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EQUITY CULTURE AND HOUSEHOLD BEHAVIOR

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Equity Culture and Household Behavior*

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Abstract

Equity culture has spread among households on both sides of the Atlantic. We study likely effects of equity culture on the behavior of households entering the stock market. Without borrowing constraints, the improved prospects arising from the equity premium tend to dominate the increase in riskiness of future income streams. This encourages entrants to increase consumption, borrowing, and precautionary wealth accumulation, and to reduce net financial wealth. Whether borrowing-constrained entrants will tend to increase consumption depends on risk aversion and on constraint tightness. Borrowing constraints can reduce, eliminate, or reverse the tendency of entrants to hold larger precautionary wealth buffers.

Keywords: Equity culture, household portfolios, stockholding, saving, borrowing constraints, non-expected utility.

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1. Introduction

Equity culture has spread to both sides of the Atlantic. Privatization of public utilities, the proliferation of mutual funds, the introduction of new types of retirement accounts, and the unusually strong performance of stock markets in recent years have encouraged households to enrich their portfolios with risky financial assets.

The percentage of US households that hold any stock, directly or indirectly, rose from 31.6% in 1989 to 40.4% in 1995 and to about 48% in 1998 (Bertaut and Starr-McCluer, 1999). Increased stock market participation has been accompanied by increased indebtedness of households, both for consumption and for asset acquisition purposes. Banks and Tanner (1999) report that at the beginning of the 1980s fewer than one in ten United Kingdom households owned shares directly. By the end of the decade, this had changed to more than one in five. Most of the increase took place from 1985 to 1988, coinciding with the heavily advertised privatization of public utilities. It was then sustained by tax-free Personal Equity Plans, Individual Savings Accounts, and de-mutualisations of building societies. In the Netherlands, 21.2% of households held risky financial assets in 1993;[1] by 1998, the number had risen to 27.7% (Alessie et al., 1999). In Italy, 11.9% of households held risky financial assets in 1989[2]. The percentage rose to 18.5% in 1995 (Guiso and Jappelli, 1999). In Germany, 14.1% of households held risky financial assets[3] in 1978, 17.9% in 1988, and by 1993 26.2% of former West Germans and 19.8% of former East Germans held risky financial assets (Boersch-Supan and Eymann, 1999).

Direct advertising (e.g. on mutual funds), employer-sponsored seminars (on pension accounts), or simply watching the financial success of neighbors were crucial in expanding the perceived asset menu and spreading equity culture. It is, therefore, worthwhile to study the implications of economic models regarding likely changes in

consumption, saving, and borrowing behavior of households that develop equity culture; and how such changes are likely to be influenced by preferences and by credit market conditions. The present paper is a first attempt to explore these topical issues.

Early theoretical analysis of household portfolios emphasized the choice between risk-free and risky financial assets in a static (atemporal) framework (Markowitz, 1952; Tobin, 1958). In the late sixties, time was introduced into the portfolio problem to study how the option to invest in risky assets tomorrow affects portfolio choice today (Mossin, 1968; Merton, 1969; Samuelson, 1969). Partly as a result of the unrealistic implication of early models that household portfolios should be complete, interest gradually shifted towards their predictions regarding asset pricing. At the same time, developments in the theory of saving were abstracting from portfolio choice. Background labor income risk was incorporated in single-asset saving models in the early seventies, but analytical solutions required stringent assumptions on preferences and very often a move back to atemporal models.[4]

Recently, the increasing diversity of household portfolios and the advent of computational methods have encouraged development of intertemporal models of household portfolio choice that allow for background labor income risk and various preferences and frictions.[5] Following this approach, we employ variants of a versatile, small-scale computational portfolio model to analyze tendencies of households that enter the stock market in response to arrival of information about how to invest in stocks.

We find that equity culture creates incentives for entrants to increase loan demand. The better prospects for future wealth accumulation arising from the equity premium tend to dominate the associated increase in riskiness of future income streams and warrant an increase in current consumption. The models show a tendency

among young entrants to lower their net financial wealth when they are not faced with borrowing constraints.

By creating greater incentives to borrow, equity culture makes the young more susceptible to any borrowing constraints. Binding borrowing limits tend to reduce stockholding by new entrants. Constrained entrants may not be able to increase their current consumption as a result of stock market participation, depending on the tightness of borrowing limits and on their willingness to undertake risk.

Equity culture tends to encourage households to accumulate a larger precautionary wealth buffer, so as to shield future consumption from earnings shocks. Increased riskiness of future income streams resulting from the introduction of stockholding risk tends to dominate their expectations of higher future wealth levels due to the equity premium. Borrowing constraints, however, can reduce, eliminate, or even reverse the tendency of new entrants to hold larger precautionary wealth buffers.

Since our partial equilibrium analysis is conducted for historically observed processes for asset returns, it abstracts from any possible effects of the spread of equity culture on asset returns. If such effects are substantial, partial equilibrium analysis should be interpreted as predicting shifts in household demands, given return processes prevailing prior to the spread of equity culture.

How substantial are effects of increased participation on asset returns? General equilibrium models of portfolio choice are in short supply. Inability to resolve the equity premium puzzle after 15 years of research (see Kocherlakota, 1996; Campbell, 2000) has discouraged extensive development of models that try to tackle simultaneously household portfolios and equilibrium asset returns. Although we are not aware of general equilibrium models of equity culture *per se*, there is a recent strand of literature on the effects of limited stock market participation that uses full-

participation models as benchmarks (Allen and Gale, 1994; Saito, 1995; Vissing-Jorgensen, 1997; Basak and Cuoco, 1998; Heaton and Lucas, 1999; and Polkovnichenko, 2000). Turned around, these models can be used to show how the steady state equilibrium with full stock market participation compares to that prior to the spread of equity culture.

The overall conclusion from these models is that changes in stock market participation are not the key to matching the historically observed equity premium nor to explaining the recent behavior of stock prices. Polkovnichenko (2000) rationalizes this finding by showing that entering investors simply tend to have too low wealth to affect asset prices and the equity premium. If effects on asset returns are small even when the economy moves from limited to full stock market participation and asset supplies are assumed fixed, they are unlikely to be crucial for discussions of the much smaller increases in participation associated with the observed spread of equity culture. Based on these findings, there seems little reason to doubt the usefulness of partial equilibrium models that treat the equity premium as given, especially since their predictions are obtained for a premium closer to the data than the levels implied by existing general equilibrium models.

The paper is organized as follows. Section 2 introduces the household problem in the absence and presence of stockholding opportunities. Section 3 describes calibration. Section 4 discusses effects of equity culture on consumption and net wealth, and the role of borrowing constraints and preferences. Section 5 shows how precautionary effects are influenced by stockholding opportunities. Section 6 discusses extensions, including issues likely to arise in future development of general equilibrium models of equity culture. Section 7 concludes.

2. The model

In this Section, we present our specifications for household preferences, the asset menu, and borrowing constraints households may be facing.

2.1 Preferences

We employ a specification that nests expected utility as well as Kreps-Porteus preferences that disentangle risk aversion from intertemporal elasticity of substitution. Following Epstein and Zin (1989), we define intertemporal utility at time t as:

$$U_t = W(c_t, \mu(U_{t+1}|I_t)) \tag{1}$$

The 'aggregator function', W, implies that current intertemporal utility is a function of current consumption and of some certainty equivalent of next period's uncertain utility, computed using information up to t, I_t. We assume that

$$W(c_t, \mu(U_{t+1}|I_t)) = \left[(1-\beta)c_t^{\rho} + \beta\mu_t^{\rho}\right]^{1/\rho}, 0 \neq \rho\ 1 \tag{2}$$

or

$$W(c_t, \mu(U_{t+1}|I_t)) = \left[(1-\beta)\ln c_t + \beta \ln \mu_t\right], \rho = 0 \tag{3}$$

where $\mu_t(\cdot)$ is an abbreviation for $\mu(\cdot|I_t)$. A constant relative risk aversion specification for $\mu_t(\cdot)$ is

$$\begin{aligned} &\mu_t(U_{t+1}) = \left[E_t\left(U_{t+1}^{\alpha}\right)\right]^{1/\alpha}, \ \ 0 \neq \alpha < 1 \\ &\ln \mu_t\left(U_{t+1}\right) = E_t\left(\ln U_{t+1}\right), \ \ \alpha = 0 \end{aligned} \tag{4}$$

where E_t is the linear expectations operator. Consider a control variable x_t (e.g. the real amount of an asset) chosen by the household in period t so as to maximize U_t. The first-order condition for x_t takes the general form:

$$c_t^{\rho-1}\frac{\partial c_t}{\partial x_t}+\beta\left(E_t\left(U_{t+1}^{\alpha}\right)\right)^{\frac{\rho}{\alpha}-1}E_t\left[U_{t+1}^{\alpha-\rho}c_{t+1}^{\rho-1}\left(\frac{\partial c_{t+1}}{\partial x_t}\right)\right]=0 \tag{5}$$

For suitable parameter restrictions, this first-order condition (FOC) nests expected utility and Kreps-Porteus specifications.

