The Spirit of Capitalism, Asset Pricing and Growth in a Small Open Economy

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Abstract

Conventional models of economic behavior have failed to account for a number of observed empirical regularities in macroeconomics and international economics. This may be due to preference specifications in conventional models. In this paper, we consider preferences with the “spirit of capitalism” (the desire to accumulate wealth as a way of acquiring status). We analyze a number of potential effects of international catching-up and the spirit of capitalism on savings, growth, portfolio allocation and asset pricing. Moreover, we obtain a multi-factor Capital Asset Pricing Model (CAPM). Our results show that status concerns have non-trivial effects on savings, growth, portfolio allocation and asset prices.

Keywords: International Catching-Up; Asset Pricing; Exchange Rates; Spirit of Capitalism; Stochastic General Equilibrium Models.
1 Introduction

Conventional models of economic behavior assume that a person’s well-being depends on the absolute quantities of various goods and services he consumes and not on how these quantities compare with those consumed by others. Yet, from Max Weber’s pursuit of wealth as an end in itself (spirit of capitalism) to Duesenberry’s “demonstration effect” in consumption, there is a long tradition in sociology and economics which acknowledges that people are concerned with their relative standing in society and individuals’ consumption decisions are influenced by others (Duesenberry (1949)).\footnote{Another line of research in sociology such as “reference group theory” and the concept of “relative deprivation” incorporate a social frame of reference whereby an individual uses other groups for self-appraisals, comparisons, and in making choices. It is not unusual for an individual to use different reference groups for different situations. For reference group theory see, Dawson and Chatman (2001).}

There is a growing recognition that modelling preferences to accommodate such elements enhances our understanding of saving/consumption, asset pricing, and economic growth. For example, several authors have recently shown that the spirit of capitalism has nontrivial consumption-saving, portfolio allocation, asset pricing and growth effects. Cole, Mailath, and Postlewaite (1992) examine how the desire to increase social status affects wealth accumulation and economic growth while Robson (1992) show that status concerns affect risk taking. Bakshi and Chen (1996) develop a model where the relative wealth status leads to a two factor capital asset pricing model (CAPM). Smith (2001) extends the model to recursive preferences and obtains a three factor CAPM. In another paper Smith (1999) also examines growth effects. In a series of papers, Gong and Zou examine long run growth, saving, policy effectiveness, and monetary issues in a cash-advance setting under the spirit of capitalism (Zou (1994), Zou (1995), Gong and Zou (2001), Gong and Zou (2002)). Following
Bakshi and Chen (1996) and others, Carroll (2000) presents a model where wealth enters consumers’ utility functions directly and shows that the model yields results consistent with the available data on the saving behavior of the wealthy.

Even though some research has shown that an individual’s well-being depends significantly on his relative standing in local rather than global hierarchies, the norms by which people make judgements tend to depend on close contact and available information.\(^2\) Thus, as the information revolution removes barriers and the world economy gets more integrated, one would expect distant reference groups to become more important and individuals to be less indifferent to wealth standards in the rest of the world. Indeed, research by Juliet Schor has emphasized that when the neighborhood declined in 1950s and 1960s so did the Joneses down the street as a focus of comparison. As such, the television became more important as a source of consumer cues and information.\(^3\)

In this paper, we model preferences to accommodate status concerns by representative individuals irrespective of the reference group. In order to distinguish between domestic and international reference groups, we use “spirit of capitalism” to describe individuals’ concern about fluctuations in individual wealth relative to a domestic wealth standard while we use “international catching-up” to describe concerns about fluctuations in individual wealth relative to international wealth standards.\(^4\) When individuals care about relative status and the associated risks of falling out of status, they will hedge against these risks. This can have potentially important portfolio allocation, consumption-saving and growth effects.

Our model incorporates the “spirit of capitalism” and “international catching-up” to analyze consumption, growth, international portfolio allocation, and asset pricing.

\(^2\)See Frank (1985) and the references cited therein.
\(^3\)See Schor (1999).
\(^4\)Since we are not making any claim as to which concern is more important or empirically relevant, we use “spirit of capitalism” and “international catching-up” to describe individuals’ status concerns.
in a dynamic stochastic general equilibrium setting. The model builds on the rich equilibrium framework of Grinols and Turnovsky (1993, 1994) and well known to be capable of addressing a number of interesting issues (such as how means and variances of domestic government policy impact on the economy and isolating determinants of the real foreign exchange rate premium). Even though the capitalist spirit model of Bakshi and Chen (1996) captures the main features of the catching-up with the Jonesses features of Abel (1990, 1999), the idea has not been modelled in a stochastic general equilibrium setup in an open economy.\(^5\)

There are several distinctive features of the model developed here (the first two are familiar from Turnovsky and Grinols (1996)): First, the equilibrium involves the joint determination of the means and variances of the relevant economic variables (in terms of the first two moments of the exogenous stochastic processes impinging on the economy).\(^6\) Second, the model incorporates portfolio choice - thereby giving rise to an integrated analysis of exchange rate determination with a risk adjusted PPP and portfolio equilibrium. Third, our use of a recursive utility function which disentangles the two preference parameters for risk aversion and intertemporal substitution ensures that the model is fully capable of assessing the importance of the distinct and separate roles played by agents’ attitudes towards risk and intertemporal substitution.\(^7\) Finally, the model has a utility function that includes the level of wealth and

\(^{5}\)The empirical analysis of the catching-up with the Jonesses in an international asset pricing set-up can be found in Gomez, Priestley, and Zapatero (2003) and Lauterbach and Reisman (2004).

\(^{6}\)It can be important to make proper allowance for interactions such as variances affecting means in a model, for example, this type of mean variance optimization framework has formed the basis for important empirical work relevant to interest parity relationships and the determination of exchange rate risk premia: see, for example Frankel (1986), Hodrick and Savastava (1986), Giovannini and Jorion (1987) and Lewis (1998).

\(^{7}\)This type of General Isoelastic Preferences was introduced by Epstein and Zin (1989), and Weil (1990) and found a wide range of applications in macroeconomics and finance. For example, one can cite Svensson (1989), Epstein and Zin (1991), Duffie and Epstein (1992a), Obstfeld (1994b), Smith
a world wealth index - thereby capturing features of ‘catching up with the Joneses’ models such as Abel (1990), and exogenous habit formation models such as Campbell and Cochrane (1999)\(^8\).

This latter feature is of particular interest because it captures elements of a popular approach to explaining a number of puzzles associated with the equity premium and the foreign exchange market. For example, Campbell and Cochrane (1999) proposed a preference specification in which there is both an aggregate consumption externality and utility is time-inseparable because of habit persistence; and this helped explain the US stylized facts of the equity premium puzzle. Because the habit persistence takes the form of an aggregate consumption externality, this preference specification embodies keeping up with the Joneses’ effects in the spirit of Duesenberry (1949) and Abel (1990). However, the particular way in which the utility function is specified here also draws on another recent and fast-developing literature which incorporates the spirit of capitalism (the desire to accumulate wealth as a way of acquiring status). Our approach runs along the lines of Bakshi and Chen (1996)) who find that the spirit of capitalism seems to be a driving force behind stock market volatility (and economic growth).

Our paper is organized as follows. Section 2 outlines our development of existing continuous time stochastic endogenous growth models and presents the solution. Section 3 presents the effects of status concerns on international portfolio diversification, asset prices, and exchange rates. Section 4 concludes the paper.

\(^8\)Strictly speaking, the literature distinguishes between different external references in the utility function: agents care about past aggregate consumption in the economy (“catching up with the Joneses” as in Abel (1990) and “external habit formation” as in Campbell and Cochrane (1999)); agents care about current per capita consumption levels in the economy (“keeping with the Joneses” as in ?)); agents care about absolute or relative wealth in the economy (“spirit of capitalism” as in Bakshi and Chen (1996)).
2 The Model

We consider a continuous-time, infinite-horizon small open economy with complete financial markets and a single production good. In our model the utility maximizing and portfolio optimizing behavior of a representative household has a somewhat nonstandard element. We assume that the representative agent’s preferences exhibit the “the spirit of capitalism” feature of Bakshi and Chen (1996), Gong and Zou (2002) and Smith (2001). Specifically, we assume that household utility is a stochastic differential function of the multiplicative of individual consumption and relative wealth. The latter is defined as the ratio of the individual’s absolute wealth to the international standard of living. This form of preferences retains the property of the standard constant relative risk aversion (CRRA) utility function that individual risk aversion does not change over time. The model is a monetary one where money enters into the utility function.\textsuperscript{9} The production technology assumes a Rebelo (1991) ‘AK’ production function which leads to endogenous growth. The stochastic nature of the model is characterized by four exogenous stochastic shocks: (i) productivity shocks; (ii) monetary growth shocks; (iii) foreign price shocks and (iv) foreign wealth index shocks. Other shocks could be included but this set is characteristic of the most important exogenous stochastic influences in a small open economy. In financial markets there exist four assets: (i) equity; (ii) money; (iii) domestic bonds with zero net supply; and (iv) foreign bonds. We allow for a full range of interactions across shocks. The paper deals with only the steady-state stochastic equilibrium which is separated into deterministic and stochastic components. The remainder of this section sets out the key features of the model and its solution.\textsuperscript{10}

\textsuperscript{9}There are alternative ways of incorporating money: the most well-known alternative is transaction cost technologies such as a cash-in-advance constraint [Lucas (1982), Svensson (1985), Rebelo and Xie (1999)]. There are difficulties in imposing a cash-in-advance constraint in continuous-time.

