The counterfactual prediction of portfolios concentrated in stocks has led researchers to look for alternative specifications that generate a demand for risk-free assets. It is possible, for instance, to increase the predicted share invested in risk-free bonds under alternative preferences. Assuming habit formation, Heaton and Lucas (1997) report positive bond holdings when effective risk aversion is high but income is low. Habit formation, however, has the undesirable property that portfolio composition is unrealistically volatile, varying sharply with the habit stock.

In general, life cycle models appear to be more successful than infinite horizon models in explaining many aspects of observed portfolio choices, and their interaction with labor income. Age can affect portfolio choice in a variety of ways. For instance, risk tolerance may vary with time horizon, earning potential or health status; and the age-earnings profile, and timing of bequests, affects savings behavior in the presence of borrowing constraints. Life cycle models, in combination with time non-separability in preferences, have been particularly successful at matching certain features of the data. Gakidas (1997) considers a finite horizon model with non-time separable preferences where the coefficient of relative risk aversion can be separated from the elasticity of intertemporal substitution. He finds that it is possible to get positive bond holdings for the elderly, by assuming a higher elasticity of intertemporal substitution than with

standard preferences. More recently, 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. Young people want to consume, not save, since they anticipate higher income in the future, and they are constrained by borrowing and short sales 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.

Business income. The higher volatility and higher correlation of business income with stock returns, as well as its prevalence in wealthy households, motivates its consideration as a potentially important background risk. It can be incorporated into models that are theoretically identical to those with non-tradable labor income under the assumption that any direct effect of business ownership on utility is additively separable. Then the main effect of including private business income is to change the stochastic process associated with background risk. As for labor income, when business income puts a floor on income, including them can make it more difficult, not easier, to explain the low level of stock holdings by many households.

Heaton and Lucas (2000a) show that a background risk process that reflects proprietary business income, in combination with somewhat higher risk aversion than assumed in their earlier analysis, is sufficient to generate considerable variation in predicted portfolio shares, although it does not explain stock market non-participation. Polkovnichenko (1998) also considers income generated from privately held businesses, or "entrepreneurial income." In part due to its higher correlation with stock market returns, he finds that the predicted demand for stocks is lower than in models that focus on labor income, but still higher than what is commonly observed.

Housing. The largest financial investment of a typical household is owner-occupied housing. Its salient features for portfolio choice are that it is undiversified, highly leveraged and costly to adjust. These factors suggest its potential to influence portfolio choice, but there are offsetting considerations. The accompanying leverage and limitations on diversification suggest it might induce lower stock holdings, but

the low correlation of housing returns with the stock market suggest it has diversification advantages that could encourage greater stock holding.

Housing is incorporated into portfolio choice models in a variety of ways. In some cases authors posit a direct effect on utility that is separate from other types of consumption. In other models it is treated as a lumpy investment with adjustment costs that provides a stream of consumption or income that is not distinguished in the utility function. In either case, analyzing the risk and return to housing is complicated by the unobservable consumption stream that it generates.

Henderson and Ioannides (1983) introduce the constraint that housing investment is at least as large as housing consumption. In a theoretical model, Brueckner (1997) shows that when this constraint is binding, there is a distortion in both housing and non-housing assets and the portfolio is inefficient in a mean-variance sense. Flavin and Yamashita (2002), also abstracting from labor income, posit that the consumption demand for housing is likely to create a highly levered position in real estate for younger households. This levered position in a risky asset should affect their tolerance for stock market risk relative to older households who have paid down their mortgage. Flavin and Yamashita, simulate what optimal portfolio shares should be in theory, calibrating the model with estimates of the correlation between housing and other investments. Because the return to housing has a low correlation with the return to stocks, housing improves the mean-variance efficient investment frontier. In their framework, using reasonable risk parameters, the optimal stock to net worth ratio is 9 percent for the youngest households and 60 percent for the oldest. In addition, it is optimal for each home to be fully mortgaged at all ages. These predictions differ from empirical evidence on stock holding by age in Table 6, and evidence on mortgage use in Curcuru (2004). Curcuru finds that only 66% of all households, and 26.4% of seniors, had a mortgage on their primary residence in the 2001 SCF.

The large transaction costs of adjusting real estate decreases housing returns and has other portfolio implications as well. Grossman and Laroque (1991) develop a theoretical model with a single illiquid durable consumption which incurs a large transaction cost when sold. They show that it is optimal to adjust consumption of the durable only after a large wealth change, and that with CRRA utility the transaction cost

reduces the optimal amount of risky asset investment. In a continuous-time framework, Cauley et. al. (2003) show that the inability to freely adjust housing investment substantially alters 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.

As with models of portfolio choice incorporating labor income, the effect of illiquid housing also plays a larger role in a life cycle setting. Cocco (2004) and Hu (2001) present similar models in which housing provides consumption and investment services, and where the frictions in the housing market influence portfolio choice differently at different ages. For households saving to meet a downpayment constraint, there is a potential tension between the higher average returns on stocks that reduce the expected time to purchase, and greater risk that could delay purchase. In these analyses, young households anticipating a house purchase or with a highly levered position in housing are predicted to hold a smaller fraction of liquid assets in stocks than in the absence of a housing decision.

4.3 Restricted Pension Investments

As discussed earlier, a defined contribution retirement account with investment choice allows an individual to accumulate wealth for retirement in a variety of assets free from annual taxation. When an optimizing agent has access to a retirement account, their choice set is enriched: in addition to conventional saving and portfolio choices on a taxable basis there are saving and portfolio choices on a tax deferred basis. Section 3.3 discussed the tax efficiency arguments for holding high taxed assets in tax deferred retirement accounts. However, in a precautionary lifecycle model with exogenous stochastic labor income, Amromin (2002) shows there will be situations where bonds are voluntarily held both inside and outside of the retirement habitat.