2.1.1 Expected-utility specification (EU) The standard FOC for an expected-utility model with constant relative risk aversion (RRA=1-α) can be obtained by imposing the restriction that $\alpha=\rho$:

$$c_t^{\alpha-1}\frac{\partial c_t}{\partial x_t}+\beta E_t\left[c_{t+1}^{\alpha-1}\left|\frac{\partial c_{t+1}}{\partial x_t}\right|\right]=0 \tag{6}$$

Under EU, the effects of varying α that governs risk aversion cannot be disentangled from those of ρ that reflects intertemporal elasticity of substitution.[6]

2.1.2 Kreps-Porteus Specification (KP) Since we consider the effects of introducing a risky asset with a return premium, it is useful to be able to disentangle effects of aversion to its riskiness from those related to its potential for generating future wealth. Under the KP specification, the restriction $\alpha=\rho$ is relaxed and the FOC become:

$$c_t^{\rho-1}\frac{\partial c_t}{\partial x_t}+\beta\left(E_t\left(U_{t+1}^{\alpha}\right)\right)^{\frac{\rho}{\alpha}-1}E_t\left[U_{t+1}^{\alpha-\rho}c_{t+1}^{\rho-1}\left|\frac{\partial c_{t+1}}{\partial x_t}\right|\right]=0 \tag{7}$$

confirming that expected utility is a special case of this formulation for $\alpha=\rho$. Differences in effects of varying risk aversion between EU and KP are attributable to the automatic change in elasticity under EU that is avoided under KP preferences.

2.2 Saving vehicles

Each household is assumed to maximize utility faced with labor income shocks.

Households with access to stocks also face uncertainty resulting from risky asset returns assumed to be uncorrelated with idiosyncratic earnings shocks. Households have an economic life of three twenty-year periods, and make decisions at the end of each period. The first two periods correspond to the two phases of working life: 20-39 years and 40-59 years. Household utility in the last, retirement period (60-79 years) may incorporate concern about the size of bequest, as follows:

$$U_3 = \left[(1-\beta)\left\{\lambda G_3^{\alpha} + (1-\lambda)c_3^{\alpha}\right\}\right]^{1/\alpha}, \quad \alpha < 0 \tag{8}$$

where G is the size of bequests. The size of λ controls the intensity of the bequest motive with λ=0 corresponding to no such motive. The control variable(s) x_t are determined by whether the household has access to stocks or not.

2.2.1 Households without equity culture A household that does not perceive stocks as part of the asset menu decides only how much to consume or save. The period-by-period constraints faced by the household are:

$$c_1 = Y_1 - B_1 \tag{9}$$

$$c_2 = Y_2 + B_1 I_2 (1 - t_b) + B_1 - B_2 \tag{10}$$

$$c_3 = Y_3 + B_2 [1 + I_3 (1 - t_b)] - G_3 \tag{11}$$

$$c_t \geq 0 \ \ \forall t \tag{12}$$

where B is the real amount in bonds, Y is real labor or pension income, I the nominal rate of interest on the riskless asset, and t_b the tax rate on interest income. The price of the consumption good has been used as a numeraire. At the end of each period, the household learns the income realization for the current period and chooses how much to hold in the form of the riskless asset, bonds, between then and the end of next period. Cash on hand in each period consists of the value of wealth plus interest

earnings on bonds minus interest taxation plus non-asset income. Given this and the decision on how much to save, the amount of consumption is also determined. Infinite consumption through infinite borrowing is ruled out through the combination of the last period budget constraint and the requirement for nonnegativity of consumption.

2.2.2 Households with Equity Culture Households that perceive stocks as part of their asset menu face a portfolio choice between riskless bonds and risky stocks. The constraints now become:

$$c_1 = Y_1 - N_1 P_1^s - B_1 \tag{13}$$

$$c_2 = Y_2 + (N_1 d_2 + B_1 I_2)(1 - t_b) + (N_1 - N_2)P_2^s + B_1 - B_2 \tag{14}$$

$$c_3 = Y_3 + N_2 [P_3^s + d_3(1 - t_b)] + B_2 [1 + I_3(1 - t_b)] - G_3 \tag{15}$$

$$c_t \geq 0 \quad \forall t \tag{16}$$

where P^s is the real stock price (deflated by the price of the consumption good), N the number of stocks, d real dividends per share, t_b is now the tax rate on interest and dividend income, and the rest of the symbols are as defined above.

The sequence of decisions is the same as before. Cash on hand is now augmented by the value of stocks outstanding plus dividend payments minus taxes on dividends received, assumed to accrue at the same rate as interest taxation. Interest and dividend taxation is set at a higher rate for college graduates than for households of lower education. The model abstracts from taxation on capital gains, as this introduces considerable complications not central to the focus of this paper. At the end of the third period, the household decides how to divide up current after-tax resources (i.e., retirement income, stock accumulation, dividend payments, any bond holdings minus

accumulated debt and associated interest payments) between final consumption and bequests, depending on the intensity of the bequest motive.

2.3 Borrowing constraints

We compare unconstrained solutions to those obtained under borrowing limits that depend on labor income. Financial institutions often adopt such limits because ability to repay is related to earning capacity, and current earnings are considered a good proxy for future earnings potential.[7] Formally, borrowing (negative bond holding) is not allowed to exceed a proportion (or multiple) k of income:

$$-B_t \leq kY_t, \quad k > 0. \tag{17}$$

Constrained net worth for those lacking equity culture is $W_t = B_t = -kY_t$, while for stockholders it is $W_t=S_t-kY_t$, where S is the amount of stockholding. We present solutions for different values of k, so as to trace the effects of constraint tightness.

3. Calibration

In this Section, we describe how we calibrate parameters and stochastic processes. The discussion can be skipped without loss of continuity.

3.1 Asset returns

Calibration of cumulative stock returns is based on a binomial model of annual pre-tax stock returns, that matches the first two moments of the empirical return distribution estimated by Mehra and Prescott (1985). They estimated a mean annual stock return and standard deviation for the period 1889-978 equal to 6.98% and 16.54% respectively. Pre-tax stock returns in our model can take a high or low value equal to the expected value plus or minus (respectively) the standard deviation of 20-year holding returns, when both moments are computed from the binomial process for annual returns.[8] Consistent with the historical findings of Schwert (1990), expected dividend yields are

calibrated to about half the expected total pre-tax return on equity.[9] The twenty-year pre-tax riskless rate, as compounded from the Mehra-Prescott mean annual riskless rate of 0.8%, is equal to 17.3% (i.e., a gross interest factor of 1.172764).

3.2 Incomes

The measure of labor income is the present value of earnings over a twenty-year interval. Households determine their saving and/or portfolio composition faced with risky human capital returns in the second half of their career. As in Hubbard et al. (1994) and in Constantinides et al. (1998), households face no uncertainty regarding pension income available to their educational category. The model is kept small by abstracting also from health risks in old age. We have run our experiments allowing for different age-earnings profiles and stochastic processes for labor income shocks depending on education level, namely for those with (i) less that high-school (LTHS), (ii) high-school (HS) education, and (iii) at least a college degree (COL).

The annual earnings process consists of the deterministic age-earnings profile, and of stochastic processes for income shocks. We calibrate age-earnings profiles from the *Survey of Consumer Finances* that contains the portfolio data, and use the stochastic processes for (multiplicative) permanent and transitory income shocks estimated by Hubbard et al. on panel data in the PSID. We adjust incomes to ensure that present-value measures of riskless labor income are equal to expected incomes under career uncertainty, and to average population incomes computed from the data.

We compute mean annual incomes for each age-education cell in the SCF, based on reported population weights, and we use them to compute twenty-year present values.[10] Since present values may be hard to interpret, we report them as annual incomes that, if received each year over a twenty-year period, would yield these present values.[11]

These are the income values used for the models without income risk, and their age profile exhibits a hump in the second period of working life.

