Portfolio Choice and Asset Prices: The Importance of Entrepreneurial Risk

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ABSTRACT

Using cross-sectional data from the SCF and Tax Model, we show that entrepreneurial income risk has a significant influence on portfolio choice and asset prices. We find that households with high and variable business income hold less wealth in stocks than other similarly wealthy households, although they constitute a significant fraction of the stockholding population. Similarly for nonentrepreneurs, holding stock in the firm where one works reduces the portfolio share of other common stocks. Finally, we show that adding proprietary income to a linear asset pricing model improves its performance over a similar model that includes only wage income.

IN CONSTRUCTING INVESTMENT PORTFOLIOS, it appears that many if not most households fail to behave in a manner consistent with simple economic theory. Even among relatively wealthy households, the share of financial assets held in different asset classes varies widely, and there is evidence that among those who hold common stock, there is often little diversification (e.g., King and Leape (1987), Blume and Zeldes (1994)). We begin this paper with an empirical investigation into some of the risk factors and demographic variables that might explain these cross-sectional differences in portfolio composition. A number of previous studies focus on the level and variability of wage income growth as one of the largest sources of undiversifiable income risk. Here we present evidence that, for the subset of the population that has significant stockholdings, income from entrepreneurial ventures (which we refer to as *proprietary business income)* represents a large source of undiversifiable risk that is more highly correlated with common stock returns. These findings motivate the investigation in the second part of the paper of a linear asset pricing model that incorporates proprietary income from privately held businesses as a risk factor.

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The potential importance of idiosyncratic risk for portfolio choice is well established in the theoretical literature, where the idea is that in the absence of complete markets, investors will alter their portfolios to offset nonmarket risk exposures (e.g., Merton (1971), Mayers (1974), Duffie et al. (1997)). Several recent papers also consider the quantitative implications of more complex theoretical portfolio choice models (e.g., Koo (1994), Heaton and Lucas (1997)).[1] A number of previous empirical studies examine some of the potential determinants of portfolio choice that we consider here (e.g., Blume and Zeldes (1994), Gakidis (1994), Guiso, Jappelli, and Terilizzesse (1996)).

This paper adds to this empirical literature by simultaneously considering a large number of potential risk factors to provide a clearer perspective on their relative importance, and by concentrating on entrepreneurs. We also provide new evidence on the theoretically central effect of cross-sectional variation in second moments on portfolio composition (e.g., the correlation between stock market returns and idiosyncratic income growth rates from various sources). To do this we use a mixture of time series and cross-sectional data sources: the Panel of Individual Tax Returns (commonly known as the "Tax Model"), and the 1989, 1992, and 1995 Survey of Consumer Finances (SCF). The SCF is the primary source for the static analysis of portfolio behavior. The Tax Model is the primary source used to address questions that involve income variability and correlations because it is the only available data set that has an annual time series and panel dimension for both income and assets.

We begin by documenting the large cross-sectional variation in the composition of asset holdings in the SCF across net worth and age cohorts, and also within cohorts. One notable impression from these data is that the relative importance of stockholdings changes significantly depending on how broadly "wealth" is defined. We consider several definitions—the most narrow being liquid assets including money, stocks, and bonds, and the broadest including also proprietary business value, real estate, defined contribution pension value, capitalized wage income, and capitalized social security and other pension income. Despite popular advice to the contrary, we find that people of retirement age actually increase the proportion of wealth held in stocks when wealth is broadly defined to include nonliquid as well as liquid assets. This behavior is consistent with a reduction in risk-taking, however, since there appears to be a substitution to stocks and away from private business ownership for older, wealthier households. Interestingly, for the high net worth households that represent most of the stockholding population, capitalized wage income is on average less than 22 percent of wealth and negligible for the subset age 65 and over. For these groups, proprietary business value and real estate are of similar magnitudes to stockholdings.

[1] The portfolio choice problem is intimately related to the question of how much in total savings to accumulate, and the factors influencing portfolio choice can also be expected to have a significant impact on total savings when markets are incomplete. This is shown theoretically in buffer-stock type savings models (e.g., Deaton (1991), Carroll (1997)). Evidence on the importance of these factors for savings behavior can be found in Alessie and Lusardi (1993) and Carroll and Samwick (1995) among others.

Many common preference specifications, including constant relative risk aversion, imply that people bearing more undiversifiable income risk will reduce the proportion of wealth held in risky financial assets such as stocks (Pratt and Zeckhauser (1987), Kimball (1990, 1993)). To examine the relationship between income variability and portfolio composition empirically, we use the Tax Model data. These data make it possible to determine whether households with a history of higher wage income risk or proprietary income risk hold a smaller fraction of savings in the form of risky stock, controlling for other factors such as age and home ownership status. Consistent with the apparent importance of proprietary business value, we find that, although the variability of the growth rate of wage income has low predictive power for portfolio composition, the share of stockholdings is negatively related to the level and variability of the growth rate of proprietary income.

The above findings suggest that proprietary business wealth is important for those households with substantial stockholdings, and that proprietary income risk influences portfolio choice. Hence, proprietary income risk may also have a significant impact on asset prices. To test this idea, in Section II we incorporate proprietary income as a risk source into a version of a conditional capital asset pricing model that follows Jagannathan and Wang (1996). We find that including aggregate proprietary income as a risk factor improves the performance of the model over specifications that focus on labor income alone.

The remainder of the paper is organized as follows. Section I contains tabulation and regression results on portfolio choice, based on SCF and Tax Model data. In Section II we describe and test several variations of the asset pricing model with proprietary income. Section III concludes.

I. Determinants of Portfolio Composition

We present evidence from the SCF on how wealth composition varies across households with different characteristics. Then we use Tax Model data to examine the cross-sectional variation in portfolio holdings as a function of the level and variability of wage income and proprietary income, controlling for other factors.

Results from the SCF are based on the three most recent surveys: 1989, 1992, and 1995. Some of the tabulations include results from all three years to highlight significant changes in investment patterns over time, but unless otherwise noted the discussion focuses on the 1992 results.[2] The summary tables report both means and medians. Although most of the qualitative trends in means and medians are similar, the median value is often considerably lower than the corresponding mean. This reflects the extreme skewness in portfolio composition—within as well as across demographic groups.

[2] 1992 was selected because it is the most recent survey year for which the data are not preliminary.

A. Decomposing the Cross-Sectional Variation in Wealth

To examine the cross-sectional variation in the composition of wealth, households are first subdivided by net worth and age. We consider three definitions of net worth, each of which produces a very different picture of how the composition of wealth varies across age and net worth cohorts: (i) *liquid net worth* is the sum of cash, bonds, bills, stocks, and mutual funds minus various types of debt including mortgages and consumer loans; (ii) *financial net worth* is liquid net worth plus housing and other real estate, the value of all proprietary businesses,[3] pensions,[4] and trusts; and (iii) *total net worth* is financial net worth plus capitalized labor, social security, and pension income. "Cash" includes actual cash, checking accounts, savings accounts, and money market accounts. This broad definition of cash is the reason the proportion of bond holdings appears to be lower than in some earlier studies that classify some of these liquid instruments as bonds. "Stocks" includes direct stockholdings, stock mutual funds, and IRAs or Keogh plans consisting primarily of stocks; "Bonds" is defined similarly to "stocks," and includes both taxable and tax exempt issues. "Liquid wealth," "financial wealth," and "total wealth" refer to the same asset classifications, but without the subtraction of debt.

Since we are interested in the portfolio composition of relatively wealthy households that hold nonnegligible quantities of stock, for most of the analysis we exclude observations with less than $500 in stockholdings or less than $10,000 of financial net worth.[5] The magnitude of some of the summary statistics reported in the tables below are somewhat sensitive to the imputation method used for missing values in the SCF, and to the set of weights used to correct for selection bias.[6] Nevertheless, there are a number of interesting and qualitatively robust findings that emerge.

In Table I, Panel A, we consider variations in the mean and median portfolio shares of cash, bonds, and stocks relative to liquid assets, by financial net worth. These statistics are consistent with the well-known fact that few

[3] The term "proprietary business value" (or "proprietary business wealth") is defined as the sum of variables in the SCF that ask respondents for how much they could sell their own and other immediate family members' equity share in their businesses. Both active and passive ownership is included. Separating active from passive holdings does not appear to change any of the qualitative results.

[4] This category is small because it consists of defined contribution pension assets that are not easily identified as falling into a particular asset category. For IRA and Keough plans, better categorical information is available, and these holdings are incorporated into the totals for stocks, bonds, or cash rather than into pensions.

[5] A precedent for this is Mankiw and Zeldes (1991), who show that conditioning on the consumption of households that hold stock results in a smaller equity premium puzzle than is generated with aggregate consumption data.

[6] The SCF is distributed with five different imputations of missing data, as described in Kennickell (1992). The population averages can differ markedly by imputation method. The data also include a number of weighting schemes designed to remove various types of selection bias. The summary statistics also are sensitive to these weights. The regression results reported below, however, are qualitatively robust to the imputation method and weighting scheme.

Table I

Portfolio Shares Relative to Liquid Net Worth

This table reports mean/median portfolio shares of various assets relative to liquid net worth across households. Data are from the Survey of Consumer Finances for the years 1989, 1992, and 1995. Households are categorized by financial net worth, defined as the sum of direct and indirect holdings of cash, bonds, bills, housing and other real estate, proprietary businesses, pensions, and trusts, minus various types of debt including mortgages and consumer loans. Asset shares are relative to liquid assets, defined as the sum of direct and indirect holdings of cash, bonds, bills, and stocks. Shares are computed for each household, and then the average or median is found across households. Panel A includes all households in the data. Panel B includes only those households where stockholding is greater than $500. "K" denotes one thousand, "M" denotes one million.