Restrictions on pension investments, such as limitations on diversifying out of ESOP investments, variations in 401(k) employer matching contributions and pre-retirement withdrawal rules, also are expected to influence portfolio choice. Moore (2004) explores the effects of typical pension plan restrictions on life cycle portfolio choice behavior. In the model, an employee can freely allocate his

retirement contributions to stocks and bonds as well as his outside portfolio, the employer makes matching contributions, and withdrawals or loans are available for emergency consumption. Calibrations suggest that the majority of wealth should be accumulated through retirement account contributions and only a small stock of wealth should be maintained outside of the retirement account to buffer income fluctuations. When employers match retirement contributions using employer stock with long holding requirements, the pension account is s less attractive, and the remaining portfolio choices become more conservative. Heterogeneity in plan rules can create significant differences in optimal plan participation and asset allocations. Counterfactually, however, the model predicts that the outside portfolio will be more aggressively invested in stocks than the retirement portfolio, a manifestation of the tax efficiency argument presented in section 3.3.

4.4 Explaining Non-participation

There have been a number of attempts to calibrate the size of the fixed costs necessary to discourage stock market participation. One of the earliest analyses is by Saito (1995), who calibrates a model in which all wealth is held in the form of stocks or bonds, and calculates how large a fixed cost would be required at time 0 to result in some agents holding only bonds. He finds costs ranging from 3% to 54% of wealth, depending on the assumed risk aversion and size of equity premium. These numbers are high for the same reason that agents are predicted to put all of their wealth into stocks in the calibrated models discussed above -- it is costly to forego the high equity premium.[5] Polkovnichenko (1998) finds that in a model with heterogeneous risk aversion and heterogeneous idiosyncratic income risk, the fixed cost required to generate non-participation is potentially much lower.

Since stock holdings are highly skewed towards households with high net worth, any convincing explanation of heterogeneity in portfolio holdings must also be consistent with this fact. Explanations emphasizing fixed costs are consistent with this observation, since such costs are especially onerous for people with low wealth. Building on the work of Luttmer (2000), Paiella (2001) uses the Consumer

Expenditure Survey and estimates the necessary fixed costs to preclude stock market participation when controlling for wealth and demographic variation at the household level. She finds that the fixed costs needed to explain non-participation might not be large. Vissing-Jorgensen (2002) finds that an annual fixed participation cost of only $50 can explain 50% of non-participants, while $260 explains 75 percent.

4.5 Exploiting the Covariance of Background and Market Risks

The models discussed in Section 3.4 establish that holding stocks in the form of a diversified market portfolio need not be optimal in the presence of non-tradable background risk. Most calibration exercises to date, however, abstract from the possibility of exploiting the correlation structure between tradable and non-traded risks, and continue to treat a maximally diversified market portfolio as the benchmark risky asset. A partial exception is Davis and Willen (2000a and b), who measure the correlation between market returns and labor income for households with different levels of education, broad occupation group and by sex, and suggest that there are significant differences between groups in the effective risk of stock market investments. They do not, however, consider whether optimized portfolios could improve the ability to hedge non-tradable risks. This question is addressed by Massa and Siminov (2004), using a unique panel of Swedish data with detailed time series information on portfolio composition and income. They examine whether people use individual stocks to hedge non-financial income risk, and find little evidence for hedging. Rather, they find a tendency to invest in stocks that are familiar in terms of geography or professional proximity. Further exploration of these issues is likely a fruitful area for future research.

5. Empirical Evidence and Issues

The predictions of calibrated models, such as those outlined in Section 4, depend critically on the assumed statistical properties of background risks and their correlations with financial assets. In section 5.1 we illustrate this issue with a typized example. Aggregate statistics can be a starting point for many

[5] Basak and Cuoco (1998) and Vissing-Jorgensen (1997) also explore these issues.

measurements of background risks. Summary statistics based on aggregate measures of background risks and their correlations with financial returns are presented in section 5.2. While these aggregate measures are suggestive about which risks might be important, panel data, when it is available, is arguably more informative about the individual risks that are most relevant to explaining cross-sectional differences in household portfolio choices. Section 5.3 summarizes the growing body of evidence based on panel data, and attempts to link it to cross-sectional differences in portfolio choice. Although some studies find that various background risks influence portfolio choice, data limitations and statistical difficulties suggest that these results must be interpreted with caution.

5.1 An Illustrative Example

To illustrate the importance of the measurement issue we review an example from Heaton and Lucas (2000a). At time t the investor is assumed to maximize the utility function given by (1) with T=∞ and subject to the budget equation given by (2). Further there is a strict restriction against borrowing and short positions in the stock. To characterize the dynamics for stock returns and non-traded income, let:

$$X_t' = \left[\log(y_t / y_{t-1}) \log(1 + r_t^s)\right] \tag{8}$$

The vector X_t is assumed to follow a first-order autoregressive process:

$$X_t = \mu + AX_{t-1} + B\varepsilon_t \tag{9}$$

where the parameters are chosen to match several alternative assumptions about non-traded income.

In the "low background risk case", the mean and standard deviation of non-traded income growth are assumed to be 1% and 15% respectively. This level of variability is consistent with studies that examine labor income risk faced by individuals. We also consider a "high background risk case" where the standard deviation of non-traded income is assumed to be 29%. As in Deaton (1991) and other studies we assume

that non-traded income growth is negatively correlated over time. This induces a precautionary demand for savings. For this example we assume that the first-order autocorrelation of income is -0.4 which is consistent with the estimates of MaCurdy (1982).

