The Spirit of Capitalism and Stock-Market Prices

By GURDIP S. BAKSHI AND ZHIWU CHEN*

In existing theory, wealth is no more valuable than its implied consumption rewards. In reality investors acquire wealth not just for its implied consumption, but for the resulting social status. Max M. Weber refers to this desire for wealth as the spirit of capitalism. We examine, both analytically and empirically, implications of Weber's hypothesis for consumption, savings, and stock prices. When investors care about relative social status, propensity to consume and risk-taking behavior will depend on social standards, and stock prices will be volatile. The spirit of capitalism seems to be a driving force behind stock-market volatility and economic growth. (*JEL* G1, G10, G11, G12)

In neoclassic economic models, the accumulation of wealth is often taken to be solely driven by one's desire to increase consumption rewards. This assumption is best demonstrated by the objective function in most consumption-portfolio and growth models:

$$\max_{C_\tau, \alpha_\tau : \tau \in [t, \infty)} E_t \int_t^\infty u(C_\tau, \tau)\, d\tau,$$

subject to certain lifetime budget constraints, where $u(\cdot, \cdot)$ is the utility of consumption; W_t and C_t are respectively time t wealth and consumption; and α_t stands for some other controls, such as portfolio weights. In those models, wealth is clearly no more valuable than the maximum amount of consumption utility that it can bring. Because consumption rewards are the only things that matter, everything has to be valued according to its relation with consumption. Thus, for instance, the equilibrium price of an asset is completely determined by its consumption beta (Douglass T. Breeden, 1979; Robert E. Lucas Jr., 1978).

While the aforementioned motive is an important—perhaps the most important—motive for wealth accumulation, it is, however, not the only important motive behind the sometimes relentless acquisition of wealth, in part because biological needs as well as social norms and customs put a limit on how much an individual can consume. To quote from Lee Iacocca (1988):

> Once you reach a certain level in a material way, what more can you do? You can't eat more than three meals a day; you'll kill yourself. You can't wear two suits one over the other. You might now have three cars in your garage—but six! Oh, you can indulge yourself, but only to a point. [Iacocca, 1988 p. 67]

Harold L. Cole et al. (1992) argue that the consumption motive fails to explain why such already rich individuals as Donald Trump "continue to work long days, endure substantial amounts of stress, and take enormous risks," for "he seems to have more money than he could spend in several life times" (pp. 1115–16). A possible counter argument to Iacocca and Cole et al. is that they save and acquire more wealth not just for themselves but also for their offspring. This argument,

* Department of Economics and Finance, University of New Orleans, New Orleans, LA 70148, and University of Maryland; Fisher College of Business, Ohio State University, 1775 College Road, Columbus, OH 43210, respectively. We have benefitted from comments by William Brock, Tzu-Kuan Chiu, George Constantinides, William Goetzmann, Stephen Heston, Jon Ingersoll, David Mauer, R. Preston McAfee (the editor), Yuki Naka, Steve Ross, Robert Shiller, Ken West, Heng-Fu Zou, and particularly, three anonymous referees. We would also like to thank the seminar participants at Columbia University, Emory University, Northwestern University, Tulane University, University of California-Irvine, University of Houston, University of New Orleans, and University of Wisconsin-Madison. Any remaining errors are ours alone.

however, is not consistent with the empirical evidence that no significant difference exists in the rate of asset decumulation between the elderly with and without children (Michael D. Hurd, 1986). Given that increasing consumption rewards cannot be the sole motive behind wealth acquisition, it may not be surprising that consumption-based asset pricing, savings, and growth models have failed to consistently explain the relevant real-life data. Among the most damaging pieces of evidence, aggregate consumption is too smooth to justify the volatile stock returns.[1]

Building on work by Chen (1990), Cole et al. (1992), Arthur J. Robson (1992), and Heng-Fu Zou (1992, 1994), we examine in the present paper, both analytically and empirically, the implications for consumption, portfolio holdings and stock-market prices of the hypothesis that investors accumulate wealth not only for the sake of consumption but also for wealth-induced social status. According to Max M. Weber (1958), this hypothesis essentially captures the spirit of capitalism:

> Man is dominated by the making of money, by acquisition as the ultimate purpose of his life. Economic acquisition is no longer subordinated to man as the means for the satisfaction of his material needs. This reversal of what we should call the natural relationship, so irrational from a naive point of view, is evidently a leading principle of capitalism. (Weber, 1958 p. 53)

This view of the capitalistic spirit has been shared by many other contemporary and past economists including Adam Smith, John S. Mill, J. Schumpeter, and John M. Keynes.[2] In the case of Keynes (1971), he wrote:

> ... society was so framed as to throw a great part of the increased income into the control of the class least likely to consume it. The new rich ... preferred the power which investment gave them to the pleasures of immediate consumption ... Herein lay, in fact, the main justification of the capitalist system ... And so the cake increased; but to what end was not clearly contemplated ... Saving was for old age or their children; but this was only in theory—the virtue of the cake was that it was never to be consumed, neither by you nor by your children after you. (pp. 11–12)

As in Robson (1992), we formalize the spirit-of-capitalism hypothesis by assuming each investor's lifetime preferences are representable in the following form

$$\int_0^\infty e^{-\rho t} E_t\{u(C_t, S_t)\}\ dt,$$

where S_t is the investor's relative social standing. We postulate S_t is strictly increasing in wealth (so as to reflect the spirit of capitalism) but decreasing in social-wealth standards (so that status is only relative). In explaining why in a capitalist society the pursuit of wealth is in part for the sake of wealth-enhanced status, Robert H. Frank (1985) observes that human beings face constant contests for position in society and relative status often dictates who gets to receive the prizes. Cole et al. (1992), for instance, argue that wealth determines status, which in turn regulates such things as marriage patterns.[3] In particular, they show that if that is the case, the reduced form preferences of investors will take the general structure as given above. In this sense, we can treat their analysis as providing a micro foundation for the preferences studied here.

Economies populated with status-conscious investors exhibit characteristics distinct from those with the standard agents. To mention a

[1] For empirical studies on the consumption-based pricing theory, see, among others, Lars P. Hansen and Ravi Jagannathan (1991, 1994), Hansen and Kenneth J. Singleton (1982), and Rajnish Mehra and Edward C. Prescott (1985). The general conclusion is that the smooth consumption process cannot explain the observed stock prices, unless the representative agent's risk aversion is unrealistically high.

[2] See Zou (1992, 1994) for a review of the history of economic thought and more references on this topic.

[3] They quote from Madonna's song *Material Girl* that "The boy with the cold hard cash is always Mister Right ..." and from Harold J. Perkin (1969) that "the pursuit of wealth *was* the pursuit of social status, not merely for oneself but for one's family."

few examples, optimal consumption-portfolio plans will be functions of not only one's own wealth and preference parameters but also social-wealth standards. Under one of three parametrized-preference models in this paper, the optimal propensity to consume is increasing in both one's relative social standing and own wealth but decreasing in (i) social-wealth standards (so as to "catch up with the Joneses"), (ii) the investor's aversion to poverty, and (iii) the degree to which the investor cares about status. Further, the investor is more averse to wealth risk (i) the more he cares about status, (ii) the higher the social-wealth standards, or (iii) the lower the investor's social standing. These and other characterizations have many important implications for consumption, savings, and portfolio choice behavior. In such economies, even if the consumption process is smooth, stock prices can be quite volatile. The spirit of capitalism is a driving force behind stock-market volatility.

To test the spirit-of-capitalism hypothesis that wealth acquisition is more than just for its consumption rewards, we subject the asset-pricing equation under one parametrized-preference model to monthly U.S. data. The test methods used include the Hansen and Jagannathan (1991) volatility-bound diagnostics, Hansen and Jagannathan (1994) specification-error tests, and the Hansen (1982) generalized method of moments (GMM) tests. Overall, the estimated values and signs of the preference parameters are supportive of the hypothesis. In particular, when compared to the standard expected-utility theory, our preference model that takes into account concerns about wealth-induced status does a better job in explaining empirically observed stock prices.

The paper is organized as follows. In Section I, we first introduce the preference structure as well as three parametrized models, and then define the investor's consumption-portfolio problem. A general asset-pricing result is also given there. Section II studies closed-form solutions to the consumption-portfolio problem under the parametrized-preference models. Section III presents results from the empirical tests. Section IV offers concluding remarks. Proof of each result is given in Appendix A, and description of the data used in the tests is provided in Appendix B.

I. A General Framework with the Spirit of Capitalism

In this section, we first outline a class of preferences that depend on relative wealth status and then offer a general characterization of the consumption-portfolio problem. Asset-pricing equations are also presented without assuming parametric functional forms for the preferences.

A. *Preferences*

Assume there is a sole perishable consumption good that is also used as the value numeraire. For a generic investor, let his consumption (flow) and relative wealth status be, respectively, C_t and S_t, from time t to $(t + \Delta t)$. The preferences of this infinitely-lived investor are assumed to be representable by

$$\sum_{t \in \{0, \Delta t, 2\Delta t, \dots\}} e^{-\rho t} E_0[u(C_t, S_t)]\, \Delta t, \tag{1}$$

where ρ is the time-preference parameter and Δt the time length in-between decision points. In addition to requiring that $u(C_t, S_t)$ be twice continuously differentiable, we impose the following restrictions: $u_C > 0$ (more consumption is strictly better), $u_S > 0$ (higher status is strictly preferred), and $u_{CC} < 0$ (utility increases in consumption but at a decreasing speed), where a subscript on u denotes the partial derivative of u with respect to the corresponding argument. In Robson (1992), u is assumed to be convex in status, that is, $u_{SS} < 0$. As for the cross partial derivative, u_{CS}, it can take either sign. If the Harry M. Markowitz (1952) hypothesis holds,[4] we will have $u_{CS} <$

[4] According to Markowitz (1952), an increase (or decrease) in wealth will shift an investor's utility-of-consumption curve to the right (or the left). An interpretation of his hypothesis is that each time an investor's wealth status changes, it essentially causes him to go back and rerank the entire consumption set, such that the wealthier the investor, the less utility from a given unit of consumption. In some sense, this means an increase in wealth can "spoil" the investor's tastes.

0; otherwise, $u_{CS} \geq 0$. For our general discussion, we leave both second-order derivatives unrestricted in sign.

The relative wealth-status variable, S_t, deserves a few clarifications. First, assume S_t is strictly increasing in the investor's absolute wealth at time t, denoted by W_t, so that higher wealth means higher status regardless of the wealth distribution for the group of people with whom the investor has social or professional contacts. Second, assume S_t is a function of the social group to which the investor belongs, so that for a given level of wealth W_t, the investor's relative status will be high (low) if he compares himself to a group of low-income (high-income) consumers.[5] While the investor's relative status should in general depend on the entire wealth distribution of his reference group, we assume that S_t is only a function of W_t and V_t:

$$S_t = f(W_t, V_t), \tag{2}$$

for some $f(\cdot, \cdot)$ such that $f_W > 0$ and $f_V < 0$, where V_t is what determines "middle class" within the investor's reference group. We refer to V_t as the *social-wealth index*. It should be emphasized that for different consumers, their wealth references, V_t, can be quite different, depending on the social or professional groups to which they compare themselves. The higher the incomes of the members in the reference group, the higher V_t. Substituting (2) into the period utility $u(C_t, S_t)$ gives the induced utility: $U(C_t, W_t, V_t) \equiv u[C_t, f(W_t, V_t)]$, where $U(C_t, W_t, V_t)$ is also twice continuously differentiable, with $U_C > 0$, $U_{CC} < 0$, $U_W > 0$, $U_V < 0$.

The following three parametrized models of preferences are useful for later sections.