\textsuperscript{10}Further details for the recursive utility part of the model can be found in Kenc (2004).
2.1 Preferences

At each point in time the representative consumer chooses its consumption $C$ and allocates its portfolio of wealth, $W$, across four assets: money $M$, capital $K$, domestic bonds $B$ and foreign bonds $B^*$. Of these assets only capital and foreign bonds are internationally traded.\footnote{The assumption that some assets are nontraded does not pose any problem as long as the risk characteristics of these nontraded assets can be replicated with those of the traded assets, i.e., nontraded assets are spanned. In other words, markets are complete in the sense that the number of stochastic processes equals the number of traded assets.} The only source of income for the representative household is the capital income received from holding these assets.

The representative agent’s intertemporal utility is defined as in Duffie and Epstein (1992b):

$$U_t = \int_t^\infty f(C_s, M_s/P_s, S_s, U_s)ds$$

(1)

where

$$f(C_s, M_s/P_s, S_s, U_s) = \delta \left\{ \left( \left[ C_s^{\theta} (M_s/P_s)^{1-\theta} S_s^\lambda \right]^{1-\frac{1}{\zeta}} - [(1 - \gamma)U_s]^{\frac{\zeta-1}{\zeta(1-\gamma)}} \right) \right\} \left\{ (1 - \frac{1}{\zeta})(1 - \gamma)U_s \right\}^{\frac{\zeta-1}{\zeta(1-\gamma)-1}}$$

(2)

Current utility $U_t$ depends upon current consumption $C_t$, real money balances $m_t$, “status” $S_t$ and expected values of future utility $U_s$, $s > t$. $f(c, U)$ is known as the normalized “aggregator” function generating ordinally equivalent utility functions. The parameter $\gamma > 0$ is the coefficient of relative risk aversion with respect to timeless gambles over $x_t$, while $\zeta > 0$ is the elasticity of intertemporal substitution defined over riskless paths of $x_t$, $\delta > 0$ is the rate of time preference.\footnote{For the special case of $\gamma = 1/\zeta$ the above utility function reduces to the well known time-separable, constant relative risk-aversion case:}

$$U_t = \int_t^\infty e^{\delta(s-t)} C_s^{1-\gamma} ds.$$
to which the investor cares about status - the degree of spirit of capitalism. Relative wealth is assumed to be status: the consumer’s absolute wealth, \( W_t \), and a world wealth index, \( V_t \). Status is thus described by a function \( S_t = f[W_t, V_t] \), where \( f_W > 0 \) and \( f_V \leq 0 \). More precisely, it is defined as
\[
S_t = \frac{W_t}{V_t}.
\]
The relative importance of money in composite consumption is measured by \( \theta \).

2.2 Prices and Asset Returns

There are three commodity prices in the model: the domestic price of the traded good (\( P \)); the foreign price level of the traded good (\( P^* \)); and the exchange rate (\( E \)). \( P^* \) is assumed to be exogenous and other two prices \( P \) and \( E \) are endogenously determined. The exchange rate (\( E \)) is measured in units of domestic currency per unit of foreign currency. Prices and returns are both generated by geometric Brownian motion (Wiener) processes. Each of the prices \( P \), \( P^* \) and \( E \) evolves according to
\[
\frac{dx}{x} = (\text{drift term}) \ dt + (\text{diffusion term}) \ dZ
\]
where \( x \) is either \( P \), \( P^* \) or \( E \); and \( \pi (\sigma_P), \pi^* (\sigma_{P^*}) \) and \( \epsilon (\sigma_E) \) are respective drift(diffusion) terms of these price processes. Thus, for example, \( \pi \ dt \) is the expected mean rate of change of \( P \) and \( \sigma_P \ dt \) is the volatility of this rate of change. \( Z_j \) is a Wiener process for \( j = P, P^*, E \). We use \( \rho \) to denote the “instantaneous” correlation coefficient between any two Wiener processes: \( \rho_{ij} = dZ_idZ_j \).

This small open economy is linked with the rest of the world through the law of one price. Formally, it means that the exchange rate \( E \) relates foreign prices \( P^* \) to domestic prices of traded goods \( P \), which is referred to as the purchasing power parity (PPP) relationship. The domestic price of the imported good is then given by
\[
P = EP^*
\]
which yields the following price process

\[
\frac{dP}{P} = (\pi^* + \epsilon + \sigma_{P*E}) dt + \sigma_{P*} dZ_{P*} + \sigma_E dZ_E \tag{5}
\]

As for asset returns, the real rate of return to equity holders is calculated from the flow of new output \(dY\) per capital \(K\) as follows

\[
dR_K = r_K dt + du_K \\
r_K = Adt \\
du_K = A\sigma_Y dZ_Y. \tag{6}
\]

where \(A\) is the marginal physical product of capital and \(\sigma_Y dZ_Y\) a productivity shock with \(\sigma_Y\) being the volatility of the shock. \(dY\) follows an AK type of the aggregate production function with endogenous growth\(^{13}\)

\[
dY = [Adt + \sigma_Y dZ_Y]K. \tag{7}
\]

Returns to other assets can be described in terms of the interest rates they pay. Domestic and foreign bonds pay nominal rates of interest, \(i\) and \(i^*\), respectively. Applying stochastic calculus and separating real returns from nominal returns, we obtain the real rates of return to domestic holders of money, domestic bonds, and foreign bonds as follows:

\[
dR_j = r_j dt - \sigma_j dZ_j, \quad j = M, B, B^* \]

where \(r_M = -\pi + \sigma_P^2\), \(r_B = i - \pi + \sigma_P^2\) and \(r_B^* = i^* - \pi^* + \sigma_{P^*}^2\).

We assume that the world-wealth index follows a diffusion process:

\[
dV = [\mu_V dt + \sigma_V dZ_V]V. \tag{8}
\]

\(^{13}\)We assume that output is produced from capital by means of the stochastic constant returns to scale technology; and the economy-wide capital stock is assumed to have a positive external effect on the individual factor capital.
2.3 Other Features of the Model

The government pursues the following monetary policy rule:

\[ \frac{dM}{M} = \phi dt + \sigma_X dZ_X \]  \hspace{1cm} (9)

where \( \phi \) is the mean monetary growth rate. The stochastic term \( \sigma_X dZ_X \) may reflect exogenous stochastic failures to meet the monetary growth target set by the monetary authority. Correlation between monetary growth shock and other shocks is important. For example, correlation between \( dZ_X \) and \( dZ_B^* \) may reflect stochastic adjustments in the money supply as the authorities respond to exogenous stochastic movements in the intermediate target, the exchange rate.

The proceeds from printing money are distributed as transfers to households. They are non-marketable assets. The real value of transfers is random because of the stochastic monetary rule described above. We assume that the household expects that its real transfer income \( dT \) will remain proportional to wealth, as follows:

\[ dT = \tau W dt + \sigma_T W dZ_T, \quad 0 < \tau < 1, \]  \hspace{1cm} (10)

where \( \tau \) is the transfer rate and \( \sigma_T dZ_T \) a shock with \( \sigma_T \) being the volatility of the shock.

2.4 Household Optimization

Utility is maximized subject (i) to the following wealth \( W \) constraint, which in real terms is

\[ W = \frac{M}{P} + \frac{B}{P} + \frac{EB^*}{P} + K \]
where $E$ is the exchange rate and $P$ equals the price level and (ii) to the stochastic wealth accumulation equation:

$$\frac{dW}{W} = \psi dt + \sigma_W dZ_W$$

$$\psi = n_M r_M + n_B r_B + n_K r_K + n^*_B r^*_B - \tau - C_t/W_t$$

$$\sigma_W dZ_W = -n_M \sigma_P dZ_P - n_B \sigma_P dZ_P + n_K A \sigma_Y dZ_Y - n^*_B \sigma^*_P dZ^*_P - \sigma_T dZ_T$$

where $n_i$ is the share of portfolio held in asset $i$. More specifically, $n_M = (M/P)/W$, $n_B = (B/P)/W$, $n_K = K/W$ and $n^*_B = (E B^*/P)/W$. The representative consumer constructs an optimal portfolio of his total wealth subject to the adding up condition for portfolio shares:

$$1 = n_M + n_B + n_K + n^*_B$$

Consumers are assumed to purchase output over the instant $dt$ at the nonstochastic rate $Cdt$ using the capital income generated from holding assets. To define each asset return, $dR_i$, requires a description of the dynamics which generate asset prices and asset returns.

The maximization of (1) subject to the stochastic differential equation (11a) and the adding up condition (12) represents a continuous-time stochastic dynamic optimization problem of the type pioneered by Merton (1969). The solution strategy is based on the dynamic programming approach of Duffie and Epstein (1992b). The household maximizes utility by choosing the optimal full (composite) consumption-wealth ratio and the optimal portfolio shares of assets, taking the rates of return on assets, and the relevant variances and covariances as given$^{14}$.