Assets / Net Worth	$10 K to $100 K	$100 K to $1 M	>$1 M
Panel A: Whole Sample			
1989			
Stocks	0.155/0.001	0.183/0.001	0.340/0.247
Bonds	0.138/0.000	0.192/0.043	0.263/0.193
Cash	0.707/0.966	0.624/0.719	0.397/0.314
Imputed no. of households	33,173,568	25,311,639	1,930,790
1992			
Stocks	0.182/0.001	0.239/0.047	0.383/0.318
Bonds	0.129/0.000	0.160/0.017	0.235/0.091
Cash	0.688/0.966	0.600/0.676	0.367/0.269
Imputed no. of households	29,684,630	33,910,053	2,686,628
1995			
Stocks	0.190/0.000	0.266/0.014	0.510/0.550
Bonds	0.127/0.000	0.159/0.012	0.217/0.119
Cash	0.676/0.909	0.552/0.557	0.251/0.108
Imputed no. of households	28,562,491	37,134,547	2,585,929
Panel B: Households with Stockholdings Greater than $500			
1989			
Stocks	0.502/0.490	0.393/0.338	0.406/0.349
Bonds	0.092/0.015	0.188/0.090	0.254/0.181
Cash	0.406/0.395	0.419/0.371	0.341/0.249
Imputed no. of households	5,229,868	10,244,662	1,582,523
1992			
Stocks	0.523/0.500	0.491/0.479	0.503/0.516
Bonds	0.106/0.021	0.162/0.048	0.240/0.119
Cash	0.370/0.305	0.347/0.277	0.257/0.152
Imputed no. of households	6,236,884	11,610,650	1,984,046
1995			
Stocks	0.558/0.604	0.554/0.572	0.633/0.706
Bonds	0.094/0.002	0.127/0.031	0.190/0.105
Cash	0.347/0.286	0.318/0.244	0.176/0.081
Imputed no. of households	8,040,568	13,726,397	1,990,435

households of low or moderate wealth hold any stocks at all, and that the average share of stockholdings increases in net worth. In this paper we do not attempt to explain why so many households hold no stock at all. Rather, we are interested in cross-sectional differences in portfolio composition among households with nonnegligible stockholdings, since these are the households whose characteristics are likely to affect stock market returns. Panel B shows that when we condition on households with more than $500 in stockholdings, there is much less variability in portfolio shares across net worth groups.[7] In fact, because the variation in these proportions is large within each net worth cohort, these statistics suggest very little variation in average or median liquid asset proportions across net worth categories. These statistics also suggest that stockholdings have become a higher percentage of liquid asset holdings over time, with the largest increase for wealthier households.

The apparent importance of stockholdings changes considerably when we look at shares of liquid assets relative to financial assets, again by financial net worth (see Table II). Liquid assets represent only about 35 to 40 percent of financial assets for each of these groups (except in 1995, when the rise in stock prices caused the share of wealth in stocks to increase to 46 percent for the wealthiest cohort). For low and moderate net worth groups, real estate accounts for most of the rest of financial wealth; for the high net worth households both proprietary business value and real estate account for most of the balance.

Conclusions about the variation in portfolio composition for different age cohorts are also very sensitive to how wealth is measured. Looking at variations in the mean portfolio shares of cash, bonds, and stocks relative to liquid assets by age suggests that the share of stocks rises slightly with age for cohorts under age 65, and then declines significantly for those age 65 and over (see Table III). This is consistent with the conventional wisdom that older households should reduce the risk profile of their portfolios. The picture changes considerably, however, when we look at these asset shares relative to financial assets by age, as shown in Table IV. Although the share of stocks in liquid assets is significantly lower for households that have reached retirement age, the share of stocks in financial assets is similar to that of younger cohorts. This can be attributed to the declining importance of other asset categories, and in particular the decline in the importance of proprietary business income and pension assets for older households. (The decline in pension value is presumably due to the annuitization of defined contribution pensions. This wealth is better captured in the calculations below, which include capitalized labor and pension income.) It appears, then, that older households do tend to move to safer assets, by substituting riskier proprietary business ownership with stocks, bonds, and especially cash.

[7] Using the 1989 SCF, Blume and Zeldes (1994) also found that once they considered households with positive stockholdings, the percentage of stockholding in liquid financial wealth is relatively constant across households of different wealth and demographic characteristics.

Table II

Portfolio Shares Relative to Financial Assets by Net Worth

This table reports mean/median of portfolio shares of various assets relative to financial assets across households. Data are from the Survey of Consumer Finances for the years 1989, 1992, and 1995. Households are categorized by financial net worth, defined as the sum of direct and indirect holdings of cash, bonds, bills, housing and other real estate, proprietary businesses, pensions, and trusts, minus various types of debt including mortgages and consumer loans. Asset shares are relative to financial assets, defined as the sum of direct and indirect holdings of cash, bonds, bills, stocks, housing and other real estate, proprietary businesses, pensions, and trusts. Shares are computed for each household, and then the average or median is found across households. The sample is limited to those households where stockholding is greater than $500.

Assets Net Worth	$10 K to $100 K	$100 K to $1 M	>$1 M
	1989		
Stocks	0.171/0.076	0.135/0.071	0.161/0.076
Bonds	0.031/0.004	0.083/0.021	0.112/0.050
Cash	0.139/0.045	0.148/0.084	0.110/0.054
Subtotal liquid	0.341	0.366	0.383
Business	0.016/0.000	0.067/0.000	0.196/0.067
Pension	0.038/0.000	0.042/0.000	0.031/0.000
Real estate	0.604/0.721	0.524/0.525	0.390/0.315
Imputed no. of households	5,229,868	10,244,662	1,582,523
	1992		
Stocks	0.182/0.093	0.166/0.125	0.211/0.125
Bonds	0.047/0.003	0.070/0.011	0.111/0.030
Cash	0.121/0.050	0.128/0.055	0.085/0.044
Subtotal liquid	0.350	0.364	0.407
Business	0.018/0.000	0.064/0.000	0.189/0.027
Pension	0.053/0.000	0.056/0.000	0.067/0.000
Real estate	0.579/0.736	0.516/0.531	0.337/0.283
Imputed no. of households	6,236,884	11,610,650	1,984,046
	1995		
Stocks	0.177/0.090	0.202/0.140	0.332/0.295
Bonds	0.038/0.001	0.052/0.006	0.092/0.050
Cash	0.125/0.034	0.099/0.057	0.054/0.025
Subtotal liquid	0.340	0.353	0.478
Business	0.023/0.000	0.037/0.000	0.191/0.000
Pension	0.086/0.000	0.076/0.000	0.026/0.000
Real estate	0.550/0.720	0.533/0.555	0.306/0.272
Imputed no. of households	8,040,568	13,726,397	1,990,435

Table III

Portfolio Shares Relative to Liquid Assets by Age

This table reports mean/median of portfolio shares of various assets relative to liquid assets across households. Data are from the Survey of Consumer Finances for the years 1989, 1992, and 1995. Households are categorized by age. Asset shares are relative to liquid assets, defined as the sum of direct and indirect holdings of cash, bonds, bills, and stocks. Shares are computed for each household, and then the average or median is found across households. The sample is limited to those households where stockholding is greater than $500 and financial net worth is greater than $10,000.

Assets Age	<35	35–49	50–64	≥65
		1989		
Stocks	0.394/0.333	0.465/0.415	0.454/0.426	0.360/0.327
Bonds	0.154/0.061	0.137/0.034	0.176/0.069	0.196/0.119
Cash	0.452/0.500	0.398/0.350	0.370/0.304	0.444/0.438
Imputed no. of households	1,836,138	6,231,389	4,653,233	4,336,293
		1992		
Stocks	0.474/0.428	0.534/0.556	0.540/0.538	0.420/0.339
Bonds	0.114/0.021	0.130/0.031	0.160/0.055	0.199/0.081
Cash	0.412/0.412	0.336/0.267	0.300/0.223	0.381/0.333
Imputed no. of households	2,613,580	6,761,088	6,016,609	4,440,303
		1995		
Stocks	0.550/0.609	0.590/0.636	0.600/0.663	0.494/0.504
Bonds	0.113/0.032	0.116/0.018	0.119/0.018	0.138/0.031
Cash	0.337/0.293	0.294/0.231	0.281/0.185	0.368/0.327
Imputed no. of households	3,885,572	8,458,425	5,646,886	5,766,517

The robustness of these qualitative features was examined in several unreported tabulations. Considering the joint effect of net worth and age on asset shares relative to liquid assets produces statistics that are consistent with the above univariate analyses. Older people in all but the lowest net worth category hold more in stocks than younger cohorts, but less in proprietary business value. The importance of real estate assets decreases in net worth and with age. Secondly, all of the above tables report the share of each asset relative to total assets, so that the mean portfolio shares add to one. It is also informative to consider asset shares relative to net worth to see the effect of leverage. For most cohorts the results are quite similar in either case. Dividing by net worth, however, emphasizes the highly leveraged real estate positions of younger households with low net worth.

Taking into account the value of capitalized wage income, pension income, and social security arguably provides the most complete picture of wealth. It again changes the picture of how wealth and the relative importance of stockholdings vary by net worth and age. To obtain total wealth and total net

Table IV

Portfolio Shares Relative to Financial Assets by Age

This table reports mean/median of portfolio shares of various assets relative to financial assets across households. Data are from the Survey of Consumer Finances for the years 1989, 1992, and 1995. Households are categorized by age. Asset shares are relative to financial assets, defined as the sum of direct and indirect holdings of cash, bonds, bills, stocks, housing and other real estate, proprietary businesses, pensions, and trusts. Shares are computed for each household, and then the average or median is found across households. The sample is limited to those households where stockholding is greater than $500 and financial net worth is greater than $10,000.