Stock returns are assumed to have a mean of 7.75% and a standard deviation of 15.7% but are unpredictable over time. To capture the potential for hedging we allow for correlation between the innovations in non-traded income and stock returns. The model is solved numerically using the methods described in Heaton and Lucas (1997). Table 10 reports summary statistics from simulations of the model under several alternative assumptions. In the table, "Corr" denotes the correlation between stock returns and non-traded income. In all cases the discount factor β is assumed to be 0.9. This low value is needed to prevent the model from producing large levels of savings. In this way the model can mimic some features of a life-cycle model where the individuals do not save early in life because of predictable increases in income. Because non-traded income is assumed to grow over time the level of savings in each security are normalized by current income.

(Table 10 here)

As we discussed in section 4, this type of model has a difficult time producing reasonable levels of stock and bond holdings simultaneously, unless relatively extreme assumptions are imposed. In particular, at low levels of the risk-aversion parameter γ and for any correlation in the assumed range, there is little savings in bonds. For example, when $\gamma = 5$ and Corr = 0, 97 percent of savings is held in the form of stock in the low background risk case. Only with very high risk aversion and high levels of background risk is there significant bond holdings. If we use the more extreme parameters (panel D) as a basis for experimentation, notice that relatively small variation in the correlation between stock returns and non-traded income causes relatively large changes in the average stock position in savings. These results imply that measurement of the characteristics of background risk is critically important.

5.2 Aggregate Income Statistics

Summary statistics on the major income components and their aggregate properties in the United States are reported in Table 11. Wage income is "real wages and salaries," and business income is real "non-farm proprietary income," from the NIPA, 1947 to 2003. Aggregate wage income, which makes up over 62 percent of total income, has a low contemporaneous correlation with the stock market, and is not very risky. The results of Table 10 illustrate that models calibrated using aggregate wage income predict a counterfactually high demand for stocks. As discussed earlier, housing can be considered another source of non-traded or background risk. In the aggregate, the correlation between housing and stock returns is low at only 5.1 percent, and housing has a very low real return and standard deviation. This increases the difficulty of explaining low stockholdings in models calibrated with aggregate data, since in aggregate housing is essentially a risk-free asset. Aggregate proprietary income is both riskier and more correlated with stock returns than is labor or housing income, suggesting it could be a slightly greater deterrent to stock holding than labor income risk. Notice, however, that at the aggregate level this risk is still relatively small. For this reason, empirically more successful models are calibrated using measurements from individual data.

(Table 11 here)

5.3 Evidence on Background Risk

Labor Income. Econometric analysis of panel data suggests that individual labor income is considerably more volatile than aggregate labor income. Individual labor income shocks appear to have a permanent and a transitory component, although estimates of the relative magnitude of each component vary depending on the types of heterogeneity considered and the statistical model employed. For instance, Carroll and Samwick (1997) find that average individual labor income risk is roughly double aggregate risk, while Meghir and Pistaferri (2004) find that the risks are of the same magnitude but that aggregate risk is 2 to 3 times more persistent. There is evidence of significant heterogeneity in labor income risk. Using the PSID, Hubbard et. al. (1995) find that labor income risk for individuals with only a household diploma is double

that for individuals with a college degree. Gourinchas and Parker (2002) also find related differences across occupations. Managers and highly skilled professionals have about 2/3 the labor income risk of laborers or administrative staff.

Estimating the correlation between individual labor income and stock returns is complicated by the lack of data on portfolio composition that has both a time series and panel dimension, and by the difficulty of identifying unanticipated income shocks for individual households. These problems also make it difficult to detect a statistically significant relation between individual income processes and portfolio decisions. Nevertheless, several authors have tried to estimate these effects. Heaton and Lucas (2000a) examine income and imputed asset holdings from the 1979-1990 Panel of Individual Tax Returns. They find extensive heterogeneity in both the variability of individual income and the correlation of this income with stock returns. Using U.S. data from the PSID, Gakidis (1997) finds that households with a larger probability of realizing extremely low wage income are less likely to participate in the stock market. He finds that for those who are participating, the probability of very low wages reduces the portion invested in stocks. Heaton and Lucas (2000b) find weak evidence supporting the idea that background income risk exerts a downward influence on risky financial asset holdings. Campbell et al. (1999) and Davis and Willen (2000b) find that the correlation between labor income shocks and aggregate equity returns rises with education. However, Davis and Willen (2000a) find little evidence that occupation-level income innovations are correlated with aggregate equity returns. However, they find for some occupations the returns on portfolios formed on market capitalization are correlated with occupation-level income innovations.

While much of the evidence presented in this paper is based on U.S. data, there is a growing body of international evidence on the effect of background risk on portfolio choice. The results are also mixed. Guiso, Jappelli, and Terlizzese (1996) find that in Italian household data, background risk has a small affect on portfolio choice. Hochguertel (1997) finds that in the Netherlands, households who report more risky income streams hold safer investment portfolios.

Business Ownership. Gentry and Hubbard (1998) examine the savings and investment decisions of entrepreneurs, and conclude that this group accumulates more wealth than non-entrepreneurs, perhaps due to a precautionary demand for financing. Using SCF data, Heaton and Lucas (2000b) find that for those investors who hold a significant fraction of their wealth in stocks, proprietary business income is a large and more correlated background risk factor than is labor income. Further, their cross-sectional regressions indicate that households with more private business wealth hold fewer stocks relative to other liquid assets.