Model 1.—Absolute wealth is status: $S_t = W_t$, with the period utility given by

$$U(C_t, W_t, V_t) = \frac{C_t^{1-\gamma}}{1-\gamma} W_t^{-\lambda}, \tag{3}$$

where $\gamma > 0$, and $\lambda \geq 0$ when $\gamma \geq 1$ and $\lambda < 0$ otherwise. The magnitude, $|\lambda|$, measures the extent to which the investor cares about status.

This specification is consistent with those in Mordecai Kurz (1968), Chen (1990), and Zou (1992, 1994) as well as with the previous quotes from Weber (1958) and Keynes (1971). Note that since any reasonable notion of the spirit of capitalism must have status strictly increasing in wealth W_t, we can think of Model 1 as capturing the first-order effect of wealth on status determination and hence on the period utility. This is particularly true when the wealth distribution for the reference group and V_t are constant over time, because in that case the utility in (3) can be treated as the reduced-form of $u[C_t, f(W_t, V_t)]$.

Model 2.—The ratio of one's own wealth to the social-wealth index determines status: $S_t = W_t/V_t$, with the utility given by

$$U(C_t, W_t, V_t) = \frac{C_t^{1-\gamma}}{1-\gamma}\left(\frac{W_t}{V_t}\right)^{-\lambda}, \tag{4}$$

where the parameters are as restricted in Model 1. This model also coincides with one in which the wealth contribution to utility is purely external.

Here, an investor is said to be in the middle class if $S_t = 1$, in the lower-wealth class if $S_t < 1$, and in the upper class otherwise. Model 2 collapses to Model 1 when the index V_t is constant over time.

Model 3.—Self-perception determines happiness: $S_t = W_t/V_t$ but the utility given by

$$U(C_t, W_t, V_t) = \frac{C_t^{1-\gamma}}{1-\gamma}(W_t - \kappa V_t)^{-\lambda}, \tag{5}$$

[5] This assumption seems natural in light of James S. Duesenberry's (1949 p. 48) observation: "Consider two groups with the same incomes. One group associates with people who have the same income as they have. The other group associates with people who have higher incomes than the members of the group. ... The two groups have the same income but the first will be better satisfied with its position than the second. Its members will make fewer unfavorable comparisons ..." (Duesenberry also provides early survey data demonstrating a positive connection between relative status and happiness.) Frank (1985) refers to status relative to one's group of close association as *local status*. He emphasizes that local status is of more concern to consumers than *global status*, because "Negative feelings are much more strongly evoked by adverse comparisons with our immediate associates than by those with people who are distant in place or time" (p. 9). In this sense, per-capita wealth for the whole country, for instance, may not be a good wealth reference for *every individual*.

for some constant $\kappa \geq 0$, where γ and λ are as restricted in Model 1 and κV_t is the investor's self-assessed reservation or subsistence wealth level.

Two points are worth noting. First, the utility in (5) is increasing both in W_t/V_t, which measures relative standing in the *objective wealth* distribution, and in $(W_t - \kappa V_t)$, which is the perceived position relative to the investor's reservation-wealth level. Second, W_t in Model 3 should never be less than or equal to the subsistence level κV_t (because otherwise the utility function would not be well defined). For a given κ value, this puts a strong restriction on the investor's consumption-portfolio behavior. An intuitive interpretation of this restriction follows. Suppose $\kappa = 1$. Then, the investor will never tolerate a wealth level below the social-wealth index (average) V_t, that is, the investor cannot tolerate the possibility of descending to the middle- or lower-wealth class. Since the coefficient κ reflects part of the investor's preferences, different investors will have different values for κ. Presumably, a consumer who was born to a low-wealth family can absorb economic hardships much better than someone born to a well-to-do family, in which case the former will have a lower κ value, or is said to be less averse to poverty, than the latter. Based on this observation, we refer to κ as *the poverty-aversion coefficient*. Of course, if one's wealth is low, it may not be feasible to have a high κ value. In this sense, the poor cannot feasibly imitate the rich by showing off with a high aversion to poverty. When $\kappa = 0$, Model 3 also becomes Model 1.

In some sense, Models 2 and 3 share the same spirit with, respectively, (i) Andrew B. Abel's (1990) "catching up with the Joneses" model in which he defines the period utility as a function of the ratio of one's own to aggregate consumption and (ii) John Y. Campbell and John H. Cochrane's (1995) habit formation model in which consumption felicity is a function of the difference between one's own and aggregate consumption. In drawing this comparison, however, one should keep in mind that in our case the wealth reference V_t is group specific and not necessarily the aggregate wealth.

B. *The Consumption-Portfolio Problem*

To introduce the investor's consumption-portfolio problem, assume that traded in this frictionless economy is one risk-free asset, with its constant rate of return given by r_0, and N risky assets with their prices at time t denoted by $P_{i,t}$, for $i = 1, ..., N$ and $t \in [0, \infty)$. These asset prices follow a vector-diffusion process:

$$(6) \qquad \frac{dP_{i,t}}{P_{i,t}} = \mu_{i,t}\, dt + \sigma_{i,t}\, d\omega_{i,t}$$

where $\mu_{i,t}$ and $\sigma_{i,t}$ are, respectively, the conditional expected value and standard deviation of the rate of return on asset i per unit time, and $\omega_{i,t}$ is a standard Wiener process. The variables, $\mu_{i,t}$ and $\sigma_{i,t}$, generally depend on the time t state of the economy.

To maintain a level of simplicity, assume that *one individual investor's* consumption-portfolio decision will have at most a negligible impact on the social-wealth index V_t (thinking of this index as reflecting a *large group's* average wealth level). Consumption-portfolio rebalancing by the investor takes place at discrete intervals of length Δt. Let the portfolio vector, $\boldsymbol{\alpha}_t \equiv (\alpha_{0,t}, \alpha_{1,t}, ..., \alpha_{N,t})$, be such that $\alpha_{i,t}$ is the fraction of time t savings invested in asset i and $\Sigma_{i=0}^{N} \alpha_{i,t} = 1$. The infinitely-lived capitalistic investor then chooses a plan, $\{(C_t, \boldsymbol{\alpha}_t): t = 0, \Delta t, ...\}$, so as to

$$(7) \qquad \max_{(C_t, \boldsymbol{\alpha}_t)} \sum_{t=0}^{\infty} e^{-\rho t} E_0 U(C_t, W_t, V_t)\, \Delta t$$

subject to the budget constraints

$$(8) \qquad W_{t+\Delta t} - W_t = \left\{ r_0 W_t - C_t + W_t \sum_{i=1}^{N} \alpha_{i,t}(\mu_{i,t} - r_0) \right\} \Delta t + W_t \sum_{i=1}^{N} \alpha_{i,t}\, \sigma_{i,t}\, \Delta\omega_{i,t}$$

$$\forall t = 0, \Delta t, \ldots .$$

Assume that $\{(C_t^*, \alpha_t^*): t = 0, \Delta t, ...\}$ is an optimal plan for (7). Following a variational argument in Sanford J. Grossman and Robert J. Shiller (1982), we arrive at the necessary Euler equation:

$$(9)\quad P_{i,t} = e^{-\rho\Delta t}E_t\left\{\frac{U_C(C_{t+\Delta t}^*, W_{t+\Delta t}^*, V_{t+\Delta t})}{U_C(C_t^*, W_t^*, V_t)} + \frac{U_W(C_{t+\Delta t}^*, W_{t+\Delta t}^*, V_{t+\Delta t})\,\Delta t}{U_C(C_t^*, W_t^*, V_t)}P_{i,t+\Delta t}\right\}.$$

The price of an asset should thus equal the expected future benefit that the asset can generate in terms of today's utility. This Euler equation differs from its state-independent expected-utility-based counterpart in that the intertemporal marginal rate of substitution in consumption (IMRS), denoted by m_t, is now a function of the investor's consumption, his wealth and the social-wealth index. Therefore, in an economy populated with capitalistic investors, we expect its IMRS to be volatile when the individual wealth processes and the social-wealth index are so. This is true even if the individual-consumption processes are quite smooth.

The discrete-time Euler equation in (9) is the basis for the empirical tests reported in Section IV. Other than for the empirical tests, we are, from now on, mainly interested in characterizing solutions to (7) in the continuous-time limit (i.e., as $\Delta t \to 0$). We first present a pricing characterization in Subsection C below.

C. *Asset-Price Restrictions*

Assume that in the continuous-time limit both the investor's optimal consumption and the social-wealth index follow a diffusion process:

$$(10)\quad \frac{dC_t^*}{C_t^*} = \mu_{c,t}\,dt + \sigma_{c,t}\,d\omega_{c,t},$$

$$(11)\quad \frac{dV_t}{V_t} = \mu_{v,t}\,dt + \sigma_{v,t}\,d\omega_{v,t},$$

where $\mu_{c,t}$, $\sigma_{c,t}$, $\mu_{v,t}$, and $\sigma_{v,t}$ generally depend on the state of the economy, and $\omega_{c,t}$ and $\omega_{v,t}$ are standard Wiener processes. A justification for this assumption is that when asset prices and optimal consumption follow diffusion processes, the resulting social-wealth index should be expected to follow a diffusion as well. In particular, based on (8), each individual investor's optimal wealth must then follow a diffusion.

PROPOSITION 1. *Suppose that in the continuous-time limit, the vector-diffusion process $\{(C_t^*, W_t^*): t \in [0, \infty)\}$ is the investor's optimal consumption-wealth path. Then, the risk premium on asset i must satisfy*

$$(12)\quad \mu_{i,t} - r_0 = -\frac{C_t^* U_{CC}}{U_C}\sigma_{i,c} - \frac{W_t^* U_{CW}}{U_C}\sigma_{i,w} - \frac{V_t U_{CV}}{U_C}\sigma_{i,v},$$

$$\forall i = 0, 1, \dots, N,$$

where $\sigma_{i,c}$, $\sigma_{i,w}$, and $\sigma_{i,v}$ are the covariances of asset i's return with, respectively, the individual investor's consumption growth, his wealth growth, and the growth on the social-wealth index, that is, $\sigma_{i,c}\,dt \equiv \mathrm{cov}_t(dP_{i,t}/P_{i,t},\ dC_t^*/C_t^*)$, $\sigma_{i,w}\,dt \equiv \mathrm{cov}_t(dP_{i,t}/P_{i,t},\ dW_t^*/W_t^*)$, and $\sigma_{i,v}\,dt \equiv \mathrm{cov}_t(dP_{i,t}/P_{i,t},\ dV_t/V_t)$, with $\mathrm{cov}_t(\cdot,\ \cdot)$ being the conditional covariance operator.

Equation (12) implies that in an economy populated with capitalistic investors, consumption risk is not the only risk that should be compensated for in equilibrium, as Breeden's (1979) consumption-based capital-asset-pricing model (CAPM) predicts. Instead, the expected-risk premium for a risky asset is determined by its covariation with each investor's consumption, his wealth, and the social-wealth index. Intuitively, when investors care about relative social standing, they will hedge not only against future consumption uncertainty but also against those factors that affect their future status. Since one's social status is determined by both his own wealth and the social-wealth index, risks that are correlated with these two variables should be compensated for.