Assets Age	<35	35–49	50–64	≥65
		1989		
Stocks	0.205/0.066	0.095/0.052	0.162/0.093	0.187/0.133
Bonds	0.059/0.013	0.045/0.003	0.065/0.021	0.116/0.067
Cash	0.155/0.074	0.094/0.036	0.113/0.072	0.236/0.193
Subtotal liquid	0.419	0.234	0.340	0.539
Business	0.068/0.000	0.075/0.000	0.086/0.000	0.020/0.000
Pension	0.043/0.000	0.056/0.001	0.053/0.000	0.001/0.000
Real estate	0.471/0.459	0.635/0.730	0.520/0.532	0.439/0.398
Imputed no. of households	1,836,138	6,231,389	4,653,233	4,336,293
		1992		
Stocks	0.144/0.064	0.156/0.087	0.187/0.127	0.205/0.164
Bonds	0.050/0.003	0.044/0.005	0.065/0.010	0.116/0.029
Cash	0.128/0.052	0.089/0.041	0.097/0.043	0.202/0.129
Subtotal liquid	0.322	0.289	0.349	0.523
Business	0.052/0.000	0.077/0.000	0.077/0.000	0.023/0.000
Pension	0.070/0.006	0.067/0.003	0.077/0.000	0.018/0.000
Real estate	0.557/0.723	0.566/0.633	0.497/0.508	0.472/0.484
Imputed no. of households	2,613,580	6,761,088	6,016,609	4,440,303
		1995		
Stocks	0.188/0.097	0.162/0.089	0.236/0.173	0.246/0.177
Bonds	0.052/0.004	0.035/0.003	0.051/0.006	0.071/0.015
Cash	0.115/0.048	0.065/0.032	0.088/0.044	0.171/0.077
Subtotal liquid	0.355	0.262	0.275	0.488
Business	0.025/0.000	0.054/0.000	0.068/0.000	0.024/0.000
Pension	0.104/0.033	0.106/0.022	0.071/0.000	0.015/0.000
Real estate	0.517/0.664	0.577/0.626	0.483/0.494	0.473/0.484
Imputed no. of households	3,885,572	8,458,425	5,646,886	5,766,517

worth measures, capitalized wage income is imputed in the simplest way possible. We assume that for each household with a respondent under age 65, wage income remains constant at its current real level until age 65 and then ceases. For the small number of respondents age 65 and over who report wage income, we assume that this income remains constant until age 70 and then ceases. The stream of labor income is then discounted back to the respondent's current age, at a real interest rate of five percent per year. For households reporting pension and/or social security income, the current level of this income is assumed to continue through age 85. For households not yet receiving social security or pension income, social security payments are assumed to be constant at $629 per month (U.S. House of Representatives (1992)), which was the average payment in 1991 for retired workers, and payments are assumed to start at age 65 and continue through age 85. In either case, this income is also capitalized at five percent per year.

This imputation of capitalized labor and retirement income results in the breakdown of portfolio composition by age and financial net worth reported in Table V. A number of interesting conclusions can be drawn from this decomposition. The inclusion of capitalized wage income strengthens the conclusion from Table IV that stocks are a relatively more important asset for older households; both the median and mean for those age 65 and over is twice to three times that for those under age 65. For those age 65 and over, stockholdings range from an average of 8.5 percent of total wealth for the low net worth group, to 25.7 percent of wealth for the high net worth group. For those under age 65, only households with more than $1 million in net worth hold more than seven percent of their wealth in stocks.[8] As one would expect, capitalized wage income is the most important single source of wealth for the nonelderly in all but the wealthiest group. For the wealthy nonelderly cohort, real estate (26.8 percent), capitalized wages (21.1 percent), and proprietary business value (18.1 percent) are of comparable size, and all are larger than stockholdings (13.5 percent). In sum, for the older and wealthier households for whom stockholdings are a significant component of wealth, both proprietary business value and real estate are as important as labor income, suggesting that these sources of risk may be of considerable importance in determining stock prices and portfolio composition. The 1989 SCF produces qualitatively identical patterns (not reported here). To highlight the large cross-sectional variation observed within all groups, the standard deviation across households is included for each variable. The total imputed asset value and the number of households in each category are listed in the last two rows. This information is sufficient to back out the aggregate and per household dollar amount of each asset category. The information shows, for instance, that total stockholdings for this population is $2.22 trillion and total proprietary business wealth is $1.63 trillion.

As a check on these tabulations, it is useful to see how the above statistics from the SCF compare to aggregate wealth statistics. As shown in Table VI, aggregate wealth statistics from the Federal Reserve Board accord with the finding in the SCF that noncorporate wealth (which corresponds to our definition of proprietary business wealth) is of similar magnitude to corporate

[8] It should be noted that the average age of the respondent in the "young" households is about 50.

Table V

Portfolio Shares Relative to Total Assets by Age and Net Worth

This table reports cross-sectional means/medians and standard deviation (in parentheses) of portfolio shares of various assets relative to total assets. Data are from the 1992 Survey of Consumer Finances. Households are categorized by age and by financial net worth. Financial net worth is defined as the sum of direct and indirect holdings of cash, bonds, bills, housing and other real estate, proprietary businesses, pensions, and trusts, minus various types of debt including mortgages and consumer loans. Asset shares are relative to total assets, defined as the sum of cash, bonds, bills, stocks, housing and other real estate, proprietary businesses, pensions, trusts, capitalized labor, social security, and pension income. Debt/assets is the ratio of all debt outstanding to total assets. Shares are computed for each household, and then the average or median is found across households. The sample is limited to those households where stockholding is greater than $500 and financial net worth is greater than $10,000.

	Net Worth					
	$10 K to $100 K		$100 K to $1 M		>$1 M	
Assets	<65	≥65	<65	≥65	<65	≥65
Stocks	0.040/0.012 (0.083)	0.085/0.023 (0.164)	0.068/0.037 (0.086)	0.132/0.101 (0.113)	0.135/0.063 (0.172)	0.257/0.177 (0.226)
Bonds	0.009/0.000 (0.032)	0.064/0.008 (0.181)	0.026/0.003 (0.055)	0.076/0.011 (0.120)	0.061/0.015 (0.107)	0.174/0.100 (0.202)
Cash	0.021/0.007 (0.038)	0.075/0.038 (0.076)	0.039/0.016 (0.064)	0.153/0.090 (0.169)	0.052/0.027 (0.088)	0.106/0.061 (0.106)
Business	0.002/0.000 (0.014)	0.000/0.000 (0.000)	0.046/0.000 (0.109)	0.010/0.000 (0.050)	0.181/0.046 (0.241)	0.098/0.000 (0.200)
Pension	0.009/0.000 (0.028)	0.004/0.000 (0.017)	0.026/0.001 (0.051)	0.001/0.000 (0.007)	0.061/0.006 (0.111)	0.001/0.000 (0.011)
Real estate	0.125/0.104 (0.136)	0.261/0.217 (0.269)	0.228/0.169 (0.174)	0.290/0.273 (0.170)	0.268/0.213 (0.268)	0.257/0.244 (0.194)
Cap. labor	0.662/0.793 (0.308)	0.018/0.000 (0.052)	0.482/0.575 (0.290)	0.020/0.000 (0.065)	0.211/0.173 (0.200)	0.005/0.000 (0.019)
Cap. ss + pension	0.131/0.047 (0.178)	0.494/0.542 (0.269)	0.085/0.045 (0.109)	0.318/0.295 (0.190)	0.030/0.018 (0.047)	0.101/0.067 (0.103)
Debt/assets	0.076/0.064 (0.084)	0.052/0.009 (0.073)	0.065/0.051 (0.071)	0.013/0.000 (0.032)	0.038/0.025 (0.048)	0.014/0.000 (0.035)
Total assets (billion $)	3,706	111	8,655	1,768	5,703	1,828
Imputed no. of households	5,685,551	551,333	8,277,319	3,321,638	1,415,286	567,332

Table VI

Components of Aggregate Wealth and Income

Wealth statistics are from the Federal Reserve Board. Income statistics are from the National Income and Product Accounts.

Panel A: National Wealth, 1989 ($billions)

Total Wealth	Corporate Equity	Noncorporate Equity	Other Financial Wealth	Owner-Occupied Real Estate	Consumer Durables
18,298	2,496	2,525	5,164	6,082	2,031
Percentage of total	13.6%	13.8%	28.2%	33.3%	11.1%

Panel B: Major Components of Aggregate Income, 1989 ($billions)

Total of Major Income Components	Wages, Salaries and Benefits	Nonfarm Proprietor's Income	Personal Dividend Income	Net Interest
4,032	3,163	289	127	453
Percentage of total	78.4%	7.2%	3.1%	11.2%

wealth (which corresponds to our definition of stockholdings). It also shows that real estate is an extremely large component of financial wealth. Table VI also presents income series from the National Income and Product Accounts (NIPA). These statistics reinforce the impression from the SCF that wage income is the most important source of wealth for the typical household, and that income from stocks is, on average, relatively unimportant.

In sum, the above analysis suggests that the composition of wealth varies considerably across demographic groups, and that the picture one gets of relative portfolio composition across these groups is quite sensitive to the wealth metric used. In particular, stockholdings appear to be a far more important component of wealth when they are measured as a share of liquid assets than when they are measured relative to financial assets or total assets, and the size of this distortion varies by age and net worth. The analysis of portfolio components relative to total wealth underscores the significance of proprietary business wealth and property ownership for the high-net-worth and older households who own the majority of stocks.[9] Finally, the often large differences between means and medians indicate the heterogeneity in portfolio composition within each cohort.

To more systematically summarize the correlation structure between stockholdings and other wealth components in the SCF, we run a set of regressions that relate the dollar value of stockholdings (STOCK) and the proportion of stock assets relative to liquid (F1STK), financial (F2STK), or total assets (F3STK) to a number of independent variables. The following specifications were estimated:

$$\begin{aligned} \mathrm{F}(j)\mathrm{STK}_i = {} & a_1 + a_2\,\mathrm{TOTINC}_i + a_3\,\mathrm{NTWTH}_i + a_4\,\mathrm{BVNW}_i + a_5\,\mathrm{AGER}_i \\ & + a_6\,\mathrm{RISKATT}_i + a_7\,\mathrm{MBNW}_i + a_8\,\mathrm{PVNW}_i \\ & + a_9\,\mathrm{REALNW}_i + \epsilon_i, \quad j = 1, 2, 3; \end{aligned} \tag{1}$$

$$\begin{aligned} \mathrm{STOCK}_i = {} & a_1 + a_2\,\mathrm{TOTINC}_i + a_3\,\mathrm{BUSVAL}_i + a_4\,\mathrm{AGER}_i \\ & + a_5\,\mathrm{RISKATT}_i + a_6\,\mathrm{MORTBAL}_i + a_7\,\mathrm{PENVAL}_i \\ & + a_8\,\mathrm{REALVAL}_i + \epsilon_i. \end{aligned} \tag{2}$$

The main difference between the specifications (1) and (2) is that in equation (1) the dependent variable is stock value relative to liquid, financial, or total assets, whereas in equation (2) the dependent variable is the dollar amount of stock held. The regressions also differ because several of the independent variables in equation (1) are measured relative to financial net worth; in equation (2) all variables are in levels. TOTINC is total dollar wage plus proprietary income, NTWTH is financial net worth, BVNW is the

[9] We focus primarily on proprietary income rather than real estate, despite the large size of real estate holdings, because it is difficult to measure the consumption stream provided by real estate holdings, and hence to evaluate the extent to which it is a source of risk.

ratio of business value to net worth, AGER is the age of the respondent, RISKATT is a qualitative variable reflecting the respondent's self-reported attitude toward risk (a lower number implies more risk tolerance), MBNW is mortgage balance relative to net worth, REALNW is real estate value relative to net worth, and PVNW is pension value relative to net worth. BUSVAL, MORTBAL, REALVAL, and PENVAL are the corresponding variables in dollars.

