Why Do Household Portfolio Shares Rise in Wealth?*

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Abstract

In the cross-section of U.S. households, the portfolio share in risky assets rises in wealth. The standard life-cycle model with homothetic utility and non-tradable labor income has the counterfactual implication that the portfolio share in risky assets declines in wealth. We develop a life-cycle model in which household utility is a nonhomothetic function of two types of consumption goods, basic and luxury. The nonhomothetic model predicts that the expenditure share for basic goods declines in total consumption and the variance of consumption growth rises in the level of consumption. When calibrated to match household facts on the basic expenditure share, this model explains both consumption volatility and portfolio shares that rise in wealth.

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1 Introduction

Surveys of household finances reveal a striking fact: the share of household wealth in risky assets rises in wealth. While poorer households are less likely to participate in the stock market, this fact alone does not account for the positive relation between wealth and the share of financial wealth invested in stocks (hereafter, the *portfolio share*). The portfolio share rises in wealth even among stockholding households. While more educated households tend to have higher portfolio shares, the portfolio share rises in wealth even among stockholding households with the same education.

The standard life-cycle model in which the household has power utility and non-tradable labor income predicts that the portfolio share declines in financial wealth (Bodie, Merton, and Samuelson 1992). This prediction follows from the fact that the present value of future labor income acts as a non-tradable "bond" in the household's portfolio. At any given level of human capital, optimal portfolio allocation requires that the household initially allocate all of its financial wealth to stocks, and allocate part of its financial wealth to bonds only at higher levels of wealth.

This paper examines the role that nonhomothetic utility plays in explaining the observed relation between wealth and portfolio choice. We develop a life-cycle model in which the household consumes two types of nondurable goods. The utility function has higher curvature over a "basic" good than it does for a "luxury" good. We calibrate and solve the model with a labor-income process that is standard in the life-cycle literature (Carroll and Samwick 1997, Gourinchas and Parker 2002). We then simulate an economy of ex ante identical households who are subject to idiosyncratic income shocks. The model has three testable predictions for the cross-section of household consumption and portfolio choice.

The first prediction is that the expenditure share falls in total consumption for some goods and rises for others. Using household consumption data from the Consumer Expenditure Survey (CEX), we identify basic goods as those goods whose expenditure shares fall in total consumption. We find a significant relation between the basic expenditure share and total consumption in the cross-section of households. In the nonhomothetic model, households with higher permanent income allocate a lower share of their total consumption to the basic good. Our empirical findings therefore imply significant differences in the utility curvature between the two types of goods. We use the estimated basic expenditure share to guide our calibration of the life-cycle model.

The second prediction is that the variance of consumption growth rises in the level of consumption. In the nonhomothetic model, households with higher permanent income are less risk averse, and consequently their consumption responds more to wealth shocks. Using the CEX, we confirm that the variance of consumption growth rises in the level of consumption, even among stockholding households.

The third prediction is that the portfolio share rises in financial wealth. Households with higher permanent income are less risk averse and consequently allocate a higher fraction of their wealth to stocks. As in the power-utility model, the nonhomothetic model also implies that the optimal portfolio share declines in wealth, holding constant the level of permanent income. However, such transitory variation in wealth is a less important determinant of portfolio choice than the cross-sectional variation in permanent income, leading to a positive relation between wealth and the portfolio share. We confirm this prediction with household portfolio data from the Survey of Consumer Finances (SCF).[1]

We build on an active literature that studies the consumption and portfolio implications of realistic labor-income processes. One branch of this literature focuses on life-cycle patterns in portfolio choice.[2] Another branch focuses on the potential role of fixed costs to explain non-participation in the stock market. In particular, Cocco (2005), Hu (2005), and Yao and Zhang (2005) find that housing crowds out stocks in the household's portfolio and can explain non-participation in the presence of fixed costs. Gomes and Michaelides (2005) find

[1] The fact that the portfolio share in risky assets rises in wealth has been documented in various household surveys. Early evidence can be found in the 1962 and 1963 Surveys of the Financial Characteristics of Consumers and Changes in Family Finances (Blume and Friend 1975, Friend and Blume 1975). Guiso, Haliassos, and Jappelli (2002, Table I.7) contains a summary of the international evidence for five countries.

[2] See Bertaut and Haliassos (1997), Cocco, Gomes, and Maenhout (2005), Davis and Willen (2002), Gakidis (1998), Heaton and Lucas (1997), and Viceira (2001).

that low risk aversion, paired with a low elasticity of intertemporal substitution, leads to a low savings motive and can explain non-participation in the presence of fixed costs. In contrast, we focus on a puzzle that has received relatively little attention: the fact that the portfolio share rises in wealth, conditional on participation.

Our work is also related to that of Carroll (2000, 2002), who proposes nonhomothetic utility in which wealth at the end of life is a luxury good. Carroll's model has the potential to explain the high savings rate and the portfolio behavior of the very wealthy (i.e., the top first percentile of the wealth distribution).[3] Nonhomothetic utility also plays an important role in the work of Aït-Sahalia, Parker, and Yogo (2004), who develop a representative household model with utility over two goods. They find that the consumption of luxury goods, constructed from data on the sales of luxury retailers, is consistent with the high historical equity premium. Unlike these previous studies, this paper calibrates and solves a life-cycle model to generate quantitatively testable implications for the cross-sectional distribution of consumption and portfolio choice. In addition, while these previous studies have focused on households at the very peak of the wealth distribution, our work aims to explain consumption and portfolio choice for the cross-sectional distribution of stockholding households.

The remainder of the paper proceeds as follows. Section 2 documents relevant facts about household consumption, and Section 3 documents relevant facts about household portfolio choice. Section 4 develops a life-cycle model with nonhomothetic utility and describes the preference and income parameters used in the calibration. Section 5 solves the model and describes the policy functions for consumption and portfolio choice. Section 6 compares the consumption and portfolio behavior of simulated households to that of actual households in household data. Section 7 concludes. The appendices contain further details on the household data and the numerical methods used in solving the life-cycle model.

[3] In related work, Roussanov (2006) develops a model in which the household's social status is effectively a luxury good, which explains why wealthier households own portfolios with undiversified private equity.

2 Facts about Household Consumption

In this section, we document relevant facts about the consumption behavior of U.S. households. Data on household consumption are from the CEX; a detailed description of the data is given in Appendix A. Our unit of analysis is annual consumption so that each household accounts for one observation in the dataset. We focus on the consumption of nondurable goods and services for the following major categories of expenditure.

- Nondurable goods: Food at home; food away from home; clothing and shoes; fuel oil, coal, and gasoline; and other nondurable goods.[4]

- Services: Household operation; transportation; personal care; personal business; and recreation.

Whenever we compare the level of consumption across households, we control for household characteristics, using a procedure similar to that in Carroll and Samwick (1997) and Gourinchas and Parker (2002). We regress log consumption on a set of dummy variables for marital status, household size, and birth cohort. For each household, we use the estimated coefficients to impute the equivalent consumption for a household that is married, that has four members, and whose head is born in the 1945–1949 cohort.[5]

We document household consumption behavior by age and total consumption. We first sort households into age groups of ten years, according to the age of the household head. Within each age group, we then sort households into quartiles by their total consumption. We sort households by consumption, rather than financial wealth, because consumption data are more complete and reliable than financial data in the CEX. However, we have verified that our main findings are robust to sorting households by financial wealth. For each age group, we create an additional bin for households whose consumption is in the top fifth

[4]Other nondurable goods includes semidurable house furnishings; cleaning and polishing preparations; and nondurable toys and sport supplies.

[5]This approach implicitly assumes that there is a cohort but no time effect. We have repeated the analysis assuming that there is a time but no cohort effect and found very similar results.

percentile, in order to separately analyze the behavior of the wealthy. Panel A of Table 1 reports the median consumption within each bin. The last row of the panel reports results for all households in that age group.

2.1 Basic versus Luxury Consumption

We first document facts about expenditure shares by age and total consumption. Table 2 reports the median expenditure share for all the components of nondurable consumption. The bins in the table are defined according to age group and total-consumption quartile, reported in Panel A of Table 1. As shown in Panel A, food at home as a share of total consumption declines in total consumption within each age group. For the 36–45 age group, food at home is 31.2% of total consumption for the lowest consumption quartile and 17.3% for the highest quartile. For the 56–65 age group, food at home is 31.3% of total consumption for the lowest consumption quartile and 16.8% for the highest quartile.

In contrast, as shown in Panel B, food away from home as a share of total consumption rises in total consumption within each age group. For the 36–45 age group, food away from home is 4.5% of total consumption for the lowest consumption quartile and 9.7% for the highest quartile. For the 56–65 age group, food away from home is 2.8% of total consumption for the lowest consumption quartile and 9.7% for the highest quartile. The fact that the expenditure share rises in total consumption is consistent with introspection, which suggests that dining out frequently is a luxury that mainly wealthier households can afford.

As shown in Panel C, clothing and shoes as a share of total consumption rises in total consumption within each age group. As shown in Panel D, fuel oil, coal, and gasoline as a share of total consumption falls in total consumption within each age group. As shown in Panel E, other nondurable goods as a share of total consumption rises in total consumption within each age group, with the exception of the highest consumption quartile.

Table 3 reports the median expenditure share for all the components of service consumption. The bins in the table are defined according to age group and total-consumption quartile, reported in Panel A of Table 1. As shown in Panel A, household operation as a share of total consumption falls in total consumption within each age group. As shown in Panel B, transportation as a share of total consumption rises in total consumption within each age group. As shown in Panel C, personal care as a share of total consumption rises in total consumption within each age group. As shown in Panel D, personal business (e.g., accounting, banking, and tax services) as a share of total consumption rises in total consumption within each age group. As shown in Panel E, recreation as a share of total consumption rises in total consumption within each age group.

Tables 2 and 3 map out the household Engel curves, that is, the variation in expenditure shares as a function of total consumption. Our working definition of basic goods is those nondurable goods and services whose expenditure shares fall in total consumption. Luxury goods are those nondurable goods and services whose expenditure shares rise in total consumption. Based on these definitions, we construct basic and luxury consumption as the sum of the following categories of expenditure.

- Basic consumption: Food at home; fuel oil, coal, and gasoline; and household operation.
- Luxury consumption: Food away from home; clothing and shoes; other nondurable goods; transportation; personal care; personal business; and recreation.