$^{14}$However, the general equilibrium conditions, i.e. market-clearing conditions, of the model will determine these rates of return, variances and covariances.
Solving the consumer’s problem yields the following optimality conditions:

\[
\frac{C}{W} = \Phi \Delta + (1 - \Phi)[r_Q - \tau - \Gamma_1 \frac{\sigma_W^2}{2}]
\]

\[+ (1 - \Phi)\frac{\lambda}{\alpha + \lambda}[\mu_V - \Gamma_2 \frac{\sigma_V^2}{2}] + (1 - \Phi)\lambda(1 - \gamma)\sigma_{WV} \tag{13}\]

where \(\Gamma_1 = 1 - (\alpha + \lambda)(1 - \gamma)\) is the effective coefficient of relative risk aversion; \(\Gamma_2 = 1 - \lambda(1 - \gamma); \Delta = \frac{\alpha \delta}{\alpha + \lambda}\) is the effective rate of time preference; and \(\Phi = \frac{\zeta}{(\zeta - (\zeta - 1)\theta\alpha)}\) is the effective elasticity of intertemporal substitution. \(r_Q\) is the return on the portfolio;

\[
r_Q = n_M r_M + n_B r_B + n_K r_K + n_{B^*} r_{B^*}.
\tag{14}\]

\[
[r_K - r_B]dt = \Gamma_1 (\sigma_{YW} + \sigma_{PW}) + \lambda(1 - \gamma)(\sigma_{YV} + \sigma_{PV}),
\tag{15}\]

\[
[r_{B^*} - r_B]dt = \Gamma_1 (-\sigma_{P*W} + \sigma_{PW}) + \lambda(1 - \gamma)(-\sigma_{P*V} + \sigma_{PV}).
\tag{16}\]

2.4.1 Goods Market Equilibrium and Balance of Payments

In our small open economy net exports in real terms are given by

\[
\text{Net Exports} = dY - dC - dK.
\]

The balance-of-payments equilibrium condition in real terms is

\[
d(EB^*/P) = (EB^*/P)dR^*_B + \text{Net Exports} \tag{17}\]

Substituting and simplifying we derive the following expression for the rate of growth of the capital stock:

\[
\frac{dK}{K} = \left[\omega \left( A - \frac{1}{n_K} \frac{C}{W} \right) + (1 - \omega)r^*_B \right] dt + \omega \sigma_Y dZ_Y - (1 - \omega)\sigma_{B^*} dZ^*_B. \tag{18}\]

where for notational convenience we define \(\omega \equiv \frac{n_K}{n_K + n_B}\) to be the share of capital in the traded portion of the consumer’s portfolio.
3 International Catching-Up and the Spirit of Capitalism

In this section, we will discuss how the spirit of capitalism or the concern for social status affects asset pricing, international portfolio diversification, exchange rate determination and economic growth. To facilitate this analysis we will simplify the model described in Section 2.

3.1 International Portfolio Diversification

First, we give the equilibrium asset-pricing relationships. To make our model comparable with that of Giuliano and Turnovsky (2003) we consider a real economy with only two assets, a domestic equity and foreign bonds. Applying the optimization method yields the following optimal portfolio share of domestic equity:

\[ n_K = \frac{\text{the Sharpe ratio}}{\Gamma_1} + \text{home bias} \]  \hspace{1cm} (19)

where

\[ \text{the Sharpe ratio} = \frac{r_K - [r_B - \Gamma_1(\sigma_{P^*}^2 - \sigma_{P^*Y})]}{\Lambda}, \]  \hspace{1cm} (20)

\[ \text{home bias} = \mathcal{H} \left( \frac{\sigma_{YV} + \sigma_{B^*V}}{\Lambda} \right), \]  \hspace{1cm} (21)

\[ \Lambda = \sigma_Y^2 + \sigma_{P^*}^2 - 2\sigma_{P^*Y}. \]

In eq. (21), the expression \( \mathcal{H} \) denotes the ‘propensity to hedge’ against unanticipated fluctuations in the world wealth index, and defined as

\[ \mathcal{H} = -\frac{J_{WV}}{J_{WW}} \frac{V}{W} = -\frac{\lambda(1-\gamma)}{\Gamma_1}. \]

Notice that the optimal share of domestic equity in (19) differs from that of Giuliano and Turnovsky (2003) in two ways: (i) the degree of the spirit of capitalism
and (ii) the international “catching-up” feature of our model. As pointed out by Smith (2001), an increase in the the degree of the spirit of capitalism, \( \lambda \), leads to a rise in the effective coefficient of relative risk aversion, \( \Gamma_1 = 1 - (\alpha + \lambda)(1 - \gamma) \), when \( \gamma > 1 \), otherwise \( \Gamma_1 \) declines. In turn, assuming \( \gamma > 1 \) the rise in \( \lambda \) decreases the demand for equity, \( n_K \).

The second part in the optimum equity share depends on the correlations of assets held in the portfolio and the world wealth index, \( V \). If these correlations are positive and \( \gamma > 1 \) to make the home bias effect positive, then domestic investors will hold more of the domestic asset. As emphasized by Bakshi and Chen (1996) adding domestic equity serves to insure against a future decline in \( V \). However, if the correlations are negative, holding too much domestic assets will reduce the investor’s status further when \( V \) rises. Therefore domestic investors will shift their portfolio to foreign assets in order to insure them against the uncertain declines in status. Note that the higher \( \lambda \), the more intensive is the insurance effect. Moreover, unless \( \gamma = 1 \), optimal portfolio shares are convex functions of \( \lambda \) as shown by Smith (2001).

Giuliano and Turnovsky (2003) point out that the size of the equilibrium portfolio shares, \( n_K, n_{B^*} \), relative to the growth variance-minimizing portfolio shares, \( \tilde{n}_K, \tilde{n}_{B^*} \), is a crucial determinant of the effects of structural changes on the equilibrium. Following Giuliano and Turnovsky (2003) we define \( \tilde{n}_K, \tilde{n}_{B^*} \) to be the portfolio shares minimizing the growth volatility \( \sigma_W^2 \) and obtain them by minimizing (11c) with respect to \( n_K, n_{B^*} \). They are given by

\[
\tilde{n}_K = \frac{\sigma_{p^*}^2 - \sigma_{p^*Y}}{\Lambda} \quad \tilde{n}_{B^*} = \frac{\sigma_Y^2 - \sigma_{p^*Y}}{\Lambda}.
\]

These are the same as those obtained in Grinols and Turnovsky (1994) apart from covariances. The equilibrium portfolio shares are now separated as follows

\[
\begin{align*}
n_K &= \frac{r_K - r_{B^*}}{\Lambda} + \text{home bias} + \tilde{n}_K \\
n_{B^*} &= \frac{r_{B^*} - r_K}{\Lambda} + \text{home bias} + \tilde{n}_{B^*}
\end{align*}
\]
These expressions show that with the spirit of capitalism our model yields different ratio of $n_j$ to $\tilde{n}_j$ for $j = \text{capital and foreign asset}$ since the base $\tilde{n}_j$ is the same\footnote{15}. Following Gong and Zou (2002) we define $\chi/[\{(1 - \Gamma_1)\Gamma_1^{1-\gamma}W^{1-\Gamma_1}V^{1-\Gamma_2}\}$ as ‘risk-free’ return, $r^f$, in this all risky world—both returns on domestic equity and foreign assets are uncertain. Now one can obtain the following equilibrium asset-pricing relationships and assets’ beta coefficients

$$r_i - r^f = \beta_i (r_Q - r^f) \quad \text{for} \quad i = K, B^*,$$

$$\beta_i = \frac{\text{cov}(\sigma_Q dZ_Q, \sigma_i dZ_i)}{\text{var}(\sigma_Q dZ_Q)} \quad \text{for} \quad i = K, B^*.$$

where $r_Q$ is the rate of return on the equilibrium (market) portfolio and $\sigma_Q dZ_Q$ is the stochastic term of this portfolio. Following Turnovsky (1995) we form the market portfolio as $Q = n_K W + n_{B^*} W$ and therefore $r_Q$ can be derived as

$$r_Q = r_K n_K + r_{B^*} n_{B^*} = \left[ \frac{r_K - r_{B^*}}{\Gamma_1 \Lambda} + \text{home bias} + \tilde{n}_K \right] (r_K - r_{B^*}) + r_{B^*}.$$

Giuliano and Turnovsky (2003) obtain the following expression

$$r_{Q}^{GT} = \left[ \frac{r_K - r_{B^*}}{\Gamma_1^{GT} \Lambda^{GT}} + \tilde{n}_K^{GT} \right] (r_K - r_{B^*}) + r_{B^*}.$$

where

$$\Lambda^{GT} = \sigma_Y^2 + \sigma_{P^*}^2 \quad \Lambda = \sigma_Y^2 + \sigma_{P^*}^2 - 2\sigma_{P^* Y}$$

$$\Gamma_1^{GT} = \gamma \quad \Gamma_1 = 1 - (\alpha + \lambda)(1 - \gamma)$$

$$\tilde{n}_K^{GT} = \frac{\sigma_{P^*}^2}{\sigma_Y^2 + \sigma_{P^*}^2} \quad \tilde{n}_K = \frac{\sigma_{P^*}^2 - \sigma_{P^* Y}}{\Lambda}.$$

Comparing our results with theirs (ignoring cross correlations) reveals that the spirit of capitalism makes difference through two channels; effective risk aversion

\footnote{The variance minimizing portfolio was recognized by Branson and Henderson (1995), who dubbed it “hedging demand” as it is independent of preferences. They called $(\frac{(\alpha - \lambda)}{\Lambda})$ “speculative demand” so the portfolio shares can be expressed as speculative demand, hedging demand, and home bias effects.}
and home bias. When $\gamma > 1$ the home bias (the risk aversion channel) increases (decreases) the rate of return on the market portfolio ($r_Q > r_Q^{GT}$).

Given the definition of the risk-free rate one can obtain the following expressions:

$$r^f = \frac{\chi}{\delta (1 - \Gamma_1) b^{1-\gamma} W^{1-\Gamma_1} \bar{V}^{\Gamma_2}}$$

$$\bar{r}^f = \frac{\chi}{\delta (1 - \gamma) b^{1-\gamma} W^{1-\gamma}}$$ (24)

where a bar over a variable denotes a benchmark without the spirit of capitalism.

Since $r_Q > r_Q^{GT}$ it is evident that the excess return on asset $i$ is enhanced by the spirit of capitalism

$$r_i - r^f > \bar{r}_i - \bar{r}^f.$$  

This is in line with the results reported in Gong and Zou (2002) who use absolute-wealth-is-status model of the spirit of capitalism. Notice that our model produces higher excess returns relative to that of Gong and Zou (2002) for two reasons; (i) international catching-up through the home bias term and (ii) lower risk-free rate [see eq. (24)]. As pointed out by Bakshi and Chen (1996) this improves the equity premium puzzle in Mehra and Prescott (1985). Moreover, the lower risk-free rate result alleviates the risk-free rate puzzle in Weil (1989).