Results using the 1992 SCF data are reported in Table VII. Households with less than \$10,000 in financial net worth or \$500 in stockholdings are omitted, and sample rather than population weights are used. Other survey years (not reported) produce qualitatively similar results. The first column of estimates in Table VII, Panel A, shows that when stocks are considered relative to the narrow measure of liquid assets, little of the total variation is explained by the regression ($R^2 = 0.04$). Interestingly, the coefficient on business value is negative, which is consistent with the idea that business risk reduces risk tolerance. Self-reported risk attitude has the expected sign, with more risk-averse households avoiding stocks. The coefficient on real estate is positive, suggesting that this source of risk does not discourage stockholding (or perhaps households that already own a house are more willing to hold riskier and less liquid assets).

The second and third columns of estimates in Table VII, Panel A, show that when stockholdings are measured relative to increasingly broad measures of wealth, the effect of age switches from insignificant to positive. This is consistent with the above analysis, which showed that liquid assets, and hence stockholdings, are a larger fraction of total wealth for older households. The effect of business value is negative, as is the effect of real estate value and pension value. This is consistent with the story that households bearing more risk from other assets cut back on stockholdings, but it is also consistent with a pure substitution effect whereby households with more in other assets hold less stock, since we are holding net worth constant. For the case of stocks relative to financial assets and total assets, a higher mortgage leads to higher stockholdings, suggesting that some stockholdings are indirectly financed via mortgage debt. Table VII, Panel B, shows that the dollar amount of stockholdings is positively related to age, business value, mortgage balance, and pension value. The positive relation between the level of stock and other financial assets is due to the fact that all of these variables proxy for net worth, which is not included in this specification.[10] It also highlights the fact that households with proprietary business wealth own a significant quantity of stocks.

On average, the households in our stockholding sample have 10 percent of their total stockholdings invested in their own company's stocks. Although these concentrated holdings may be voluntary, they may not be due to company com-

[10] A similar regression (not reported here) that includes net worth results in a negative coefficient on real estate, pension value, and business value, reflecting a substitution effect across asset classes when net wealth is held constant.

pensation policies. To the extent that such holdings are mandated, they represent a source of undiversifiable risk that is presumably correlated with wage earnings. As with entrepreneurial assets, one would expect a negative impact of these holdings on other risky investments, all else equal. Table VII, Panel C, reports the results of a regression similar to the first column of Panel A, but the components of the dependent variable are net of stocks in the company one works for. An additional independent variable, STKWRK, is the ratio of stocks where one works to total stocks held. Consistent with the idea of induced risk aversion, we find that the share of other stocks in other liquid assets is negatively related to the share of stock at work.

B. Differences between Entrepreneurs and Wage Earners

In order to get a clearer sense of whether entrepreneurs, who comprise less than a quarter of the total population of stockholding households, are an important fraction of the stockholding population, we consider how stockholdings vary with the level of business ownership.[11] Table VIII tabulates stockholdings in 1992 as a function of proprietary business value and financial net worth. For the 2.6 million households with net worth over $1 million, $667 billion in stock is held by the approximately[12] half of the households that have a business value less than $10,000, and $542 billion is held by the other half of the households that have a business value in excess of $10,000. The stockholdings of these two high-wealth groups account for more than half of the total reported stockholdings. In total, households with business holdings greater than $10,000 account for about one-third of stockholdings.

Whether a given source of income risk should be expected to influence stockholdings is determined in part by the covariance structure of the income source with stock returns. To calculate the variance and covariance of proprietary income growth, labor income growth, and stock returns, we use the Tax Model data (described below), CRSP quarterly stock returns, and National Income and Product Account (NIPA) data.

At the aggregate level, proprietary income is considerably more variable and more highly correlated with the stock market than is wage income. For example, the correlation between the quarterly growth rate of real nonfarm proprietary income (as reported in the NIPA) and the CRSP value-weighted return is 0.14, whereas the correlation between the value-weighted return and the quarterly growth rate of real aggregate wages is -0.07. The quarterly standard deviation of the growth rate of nonfarm proprietary income is

[11] In 1992, households with financial net worth in excess of $10,000 and stocks in excess of $500 number 19.82 million. Households satisfying this criteria, and with $500 in proprietary business value, number 4.09 million. See also Gentry and Hubbard (1998) for an analysis of the savings behavior of entrepreneurs.

[12] These population numbers should be treated with some caution because it is difficult to accurately impute the number of entrepreneurs in the United States from the population weights in the SCF. The weights are designed to scale individual observations to their population share based on general attributes such as age or wealth. There is no guarantee, however, that these weights will correctly reproduce more specific attributes such as business ownership.

Table VII

Determinants of Stockholdings

Results of cross-sectional least squares regressions relating household stockholding to a number of household level variables taken from the 1992 Survey of Consumer Finances. In Panel A the dependent variable is the share of stocks relative to different measures of total assets. In Panel B, the dependent variable is the total holding of stocks. Panel C reports results similar to Panel A, except that the components of the dependent variable are net of stocks in the company where one works. In all the regressions, sample weights, not population weights, are used. Households with stock less than \$500 or financial net worth less than \$10,000 are excluded. Total income is total dollar wage plus proprietary income, Net worth is financial net worth, Relative business is the ratio of business value to financial net worth, Risk attitude is a qualitative variable reflecting the respondent's self-reported attitude toward risk (a lower number implies more risk tolerance), Relative mortgage is mortgage balance relative to financial net worth, Relative real estate is real estate value relative to financial net worth, Relative pension is pension value relative to financial net worth. Business, Mortgage, Real estate, and Pension are the corresponding variables in dollars. Stock where work is the ratio of stocks where one works to total stocks. (t-statistics are reported in parentheses.)

	Panel A: Share of Stock in Assets			Panel B: Dollar Holdings of Stock	Panel C: The Effect of Stock Where You Work
	Stock Relative to Liquid Assets	Stock Relative to Financial Assets	Stock Relative to Total Assets		
Intercept	0.71	0.53	0.24	−181,342	0.661
	(14.8)	(21.28)	(10.54)	(−0.175)	(16.2)
Total income	-1.80×10^{-10}	-4.16×10^{-11}	-1.72×10^{-10}	-7.28×10^{-3}	-1.38×10^{-10}
	(−0.435)	(−0.19)	(−0.85)	(−0.68)	(−0.3)
Net worth	2.75×10^{-10}	5.04×10^{-10}	7.37×10^{-10}		2.18×10^{-10}
	(0.895)	(3.156)	(5.02)		(0.7)
Relative business	−0.14	−0.50	−0.32		−0.110
	(−4.34)	(−29.31)	(−20.62)		(−3.7)

Age of respondent	-7.94×10^{-4}	-6.99×10^{-5}	2.44×10^{-3}	63,060	-4.19×10^{-3}
	(−1.26)	(−0.21)	(−4.23)	(4.30)	(−0.7)
Risk attitude	−0.05	−0.02	−0.02	−728,391	−0.050
	(−4.74)	(−3.82)	(−4.23)	(−2.79)	(−5.0)
Relative mortgage	0.05	0.43	0.30		4.38×10^{-3}
	(1.31)	(20.90)	(16.19)		(0.2)
Relative pension	0.07	−0.41	−0.31		0.110
	(1.10)	(−11.67)	(−9.60)		(2.0)
Relative real estate	−0.04	−0.44	−0.31		-4.24×10^{-3}
	(−1.41)	(−27.00)	(−20.37)		(−0.2)
Business				0.06	
				(5.82)	
Mortgage				−0.68	
				(−0.50)	
Pension				0.99	
				(1.39)	
Real estate				0.08	
				(2.22)	
Stock where work					−0.112
					(−2.26)
Adjusted R^2	0.03	0.48	0.40	0.05	0.025

Table VIII

Household Stockholdings by Proprietary Business Value and Financial Net Worth

Total stockholdings by households in billions of dollars in 1992 for different levels of proprietary income and financial net worth. Data are from the 1992 Survey of Consumer Finances. Financial net worth is defined as the sum of direct and indirect holdings of cash, bonds, bills, housing and other real estate, proprietary businesses, pensions, and trusts, minus various types of debt including mortgages and consumer loans. The total number of households in millions (M) in each cell is reported in parentheses.

	Net Worth			
Business Value	<\$10 K	\$10 K to \$100 K	\$100 K to \$1 M	>\$1 M
<\$10 K	6 (32.7)	73 (31.5)	539 (21.1)	667 (1.1)
\$10 K to \$100 K	0 (0.3)	2 (2.2)	47 (2.6)	103 (0.2)
\$100 K to \$1 M	0 (0.0)	0 (0.0)	86 (2.8)	187 (0.6)
>\$1 M	—	—	—	252 (0.7)

eight percent on an annual basis, and the quarterly standard deviation of the growth rate of real wage income is four percent on an annual basis.[13] The standard deviation of individual income growth is much larger than these aggregate statistics, for both income sources. From the Tax Model, we find that the median standard deviation of the growth rate of nonfarm proprietary income is 64 percent annually, and the median standard deviation of the growth rate of real wage income is 35 percent annually. The much greater volatility of individual income is due to the presence of idiosyncratic risk, and may also be partly due to measurement error.

C. Portfolio Choice and Income Risk

A number of academic papers (e.g., Bodie, Merton, and Samuelson (1992)) and countless stories in the financial press offer investors suggestions about how to structure their stock and bond portfolios as a function of their age and wealth. For instance, according to Bodie and Crane (1997), Fidelity Investments and the Vanguard Group both recommend that the fraction of assets invested in equities should rise with one's wealth and decline with one's age. TIAA-CREF recommends a 50/50 stock bond mix for people of all ages.[14]

Given the primary importance of other asset classes and the heterogeneity in asset holdings documented above, it seems that such simple rules are unlikely to lead to optimal portfolio allocations. Rather, one would expect optimal portfolio composition to be influenced by any risk factor that rep-

[13] We use proprietary income as a readily available proxy for the returns on proprietary business ownership. Unfortunately, the correlation between business net income and business value in the SCF is only 0.084. It is not clear then whether this variable really picks up the risk and returns inherent in business ownership.