Panel B of Table 1 reports basic consumption as a share of total consumption. For the 36–45 age group, basic consumption is 64.0% of total consumption for the lowest consumption quartile and 42.1% for the highest quartile. The basic expenditure share is 35.4% for households in the top fifth percentile of total consumption. For the 56–65 age group, basic consumption is 68.1% of total consumption for the lowest consumption quartile and 41.7% for the highest quartile. The basic expenditure share is 31.1% for households in the top fifth percentile of total consumption.

2.2 Consumption Volatility

We now document facts about consumption volatility by age and total consumption. Estimation of the variance of consumption growth is complicated by the fact that household consumption data are subject to considerable measurement error. Because measurement error is (by definition) transitory, we cannot identify the variance of the transitory component of consumption. However, we can identify the variance of the permanent component of consumption, following an identification strategy similar to that used by Carroll and Samwick (1997) to identify the variance of the permanent component of income.

Each household in the CEX is interviewed for four consecutive quarters. Let $C_1, \ldots, C_4$ denote quarterly consumption in interviews one through four. For each household, we compute a statistic that we refer to as consumption volatility,

$$\widehat{\sigma}_C^2 = \frac{1}{2}\left[\left(\log\frac{C_3}{C_1}\right)^2 + \left(\log\frac{C_4}{C_2}\right)^2\right] - \frac{1}{3}\left[\left(\log\frac{C_2}{C_1}\right)^2 + \left(\log\frac{C_3}{C_2}\right)^2 + \left(\log\frac{C_4}{C_3}\right)^2\right]. \tag{1}$$

Suppose log consumption can be decomposed into permanent and transitory components as

$$\log\frac{C_{t+T}}{C_t} = \sum_{s=1}^{T} \eta_{t+s} + \epsilon_{t+T} - \epsilon_t, \tag{2}$$

where (η_t, ϵ_t) are independently and identically distributed (i.i.d.) mean-zero shocks. Then the variance of the permanent component of log consumption can be identified through the moment condition

$$\mathbf{E}[\widehat{\sigma}_C^2] = \sigma_\eta^2, \tag{3}$$

where the expectation is taken over the cross-section of households.

Panel C of Table 1 reports the square root of the median of consumption volatility within each bin, defined according to age group and total-consumption quartile.[6] Consumption

[6] We report the median, rather than the mean, because it is less sensitive to measurement error.

volatility rises in total consumption within each age group, as documented by Yogo (2006). For the 36–45 age group, consumption volatility is 9.2% for the lowest consumption quartile and 10.2% for the highest quartile. Consumption volatility is 15.8% for households in the top fifth percentile of total consumption. For the 56–65 age group, consumption volatility is 10.2% for the lowest consumption quartile and 11.4% for the highest quartile. Consumption volatility is 15.8% for households in the top fifth percentile of total consumption.

As documented by Mankiw and Zeldes (1991), households that own stock have consumption that is more volatile than those that do not. To the extent that stockholding is positively related to wealth, a relevant question is whether the relation in Panel C is explained, at least partly, by stockholding. As shown in Table 9, however, consumption volatility rises in total consumption even within the sub-sample of stockholding households. In fact, the relation is even stronger for stockholding households.

3 Facts about Household Portfolios

In this section, we document relevant facts about the portfolio behavior of U.S. households. Data on household portfolios are from the SCF; a detailed description of the data is given in Appendix B. The SCF is a repeated cross-section of households every three years, available in the current format for the period 1989–2004. The main results that we report here are for the 2001 SCF. However, we find very similar results for the other years of the survey, which we report in Wachter and Yogo (2007).

Our working definition of the portfolio share is the share of financial wealth invested in stocks. A broader definition is the share of net worth invested in risky assets, which includes corporate, foreign, and mortgage-backed bonds; business equity; and investment real estate (see Bertaut and Starr-McCluer (2002, Table 5.7)). We find very similar results for this alternative definition of the portfolio share, which we report in Wachter and Yogo (2007).

We document household portfolio behavior by age and financial wealth. As emphasized by Ameriks and Zeldes (2004), the fact that age, time, and cohort effects are not separately identified complicates the interpretation of household portfolio behavior. We focus on the 2001 SCF and control for age. A standard practice in the literature is to interpret age patterns in household portfolios by assuming that that there is no cohort effect (e.g., Bertaut and Starr-McCluer (2002) and Campbell (2006)). Instead, we remain agnostic about the presence of a cohort effect and abstain from interpreting age patterns. The focus of our analysis will be the relation between financial wealth and the portfolio share, controlling for age.

3.1 Portfolio Share by Wealth

We first sort households into age groups of ten years, according to the age of the household head. Within each age group, we then sort households into quartiles by their financial wealth. For each age group, we create an additional bin for households whose financial wealth is in the top fifth percentile, in order to separately analyze the behavior of the wealthy. Panel A of Table 4 reports the median financial wealth within each bin. The last row of the panel reports results for all households in that age group.

Panel B reports the percentage of households that hold stocks within each age group and wealth quartile. The average participation rate is well below 100%, as documented by Haliassos and Bertaut (1995) and Mankiw and Zeldes (1991). For each age group, the participation rate rises rapidly in financial wealth. For the middle three age groups, the participation rate is above 90% in the highest wealth quartile. In contrast, for all age groups, the participation rate is below 10% in the lowest wealth quartile.

Panel C reports the median portfolio share in stocks within each age group and wealth quartile. Given the low participation rates reported in Panel B, it is unsurprising that the median portfolio share is quite low for households in the lower wealth quartiles. Like participation, the median portfolio share also rises rapidly in financial wealth, with values ranging from 45% to 60% in the top wealth quartile.[7]

[7] This relation between wealth and portfolio share and the refinements that follow can be reconciled with

Table 4 reveals an age profile in portfolio choice that is consistent with that reported by Ameriks and Zeldes (2004). In Panel B, the participation rate first rises and then falls in age. This hump-shaped pattern is also evident within each of the wealth quartiles. As shown in Panel C, the portfolio share for all households also inherits the hump-shaped pattern in age.

3.2 Portfolio Share for Stockholders

In Table 5, we restrict the sample to only those households that own stock. We again sort households by age, and then into quartiles of financial wealth within each age group. Panel A reports the median financial wealth within each age group and wealth quartile. The level of financial wealth in each bin is higher than those in Panel A of Table 4 because stockholders tend to be wealthier than nonstockholders.

Panel B of Table 5 reports the median portfolio share for stockholders. This panel shows that the relation between financial wealth and the portfolio share is not due to participation alone. For the 36–45 age group, the portfolio share is 43% for the lowest wealth quartile and 68% for the highest quartile. The portfolio share is 69% for households in the top fifth percentile of financial wealth. For the 56–65 age group, the portfolio share is 45% for the lowest wealth quartile and 54% for the highest quartile. The portfolio share is 55% for households in the top fifth percentile of financial wealth.[8]

3.3 Portfolio Share by Education and Wealth

More educated households tend to be wealthier, and more educated investors tend to have a higher share of their financial assets invested risky assets (see Campbell (2006)). Therefore,

recent findings by Brunnermeier and Nagel (2005). Household portfolios may respond to changes in wealth at lower life-cycle frequencies but not at higher frequencies, perhaps due to various transaction costs.

[8]Among older, wealthier households, the median portfolio share falls off slightly from the third to the fourth wealth quartile. This pattern can be explained by the increased ownership in private equity among this group, which crowds out the demand for other risky assets (Heaton and Lucas 2000). See Wachter and Yogo (2007) for tabulations of the risky-asset share, which includes private equity.

the relation between financial wealth and the portfolio share may be explained, at least partly, by education. To address this issue, Table 6 repeats the analysis in Table 5 separately by education group. The three education groups are households whose head is a high school graduate, whose head has some college education, or whose head is a college graduate. For each education group, we again sort households by age, and then into quartiles of financial wealth within each age group. Even controlling for eduction, the portfolio share rises in financial wealth, and the effect is generally as strong as that found in Table 5.

Our tabulations allow the portfolio share to depend on age, wealth, stockholding, and education in potentially nonlinear ways. We have shown that the positive relation between financial wealth and the portfolio share is robust to these covariates. However, many factors other than age and education can influence household portfolio choice. Proper control for a large number of factors is most easily implemented through a regression model. Estimates of such models indicate that the portfolio share rises in wealth, even in the presence of an extensive set of controls (see Bertaut and Starr-McCluer (2002) and Calvet, Campbell, and Sodini (2006)).

4 A Life-Cycle Model of Consumption and Portfolio Choice

4.1 Nonhomothetic Utility

We assume that the household consumes two types of nondurable goods, denoted by B and L (for reasons that will be clear in what follows). For simplicity, we assume that the relative price between the two goods is constant and normalize it to be one. The household's utility is specified as a nonhomothetic function over the two goods,

$$U(B, L) = \frac{V(B, L)^{1-\gamma}}{1-\gamma}, \tag{4}$$

where $\gamma > 1$ and

$$V(B, L) = \left(B^{1-\lambda} + \frac{\alpha(1-\lambda)}{1-\phi} L^{1-\phi} \right)^{1/(1-\lambda)}. \tag{5}$$

The parameter $\alpha \geq 0$ is the utility weight on L. The curvature parameters satisfy the restriction $\lambda \geq \phi > 1$. This utility specification can be generalized to a model with multiple goods and multiple corresponding curvatures. The two-good model can be thought of as a simplification of such a model that captures the main economic effects.

The household's intratemporal allocations are determined entirely by the properties of period utility, $V(B, L)$. The elasticity of substitution between the two goods is

$$\frac{d \log(B/L)}{d \log(V_L/V_B)} = \frac{B^{-1} + L^{-1}}{B^{-1}\lambda + L^{-1}\phi}. \tag{6}$$

Optimal consumption between the two goods requires that

$$B^{-\lambda} = \alpha L^{-\phi}. \tag{7}$$

Let $C = B + L$ denote total consumption. The first-order condition implies the expenditure shares

$$\frac{B}{C} = \frac{1}{1 + \alpha^{1/\phi} B^{\lambda/\phi - 1}}, \tag{8}$$

$$\frac{L}{C} = \frac{1}{1 + \alpha^{-1/\lambda} L^{\phi/\lambda - 1}}. \tag{9}$$

The level of expenditure for both B and L rises in total consumption. However, the expenditure share for B falls, and the expenditure share for L rises in total consumption. We therefore refer to B as the basic good and L as the luxury good.