In this type of representative agent setting the equilibrium requires that

$$\sigma_Q dZ_Q = \sigma_W dZ_W.$$ (25)

Using (25) we obtain the beta coefficients as

$$\beta_K = \frac{n_K \sigma^2_Y}{n_K \sigma^2_Y + n^2_{K^*} \sigma^2_{P^*} + 2n_K n_{B^*} \sigma_{Y P^*}}$$ (26)

$$\beta_{B^*} = \frac{n_{B^*} \sigma^2_{P^*}}{n^2_{K^*} \sigma^2_Y + n^2_{B^*} \sigma^2_{P^*} + 2n_K n_{B^*} \sigma_{Y P^*}}$$ (27)

Substituting (22) and (23) into (26) and (23) respectively and ignoring the cross correlations appearing in $\Lambda$ yield

$$\beta_K = \frac{\sigma^2_Y \left[ \left( \frac{r_K - r_{B^*}}{1_h} \right) + \sigma^2_{P^*} \right] + \sigma^2_Y h}{\left( \frac{r_K - r_{B^*}}{1_h} \right)^2 + \sigma^2_{P^*} \sigma^2_Y + h^2 + 2h \left( \frac{r_K - r_{B^*}}{1_h} \right) \left( \frac{\sigma^2_Y - \sigma^2_{P^*}}{\sigma^2_Y + \sigma^2_{P^*}} \right) + 4 \left( \frac{\sigma^2_Y \sigma^2_{P^*}}{\sigma^2_Y + \sigma^2_{P^*}} \right) \sigma^2_Y}$$ (28)
\[
\beta_{p^*} = \frac{\sigma^2_{p^*} \left[ \left( \frac{r_{B^*} - r_K}{\Gamma_1} \right) + \sigma^2_Y \right] + \sigma^2_{p^*} h}{\left( \frac{r_K - r_{B^*}}{\Gamma_1} \right)^2 + \sigma^2_{p^* \sigma^2_Y} + h^2 + 2h \left( \frac{r_K - r_{B^*}}{\Gamma_1} \right) \left( \frac{\sigma^2_Y - \sigma^2_{p^*}}{\sigma^2_Y + \sigma^2_{p^*}} \right)} + 4 \left( \frac{\sigma^2_Y \sigma^2_{p^*} h}{\sigma^2_Y + \sigma^2_{p^*}} \right)
\]

where \(h\) denotes the home bias. Setting \(h = 0\) (i.e., without the international catching-up feature) and \(\Gamma_1 = \gamma\) (i.e., without the spirit of capitalism) asset beta coefficients reduce the expressions obtained by Giuliano and Turnovsky (2003). However, equations (28) and (29) do not give us a clear-cut comparison to those in Giuliano and Turnovsky (2003). Ultimately, numerical analysis can be used to assess any effects for a reasonable set of parameter values.

### 3.2 Growth and Consumption Effects

The expressions for the equilibrium growth rate and the consumption wealth ratio can be obtained by substituting the equilibrium portfolio shares implied by equation (19) into (18):

\[
\psi = \psi^{GT}
\]

\[
\Phi \frac{h (r_K - r_{B^*})}{\sigma^2_{p^*} + \sigma^2_Y} \left[ (1 - \Phi) \right] \left( \frac{r_K - r_{B^*}}{\Gamma_1} \right) \left( \frac{\sigma^2_Y - \sigma^2_{p^*}}{\sigma^2_Y + \sigma^2_{p^*}} \right) + 2\sigma^2_{p^*} \sigma^2_Y h
\]

\[
\left( \frac{1 - \Phi}{\sigma^2_{p^*} + \sigma^2_Y} \right) \lambda (1 - \gamma) \left\{ (\sigma_{VV} + \sigma_{P^*, V}) h \right\} + \left( \frac{1 - \Phi}{\frac{\lambda}{\alpha + \lambda} \mu - \Gamma_2 \sigma^2_Y} \right)
\]

\[
\left( \sigma_{V^* V} \sigma_{Y^*} + \sigma_{P^*, V} \right) \left( \frac{r_{B^*} - r_K}{\Gamma_1} \right)
\]

\[
= \left( \frac{1}{2 \Gamma_1} \right) (r_K - r_{B^*})^2 + \Phi [r_K \sigma^2_{p^*} + r_{B^*} \sigma^2_Y] + (1 - \Phi) \left( \frac{\Gamma_1}{2} \sigma^2_{p^*} \sigma^2_Y \right) \frac{1}{\sigma^2_Y + \sigma^2_{p^*}} - \Phi \Delta.
\]

where
\[
\frac{C}{W} = \left( \frac{C}{W} \right)^{GT} + \frac{(r_K - r_{B^*})h}{\sigma^2_{P^*} + \sigma^2_Y} - \psi
\] (31)

where
\[
\left( \frac{C}{W} \right)^{GT} = \frac{(r_K - r_{B^*})^2}{\Gamma_1(\sigma^2_Y + \sigma^2_{P^*})} + \frac{\Gamma_1(r_K \sigma^2_{P^*} - r_{B^*} \sigma^2_Y)}{\sigma^2_Y + \sigma^2_{P^*}} - \psi^{GT}
\] (32)

Similarly, the variance of the equilibrium growth rate is given by
\[
\sigma^2_{\psi} = (\sigma^2_{\psi})^{GT} + \frac{h^2}{\sigma^2_{P^*} + \sigma^2_Y} + \frac{2h}{(\sigma^2_{P^*} + \sigma^2_Y)^2} \left\{ \left( \frac{r_K - r_{B^*}}{\Gamma_1} \right) (\sigma^2_Y - \sigma^2_{P^*}) + 2 \sigma^2_{P^*} \sigma^2_Y h \right\},
\] (33)

where
\[
(\sigma^2_{\psi})^{GT} = \frac{(r_K - r_{B^*}) \sigma^2_{P^*}}{\sigma^2_{P^*} + \sigma^2_Y}.
\]

These expressions highlight the additional channels whereby the home bias and international catching-up influence the equilibrium growth and consumption rates and their variability relative to those found by Giuliano and Turnovsky (2003). However, the qualitative effects of these additional terms cannot be determined \textit{a priori}.

For example, a calibration analysis for the UK economy based on the guesstimated values for the “deep parameters” such as the risk aversion and intertemporal elasticity substitution parameters and the estimated values for the parameters governing the dynamics of the state variables suggests that the growth effect of the spirit of capitalism is in the region of a 30% rise in the equilibrium growth rate.

### 3.3 A Multi-Factor CAPM

Following Duffie and Epstein (1992a) \[cf. eq. (35)\] in terms of the normalized aggregator \( f \) we define a \textbf{stochastic discount factor} (state-pricing process) as follows:
\[
\xi_t = \exp \left[ \int_0^t f_u ds \right] [f_c + f_{m/p} + f_s]
\] (34)

where \( f_i \) stands for the partial differentiation of the function \( f(C, M/P, S, U) \) with respect to \( i = C, M/P, S, U \). As in Duffie and Epstein (1992a) applying Ito’s formula
to $\xi$ yields

$$\frac{d\xi}{\xi_t} = \mu_\xi dt + \sigma_\xi dZ$$  \hspace{1cm} (35)$$

where

$$\mu_\xi = f_u + \frac{D J_W}{J_W}$$

$$\sigma_\xi = \sum_i \left[ \frac{W J_{WW}}{J_W} n_i \sigma_i \right] + \frac{V J_{VW}}{J_W} \sigma_V \quad \text{for } i = M, K, B, B^*$$

The first order condition for the Bellman equation for optimal interior $c$ is $f_c = J_W$. Assuming that the optimal consumption policy is given by a smooth function $C$ of states [i.e., $c_t = C(W_t, S_t, t)$], we can differentiate $J_W = f_c$ with respect to $W$ and obtain $J_{WW} = f_{cc}C_W + f_{cu}J_W$. Substituting these definitions together with the definitions of $\sigma_c, \sigma_i$ for $i = M, K, B, B^*$ and $\sigma_V$ in expression for $\sigma_\xi$ we obtain a new expression for $\sigma_\xi$ in term of key volatility terms such as $\sigma_c$ as follows:

$$\sigma_\xi = \frac{(\eta - 1)}{c} \sigma_c - \frac{(\eta - 1)}{\xi} \frac{1}{W} \sum_i [\sigma_i] + \lambda \sigma_V$$  \hspace{1cm} (36)$$

$i = P, P, Y, P^*$. The derivation of Eq. (36) can be found in Appendix. The process for the stochastic discount factor in (35) is well-defined provided that each of the underlying variable can be characterized as a diffusion process:

$$\frac{dX(j)}{X(j)} = \mu_j dt + \sigma_j dZ, \quad j = M, P, W, V.$$ 

Having obtained the stochastic discount factor we can use the fundamental asset pricing expression given in Cochrane (2001) [cf. eq. (1.35)]

$$\text{(APE)} \quad \mathcal{E}_t \left( \frac{dP_t}{P_t} \right) + \frac{D}{P_t} dt = r_t - \mathcal{E}_t \left[ \frac{d\xi_t}{\xi_t} \frac{dP_t}{P_t} \right]$$

to derive a multi-factor version of the Capital Asset Pricing Model (CAPM). Here, $D_t$ is the dividend at time $t$ and $P_t$ is the price of common stock at time $t$. 