[14] All of these companies also state that the optimal asset mix for a particular household might differ from this due to specific circumstances.

resents a large fraction of wealth, that is difficult to insure, and that has a high covariance with common stock returns. The idea that portfolio composition is influenced by the covariance structure between various asset classes is consistent with both static and dynamic theoretical models, including Merton (1971), Duffie et al. (1997), Koo (1994), and Heaton and Lucas (1997).

It is natural to ask, then, whether differing levels of cash flow variability from these sources have a measurable effect on portfolio composition. Determining this requires a data set with a time series as well as a cross-sectional dimension. We rely on the 1979 to 1990 Panel of Individual Tax Return Data (the "Tax Model"). This data set, compiled by the University of Michigan and Ernst and Young, in cooperation with the Statistics of Income Division of the IRS, contains information on a large panel of taxpayers who were randomly chosen by the last four digits of their Social Security number. Approximately 45,000 households have data for at least three years in the 1979 to 1990 period, and data for the entire period are available for a subset of approximately 5,000 households.[15] The data include all items from Form 1040 and many items from the accompanying schedules.

The advantage of the Tax Model over more frequently studied data sets (e.g., the Panel Study of Income Dynamics and the SCF) is that it is a relatively large panel with annual frequency data on both income and assets. It has rarely been used to look at savings dynamics or portfolio choice, however, because it lacks direct measures of asset holdings and detailed demographic information. We discuss these shortcomings and the potential biases in the Appendix. The Appendix also presents population summary statistics for stock and bond holdings that are broadly consistent with our assessment of security holdings based on the SCF, and Poterba (1994) reports similar results. For these reasons and others discussed in the Appendix, we conclude that these data are quite useful for the specific questions that we wish to address.

To impute stock and bond holdings for each household each year, we use reported taxable dividend and taxable interest income in combination with average market dividend yields and three-month T-bill yields.[16] Taxable bond holdings at time t for taxpayer i are approximated by

$$B_{it} = I_{it}/r_t \tag{3}$$

and taxable stock holdings at time t are approximated by:

$$S_{it} = d_{it}/\mathrm{YLD}_t \tag{4}$$

where I_{it} is interest included in taxable income, r_t is the three month T-bill rate, d_{it} are dollar dividends reported as taxable income, YLD_t is the divi-

[15] Also available is a stratified random sample of about 100,000 tax returns per year that oversamples higher income taxpayers but has no time series component. Due to the higher quality of the SCF asset data, however, we only use the panel component of the tax data.

[16] Here we use the term "bonds" loosely to denote any security that generates (taxable) interest income. This category includes a variety of instruments such as savings accounts, certificates of deposit, T-bills, Treasury bonds, and corporate bonds.

dend yield on the S&P 500. Capital gains realizations are not used in the imputation of asset holdings because they are highly discretionary and therefore poor indicators of the underlying quantity of stocks.

The exemption variables in the Tax Model provide some useful clues about demographics. To identify older taxpayers, any household with one or more old-age exemptions in any year is classified with a dummy variable as old. Total exemptions, *XT*, are used as a proxy for household size. Marginal tax rates, *TX*, are included as a potential determinant of portfolio composition, and as a further indicator of wealth. Finally, households that own or intend to purchase a house may modify their savings behavior or portfolio composition, due to liquidity or diversification considerations. Mortgage interest paid is used as an indicator of home ownership, with HOUSE defined as an indicator variable equal to one if mortgage interest paid is greater than zero in any year.

We construct several measures of nondiversifiable income to examine whether portfolio choice is sensitive to the source and variability of other income. The first is wage and salary income, *W*, which is taken directly from each tax return. The second is adjusted gross income minus wage and salary income, dividend and interest income, and capital gains. We refer to this measure of income as proprietary income, *P*, since a large component of this income is reported on Schedules C (self-employment income) and E (supplemental income including rents and royalties). We also consider the sum of wage, salary, and proprietary income, *I*.

The Tax Model data allow us to test the hypothesis that the proportion of stocks relative to stocks plus bonds, *SS*, is lower for households with greater exposure to other sources of income risk. This effect should be stronger for risks that are positively correlated with stock market returns and hard to insure against. In particular, depending on the utility function and assumed transactions cost structure, the proportion of stocks should vary with the average level and volatility of other income. To the extent that households with proprietary income have a larger investment in other risky assets, they may be less inclined to hold stocks. Investors whose wage or proprietary income is highly correlated with the stock market may for diversification reasons be more reluctant to hold stocks. Households holding mortgages may have a different attitude toward risk, for instance because of concern over meeting mortgage payments. Finally, the number of exemptions may be correlated with stockholdings because households with more dependents may be more risk averse. To look for evidence on these effects we run the following regressions:

$$\begin{aligned}\mathrm{AV(SS)}_i = {} & a_1 + a_2\,\mathrm{AV(AGI)}_i + a_3\,\mathrm{AV(AGI)}_i^2 + a_4\,\mathrm{AV(CAP)}_i + a_5\mathrm{HOUSE}_i \\ & + a_6\,\mathrm{AV(XT)}_i + a_7\,\mathrm{AV(TX)}_i + a_8\,\mathrm{STD(I)}_i + a_9\,\mathrm{COV(I,SP)}_i + \epsilon_i,\end{aligned} \tag{5}$$

$$\begin{aligned}\mathrm{AV(SS)}_i = {} & a_1 + a_2\,\mathrm{AV(AGI)}_i + a_3\,\mathrm{AV(AGI)}_i{}^2 + a_4\,\mathrm{AV(CAP)}_i + a_5\,\mathrm{HOUSE}_i \\ & + a_6\,\mathrm{AV(XT)}_i + a_7\,\mathrm{AV(TX)}_i + a_8\,\mathrm{STD(W)}_i + a_9\,\mathrm{COV(W,SP)}_i \\ & + a_{10}\,\mathrm{STD(P)}_i + a_{11}\,\mathrm{COV(P,SP)}_i + \epsilon_i.\end{aligned} \tag{6}$$

The naming convention in equations (5) and (6) is that $\mathrm{AV}(X)_i$ denotes the average value of variable X for filer i over the period for which data are available. For instance, the independent variable in each case, $\mathrm{AV(SS)}_i$, is the ratio of average stockholdings to average stocks plus bonds for filer i. Similarly, $\mathrm{STD}(X)_i$ ($\mathrm{COV}(X,Y)_i$) denotes the standard deviation of X (covariance between X and Y) calculated using observations for filer i over the period for which data are available. These statistics are always computed using data from all years for which it is available for filer i. Filers with less than three years of data are excluded in the reported regressions.[17]

The independent variables include proxies for wealth and variables that reflect exposure to background risk. Variable averages included as proxies for wealth include adjusted gross income in 1988 dollars, AGI, adjusted gross income in 1988 dollars squared, the marginal tax rate, TX, and the sum of stock and bond holdings, CAP. Independent variables directly related to risk exposure include the standard deviation of the growth rate of wage plus proprietary income, $\mathrm{STD(I)}_i$ and the individual standard deviations of the growth rate of each of these income sources, $\mathrm{STD(W)}_i$ and $\mathrm{STD(P)}_i$. Also included are $\mathrm{COV(W,SP)}_i$, the covariance between wage growth and stock returns (measured as the return to the S&P500), $\mathrm{COV(P,SP)}_i$, the covariance between proprietary income growth and stock returns, and $\mathrm{COV(I,SP)}_i$, the covariance between proprietary plus labor income growth and stock returns.

The key difference between equations (5) and (6) is that in equation (5) all income is aggregated into one number, whereas in equation (6) income is subdivided between wage and proprietary income. The equations also differ in that (5) is estimated using our entire sample, whereas equation (6) is estimated using a subsample of households with average proprietary income greater than \$500.

In the reported regression results, we focus on those households where the risk of nondiversifiable income is likely to be important. Theoretical results reported by Heaton and Lucas (1997), for example, show that as the level of financial wealth relative to nondiversifiable income becomes large, households will choose portfolio holdings similar to those predicted by models where nondiversifiable income is zero (e.g., Merton (1971)). Further, Heaton and Lucas (1997) show that variation in the properties of nondiversifiable income has little effect on predicted portfolio holdings when nondiversifiable income is relatively unimportant. For these reasons we limit our sample to those households where the value of the stock and bond portfolio is less than four times the adjusted gross income. If, instead, the sample is expanded to those with a significant holding of stock and bond holdings relative to adjusted gross income, then the statistical significance of nondiversifiable income risk in explaining portfolio choice is substantially reduced. For example, when the sample includes all those with average proprietary income greater than \$500, the standard deviation of proprietary income is statistically insignificant at the 95 percent confidence level.

[17] The Appendix contains a more detailed discussion of the construction of the regression variables.

Table IX
Explaining Portfolio Choice

Results of regressing the average share of stocks in each household's portfolio on several explanatory variables using data from the Tax Model for the period 1979 to 1990. The explanatory variables are: average adjusted gross income (Avg. AGI), average adjusted gross income squared (Avg. AGI^2), sum of average stock and bond holdings (Capitalization), an indicator for house ownership (House), the average number of exemptions (Exemptions), average marginal tax rate (Marginal tax rate), the standard deviation of different measures of nondiversifiable income (Std. "X" Income), and the covariance of this income with the S&P 500 return (Cov. "X" Income with S&P 500), where X = Total refers to the growth rate of wage plus proprietary income, X = Wage refers to the growth rate of wage income, and X = Proprietary refers to the growth rate of proprietary income. In Panel A, no distinction is made between wage and proprietary income. In Panel B, these two sources of non-marketed income enter separately. (t-statistics are reported in parentheses.)