The importance of private business ownership for households with significant stock holdings are confirmed by data in the 2001 SCF, as summarized in Table 12. All households with net worth above $10,000 are included, and the survey weights are used. Business owners include households who report a businesses value of more than $500. The average net worth of business owners is about four times greater than non-owners, and on average their business accounts for 32.5% of their wealth. Consistent with higher average risk tolerance, business owners have 55.8% of their liquid financial wealth invested in stocks, while non-owners have 47.8%. Polkovnichenko (1998) also finds that entrepreneurs appear to be less risk-averse than average, using a variable from the SCF that polls people about their risk tolerance.

(Table 12 here)

Employer Stock. Employers' stock is another source of concentrated risk for a significant number of households. To the extent that these holdings are voluntary, they cannot properly be considered uninsurable background risk. If, on the other hand, there are restrictions on pension holdings, as discussed below, they represent a source of background risk that may influence portfolio choices. Consistent with the idea that the concentrated risk that is assumed by holding employer's stock discourages investment in other risky stocks, Heaton and Lucas (2000b) report regression results indicating that the more of the employer's stock held, the lower is the share of other stocks in liquid assets.

Some evidence is available on the rising historical incidence of employer stock holding, both within and outside the retirement market. For top management, employer stock (and stock options) are used extensively as motivation (see Murphy (1998) for a review). Simple information theoretic models are able

to predict qualitatively some of the observed differences in executive compensation across firms, particularly the degree of pay-performance sensitivity. There is a tradeoff, however, between overcoming such agency costs through performance contingent payments and the cost to shareholders and lost diversification of risk averse managers. Hall and Murphy (2002) examine the diversification cost of executive options in a certainty equivalent framework and review relevant literature. Aggarwal and Samwick (1999) support the idea that diversification costs matter, finding empirically that pay performance sensitivities appear to vary with the volatility of the firm's equity so that executives in the most volatile firms have the least dollar exposure to the company's equity.

There is an extensive empirical literature on employer stock held in retirement accounts. The National Center for Employee Ownership cites increasingly prevalent employee ownership patterns over time. According to their estimates, as of 2003, there were about 700 private and public companies that were majority owned by their ESOPs and about 500 of the top 2000 public companies offer broad based employee ownership plans in some form (such as 401(k) plans, ESOP plans, option or stock purchase plans). They also report steady growth in ESOP coverage from around 250,000 participants in 1975 to over 8 million in 2001. In terms of asset values, total 401(k) holdings of company stock are estimated at around $400bn and there is an estimated additional $120bn held by ESOPs.

Mitchell and Utkus (2003) provide a review of the recent evidence on the extent of employer stock holdings in defined contribution (DC) plans. Estimates from the 1998 US Department of Labor data suggests that roughly 16% of all plan assets are held in company stock. Not all 401(k) plans offer company stock as an investment option, but among plans that do offer company stock it is estimated from the EBRI/ICI 401k database that 29% of balances are invested in company stock. Similarly, Benartzi (2000) reports that about 1/3 of the assets in large companies' retirement savings plans are invested in own company stock. Plans offering company stock as a 401(k) option are estimated to cover 42% of all plan participants and 59% of all plan assets.

Mitchell and Utkus also report a great deal of diversity in the concentration of employer stock holding across plans. Of the plans offering company stock, roughly half held less than 20% of the plan

balance in company stock. At the other end of the spectrum, more than 25% of plans held at least 60% of the plan balance in company stock. While a large quantity of this stock appears to be voluntarily held by participants, a significant portion is contributed by the company and cannot be diversified. This is common in large listed firms using the previously discussed ESOP/401(k) combination arrangements. For example, Brown et al. (2004) study a sample of firms that match employee contributions with company stock finding that on average 28% of new contributions to a 401(k) plan are required to be held in company stock and an additional 17.1% is voluntarily directed to company stock. Brown et al. also suggest that firms with high dividend payout are more likely to offer matches in company stock due to the tax deductibility of dividends paid under ESOP arrangements. However, they do not find evidence that factors usually associated with agency costs in studies of executive compensation have any impact on the provision of company stock in retirement plans.

Using the EBRI/ICI 401(k) database of participant level data, Vanderhei (2002) provides evidence on portfolio allocation in 401(k) plans and on the employee reaction to employer mandated company stock holding. The average share of retirement assets voluntarily allocated to equities across participants is lower in plans that match in company stock than plans that match in cash. However, employees enrolled in plans offering employer stock as an investment option are more likely to hold the employers stock instead of more diversified forms of equity if the company matches in stock (a finding consistent with Brown et al.). Furthermore, at least 15% of participants in every age cohort voluntarily hold nearly all of their 401(k) balance in employer stock. Choi et al. (2004b) support this evidence and also report that employer securities are voluntarily held by participants for a significant amount of time (usually a large number of years) due to the overall passivity in trading their accounts, as discussed further under Pension Investments. Bernartzi (2001), Purcell (2002), Huberman and Sengmueller (2002), studying data at the plan (rather than participant) level, find that plans that match in company stock and plans whose stock outperformed the S&P 500 index in recent years are the ones most likely to be heavily invested in company stock.

A Vanguard report by Utkus and Waggoner (2003) surveys sponsor and participant attitudes to employer stock in 401(k) plans. Plan sponsors appear to be divided into two camps on the basis of whether

the employer's match is directed to employer stock or made in cash. Those that direct in stock emphasize the role of incentives and retaining control in friendly employee hands and are less worried about employee diversification and fiduciary risks (consistent with this, Brown et al. (2004) find that low risk firms are more likely to provide the employer match in company stock). The opposite appears to be the case for those that match in cash. Sales restrictions go hand in hand with matching employee contributions in stock.