An important implication of nonhomothetic utility is decreasing relative risk aversion (Stiglitz 1969). Through Hanoch (1977, Theorem 1), we can calculate the household's relative risk aversion as

$$\begin{aligned}
\text{RRA} &= -\frac{(BU_B + LU_L)(U_{BB}U_{LL} - U_{BL}^2)}{U_B^2 U_{LL} - 2U_B U_L U_{BL} + U_L^2 U_{BB}} \\
&= \left(\frac{1}{\lambda}\frac{B}{C} + \frac{1}{\phi}\frac{L}{C}\right)^{-1} \left(B + \frac{1-\lambda}{1-\phi}L\right)^{-1} \left(\frac{\gamma}{\lambda}B + \frac{\xi(1-\lambda)}{\phi(1-\phi)}L\right), \qquad (10)
\end{aligned}$$

where

$$\xi = \frac{\gamma(1-\phi) + \phi - \lambda}{1-\lambda} < \gamma. \qquad (11)$$

When the household is poor, it consumes mostly basics, and its relative risk aversion is close to γ. As the household becomes wealthier, it consumes more luxuries, and its relative risk aversion falls toward ξ.

When $\lambda = \phi$, the household's period utility collapses to a homothetic utility function,

$$V(B, L) = (B^{1-\lambda} + \alpha L^{1-\lambda})^{1/(1-\lambda)}. \qquad (12)$$

The elasticity of substitution between the two goods is constant at $1/\lambda$. Under the maintained assumption that the relative price is constant, the expenditure shares for both goods are constant. Finally, the relative risk aversion is constant at γ. To highlight the distinct implications of the nonhomothetic model, we also calibrate and solve the homothetic model.

4.2 Life-Cycle Problem

We solve a life-cycle consumption and portfolio-choice problem for a household with nonhomothetic utility (4). The household starts adult life with initial financial wealth W_1. The household enters each period $t = 1, \ldots, T$ with cash-on-hand W_t, which is composed of financial assets and labor income Y_t. The household's total consumption is C_t, which is optimally allocated between basics B_t and luxuries L_t. Financial wealth remaining after consumption,

$S_t = W_t - C_t$, is saved either in bonds or stocks. Bonds have a constant gross rate of return R_f, and stocks have a stochastic gross rate of return R_{et}. The household is subject to a borrowing constraint, so that $S_t \geq 0$. Following a standard assumption in the life-cycle literature, the household is subject to a short-sales constraint, so that the portfolio share in stocks must satisfy $a_t \in [0, 1]$.

Let $\beta \in (0, 1)$ denote the household's subjective discount factor. The household's problem is to choose consumption and the portfolio share in each period to maximize the expected discounted sum of future utility flow,

$$\mathbf{E}_1 \sum_{t=1}^{T} \beta^{t-1} U(B_t, L_t). \tag{13}$$

The household is subject to the intertemporal budget constraint

$$W_{t+1} = R_{t+1}(W_t - B_t - L_t) + Y_{t+1}, \tag{14}$$

$$R_{t+1} = R_f + a_t(R_{e,t+1} - R_f), \tag{15}$$

for $t = 1, \ldots, T - 1$.

4.3 Calibration of the Model

Following Carroll (1997), we calibrate the model to a 50-year life cycle. The household works and earns labor income from ages 26 through 65 (i.e., $t = 1, \ldots, 40$). The household is retired and earns retirement income from ages 66 through 75 (i.e., $t = 41, \ldots, 50$). Table 7 summarizes the parameters in the benchmark calibration, which we now discuss in more detail.

4.3.1 Preferences

For the homothetic model, we set the discount factor to $\beta = 0.96$, which is standard in the literature (e.g., Cocco, Gomes, and Maenhout (2005) and Gomes and Michaelides (2005)). We then set $\gamma = 5$ to match the median portfolio share for the 46–55 age group, which is 49%.

For the nonhomothetic model, we also set the discount factor to $\beta = 0.96$. We then set $\lambda = 1.8$ and $\phi = 1.1$, which determine the elasticity of substitution between the two goods (see equation (6)). These parameter values are chosen to match the spread in the basic expenditure share for the 46–55 age group, which is 55% for the lowest quartile and 35% for the highest quartile. We then set $\alpha = 2$ to match the median basic expenditure share for the 46–55 age group, which is 45%. Finally, we set $\gamma = 21$ to match the median portfolio share in the 46–55 age group, which is 49%.

4.3.2 Labor Income

Following Carroll (1997) and Zeldes (1989), we model the household's stochastic labor income as

$$Y_t = P_t \epsilon_t, \tag{16}$$

$$P_{t+1} = G_{t+1} P_t \eta_{t+1}, \tag{17}$$

given an initial level P_0. The variable P_t denotes "permanent income" in period t, defined as the labor income that would be earned in the absence of transitory shocks (i.e., $\epsilon_t = 1$). Permanent income has a deterministic component that grows at the rate G_t each period. During the household's working life (through age 65), permanent income is subject to an i.i.d. shock

$$\log \eta_t \sim \mathbf{N}(-\sigma_\eta^2/2, \sigma_\eta^2), \tag{18}$$

where $\mathbf{N}$ denotes the normal distribution. The permanent shock has mean $\mathbf{E}[\eta_t] = 1$.

During the working life, labor income is also subject to an i.i.d. transitory shock

$$\epsilon_t = \begin{cases} 0 & \text{with probability } p \\ \widetilde{\epsilon}_t & \text{with probability } 1-p \end{cases}, \tag{19}$$

$$\log \widetilde{\epsilon}_t \sim \mathbf{N}(\mu_\epsilon, \sigma_\epsilon^2). \tag{20}$$

Unemployment occurs with probability p. The parameter μ_ϵ is chosen so that the transitory shock has mean $\mathbf{E}[\epsilon_t] = 1$. In our benchmark case, we set the probability of unemployment to zero so that $\mu_\epsilon = -\sigma_\epsilon^2/2$ (as in the benchmark calibrations of Cocco, Gomes, and Maenhout (2005) and Gomes and Michaelides (2005)). We also consider a case that allows for a positive probability of unemployment. During retirement, the household receives deterministic income that grows at the rate G_t.

We calibrate the labor-income process using standard parameters in the life-cycle consumption literature (Carroll and Samwick 1997, Gourinchas and Parker 2002). The variance of the income shocks are set to $\sigma_\eta^2 = 2.12\%$ and $\sigma_\epsilon^2 = 4.40\%$. In the calibration with unemployment, the probability of unemployment in any given year is set to 0.5% (Carroll 1992).

In order to calibrate the deterministic component of income, we follow Gourinchas and Parker (2002) and estimate average life-cycle income using CEX data on disposable income. We regress log disposable income on a third degree polynomial in age, which is interacted with a dummy variable for whether or not the household is retired. The regression also includes dummy variables for marital status, household size, and birth cohort. We use the estimated coefficients to build the life-cycle income profile for a "typical" household that works from ages 26 through 65 and is retired from ages 66 through 75. (At retirement, labor income is estimated to fall by 23.5% relative to the previous period.) We calibrate the growth rate to that of a household that is married, that has four members, and whose head is born in the 1945–1949 cohort. Further details are contained in Wachter and Yogo (2007).

4.3.3 Asset Returns

We calibrate asset returns using a standard specification in the life-cycle portfolio-choice literature (e.g., Gomes and Michaelides (2005)). The bond return is set to 2% per year, and the equity premium is set to 4% per year. Stock returns are distributed as

$$R_{et} = \overline{R}_e \nu_t, \tag{21}$$

$$\log \nu_t \sim \mathbf{N}(-\sigma_\nu^2/2, \sigma_\nu^2). \tag{22}$$

The shock to stock returns has mean $\mathbf{E}[\nu_t] = 1$ and standard deviation $\sigma_\nu = 18\%$. We set the correlation between the shocks to stock returns and permanent income to $\rho = \mathbf{E}[(\log \nu_t)(\log \eta_t)]/(\sigma_\nu \sigma_\eta) = 15\%$ as estimated in the prior literature (see Campbell, Cocco, Gomes, and Maenhout (2001) and Gomes and Michaelides (2005)).

4.4 Discussion of the Model

In modeling household consumption and portfolio choice, we have made several simplifying assumptions. The assumptions allow us to focus on the portfolio implications of the non-homothetic model in the simplest setting. We now discuss these assumptions briefly and provide some intuition for how modifications of these assumptions are likely to affect our results.

We assume that the relative price of luxury goods is constant. A time trend in the relative price of goods can induce a time trend in the relative expenditure shares of those goods. Instead of introducing a time trend in the relative price through the model, we take out a potential time effect in the data. Our tabulations of the basic expenditure share are conditional on age and cohort, so that we have effectively controlled for a time effect. Even in the absence of a time trend, the relative price could affect portfolio choice if shocks to the relative price are correlated with stock returns. Indeed, Aït-Sahalia, Parker, and Yogo (2004) find that growth rate of the price of luxury goods is highly positively correlated with stock returns. In the presence of such correlation, a wealthy household, who has a higher expenditure share for luxury goods, has an incentive to holds stocks to partially hedge the price risk of luxury goods. Therefore, such correlation can magnify the positive relation between wealth and the portfolio share, making it easier for the nonhomothetic model to explain the data.

We assume an identical income process for all households. In order for income heterogeneity to explain the empirical patterns in consumption volatility (Table 1) under homothetic utility, it would be necessary for the volatility of labor income to be higher for wealthier households. However, more volatile labor income would lead to lower portfolio shares for wealthier households, making the evidence in Table 5 more difficult to explain. Moreover, Carroll and Samwick (1997, Table 1) report the variance of permanent income shocks by education: 2.1% for some high school, 2.8% for high school graduates, 2.4% for some college, 1.5% for college graduates, and 1.2% for graduate school. Insofar as education proxies for permanent income, the variance of permanent income shocks appears to *fall* in the level of permanent income. To verify that income heterogeneity is not driving our results, we calibrate the model separately by education group and report the results in Wachter and Yogo (2007).

We assume a constant investment opportunity set, that is, expected stock returns are constant. A time-varying opportunity set generates life-cycle patterns in stock ownership, but is unlikely to affect the relation between wealth and the portfolio share that is the focus of this paper (see Balduzzi and Lynch (1999), Barberis (2000), Campbell and Viceira (1999), Kim and Omberg (1996), and Wachter (2002)).

5 Solution of the Life-Cycle Model

We solve the life-cycle problem through numerical dynamic programming as described in Appendix C. As shown in the appendix, the household's value function can be written as a function of age (t), normalized cash-on-hand ($w_t = W_t/P_t$), and permanent income (P_t). This section describes the optimal policies for consumption and portfolio choice.