We consider multiplicative persistent and transitory shocks to annual labor incomes, U_t and V_t. To a first approximation, an annual income realization in models with income risk is equal to the annual income under certainty times the product of the two earnings shocks.[12] As in Hubbard et al. (1994), the logarithms of earnings shocks follow:

$$u_{LTHS,t} = 0.955\, u_{LTHS,t-1} + e_{LTHS,t}\,,\ e_{LTHS,t} \_ i.i.d.\ N(0,0.033)\,,\ v_{LTHS,t} \_ N(0,0.04)$$

$$u_{HS,t} = 0.946\, u_{HS,t-1} + e_{HS,t}\,,\ e_{HS,t} \_ i.i.d.\ N(0,0.025)\,,\ v_{HS,t} \_ N(0,0.021) \qquad (16)$$

$$u_{COL,t} = 0.955\, u_{COL,t-1} + e_{COL,t}\,,\ e_{COL,t} \_ i.i.d.\ N(0,0.016)\,,\ v_{COL,t} \_ N(0,0.014)$$

Serial correlation for persistent shocks is high for all education categories, but variance is decreasing in education. We stochastically generate 20,000 time series of annual incomes (for ages 40 to 59) for each education level and compute their present values. The 'high' and 'low' labor income values used equal the expected present value plus or minus one standard deviation, respectively.[13]

3.3 Other Parameters

Attitudes towards risk are controlled by parameter α, equal to one minus the degree of relative risk aversion. Our 'benchmark' value for relative risk aversion is 3, which is often used for representative-agent models, but we consider values between 2 and 10, viewed by Mehra and Prescott (1985) as the relevant range given the size of the stockholding 'gamble'. The weight attached to the bequest motive is λ. We use a benchmark value of 0.25, but results are not particularly sensitive to the specific nonzero value chosen. The rate of time preference is set at 3.13% per annum, around the values typically assumed in the literature. Since it exceeds the riskless rate, we consider 'impatient' consumers. When we consider Kreps-Porteus preferences, we need to

distinguish between the elasticity of intertemporal substitution, $\sigma=(1-\rho)^{-1}$, and the degree of risk aversion. Our benchmark value of ρ implies an elasticity of 0.5. The tax rate on interest and dividend income, t_b, is set at 15% for high school dropouts and high school graduates, and at 30% for college graduates.

4. Effects of Equity Culture on Consumption and Asset Holding

In this section, we compare consumption, borrowing, and wealth behavior of households that have not yet developed equity culture to that once they perceive stocks as part of their asset menu. We explore the roles of preferences, risk aversion, and income-based borrowing constraints.

4. 1 Consumption

Figure 1 presents policy functions for first-period consumption, wealth, and riskless asset holdings ('bonds') of high-school dropouts plotted against initial cash on hand, i.e. against the sum of initial wealth and first-period labor income. The policy functions for the young of other education categories are of a similar shape.

Young households who develop equity culture experience an upward shift in the policy function for consumption and a slight increase in the marginal propensity to consume out of cash on hand. The shift is the net effect of two competing factors. First, access to stocks creates expectations of higher future wealth because of the equity premium, and facilitates consumption smoothing, because of the presence of a second asset. In view of higher expected future wealth, young entrants can afford to increase current consumption at any given level of cash on hand. The extent to which they choose to do so is governed by their aversion to intertemporal consumption variability, measured by the degree of absolute risk aversion, *A*. Access to stocks, however, has a second competing effect: it makes future income streams more risky.

Increased riskiness of future income discourages current consumption, and the intensity of this precautionary motive is measured by the degree of prudence, $P = -\frac{u'''}{u''}$. In all calibration experiments we performed, the former (wealth) effect dominates the latter (prudence) effect.[14]

Fig. 2 shows second-period policy functions for consumption of middle-aged high school dropouts with and without equity culture. Given first-period portfolios, a different range of second-period cash on hand can be observed in each second-period state, possibly with some overlapping. We show the complete policy function for those without equity culture in two parts, corresponding to the two possible second-period (labor income) states. Stockholders face four possible states, but we show only the parts for the best and worst state to avoid cluttering the diagram.

Access to stocks expands the range of possible second-period levels of cash on hand (hence, of consumption).[15] Combined with the upward shift in the policy function, this causes an increase in expected future consumption and a higher variance of consumption of stockholders than of nonstockholders. The result is consistent with the empirical finding of Mankiw and Zeldes (1991) that variability of consumption is higher for stockholders.

Table 1 considers effects of access to stocks for stockholders with no initial wealth and with mean first-period labor income in each education category. As suggested by policy functions, these households want to increase current and expected future consumption, because doing so results in higher expected lifetime utility. The planned increases get bigger with age, despite impatience (i.e., a rate of time preference in excess of the riskless rate). Early consumption increases would satisfy impatience, but they would be in direct competition with stockholding and diminish expected lifetime consumption gains. Expected second-period consumption gains are

also larger the higher the level of education (because of the concomitant changes in the earnings process), and they diminish with risk aversion. This is explained by the limited stockholding predicted, *ceteris paribus*, for the more risk averse and the less educated, which is also consistent with existing portfolio data.

Table 1 shows that uncertainty about future consumption, measured by the coefficient of variation conditional on first-period information, is influenced by access to stocks, by risk aversion, and by the earnings process since earnings depend on education. Two competing factors, namely (i) higher consumption variability of the less educated in the absence of stockholding and (ii) lower level of stockholding when they do undertake it, yield rankings of consumption variability that tend to reflect the rankings of earnings risk by education category.[16]

4.2 Asset holding

For given cash on hand, wealth held between the current and the next period is equal to what is left over after consumption needs are met (Section 2). Thus, the tendency of entrants to increase consumption implies a corresponding tendency to lower their net wealth. Intuitively, the introduction of stocks encourages households to borrow (or reduce their bond holdings) in order to finance stockholding and to consume more in view of their better future wealth prospects. While the former is a mere portfolio substitution effect, the latter creates a tendency for current net wealth of entrants to go down. The tendency is stronger at low degrees of risk aversion, where stockholding is more sizeable.

Access to stocks does not change the tendency to hold wealth as much as it changes the tendency to hold the riskless asset. Intuitively, the reason is that in the absence of stocks, the riskless asset plays the role of total wealth (intertemporal

consumption smoothing), while in the presence of stocks it plays the very different role of a portfolio component that interacts with stocks to form total wealth.

4.3 Effects of borrowing constraints

Since access to stocks tends to encourage borrowing for consumption and stockholding, income-based borrowing constraints (Section 2) should influence the extent to which behavior is modified to take advantage of stockholding opportunities. Moreover, the effects of borrowing constraints should depend on the presence or absence of perceived stockholding opportunities. We explore these issues by introducing borrowing limits, kY, in all periods.

Figure 3 confirms that borrowing constraints tend to bind over a greater range of risk aversion and constraint tightness for households who have developed equity culture. When borrowing limits are tight (k is zero or low) and risk aversion is at the benchmark of 3, young entrants tend to lower current consumption and increase net wealth. Interestingly, this is the opposite of what we found in the absence of borrowing constraints and can be explained as follows. For k so low that the constraint binds regardless of the presence of stockholding opportunities, borrowing is equal to the limit kY but wealth must be higher when stocks are also held. The reversal in rankings continues for a range of k values where the constraint is binding in the presence but not in the absence of stocks. Such a region exists because there is more reason for young households to borrow when they develop equity culture. As constraints become progressively looser, the ranking observed in the absence of constraints is restored.

Figure 4 shows that analogous reversals are observed if we focus on constraints precluding any borrowing (k=0) as is often done, and we vary risk aversion. Equity culture makes it likely that constraints will be binding over a wider

range of risk aversion than in its absence. For low risk aversion and k=0, there is a tendency to increase wealth as a result of developing equity culture. For higher risk aversion, it is possible for this tendency to be reversed when borrowing constraints cease to be binding for households without equity culture, even before they cease to bind for stockholders. Thus, borrowing constraints can alter both the size and direction of the consequences of developing equity culture.

The effects of changes in credit conditions, as reflected in borrowing limits, also depend on whether the household has developed equity culture. Fig. 5 shows expected second-period consumption for a young high school dropout as a function of borrowing constraint tightness. Relaxation of borrowing limits tends to increase expected future consumption for the young entrant: the household uses part of extra borrowing to finance purchases of stocks, thus improving future consumption prospects. The opposite is true if the household has not yet developed equity culture, because all extra borrowing goes to finance first-period consumption. Moreover, current consumption of a household with equity culture tends to be less sensitive to variations in borrowing limits than that of its counterpart without equity culture. This is because the former adjusts not only consumption but also stockholding in response to a given change in the borrowing limit.

4.4 Effects of preference specification

Results presented so far are based on expected-utility models. It is instructive to verify that results are not an artifact of the restriction that risk aversion be inversely related to the elasticity of substitution, i.e. that the main results hold under KP preferences as well (see Section 2). Expected-utility (EU) and Kreps-Porteus (KP) models coincide for the level of risk aversion that happens to be equal to the inverse of the elasticity of

substitution used in the KP model. For other configurations of elasticity and risk aversion, the size of differences between EU and KP model predictions is a function of the extent to which the choices of risk aversion and elasticity parameters violate this equality.