To further appreciate Proposition 1, apply the utility of Model 1 to (12) to yield

$$\mu_{i,t} - r_0 = \gamma\sigma_{i,c} + \lambda\sigma_{i,w}, \tag{13}$$

which appears to resemble the pricing equation of Larry G. Epstein and Stanley E. Zin (1991 eq. 24) or Darrell J. Duffie and Epstein (1992 eq. 21) in the sense that equilibrium risk premium is determined by the covariance of the asset with both consumption and wealth growth. But, their model is fundamentally different from ours. In the case of Epstein and Zin where they examine a particular class of recursive preferences, wealth enters the pricing equation and the IMRS as a stand-in for tomorrow's utility index, whereas here wealth risk also matters because the investor cares about wealth-induced status. As will be noted later, however, the *discrete-time pricing equation under Model* 1 is distinct from the counterpart in Epstein and Zin (eq. 16). Besides, the two models impose different restrictions on γ and λ. To see this, recall that under Model 1, $\lambda \geq 0$ if $\gamma \geq 1$ and $\lambda < 0$ otherwise. Under Epstein and Zin's model, the restriction is that $\gamma > 0$ if $\lambda < 1$; $\gamma < 0$ if $\lambda > 1$; and $\gamma = 0$ if $\lambda = 1$. This is the case because the parameters λ and γ here have the following correspondence with their notation:

$$\lambda = 1 - \bar{\gamma} \quad \text{and} \quad \gamma = \frac{1 - \lambda}{\bar{\sigma}},$$

where $\bar{\gamma}$ is their "γ" and $\bar{\sigma} > 0$ is their elasticity coefficient (σ). Thus, one can still empirically distinguish our Model 1 from their model.

Substituting the utility in (4) of Model 2 into (12) yields

$$\mu_{i,t} - r_0 = \gamma\sigma_{i,c} + \lambda\sigma_{i,w} - \lambda\sigma_{i,v}. \tag{14}$$

Given $\gamma \geq 1$ and $\lambda > 0$, this implies that if an asset is positively correlated with the investor's consumption or wealth, it deserves a positive consumption or wealth-risk premium. In the mean time, the more positively correlated an asset is with the social-wealth index, the less risk premium it deserves, which may not come as a surprise. To see this, note that fixing the investor's wealth level, a rise in V_t leads to a decline in the investor's social status ($S_t = W_t/V_t$). Thus, an asset that is positively correlated with V_t should be desirable to the investor because adding it to the portfolio will increase the correlation between W_t and V_t, which helps better insure against future status uncertainty and allows the investor to "catch up with the Joneses."

Under the class of preferences in Model 3, equation (12) becomes

$$\mu_{i,t} - r_0 = \gamma\sigma_{i,c} + \lambda\frac{W_t^*}{W_t^* - \kappa V_t}\sigma_{i,w} - \lambda\frac{\kappa V_t}{W_t^* - \kappa V_t}\sigma_{i,v}. \tag{15}$$

Again, the more positively correlated an asset is with V_t, the less risk premium it deserves. Unlike in Model 2, however, this type of economy will typically experience stochastic investment opportunities in the sense that the risk premium, $(\mu_{i,t} - r_0)$, will depend on W_t^* and V_t.

Before closing this section, note that if we adopt the common assumption of identical preferences but possibly different endowments across investors in the economy, the pricing restriction in (14) under Model 2 (and hence Model 1) also applies to aggregate consumption and wealth—*so long as all investors compare themselves to the same exogenous wealth standard* V_t. To briefly see this, suppose that there are K exogenous state variables, $\mathbf{x}_t \equiv (x_{1,t}, \ldots, x_{K,t})$, following a joint vector-diffusion process. By using the solution method in Subsections A and B (see also Robert C. Merton, 1971), we have the optimal consumption for Model 2 given by: $C_t^* = g(\mathbf{x}_t, t)W_t^*$, for some "well-behaved" function $g(\mathbf{x}_t, t)$. Substituting this solution into (14) and applying Ito's lemma, we arrive, upon rearranging, at (16) below. Since investors are identical (except in endowments), the propensity to consume, g, is also identical for them. Summing this equation across all investors and reversing the above derivation yield (17) below, where $\bar{W}_t$ is aggregate wealth at t, and $\sigma_{i,\bar{c}}(\sigma_{i,\bar{w}})$ is the covariance between return on asset i and aggregate-consumption (wealth) growth. This substantiates our

$$(16)\quad W_t^*(\mu_{i,t} - r_0)$$

$$= W_t^*\left[\gamma \sum_{k=1}^{K} \frac{1}{g}\frac{\partial g}{\partial x_k}\frac{1}{dt}\operatorname{cov}_t\left(\frac{dP_{i,t}}{P_{i,t}}, dx_{k,t}\right) - \lambda\sigma_{i,v}\right] + (\gamma + \lambda)\frac{1}{dt}\operatorname{cov}_t\left(\frac{dP_{i,t}}{P_{i,t}}, dW_t^*\right)$$

$$(17)\quad \mu_{i,t} - r_0 = \gamma \frac{1}{dt}\operatorname{cov}_t\left(\frac{dP_{i,t}}{P_{i,t}}, \sum_{k=1}^{K} \frac{1}{g}\frac{\partial g}{\partial x_k} dx_{k,t} + \frac{d\bar{W}_t}{\bar{W}_t}\right) + \gamma\sigma_{i,\bar{w}} - \lambda\sigma_{i,v}$$

$$= \gamma\sigma_{i,\bar{c}} + \gamma\sigma_{i,\bar{w}} - \lambda\sigma_{i,v}$$

claim.[6] If investors differ in preferences or in wealth reference groups, however, aggregation may be difficult to obtain. In addition, as the solution structure in Subsection C implies, aggregation may not obtain under Model 3 even when investors have identical preferences.

II. Consumption, Saving, and Portfolio Choice

This section uses the parametrized preferences in Models 1, 2, and 3 to study optimal consumption, saving, and portfolio rules in detail. To economize the discussion, assume that there are only two traded assets, a risky stock and a risk-free bond, and that trading and consumption decision making takes place continuously over time. The price of the stock and the social-wealth index follow two separate geometric Brownian motions, that is, the coefficients in (6) and (11) are all constants: $\mu_{1,t} = \mu$, $\sigma_{1,t} = \sigma$, $\mu_{v,t} = \mu_v$, and $\sigma_{v,t} = \sigma_v$, for some positive μ, σ, μ_v, and σ_v. Under this and the continuous decision-making assumption, the investor's problem in (7) can be reexpressed as solving at each time $t \in [0, \infty)$

$$(18)\quad J(W_t, V_t) \equiv \max_{C_s, \alpha_s; s \in [t,\infty)} E_t\left\{\int_t^{\infty} e^{-\rho(s-t)} \times U(C_s, W_s, V_s)\, ds\right\},$$

subject to

$$(19)\quad dW_t = \{W_t[r_0 + \alpha_t(\mu - r_0)] - C_t\}\, dt + \alpha_t\sigma W_t\, d\omega_t,$$

where α_t is now the fraction of savings invested in the risky stock, ω_t the standard Wiener process governing the return on the stock, and the other notation is the same as before. Let $\sigma_{1,v}$ be the covariance between the return on the risky stock and the growth rate of V_t. The first-order condition for (18) yields

$$(20)\quad J_W(W_t, V_t) = U_C(C_t, W_t, V_t)$$

$$(21)\quad \alpha_t = \frac{1}{\mathrm{RRA}}\frac{\mu - r_0}{\sigma^2} - \frac{V_t J_{VW}}{W_t J_{WW}}\frac{\sigma_{1,v}}{\sigma^2},$$

[6] Since Model 1 is free of V_t, the above aggregation argument holds even if investors face different wealth standards. In the case of Model 2, however, not only should the investors refer to the same wealth standard, but also the wealth standard should be exogenous to the model, in order for this aggregation argument to go through. The assumption of an exogenous wealth standard may not be restrictive when examining an individual's consumption-portfolio decision, but when aggregation is the concern this seems quite restrictive. It is hard to imagine that the wealth index in the aggregate is still exogenous, and in a true general equilibrium the social-wealth index should be endogenized, which is a topic beyond the scope of the present paper.

where RRA $\equiv -(W_t J_{WW}/J_W)$ is the Arrow-Pratt relative risk aversion in wealth. The optimal proportion of savings invested in the risky asset is thus linear in both the market price of risk and the investor's relative risk tolerance. However, unlike in the case of the standard state-independent expected utility, the optimal portfolio also depends on both how the investor cares about social standing and how the risky stock is correlated with the social-wealth level.

A. *Model 1: Absolute Wealth Is Status*

Let's first examine the case of Model 1 because it represents a relatively simple benchmark that renders the comparative statics easier to see. Since Model 1 is a special case of Model 2, we report the general result under Model 2 below.

PROPOSITION 2. *Let the utility be as given in (4). Then, the optimal solution to the consumption-portfolio problem in (18) is*

$$C_t^* = \eta W_t^* \tag{22}$$

$$\alpha_t^* = \frac{\mu - r_0}{\sigma^2}\frac{1}{\gamma + \lambda} + \frac{\sigma_{1,v}}{\sigma^2}\frac{\lambda}{\gamma + \lambda} \tag{23}$$

$$J(W_t, V_t) = \frac{\eta^{-\gamma}}{1 - \gamma - \lambda} W_t^{1-\gamma-\lambda} V_t^{-\lambda}, \tag{24}$$

where

$$\eta \equiv \frac{\gamma - 1}{\gamma(\gamma + \lambda - 1)}\left\{\rho + (\gamma + \lambda - 1)r_0 - \lambda\mu_v - \frac{1}{2}\lambda(\lambda - 1)\sigma_v^2 + \frac{1}{2}\frac{\gamma + \lambda - 1}{\gamma + \lambda}\left(\frac{\mu - r_0 + \lambda\sigma_{1,v}}{\sigma}\right)^2\right\},$$

$$\eta \geq 0, \gamma + \lambda \geq 1.$$

The restriction that $\eta \geq 0$ and $\gamma + \lambda \geq 1$ is demanded by the transversality condition for the infinite-horizon problem. Given the utility of wealth in (24), the relative risk aversion in wealth is simply RRA $= \gamma + \lambda$, which is in contrast with the fact that under the standard expected utility, the relative-risk-aversion coefficient is γ. As noted earlier, when the investor prefers higher social status, we have $\lambda \geq 0$ if $\gamma \geq 1$ and $\lambda < 0$ if $\gamma < 1$. Since the above solution requires $\gamma + \lambda \geq 1$, *the internally permissible parameter values can only be*: $\gamma \geq 1$ and $\lambda > 0$, which is what the remainder of this section is based on. The more the investor cares about status, the more risk averse he becomes.

Model 1 is obtained from Model 2 by letting V_t be a constant, which means by choosing $\mu_v = 0$ and $\sigma_v = 0$. Substituting these values into (22) and (23) yields *the optimal policy under Model 1:*

$$C_t^* = \bar{\eta} W_t^* \tag{25}$$

$$\alpha_t^* = \frac{\mu - r_0}{\sigma^2}\frac{1}{\gamma + \lambda}, \tag{26}$$

where

$$\bar{\eta} \equiv \frac{\gamma - 1}{\gamma}\left\{r_0 + \frac{\rho}{\gamma + \lambda - 1} + \frac{1}{2}\frac{1}{\gamma + \lambda}\left(\frac{\mu - r_0}{\sigma}\right)^2\right\}.$$

By (26), the optimal proportion invested in the risky stock is decreasing in both γ and λ: $\partial\alpha_t^*/\partial\gamma < 0$ and $\partial\alpha_t^*/\partial\lambda < 0$. Then, the more the investor cares about wealth status, the higher the coefficient λ and hence the less the investor will hold of the risky stock. This is because in this case caring about wealth status makes the investor more risk averse.

By (25), the propensity to consume, $\bar{\eta}$, is decreasing in λ: $\partial\bar{\eta}/\partial\lambda < 0$. The more the investor cares about status, the higher the savings rate. To see the implications of this for economic growth, note that (19) and (25) together result in

$$\frac{dC_t^*}{C_t^*} = \frac{dW_t^*}{W_t^*} = \mu_w\, dt + \frac{\mu - r_0}{\sigma(\gamma + \lambda)}\, d\omega_t, \tag{27}$$

where $\mu_w \equiv r_0/\gamma + ((\gamma + 1)/2\gamma(\gamma + \lambda))((\mu - r_0)/\sigma)^2 + \rho(\gamma - 1)/\gamma(1 - \gamma - \lambda)$. The impact of an increase in λ on μ_w and μ_c is clouded by two opposite effects: the portfolio effect and the savings effect. On the one hand, when the investor cares more about status (i.e., λ is higher), his risk aversion in wealth, RRA $= \gamma + \lambda$, will increase, which means holding less of the risky stock and a lower α_t^*. This implies the first part of expected wealth growth in (19) will be lower. Consequently, the increased risk aversion asserts a negative effect on wealth growth. On the other hand, an increase in λ induces the investor to consume less and raise the savings rate, which means the second part of expected growth in (19) will be higher.