5.1 Optimal Consumption Policy

Figure 1 shows the optimal consumption policy, as a function of normalized cash-on-hand and permanent income, for the household at age 50. The policy variables are basic consumption ($b_t = B_t/P_t$) and luxury consumption ($l_t = L_t/P_t$), both normalized by permanent income. Holding fixed the level of permanent income, the consumption function for both basics and luxuries share the two key features of the standard consumption function in the homothetic model. First, the consumption function is monotonic in cash-on-hand. The higher is current wealth, the higher is the consumption of both basics and luxuries. Second, the consumption function is concave in cash-on-hand. The consumption of both basics and luxuries rises steeply at lower levels of cash-on-hand. The marginal propensity to consume (MPC), or the slope of the consumption function with respect to wealth, then levels off at higher levels of cash-on-hand.

Holding fixed the level of normalized cash-on-hand, b_t falls and l_t rises in permanent income. Wealthier households allocate a higher share of total consumption to the luxury good. This effect is a consequence of the nonlinear Engel curves (see equations (8) and (9)). At a low level of permanent income, basic consumption rises sharply in cash-on-hand, while luxury consumption is relatively flat in cash-on-hand. In other words, the MPC for basic consumption is high, while the MPC for luxury consumption is low. The exact opposite holds at a high level of permanent income. The MPC for luxury consumption rises more rapidly in permanent income than does the MPC for basic consumption. Because the rising MPC of luxury consumption more than compensates for the falling MPC of basic consumption, total consumption is more responsive to cash-on-hand at higher levels of permanent income. This effect translates to a testable implication, that wealthier households should have consumption that is more volatile than poorer households.

5.2 Optimal Portfolio Policy

Figure 1 shows the optimal portfolio policy, as a function of normalized cash-on-hand and permanent income, for the household at age 50. The policy variable is the portfolio share, the percent of financial wealth allocated to stocks. Holding fixed the level of permanent income, the portfolio share falls in cash-on-hand, just as it does in the homothetic model. Because labor income is relatively stable and has a low correlation with stock returns, human capital is nearly a substitute for bonds. The lower is cash-on-hand relative to permanent income, the lower are stock holdings as a share of total (i.e., financial and non-financial) wealth. Therefore, the lower is normalized cash-on-hand, the higher is the optimal allocation to stocks as a share of financial wealth.

At a low level of permanent income, a higher share of total consumption is allocated to basics, and the household resembles a power-utility investor with higher risk aversion γ. At a high level of permanent income, a higher share of total consumption is allocated to luxuries, and the household resembles a power-utility investor with lower risk aversion ξ. Therefore, holding fixed the level of normalized cash-on-hand, the household allocates a higher share of financial wealth to stocks at higher levels of permanent income.

In summary, the model predicts that there are two offsetting effects of wealth on portfolio choice, one that operates through cash-on-hand, and the other that operates through permanent income. In the next section, we simulate the model to understand the interplay between these two effects.

6 Simulation of the Life-Cycle Model

In order to assess the quantitative implications of the model, we simulate a cross-section of 10,000 households at an annual frequency. The households are ex ante identical, have non-homothetic utility, and face non-tradable labor income, with the parameters summarized in Table 7. For each household, we draw an initial level of financial wealth (relative to permanent income) from a lognormal distribution, based on estimates from the CEX (Gourinchas and Parker 2002, Table 2). The mean of W_1/P_1 is set to 0.3, and its log standard deviation is set to 1.784. Similarly, the initial level of permanent income is drawn from a lognormal distribution, based on estimates from the CEX (see Wachter and Yogo (2007)). The mean of P_1 is normalized to one, and its log standard deviation is set to 0.562. In order to highlight the novel implications of the nonhomothetic model, we repeat the same simulation exercise for the homothetic model.

In our benchmark model, it is always optimal for the household to own some equity, regardless of the level of wealth. In reality, however, a significant fraction of the population does not own equity, as documented in Table 4. Explanations for non-participation include fixed costs of participation (Cocco 2005, Gomes and Michaelides 2005, Hu 2005, Yao and Zhang 2005) and investor mistakes (Calvet, Campbell, and Sodini 2006). Because non-participation is outside the scope of our study, we interpret our model as a description of stockholding households (i.e., those that have already paid the fixed cost and are making optimal decisions). In order to assure that the model's moments are comparable to the empirical moments, all of the CEX and SCF tabulations in this section are for the sub-sample of stockholding households. Therefore, the empirical moments differ from those discussed in Sections 2 and 3, which are for all households.

6.1 Implications for Consumption

6.1.1 Basic Expenditure Share

We first look at the implications of our model for consumption data. Panel A of Table 8 reports the basic expenditure share for stockholding households in the CEX, tabulated by age group and consumption quartile. For the 36–45 age group, basic consumption is 56% of total consumption for the lowest consumption quartile and 38% for the highest quartile. The basic expenditure share is 31% for households in the top fifth percentile of total consumption. For the 56–65 age group, basic consumption is 56% of total consumption for the lowest consumption quartile and 36% for the highest quartile. The basic expenditure share is 26% for households in the top fifth percentile of total consumption.

In Panel B, we sort households simulated in the nonhomothetic model by age, and then consumption quartile within each age group. We then tabulate the median of basic expenditure share within each bin and compare the results with the empirical moments in Panel A. Within each age group, the basic expenditure share falls in total consumption, essentially matching the empirical moments. For the 36–45 age group, basic consumption is 57% of total consumption for the lowest consumption quartile and 36% for the highest quartile. The basic expenditure share is 32% for households in the top fifth percentile of total consumption. For the 56–65 age group, basic consumption is 55% of total consumption for the lowest consumption quartile and 32% for the highest quartile. The basic expenditure share is 28% for households in the top fifth percentile of total consumption.

These results can be explained by the shape of the policy functions in Figure 1. As households become wealthier, their consumption of luxuries (i.e., the good with the lower curvature) rises relative to their consumption of basics (i.e., the good with the higher curvature). Therefore, the basic expenditure share falls in wealth in the nonhomothetic model, in contrast to the homothetic model in which the expenditure share is constant.

6.1.2 Consumption Volatility

Panel A of Table 9 reports the consumption volatility for stockholding households in the CEX, tabulated by age group and consumption quartile. As discussed in Section 2, the CEX data show striking differences in consumption volatility between low and high wealth households. Panel A shows that this relation also holds in the sub-sample of stockholding households. For the 36–45 age group, consumption volatility is 7.6% for the lowest consumption quartile and 10.6% for the highest quartile. Consumption volatility is 15.3% for households in the top fifth percentile of total consumption. For the 56–65 age group, consumption volatility is 6.5% for the lowest consumption quartile and 12.4% for the highest quartile. Consumption volatility is 24.8% for households in the top fifth percentile of total consumption.

Because the model is solved and simulated at an annual frequency, it is impossible to compute the direct analog of consumption volatility in the model. We therefore approximate consumption volatility as squared annual consumption growth for each household simulated in the nonhomothetic model. In Panel B, we tabulate the square root of median consumption volatility within each bin with the caveat that the numbers are not directly comparable to the empirical moments in Panel A. Except in the youngest age group, the nonhomothetic model generates consumption volatility that rises in total consumption. For the 36–45 age group, consumption volatility is 7.7% for the lowest consumption quartile and 9.0% for the highest quartile. Consumption volatility is 9.0% for households in the top fifth percentile of total consumption. For the 56–65 age group, consumption volatility is 5.1% for the lowest consumption quartile and 6.8% for the highest quartile. Consumption volatility is 7.5% for households in the top fifth percentile of total consumption.

These results can be explained by the fact that households with higher permanent income have lower risk aversion in the nonhomothetic model. As shown in Figure 1, the MPC for basic consumption falls gradually, while the MPC for luxury consumption rises rapidly in permanent income. Therefore, luxury consumption accounts for much of the rise in consumption volatility as a function of permanent income. Simply put, consumption fluctuations become more tolerable as the household becomes wealthier because luxury consumption is more discretionary than basic consumption.

For the purposes of comparison, Panel C repeats the same exercise for the homothetic model and shows that consumption volatility is roughly constant within an age group, which is at odds with the data.[9] Comparing Panels B and C, there are two features of consumption volatility that are common to both the nonhomothetic and the homothetic model. First,

[9]The fact that consumption volatility is slightly rising in consumption can be explained by the fact that the consumption function is concave in normalized cash-on-hand. Sorting households on consumption is, in effect, sorting households on permanent income. Therefore, households with higher consumption tend to have lower normalized cash-on-hand, so their consumption is more responsive to shocks.

consumption volatility is very high for low consumption households in the 26–35 age group. Younger households have had less time to accumulate wealth and are less able to buffer income shocks. Second, consumption volatility falls in age because younger households, who have accumulated less wealth, have a higher MPC than do older households.

6.2 Implications for Portfolio Choice

Panel A of Table 10 reports the median portfolio share for stockholding households in the SCF, tabulated by age group and wealth quartile. Panel B reports the portfolio share for households simulated in the nonhomothetic model, and Panel C reports the portfolio share in the homothetic model.

In the nonhomothetic model, the portfolio share rises in financial wealth for all age groups, consistent with the evidence in Panel A. For the 36–45 age group, the portfolio share is 54% for the lowest wealth quartile and 71% for the highest quartile. The portfolio share is 72% for households in the top fifth percentile of financial wealth. For the 56–65 age group, the portfolio share is 35% for the lowest wealth quartile and 54% for the highest quartile. The portfolio share is 56% for households in the top fifth percentile of financial wealth. The rise in the portfolio share becomes more pronounced as households age.

In stark contrast, the portfolio share falls in wealth in the homothetic model. This fall in the portfolio share becomes less pronounced as households age because human capital becomes a smaller fraction of the household's portfolio. For older households, the model more closely resembles that of Samuelson (1969), in which all wealth is financial and the optimal portfolio share is constant in wealth.

The key to understanding the findings for the nonhomothetic model lies in the portfolio policy function, shown in Figure 2. The optimal portfolio share falls in normalized cash-on-hand and rises in permanent income. As a result, there are two offsetting effects that determine the relation between financial wealth and the portfolio share in the nonhomothetic model. On the one hand, households with higher financial wealth have higher normalized cash-on-hand, holding constant the level of permanent income. These households have a smaller implicit holding in the bond through labor income, and therefore a greater allocation to bonds in the financial part of their portfolio. This standard effect is also present in the homothetic model. On the other hand, higher financial wealth implies higher permanent income, holding constant the level of normalized cash-on-hand. Higher permanent income leads to lower risk aversion under nonhomothetic utility and consequently a higher allocation of financial assets to stocks. As households age and permanent income shocks accumulate, the cross-sectional dispersion in permanent income rises. This effect explains why the spread in the portfolio shares between high and low wealth households becomes more pronounced from youth to middle age.