The finding that young entrants will tend to lower their current net wealth upon entering the stock market continues to hold under KP preferences (Fig. 6). So is the prediction that effects of equity culture will be smaller for households with high degrees of risk aversion, since they will not be investing much in stocks. The rate at which effects diminish, however, is faster under KP preferences that maintain the elasticity of substitution unchanged when varying risk aversion.

Fig. 7 compares first-period wealth predictions under EU and KP preferences for various degrees of constraint tightness, k. Horizontal portions show predictions over a range of k for which borrowing limits are not binding. Whether one looks at households with or without equity culture, binding borrowing constraints tend to reduce differences between EU and KP preferences. Intuitively, when constraints are binding, borrowing is at the same binding limit regardless of preferences or asset menu. Thus, any differences in net wealth result from differences in stockholding. But we showed above that binding borrowing limits tend to discourage stockholding, reducing the scope for differences in wealth or consumption.

5. Effects of equity culture on precautionary asset holding

In this section, we discuss precautionary effects on consumption, wealth, and bond holdings of the young that arise from second-period earnings risk. Faced with earnings risk in the absence of borrowing constraints and other frictions, households with preferences characterized by prudence[17] set aside more wealth (or curtail their net borrowing) in order to buffer future consumption from income shocks. Figure 8

shows policy functions for precautionary reductions in consumption and in borrowing (increases in bond holding) for young high school dropouts, as a function of initial cash on hand. We observe that, regardless of the perceived asset menu, poorer households tend to curtail their consumption and their borrowing more than their richer counterparts. When initial resources are low, it is more imperative for young households faced with earnings risk to build a precautionary wealth buffer.

Households that do perceive stockholding opportunities tend to lower consumption and borrowing by larger amounts in the face of labor income risk.[18] Figure 8 demonstrates this result for high-school dropouts. Table 2 focuses on the case of zero initial wealth and shows that it extends to all education categories and degrees of risk aversion considered, as well as to percentage changes in consumption.

The finding that equity culture tends to encourage precautionary responses to given amounts of earning risk may be interpreted as follows. When stockholders are confronted with income risk, they curtail stock demand but they reduce borrowing (or increase riskless asset holding) by much more so as to generate precautionary (net) wealth holdings. Thus, they combine precautionary wealth accumulation with a portfolio shift away from stocks and towards bonds, in an effort to reduce *total* income risk. This portfolio shift, which obviously does not occur for those without stocks, tends to lower expected future wealth and future consumption since the household foregoes the equity premium. In order to mitigate these effects, the stockholder sets aside a larger amount of precautionary wealth than in the absence of a portfolio shift. The Table also confirms that, as risk aversion increases, precautionary wealth holdings are less influenced by equity culture, since less use of stockholding opportunities is made.

Let us now examine the interaction between precautionary asset holding, equity culture, and borrowing constraints. Regardless of equity culture, precautionary asset holding is the difference between holdings in the presence of earnings risk and in its absence given that borrowing constraints exist in both cases. We have seen that unconstrained borrowing is larger when income is riskless rather than risky. Thus, if a household faces a binding borrowing constraint in the presence of income risk, it does so in its absence as well. Borrowing is at its limit of kY under both risky and riskless income, and precautionary bond holding is zero. In such cases, binding constraints eliminate precautionary adjustments in borrowing (bond holding) for a given asset menu by pushing households to the same limit regardless of labor income risk.

Figs 9 and 10 can be read in two ways. First, as showing how the effects of equity culture on precautionary holdings depend on the tightness of borrowing constraints, k. Second, as showing that a borrowing constraint of given tightness (k) has different effects on precautionary asset holding in the absence and in the presence of equity culture. For brevity, we focus on the former issue.

Binding borrowing constraints can eliminate or reverse the effect of equity culture on precautionary holdings of the riskless asset (Fig. 9). This result can be understood as follows. We have already seen that equity culture tends to encourage borrowing. In a range of very low k values, constraints are binding regardless of perceived asset menu and income risk. Binding constraints eliminate the effects of equity culture on precautionary holdings of the riskless asset, since constrained holdings are zero regardless of the perceived asset menu. This range of k values is followed by another where stockholders continue to face binding constraints, but those lacking equity culture do undertake precautionary holding of the riskless asset.

As borrowing limits are further relaxed, they cease to be binding regardless of equity culture.

Whether overall precautionary wealth holdings (i.e. net precautionary holdings of the two assets) are encouraged or discouraged by equity culture in the presence of borrowing constraints depends on two competing factors (Fig. 10). On one hand, households with equity culture can build a precautionary wealth buffer with stocks, even when precautionary bond holding is zero. On the other hand, their precautionary holdings of the riskless asset tend to be constrained to zero for a wider range of constraint tightness (see Fig. 9). As Fig. 10 shows, at very low k, the former effect dominates because borrowing constraints are binding regardless of equity culture. As k increases, however, the household without equity culture becomes unconstrained, and this allows it to accumulate more precautionary wealth, albeit in only one asset. For even larger k, the ranking of precautionary wealth is restored to that observed without borrowing constraints. All in all, the likely effects of equity culture on precautionary asset holdings depend crucially on prevailing credit market conditions.

6. Limitations and Extensions

We have used models with a small number of periods and states of the world, but have solved them for different preference specifications, earnings processes, with and without borrowing constraints, and for a large number of possible values of risk aversion and constraint tightness. It is computationally feasible to expand the number of periods and of states, thus obtaining year-by-year predictions of consumption and portfolio shares. Because of the different computational algorithms suitable for such models, it becomes very difficult to obtain solutions for specifications without borrowing constraints, because the grid of possible values for endogenous variables is too wide. Even if borrowing constraints are imposed, mapping the effects of so many

different parameter configurations entails enormous computational costs. In any event, qualitative results from small-scale models are consistent with those from larger scale models in cases for which larger models have been solved and the two can be compared.[19]

Our analysis was conducted in partial equilibrium, for given processes of asset returns. Future research can analyze how the effects of the behavior of new stockholders are likely to be divided between responses of asset returns, asset supplies, and responses of experienced participants, both in steady state and in the transition to it. The task is worthwhile but challenging.

The existing limited-participation literature focuses only on comparisons of steady states. It closes the portfolio model by specifying exogenously fixed asset supplies and an exogenous allocation rule for separating households into nonstockholders and (potential) stockholders. Specifically, the supply of stocks is restricted to be the same across steady states regardless of the extent of equity culture in the population, while the net supply of bonds is assumed to be zero thus precluding the existence of outside (e.g., government) debt. The household allocation rule typically amounts to specifying exogenously a percentage or category of households (e.g., workers) who are assumed to have no access to stocks, and then either imposing that the rest (e.g., entrepreneurs) hold stocks or giving them the option to hold stocks. In such an environment, the models have usefully shown that asset returns are not likely to change much in response to more extensive participation.

A number of hurdles need to be overcome before limited-participation, general-equilibrium models are fully adapted to analyze the spread of equity culture. Instead of being fixed, stock or bond supplies may well change as the equity culture spreads. Indeed, privatization in the UK was what stimulated the huge advertising

campaign popularizing stock investments. The supply of bonds, government or corporate, can also change in response to a spread in equity culture, e.g. as a result of monetary policy measures or changes in the financing decisions of companies.

If the allocation of households into stockholders and nonstockholders is to be made endogenous, we need to identify the sources of limited participation. The stockholding puzzle is not fully resolved yet, though there is some theoretical and empirical evidence that reasonably small entry costs could deter households from entering the stock market. An important element in participation decisions is earnings risk, but only some of the existing limited participation models allow for it. Without earnings risk, the incomes of stockholders are unrealistically volatile relative to those of nonstockholders, thus distorting the choice faced by potential entrants.

Moreover, uniqueness of participation equilibrium is not guaranteed. For example, as shown by Allen and Gale (1994), multiple equilibria exist when asset market volatility declines with household participation in the stock market: the expectation of high (low) volatility discourages (encourages) participation, confirming the expectation. Finally, the point to moving towards general equilibrium models of equity culture is to be able to address not only portfolios but also asset returns. Such a move can compound portfolio puzzles with asset return puzzles as long as the equity premium puzzle remains unresolved.

7. Concluding remarks

We have investigated how receipt of information regarding stockholding is likely to affect the consumption, saving, borrowing, and precautionary behavior of households. We found that equity culture tends to encourage households to increase current consumption and their demand for loans, both for asset purchase and for consumption. This is consistent with recently observed upward trends in household indebtedness.