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We now exclude money in this setup to render the results comparable to the existing literature e.g., Epstein and Zin (1991), Bakshi and Chen (1996), Smith (2001). In our case applying (APE) to the expected rate of return on asset $X_j$ yields

$$\mathcal{E}_t\left(\frac{dX_j}{X}\right) - r^f_t = -\mathcal{E}_t\left[\frac{d\xi_t}{\xi_t}X_j\right]$$

Simplifying it gives

$$\mu_x - r^f_t = -\left[\frac{\eta - 1}{\varepsilon}c - \gamma - 1\right] \mathcal{E}_t\left[\frac{d\xi_t}{\xi_t}X_j\right]$$

where $\eta = \frac{1}{\zeta} - 1$ and $\varepsilon = 1 - \gamma$. This is a multi (five) factor CAPM model—an extension of equation 22 in Duffie and Epstein (1992b) to include domestic and foreign inflation uncertainties and the relative reference wealth uncertainty. The first factor (first term on the right hand side) is a “premium” due to the variation in consumption, as the agent must be compensated for bearing consumption risk. The second term represents compensation due to variation in wealth: this matters for the risk premium because in recursive utility, wealth is a proxy for future utility. Moreover, in the spirit of capitalism framework, the investor cares about wealth induced status, as such the investor must be compensated for risks associated with the variation in wealth. Similarly, agents need to be compensated for bearing domestic and foreign inflation risks in equilibrium, which is evident in the third and fourth terms in equation (37). Finally, as in Bakshi and Chen (1996), and Smith (2001), the risk premium depends on the covariance of an asset’s return with reference wealth and the investor must be compensated for risks associated with the variations in the reference wealth index.

### 3.4 Exchange Rate Determination

In this section, we derive the stochastic process generating the equilibrium exchange rate. To this end a full version of the model is used but with logarithmic preferences
In order for explicit expressions.\textsuperscript{16}

In particular, we obtain the equilibrium drift and diffusion terms of the following stochastic process:

\[
\frac{dE}{E} = \tilde{\epsilon} dt + \tilde{\sigma} \epsilon dZ = \tilde{\epsilon} dt + \sigma_X dZ_X - \tilde{\omega} \left[ \sigma_Y dZ_Y + \sigma_{P*} dZ_{P*} \right]
\]

where \(\tilde{\epsilon}\) is the equilibrium depreciation of the exchange rate. This will be determined by two equilibrium loci governing domestic and foreign real rates of return (RR) and portfolio balance (PP) as is done by Grinols and Turnovsky (1994). With logarithmic preferences the optimum share of capital in the traded component of the portfolio, \(\omega\), derived from the portfolio optimality conditions (15) and (16) is given by

\[
\omega = r_K - (i^* - \pi^*) + \frac{\sigma_{P*}}{\sigma_Y^2 + 2\sigma_{P*} + \sigma_{P*}^2} \sum \frac{\alpha\theta\delta}{\alpha + \lambda}
\]  

This expression is the same as that obtained in Grinols and Turnovsky (1994) apart from covariances [cf eq. (25)]. This is not surprising because logarithmic preferences eliminate tangency portfolio effects, hence no international portfolio diversification effects.

The relationship between \(\epsilon\) and \(\pi\) that maintains equilibrium between the real rates of return is

\[
(RR) \quad \pi = i^* + \epsilon - r_K + \sigma_Y^2 \omega
\]

Similarly, the relationship between \(\epsilon\) and \(\pi\) that maintains the portfolio balance is given by

\[
(PP) \quad \pi = \phi - (i^* - \pi^*) + (i^* - \pi^* - \sigma_{P*}^2 - r_K)\omega + (\sigma_Y^2 + \sigma_{P*}^2)\omega^2 + \frac{1}{\alpha + \lambda}
\]

\textsuperscript{16}In this case the intertemporal utility function is given by

\[
U_t = \int_t^{\infty} e^{-\delta s} \left[ \alpha [\theta \ln C_s + (1 - \theta) \ln (M_s/P_s)] + \lambda \ln S_s \right] ds.
\]
where
\[ \Upsilon = 1 - \frac{(1 - \theta)\alpha \delta}{(\alpha + \lambda)(i^* + \epsilon - \sigma_X^2)}. \]

The equilibrium values of \( \pi \) and \( \epsilon \) are determined by the intersection of (RR), which is a 45 degree line in the \( \pi - \epsilon \) space, and (PP), which is a rectangular hyperbola. The effects of various exogenous shocks on the equilibrium values of the inflation rate and the exchange rate depreciation can be analyzed as in Grinols and Turnovsky (1994). Here we restrict our focus to the effects of the spirit of capitalism. As seen from (RR) none of the parameters representing the spirit of capitalism such as \( \lambda, \mu_V \) or \( \sigma_V \) appear in the equation. However, the degree of the spirit of capitalism \( \lambda \) affects the (PP) schedule causing it to shift down; this results in lower equilibrium values for inflation and exchange rate depreciation. As is well known from Smith (1999) and Gong and Zou (2002) the presence of the spirit of capitalism unambiguously reduces consumption and hence increases savings. This is evident from equation (13) where imposing logarithmic preferences yields the following optimal consumption-wealth ratio:
\[ \frac{C}{W} = \Delta = \frac{\alpha \theta \delta}{\alpha + \lambda}. \]

The resulting increase in saving reduces the equilibrium interest rate. Given perfect capital mobility \( \text{uncovered interest parity} \) necessitates a domestic currency depreciation. Similarly, with the \( \text{Fisher effect} \) the decrease in \( i \) is fully reflected in \( \pi \).

A numerical analysis based on a full version of the model suggests a depreciation in the region of a 30\% in the equilibrium exchange rate reflecting the similar drop in the domestic inflation rate. We also observe a decline of 5\%-7\% in the equilibrium interest rate.
4 Conclusions

We considered preferences with the “spirit of capitalism” in a continuous-time, infinite-horizon, small open economy model with complete financial markets and a single production good. We analyzed the effects of international catching-up and the spirit of capitalism on savings, growth, portfolio allocation and asset pricing. Our results show that status concerns affect equilibrium consumption, growth and portfolio allocation through “home bias” and the catching-up effects. The former effect arises due to hedging against future fluctuations in the external wealth reference index. When assets held in the portfolio are positively correlated with the reference world wealth index, the home bias effect is positive and individuals hold more of the domestic equity. The degree of the spirit of capitalism acts to amplify this effect. Moreover, we obtain higher excess returns due to international catching up through home bias and a lower risk free rate. These improve on the risk premium and low risk free rate puzzles.

We also obtain a five-factor Capital Asset Pricing Model: in addition to the variation in domestic consumption and wealth, the representative investor needs compensation to bear risks associated with domestic and foreign inflation and the relative reference wealth uncertainty.

Preliminary numerical exercises show that an increase in the spirit of capitalism gives rise to a substantial increase in the equilibrium growth rate. Similarly the concern for status leads to non-trivial price effects. All the interest rate, the inflation rate, and the exchange rate decline in response to the degree of the spirit of capitalism. Even though ”the capitalist spirit” matters, proper care should be taken to account for government expenditure and finance, and market imperfections such as those in credit, insurance, input and output markets. These are avenues for future research.
References


Appendix: Derivation of Eq. (36)

Reproduce expression \( \sigma_\xi \):

\[
\sigma_\xi = \sum_i \left[ \frac{W J_{WW}}{J_W} n_i \sigma_i \right] + \frac{V J_{VW}}{J_W} \sigma_V. 
\]

The first order condition for the Bellman equation for optimal interior \( c \) is \( f_c = J_W \).

Assuming that the optimal consumption policy is given by a smooth function \( C \) of states [i.e., \( c_t = C(W_t, S_t, t) \)], we can differentiate \( J_W = f_c \) with respect to \( W \) and obtain \( J_{WW} = f_{cc} C W + f_{cu} J_W \).

\[
\sigma_\xi = \sum_i \left[ \frac{W [f_c C_w + f_{cu} J_W]}{J_W} n_i \sigma_i \right] + \lambda \sigma_V
\]

\[
\sigma_\xi = \sum_i \left[ \frac{W [f_c C_w n_i \sigma_i + f_{cu} J_W n_i \sigma_i]}{J_W} \right] + \lambda \sigma_V
\]

\[
\sigma_\xi = \sum_i \left[ \frac{f_c}{f_c} C_w n_i W \sigma_i + \frac{f_{cu} J_W n_i \sigma_i}{J_W} \right] + \lambda \sigma_V
\]

\[
\sigma_\xi = \frac{f_c}{f_c} \sigma_c + \sum_i \left[ \frac{f_{cu} W n_i \sigma_i}{f_c} \right] + \lambda \sigma_V
\]

(A. 1)

Taking first and second differentiation of the normalized “aggregator” function \( f \) with respect to \( c \) and \( u \) we obtain

\[
f_c = \beta \frac{c^{\eta-1}}{(c u)^{\eta/\varepsilon - 1}} \quad f_{cc} = (\eta - 1) \beta \frac{c^{\eta-2}}{(c u)^{\eta/\varepsilon - 1}} \quad f_{cc} = (\eta - 1) \frac{c^{\eta-1}}{c}
\]

\[
f_{cu} = -\beta \varepsilon \left( \frac{\eta}{\varepsilon} - 1 \right) \frac{c^{\eta-1} (c u)^{\eta/\varepsilon - 2}}{(c u)^{\eta/\varepsilon - 1}} = -\beta \varepsilon \left( \frac{\eta}{\varepsilon} - 1 \right) \frac{c^{\eta-2} (c u)^{\eta/\varepsilon - 2}}{(c u)^{\eta/\varepsilon - 1}} = -\left( \frac{\eta}{\varepsilon} - 1 \right) \frac{f_{cc}}{(\eta - 1) u}
\]

\[
= -\left( \frac{\eta}{\varepsilon} - 1 \right) \frac{f_{cc}}{(\eta - 1) u}
\]

where \( \eta = \frac{1}{\varepsilon} - 1 \) and \( \varepsilon = 1 - \gamma \). Substituting these partial differentials in expression (A. 1) yields

\[
\sigma_\xi = \frac{(\eta - 1)}{c} \sigma_c - \left( \frac{\eta}{\varepsilon} - 1 \right) \frac{1}{W} \sum_i \left[ \sigma_i \right] + \lambda \sigma_V \quad \text{for} \quad i = P, P, Y, P^*
\]

which is equation (36) in the text.
Appendix:

Guidance for referees
A Solution to the Consumer’s Optimization Problem

Consumption and portfolio rebalancing by the household takes place at discrete intervals of length $\Delta t$. The household’s flow budget constraint over the interval $\Delta t$ is then

$$dW_t = \psi W_t dt + \sigma W_t dZ_W$$ (A. 1a)

$$\psi = n_M r_M + n_B r_B + n_K r_K + n^*_B r^*_B - \tau - C_t/W_t$$ (A. 1b)

$$\sigma W_t dZ_W = -n_M \sigma P dZ_{P_t} - n_B \sigma P dZ_{P_t} + n_K A \sigma Y dZ_{Y_t}$$ (A. 1c)

$$- n^*_B \sigma Q dZ_{P^*_t} - \sigma T dZ_{T_t}$$ (A. 1d)

The household maximizes the utility functional given by Equation (1) in the text, subject to (A. 1a) and given an initial wealth and an initial world wealth.