6.2.1 Discussion of the Age Profile

In both models, the portfolio share falls in age, which is a standard implication of the life-cycle model (see Cocco, Gomes, and Maenhout (2005)). Households are born with little financial wealth, but a large stake in non-tradable human capital. Because stocks have a high average rate of return and low correlation with labor income, optimal portfolio allocation requires that households initially allocate most of their financial wealth to stocks. As households age, they accumulate financial wealth and decumulate their human capital. Because there is less need to diversify human capital, the portfolio share in stocks falls.

As shown in Panel A, the portfolio share in the SCF appears mostly flat in age. There are several proposed explanations for the discrepancy between the standard implication of the model and the data. First, the true relation between age and the portfolio share is unknown because of the lack of identification between age, time, and cohort effects (Ameriks and Zeldes 2004). Second, the purchase of housing and small fixed costs can crowd out stocks from the household's portfolio early in life (Cocco 2005, Hu 2005, Yao and Zhang 2005). Third, internal habit formation can induce a strong motive to save in the riskfree asset early in life, crowding out stocks from the household's portfolio (Gomes and Michaelides 2003, Polkovnichenko 2007). Finally, different assumptions on the joint process for stock returns and labor income can substantially reduce stockholding for younger households (Benzoni, Collin-Dufresne, and Goldstein 2007, Lynch and Tan 2006, Storesletten, Telmer, and Yaron 2007).

In the nonhomothetic model, the age effect in portfolio choice is partly offset by the fact that households become less risk averse over the life cycle as their permanent income grows. Table 10 shows that the median portfolio share falls from 100% to 47% in the nonhomothetic model, compared to 100% to 39% in the homothetic model. However, decreasing relative risk aversion cannot fully account for the age profile in household portfolios, especially for younger households. Rather than taking a stance on these various explanations for the age profile, we have focused on the relation between wealth and the portfolio share conditional on age. We could simultaneously explain the age profile by incorporating one of these additional ingredients. We leave this issue for future research.

6.3 Portfolio Choice with Unemployment Risk

We now examine how unemployment risk, modeled as a positive probability of zero income, affects portfolio choice. This scenario is of interest because the optimal portfolio share can rise in cash-on-hand at a sufficiently low level of wealth, even under standard power utility (see Cocco, Gomes, and Maenhout (2005)). Distributional assumptions that lead to more dependence between stock returns and labor income can have a similar effect to unemployment risk, that is, the portfolio share can rise in cash-on-hand at a sufficiently low level of wealth (Benzoni, Collin-Dufresne, and Goldstein 2007, Lynch and Tan 2006). However, this effect disappears in age and should be nonexistent for retired households with no labor income. Therefore, it cannot explain the fact that the relation between wealth and the portfolio share persists in age.

The parameters of the model remain the same as those in Table 7, except that labor income can be zero in any period of the working life with probability 0.5%. Because the implications for consumption are nearly identical to those in the benchmark case with no unemployment, we focus on implications for portfolio choice in this section.

Table 11 shows the portfolio share for the nonhomothetic model in Panel B and for the homothetic model in Panel C. The portfolio share by age group and wealth quartile from the SCF are repeated in Panel A for the purposes of comparison to the models. Unemployment risk lowers the allocation to equity for youngest households in the lowest wealth quartile. However, it hardly affects older households who have accumulated enough wealth to buffer these temporary shocks to labor income. Given the preference and income parameters that have realistic implications for household behavior, unemployment risk does not have a large effect on portfolio choice.

7 Conclusion

Evidence from the CEX shows that the expenditure share for various categories of nondurable goods and services vary significantly in total consumption. Moreover, the variance of consumption growth rises in the level of consumption. Evidence from the SCF shows that the portfolio share in stocks rises in wealth, even after controlling for stock market participation and education. All these facts from household data are inconsistent with the standard life-cycle consumption and portfolio choice model with homothetic utility.

In this paper, we propose a parsimonious model that is consistent the evidence on household consumption and portfolio choice. We develop a life-cycle model in which the household has nonhomothetic utility over two types of consumption goods. As the household's wealth grows, it consumes relatively more of the good with lower curvature, and relatively less of the good with higher curvature. The household's relative risk aversion therefore falls in wealth. We calibrate the model using a standard process for labor income and find that the nonhomothetic model can account for most of the observed cross-sectional variation in consumption and portfolio behavior.

More broadly, this paper shows that household portfolios respond to wealth-varying risk aversion. This finding provides microeconomic foundations for recent representative-agent asset pricing models that are based on preferences that generate wealth-varying risk aversion (Aït-Sahalia, Parker, and Yogo 2004, Campbell and Cochrane 1999).

Appendix A Consumer Expenditure Survey

In the Interview Survey component of the CEX, the Bureau of Labor Statistics (BLS) collects data on the characteristics and major expenditures of U.S. households. The CEX is a rotating panel that samples approximately 5,000 households every calendar quarter (over 7,000 households more recently). The BLS interviews each household up to five times every three months before replacement. The first interview is for practice, so only the second through fifth interviews are available in the public-use data files. The BLS interviews approximately the same number of households in each of the three months of a calendar quarter, and at each interview, households report their expenditures from the previous three months. Therefore, the CEX can be thought of as three non-overlapping panels of quarterly expenditure data. The BLS estimates that approximately 90–95% of total household expenditures are covered by the survey.

Although CEX data are available in the present format since 1980, we use the CEX files from 1982–2002. We do not use data from 1980–1981 since the expenditure on food was collected with a different questionnaire. The BLS has changed the sampling design of the CEX on two occasions, between 1985–1986 and between 1995–1996. Consequently, households cannot be linked across files during these years. Therefore, households in the 1985:4 file are linked to the same households in the early release of 1986:1 data from the 1985 CEX files. Similarly, we use the early release of 1996:1 data from the 1995 CEX files.

We use the Member Characteristics and Income File to identify the reference person of each household and, for married households, the spouse. We define the household head as the husband for married households and as the reference person otherwise. Only households whose head is between ages 26 and 75 at the time of interview are kept for analysis. Households are grouped by birth cohort and education according to the characteristics of the household head. We create thirteen birth cohorts in five year bins, from those born 1910–1914 to those born 1970–1974. The four education groups are some high school, high school graduate, some college, and college graduate.

We follow the procedure in Attanasio and Weber (1995) to prepare the CEX files for empirical analysis. To summarize, we first drop households that live in rural areas, live in student housing, or are incomplete income respondents. Rural households are dropped since the BLS failed to survey them during 1981:3–1983:4. Household consumption is constructed from the Monthly Expenditures File and is defined as all expenditures excluding consumer durables (as defined in the national accounts), housing, health, and education. Nominal expenditures are deflated to real 1997 dollars using the Consumer Price Index (CPI) for all urban consumers. Each expenditure item in the CEX is carefully matched to a region- and item-specific CPI, so that the price deflator is household specific. To eliminate obvious data errors, we drop households that report no food or only food expenditures. Monthly expenditures are summed over all three months of an interview period, which results in total household consumption for that quarter.

In the second and fifth interviews, the BLS collects income data for the previous twelve months. Disposable income is computed as total household income after taxes less capital income and pension contributions. Capital income includes interest on savings accounts and bonds as well as income from dividends, royalties, estates, and trusts. Pension contributions is the sum of income contributed to social security, railroad retirement, government retirement, private pension, and individual retirement plans.

In the fifth interview, the BLS collects financial data for the previous twelve months. In particular, households report the estimated value of securities such as stocks, mutual funds, private bonds, and Treasury notes. Following Vissing-Jørgensen (2002), a household is identified as a stockholder if its holding in these securities was positive twelve months prior to the interview or has increased in the previous twelve months.

Appendix B Survey of Consumer Finances

The SCF is a triennial survey conducted by the Federal Reserve Board. The SCF employs a dual sampling methodology, combining data collected from a representative sample of approximately 3,000 U.S. households with data collected from a sample of approximately 1,500 high-wealth households identified through tax-return data. Sample weights are constructed to adjust for biases caused by missing responses and to create a sample that is representative of the population as a whole. Aizcorbe, Kennickell, and Moore (2003) and references therein describe the sampling methodology in detail. We use data that is publicly available through http://www.federalreserve.gov/Pubs/oss/oss2/scfindex.html. The variable names below refer to those from the SCF codebook.

We classify survey respondents using the age-class variable (AGECL). This variable divides the population into six age groups (26–35, 36–45, . . . , 75+), based on the age of the household head. Because we do not model households in the 75+ age group, we focus on the first five age groups. Within each age group, we weight the observations using the weight variable (WGT). Using these weights, we construct quartiles for total financial assets (FIN). We consider five age groups and four asset quartiles for a total of 20 bins. We use the education-class variable (EDCL) to identify the education level of the household head. EDCL is equal to 1 for no high school diploma or GED, 2 for high school diploma or GED, 3 for some college, and 4 for a college degree.

Total financial assets includes liquid financial assets (transaction accounts), certificates of deposit, mutual funds, directly held stocks and bonds, IRAs, thrift accounts and future pensions, savings bonds, the cash value of life insurance, and "other" managed and financial assets (loans, future proceeds, royalties, futures, non-public stock, deferred compensation, oil/gas/mineral investments, cash, trusts, annuities, and managed investment accounts in which the household has an equity interest). We use the total equity variable (EQUITY) to determine the household's equity holdings, which includes both directly-held stock and stocks held through mutual funds, retirement accounts, trusts, and other managed assets.

The portfolio share is equal to EQUITY divided by FIN. The variable HEQUITY is equal to one if EQUITY is greater than zero and is equal to zero otherwise. For results conditional on holding stocks, we repeat the analysis on the sub-sample of respondents with HEQUITY equal to one.