	Panel A	Panel B
Intercept	0.21 (14.22)	0.17 (6.00)
Avg. AGI	-3.29×10^{-7} (−1.46)	-8.81×10^{-7} (−2.47)
(Avg. AGI)^2	4.52×10^{-14} (0.20)	5.45×10^{-14} (1.74)
Capitalization	4.32×10^{-7} (7.69)	3.53×10^{-7} (4.36)
House	-4.29×10^{-3} (−0.53)	1.40×10^{-2} (0.99)
Exemptions	-2.44×10^{-3} (−0.85)	-9.40×10^{-3} (−0.18)
Marginal tax rate	2.66×10^{-3} (4.72)	4.48×10^{-3} (4.47)
Std. total income	-1.57×10^{-3} (−0.29)	—
Cov. total income with S&P 500	−0.223 (−2.53)	—
Std. wage income	—	-4.46×10^{-3} (−0.41)
Cov. wage income with S&P 500	—	-1.27×10^{-6} (−0.18)
Std. proprietary income	—	-3.95×10^{-3} (−2.27)
Cov. proprietary income with S&P 500	—	-1.71×10^{-2} (−0.66)
Adjusted R^2 (no. of obs.)	0.03 (5,220)	0.04 (1,732)

The results, reported in Table IX, indicate that under both specifications the proportion of stockholdings increases with the average of bond plus stockholdings. This could be due to the greater risk tolerance of wealthier households. Both specifications also show a significant positive impact of the average marginal tax rate on stockholding. To the extent that the average marginal tax rate is also a proxy for wealth, this again could be due to an increase in risk tolerance with wealth. Another possible explanation for the effect of the tax rate is that total bond holdings are relatively underestimated for individuals in the higher marginal tax rate since they are more likely to invest in tax exempt bonds.

Although the results on the effects of income variability and covariances are statistically mixed, they are supportive of the hypothesis that nondiversifiable income has a negative effect on stockholding and that proprietary income is relatively important. The standard deviation of the growth rate of wage plus proprietary income has a negative but statistically insignificant effect on stockholding. Notice, however, that when the standard deviation of the growth rate of proprietary income is included separately in equation (6), it has a significant negative effect on the proportion of stockholding. The covariance measures in both specifications all have a negative impact on stockholding as predicted, although only when wage plus proprietary income is used (specification (5)) is this covariance effect statistically significant. The lack of statistical precision in measuring the effects of the covariance variables in specification (6) could be due to the reduction in the sample size that occurs when we condition on those households with significant amounts of proprietary income.

These results are consistent with the fact that proprietary income represents an important source of income risk for many stockholders, and that this income is more highly correlated with stock returns than is labor income. Although we interpret cross-sectional differences in portfolios as arising from differences in risk exposures, it should be noted that some of these variables may also proxy for differences in risk preferences.

II. Entrepreneurial Income and Asset Prices

The analysis in Section I indicates that the properties of proprietary income at the individual level influence investors' portfolio decisions. For example, households with more variable proprietary income appear to substitute away from stocks. Whether this effect influences equilibrium asset returns depends on the exact dynamics of proprietary income, the equilibrium pattern of security holdings, and the extent to which proprietary income risk is shared throughout the population. The development of a completely specified general equilibrium model to assess the effects of proprietary income on asset prices (e.g., Polkovnichenko (1998)) is beyond the scope of this paper. We do know, however, that the aggregate risk of proprietary income must be held and, as we discussed in Section I.B, this risk is substantial. Aggregate proprietary wealth may therefore be an important component of a successful asset-pricing model, and may help to address the Roll (1977) critique. We begin to test the importance of proprietary income for asset returns using aggregate income measures and an extension of the framework developed by Jagannathan and Wang (1996).

A. Model Specification

In the traditional approach to testing the CAPM, a stock market index is used to proxy for the return to aggregate wealth. Jagannathan and Wang (1996) (JW hereafter) consider an extension in which aggregate wealth is the sum of stock market wealth and human capital. JW assume that human capital is given by the capitalized value of "labor income." To construct a value for human capital, they assume that labor income follows the process:

$$Y_t = (1 + g)Y_{t-1} + \epsilon_t, \tag{7}$$

where Y_t is labor income at time t, g is the average growth rate of labor income, and ϵ_t has mean zero and is independently distributed over time. Under the further assumption that labor income is discounted at a constant rate, the time t return to human capital is given by the growth rate of labor income from time $t-1$ to time t. The return to aggregate wealth is then given by a linear combination of the return to the stock market portfolio and the growth rate of labor income.

These assumptions provide motivation for a model of the stochastic discount factor that is a linear combination of a constant, the return to a value-weighted stock market index (R_t^{vw}), and the growth rate in labor income (R_t^{labor}). JW use the value-weighted CRSP return for R_t^{vw} and construct R_t^{labor} as

$$R_t^{labor} = \frac{L_{t-1} + L_{t-2}}{L_{t-2} + L_{t-3}}, \tag{8}$$

where L_t is the difference between the NIPA measure of monthly total personal income and total dividends, normalized by total U.S. population. Notice that this measure of labor income includes wage compensation, proprietary income, and net interest payments. The return to labor is smoothed over two months to minimize the effects of measurement error. It is also lagged one month to account for the lags in the official reports of aggregate income. In completing their empirical specification of the discount factor, JW allow for predictable variation in the covariance between asset returns and the market portfolio. This is captured by allowing the discount factor to depend on the lagged value of the yield spread between BAA- and AAA-rated bonds (R_t^{prem}). This lagged default premium is used because it has been shown to be a good predictor of future economic conditions.

To test this specification, JW construct 100 portfolios from NYSE and AMEX stocks taken from the CRSP database. The portfolios are constructed by sorting the stocks into size deciles and beta deciles where the betas are estimated by regressing past returns on the return to the value-weighted portfolio. The details of this data construction are discussed by JW. Given this time series of asset returns $\{R_{i,t}: i = 1,2,\ldots,100\}$, the linear model of the discount factor implies the following set of unconditional moment restrictions:

$$E[R_{i,t}(\delta_0 + \delta_{vw} R_t^{vw} + \delta_{prem} R_t^{prem} + \delta_{labor} R_t^{labor})] = 1 \tag{9}$$

for all i.

Following JW, we estimate the parameters of the stochastic discount factor and examine the restrictions implied by equation (9) using GMM. We initially use the data constructed by JW[18] that is monthly and runs from July 1963 to December 1990. We also consider a variant of this model in

[18] These data were kindly provided to us by Jagannathan and Wang.

Table X

Jagannathan and Wang Model with Efficient GMM

Estimation and tests of a linear stochastic discount factor model using the 100 portfolios of Jagannathan and Wang (1996) which are sorted by size and market beta for the period July 1963 to December 1990. R_t^{vw} is the return on the CRSP value-weighted index. R_t^{prem} is the lagged value of the yield spread between BAA- and AAA-rated bonds. R_t^{labor} is the lagged growth rate in labor income. The model

$$E[R_{i,t}(\delta_0 + \delta_{vw}R_t^{vw} + \delta_{prem}R_t^{prem} + \delta_{labor}R_t^{labor})] = 1$$

is estimated using Hansen's (1982) efficient GMM. t-statistics for each estimate are reported in parentheses. The minimized value of the GMM criterion is reported as J, along with the corresponding p-value for the chi-square test of the overidentifying conditions. The No Premium column reports the case where the variable R_t^{prem} is not included in the estimation. The weighting matrix from the complete model is used for this estimation. The difference between the GMM criterion under this restriction and the unrestricted GMM criterion is reported as $J_{UR} - J_R$. If the restriction is true this should be distributed as a chi-square random variable with one degree of freedom. The implied probability value is reported in parentheses. The No Labor column is constructed in a similar manner.

	Complete Model	No Premium	No Labor
Coefficient estimates			
δ_0	2.62 (7.71)	1.42 (7.47)	1.66 (7.55)
δ_{vw}	2.13 (1.61)	1.35 (0.95)	2.28 (1.62)
δ_{prem}	−84.67 (−4.24)	—	−62.34 (−3.25)
δ_{labor}	−112.26 (−3.59)	−72.82 (−2.56)	—
GMM criterion			
J (p-value)	92.21 (0.59)	111.22 (0.15)	106.49 (0.24)
$J_{UR} - J_R$ (p-value)	—	19.01 (0.00)	14.27 (0.00)

which human capital is determined by two components: the value of future wage income and the value of future proprietary income. The returns to these two components of human capital are constructed using the growth in aggregate wage income (R_t^{wage}) and the growth in aggregate nonfarm proprietary income (R_t^{prop}). Similar to the construction of R_t^{labor}, we use a two-month moving average of the respective monthly income measures from NIPA, and lag these growth rates by one month. These alternative measures of the components of human capital lead to the following alternative to equation (9):

$$E[R_{i,t}(\delta_0 + \delta_{vw}R_t^{vw} + \delta_{prem}R_t^{prem} + \delta_{wage}R_t^{wage} + \delta_{prop}R_t^{prop})] = 1. \qquad (10)$$

B. Empirical Results

Tables X and XI report the results of two-stage efficient GMM estimation of the parameters of the stochastic discount factor using the moment conditions (9) and (10).[19] In implementing the efficient GMM estimator, we con-

[19] In their implementation of GMM, JW use the second moment matrix of the vector of asset returns as the GMM weighting matrix. Instead, we use Hansen's (1982) efficient GMM.

Table XI
Model with Wage and Proprietary Income

Estimation and tests of a linear stochastic discount factor model using the 100 portfolios of Jagannathan and Wang (1996) which are sorted by size and market beta for the period July 1963 to December 1990. R_t^{vw} is the return on the CRSP value-weighted index. R_t^{prem} is the lagged value of the yield spread between BAA- and AAA-rated bonds. R_t^{wage} is the growth rate in wage income. R_t^{prop} is the growth rate of nonfarm proprietary income. The model

$$E[R_{i,t}(\delta_0 + \delta_{vw} R_t^{vw} + \delta_{prem} R_t^{prem} + \delta_{wage} R_t^{wage} + \delta_{prop} R_t^{prop})] = 1$$

is estimated using Hansen's (1982) efficient GMM. Panel A uses the timing convention of Jagannathan and Wang (1996) where the growth rates of wage and proprietary income are lagged a period. In Panel B, these variables are not lagged. Estimation is done using Hansen's efficient GMM. t-statistics for each estimate are reported in parentheses. The minimized value of the GMM criterion is reported as J, along with the corresponding p-value for the chi-square test of the overidentifying conditions. In each panel, the No Wage column reports the case where the variable R_t^{wage} is not included in the estimation. The weighting matrix from the complete model is used for this estimation. The difference between the GMM criterion under this restriction and the unrestricted GMM criterion is reported as $J_{UR} - J_R$. If the restriction is true this should be distributed as a chi-square random variable with one degree of freedom. The implied probability value is reported in parentheses. The No Proprietary column is constructed in a similar manner.