Young entrants facing tight borrowing constraints may not increase current consumption demand, despite improved future wealth prospects arising from the equity premium. Such increases will be optimal, by contrast, when binding borrowing limits are higher, or when either limits are so high or households so risk averse that borrowing constraints are not binding. Moreover, the effects of a given change in credit conditions are influenced by whether or not the household perceives stocks as part of the asset menu.

Equity culture is also likely to enhance the tendency of households to make precautionary adjustments to consumption, wealth holding, and borrowing in the face of earnings risk. Households are likely to be more eager to safeguard future consumption prospects when faced with exogenous increases in earnings risk, despite better wealth prospects due to the equity premium. The effects of equity culture on the tendency to hold precautionary assets can be reduced, eliminated, or even reversed by binding borrowing limits.

Understanding the tendencies likely to be exhibited by new stock market participants is a useful first step on the road towards identifying the full economic consequences of the spread of equity culture. Based on the expansion of the stockholder base in the last decade, on the prospects for further expansion, and on the numerous theoretical, institutional, and policy issues this raises, further steps in this direction are worthwhile.

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Endnotes

[1] Risky financial assets in the Dutch data include stocks, bonds, mutual funds and/or mutual fund accounts.

[2] Risky financial assets in Italian data include stocks, long term government bonds, other bonds, mutual funds, and defined contribution pensions.

[3] Bonds other than government bonds and savings certificates, mutual funds, and stocks.

[4] See, for example, the seminal papers by Leland (1968), Sandmo (1970), and Kimball (1990, 1993).

[5] See Deaton (1991), Carroll (1992, 1997), Haliassos and Bertaut (1995), Guiso et al. (1996), Bertaut and Haliassos (1997), Heaton and Lucas, (1997, 2000), Constantinides et al. (1998), Campbell (1999), Haliassos and Michaelides (1999a), Cocco et al. (1999), Haliassos and Hassapis (2001).

[6] In a model without background income risk, the intertemporal elasticity of substitution, σ is equal to $(1-\rho)^{-1}$.

[7] For example, Marcet and Singleton (1991) argue that financial institutions commonly impose a constraint that the costs of servicing personal debt not exceed one-third of personal income. In their case as in ours, of one-period debt, the constraint applies to the repayment of principal and interest on loans. Ludvigson (1999) models the credit limit as a function of current income.

[8] The low value turns out to be -0.140753187, while the high value is 5.851241209.

[9] The low value of the dividend yield we use is 0.849246813, and the high value is 2.005997198.

[10] It is not possible to use single-year cells, because of the small number of observations once we condition both on education and on age. Five-year cells are used whenever possible. For example, we identify college graduates between 20 and 25 years of age, compute their mean income, and use this observation as the deterministic component of income for ages 20 to 25 when computing the present value of income in the first twenty-year period of life. We repeat the exercise for all other 5-year ranges until the age of 80. We should note that estimating deterministic profiles from a cross section does not incorporate any cohort effects that may be present in the data.

[11] For high-school dropouts, scaled down age-earnings profiles for the three periods of life are (Y_1, Y_2, Y_3)= (15019, 21570, 13633), for high-school graduates (25920, 37583, 22032), and for college graduates (39483, 75527, 49663).

[12] In fact, since shocks are assumed to be lognormally distributed, we adjust these annual income realizations so as to remove the unwanted effects of lognormally distributed shocks on the mean. These adjustments are described in detail in Bertaut and Haliassos (1997). Annual income realizations, so adjusted, are then used to compute realizations of twenty-year present values.

[13] If Y_t refers to income in period t,, while h and l refer to the high and low income states respectively, then the benchmark income figures under labor income risk are the following. For high-school dropouts, $(Y_1, Y_{2h}, Y_{2l}, Y_3)$ equals (15019, 30088.5, 13219.5, 13633), for high-school graduates, (25920, 48691, 26219, 22032), while for college graduates, (39483, 96010, 55338, 49663).

[14] In an unpublished paper, Gollier and Kimball (1996) have derived a condition for the wealth effect to dominate the precautionary effect thus increasing initial consumption, but in a model without background labor income risk. The condition is $P < 2A$, which happens to be satisfied by our utility function. For a description of their result, see also Gollier (2000).

[15] The source of the range effects can be seen as follows. The width of the range of second-period cash on hand is given by $WID=(y2+R_sS_{0,Max}+R_BB_{0,Max}) - (y2+R_sS_{0,Min}+R_BB_{0,Min})$, where R_s and R_B are the realized second-period gross asset returns on stocks and bonds, respectively, $S_{0,Max}$ ($S_{0,Min}$) is first-period stockholding undertaken by the household with the maximum (minimum) second-period cash on hand in the relevant state, and correspondingly for $B_{0,Max}$ and $B_{0,Min}$. Labor income cancels out, and the width depends only on the stock return state. In the saving model, it is state-independent. In the portfolio model, it is bigger if high rather than low stock returns are realized. Finally, in high (low) stock-return states, the worst cash on hand outcome is higher (lower) in the presence of stocks than in their absence. This yields the expansion in the overall range of attainable outcomes.

[16] An exception occurs at risk aversion of 2 and 3 in our calibration, where high school graduates appear to have slightly larger variability.

[17] Preferences exhibit prudence if the third derivative of the felicity function in positive.
[18] It also holds for percentage changes at any level of cash on hand considered.
[19] For comparisons of small- and large-scale models, see Haliassos and Michaelides (1999b).

Table 1: Consumption Effects of the Introduction of Stocks in the Asset Menu by Education Group and Degree of Relative Risk Aversion

Degree of Relative Risk Aversion	Household Without Equity Culture					Household With Equity Culture					
	First Period Cons.	Expected Second Period Cons.	Expected Third Period Cons.	Coefficients of Variation of Future Cons.	Expected Lifetime Utility	First Period Cons.	Expected Second Period Cons.	Expected Third Period Cons.	Coefficients Of Variation		Expected Lifetime Utility
									Second-period Cons.	Third-period Cons.	
Less than High School Education											
2	18277	15647	10346	0.274	16971	20462	29729	35587	0.564	0.888	21563
3	16008	15163	11509	0.254	14627	17841	22753	24520	0.417	0.625	17278
4	14791	14848	12074	0.244	13659	16259	19914	20682	0.341	0.489	15520
5	14025	14640	12407	0.239	13086	15229	18410	18805	0.299	0.410	14516
6	13496	14494	12627	0.235	12697	14510	17490	17711	0.274	0.360	13855
7	13108	14387	12783	0.232	12412	13981	16871	17001	0.258	0.327	13385
8	12811	14305	12899	0.230	12195	13577	16428	16504	0.248	0.304	13033
9	12578	14240	12989	0.228	12024	13258	16095	16137	0.241	0.287	12759
10	12390	14187	13060	0.227	11886	13002	15834	15855	0.236	0.275	12541
High School Education											
2	31874	26160	17299	0.218	29378	35803	51053	61112	0.575	0.897	37443
3	28032	25375	19260	0.202	25469	31297	38850	41867	0.418	0.626	30141
4	25991	24850	20207	0.194	23899	28600	33860	35166	0.333	0.483	27189
5	24712	24500	20764	0.190	22986	26850	31204	31873	0.284	0.398	25516
6	23826	24255	21132	0.187	22366	25626	29573	29947	0.253	0.344	24419
7	23175	24077	21394	0.185	21911	24724	28477	28695	0.233	0.306	23635
8	22673	23942	21590	0.183	21559	24032	27694	27821	0.219	0.280	23045
9	22276	23837	21743	0.182	21279	23484	27106	27178	0.209	0.260	22583
10	21953	23751	21866	0.181	21051	23040	26650	26685	0.202	0.245	22213
College Education											
2	64763	50260	31774	0.201	57274	72615	93993	102459	0.557	0.862	72636
3	55907	48495	35721	0.185	49242	62388	72598	73775	0.403	0.599	58208
4	51304	47287	37598	0.178	46026	56452	63533	63242	0.320	0.461	52351
5	48461	46473	38685	0.174	44171	52661	58609	57915	0.271	0.380	49039
6	46516	45901	39395	0.171	42921	50040	55545	54742	0.240	0.327	46870
7	45094	45481	39896	0.169	42007	48119	53468	52654	0.220	0.290	45322
8	44006	45162	40270	0.167	41301	46652	51973	51183	0.206	0.264	44157
9	43146	44911	40560	0.166	40739	45494	50847	50094	0.196	0.245	43245
10	42449	44709	40791	0.165	40279	44558	49970	49257	0.189	0.231	42511