Appendix C Numerical Solution of the Life-Cycle Model

Following the usual methodology, the model is solved backward from the last period of life. Because it is optimal to consume all of cash-on-hand in the last period, optimal consumption policy is given by the equations

$$B_T = \frac{W_T}{1+\alpha^{1/\phi}B_T^{\lambda/\phi-1}}, \tag{23}$$

$$L_T = \frac{W_T}{1+\alpha^{-1/\lambda}L_T^{\phi/\lambda-1}}. \tag{24}$$

The value function in period $T-1$ is given by

$$J_{T-1}(W_{T-1},P_{T-1}) = \max_{B_{T-1},L_{T-1},a_{T-1}} \{U(B_{T-1},L_{T-1}) + \beta\mathbf{E}_{T-1}[U(B_T,L_T)]\}. \tag{25}$$

We normalize the consumption policy variables by permanent income as $b_t = B_t/P_t$ and $l_t = L_t/P_t$. Similarly, we normalize cash-on-hand as $w_t = W_t/P_t$ and savings as $s_t = w_t - b_t - l_t$. Finally, we define the recursive function

$$j_t(w_t,P_t) = \max_{b_t,l_t,a_t}\{u_t(b_t,l_t) + \beta\mathbf{E}_t[(G_{t+1}\eta_{t+1})^{1-\gamma}j_{t+1}(w_{t+1},P_{t+1})]\}, \tag{26}$$

where

$$u_t(b_t,l_t) = \frac{1}{1-\gamma}\left(b_t^{1-\lambda} + \frac{\alpha(1-\lambda)}{1-\phi}P_t^{\lambda-\phi}l_t^{1-\phi}\right)^{(1-\gamma)/(1-\lambda)}. \tag{27}$$

The value function in period $T-1$ can be rewritten as

$$J_{T-1}(W_{T-1}, P_{T-1}) = P_{T-1}^{1-\gamma} j_{T-1}(w_{T-1}, P_{T-1}). \tag{28}$$

By induction, the value function in any period t is given by

$$J_t(W_t, P_t) = P_t^{1-\gamma} j_t(w_t, P_t). \tag{29}$$

We redefine the life-cycle problem as the solution to Bellman equation (26) subject to the intertemporal budget constraint,

$$w_{t+1} = \frac{R_{t+1} s_t}{G_{t+1} \eta_{t+1}} + \epsilon_{t+1}, \tag{30}$$

and the law of motion for permanent income (17). The first-order conditions for the Bellman equation, together with the envelope theorem, imply that

$$u_{bt} = \mathbf{E}_t[\beta R_{t+1} (G_{t+1} \eta_{t+1})^{-\gamma} u_{b,t+1}], \tag{31}$$

$$0 = \mathbf{E}_t[\beta s_t (R_{e,t+1} - R_f)(G_{t+1} \eta_{t+1})^{-\gamma} u_{b,t+1}], \tag{32}$$

where

$$u_{bt} = b_t^{-\gamma} \left(1 + \frac{\alpha(1-\lambda)}{1-\phi} P_t^{\lambda-\phi} \frac{l_t^{1-\phi}}{b_t^{1-\lambda}} \right)^{(\lambda-\gamma)/(1-\lambda)}. \tag{33}$$

The life-cycle problem is essentially solved through recursion on these equations.

We discretize the joint probability distribution for stock returns and income shocks as

$$\begin{aligned}
\{(\nu_i, p_i^\nu)\}_{i=1}^I &= \{(\nu_1, p_1^\nu), \ldots, (\nu_I, p_I^\nu)\}, \\
\{(\eta_j, p_j^\eta)\}_{j=1}^J &= \{(\eta_1, p_1^\eta), \ldots, (\eta_J, p_J^\eta)\}, \\
\{(\epsilon_k, p_k^\epsilon)\}_{k=1}^K &= \{(\epsilon_1, p_1^\epsilon), \ldots, (\epsilon_K, p_K^\epsilon)\}.
\end{aligned}$$

We discretize the state space as

$$\begin{aligned}
\{s_l\}_{l=1}^{L} &= \{s_1, \ldots, s_L\}, \\
\{w_m\}_{m=1}^{M} &= \{w_1, \ldots, w_M\}, \\
\{P_n\}_{n=1}^{N} &= \{P_1, \ldots, P_N\}.
\end{aligned}$$

In each period t, we define the functions

$$\begin{aligned}
\Theta_t(s_l, P_n) &= \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K} p_i^{\nu} p_j^{\eta} p_k^{\epsilon} \beta [R_f + a_t(s_l, P_n)(\overline{R}_e \nu_i - R_f)](G_{t+1}\eta_j)^{-\gamma} \\
&\quad \times u_{b,t+1}(w_{t+1}(s_l, P_n; \nu_i, \eta_j, \epsilon_k), G_{t+1} P_n \eta_j), \qquad (34) \\
\Omega_t(s_l, P_n) &= \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K} p_i^{\nu} p_j^{\eta} p_k^{\epsilon} \beta s_l (\overline{R}_e \nu_i - R_f)(G_{t+1}\eta_j)^{-\gamma} \\
&\quad \times u_{b,t+1}(w_{t+1}(s_l, P_n; \nu_i, \eta_j, \epsilon_k), G_{t+1} P_n \eta_j), \qquad (35)
\end{aligned}$$

where

$$\begin{aligned}
u_{bt}(w_t, P_t) &= b_t(w_t, P_t)^{-\gamma} \left(1 + \frac{\alpha(1-\lambda)}{1-\phi} P_t^{\lambda-\phi} \frac{l_t(w_t, P_t)^{1-\phi}}{b_t(w_t, P_t)^{1-\lambda}}\right)^{(\lambda-\gamma)/(1-\lambda)}, \qquad (36) \\
l_t(w_t, P_t) &= \alpha^{1/\phi} P_t^{\lambda/\phi - 1} b_t(w_t, P_t)^{\lambda/\phi}, \qquad (37) \\
w_{t+1}(s_l, P_n; \nu_i, \eta_j, \epsilon_k) &= \frac{[R_f + a_t(s_l, P_n)(\overline{R}_e \nu_i - R_f)] s_l}{G_{t+1}\eta_j} + \epsilon_k. \qquad (38)
\end{aligned}$$

Starting with the known solution in period T, we use the following algorithm to solve the life-cycle problem recursively for periods $t = T-1, \ldots, 1$.

1. For each point (s_l, P_n) on the grid, find $a_t(s_l, P_n)$ such that $\Omega_t(s_l, P_n) = 0$. If an interior solution does not exist,

$$a_t(s_l, P_n) = \begin{cases} 0 & \text{if } \Omega_t(s_l, P_n) < 0 \\ 1 & \text{if } \Omega_t(s_l, P_n) > 0 \end{cases}.$$

2. For each point (s_l, P_n) on the grid, find $b_t(s_l, P_n)$ and $l_t(s_l, P_n)$ such that $u_{bt}(s_l, P_n) = \Theta_t(s_l, P_n)$.

3. Define $w_l = s_l + b_t(s_l, P_n) + l_t(s_l, P_n)$, $a_t(w_l, P_n) = a_t(s_l, P_n)$ (with a slight abuse of notation), and $b_t(w_l, P_n) = b_t(s_l, P_n)$.

4. For each point (w_m, P_n) on the grid, compute $a_t(w_m, P_n)$ by interpolating $a_t(w_l, P_n)$ as a function of w_l and imposing the constraint $a_t(w_m, P_n) \in [0, 1]$.

5. For each point (w_m, P_n) on the grid, compute $b_t(w_m, P_n)$ by interpolating $b_t(w_l, P_n)$ as a function of w_l. Compute $l_t(w_m, P_n) = \alpha^{1/\phi} P_n^{\lambda/\phi - 1} b_t(w_m, P_n)^{\lambda/\phi}$.

In our implementation of this algorithm, we set $I = J = K = 10$, $L = M = 40$, and $N = 20$. The grid for the state variables are spaced on a logarithmic scale with the maximum values $s_L = w_M = 40$ and $P_N = 5$.

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Table 1: Basic Expenditure Share and Consumption Volatility by Age and Total Consumption

We sort the sample of households in the 1982–2002 CEX into age (columns) groups, then quartiles of nondurable and service consumption (rows) within each age group. Panel A reports the median (within each bin) of total annual consumption. Panel B reports the median (within each bin) of basic consumption as a share of total consumption. Panel C reports the square root of the median (within each bin) of consumption volatility. For each household, consumption volatility is measured as the mean squared log consumption growth over two quarters minus that over one quarter.

Percentile of Consumption	Age				
	26–35	36–45	46–55	56–65	66–75
Panel A: Consumption (Thousands of 2001 Dollars)					
0–25	3.4	3.7	3.6	3.4	3.2
25–50	5.1	5.5	5.5	5.2	4.9
50–75	6.8	7.4	7.5	7.1	6.9
75–100	10.0	10.8	11.3	11.1	11.0
Top 5	15.5	16.4	17.8	18.8	19.3
All Households	5.8	6.4	6.5	6.1	5.8
Panel B: Basic Consumption (% of Consumption)					
0–25	64.2	64.0	64.7	68.1	72.6
25–50	56.7	55.4	54.9	58.5	62.3
50–75	50.8	50.0	48.3	51.0	56.0
75–100	42.2	42.1	39.7	41.7	44.8
Top 5	32.0	35.4	31.6	31.1	34.3
All Households	53.9	52.8	51.7	54.9	58.7
Panel C: Standard Deviation of Consumption Growth					
0–25	9.2	9.2	9.3	10.2	8.7
25–50	8.2	6.4	6.9	8.8	6.1
50–75	8.9	7.1	7.5	7.5	8.7
75–100	10.6	10.2	11.9	11.4	10.5
Top 5	15.2	15.8	16.8	15.8	15.2
All Households	9.2	8.2	8.7	9.4	8.4

Table 2: Nondurable Expenditure Share by Age and Total Consumption

We sort the sample of households in the 1982–2002 CEX into age (columns) groups, then quartiles of nondurable and service consumption (rows) within each age group. The levels of total consumption that define the quartiles are reported in Panel A of Table 1. The panels report the median (within each bin) of the components of nondurable consumption as a share of total consumption.