The Vanguard survey also examines 401(k) participants' understanding of their investment in employer securities. Participants are found to have good recall of past performance of the employer's stock, but poor recall of the value of their stake and a poor understanding of risk and return concepts, with many believing their employer's stock to be as safe as or safer than a diversified equity portfolio. This is partially attributed to past performance of the employer's stock: those believing their employer's stock to be safe having experienced good past investment returns. If offered a choice between cash and stock sold to the employee at a discount that cannot be sold until age 50, 40% of respondents required a discount of less than 10% (many required no discount at all).

Pension Investments. An emerging strand of literature is that devoted to documenting empirical patterns in retirement plan participation rates, contribution levels and portfolio choices. A recent review is Choi et. al. (2004a). As in the closely related literature on employer stock holdings in pension plans discussed above, much of this research focuses on whether observed household retirement saving and portfolios appear to be more consistent with irrational psychological impulses than rational forward looking motives. Because most of these studies rely on data capturing only a portion of financial assets, however, it is often hard to infer the reason for the observed behavior.

Holden and Vanderhei (2003) provide estimates for the year 2002 of aggregate 401(k) asset allocation using the EBRI/ICI 401(k) database. The breakdown of asset allocation across all plans in their database is 45% to equity funds (including mutual funds and brokerage accounts), 23% to bond and money market funds, 16% to guaranteed investment contracts (GICs) and 16% to stock of the employer. However, there is a great deal of cross sectional variation in these allocations across both plans and individuals. Some

plans do not offer employer stock or GICs and some plans choose the asset allocation of both employee and employer matching contributions. Holden and Vanderhei also show that asset allocation is more conservative for older participants and participants with lower salaries. There is also some evidence that asset allocation is more aggressive in 401(k) plans when the individual (or their family) participates in a defined benefit plan, a relatively safe asset (see Uccello (2000)).

Papke (2004) looks at the impact individual free choice in 401(k) asset allocation has on contribution activity. She estimates that participants in a plan with investment choice are more likely to make contributions, make larger contributions, invest more aggressively in risky securities and have larger plan balances. Iyengar and Jiang (2003), in contrast with Papke, actually find that too much choice can be a bad thing. Increasing the number of plan options (such as the number of mutual funds on offer) is associated with lower participation rates and contribution levels, and more conservative portfolio choices. This is related to findings of Bernartzi and Thaler (2001), who that suggest participants apply naïve diversification strategies where they apportion funds equally among the available choices despite differences in the risk. Bernartzi and Thaler (2002) argue that most individuals would prefer to have their investment allocation selected by a financial adviser than make the choice themselves.

An important finding about 401(k) participant behavior is the apparent inertia in plan choices (see Choi et al (2004a) and Madrian and Shea (2001) for example). Low tenure participants often opt into the default level of salary deferrals and asset allocation decisions rather than make an active decision. Furthermore, it often takes a period of several years before the participant deviates from these default choices. Thus, otherwise similar participants at different firms can end up with quite different retirement account balances and asset allocation just because of differences in the default choices. Such observations are consistent with participants being uninformed about their retirement plans, which according to Gustman and Steinmeier (2001) is widespread. Gustman and Steinmeier (2001) find that ignorance about retirement plans is widespread. However, they find that individuals who are most reliant on their retirement plan as a source of retirement income are more likely to be well informed about their plan, and thus make efficient choices.

Other studies (e.g., Holden and Vanderhei (2003)) are more optimistic about the role of DC pension plans in fostering diversification and participation in equity markets. As discussed in Section 2, much of the growth in mutual fund participation has been through DC plans, and the prevalence of apparently diversified holdings in these plans and overall has increased over time (see Table 3).

Housing. PSID estimates of the idiosyncratic variance in housing returns is much higher than the aggregate risk Flavin and Yamashita (2002) estimate idiosyncratic housing risk of 14.2 percent, using the the PSID. The idea that housing affects portfolio choice has found empirical support from a variety of data sources. Using the 1983 SCF, Brueckner (1997) shows that when a housing investment constraint is binding (households are over-invested in housing because of consumption demands) non-housing assets are different than they would be if housing allocation was optimal from an investment view.

Although all studies agree that housing affects portfolio choice, the effect of home ownership and mortgage debt on asset allocation is not yet clear. Existing research varies widely in its approach to this difficult problem, and the results are seemingly contradictory. Examination of this relationship is complicated by heterogeneity simultaneously affecting portfolio allocations and housing choices. Fratantoni (1998) finds that households with higher mortgage payment to income ratios have lower risky asset holdings in the 1989 SCF. Chetty and Szeidl (2004) find that a $1 increase in mortgage debt results in a portfolio shift of $0.50 from stocks to bonds. In their dynamic consumption model, Yao and Zhang (2001) posit that in the presence of labor income risk, home owners increases the proportion of stocks in liquid assets because of the diversification benefit, and find some empirical support in the 1998 SCF. Decreases in the house value to net worth ratio as households age correspond to increases in stock to net worth ratio with age. Similarly, Flavin and Yamashita (2002) find evidence that the housing constraint induces a life-cycle pattern in holdings of stocks and bonds in the 1984 and 1989 PSID, with households holding more stock as they age and reduce the amount of mortgage debt. De Roon et. al. (2002) use quarterly data for five major United States cities through 1997 and find that in each region home ownership had no impact on the relative holdings of stocks and bonds, but significantly decreased the total assets allocated to stocks and bonds.