In economic growth models the existence of a sole investment asset is often assumed, presumably to isolate the savings effect from the portfolio effect. To adopt that assumption here, let the sole asset be the risky stock. Then, there is no portfolio choice involved and every dollar saved is fully invested in the sole asset: $\alpha_t^* = 1$. Substituting this into (19), (25), and (26) and rearranging the terms yield a new set of wealth dynamics:

$$(28) \qquad \frac{dC_t^*}{C_t^*} = \bar{\mu}_c \, dt + \sigma \, d\omega_t$$

$$= \frac{dW_t^*}{W_t^*} = \bar{\mu}_w \, dt + \sigma \, d\omega_t,$$

where $\bar{\mu}_w = \bar{\mu}_c \equiv \mu/\gamma + ((\gamma - 1)/\gamma)(\sigma^2(\gamma + \lambda)/2 + \rho/(1 - \gamma - \lambda))$.

Clearly, the expected wealth growth $\bar{\mu}_w$ is increasing in λ, as $\partial\mu_w/\partial\lambda > 0$. Using such a conventional-growth-model framework, we are thus able to show that the stronger the spirit of capitalism or the more the investor cares about status, the faster the capital stock (or wealth) will grow. This formally justifies the reasoning by, among others, Weber (1958) and Keynes (1971) that the spirit of capitalism is the underlying driving force for fast economic growth.

As an aside, note that by definition the elasticity of intertemporal substitution in consumption is given by the response of $\bar{\mu}_c$ to a change in the marginal product of capital,[7] which means the elasticity coefficient here is just the reciprocal of γ, as $\partial\bar{\mu}_c/\partial\mu = 1/\gamma$. Since RRA $= \gamma + \lambda$, we conclude that in an economy with capitalistic investors the intertemporal-elasticity and the risk-aversion coefficients are no longer reciprocal.

B. *Model 2: Ratio of One's Own Wealth to Social Index Determines Status*

When making consumption-portfolio decisions, investors under Model 2 will have to take into account what happens to the social-wealth index so that their relative status will not suddenly sink below a certain level. In Proposition 2, the optimal proportion invested in the risky stock, α_t^*, precisely reflects this concern. The first term in (23), $((\mu - r_0)/\sigma^2)(1/(\gamma + \lambda))$, is dictated by the investor's aversion to wealth risk. In particular, since caring about status makes the investor more risk averse, he will hold less of the risky stock than someone who does not care about status ($\lambda = 0$).

The second term in (23), $(\sigma_{1,v}/\sigma^2)(\lambda/(\gamma + \lambda))$, deserves more comments. This part of the optimal holding depends critically on how the risky stock is correlated with the social-wealth index V_t. (i) Suppose $\sigma_{1,v} > 0$, that is, the stock is positively correlated with the index V_t. Then, as discussed earlier, adding this stock to the portfolio will increase the correlation between W_t^* and V_t, which serves to insure against future uncertain declines in status that can result from rises in social-wealth standards. Consequently, the second term in (23) is positive and increasing in $\sigma_{1,v}$, and the investor puts a higher proportion into the stock than dictated by risk aversion alone. The intensity of the investor's desire to insure against status falls is indicated by $\lambda/(\gamma + \lambda)$, which is increasing in λ. The more the investor cares about status, the more of the risky stock he will hold for insurance purposes. (ii) Suppose $\sigma_{1,v} = 0$, that is, the stock is uncorrelated with V_t. Then, the risky asset is of no status-insurance value. As a result, the second term is zero and

[7] See, among others, George M. Constantinides (1990) and Epstein and Zin (1991). It is discussed there that under the standard expected utility the elasticity coefficient and the relative risk aversion are reciprocal of one another and captured by the same parameter.

the investor's holding is completely dictated by the investor's aversion to wealth risk. (iii) Finally, suppose $\sigma_{1,v} < 0$. In this case, holding too much of the stock will only work toward reducing the investor's status some further when V_t rises. To avoid such a "double penalty," the investor will hold less of the risky stock than determined by risk aversion.

For the same reason as given above, the propensity to consume under Model 2, η, has a mixed response to an increase in the extent to which the investor cares about status, that is, $\partial\eta/\partial\lambda$ can take either sign. The propensity to consume decreases as the expected growth rate in the social-wealth index increases: $\partial\eta/\partial\mu_v < 0$. Intuitively, when V_t is expected to grow faster, the investor will have to consume less in order to maintain a desired social status. An increase in the volatility of V_t, σ_v^2, can lead to either a decrease or an increase in the propensity to consume, depending on whether $\lambda > 1$ or not. If the investor cares a lot about status in the sense that $\lambda > 1$, an increase in σ_v^2 will lead to a lower η: $\partial\eta/\partial\sigma_v^2 < 0$. This is to say that savings rates will be high in an economy where investors care much about status and where the social-wealth standards grow fast and volatilely.

The optimal-wealth and consumption-growth dynamics under Model 2 are given below:

$$(29) \qquad \frac{dC_t^*}{C_t^*} = \frac{dW_t^*}{W_t^*} = \mu_w' \, dt + \frac{\mu - r_0 + \lambda\sigma_{1,v}}{\sigma(\gamma + \lambda)} \, d\omega_t,$$

where

$$\mu_w' \equiv \frac{r_0}{\gamma} + \frac{(\gamma - 1)(\lambda\mu_v - \rho + \frac{1}{2}\lambda(\lambda - 1)\sigma_v^2)}{\gamma(\gamma + \lambda - 1)} + \frac{(\gamma + 1)(\mu - r_0 + \lambda\sigma_{1,v})^2}{2\sigma^2\gamma(\gamma + \lambda)} - \frac{2\gamma\lambda\sigma_{1,v}(\mu - r_0 + \lambda\sigma_{1,v})}{2\sigma^2\gamma(\gamma + \lambda)}.$$

It is clear that expected wealth growth is increasing in μ_v and, if $\lambda > 1$, in the volatility σ_v^2 as well. Therefore, when social-wealth standards grow fast, the desire to "catch up with the Joneses" will make the capital stock also grow fast. Next, the impact of an increase in λ on expected wealth growth will be determined by the joint working of three effects: the portfolio effect, the savings effect, and the status-hedging effect. As in Model 1, the more the investor cares about status, the more averse to wealth risk (*causing wealth to grow slower*) and the higher the savings rate (*causing wealth to grow faster*). But, unlike in Model 1, this also increases the investor's desire to insure against status declines, which means investing more in the risky stock (assuming the stock has a positive correlation with V_t) and *causing wealth to grow faster*. Depending on which effect dominates, a higher λ can mean higher or lower expected wealth growth. However, as in the previous subsection, if we adopt the common assumption from the growth literature of a sole investment asset, the portfolio and the hedging effects due to caring about status will not matter and only the savings effect will play a role. This is to say that in that case economic growth will be faster as investors care more about status.

C. *Model 3: Self-Perception Determines Happiness*

With the preferences of Model 3, the complexity of the consumption-portfolio problem rises significantly.[8] For our purpose, assume V_t grows at a deterministic rate:

$$(30) \qquad \frac{dV_t}{V_t} = r_0 \, dt,$$

that is, set $\mu_{v,t} = r_0$ and $\sigma_{v,t} = 0$ in (11). The wealth standard grows at the risk-free rate.

PROPOSITION 3. *Let the utility and the V_t process be respectively as given in (5) and (30). Then,*

[8] The Hamilton-Jacobi-Bellman equation in (46) is difficult to solve in closed form even when, for example, V_t follows a geometric Brownian motion as in the last two subsections. The case which renders a closed-form solution obtainable by us is the one examined in this subsection.

$$(31)\qquad C_t^* = \xi(W_t^* - \kappa V_t)$$

$$(32)\qquad \alpha_t^* = \frac{\mu - r_0}{\sigma^2}\frac{1}{\gamma + \lambda}\left(1 - \kappa\frac{V_t}{W_t^*}\right)$$

$$(33)\qquad J(W_t, V_t) = \frac{\xi^{-\gamma}}{1 - \gamma - \lambda}(W_t - \kappa V_t)^{1-\gamma-\lambda},$$

$$\textit{where } \xi \equiv \frac{\gamma - 1}{\gamma}\left\{r_0 + \frac{\rho}{\gamma + \lambda - 1} + \frac{1}{2}\frac{1}{\gamma + \lambda}\left(\frac{\mu - r_0}{\sigma}\right)^2\right\},$$

$$\xi \geq 0,\ \gamma + \lambda \geq 1.$$

The above result has many intuitively appealing implications. First, optimal consumption is proportional to the difference between the investor's wealth and his subsistence reference. The optimal proportion, ξ, is strictly decreasing and convex in λ: caring about status induces the investor to consume less, but the speed at which the investor lowers the optimal proportion increases as the extent to which the investor cares about status increases. Unlike in Models 1 and 2, the propensity to consume here depends on the investor's relative status:

$$(34)\qquad \pi_t \equiv \xi\left[1 - \kappa\left(\frac{W_t^*}{V_t}\right)^{-1}\right] \geq 0,$$

which means that (i) the higher the poverty-aversion coefficient (κ), the lower the propensity to consume; (ii) the higher the investor's relative social status as measured by W_t^*/V_t, the higher the propensity to consume; and (iii) π_t is increasing in wealth W_t^* but decreasing in social-wealth index V_t. Therefore, in a society where status is crucial and where members compete to get into the upper-wealth class (by setting high κ values), the propensity to consume will be relatively low and the savings rate will be relatively high. Since W_t^* follows a diffusion process, so will π_t.

Second, based on (33), the implied relative risk aversion is

$$(35)\qquad \mathrm{RRA} = (\gamma + \lambda)\frac{W_t^*}{W_t^* - \kappa V_t} > 0,$$

which is increasing in γ, λ, κ and V_t but decreasing in W_t^*. In words, an investor will become more averse to wealth risk as (i) the investor cares more about status; (ii) he becomes more averse to poverty; (iii) the social-wealth standard goes higher; (iv) the investor's wealth goes lower; and (v) the investor's social status declines. Thus, including status in the preferences allows us to relate an investor's risk aversion to both his relative standing in the wealth distribution and the degree to which the investor can handle poverty.

Third, since the wealth index V_t follows a deterministic process, there is no social-wealth uncertainty to hedge against. Consequently, the optimal proportion of savings invested in the risky stock is entirely determined by the investor's relative risk aversion, RRA, and the market price of risk. As before, higher relative risk aversion means lower investment in the risky stock. The comparative statics of α_t^* with respect to λ, κ, V_t, W_t^*, and W_t^*/V_t are exactly the opposite of those of RRA with respect to the respective parameters and variables (see the paragraph above).

Next, the growth process of wealth is as follows:

$$(36)\qquad \frac{dW_t^*}{W_t^*} = \mu_{w,t}\,dt + \frac{1}{\gamma + \lambda}\frac{\mu - r_0}{\sigma}\frac{W_t^* - \kappa V_t}{W_t^*}\,d\omega_t,$$

where

$$(37)\qquad \mu_{w,t} \equiv r_0 + \left(\frac{(\gamma + 1)(\mu - r_0)^2}{2\gamma(\gamma + \lambda)\sigma^2} - \frac{\gamma - 1}{\gamma}r_0 - \frac{\rho(\gamma - 1)}{\gamma(\gamma + \lambda - 1)}\right) \times \frac{W_t^* - \kappa V_t}{W_t^*}.$$

As in Model 1, caring about status may mean lower or higher expected wealth growth (i.e., $\partial\mu_{w,t}/\partial\lambda$ can take either sign), depending on whether its portfolio effect dominates its savings effect.