Percentile of Consumption	Age				
	26–35	36–45	46–55	56–65	66–75
Panel A: Food at Home (% of Consumption)					
0–25	31.4	31.2	30.9	31.3	35.1
25–50	24.8	25.4	24.5	25.8	28.4
50–75	20.7	22.5	21.2	22.0	24.0
75–100	16.6	17.3	16.2	16.8	17.9
Top 5	12.1	12.7	11.7	11.5	12.0
All Households	22.7	23.6	22.5	23.7	25.9
Panel B: Food Away from Home (% of Consumption)					
0–25	4.7	4.5	4.0	2.8	1.7
25–50	6.7	7.2	7.2	5.6	4.8
50–75	8.5	8.4	8.5	7.4	6.1
75–100	10.9	9.7	10.7	9.7	8.8
Top 5	13.7	11.4	11.2	11.5	10.3
All Households	7.5	7.4	7.5	6.3	5.3
Panel C: Clothing and Shoes (% of Consumption)					
0–25	5.1	4.3	2.8	1.8	0.8
25–50	6.2	6.1	5.3	4.3	2.7
50–75	6.7	7.2	6.5	5.3	4.2
75–100	6.8	7.6	7.0	6.1	5.1
Top 5	6.7	7.8	7.0	6.0	4.5
All Households	6.2	6.3	5.4	4.4	3.2
Panel D: Fuel Oil, Coal, and Gasoline (% of Consumption)					
0–25	8.9	8.6	8.4	7.9	5.7
25–50	8.5	8.0	8.5	8.0	6.6
50–75	7.5	7.3	7.7	7.5	6.4
75–100	5.8	5.6	5.9	5.7	4.9
Top 5	4.2	3.9	4.4	4.2	3.5
All Households	7.6	7.3	7.5	7.2	5.9
Panel E: Other Nondurable Goods (% of Consumption)					
0–25	3.6	3.5	3.3	3.1	2.4
25–50	4.1	4.0	3.9	4.3	3.4
50–75	4.2	4.2	4.0	4.3	3.8
75–100	3.7	3.7	3.3	3.9	3.3
Top 5	3.1	3.3	2.8	2.9	2.4
All Households	3.9	3.9	3.6	3.9	3.2

Table 3: Service Expenditure Share by Age and Total Consumption

We sort the sample of households in the 1982–2002 CEX into age (columns) groups, then quartiles of nondurable and service consumption (rows) within each age group. The levels of total consumption that define the quartiles are reported in Panel A of Table 1. The panels report the median (within each bin) of the components of service consumption as a share of total consumption.

Percentile of Consumption	Age				
	26–35	36–45	46–55	56–65	66–75
Panel A: Household Operation (% of Consumption)					
0–25	20.6	20.5	21.2	23.8	26.0
25–50	19.8	18.6	18.9	20.7	23.2
50–75	18.6	17.0	16.5	17.6	20.8
75–100	15.7	15.5	14.4	14.7	17.0
Top 5	12.2	14.4	12.8	12.0	13.7
All Households	18.8	17.9	17.6	18.9	21.5
Panel B: Transportation (% of Consumption)					
0–25	4.5	5.5	5.7	4.6	2.2
25–50	7.5	8.0	9.2	8.0	6.6
50–75	8.8	8.9	10.4	10.2	9.0
75–100	10.8	10.6	12.5	11.3	11.1
Top 5	12.9	11.1	13.8	11.6	11.1
All Households	8.0	8.2	9.5	8.8	7.2
Panel C: Personal Care (% of Consumption)					
0–25	2.0	1.9	1.8	1.7	1.9
25–50	2.1	2.0	2.0	2.1	2.2
50–75	2.1	2.1	2.0	2.1	2.3
75–100	2.2	2.1	2.2	2.2	2.1
Top 5	2.2	2.1	2.0	1.9	1.6
All Households	2.1	2.0	2.0	2.0	2.1
Panel D: Personal Business (% of Consumption)					
0–25	1.3	2.0	2.2	2.0	0.6
25–50	3.2	4.0	3.8	3.2	1.9
50–75	3.5	4.5	4.5	4.0	2.5
75–100	3.8	4.4	4.8	4.3	2.9
Top 5	3.5	4.7	5.5	5.0	4.3
All Households	3.0	3.8	3.9	3.4	2.0
Panel E: Recreation (% of Consumption)					
0–25	2.7	3.2	2.9	2.8	1.7
25–50	4.0	4.4	4.0	3.4	3.2
50–75	4.7	4.9	4.8	3.8	3.7
75–100	5.5	5.9	5.8	4.8	4.2
Top 5	6.8	6.3	6.2	6.0	5.3
All Households	4.2	4.6	4.3	3.7	3.4

Table 4: Portfolio Share by Age and Wealth

We sort the sample of households in the 2001 SCF into age (columns) groups, then quartiles of financial wealth (rows) within each age group. Panel A reports the median (within each bin) of financial wealth. Panel B reports the percentage of households that own stocks within each bin. Panel C reports the median (within each bin) of the portfolio share in stocks.

Percentile of Financial Assets	Age				
	26–35	36–45	46–55	56–65	66–75
Panel A: Financial Assets (Thousands of 2001 Dollars)					
0–25	0.0	0.4	0.5	0.4	0.6
25–50	1.9	9.0	19.3	18.6	17.3
50–75	9.4	44.7	80.8	106.8	100.6
75–100	60.8	205.8	385.0	558.9	525.1
Top 5	262.0	658.4	1343.3	2655.0	2293.0
All Households	4.2	22.1	40.0	47.1	42.5
Panel B: Percentage of Households with Stocks					
0–25	3	9	9	5	1
25–50	36	52	53	46	15
50–75	71	83	78	83	53
75–100	86	93	96	95	88
Top 5	91	97	98	99	96
All Households	49	60	59	57	39
Panel C: Stocks as Percentage of Financial Assets					
0–25	0	0	0	0	0
25–50	0	6	8	0	0
50–75	31	47	36	38	1
75–100	45	59	59	54	60
Top 5	60	71	63	67	59
All Households	7	29	25	23	0

Table 5: Portfolio Share by Age and Wealth for Stockholders

We sort the sub-sample of stockholding households in the 2001 SCF into age (columns) groups, then quartiles of financial wealth (rows) within each age group. Panel A reports the median (within each bin) of financial assets. Panel B reports the median (within each bin) of the portfolio share in stocks.

Percentile of Financial Assets	Age				
	26–35	36–45	46–55	56–65	66–75
Panel A: Financial Assets (Thousands of 2001 Dollars)					
0–25	2.3	9.1	18.2	28.0	51.4
25–50	10.0	39.6	68.0	105.3	190.5
50–75	32.6	94.0	185.0	269.9	409.6
75–100	119.2	310.4	609.0	989.2	1079.0
Top 5	459.3	850.0	2009.1	3836.3	4005.0
All Households	18.0	62.8	105.3	161.4	269.5
Panel B: Stocks as Percentage of Financial Assets					
0–25	45	43	39	45	39
25–50	54	49	47	48	47
50–75	48	56	49	53	64
75–100	60	68	67	54	62
Top 5	67	69	69	55	58
All Households	49	53	49	50	58

Table 6: Portfolio Share by Education, Age, and Wealth for Stockholders

We sort the sub-sample of stockholding households in the 2001 SCF into education (panels) and age (columns) groups, then quartiles of financial wealth (rows) within each education/age group. The levels of financial wealth that define the quartiles (not reported) are education/age specific. Each panel reports the median (within each bin) of the portfolio share in stocks.

Percentile of Financial Assets	Age				
	26–35	36–45	46–55	56–65	66–75
Panel A: High School Graduates					
0–25	50	41	47	31	39
25–50	47	49	60	39	9
50–75	49	57	59	68	37
75–100	31	58	60	46	62
Top 5	11	47	81	47	51
All Households	42	50	50	43	41
Panel B: Some College					
0–25	43	38	32	47	36
25–50	48	46	38	29	68
50–75	50	47	47	41	42
75–100	54	55	50	46	57
Top 5	67	88	46	38	71
All Households	48	48	42	46	47
Panel C: College Graduates					
0–25	45	44	41	45	56
25–50	41	55	46	53	64
50–75	53	69	60	66	80
75–100	68	71	70	64	64
Top 5	62	59	74	55	64
All Households	54	57	55	58	70

Table 7: Parameters in the Benchmark Calibration

The table reports parameters used in the benchmark calibration of the life-cycle consumption and portfolio-choice model with stochastic labor income. In the nonhomothetic model, the household has nonhomothetic utility over two consumption goods, a basic and a luxury good. In the homothetic model, the parameters α, λ, and ϕ are not identified because the relative price is assumed to be constant. Both models are simulated at an annual frequency.

Parameter	Symbol	Nonhomothetic	Homothetic
Preferences:			
Discount factor	β	0.96	0.96
Utility weight on the luxury good	α	2.0	
Inverse of the elasticity of substitution when all consumption is basic	λ	1.8	
Inverse of the elasticity of substitution when all consumption is luxury	ϕ	1.1	
Relative risk aversion when all consumption is basic	γ	21.0	5.0
Labor income:			
Standard deviation of permanent income	σ_η	15%	15%
Standard devation of transitory income	σ_ϵ	21%	21%
Asset returns:			
Riskfree rate	$R_f - 1$	2%	2%
Equity premium	$\overline{R}_e - R_f$	4%	4%
Standard deviation of stock returns	σ_ν	18%	18%
Correlation between permanent income and returns	ρ	15%	15%

Table 8: Basic Expenditure Share in the Nonhomothetic Model

Panel A reports the median of basic consumption as a share of total consumption for stockholding households, tabulated with the 1982–2002 CEX. Panel B reports the median of basic expenditure share for households simulated in the nonhomothetic model.

Percentile of Consumption	Age				
	26–35	36–45	46–55	56–65	66–75
Panel A: CEX (Stockholders Only)					
0–25	56	56	55	56	63
25–50	50	50	48	51	54
50–75	46	45	43	46	48
75–100	38	38	35	36	39
Top 5	28	31	28	26	29
All Households	48	47	45	47	51
Panel B: Nonhomothetic Model					
0–25	64	57	55	55	56
25–50	54	49	47	46	47
50–75	48	43	41	40	40
75–100	41	36	33	32	32
Top 5	37	32	29	28	28
All Households	51	46	44	43	43

Table 9: Consumption Volatility in the Life-Cycle Model

Panel A reports the median of consumption volatility for stockholding households, tabulated with the 1982–2002 CEX. Panel B (Panel C) reports the median of consumption volatility for households simulated in the nonhomothetic (homothetic) model.