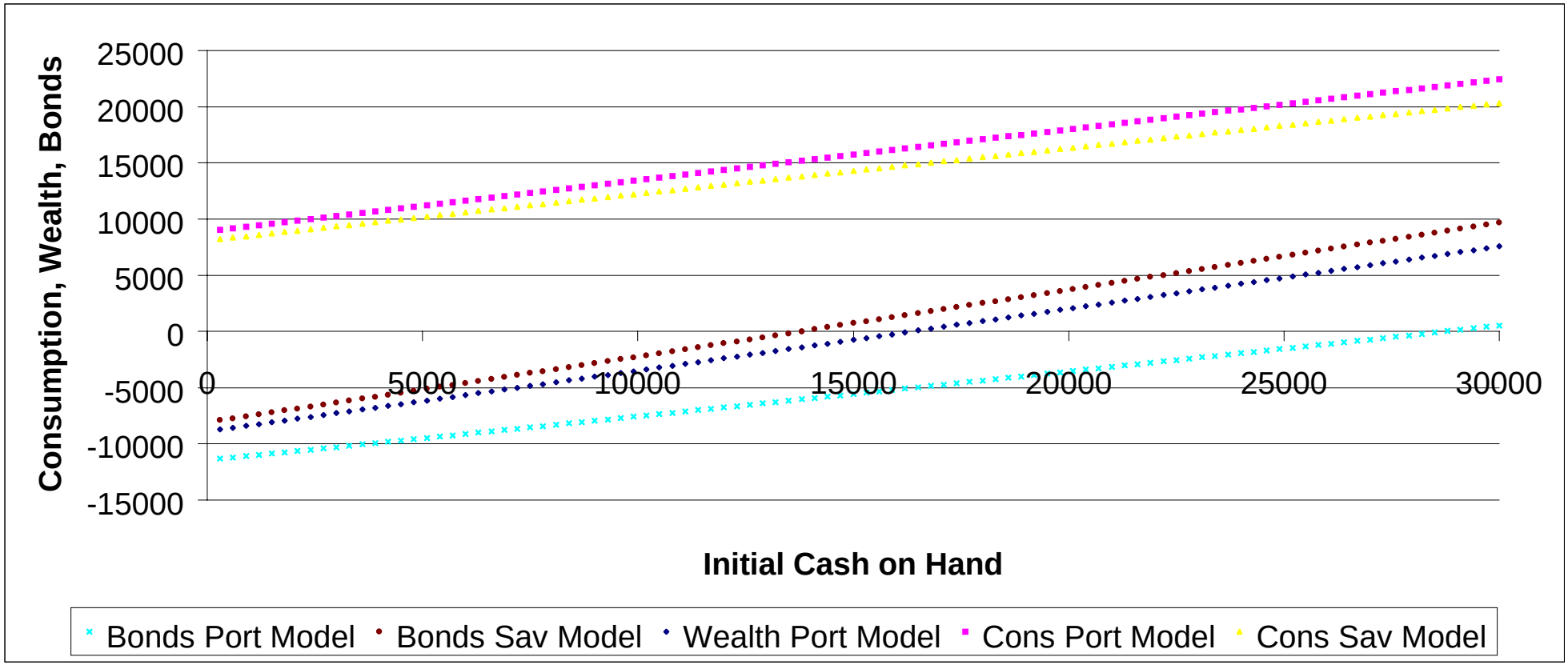
Notes: The household without equity culture can only hold the riskless asset (bonds), while the household with equity culture perceives access to both stocks and bonds. Cons. stands for consumption.

Table 2: Precautionary Effects on Consumption, Wealth, and Borrowing

Degree Of Relative Risk Aversion	Household Without Equity Culture		Household With Equity Culture		
	Precautionary Decrease in Consumption and Increase in Wealth	Precautionary Decrease in Consumption (%)	Precautionary Decrease in Consumption and Increase in Wealth	Precautionary Decrease in Consumption (%)	Precautionary Increase in Riskless Asset Holdings (or Reduction in Debt)
Less than High School Education					
2	1255.91	6.430	1657.42	7.493	2992.32
3	1318.78	7.611	1600.03	8.230	2553.34
4	1410.13	8.704	1631.26	9.118	2396.28
5	1497.67	9.648	1681.88	9.946	2321.53
6	1574.22	10.446	1732.89	10.669	2279.23
7	1639.02	11.114	1778.70	11.287	2252.29
8	1693.23	11.674	1818.12	11.810	2233.67
9	1738.49	12.143	1851.48	12.254	2220.00
10	1776.39	12.540	1879.57	12.630	2209.52
High School Education					
2	1438.02	4.317	1920.52	5.091	3457.46
3	1517.63	5.136	1859.03	5.607	2975.05
4	1638.67	5.931	1910.63	6.262	2829.09
5	1761.22	6.653	1990.55	6.902	2779.24
6	1874.29	7.293	2073.96	7.487	2764.39
7	1974.91	7.853	2152.32	8.008	2763.59
8	2062.96	8.340	2222.82	8.466	2768.52
9	2139.41	8.763	2284.99	8.867	2775.59
10	2205.62	9.130	2339.29	9.217	2783.19
College Degree or More					
2	2384.17	3.551	3199.00	4.220	5656.38
3	2489.74	4.263	3054.76	4.668	4873.38
4	2686.43	4.976	3134.75	5.261	4654.54
5	2894.74	5.637	3273.37	5.852	4596.36
6	3092.19	6.233	3422.99	6.403	4595.43
7	3271.60	6.764	3566.73	6.901	4616.02
8	3431.40	7.233	3698.43	7.345	4643.95
9	3572.28	7.646	3816.40	7.740	4673.18
10	3695.89	8.009	3920.84	8.088	4701.18

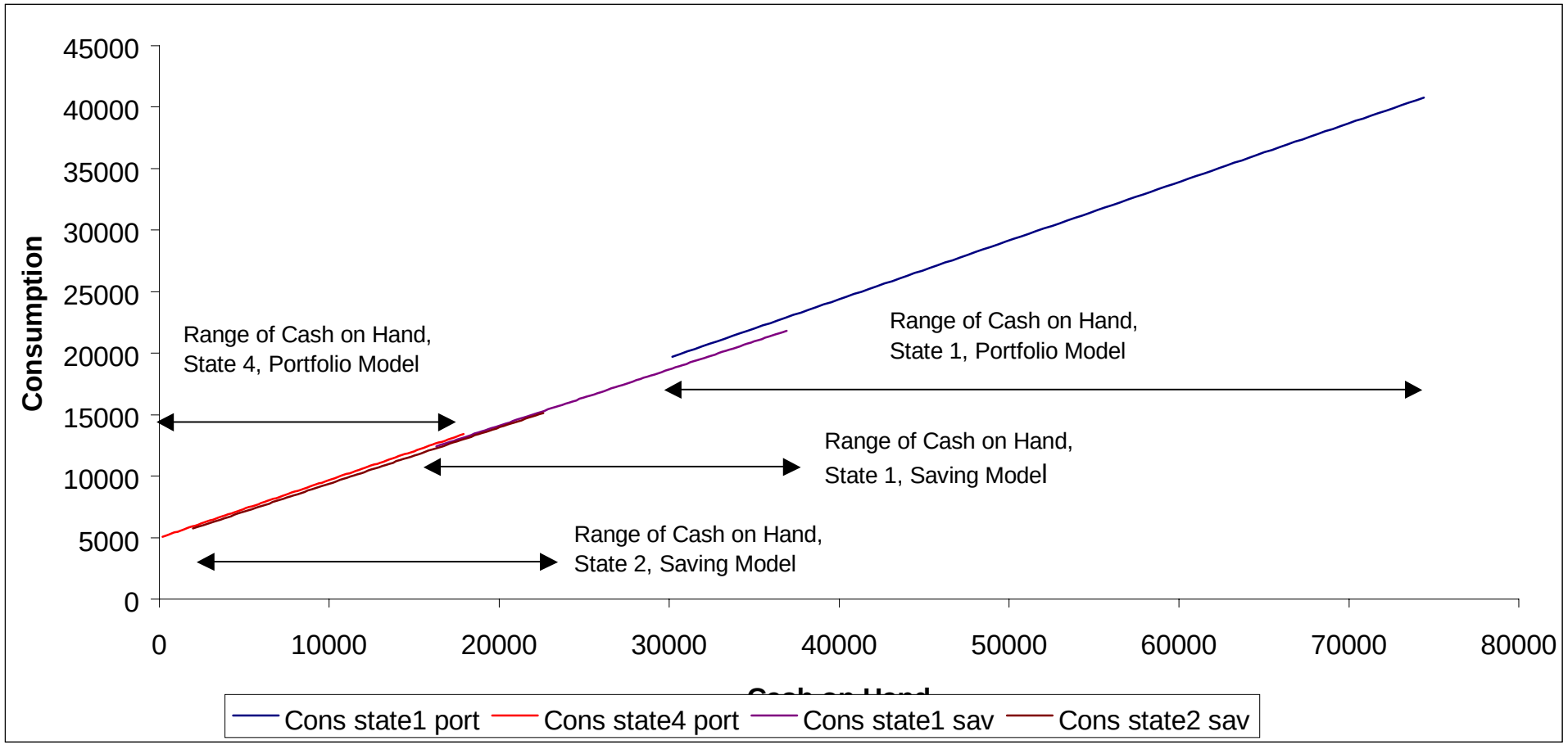
Notes: See Table 1.