Using the 1984-1999 PSID, Kullman and Siegal (2002) find that homeowners are more likely to participate in the stock market than renters, but contrary to these other results, 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 also is mixed. Pelizzon and Weber (2003) perform an analysis similar to that of Flavin and Yamashita (2002) for Italian households, and find that household portfolios are not conditionally efficient given housing investment. However, le Blanc and Lagarenne (2002) perform this analysis on French households, and find that the portfolios of French households are efficient conditional on housing and observe the life-cycle pattern of risky asset holdings predicted by Flavin and Yamashita (2002).

6. Conclusions

There is substantial heterogeneity in the portfolio allocations of households. While the majority of investors with significant net worth appear to hold diversified portfolios, a large number of households still hold no position in risky securities while others take significant undiversifed positions in stocks. This lack of diversification sometimes is in the form of large holdings in an employer's stock. Understanding the choices made by investors will shed light on the important factors explaining the pricing of risk in financial markets. Also many public policy choices have an impact on the portfolio allocations of households. Examples include the privatization of Social Security and the taxation of capital income. The potential effects of these policies greatly depend on the predicted impact on the savings and portfolio choices of households.

To understand the portfolio allocations of households it is important to examine their financial positions beyond investment in marketable securities. For example a household's total net worth is well known to be a significant predictor of whether the household participates in financial markets. Beyond this, however, non-traded or background risks in the form of housing, privately held businesses, human capital and the like, are predicted to have an impact on portfolio choice. Although theoretical attempts to include

these risks in models of portfolio choice have had limited quantitative success, less structured results point to the empirical importance of these factors.

An inability to contract on assets such as private business can be explained by information frictions that result in moral hazard or adverse selection in markets. Actively chosen undiversifed positions in a small number of stocks or an employer's stock cannot easily be explained by this economic mechanism. Institutional frictions such as costs of trading, restrictions on pension investments, costs of setting up brokerage accounts, costs of education, and so on, are more consistent with this observed lack of diversification. In fact, both participation in financial markets and the level of diversification of households has increased with the rise of mutual funds and defined contribution funds. The fall in real or perceived costs of investing due to these institutional changes is an important determinant of the increased stock market participation and diversification of households. Understanding the impact on household portfolio choice of past and predicted institutional changes remains a fruitful area of investigation.

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Table 1: The Composition of Financial Wealth

	PERCENT
ASSET CLASS	
Cash	24.4
Bonds	7.6
Stocks	15.8
SUBTOTAL LIQUID ASSETS	47.8
housing	41.3
other real estate	4.8
private businesses	4.2
other	1.9
TOTAL	100.

Tabulations are from the 2001 SCF, and based on survey weights.

Table 2: Cross-Sectional Variation of Share of Stock in Financial Assets

YEAR	25%	50%	75%	MEAN	STD DEV	SKEWNESS
1989	0	0	0.047	0.058	0.133	3.560
1992	0	0	0.077	0.077	0.158	3.005
1995	0	0	0.110	0.099	0.188	2.587
1998	0	0.021	0.217	0.140	0.210	1.800
2001	0	0.042	0.260	0.162	0.229	1.598

Tabulations are from the SCF, various years, and based on survey weights.

Table 3: How Stocks are Held (% of population)

YEAR	DIRECTLY OWNS MUTUAL FUND	ONLY OWNS EQUITY IN PENSION FUND	ONLY OWNS DIRECT EQUITY	OWNS EQUITY (ALL ACCOUNT TYPES)
1989	6.0	11.2	12.6	31.8
1992	8.4	14.9	11.1	36.7
1995	11.3	17.6	10.5	40.4
1998	15.2	20.2	10.4	48.9
2001	16.7	21.2	9.8	51.9

Tabulations are from the SCF, various years, and based on survey weights.

Table 4: Characteristics of Stockholders and Non-Stockholders (2001 Dollars)

	NON-STOCKHOLDERS		STOCKHOLDERS	
	Mean	Median	Mean	Median
1992				
Total Financial Wealth	171,687	74,799	525,880	207,092
Owner-Occ. RE Wealth	78,489	51,969	143,474	107,651
Mortgage	22,854	0	47,815	18,560
Net Other RE Wealth	21,132	0	54,494	0
Business Wealth	32,810	0	99,689	0
Labor Income	35,590	25,985	79,759	56,919
Age	52.1	50	49.8	48.0
Education	12.3	12.0	14.3	15.0
Risk Tolerance	3.5	4.0	3.0	3.0
Number of Households	43,058,522		35,571,987	
2001				
Total Financial Wealth	167,729	77,885	794,817	290,850
Owner-Occ. RE Wealth	80,458	60,000	198,482	135,000
Mortgage	23,080	0	66,929	37,000
Net Other RE Wealth	20,065	0	62,980	0
Business Wealth	28,315	0	140,125	0
Labor Income	35,659	25,000	107,120	65,000
Age	55.3	54.0	49.0	47.0
Education	12.1	12.0	14.3	15.0
Risk Tolerance	3.5	4.0	2.8	3.0
Number of Households	39,937,214		49,606,571	

Tabulations are from the 1992 and 2001 SCF, and based on survey weights.

Table 5: Cross-Sectional Variation of Share of Stock in Financial Assets (Stockholders Only)

25%	50%	75%	MEAN	STD DEV	SKEWNESS
0.070	0.200	0.405	0.269	0.242	1.048

Tabulations are from the 2001 SCF, and based on survey weights.