Unlike in Models 1 and 2, however, expected wealth growth $\mu_{w,t}$ is decreasing in the poverty-aversion coefficient κ and the social-wealth level V_t.[9] Note that even though an increase in κ or V_t will lead to a decrease in consumption and hence an increase in savings, it will also imply an increase in risk aversion and thus a decrease in risky investment. The latter results in a decline in expected wealth growth. Here, the risk-aversion effect of a higher κ or V_t dominates the savings effect, making its overall impact on wealth growth negative. Higher wealth, on the other hand, means higher expected wealth growth. To see this, an increase in W_t^* causes the investor both to consume more (and thus save less) and to be less risk averse. But, in this case, the positive effect (on risk taking) dominates the negative effect (on savings), rendering the overall impact on wealth growth positive.

Finally, the growth process for consumption is no longer the same as that for wealth:

$$(38) \quad \frac{dC_t^*}{C_t^*} = \mu_{c,t}\, dt + \frac{1}{\gamma + \lambda} \frac{\mu - r_0}{\sigma}\, d\omega_t,$$

where $\mu_{c,t} \equiv (r_0/\gamma - \rho(\gamma - 1)/\gamma(\gamma + \lambda - 1) + (\gamma + 1)(\mu - r_0)^2/2\gamma(\gamma + \lambda)\sigma^2)$. While the optimal consumption *level* is decreasing in κ and increasing in W_t^*/V_t, consumption *growth* is independent of these two factors. Note that in this economy both the return process on the risky stock and the consumption-growth process are independently-and-identically-distributed random walks, whereas the growth process for wealth has both its drift and diffusion terms state and time dependent.

[9] This statement relies on the fact that

$$\left(\frac{(\gamma + 1)(\mu - r_0)^2}{2\gamma(\gamma + \lambda)\sigma^2} - \frac{\gamma - 1}{\gamma} r_0 - \frac{\rho(\gamma - 1)}{\gamma(\gamma + \lambda - 1)}\right) \geq 0.$$

To see why this expression in (37) must be nonnegative, suppose, to the contrary, that it were negative. Then, W_t^* would be expected to grow at a rate, $\mu_{w,t}$, lower than the risk-free rate r_0 at which κV_t grows. This means $(W_t^* - \kappa V_t)$ would become negative in the long run, which contradicts the restriction that $(W_t^* - \kappa V_t) > 0$ at each t.

In this sense, Model 3 not only offers many empirically plausible features but also leads to richer economic dynamics.

III. Empirical Tests

Like the standard expected-utility theory, models of preferences that take into account concerns about relative status are ultimately judged on how well they fare empirically. Following standard practice, one can test such preference models by examining the empirical validity of their implied Euler equations. That is, we can achieve this goal by testing the discrete-time Euler equation in (9) or the continuous-time pricing equation in (12). Since all economic data is collected at discrete time intervals, we chose to focus efforts on the Euler equation in (9).

Applying the preferences of Models 2 and 3 to (9), one obtains two parametrized versions of the Euler equation and both are testable—so long as all required data can be collected. In addition to stock prices, one needs data on consumption, wealth and the social-wealth index in order to test the two models. Whereas proxies for consumption and wealth, at either the individual or aggregate level, are available at some sacrifice of quality, the choice of proxies for the social-wealth index is not apparent. At the aggregate level, it's not clear what the social-wealth reference for the "representative investor" corresponds to in reality, not to mention collecting such data. By definition, the "representative investor" will always be exactly in the middle class: $\bar{S}_t = \bar{W}_t/\bar{W}_t = 1$, if we use per-capita wealth as the wealth standard, where a bar indicates it's the per-capita counterpart of the variable. Under Model 2, for instance, this effectively means that even if individual investors care about status, the representative investor will not, because no matter what this so-defined investor does he cannot get out of the middle-class status. As such, even though we showed that aggregation does obtain for Model 2 under certain conditions, it may not make sense to test Model 2 using aggregate data because the very feature of caring about status will not be present in the Euler equation for the representative investor. In the case of Model 3, it is probably even less justified to subject the corresponding Euler equation to aggregate data because in that case aggregation may not obtain even under the assumption of identical preferences across investors. For this reason, it may make more sense to subject the Euler equations for Models 2 and 3 to individual consumer data. But, as discussed before, two consumers who are in two distinct reference groups will have two different social-wealth indices to which they compare themselves. This means that possibly *for each individual* a social-wealth index may have to be constructed and collected, in order to have the two models tested on cross-sectional consumer data. To maintain the scope of this paper, we leave such an investigation for a follow-up project.

We are thus led to focus on Model 1 as this preference model is independent of any social-wealth index and yet captures an important part of investors' desire to improve relative social standing. Alternatively, if we assume that wealth standards stayed unchanged in the United States during the sample period 1959–1991, we can interpret our tests of Model 1 as tests of Model 2 because the latter in that case collapses to the former. In any case, as shown earlier, aggregation obtains under Model 1 if we adopt the assumption of identical preferences across investors. This means that under this assumption it is justified to subject the Euler equation for Model 1 to aggregate data. The Euler equation below is used for the empirical tests to follow:

$$E\{m_{t+1}R_{i,t+1}|Z_t\} = 1, \tag{39}$$

which is obtained by substituting the utility function of Model 1 into (9) and setting $\Delta t = 1$, where $\beta \equiv e^{-\rho}$, $R_{i,t+1}$ is the gross return on asset i, Z_t the time t information set with respect to which the conditional expectation is taken, and

$$m_{t+1} \equiv \beta R_{c,t+1}^{-\gamma} R_{w,t+1}^{-\lambda} \times \left(1 + \frac{\lambda}{\gamma - 1}\frac{C_{t+1}}{W_{t+1}}\right), \tag{40}$$

letting $R_{c,t+1} \equiv C_{t+1}/C_t$ and $R_{w,t+1} \equiv W_{t+1}/W_t$. Note that when $\lambda = 0$, this IMRS collapses to that implied by the standard constant-relative-risk-aversion (CRRA) power utility. The IMRS in Epstein and Zin (1991 eq. 20) can, following our notation, be expressed as

$$m_{t+1}^{ez} \equiv \beta R_{c,t+1}^{-\gamma} R_{w,t+1}^{-\lambda}, \tag{41}$$

which is clearly different from the m_{t+1} in (40). Indeed, using discrete-time data, one can distinguish our Model 1 from their parametrized model.

To identify the IMRS in empirical tests, we need three time series: $\{R_{c,t}\}$, $\{R_{w,t}\}$, and $\{C_t/W_t\}$. Following standard practice, we choose the real-growth series for per-capita nondurables and services consumption as a proxy for $R_{c,t}$. The proxy choice of $R_{w,t}$ is nontrivial. As Richard W. Roll (1977) argues, aggregate wealth or the market portfolio is almost impossible to estimate because a major portion of it is not traded and hence its value is not observable. For this reason, researchers often have to look for some observable proxy. Following Cochrane and Hansen (1992), Epstein and Zin (1991), and Robert E. Hall (1978), we use the return on the New York Stock Exchange (NYSE) value-weighted index as a stand-in for $R_{w,t}$. The time series for consumption-to-wealth ratio, $\{C_t/W_t\}$, is constructed as follows. Note that $C_t = C_0 \prod_{\tau=1}^{t} R_{c,\tau}$ and $W_t = W_0 \prod_{\tau=1}^{t} R_{w,\tau}$, which gives

$$\frac{C_t}{W_t} = \frac{C_0}{W_0}\prod_{\tau=1}^{t}\frac{R_{c,\tau}}{R_{w,\tau}}.$$

Given that we have chosen the real-life counterparts for $R_{c,t}$ and $R_{w,t}$, we only need the starting value, C_0/W_0, in order to construct the time series for C_t/W_t. The starting value, C_0/W_0, is chosen via a calibration exercise such that the mean of the resulting time series for C_t/W_t is consistent with what has been reported in the literature. This criterion has lead to a monthly initial value of $C_0/W_0 = 0.0076$ (i.e., for the first month of 1959), which corresponds to an annualized initial consumption-to-wealth ratio of 9.12 percent. The mean of the resulting time series for C_t/W_t is an annualized 6.83 percent.[10] Since the estimate for β was close to

[10] Lawrence Christiano (1991), for example, reports that the average consumption-to-GNP ratio (per capita) is about 0.73, while the average capital stock-to-GNP ratio is about 10.59. The implied average consumption-to-capital stock ratio is then about 6.89 percent, which is

one in all pre-tried estimations, we set $\beta = 1$ in all reported tests so that there is one less parameter to estimate.

The data set used, a detailed description of which is in Appendix B, contains monthly observations on stock and bond returns, per-capita consumption, and returns on the NYSE value-weighted index. Monthly data has been used in numerous empirical studies of asset pricing including, among others, Epstein and Zin (1991), Wayne Ferson and George M. Constantinides (1991), Hansen and Jagannathan (1991, 1994), and Hansen and Singleton (1982).

To aid the discussion to follow, recall that according to the spirit-of-capitalism hypothesis, the preference parameters should be such that $\lambda > 0$ when $\gamma \geq 1$ and $\lambda < 0$ when $\gamma < 1$. If this hypothesis is empirically true, we should expect the resulting asset-pricing model to perform better when the values of γ and λ are consistent with this restriction.

A. *Hansen-Jagannathan Bound Diagnostics*

We first apply the Hansen and Jagannathan (1991) diagnostic method to check whether the IMRS in (40) satisfies the volatility bounds for any admissible IMRS or *stochastic discount factor*. Let $\mathbf{R}$ be the N vector of payoffs to the N assets included in the investigation, $\mathbf{q}$ the N vector of prices for the payoffs, and Σ_R the covariance matrix of $\mathbf{R}$. Then, if our asset-pricing model in (39) can empirically explain the pricing structure for the N assets, it is, according to Hansen and Jagannathan (eq. 12), *necessary* that its IMRS in (40) satisfy

$$(42)\quad \sigma_m \geq \sigma_{\mathbf{R}} \equiv ([E(\mathbf{q}) - \mu_m E(\mathbf{R})]'\Sigma_{\mathbf{R}}^{-1} \times [E(\mathbf{q}) - \mu_m E(\mathbf{R})])^{1/2},$$

where μ_m and σ_m are, respectively, the unconditional mean and standard deviation of the proposed IMRS. For any given value of μ_m, the volatility bound is constructed by estimating the mean vector $E(\mathbf{R})$ and the matrix $\Sigma_{\mathbf{R}}$. We refer the reader to Hansen and Jagannathan (1991) for detailed derivation and interpretation of this diagnostic.

As for the choice of assets in $\mathbf{R}$, Hansen and Jagannathan (1991) suggest that including returns generated by using conditioning information should sharpen the volatility bounds considerably. Guided by their suggestion, we include in $\mathbf{R}$: (i) real returns respectively on the NYSE value-weighted index and on long-term government bonds and (ii) scaled returns constructed via multiplying each of these two assets, separately, by their lagged returns and the lagged real return on the smallest decile of NYSE stocks. Thus, $\mathbf{R}$ contains a total of 8 assets (2 primitive and 6 scaled). The resulting Hansen-Jagannathan bounds are shown as the $\square$-curve in Figure 1. The $\diamond$-curve in Figure 1 indicates the (μ_m, σ_m) pairs obtained via fixing the value of γ and varying the value of λ, and the $\triangle$-curve by fixing λ and varying γ.