Figure 1: Policy Functions for Consumption, Wealth and Bonds
in the Saving and in the Portfolio Model



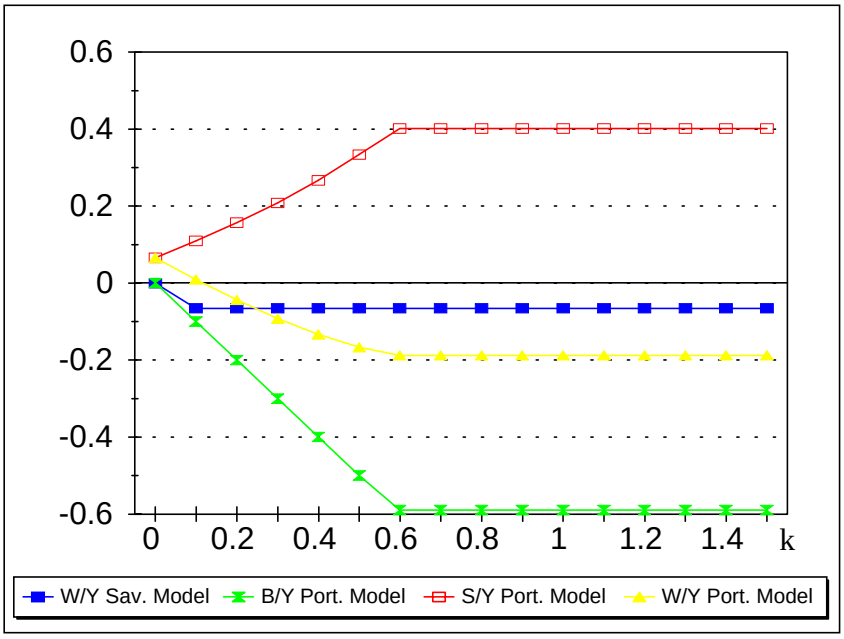
Notes: The figure presents results for Young High School Dropouts.

Figure 2: Second-Period Policy Functions for Consumption
in Saving and in Portfolio Models



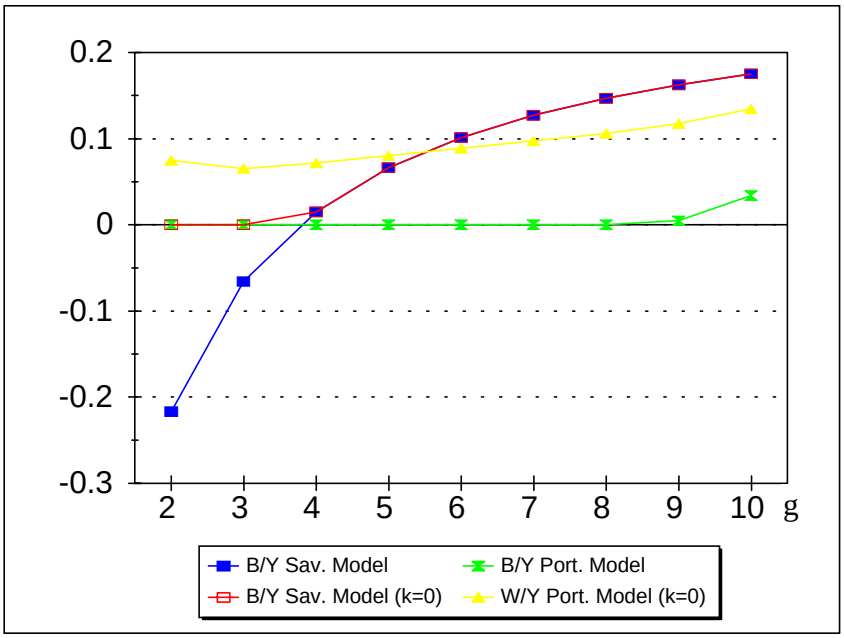
Notes: The figure presents results for Middle-Aged High-School Dropouts

Figure 3: Effects of Borrowing Constraint Tightness on Asset-to-Income Ratios in the Saving and Portfolio Models



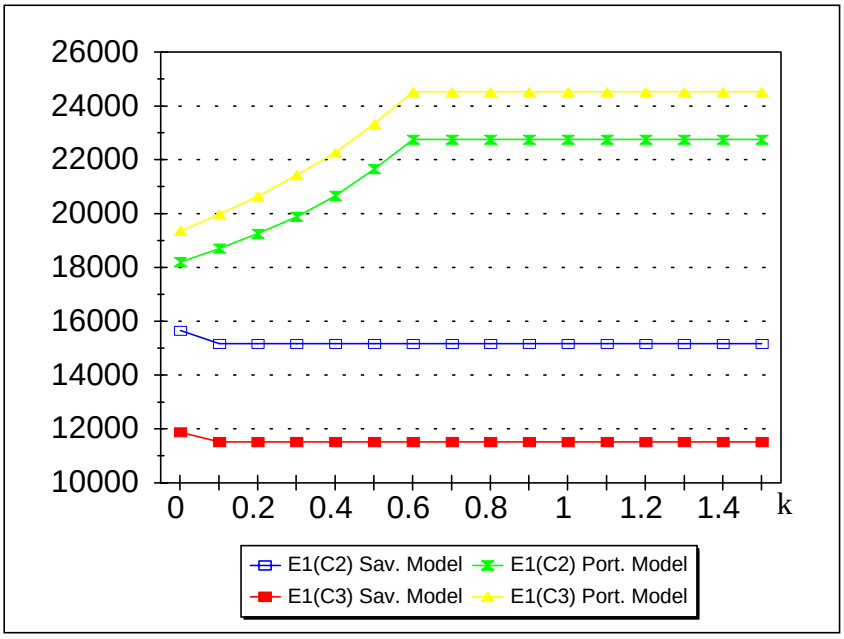
Notes: The figure presents results for Young High School Dropouts. B/Y stands for the ratio of first-period bond to labor income. S/Y stands for the ratio of first-period stock to labor income. The risk aversion g is equal to 3. The household faces borrowing limits equal to kY in each period of life.

Figure 4: Effects of Risk Aversion on Asset-to-Income Ratios in the Saving And Portfolio Models with Borrowing Constraints



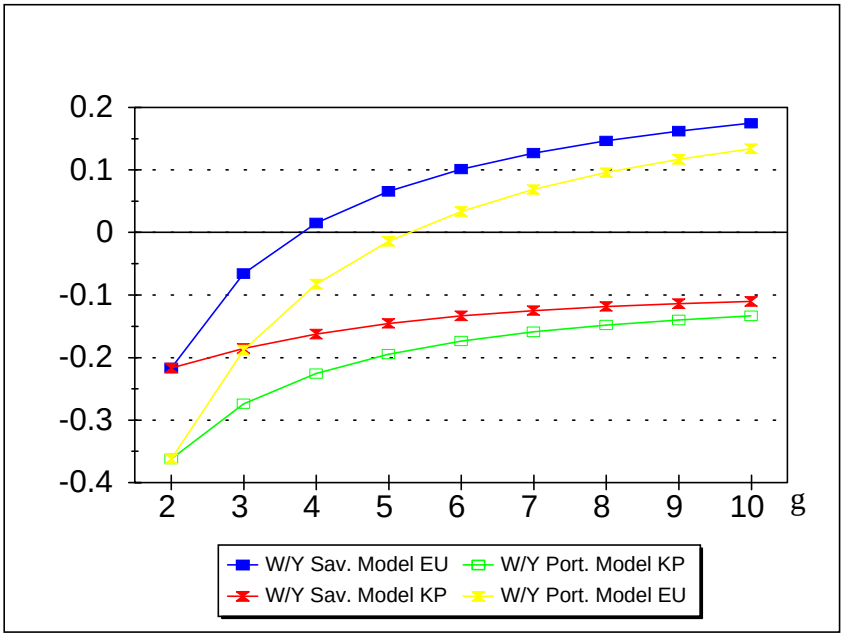
Notes: The figure presents results for Young High School Dropouts. B/Y stands for the ratio of first-period bond to labor income. S/Y stands for the ratio of first-period stock to labor income. k=0 prohibits borrowing at the riskless rate. g is the risk aversion

Figure 5: Effects of Changes in Borrowing Limits on expected Second-Period Consumption