Table 6: Shares of Financial Assets by Age and Net Worth (Mean / Median)

AGE	<35	35-44	45-54	55-64	65-74	75+
$10K < Net Worth < $100K						
Stocks	16.2 / 5.8	16.2 / 3.7	11.2 / 0.9	9.2 / 0.0	0.6 / 0.0	1.7 / 0.0
Bonds	7.0 / 0.3	8.3 / 0.6	7.8 / 0.0	5.2 / 0.0	4.2 / 0.0	4.9 / 0.0
Cash	12.9 / 3.2	9.2 / 3.1	9.8 / 3.1	9.6 / 2.0	15.8 / 4.8	29.8 / 9.1
Owner-Occupied Housing	52.4 / 70.9	57.6 / 72.3	64.6 / 81.4	68.6 / 85.1	72.7 / 89.2	60.1 / 85.1
Other Real Estate	3.7 / 0.0	4.5 / 0.0	3.2 / 0.0	3.4 / 0.0	4.5 / 0.0	2.2 / 0.0
Business	2.9 / 0.0	2.4 / 0.0	1.9 / 0.0	2.8 / 0.0	1.2 / 0.0	0.0 / 0.0
Income ($1,000)	51.6 / 50.0	52.4 / 46.0	46.4 / 42.0	32.3 / 29.0	25.6 / 20.0	19.8 / 15.0
$100K < Net Worth < $1M						
Stocks	19.7 / 12.1	21.2 / 15.9	21.4 / 15.7	21.2 / 15.0	16.8 / 3.1	13.3 / 0.0
Bonds	3.4 / 0.3	6.8 / 1.0	7.1 / 1.8	8.6 / 0.7	7.5 / 0.0	5.5 / 0.0
Cash	7.8 / 3.4	6.2 / 3.2	8.2 / 3.6	8.7 / 3.4	16.5 / 9.1	21.1 / 12.0
Owner-Occupied Housing	50.4 / 51.6	51.1 / 51.6	47.9 / 45.6	48.0 / 44.1	47.7 / 46.5	52.1 / 51.0
Other Real Estate	5.8 / 0.0	5.7 / 0.0	6.5 / 0.0	7.2 / 0.0	6.3 / 0.0	5.8 / 0.0
Business	10.7 / 0.0	7.4 / 0.0	6.8 / 0.0	4.9 / 0.0	3.4 / 0.0	0.7 / 0.0
Income ($1,000)	84.5 / 78.0	93.3 / 77.0	87.2 / 75.0	64.9 / 58.0	47.0 / 37.0	34.3 / 28.0
Net Worth > $1M						
Stocks	20.4 / 6.1	23.8 / 20.2	29.4 / 23.1	33.9 / 33.4	31.5 / 30.1	37.3 / 37.8
Bonds	9.0 / 0.1	5.0 / 0.5	8.5 / 3.3	12.3 / 4.7	11.4 / 5.9	18.0 / 12.1
Cash	4.2 / 1.3	4.9 / 2.1	5.6 / 2.3	6.1 / 2.4	9.9 / 3.6	7.0 / 3.8
Owner-Occupied Housing	10.6 / 4.3	24.7 / 22.7	22.9 / 19.1	17.7 / 16.1	16.5 / 16.0	20.1 / 17.6
Other Real Estate	6.4 / 0.0	8.3 / 0.7	11.5 / 1.8	12.6 / 2.6	18.2 / 8.7	9.3 / 0.8
Business	41.7 / 28.6	31.9 / 27.3	19.8 / 3.2	14.8 / 0.0	11.2 / 0.0	7.1 / 0.0
Income ($1,000)	317.5 / 130.0	413.6 / 235.0	443.2 / 200.0	365.6 / 168.0	222.5 / 120.0	144.4 / 97.0

Tabulations are from the 2001 SCF, and based on survey weights.

Table 7: Probit Regressions on Stock Ownership

	(1)		(2)		(3)		(4)		(5)		(6)
Intercept	-4.40	(13.78)	-5.47	(15.92)	-4.96	(16.25)	-5.88	(17.93)	-4.22	(13.01)	-5.
Age	-0.02	(8.46)	-0.01	(3.00)	-0.02	(9.04)	-0.01	(3.87)	-0.02	(8.45)	-0.
Log(Income)	0.14	(5.01)	0.08	(2.60)	0.15	(5.53)	0.09	(3.01)	0.14	(4.89)	0.
Log(Assets)	0.26	(10.63)	0.32	(11.93)	0.28	(11.78)	0.33	(12.75)	0.25	(10.34)	0.
Num. Children	-0.02	(0.77)	-0.05	(1.77)	-0.03	(1.16)	-0.06	(1.82)	-0.01	(0.49)	-0.
Married (Yes=1)	0.14	(2.09)	0.10	(1.40)	0.12	(1.76)	0.09	(1.27)	0.15	(2.22)	0.
Yrs. Education	0.09	(8.41)	0.09	(7.62)	0.10	(9.13)	0.10	(8.23)	0.09	(8.36)	0.
RE Equity/NW	0.005	(6.34)	0.004	(5.54)							
Mortgage/Fin. Wealth					0.003	(2.30)	-0.01	(3.46)			
House/Fin. Wealth									-0.01	(7.43)	-0.
In DB Plan			-0.05	(0.59)			-0.06	(0.77)			-0.
In DC Plan			1.34	(17.23)			1.38	(17.69)			1.
Pseudo-R^2	0.28		0.35		0.27		0.35		0.28		0.