For certain $\{\gamma, \lambda\}$ values, the resulting (μ_m, σ_m) pairs for the IMRS are inside the Hansen-Jagannathan acceptance region. For instance, the Hansen-Jagannathan bounds are not violated when γ is fixed at 4.50 and λ is in the range 4.08–4.58, or when λ is fixed at 4.50 and γ is in the range 5.50–8.50. In these cases, the implied relative risk aversion in wealth, RRA $= \gamma + \lambda$, is around 9. This is in sharp contrast with the finding of Hansen and Jagannathan (1991) that the relative risk aversion needs to be in excess of 100 in order for the standard expected-utility model to satisfy the volatility bounds.

Observe that the $\triangle$-curve (corresponding to a fixed value for λ) is virtually flat, whereas the $\diamond$-curve (corresponding to a fixed value for γ) is not. This is the case because, with the consumption growth series being smooth, varying the value of γ by a small value will mostly change the mean, but not the standard deviation, of the IMRS. On the other hand, given the volatility of wealth growth, changing the value of λ even by a small amount can lead to a large change in the volatility of the IMRS.

roughly the same as the annualized mean of our monthly time series for C_t/W_t as constructed above. Also see Campbell (1993).

Therefore, the ability of our model to generate a volatile IMRS comes mostly from the impact of the spirit of capitalism.

Stephen G. Cecchetti et al. (1994) argue that the original Hansen-Jagannathan bound diagnostic is not a statistical test as it involves comparing the point estimates of the volatility bound with those of the standard deviation of the IMRS. To take into account sampling errors, we follow their procedure to test whether $\sigma_m \geq \sigma_{\mathbf{R}}$ for a given value of μ_m and whether σ_m lies within two standard errors from the Hansen-Jagannathan bounds.[11] Table 1 presents the results of such an investigation for several values of λ and γ. The reported t statistic tests the one-sided null hypothesis that $\sigma_m - \sigma_{\mathbf{R}} \leq 0$. As in Cecchetti et al., the standard errors for this t test are calculated using the method in Whitney K. Newey and Kenneth D. West (1987a) with 11 lags (the results were quantitatively similar when alternate numbers of lags, such as 6, 9, or 15, were employed). The appropriate critical values for this test statistic are -1.65 and -2.33 for the 5- and 1-percent significance levels, respectively. That is, an absolute t value below 1.65 means a rejection of the null at the 5-percent significance level, and an absolute t value below 2.33 a rejection at the 1-percent level.

Start with the IMRS implied by the standard CRRA expected utility, which corresponds to our IMRS with $\lambda = 0$. Table 1 indicates that the standard IMRS is not volatile enough even for large values of γ, and the t values for the null that $\sigma_m - \sigma_{\mathbf{R}} \leq 0$ are much higher in absolute value than the critical value, 1.65. Therefore, the standard model fails to satisfy the volatility bounds even when sampling errors are taken into consideration.

In contrast, when $\lambda > 0$, the results are substantially different. For instance, let $\lambda = 2$. Then, the resulting IMRS is volatile and the null hypothesis that $\sigma_m \leq \sigma_{\mathbf{R}}$ is rejected at the 5-percent significance level when γ is between 4.0 and 6.0. This implies that with sampling errors taken into consideration, the Hansen-Jagannathan bounds are not violated when the relative risk aversion varies between 6 and 8. Similar conclusions emerge when $\lambda = 4.0$ and γ varies between 3 and 15, with the implied relative risk aversion between 7 and 19.

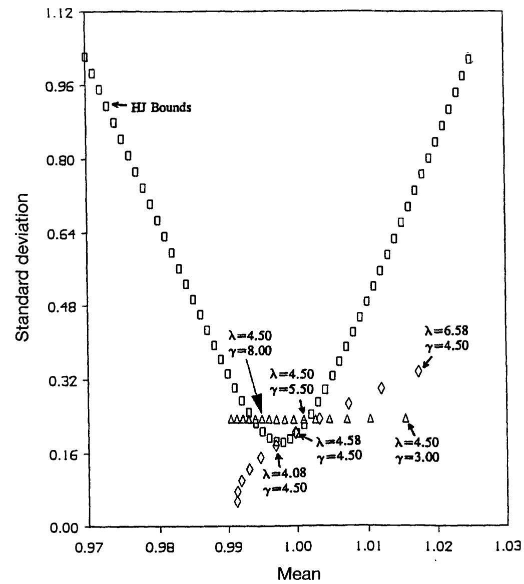

FIGURE 1. HANSEN-JAGANNATHAN VOLATILITY BOUNDS

Note: The Hansen-Jagannathan bounds are illustrated by the □-curve. The candidate IMRS is given by

$$m_{t+1} \equiv \beta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}\left(\frac{W_{t+1}}{W_t}\right)^{-\lambda}\left(1 + \frac{\lambda}{\gamma - 1}\frac{C_{t+1}}{W_{t+1}}\right).$$

The ◇-curve stands for the mean-standard deviation pairs of the IMRS obtained by fixing $\beta = 1$, $\gamma = 4.50$, and varying λ. The △-curve stands for the mean and standard deviation pairs of the IMRS obtained by fixing $\beta = 1$, $\lambda = 4.50$, and varying γ.

Also note that when $\gamma < 1$ and $\lambda > 0$ (i.e., the first three rows in Table 1), the parameter restriction implied by the spirit-of-capitalism hypothesis is violated. In these cases, the volatility bounds are overwhelmingly violated as well. Together with the other results in Table 1, this suggests that parameter values consistent with the spirit-of-capitalism hypothesis lead to better-performing IMRS models.

The above Hansen-Jagannathan bound-based results are robust to the inclusion of other assets in **R**. In most cases, values for the

[11] See Cecchetti et al. (1994) for details regarding the test method and technical results on the asymptotic-distribution theory. Also see Hansen et al. (1995). We thank Nelson Mark for providing us with his code for their test procedure.

TABLE 1—CECCHETTI-LAM-MARK VOLATILITY BOUND TESTS

	$\lambda = 0$			$\lambda = 2$			$\lambda = 4$		
γ	σ_m	$\sigma_{\mathbf{R}}$	t value	σ_m	$\sigma_{\mathbf{R}}$	t value	σ_m	$\sigma_{\mathbf{R}}$	t value
0	0.000	0.224	−4.10	0.091	0.488	−2.71	0.192	0.744	−3.71
0.50	0.002	0.206	−3.78	0.091	0.912	−4.99	0.187	1.591	−3.85
0.75	0.003	0.200	−3.65	0.088	1.743	−7.98	0.178	3.265	−7.20
2	0.007	0.183	−3.25	0.095	0.319	−1.91	0.203	0.855	−1.90
3	0.011	0.189	−3.30	0.095	0.183	−1.69	0.201	0.409	−0.68
4	0.016	0.210	−3.52	0.096	0.220	−1.14	0.200	0.253	−0.22
5	0.019	0.024	−3.74	0.097	0.278	−1.32	0.200	0.190	−0.11
6	0.023	0.028	−3.91	0.098	0.338	−1.56	0.201	0.187	−0.13
7	0.027	0.032	−4.05	0.099	0.395	−1.79	0.201	0.218	−0.07
8	0.031	0.037	−4.14	0.100	0.450	−2.01	0.202	0.263	−0.21
9	0.034	0.417	−4.22	0.102	0.504	−2.20	0.203	0.312	−0.34
10	0.038	0.465	−4.29	0.104	0.556	−2.38	0.214	0.363	−0.47
15	0.057	0.704	−4.48	0.114	0.806	−3.02	0.209	0.609	−1.01

Notes: The volatility bound tests reported here are based upon Cecchetti et al. (1994). The IMRS being tested is

$$m_t = \beta\left(\frac{C_t}{C_{t-1}}\right)^{-\gamma}\left(\frac{W_t}{W_{t-1}}\right)^{-\lambda}\left(1 + \frac{\lambda}{\gamma - 1}\frac{C}{W_t}\right).$$

The asset vector used includes eight assets: RVWI_t, RLTGB_t, $\mathrm{RVWI}_t \cdot \mathrm{RVWI}_{t-1}$, $\mathrm{RVWI}_t \cdot \mathrm{RLTGB}_{t-1}$, $\mathrm{RLTGB}_t \cdot \mathrm{RVWI}_{t-1}$, $\mathrm{RLTGB}_t \cdot \mathrm{RLTGB}_{t-1}$, $\mathrm{RVWI}_t \cdot \mathrm{RDEC}_{1,t-1}$, $\mathrm{RLTGB}_t \cdot \mathrm{RDEC}_{1,t-1}$, where RVWI, RLTGB, and RDEC_1 denote, respectively, the real returns on the NYSE value-weighted index, long-term government bonds and the lowest decile of NYSE stocks. The asymptotic standard errors are based on Cecchetti et al. (eq. 19) and a lag length of 11 is used in the computation of the Newey-West (1987a) covariance matrix. For each estimation, set $\beta = 1$. The reported t value tests the null hypothesis that $\sigma_m - \sigma_{\mathbf{R}} \leq 0$, where σ_m and $\sigma_{\mathbf{R}}$ are, respectively, the standard deviation of the IMRS and the volatility bound. The critical t value, above which the null is rejected, is −1.65 at the 5-percent and −2.33 at the 1-percent significance level.

preference parameters that support the volatility bounds are similar to those reported in Table 1.

B. *Hansen-Jagannathan Specification Error Tests*

Hansen and Jagannathan (1994) propose the following distance measure to reflect the performance of an asset-pricing model in pricing the assets in $\mathbf{R}$:

$$(43) \quad \delta = [(E(\mathbf{q}) - E(m\mathbf{R}))'[E(\mathbf{R}\mathbf{R}')]^{-1} \times (E(\mathbf{q}) - E(m\mathbf{R}))]^{1/2},$$

where all variables are as defined before and m is the IMRS implied by the pricing model. They show that this δ measures the minimum distance between the candidate m and the set of admissible stochastic discount factors. It can also be interpreted as measuring the maximum pricing error induced by the IMRS over the unit ball in the payoff span of $\mathbf{R}$. A nice property of this measure is that if two-asset pricing models lead to two different δ values, we can say the one with the smaller δ performs better than the other in pricing the assets in $\mathbf{R}$. An admissible pricing model is one whose δ value is zero. For further discussion, see Hansen and Jagannathan.