The value function for this problem can be written as

$$J(W_t, V_t) = \int_t^\infty f[C_s, M_s/P_s, S_s, J(W_t, V_t)] ds$$ (A. 2)

where

$$f(C_s, U_s) = \delta \left\{ \left( [C_s^{\theta} (M_s/P_s)^{1-\theta} S_s^\lambda]^{1-\frac{1}{\xi}} - [(1-\gamma)U_s]^{\frac{\xi-1}{\xi(1-\gamma)}} \right) \right\}$$ (A. 3)

Duffie and Epstein (1992b) [cf. their equations (44) and (45)] show that the Bellman equation for optimal control is

$$\sup_{\{C, \bar{n} \in C \times R^N\}} D J(W_t, V_t) + f[C_s, M_s/P_s, S_s, J(W_t, V_t)] = 0$$ (A. 4)

where

$$D J(W_t, V_t) = J_w \psi W + J_Y \mu V + \frac{1}{2} tr(\Sigma)$$
with
\[
\Sigma = \begin{pmatrix}
W \vec{n}^T - \sigma V \\
\sigma_V V
\end{pmatrix}
\begin{pmatrix}
J_{WW} & J_{WV} \\
J_{VW} & J_{VV}
\end{pmatrix}
\begin{pmatrix}
W \vec{n}^T - \sigma V \\
\sigma_V V
\end{pmatrix}
\]

and
\[
\vec{n}^T \sigma = -n_M \sigma_P - n_B \sigma_P + n_K \sigma_Y - n_P \sigma_P^*.
\]

We conjecture that the value function and consumption function are
\[
J(W_t, V_t) = b_1 - \gamma_1 - \gamma W_t \alpha + \lambda (1 - \gamma) \\
C_t = \kappa W_t
\]

and use the following definition
\[
M/P = n_M W
\]

where \( b \) and \( \kappa \) are constants to be determined. Using these conjectures, and setting \( \eta = 1 - 1/\zeta \) and \( \varrho = 1 - \gamma \), the expression in brackets in (A. 4) can be expressed as
\[
\sup_{\kappa, \vec{n}} \left\{ \eta (\alpha + \lambda) \left[ \psi - (1 - \Gamma_1) W_t^{(\alpha + \lambda)} (1 - \gamma) V_t^{(1 - \gamma)} \right] + \frac{\eta \lambda}{\eta \sigma_V} \left[ \sigma_W^2 \right] + \eta \lambda \left[ \mu_V - \Gamma_2 \frac{\sigma_V^2}{2} \right] + \eta (\alpha + \lambda) (1 - \gamma) \sigma_W V \ight\} + \delta \left( \left[ \frac{\left( \kappa n_M^{1/\theta} \right)^{\alpha}}{b} \right]^{\eta} - 1 \right) = 0
\]

(A. 8)
Subject to the portfolio adding-up condition (12) the Bellman equation gives optimality conditions for $\kappa$, $n_K$, $n_M$, $n_B$ and $n_B^*$ as follows

$$\frac{\partial}{\partial \kappa}: \alpha \theta \left[ \left( \frac{\kappa \theta n_M^{1-\theta}}{\kappa} \right)^{1/\theta} \right] - (\alpha + \lambda) = 0,$$

(A. 9a)

$$\frac{\partial}{\partial n_K}: (\alpha + \lambda) r_K - (\alpha + \lambda) \Gamma_1 \sigma_{YW} + (\alpha + \lambda) \lambda (1 - \gamma) \sigma_{YV} - \frac{\chi}{\delta} = 0,$$

(A. 9b)

$$\frac{\partial}{\partial n_M}: \alpha (1 - \theta) \left[ \left( \frac{\kappa \theta n_M^{1-\theta}}{\kappa} \right)^{1/\theta} \right] + (\alpha + \lambda) r_M$$

$$+ (\alpha + \lambda) \Gamma_1 \sigma_{PW} - (\alpha + \lambda) \lambda (1 - \gamma) \sigma_{PV} - \frac{\chi}{\delta} = 0,$$

(A. 9c)

$$\frac{\partial}{\partial n_B}: (\alpha + \lambda) r_B + (\alpha + \lambda) \Gamma_1 \sigma_{PW} - (\alpha + \lambda) \lambda (1 - \gamma) \sigma_{PV} - \frac{\chi}{\delta} = 0,$$

(A. 9d)

$$\frac{\partial}{\partial n_B^*}: + (\alpha + \lambda) r_B^* + (\alpha + \lambda) \Gamma_1 \sigma_{PW} - (\alpha + \lambda) \lambda (1 - \gamma) \sigma_{PV} - \frac{\chi}{\delta} = 0.$$

(A. 9e)

where $\chi$ is the Lagrangian multiplier associated with the portfolio adding-up condition.

Substituting (A. 9a) into (A. 8) yields:

$$\kappa = \Phi \Delta + (1 - \Phi) \left[ r_Q - \tau - \Gamma_1 \frac{\sigma_W^2}{2} \right]$$

$$+ (1 - \Phi) \frac{\lambda}{\alpha + \lambda} \left[ \frac{\mu_V}{2} - \Gamma_2 \frac{\sigma_V^2}{2} \right] + (1 - \Phi) \lambda (1 - \gamma) \sigma_{YW}$$

(A. 10)

where $\Delta = \frac{a \theta}{a + \lambda}$ is the effective rate of time preference and $\Phi = \frac{\epsilon}{(\epsilon - (\epsilon - 1) \theta \alpha)}$ is the effective elasticity of intertemporal substitution.

As for portfolio shares we obtain them (i) by subtracting (A. 9e) from (A. 9b) (ii) by subtracting (A. 9f) from (A. 9b) and (iii) by subtracting (A. 9e) from (A. 9c) together with (A. 9a):

$$[r_K - r_B]dt = \Gamma_1 (\sigma_{YW} + \sigma_{PW}) + \lambda (1 - \gamma) (\sigma_{YV} + \sigma_{PV}),$$

(A. 11)

$$[r_B^* - r_B]dt = \Gamma_1 (-\sigma_{PW} + \sigma_{PW}) + \lambda (1 - \gamma) (-\sigma_{PV} + \sigma_{PV}),$$

(A. 12)

$$n_M = \frac{(1 - \theta)}{\theta} \frac{C}{W},$$

(A. 13)
B Equilibrium

The assumption of constant drift (mean) and diffusion (variance) parameters in the geometric Brownian motion which describes the model variables ensures that risks and returns on assets are unchanging through time. This feature of the model, together with the constant elasticity utility function, generates a recurring equilibrium, implying that the consumer chooses the same portfolio shares $n_M$, $n_B^*$, $n_K$ and consumption-wealth ratio, $C/W$, at each instant of time. Since domestic bonds are in zero net supply they will not be held in equilibrium. Moreover, the multiplicity of all shocks (meaning that stochastic disturbances are proportional to the current state variables such as the capital stock and wealth), leads to an equilibrium in which means and variances of the relevant endogenous variables are jointly and consistently determined – a mean-variance equilibrium.

The exogenous factors, apart from the four stochastic shocks explained above, include (i) the preference and technology parameters $\gamma, \lambda, \delta, \theta, A$, (ii) the monetary policy parameter $\phi$ (monetary), and (iii) the mean foreign inflation rate $\pi^*$. The endogenous variables include (i) the stochastic adjustments in the economy $\sigma_PdZ_P$ (the stochastic adjustment in the domestic price level), $\sigma_EdZ_E$ (the stochastic PPP relationship), $\sigma_TdZ_T$ (the stochastic adjustment in transfers), $\sigma_WdZ_W$ (the stochastic component of wealth), (ii) the transfer rate $\tau$, (iii) the optimal consumption-wealth ratio and optimal portfolio shares, (iv) the equilibrium prices $\pi$ (the expected domestic inflation rate), $i$ (the nominal domestic interest rate), $\epsilon$ (the expected exchange rate depreciation), and (v) the equilibrium growth rate $\psi$.

The determination of endogenous variables involves several stages. By using the constancy assumption of portfolio shares we first solve the model for the price level and thereby $\pi$ and $\sigma_PdZ_P$. The next stage is to determine stochastic adjustments. With the stochastic adjustments obtained, one can then calculate the endogenous variances.
and covariances that appear in the optimality conditions for the consumption-wealth ratio, portfolio shares etc. The final stage is to substitute these variances and covariances into the deterministic components of the equilibrium.

B.1 Price level

Some of the expressions set out in the remainder of this Section are familiar from the literature developed by Grinols and Turnovsky. However, there are some important differences, resulting from particular characteristics of the model developed here - most notably, these can be seen in the expressions for core variables in Section 3.4 (equations 30-35).