Tabulations are from the 2001 SCF. In all regressions the dependent variable is 1 if the household owns more than $500 in stock. All households with net worth > $10K are included. T-statistics are in parenthesis

Table 8: OLS Regressions on Stock as a Share of Liquid Financial Assets– Stockholders Only

	(1)		(2)		(3)	
Intercept	37.98	(4.65)	29.08	(3.62)	37.23	(4.52)
Age	-0.19	(-4.07)	-0.19	(-3.98)	-0.19	(-4.24)
Log(Income)	-1.31	(-1.48)	-1.06	(-1.19)	-1.27	(-1.44)
Log(Fin. Assets)	3.23	(5.00)	3.51	(5.41)	3.30	(5.11)
Num. Children	1.13	(2.20)	0.92	(1.78)	1.18	(2.28)
Married (Yes=1)	-0.86	(-0.62)	-1.44	(-1.03)	-0.86	(-0.62)
Yrs. Education	0.51	(2.04)	0.58	(2.32)	0.53	(2.13)
RE Equity/Net Worth	-0.07	(-4.31)				
Mortgage/Fin. Wealth			-0.02	(-0.64)		
House/Fin. Wealth					-0.07	(-3.66)
Adj.-R^2	0.03		0.03		0.03	

Tabulations are from the 2001 SCF, and based on survey weights. Stock/Liquid Financial Assets (stocks + bonds + cash) is the dependent variable in all regressions. All households with positive stock holdings and net worth > $10K are included in these regressions. T-statistics are in parenthesis.

Table 9: Evidence on the Diversification of Stock Holdings

	1989	1992	1995	1998	2001
mean % of equity held in...					
brokerage accts	36.4	38.4	21.4	20.0	19.3
mutual funds	8.9	11.6	15.3	15.7	14.6
Trusts & managed accts	4.2	3.3	2.6	4.2	4.8
Defined contribution pensions	50.4	56.7	60.7	60.2	61.3
mean % own company stock/total	12.3	8.9	6.4	5.2	5.3
undiversified households (more than 50% of equity in brokerage acct with fewer than 10 stocks)					
% total equity reported	21.0	18.3	13.6	11.3	12.0
% of households with equity	32.5	23.7	17.8	14.8	13.7
mean % own company stock/total	35.0	31.5	30.5	25.2	29.2
mean age	50.9	51.0	53.9	51.7	50.3
mean equity/net worth	16.7	18.3	23.6	29.1	28.4
mean business/net worth	7.6	8.3	5.5	5.3	5.2
mean real estate/net worth	51.8	48.0	47.9	49.7	50.0
real net worth	461,327	413,194	392,998	429,649	517,481
diversified households					
mean % own company stock/total	1.4	1.9	1.2	1.7	1.5
mean age	47.0	47.6	46.0	47.2	47.1
mean equity/net worth	20.0	26.5	31.4	35.7	36.2
mean business/net worth	5.6	6.1	4.3	5.7	5.8
mean real estate/net worth	53.8	49.5	50.1	42.9	45.2
real net worth	466,896	360,744	341,218	433,978	549,104

Unless otherwise noted all households with positive stockholdings are included. Averaged over the 5 imputed weights in the SCF. Winsorized at 99% level.

Table 10: Model Predictions of Average Stock and Bond Holdings

	Corr = -0.1	Corr = 0	Corr = 0.1	Corr = 0.2
	A. $\gamma = 5$, Low Background Risk Case			
Avg. Bond Holdings	0.03	0.05	0.07	0.11
Avg. Stock Holdings	1.12	1.14	1.15	1.15
Avg. Proportion Stock	0.98	0.97	0.96	0.93
	B. $\gamma = 8$, Low Background Risk Case			
Avg. Bond Holdings	0.46	0.52	0.68	0.83
Avg. Stock Holdings	0.98	0.95	0.83	0.70
Avg. Proportion Stock	0.72	0.68	0.58	0.48
	C. $\gamma = 5$, High Background Risk Case			
Avg. Bond Holdings	0.18	0.24	0.39	0.46
Avg. Stock Holdings	1.11	1.08	0.96	0.92
Avg. Proportion Stock	0.89	0.85	0.74	0.70
	D. $\gamma = 8$, High Background Risk Case			
Avg. Bond Holdings	0.75	0.79	0.89	0.97
Avg. Stock Holdings	0.67	0.64	0.55	0.48
Avg. Proportion Stock	0.50	0.46	0.39	0.34

All holdings are normalized by current income to induce stationarity.

Table 11: Aggregate Income Statistics – 1947-2003

	2003 Values from NIPA ($ Billions)		
		% of total	
Wage Income	5,100.2	59.9%	
Business Income	673.2	7.9%	
Dividend Income	431.0	5.1%	
Interest Income	583.2	6.9%	
Rental Income	176.3	2.1%	
Housing Services	1,544.9	18.2%	
Total	8,508.8		
	Annual Real Log Growth Rate 1947-2003		
	Mean	Std	Correlation with stock returns
Wage Income	3.14%	2.06%	0.06
Business Income	1.94%	4.52%	0.11
Housing	1.96%	2.21%	0.051
VW Stock	6.80%	16.71%	

Income, housing services and tax data is from NIPA tables. The Value-Weighted Stock returns are from CRSP. Housing returns are from Piazzesi et al. (2003).

Table 12: Mean Portfolio Characteristics of Business Owners vs. Non-Owners

	Owners	Non-Owners
Liquid Fin. Assets / Total Assets	24.9	37.9
Stocks / Liquid Fin. Assets	55.8	47.8
Bonds / Liquid Fin. Assets	18.2	20.3
Cash / Liquid Fin. Assets	26.1	31.9
Owner-Occupied Housing / Total Assets	34.3	54.2
Other Real Estate / Total Assets	6.8	5.7
Business / Total Assets	32.5	-
Age	49.1	52.0
Education (Years)	14.4	13.5
Risk Tolerance*	2.8	3.0
Income	$ 169,693	$ 69,533
Net Worth	$ 1,298,065	$ 323,255

*1= willing to take substantial financial risks to achieve higher returns,
2 = above average risk, 3 = average risk , 4= no risk

Tabulations are from the 2001 SCF, and based on survey weights.