Using the same set of assets from Subsection A, we report in Table 2 specification error estimates for the IMRS in (40). The standard errors are calculated with the help of Proposition 3.2 in Hansen et al. (1995) and by using 11 lags in the Newey-West (1987a) correction procedure. Again, the case with $\lambda = 0$ corresponds to the standard time-separable model. In Table 2, δ values for the standard model are between 0.180 to 0.184. When $\lambda > 0$, the implied IMRS typically leads to lower δ values. For example, when λ varies between 0.5 and 2.0, the value of δ corresponding to any given γ is consistently smaller than when $\lambda = 0$. The last two rows in Table 2 report the minimum

TABLE 2—HANSEN-JAGANNATHAN SPECIFICATION ERROR TESTS

	δ					
γ	$\lambda = 0$	$\lambda = 0.50$	$\lambda = 1.00$	$\lambda = 1.50$	$\lambda = 2.00$	$\lambda = 2.50$
0.50	0.184 (0.049)	0.180 (0.049)	0.178 (0.049)	0.178 (0.049)	0.181 (0.050)	0.186 (0.050)
2	0.183 (0.049)	0.179 (0.049)	0.177 (0.049)	0.177 (0.050)	0.180 (0.050)	0.184 (0.052)
5	0.183 (0.050)	0.179 (0.050)	0.177 (0.050)	0.177 (0.050)	0.179 (0.050)	0.184 (0.051)
10	0.181 (0.050)	0.178 (0.050)	0.176 (0.050)	0.177 (0.050)	0.179 (0.050)	0.184 (0.051)
15	0.181 (0.050)	0.177 (0.050)	0.176 (0.050)	0.177 (0.050)	0.180 (0.050)	0.184 (0.051)
20	0.180 (0.050)	0.177 (0.050)	0.176 (0.050)	0.177 (0.050)	0.180 (0.050)	0.185 (0.051)
25	0.180 (0.050)	0.177 (0.050)	0.177 (0.050)	0.178 (0.050)	0.181 (0.050)	0.186 (0.051)
30	0.180 (0.050)	0.177 (0.050)	0.177 (0.050)	0.178 (0.050)	0.182 (0.050)	0.187 (0.051)
Minimum $\delta = 0.176$ obtained at $\gamma = 6.40$ and $\lambda = 1.07$						
Constrained minimum $\delta = 0.180$ obtained at $\gamma = 29.44$ and λ fixed at 0						

Notes: Estimation of the specification error, δ, is based on Hansen and Jagannathan (1994 eq. 2.10). The standard errors, reported in parentheses, are estimated following Hansen et al. (1995 Proposition 3.2). A lag length of 11 is employed for the Newey-West (1987a) correction. The payoff vector used includes eight assets: $RVWI_t$, $RLTGB_t$, $RVWI_t \cdot RVWI_{t-1}$, $RVWI_t \cdot RLTGB_{t-1}$, $RLTGB_t \cdot RVWI_{t-1}$, $RLTGB_t \cdot RLTGB_{t-1}$, $RVWI_t \cdot RDEC_{1,t-1}$, $RLTGB_t \cdot RDEC_{1,t-1}$, where RVWI, RLTGB, and $RDEC_1$ denote, respectively, the real returns on the NYSE value-weighted index, long-term government bonds and the lowest decile of NYSE stocks. For each estimation, set $\beta = 1$. The reported minimum δ is obtained by choosing γ and λ, in the unconstrained case, and γ, in the constrained case, to minimize the Hansen-Jagannathan specification error.

δ values obtained, respectively, by the choice of both γ and λ and by the choice of γ subject to the constraint $\lambda = 0$. The constrained minimum δ is 0.180, with the estimated γ at 29.44, whereas its unconstrained counterpart is 0.176, with the estimated γ at 6.40 and λ at 1.07. Thus, when concerns about status are reflected in preferences, the resulting asset-pricing model generates smaller pricing errors.

We can also use the Hansen-Jagannathan specification error measure to compare the performance of our IMRS, m_{t+1}, versus that of Epstein and Zin's (1991) IMRS, m^{ez}_{t+1}, as given in (41). Recall that in the case of Epstein and Zin, the parameter restriction is that $\gamma > 0$ if $\lambda < 1$; $\gamma < 0$ if $\lambda > 1$; and $\gamma = 0$ if $\lambda = 1$. Under the spirit-of-capitalism hypothesis, however, it should be that $\lambda > 0$ when $\gamma \geq 1$ and $\lambda < 0$ when $\gamma < 1$. As the first example, fix $\lambda = 1.07$. Then, in the case of Epstein and Zin, the minimum δ among all m^{ez}_{t+1} corresponding to the permissible range for γ (i.e., $\gamma < 0$) is 0.178, whereas in our case the minimum δ obtainable at $\lambda = 1.07$ is 0.176, with $\gamma = 6.40$ (see Table 2). As another example, fix $\lambda = 2.0$. The minimum δ within the permissible γ value range for the Epstein-Zin model is 0.180, while that for our Model 1 within γ values consistent with the spirit-of-capitalism hypothesis is 0.179. Therefore, taking the parameter restrictions into account, our Model 1 does slightly better than Epstein and Zin's. The parameter range, $\{\gamma \geq 1, 1 \geq \lambda \geq 0\}$, is consistent with both our hypothesis and their model. Within this range, both models generate virtually identical pricing errors and perform equally well (for this reason, the corresponding specification error values for m_{t+1}^{ez} are not reported in Table 2).

C. *Criterion-Based Inferences and GMM Tests of the Euler Equation*

The purpose of this subsection is to apply Hansen's (1982) generalized method of moments (GMM) to test the Euler equation in (39). To briefly explain the implementation, suppose the ith portfolio is included in the test and define the disturbance:

$$\varepsilon_{i,t+1} \equiv \beta R_{c,t+1}^{-\gamma} R_{w,t+1}^{-\lambda} \left(1 + \frac{\lambda}{\gamma - 1} \frac{C_{t+1}}{W_{t+1}}\right) \times R_{i,t+1} - 1.$$

Stack all $\varepsilon_{i,t+1}$ into the vector $\boldsymbol{\varepsilon}_{t+1}$. Under the null that the model holds, we have $E(\boldsymbol{\varepsilon}_{t+1} \otimes \mathbf{Z}_t) = 0$, that is, the disturbance must be orthogonal to the information variables in $\mathbf{Z}_t$. Each GMM estimation is based on minimizing the quadratic form, $G_T' \Omega_T \mathbf{G}_T$, where T is the number of monthly observations, $\mathbf{G}_T$ the sample analog of the process $\{\boldsymbol{\varepsilon}_{t+1} \otimes \mathbf{Z}_t\}$, and $\boldsymbol{\Omega}_T$ a positive-definite, symmetric-weighting matrix. The minimized value of the quadratic form multiplied by T, called the J_T statistic, is χ^2 distributed under the null that the model is true, with degrees of freedom, df, equal to the number of orthogonality conditions net of the number of parameters to be estimated. The J_T statistic provides a goodness-of-fit measure for the model: a higher value means a more misspecified model.

The choice of information instruments in $\mathbf{Z}_t$ is an important one and in this regard theory has little guidance (Hansen and Singleton, 1982). Based on previous research, $\mathbf{Z}_t$ is chosen to contain a constant and two lags each of the default premium, the term premium, and the nominal returns on the NYSE value-weighted index (except that when more than one portfolio is included in the test, only one lag of each instrument is used so as to keep the number of moment conditions at a proper level, i.e., 8). To check robustness, we experimented with alternate sets of instruments and found that the results do not differ significantly. To save space, we concentrate on the said set of instruments.

Table 3 reports results from estimations using a broad set of portfolios. For instance, estimates of $\{\gamma, \lambda\}$ in the first three rows are obtained each by including a size-based portfolio, RDEC_1, RDEC_5, or RDEC_{10}. The standard errors reported in parenthesis are calculated using the simple covariance matrix outlined in Hansen (1982). The p value in brackets tests the null that the estimated parameter equals zero. The p value reported below the J_T statistic indicates the probability that a χ^2 variate exceeds the minimized sample value of the GMM criterion function.

Start with results from estimations in which λ and γ are unrestricted. When only one portfolio is included, the estimated range for γ is 2.27–3.08. Note that the magnitude of γ tends to decrease with firm size. For instance, the point estimate of γ is 3.08 in the case of decile 1, while in the cases of deciles 5 and 10 the estimates are 2.67 and 2.27, respectively. This is consistent with the fact that small stocks are generally more volatile than large ones. When more than one asset is included the test, the value of γ varies between 2.29–2.38. In all cases, the estimated value for γ is more than two standard errors away from zero and the p value is less than 5 percent.

The point estimates for λ are in the range 0.75–1.27, and in all cases they are many standard errors away from zero, with the lowest p value being 0 percent. For example, when decile 10 and a portfolio of long-term government bonds are included in the test, the estimate for λ is 0.75, with a standard error of 0.08 and a p value of 0.00. Note that the point estimates for γ are uniformly greater than 1 and those for λ uniformly positive, which is consistent with the restriction implied by the spirit-of-capitalism hypothesis. Together the implied relative risk aversion in wealth, $\gamma + \lambda$, is in the range 3.04–4.24, which is in line with the estimates of Irvin Friend and Marshall E. Blume (1975), who report relative risk aversion coefficients higher than 2.0.

In two out of the three single-portfolio cases, the overidentifying restrictions imposed by the model are not rejected, as indicated by the p values below the J_T statistic

TABLE 3—GMM TESTS OF THE EULER EQUATION

	Unrestricted λ & γ			Restricted $\lambda = 0$		Restricted $\gamma = 0$	
Assets	γ	λ	$J_{T,U}$	γ	$\tilde{J}_T$	λ	$\tilde{J}_T$
$RDEC_1$	3.08	1.16	22.71	5.44	8.51	0.90	3.76
	(0.91)	(0.34)	[0.00]	(1.60)	[0.00]	(0.22)	[0.05]
	[0.00]	[0.00]	{5}	[0.00]		[0.00]	
$RDEC_5$	2.67	1.27	7.05	4.50	44.18	0.89	12.80
	(0.37)	(0.18)	[0.22]	(0.87)	[0.00]	(0.11)	[0.00]
	[0.00]	[0.00]	{5}	[0.00]		[0.00]	
$RDEC_{10}$	2.27	0.84	10.90	3.38	150.20	0.60	18.41
	(0.13)	(0.07)	[0.06]	(0.32)	[0.00]	(0.06)	[0.00]
	[0.00]	[0.00]	{5}	[0.00]		[0.00]	
$RDEC_5$ & $RDEC_{10}$	2.38	0.82	17.51	4.22	100.81	0.58	18.87
	(0.15)	(0.07)	[0.00]	(0.34)	[0.00]	(0.04)	[0.00]
	[0.00]	[0.00]	{6}	[0.00]		[0.00]	
$RDEC_{10}$ & RLTGB	2.29	0.75	13.21	3.44	85.08	0.55	18.47
	(0.15)	(0.08)	[0.04]	(0.37)	[0.00]	(0.04)	[0.00]
	[0.00]	[0.00]	{6}	[0.00]			

Notes: Estimation of the following Euler equation is based on Hansen's (1982) generalized method of moments,

$$\beta E\left\{\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}\left(\frac{W_{t+1}}{W_t}\right)^{-\lambda}\left(1+\frac{\lambda}{\gamma-1}\frac{C_{t+1}}{W_{t+1}}\right)R_{i,t+1}\,|\,Z_t\right\}=1,$$

where Z_t contains a constant and two lags (one lag when two assets are included in the test) each of term premium, default premium and the nominal returns of the NYSE value-weighted index. The standard errors reported in parentheses are based on the simple covariance-matrix estimator as outlined in Hansen. The p value in brackets indicates the probability that the estimated parameter equals zero. The degree of freedom df (reported in curly brackets) is the number of moment conditions minus the number of parameters to be estimated. The J_T statistic, $J_{T,U}$, tests whether the overidentifying restrictions of the model are true with the degrees of freedom, df. The statistic, $\tilde{J}_T = J_{T,R} - J_{T,U}$, is $\chi^2(1)$-distributed, with $J_{T,R}$ being the GMM criterion function value from the restricted estimation. For each estimation, set $\beta = 1$. $RDEC_i$ is the real return on the ith decile of NYSE stocks and RLTGB the real return on a portfolio of long-term government bonds.

(if we use the 5-percent acceptance criterion).[12] In the two cases that involve more than one portfolio, the p values below the J_T statistic are smaller than 5 percent, which means the overidentifying restrictions are rejected by the data. In Euler equation-based tests of the standard consumption-based asset pricing theory, rejections of the overidentifying restrictions are not uncommon (e.g., Hansen et al., 1994 and the references therein). Thus, some rejections of the model in (39) based on the GMM criterion function should not come as a surprise.