The constant portfolio share requirement implies \( \frac{M/P}{B^*/P^* + K} = \frac{n}{n^*_M} \). The price level can then be written as

\[
P = \frac{n_K + n^*_B}{n_M} \frac{M}{EB^* + K}
\]

Calculating \( dP/P \) and equating its deterministic and stochastic parts yields

\[
\pi - \omega \frac{C}{n_K} = R_1, \tag{B. 14a}
\]

\[
\sigma_p dB_p = \sigma_X dB_X - \omega \sigma_Y dB_Y + (1 - \omega) \sigma_{p^*} dB_{p^*}, \tag{B. 14b}
\]

where

\[\begin{align*}
R_1 &= \phi - \omega - (1 - \omega)(\pi^* - \pi^*_p) - \text{cov}\left(\sigma_X dB_X, \omega \sigma_Y dB_Y - (1 - \omega) \sigma_{p^*} dB_{p^*}\right) \\
&\quad + \text{var}\left(\omega \sigma_Y dB_Y - (1 - \omega) \sigma_{p^*} dB_{p^*}\right). \tag{B. 14c}
\end{align*}\]

B.2 Determination of transfers

Real transfers \( dT \) depend on the money supply rule and the price level. That is,

\[
dT = (1/P)dM = \phi(M/P)dt + \sigma_X(M/P)dX
\]
Using the definition of \( n_M \) (portfolio share of money) and substituting (10) for \( dT \) we obtain

\[
\tau = \phi n_M, \quad \text{(B. 15)}
\]

\[
\sigma_T dZ_T = \sigma_X n_M dZ_X. \quad \text{(B. 16)}
\]

### B.3 Endogenous stochastic processes

Since random shocks that impinge on the economy remain constant through time, the investment opportunity set is constant over time. Stochastic differentiation of the equations for portfolio shares \( n_M, n_K \) and \( n_B^* \) (following equation \([\sigma_W dZ_W]\)) then implies

\[
\sigma_X dZ_X - \sigma_P dZ_P - \sigma_W dZ_W = 0, \quad \text{(B. 17a)}
\]

\[
\sigma_K dZ_K - \sigma_W dZ_W = 0 \quad \text{(B. 17b)}
\]

\[
\sigma_B^* dZ_B^* - \sigma_P^* dZ_P^* - \sigma_W dZ_W = 0. \quad \text{(B. 17c)}
\]

Equations for \( \sigma_P dZ_P \) (B. 14b), \( \sigma_W dZ_W \) (11c), \( \sigma_T dZ_T \) (B. 16) and (B. 17a)—(B. 17c) form a six-equation linear system in the six unknowns \((\sigma_P dZ_P, \sigma_E dZ_E, \sigma_K dZ_K, \sigma_W dZ_W, \sigma_T dZ_T, \sigma_B^* dZ_B^*)\). Solving implies

\[
\sigma_P dZ_P = \sigma_X dZ_X - \omega \sigma_Y dZ_Y + (1 - \omega)\sigma_P^* dZ_P^*, \quad \text{(B. 18a)}
\]

\[
\sigma_E dZ_E = \sigma_X dZ_X - \omega \sigma_Y dZ_Y - \omega \sigma_P^* dZ_P^*, \quad \text{(B. 18b)}
\]

\[
\sigma_K dZ_K = \omega \sigma_Y dZ_Y + (1 - \omega)\sigma_P^* dZ_P^*, \quad \text{(B. 18c)}
\]

\[
\sigma_W dZ_W = \omega \sigma_Y dZ_Y + (1 - \omega)\sigma_P^* dZ_P^*, \quad \text{(B. 18d)}
\]

\[
\sigma_T dZ_T = \sigma_X n_M dZ_X, \quad \text{(B. 18e)}
\]

\[
\sigma_B^* dZ_B^* = \omega (\sigma_Y dZ_Y + \sigma_P^* dZ_P^*). \quad \text{(B. 18f)}
\]
B.4 Expressions for core variables

- **Portfolio shares:**

  The portfolio share for real balances \( n_M \) is obtained from the FOC:

  \[
  n_M = \frac{(1 - \theta) \cdot C \cdot 1}{\theta \cdot \tilde{W} \cdot i}.
  \]  
  \[\text{(B. 19)}\]

  The optimal portfolio share of each of the remaining three assets (equity, foreign bonds and domestic bonds), \( n_K \) and \( n_B^* \), are determined from adding up condition for portfolio shares (12) with \( n_B = 0 \) and the definition of \( \omega \):

  \[
  n_K = \omega (1 - n_M)
  \]  
  \[\text{(B. 20a)}\]

  \[
  n_B^* = \frac{1 - \omega}{\omega} n_K
  \]  
  \[\text{(B. 20b)}\]

- \( \omega \) can now be calculated from the optimality conditions (15) and (16)

  \[
  \omega = \frac{A - (\pi^* - \pi^*) + \Gamma_1 [A \sigma_{P^*Y} + \sigma_{P^*}^2]}{\Gamma_1 \Lambda} + \text{bias}
  \]  
  \[\text{(B. 21)}\]

  where the term (home) bias can be written as

  \[
  \text{bias} = \mathcal{H} \left( \frac{\sigma_{YV} + \sigma_{P^*V}}{\Lambda} \right)
  \]  
  \[\text{(B. 22)}\]

  and the \( \Lambda \) is defined as

  \[
  \Lambda = A^2 \sigma_Y^2 + 2 \sigma_{P^*Y} + \sigma_{P^*}^2.
  \]

  In eq. (B. 22), the expression \( \mathcal{H} \) denotes the ‘propensity to hedge’ against unanticipated fluctuations in the world wealth index, and defined as

  \[
  \mathcal{H} = -\frac{J_{VV} V}{J_{WW} W} = -\frac{\lambda(1 - \gamma)}{\Gamma_1}.
  \]

- The optimality condition (15) yields

  \[
  i - \pi = R2
  \]  
  \[\text{(B. 23)}\]

  where

  \[
  R2 = A - \sigma_P^2 - \Gamma_1 (\sigma_{WY} + \sigma_{WP}) + \lambda(1 - \gamma)(\sigma_{PV} - \sigma_{YV})
  \]
• The optimality condition (16) yields

\[ i - \pi = R3 \quad \text{(B. 24)} \]

\[ R3 = i^* - \pi^* + \sigma^2_{P^*} - \sigma^2_P - \Gamma_1(\sigma_{PW} - \sigma_{P^*W}) - \lambda(1 - \gamma)(\sigma_{PV} - \sigma_{P^*V}) \]

• The deterministic part of the PPP condition (5) yields

\[ \pi - \epsilon = R4 \quad \text{(B. 25)} \]

where

\[ R4 = \pi^* + \sigma_{P^*E} \]

• The optimality condition for consumption (13) yields

\[ \frac{C}{W} + \frac{a_1}{b_1} \psi = \frac{R5}{b_1} \quad \text{(B. 26)} \]

where

\[ R5 = \Phi \Delta - (1 - \Phi) \Gamma_1 \frac{\sigma^2_{V}}{2} + (1 - \Phi) \frac{\lambda}{\alpha + \lambda} [\mu - \Gamma_2 \frac{\sigma^2_V}{2}] + (1 - \Phi) \lambda(1 - \gamma) \sigma_{WV} \]

\[ a_1 = \Phi - 1, \]

\[ b_1 = \Phi. \]

• Setting the deterministic part of the capital accumulation expression (18) to the equilibrium growth rate \( \psi \) yields

\[ \psi + \frac{\omega}{n_K} \frac{C}{W} = R6 \quad \text{(B. 27)} \]

where

\[ R6 = \omega + (1 - \omega)(i^* - \epsilon + \sigma^2_{P^*}) \]

As in Grinols (1996) there is now a seven-equation system ((B. 14a), (B. 20a), (B. 23)-(B. 26)) plus (14) in the seven unknowns \( (C/W, \pi, n_K, i, \epsilon, n_M, \psi) \).
C Numerical Analysis

In this section we undertake a full numerical analysis of the model. The generation of numerical estimates requires the specification of a number of baseline parameters and variables. Tables 2 and 3 set out the values used in the numerical exercises carried out here.

[Tables 2 and 3 approximately here.]

In an attempt to utilize plausible values, a number of the parameter values have been set by reference to quarterly data relevant for the UK economy from the period 1979Q1 to 1999Q2. All data were obtained from Datastream. For the UK, we have used series averages and standard deviations for: industrial production, government expenditure, the M1 money supply, and the inflation rate derived from the consumer price index. To capture ‘foreign’ price and interest rate variables we have used US data, in particular: series averages and standard deviations for the consumer price index and the 3-month Treasury bill rate.

The variance and covariance parameters were calculated using the discrete time version of geometric Brownian motion

$$\Delta \ln \bar{X}(t_s) = \bar{\eta} \Delta t + \bar{\Gamma}' \Delta \bar{Z}(t_s)$$  \hspace{1cm} (C. 28)

where $\bar{X}(t_s) = (x_1(t_s), \ldots, x_4(t_s))'$ is the (four) exogenous stochastic shock vector, $\bar{Z}(t_s)$ is the independent normal variates vector $N(0, I \Delta t)$, $\bar{\eta} \equiv (\mu_1 - \frac{1}{2} \sigma_1^2, \ldots, \mu_4 - \frac{1}{2} \sigma_4^2)$ is the mean vector, and the variance-covariance matrix $\Sigma \equiv \bar{\Gamma} \bar{\Gamma}'$ with $\bar{\Gamma} = (\sigma_1, \ldots, \sigma_4)$. Finally, time evolves $t_{s+1} = t_s + \Delta t, \ s = 0, \ldots, S - 1$ with $t_S = T$. Because the regressors in (C. 28) are identical equation by equation, the least squares estimator $\tilde{\eta}$ of $\bar{\eta}$ becomes

$$\tilde{\eta} = \frac{1}{T} [\ln X(T) - X(0)]$$
for $S\Delta t$. Similarly, the sampling estimator $\hat{\Sigma}$ of $\Sigma$ is

$$
\hat{\Sigma} = \frac{1}{T} \left( \frac{S}{S-1} \right) \sum_{s=0}^{S-1} \left\{ \left[ \Delta \ln \vec{X}(t_s) - \frac{1}{S}(\ln \vec{X}(T) - \vec{X}(0)) \right] \right.
\times \left[ \Delta \ln \vec{X}(t_s) - \frac{1}{S}(\ln \vec{X}(T) - \vec{X}(0)) \right] \right\}.
$$

(C. 29)

Particular mention should be made of the values assigned to the parameters for risk aversion and the intertemporal substitution elasticity: the values 4 and 0.5 are those used in Obstfeld (1994b). The former is the mid point of the range of conventional estimates (2 - 6) referred to in Obstfeld (1994a) although we are mindful that some authors suggest that values of unity or values as high as 30 cannot be ruled out (see Epstein and Zin (1991); and Kandel and Stambough (1991), respectively). The intertemporal substitution elasticity set to 0.5 is consistent with what Epstein and Zin (1991) describe as ‘a reasonable inference’. However, smaller values cannot be ruled out, for example Hall (1988) and Campbell and Mankiw (1989) suggest an intertemporal substitution elasticity of 0.10; and Ogaki and Reinhart (1998) refer to the range 0.32 - 0.45. Later in this paper we explore the sensitivity of our results to different values for the key risk aversion parameter and for a range of correlation coefficients.