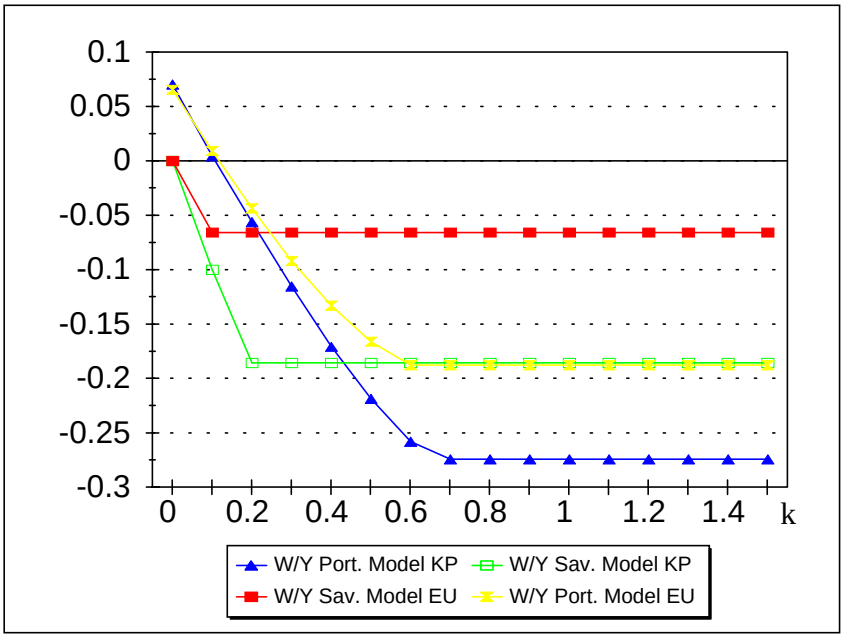
Notes: The figure presents results for Young High School Dropouts. E1(C2) stands for the expected second period consumption based on information at the beginning of life. E1(C3) stands for the expected third period consumption based on information at the beginning of life. The household faces borrowing limits equal to kY in each period of life.

Figure 6: Wealth Predictions of Saving and Portfolio Models Under EU and KP Preferences and Various Degrees of Risk Aversion



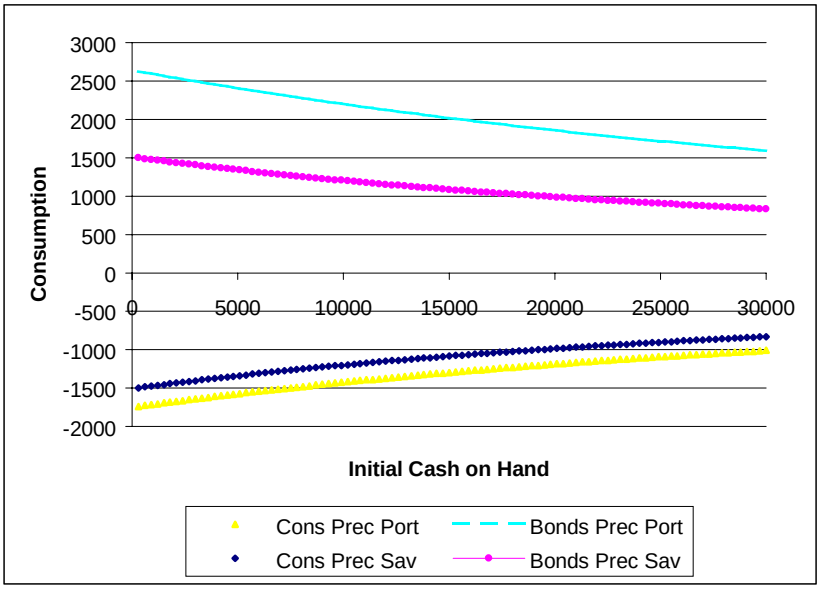
Notes: The figure presents results for Young High School Dropouts. W/Y stands for the ratio of first-period wealth to labor income. EU stands for the expected utility model. KP stands for the Kreps-Porteus model. g is the risk aversion

Figure 7: Differences in Wealth Predictions between EU and KP Preferences for Saving and Portfolio Models and Various Degrees of Constraint Tightness



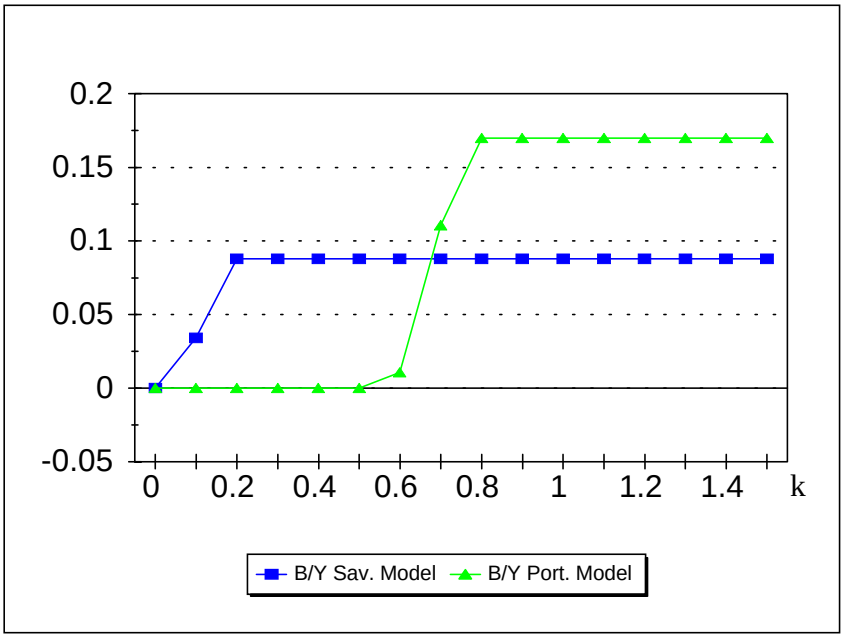
Notes: The figure presents results for Young High School Dropouts. W/Y stands for the ratio of first-period wealth to labor income. EU stands for the expected utility model. KP stands for the Kreps-Porteus Model. The household faces borrowing limits equal to kY in each period of life.

Figure 8: Precautionary Effects on First-Period Consumption and Bond Holding. Saving versus Portfolio Model



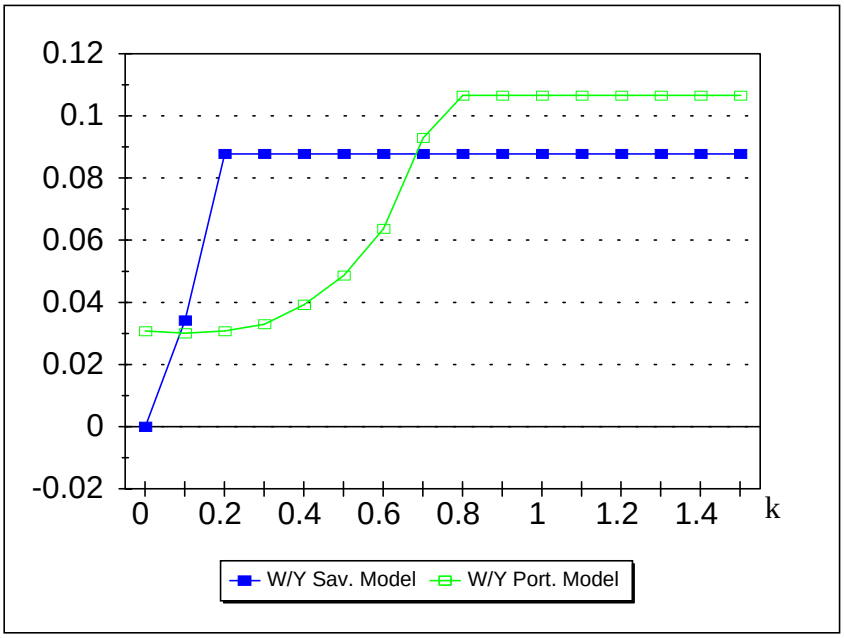
Notes: The figure presents results for Young High School Dropouts.

Figure 9: Precautionary Effects on Bondholding. Saving versus Portfolio Model under Various Degrees of Constraint Tightness



Notes: The figure presents results for Young High School Dropouts. B/Y stands for the ratio of first-period bond to labor income. The household faces borrowing limits equal to kY in each period of life.

Figure 10: Precautionary Effects on Wealth Holding Saving versus Portfolio Model under Various Degrees of Constraint Tightness



Notes: The figure presents results for Young High School Dropouts. W/Y stands for the ratio of first-period wealth to labor income. The household faces borrowing limits equal to kY in each period of life.

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