	Panel A: JW Timing			Panel B: Contemporaneous Timing		
	Complete Model	No Wage	No Proprietary	Complete Model	No Wage	No Proprietary
Coefficient estimates						
δ_0	3.11 (7.78)	1.84 (8.36)	3.15 (7.88)	2.05 (5.52)	1.77 (8.05)	3.12 (8.43)
δ_{vw}	2.24 (1.53)	2.90 (2.00)	1.80 (1.30)	3.40 (2.40)	3.29 (2.28)	2.41 (1.83)
δ_{prem}	−104.92 (−4.67)	−65.55 (−3.34)	−113.82 (−5.15)	−72.80 (−3.41)	−62.90 (−3.38)	−78.43 (−3.74)
δ_{wage}	−142.75 (−3.92)	—	−156.47 (−4.35)	−32.12 (−0.95)	—	−49.70 (−1.50)
δ_{prop}	−26.31 (−2.39)	−33.03 (−2.98)	—	−19.22 (−2.15)	−21.31 (−2.42)	—
GMM criterion						
J (p-value)	88.00 (0.68)	105.01 (0.25)	94.40 (0.53)	97.52 (0.41)	98.43 (0.41)	102.11 (0.32)
$J_{UR} - J_R$ (p-value)	—	16.31 (0.00)	6.40 (0.01)	—	0.91 (0.34)	4.59 (0.03)

struct a first-stage estimator of the parameters of the stochastic discount factor using the inverse of the second moment matrix of the vector of portfolio returns. These first-stage estimates of the parameters are then used to construct estimates of the second moment matrix of the vector of pricing errors based on equations (9) and (10). The inverse of this covariance matrix is used to construct the parameter estimates reported in the tables. Note that under the null hypothesis the model is correctly specified, the minimized value of the second-stage GMM criterion should be distributed as a chi-square random variable with degrees of freedom given by the number of portfolio returns less the number of parameters. In the tables, this minimized criterion is reported as J. In the tables we also report results where several of the parameters of the models are set to zero. For example, in Table X the "No Premium" model restricts the parameter δ_{prem} to zero. To examine the statistical significance of these restrictions, we fix the GMM weighting matrix based on the first-stage estimates of the complete model. The difference between the GMM criterion function with and without the restriction is denoted $J_{UR} - J_R$, and is asymptotically distributed as a chi-square random variable with one degree of freedom.

Table X essentially replicates the results of JW. Notice that both R_{t-1}^{prem} and R_t^{labor} are statistically important components of the stochastic discount factor. Eliminating either factor from the pricing model results in quite a significant deterioration in the GMM criterion. In our context, the importance of R_t^{labor} is interesting since it indicates the potential significance of the nonmarket risk factor in explaining asset returns.

Table X, Panel A, examines the model (10) where there is a distinction between wage income and proprietary income. Notice that in this case removing either factor from the discount factor results in a significant increase in the GMM criterion. This implies that both wage and proprietary income risk are important determinants of expected returns. Note, however, that the deterioration in the criterion is greater when R_t^{wage} is removed than when R_t^{prop} is removed. It appears that wage income variability is more important than proprietary income variability in this specification.

In Table X, Panel B, we report results similar to Table X, Panel A, except that we change the timing of R_t^{wage} and R_t^{prop}. In this case R_t^{wage} is given by

$$R_t^{wage} = \frac{W_t + W_{t-1}}{W_{t-1} + W_{t-2}}, \tag{11}$$

where W_t is wage income at time t. R_t^{prop} is defined using similar timing. In this case the wage and proprietary income is not lagged relative to asset returns as was done in equation (8). We call this "contemporaneous timing" in comparison to the timing used by JW (referred to as "J&W timing" in Table XI). This alternative timing assumption is plausible since individuals observe their own income and asset returns simultaneously. Under contemporaneous timing for the returns to human capital and stock returns, the removal of R_t^{wage} no longer results in a significant increase in the GMM criterion function. Setting δ_{prop} to zero, however, results in a very substantial deterioration in the criterion. The proprietary income factor is therefore more robust to the exact timing. A potential reason for the effect of timing on the importance of wage growth is the observed reaction of the stock market to announcements about unemployment and other labor market statistics. These reactions are often interpreted as reflecting the stock market's assessment of the impact of the new information on the future course of monetary policy. The results for wage income growth may therefore be due to this announcement effect and not due to a direct link between wage income growth and the current wealth of stockholders. Jagannathan, Kubota, and Takehara (1998) interpret some of their results for the wage factor in Japan in a similar way. The results of Section I indicate that proprietary income may be a more important wealth factor for individuals holding stocks, so that the contemporaneous movement in the value of this wealth is more important for the determination of asset returns.

Fama and French (1993) propose size and book-to-market factors, SMB_t and HML_t, as important components of linear asset-pricing models. To further assess whether entrepreneurial income is a robust component of the model we also consider an alternative in which the linear model of the stochastic discount factor is allowed to depend on SMB_t and HML_t:

$$E[R_{i,t}(\delta_0 + \delta_{vw} R_t^{vw} + \delta_{prem} R_t^{prem} + \delta_{prop} R_t^{prop} + \delta_{smb}\mathrm{SMB}_t + \delta_{hml}\mathrm{HML}_t)] = 1. \tag{12}$$

Table XII reports the results of estimating this specification using GMM and contemporaneous timing. Notice that when the complete model is estimated with proprietary income as a factor, the coefficients on the SMB and HML factors are jointly only marginally significant. For example, when these two factors are eliminated from the pricing model, the GMM criterion increases by 4.28, giving a p-value of 12 percent. When the growth rate in proprietary income is eliminated, however, the increase in the criterion results in a much lower p-value of four percent. On this statistical basis, the proprietary income factor is more important than the Fama–French factors for this set of portfolios. JW found a similar result when using just the growth rate of labor income. The importance of proprietary income relative to the SMB and HML factors may be because these latter factors are only proxies for the "true" economic factor or state variable that is the wealth of stockholders. Since entrepreneurs are important stockholders, the addition of their income moves the model closer to including a direct measure of the wealth of stockholders and hence the importance of the proxies is reduced. Consistent with this interpretation, Polk (1998) finds that there is substantial covariance (both conditionally and unconditionally) between the Fama–French factors and the growth rate of entrepreneurial income.

Table XII

Model with Fama–French Factors

Estimation and tests of a linear stochastic discount factor model using the 100 portfolios of Jagannathan and Wang (1996) which are sorted by size and market beta for the period July 1963 to December 1990. R_t^{vw} is the return on the CRSP value-weighted index. R_t^{prem} is the lagged value of the yield spread between BAA- and AAA-rated bonds. R_t^{prop} is the growth rate in nonfarm proprietary income. Fama and French (1993) propose size and book-to-market factors, SMB_t and HML_t are Fama and French's (1993) size and book-to-market factors respectively. The model

$$E[R_{i,t}(\delta_0 + \delta_{vw} R_t^{vw} + \delta_{prem} R_t^{prem} + \delta_{prop} R_t^{prop} + \delta_{smb}\mathrm{SMB}_t + \delta_{hml}\mathrm{HML}_t)] = 1$$

is estimated using Hansen's (1982) efficient GMM. t-statistics for each estimate are reported in parentheses. The minimized value of the GMM criterion is reported as J, along with the corresponding p-value for the chi-square test of the overidentifying conditions. The No Proprietary column reports the case where the variable R_t^{prop} is not included in the estimation. The weighting matrix from the complete model is used for this estimation. The difference between the GMM criterion under this restriction and the unrestricted GMM criterion is reported as $J_{UR} - J_R$. If the restriction is true, this should be distributed as a chi-square random variable with one degree of freedom. The implied probability value is reported in parentheses. The No SMB or HML and No SMB columns are constructed in a similar manner.

	Complete Model	No Proprietary	No SMB or HML	No SMB
Coefficient estimates				
δ_0	1.64 (7.78)	1.56 (7.43)	1.71 (7.95)	1.71 (7.95)
δ_{vw}	4.92 (1.53)	3.68 (1.95)	3.25 (2.25)	3.29 (1.79)
δ_{prem}	−53.42 (−4.67)	−53.25 (−2.90)	−58.33 (−3.13)	−58.34 (−3.12)
δ_{prop}	−18.95 (−2.39)	—	−21.64 (−2.45)	−21.73 (−2.36)
δ_{smb}	−4.44 (−2.04)	−5.07 (−2.40)	—	—
δ_{hml}	1.70 (0.52)	0.25 (0.08)	—	0.11 (0.03)
GMM criterion				
J (p-value)	92.08 (0.54)	96.25 (0.44)	96.36 (0.47)	93.36 (0.44)
$J_{UR} - J_R$ (p-value)	—	4.17 (0.04)	4.28 (0.12)	4.28 (0.04)

It should be noted, however, that the statistical insignificance of the Fama–French factors when examined jointly appears to be due to the HML factor alone. To see this, consider the last column of Table XII, which reports results when only the SMB factor is removed from the model of the stochastic discount factor. In this case, there is a significant decline in the GMM criterion, indicating that the SMB factor is important, along with proprietary income. This is consistent with the statistical insignificance of the coefficient on the HML factor reported in the second and third columns of Table XII. Jagannathan and Wang (1996) also found that the HML factor is statistically insignificant in explaining the average returns of the portfolios they considered.

III. Conclusions

Using a variety of data sources, we have argued that entrepreneurial income risk has a significant influence on portfolio choice and asset prices. Households with high and variable proprietary business income hold less wealth in stocks than other similarly wealthy households, perhaps due to the higher background income risk they face. Nevertheless, they constitute a significant fraction of the stockholding population. Consistent with this, we find that adding proprietary income to a linear asset pricing model does in fact improve its performance over a similar model that includes only wage income. Although proprietary income appears to be an important factor, our asset pricing model has the shortcoming that it is static, and relies on aggregate data. Hence, it does not make use of the considerable cross-sectional and time series variation in the data. One fruitful direction for future research would be to develop an asset pricing model that more fully exploits the significant heterogeneity in background risks.

Appendix

A. Potential Biases in Asset Imputations from the Tax Model

A number of potential biases arise in the imputation of stock and bond holdings using equations (3) and (4). First, imputed stock and bond holdings are likely to underestimate true stock and bond holdings, and hence what we define as total liquid assets, for several reasons: Non-interest-bearing assets (e.g., checking deposits) and tax exempt securities (e.g., municipal bonds[20]) are not counted. In some years dividends below a threshold level are tax exempt, causing stocks to be undercounted and some small stockholders to be misclassified as nonstockholders. It is also possible that stocks are underestimated due to the compositional effect that individuals hold stocks

[20] Interest earned on municipal bonds is reported to the IRS for 1987 and 1988, but not in earlier years. Tabulations based on SCF data suggest, however, that tax exempt holdings are relatively small for the typical high net worth household.