Percentile of Consumption	Age				
	26–35	36–45	46–55	56–65	66–75
Panel A: CEX (Stockholders Only)					
0–25	5.8	7.6	8.9	6.5	8.0
25–50	7.9	7.3	8.4	6.0	4.2
50–75	8.2	7.0	8.1	7.8	7.2
75–100	11.6	10.6	14.5	12.4	7.8
Top 5	15.7	15.3	19.1	24.8	15.6
All Households	8.2	8.0	9.3	8.3	7.0
Panel B: Nonhomothetic Model					
0–25	18.9	7.7	6.2	5.1	2.7
25–50	10.5	8.4	6.9	5.9	3.0
50–75	10.4	8.6	7.4	6.1	3.2
75–100	10.1	9.0	7.9	6.8	3.4
Top 5	10.6	9.0	8.2	7.5	3.4
All Households	11.5	8.4	7.0	6.0	3.0
Panel C: Homothetic Model					
0–25	15.0	7.6	6.2	5.0	2.8
25–50	9.6	7.7	6.4	5.2	2.8
50–75	9.3	7.8	6.5	5.5	2.8
75–100	9.1	8.0	6.7	5.7	2.8
Top 5	8.8	7.9	6.7	6.0	2.8
All Households	10.2	7.8	6.5	5.3	2.8

Table 10: Portfolio Share in the Life-Cycle Model

Panel A reports the median of portfolio share in stocks for stockholding households, tabulated with the 2001 SCF (also reported in Panel B of Table 5). Panel B (Panel C) reports the median of portfolio share for households simulated in the nonhomothetic (homothetic) model.

Percentile of Financial Assets	Age				
	26–35	36–45	46–55	56–65	66–75
Panel A: 2001 SCF (Stockholders Only)					
0–25	45	43	39	45	39
25–50	54	49	47	48	47
50–75	48	56	49	53	64
75–100	60	68	67	54	62
Top 5	67	69	69	55	58
All Households	49	53	49	50	58
Panel B: Nonhomothetic Model					
0–25	100	54	38	35	43
25–50	100	61	47	42	44
50–75	99	66	52	48	47
75–100	97	71	59	54	52
Top 5	96	72	61	56	54
All Households	100	63	49	45	47
Panel C: Homothetic Model					
0–25	100	84	51	41	40
25–50	100	73	50	41	39
50–75	100	68	49	41	39
75–100	99	62	48	41	39
Top 5	93	61	47	41	38
All Households	100	71	49	41	39

Table 11: Portfolio Share in the Life-Cycle Model with Unemployment Risk
Panel A reports the median of portfolio share in stocks for stockholding households, tabulated with the 2001 SCF (also reported in Panel B of Table 5). Panel B (Panel C) reports the median of portfolio share for households simulated in the nonhomothetic (homothetic) model. The probability of unemployment in the model is 0.5%.

Percentile of Financial Assets	Age				
	26–35	36–45	46–55	56–65	66–75
Panel A: 2001 SCF (Stockholders Only)					
0–25	45	43	39	45	39
25–50	54	49	47	48	47
50–75	48	56	49	53	64
75–100	60	68	67	54	62
Top 5	67	69	69	55	58
All Households	49	53	49	50	58
Panel B: Nonhomothetic Model					
0–25	14	52	38	34	43
25–50	76	60	46	42	43
50–75	88	64	52	47	46
75–100	93	70	59	54	52
Top 5	95	71	60	58	53
All Households	75	62	49	45	46
Panel C: Homothetic Model					
0–25	51	82	51	41	39
25–50	100	72	49	41	39
50–75	100	67	48	41	38
75–100	98	61	48	41	38
Top 5	92	60	47	42	38
All Households	100	70	49	41	39

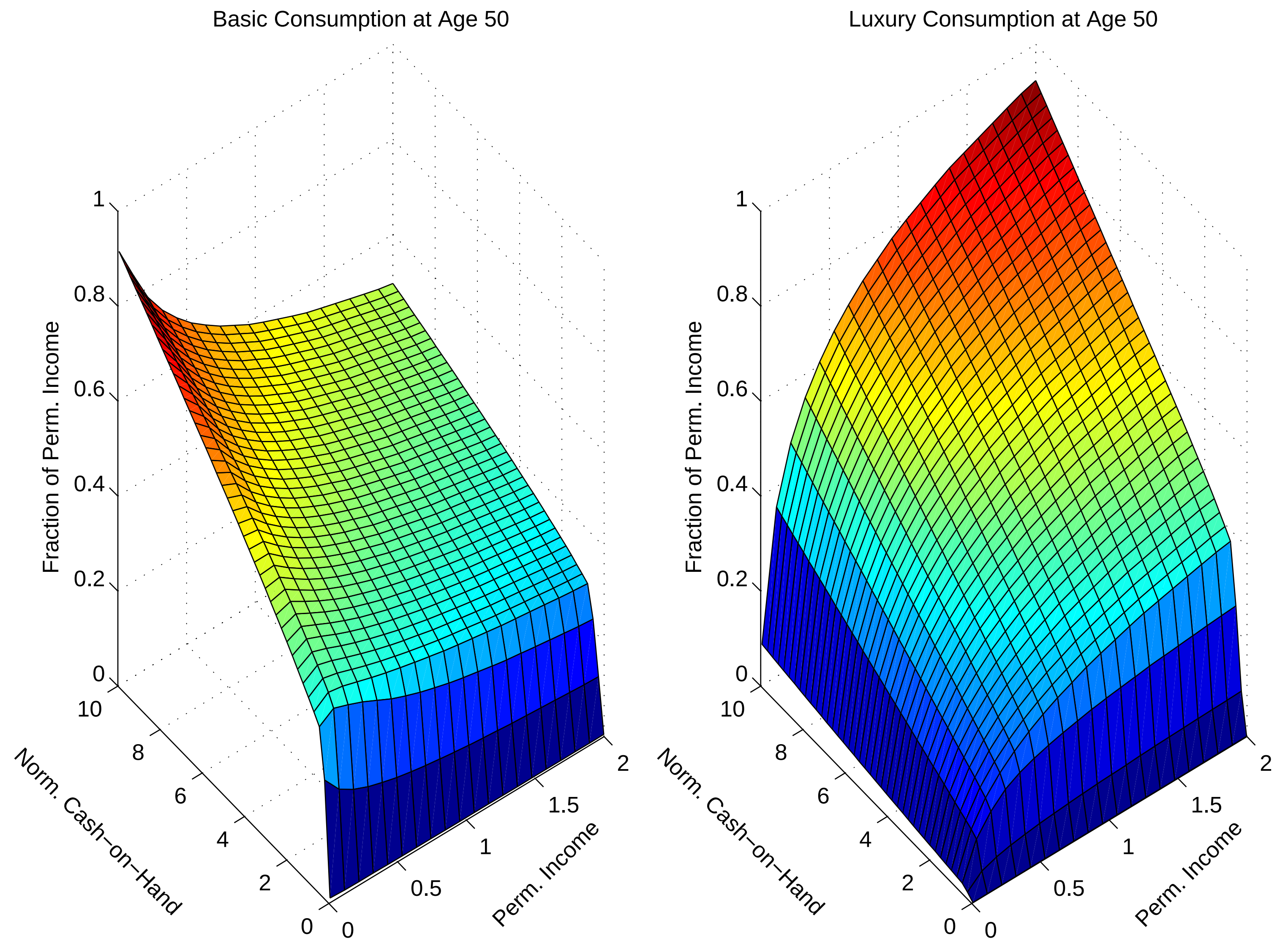

Figure 1: Optimal Consumption Policy in the Nonhomothetic Model

The figure shows the optimal consumption policy at age 50 for a life-cycle consumption and portfolio-choice model with nonhomothetic utility. The household receives stochastic labor income from ages 26 through 65 and deterministic retirement income until age 75. The state variables are normalized cash-on-hand ($w = W/P$) and permanent income (P). The figure shows the policy variables B (basic consumption) and L (luxury consumption), both shown as a fraction of permanent income. Table 7 reports the preference and income parameters of the model.

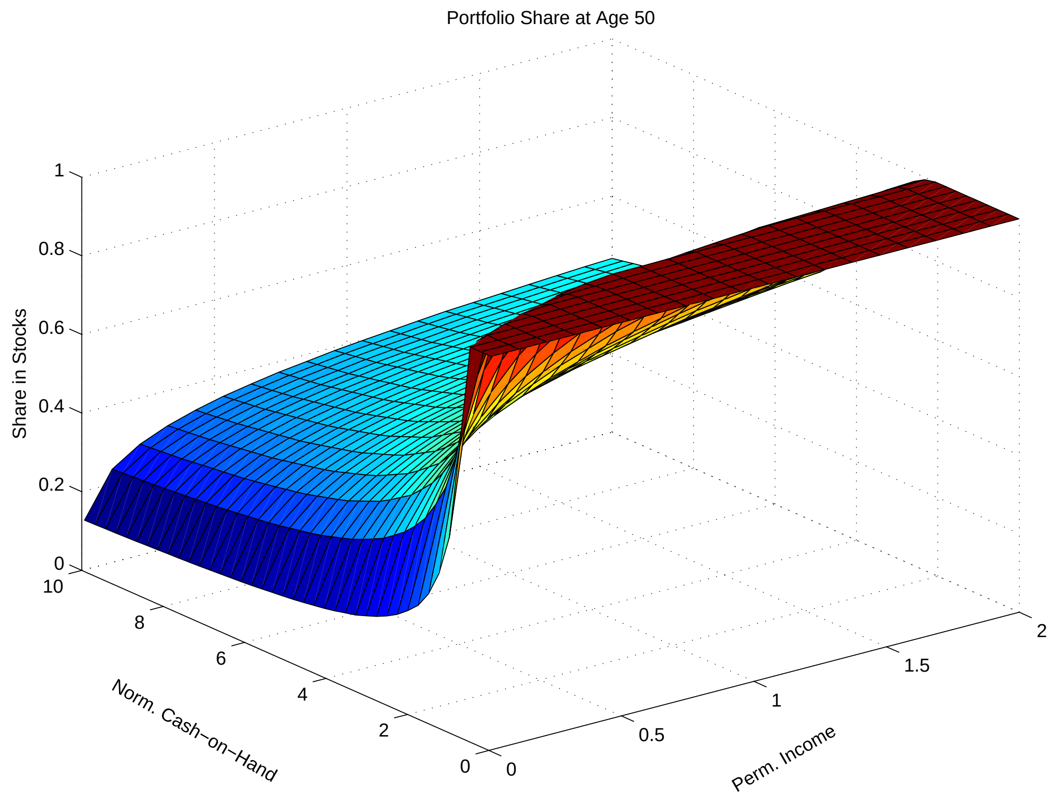

Figure 2: Optimal Portfolio Policy in the Nonhomothetic Model
The figure shows the optimal portfolio policy at age 50 for a life-cycle consumption and portfolio-choice model with nonhomothetic utility. The household receives stochastic labor income from ages 26 through 65 and deterministic retirement income until age 75. The state variables are normalized cash-on-hand ($w = W/P$) and permanent income (P). The figure shows the policy variable a (the portfolio share in stocks). Table 7 reports the preference and income parameters of the model.