Since the standard CRRA model is nested within our model, GMM criterion function-based inferences can be conducted (e.g., Martin Eichenbaum et al., 1988; Hansen et al., 1994; and Newey and West, 1987b). First, keep the weighting matrix from the unrestricted GMM estimation; second, use this weighting matrix in the restricted GMM estimation by assuming $\lambda = 0$ or $\gamma = 0$; then, compare the minimized GMM-criterion value (multiplied by T) from the restricted estima-

[12] The above estimation results are robust to a change in the measure of aggregate consumption. For example, we reestimated the parameters in the Euler equation, separately using seasonally-adjusted nondurables consumption and services consumption. But, that did not lead to any qualitatively different results. The estimates for γ and λ are also similar in both magnitude and statistical significance, for the two subperiods: 1959:1–1974:12 and 1975:1–1991:12. Thus, our conclusion regarding the goodness-of-fit of the model as well as the spirit-of-capitalism hypothesis is robust.

tion, denoted by $J_{T,R}$, to that from the unrestricted, denoted by $J_{T,U}$:

$$\tilde{J}_T = J_{T,R} - J_{T,U}.$$

This test statistic, $\tilde{J}_T$, is asymptotically χ^2-distributed with degrees of freedom equal to the number of exclusion restrictions. Results from this exercise of imposing either $\lambda = 0$ or $\gamma = 0$ are reported in columns marked "Restricted" in Table 3. With either restriction, $\lambda = 0$ or $\gamma = 0$, the GMM-criterion function value increases substantially. In the case of $\lambda = 0$, for example, when the long-term government bond portfolio and decile 10 are included in this likelihood-ratio test, the estimate of γ is 3.44 and the $\tilde{J}_T$ statistic equals 85.08 with a p value of 0 percent. The hypothesis that restricting the value of λ to zero does not change the GMM-criterion value is therefore overwhelmingly rejected. The same conclusion holds when γ is restricted to zero.

In summary, results from the GMM tests are consistent with those from the Hansen-Jagannathan bound and the Hansen-Jagannathan specification error-tests reported earlier, all supporting the claim that incorporating the spirit of capitalism, or concerns about status, into the investor's preferences improves the ability of the asset-pricing model to explain both stock and bond price movements. The magnitudes and signs of the estimated γ and λ are supportive of the spirit-of-capitalism hypothesis.

IV. Concluding Remarks

In this paper, we examined the implications for consumption, portfolio choice, and stock prices, of the hypothesis that investors acquire wealth not just for its implied consumption but also for its induced status. We formalized the spirit-of-capitalism hypothesis in a way that is compatible with the more formal models of asset pricing that have been the prevailing mode of analysis in the past two decades. Among other things, we found that when investors care about status and about "catching up with the Joneses," they will be more conservative in risk taking and more frugal in consumption spending. Their consumption and risk taking will depend both on their relative social standing and on the prevailing wealth standards at the time. Further, stock prices tend to be more volatile than when the spirit of capitalism is absent.

Our work adds to the recent literature on the economic implications of social norms, customs, and culture.[13] Cole et al. (1992) study how the desire to increase social status may affect wealth accumulation and economic growth. In some sense, our preference structure can be viewed as a parametrization of their wealth-is-status equilibrium. Zou (1992, 1994) also assumes a direct utility function that has wealth as a variable to discuss economic growth and savings issues. By focusing attention on implications of the capitalistic spirit for risk taking and investment behavior, our exercise has lead to explicitly-testable restrictions relating concerns for status to stock prices and other economic variables.[14] The reported empirical results are supportive of the spirit-of-capitalism hypothesis and the resulting asset-pricing model performs better than the standard expected-utility model.

As noted earlier, wealth enters the IMRS under both our Model 1 and Epstein and Zin's (1991) parametrized recursive utility. In our discussion, this occurs due to investors' concern about wealth-induced status, whereas in theirs it is due to investors' concern about the timing of uncertainty resolution. In reality, both types of concern may exist simultaneously. In order for a preference model to capture these distinct concerns, one can substitute our Model 1, for instance, for the period utility in their recursive structure so that the two concerns are separately parametrized. Such a parametrization is potentially useful for empirical work since it allows one to estimate how much the effect of wealth on the IMRS is due to the timing concern and how much to the status concern. Along the same line, one can incorporate the concern for status into the habit-forming preferences of Constantinides (1990) and John Heaton (1995). Such extensions will generally be more complex, but should nonetheless make modelled preferences closer to their real-life counterparts.

[13] See Chaim Fershtman and Yoram Weiss (1993) for more references on this topic.

[14] For a different study on wealth-dependent preferences and asset prices, see Tzu-Kuan Chiu (1993).

APPENDIX A: PROOF OF RESULTS

PROOF OF PROPOSITION 1:

Rewrite equation (9) as follows:

$$\text{(A1)} \quad e^{-\rho\Delta t}E_t\left\{\frac{U_C(C^*_{t+\Delta t}, W^*_{t+\Delta t}, V_{t+\Delta t})}{U_C(C^*_t, W^*_t, V_t)} + \frac{U_W(C^*_{t+\Delta t}, W^*_{t+\Delta t}, V_{t+\Delta t})\cdot\Delta t}{U_C(C^*_t, W^*_t, V_t)} \times\left(1+\frac{\Delta P_{i,t}}{P_{i,t}}\right)\right\} = 1$$

for any risky asset i and the risk-free asset, where $\Delta P_{i,t} \equiv P_{i,t+\Delta t} - P_{i,t}$. Subtracting the risk-free asset counterpart of (A1) from equation (A1) yields (A2):

$$\text{(A2)} \quad E_t\left\{\frac{U_C(C^*_{t+\Delta t}, W^*_{t+\Delta t}, V_{t+\Delta t})}{U_C(C^*_t, W^*_t, V_t)} + \frac{U_W(C^*_{t+\Delta t}, W^*_{t+\Delta t}, V_{t+\Delta t})\cdot\Delta t}{U_C(C^*_t, W^*_t, V_t)} \times\left(\frac{\Delta P_{i,t}}{P_{i,t}} - r_0\Delta t\right)\right\} = 0.$$

Note that the term $U_W(C^*_{t+\Delta t}, W^*_{t+\Delta t}, V_{t+\Delta t})\cdot\Delta t$ in (A2) becomes negligible as $\Delta t \to 0$. Then, we can take the Taylor series of $U_C(C^*_{t+\Delta t}, W^*_{t+\Delta t}, V_{t+\Delta t})$ around the point (C^*_t, W^*_t, V_t) in equation (A2) and apply Ito's lemma to the resulting equation. Simplifying and rearranging the final terms will yield equation (12).

PROOF OF PROPOSITION 2:

The Hamilton-Jacobi-Bellman equation for (18) is

$$\text{(A3)} \quad 0 = \max\Big\{U(C_t, W_t, V_t) + \tfrac{1}{2}\alpha_t^2\sigma^2W_t^2J_{WW} + \{W_t[r_0 + \alpha_t(\mu - r_0)] - C_t\}J_W + \tfrac{1}{2}\sigma_v^2V_t^2J_{VV} + \mu_vV_tJ_V + \alpha_t\sigma_{1,v}W_tV_tJ_{VW} - \rho J\Big\},$$

the first-order conditions of which are stated in (20) and (21). Conjecturing that the value function has the form: $J(W, V) = \eta^{-\gamma}(W^{1-\gamma-\lambda})/(1-\gamma-\lambda))V^{-\lambda}$, we substitute it into (20), (21), and (A3) and solve the system jointly for C^*_t, α^*_t and η, which will give the desired result. See Merton (1971) for further details of the solution technique.

PROOF OF PROPOSITION 3:

The solution steps are the same as in the proof of Proposition 2 except that the conjectured value function is $J(W, V) = \xi^{-\gamma}((W - \kappa V)^{1-\gamma-\lambda}/(1-\gamma-\lambda))$.

APPENDIX B: DATA DESCRIPTION

The variables employed in our tests and their sources are explained below:

C_t: per-capita real consumption in nondurables and services during month t. Source: CITIBASE. It equals real consumption expenditures divided by the residential population. The variable DCON_t is the percentage change in C_t from month $(t-1)$ to month t.

INF_t: percentage change in the nondurables plus services consumption deflator from month $(t-1)$ to t. Source: CITIBASE.

$\text{RDEC}_{i,t}$: real return on the ith decile stock portfolio in month t, for $i = 1, \ldots, 10$. The decile portfolios are the 10 standard CRSP size-based portfolios, with each monthly return for any decile portfolio given by the value-weighted average of the component stock returns in that decile. Decile 1 includes the smallest 10 percent stocks; decile 2 the next smallest 10 percent; and so on. The nominal returns on the deciles are then adjusted by the nondurables and services consumption deflator to get the real returns. The data source for the nominal returns is the Center of Research for Security Prices (CRSP), University of Chicago.

TBILL_t: real return on one-month Treasury bills, which is the nominal return, obtained from Ibbotson Associates, adjusted by the nondurables and services consumption deflator.

RLTGB_t: real return on a portfolio of long-term government bonds (source: Roger G. Ibbotson and Rex A. Sinquefield, 1992). It is the nominal return minus the nondurables and services inflation rate.

TABLE 4—SUMMARY STATISTICS

Variable	Mean	STD	θ_1	θ_2	θ_3	θ_6	θ_{12}	θ_{24}
RVWI	0.0053	0.044	0.07	−0.05	0.00	−0.06	0.03	0.00
RDEC_1	0.0106	0.082	0.20	0.00	−0.02	−0.03	0.31	0.13
RDEC_5	0.0071	0.061	0.15	−0.02	−0.02	−0.01	0.13	0.01
RDEC_{10}	0.0047	0.043	0.03	−0.04	0.01	−0.06	0.04	−0.00
RLTGB	0.0014	0.031	0.05	−0.01	−0.13	0.04	0.04	−0.07
RLTCB	0.0026	0.026	0.18	−0.03	−0.04	0.07	0.11	−0.04
TBILL	0.0011	0.002	0.51	0.45	0.36	0.42	0.31	0.24
TERM	0.0003	0.031	0.04	−0.03	−0.13	0.03	0.03	−0.08
DEF	0.0015	0.026	0.16	−0.04	−0.05	0.05	0.10	−0.05
DCON	0.0016	0.004	−0.24	0.06	0.15	0.05	−0.04	−0.15
INF	0.0039	0.003	0.64	0.60	0.52	0.57	0.45	0.31
C/W	0.0057	0.002	0.97	0.95	0.93	0.85	0.73	0.55

Notes: All variables are in monthly values. RDEC_1 through RDEC_{10} are the value-weighted real returns on the 10 size-based portfolios. RVWI is the real return on the value-weighted index of the NYSE stocks. RLTGB and RLTCB are the real returns of a portfolio of long-term government bonds and a portfolio of long-term corporate bonds, respectively. TBILL is the nominal Treasury bill return minus the nondurables and services inflation rate. TERM is the total return on a portfolio of long-term government bonds minus the nominal Treasury bill return. DEF is the total return on a portfolio of corporate bonds minus the nominal Treasury bill rate. DCON is the real growth rate of per-capita nondurables plus services consumption. INF is the nondurables and services inflation rate. *C/W* is the consumption-to-wealth ratio. θ_τ denotes autocorrelation at lag τ. The sample period is 1959:1–1991:12 (396 observations).

RLTCB_t: real return on a portfolio of long-term corporate bonds. It is again the nominal return (source: Ibbotson and Sinquefield) minus the nondurables and services inflation rate.

TERM_t: term premium, which is the difference between the nominal return on a portfolio of long-term government bonds and the nominal return on the Treasury bills (source: Ibbotson and Sinquefield).

DEF_t: default premium, which is the excess return on long-term corporate bonds over the short-term interest rate from the one-month Treasury bills (source: Ibbotson and Sinquefield).

RVWI_t: real rate of return on the New York Stock Exchange value-weighted index.

Table 4 reports the summary statistics for the variables. Many of the stylized facts about consumption and asset returns are known. For instance, decile 1 (the smallest firms) has the highest average return and the highest standard deviation while decile 10 has the lowest standard deviation and the lowest average return. The average real-consumption growth is 0.0016 with a standard deviation of 0.004, which is quite smooth relative to the volatility of stock returns.

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