Table AI

Mutual Fund Holdings Relative to Stocks Plus Mutual Funds from Flow of Funds

This table reports the share of money market funds held by the household sector as a percent of direct equity holdings by households plus mutual fund shares for the years 1979 to 1989. The data are from the Flow of Funds produced by the Federal Reserve.

Date	Proportion
1979	3%
1980	7%
1981	13%
1982	19%
1983	11%
1984	13%
1985	13%
1986	12%
1987	10%
1988	14%
1989	15%

with relatively low dividend yields outside of tax-exempt accounts, so that realized dividend yields are systematically lower than the market yield used to impute holdings (although Bodie and Crane (1997), among others, find little evidence of tax effects). The relative share of stock and bond holdings is also subject to measurement error. For instance, we cannot observe the composition of defined contribution pension plans, which, when taken in combination with directly held assets, may provide a very different picture of portfolio composition for some households.

A systematic misclassification problem arises due to the tax treatment of mutual fund income as dividends, even for mutual funds that invest entirely in interest-bearing assets. This puts an upward bias into estimated average stockholdings relative to bond holdings. Flow of funds data suggest that the degree to which mutual funds cause interest payments to be misclassified as dividends has increased over time. Table AI shows that the share of money market funds held by the household sector as a percentage of direct equity plus mutual fund shares has increased from three percent in 1983 to 15 percent in 1989. These numbers provide an upper bound on the extent of misclassification, however, since only a fraction of the assets held in mutual funds are interest-bearing.

Due to the estimation problems inherent in using the Tax Model, we do not want to emphasize the implied population statistics, particularly since these statistics are more accurately compiled from the SCF in Section I.A.[21]

[21] See Kennickell and Starr-McCluer (1994) and Blume and Zeldes (1994) for a complete description of the SCF data. See also Poterba (1994) for a comparison of the estimation biases across a number of frequently used data sources.

Table AII

Summary Statistics for Tax Model Data (1988 dollars)

Cross-sectional summary statistics from the Tax Model. The time series dimension of the data is used to construct time series moments for each household. The table reports the cross-sectional average, median, standard deviation, minimum, and maximum for each statistic. Panel A is households with average Adjusted Gross Income greater than $200,000. Panel B is those households who report nonzero interest and dividend income ("Both"). Panel C is those households who report only nonzero interest income ("Bonds Only"). Panel D is those households who report only nonzero dividend income ("Stocks Only"). Panel E is for households who report neither interest income nor dividend income.

	Mean/Median	Std. Dev.	Min.	Max.
Panel A: AGI > $200,000 (287 households)				
Avg. AGI	$299,552/$191,382	$573,349	$47,922	$9,351,494
Std. dev. AGI	$150,366	$310,647	$765	$4,640,019
Avg. AGI growth	0.068	0.40	−1.85	5.81
Std. dev. AGI growth	0.55	0.46	0.03	3.42
Avg. wage income	$150,835	$223,633	$0	$3,093,171
C.V. wage income	0.79/0.61	0.66	0.02	3.46
Avg. interest income	$30,092	$102,548	$10.2	$1,250,207
Avg. dividend income	$28,598	$89,841	$0	$963,351
Avg. long-term capital gains	$52,219	$144,299	−$122,161	$1,328,536
Avg. bond holdings	$362,300/$96,825	$1,337,424	$94	$16,656,862
Avg. stockholdings	$663,798/$70,373	$2,211,010	$0	$26,640,167
Taking old age exemption (%)	15.0			
Taking mortgage interest or property tax deduction (%)	81.4			
Panel B: Both Stocks and Bonds (11,950 households)				
Avg. AGI	$42,099/$33,088	$61,032	$251	$2,904,997
Std. dev. AGI	$12,370	$53,791	$30	$4,199,602
Avg. AGI growth	0.018	0.27	−3.6	4.8
Std. dev. AGI growth	0.31	0.37	0.0	6.3
Avg. wage income	$30,325	$38,230	$0	$1,609,151
C.V. wage income	0.47/0.19	0.55	0.0	3.2
Avg. interest income	$4,173	$12,098	$0.2	$621,534
Avg. dividend income	$2,302	$13,306	$0.1	$670,015
Avg. long-term capital gains	$2,900	$27,130	−$131,937	$1,372,832
Avg. bond holdings	$42,975/$10,479	$143,570	$2.0	$8,343,636
Avg. stockholdings	$48,230/$4,262	$299,830	$1.6	$18,224,229
Taking old age exemption (%)	12.4			
Taking mortgage interest or property tax deduction (%)	52.9			
Panel C: Bonds Only (20,081 households)				
Avg. AGI	$23,969/$20,274	$17,253	$326	$324,610
Std. dev. AGI	$5,828	$6,335	$18	$227,923
Avg. AGI growth	0.044	0.34	−3.3	4.7
Std. dev. AGI growth	0.35	0.43	0.0	6.1
Avg. wage income	$21,078	$17,565	$0	$312,961

Table AII—*Continued*

	Mean/Median	Std. Dev.	Min.	Max.
Panel C: Bonds Only (20,081 households) *(Continued)*				
C.V. wage income	0.41/0.24	0.43	0.0	3.16
Avg. interest income	\$1,247	\$3,413	\$0.1	\$90,386
Avg. bond holdings	\$12,375/\$1,316	\$34,257	\$1.1	\$765,139
Taking old age exemption (%)	6.0			
Taking mortgage interest or property tax deduction (%)	37.1			
Panel D: Stocks Only (258 households)				
Avg. AGI	\$22,739/\$18,509	\$15,525	\$1,281	\$89,095
Std. dev. AGI	\$4,930	\$5,651	\$95	\$65,025
Avg. AGI growth	0.059	0.29	−0.89	1.42
Std. dev. AGI growth	0.36	0.52	0.0	5.9
Avg. wage income	\$21,268	\$15,572	\$0	\$73,255
C.V. wage income	0.33/0.20	0.34	0.0	1.73
Avg. dividend income	\$774	\$5,328	\$0	\$76,307
Avg. long-term capital gains	\$337	\$2,609	−\$1100	\$32,550
Avg. stockholdings	\$14,928/\$586	\$100,426	\$2.0	\$1,440,689
Taking old age exemption (%)	1.1			
Taking mortgage interest or property tax deduction (%)	31.4			
Panel E: Neither Stocks nor Bonds (12,318 households)				
Avg. AGI	\$14,732/\$11,825	\$10,776	\$252	\$91,922
Std. dev. AGI	\$3,890	\$3,319	\$13	\$48,066
Avg. AGI growth	0.07	0.42	−2.9	4.6
Std. dev. AGI growth	0.46	0.52	0.0	5.7
Avg. wage income	\$14,426	\$10,867	\$0	\$81,449
C.V. wage income	0.38/0.31	0.31	0.0	3.2
Taking old age exemption (%)	0.6			
Taking mortgage interest or property tax deduction (%)	12.4			

For the variances and covariances that are the focus of the Tax Model regressions, however, we do need to assume that the imputed *changes* in household stock and bond holdings over time are not systematically different from actual changes in stock and bond holdings, and that the implied *relative* asset holdings across households with different characteristics are not systematically biased. Under this assumption, the imputed asset holdings should be reasonable proxies to explore issues such as how portfolio weights vary with the level and volatility of wage income, proprietary income, and with demographic characteristics.

B. Summary Statistics from the Tax Model

As a check on the asset imputations, it is useful to summarize the characteristics of the various population subgroups identified in the Tax Model data (see Table AII). The sample is divided into five partially overlapping subgroups: those with adjusted gross income (AGI) in some year in excess of $200,000, those with nonzero dividend and interest income in at least one year ("both"), those with nonzero dividend income in at least one year but no interest income ("stocks only"), those with nonzero interest income in at least one year and no dividend income ("bonds only"), and those with neither dividend nor interest income in any year ("neither").

Summary statistics for each subgroup are reported using the largest sample considered in the Tax Model, which includes all taxpayers with at least three years of data and a minimum of $100 of AGI in each of these years. As in previous studies (e.g., Mankiw and Zeldes (1991)), only a minority of the sample population (27 percent) appears to hold any common stock.[22] By far the smallest group are those who hold stocks but no bonds (0.5 percent), and in the analysis reported in Section I.C this subgroup is excluded. Notice that even within subgroups the distribution of asset holdings is very skewed, with median stock and bond holdings much lower than mean holdings.

Consistent with the analysis based on the SCF reported in Section I.A, the group comprised of stock and bond holders is older (OLD = 12.4 percent), richer (AGI = $42,099 and average WAGES = $30,325), and more likely to have a mortgage (78.4 percent) than the other groups. At the other extreme, households with no income from either stocks or bonds are unlikely to be age 65 and over (OLD = 0.6 percent),[23] have a lower income that derives primarily from wages (average AGI = $14,732 and average WAGES = $14,426), and are much less likely to have a mortgage (12.4 percent). In the middle is the large "bonds only" group, with average AGI of $23,969 and average wages of $21,078, six percent classified as old, and 37 percent with a mortgage. Apart from a high average AGI of $254,994, the rich (who are generally a subset of the "both" group) are distinguished by their significantly higher variability of wage and total income, and by the fact that almost 50 percent of their income is from nonwage sources. Notice that this group has a large amount of Schedule C and Schedule E income, which is approximated by taking AGI − WAGES − INT − DIV. Subsamples including only relatively wealthy filers are of particular interest in this analysis, since for the other groups liquid asset holdings are a relatively small fraction of income and wealth.

[22] A small group (133 households) report some capital gains but no dividend income over the sample period. Although this group may hold stocks, we exclude them from the stockholding group since their holdings cannot be imputed from dividend information.

[23] Older people who might actually fall into this group may be missing due to the fact that they have no taxable income.

C. Construction of Variables

The construction of the number of age exemptions, adjusted gross income, dividend income, interest income, wage income, mortgage interest paid, and the marginal tax rate was conducted following the suggestions in "Tax Model Files: Summary Documentation for 1979–1989" prepared by the National Bureau of Economic Research. To create the growth rate of total income, wage income, or proprietary income in year t, we required positive income in years t and $t - 1$. For any year for which this requirement was not met for a household, that year's observation was not included.

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