Table 4 presents numerical exercises to ascertain the effects of international catching up and the spirit of capitalism. The column labelled Model 0 presents the baseline model values whereas Model 1 gives the results from the absolute-wealth-is-status specification. Results from the Model 2 column are obtained from the relative-wealth-is status specification with a degree of the spirit of capitalism parameter $\lambda$ set to 0.1. All numbers in Models 1 and 2 represent percentage changes relative to the baseline. It can be seen that the model generates significant growth and price effects. The consumption wealth ratio stays the same in Model 1 and declines in Model 2. This gives rise to a substantial increase in the equilibrium growth rate where the growth
rate rises by 27% and 38% in models 1 and 2 respectively. Similarly the decline in the interest rate, the inflation rate and the exchange rate are also substantial - ranging from 5% to 39%. Notice also that the variance of the equilibrium growth rate and of the price level decline in Model 2.

[Table 4 approximately here.]

C.1 Sensitivity analysis

In this section we run a sensitivity analysis in order to gauge the robustness of our results with respect to the key parameters; (i) intertemporal elasticity of substitution \( \zeta \), (ii) risk aversion \( \gamma \) and (iii) degree of the spirit of capitalism \( \lambda \). However, values should be chosen in such way that they satisfy both feasibility (\( \epsilon \leq 1 \)) and transversality (\( \gamma \geq 1 \)) conditions as demonstrated in Smith (1996a). Figure 1 plots the sensitivity of the equilibrium growth rate, the portfolio share of foreign bonds, the exchange rate and the beta of foreign bonds with respect to \( \zeta \) and \( \gamma \) under the benchmark value of \( \lambda \). Figure 1 reveals that the growth rates and exchange rate are sensitive whereas the beta and portfolio share of foreign bonds are robust. However, \( \gamma \) plays no role in the determination of the equilibrium exchange rate as a result of the small-open economy representative agent nature of the model [see Sibert (1996)]. Figures 2 and 3 also reveal the sensitivity of the results with respect to \( \lambda \).

C.2 Determination of nominal interest rate

Substituting (B. 14a) in (B. 23) we obtain an expression for \( i \):

\[
i = R1 + R2 + \frac{\omega \kappa}{nK} \tag{C. 30a}
\]

We use (A. 13) and (B. 20a) to eliminate \( n_M \)

\[
\frac{(1 + \nu)(1 - \theta)\kappa}{i\theta} + \frac{nK}{\omega} = 1 \tag{C. 30b}
\]
We use (B. 26) and (B. 27) to eliminate $\psi$

$$\kappa - \frac{a_1}{a_1 + b_1} \frac{\omega \kappa}{n_K} + \frac{a_1}{a_1 + b_1} R_6 = \frac{R_5}{a_1 + b_1} \quad (C. 30c)$$

Solve (C. 30c) for $n_K$

$$n_K = \frac{c_1 \omega \kappa}{\kappa + c_1 R_6 - d_1 R_5} \quad (C. 31a)$$

where $c_1 = \frac{a_1}{b_1}$ and $d_1 = \frac{1}{b_1}$.

Substitute (C. 31a) into (C. 30a) and (C. 30b) and rearranging gives

$$i - R_1 - R_2 - \frac{[\kappa + c_1 R_6 - d_1 R_5]}{c_1} = 0 \quad (C. 31b)$$

$$-i + \frac{(1 + \nu)(1 - \theta)}{\theta} \kappa + \frac{i}{i - R_1 - R_2} \kappa = 0 \quad (C. 31c)$$

Solve (C. 31b) for $\kappa$

$$\kappa = c_1 (i - R_1 - R_2) - [c_1 R_6 - d_1 R_5] \quad (C. 32)$$

Finally, by placing (C. 32) in (C. 31c) and simplifying we obtain a quadratic expression for the interest rate:

$$-a_0 i^2 + b_0 i + c_0 = 0. \quad (C. 33)$$

$$a_0 = (1 - \theta) - (1 + \nu) \theta c_1 - (1 - \theta) c_1$$

$$b_0 = R_12 (1 - \theta) - (1 + \nu) \theta c_1 R_12 - (1 + \nu) \theta R_65$$

$$- (1 + \nu) \theta c_1 R_12 - (1 - \theta) c_1 R_12 - (1 - \theta) R_65$$

$$c_0 = (1 + \nu) \theta c_1 R_12^2 + (1 + \nu) \theta R_12 R_65$$

where

$$R_12 = R_1 + R_2 \quad \text{and} \quad R_65 = c_1 R_6 + d_1 R_5.$$
### Table 1: Descriptive Statistics and Variance-Covariance Matrix

**Panel A: Moments**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Y</th>
<th>M</th>
<th>P*</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.02500</td>
<td>0.03500</td>
<td>0.05000</td>
<td>0.03500</td>
</tr>
<tr>
<td>Std. Deviation</td>
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<td>0.06000</td>
<td>0.05000</td>
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<tr>
<td>Variance</td>
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<td>0.00360</td>
<td>0.00250</td>
<td>0.00150</td>
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</tbody>
</table>

**Panel B: Covariances (normal text) and Correlations (italicized text)**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Y</th>
<th>M</th>
<th>P*</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.20833</td>
<td>0.70000</td>
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<td>M</td>
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<td>0.00360</td>
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<td>0.27778</td>
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<tr>
<td>P*</td>
<td>0.00140</td>
<td>0.00083</td>
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<td>V</td>
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<td>0.00129</td>
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</tr>
<tr>
<td>Variable</td>
<td>Symbol</td>
<td>Values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Parameters</strong></td>
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<tr>
<td>Marginal product of capital</td>
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<td>Risk aversion parameter</td>
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<td>Intertemporal substitution elasticity</td>
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<td>Degree of the spirit of capitalism</td>
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<td>Rate of time preference</td>
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<td>Money growth intensity</td>
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<tr>
<td>Foreign inflation rate</td>
<td>$\pi^*$</td>
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<td></td>
</tr>
<tr>
<td><strong>Variables</strong></td>
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<tr>
<td>Consumption–wealth ratio</td>
<td>$\frac{C}{W}$</td>
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</tr>
<tr>
<td>Rate of return on portfolio</td>
<td>$r_Q$</td>
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<tr>
<td>Mean equilibrium growth rate</td>
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<td>Variance of price level</td>
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<td>Inflation rate</td>
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<td>Interest rate</td>
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<td>Exchange rate</td>
<td>$\epsilon$</td>
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<tr>
<td>Rate of return on capital</td>
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<td>Rate of return on foreign bond</td>
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</tr>
<tr>
<td>Risk adjusted rate of return</td>
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</tr>
<tr>
<td>Equity beta</td>
<td>$\beta_K$</td>
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</tr>
<tr>
<td>Foreign bonds beta</td>
<td>$\beta_B$</td>
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<tr>
<td>Portfolio share of equity in tradeable</td>
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<tr>
<td>Portfolio share of money</td>
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<td>Portfolio share of equity</td>
<td>$n_K$</td>
<td>0.582</td>
<td></td>
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</tr>
<tr>
<td>Portfolio share of foreign bonds</td>
<td>$n_F$</td>
<td>0.313</td>
<td></td>
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Table 3: International Catching-up and the Spirit of Capitalism Effects

<table>
<thead>
<tr>
<th>Variable</th>
<th>Symbol</th>
<th>Model 0</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption–wealth ratio</td>
<td>$\frac{C}{W}$</td>
<td>0.004</td>
<td>0.000</td>
<td>-0.270</td>
</tr>
<tr>
<td>Rate of return on portfolio</td>
<td>$r_Q$</td>
<td>0.073</td>
<td>0.890</td>
<td>1.268</td>
</tr>
<tr>
<td>Mean equilibrium growth rate</td>
<td>$\psi$</td>
<td>0.017</td>
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<td>38.250</td>
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<tr>
<td>Variance of growth rate</td>
<td>$\sigma^2_w$</td>
<td>0.001</td>
<td>0.000</td>
<td>-0.115</td>
</tr>
<tr>
<td>Variance of price level</td>
<td>$\sigma^2_p$</td>
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<td>0.000</td>
<td>-0.024</td>
</tr>
<tr>
<td>Inflation rate</td>
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<td>0.019</td>
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<td>-35.571</td>
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<tr>
<td>Interest rate</td>
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<tr>
<td>Exchange rate</td>
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<td>Rate of return on capital</td>
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<td>Rate of return on foreign bond</td>
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<td>0.063</td>
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<td>0.915</td>
<td>1.306</td>
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<tr>
<td>Equity beta</td>
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<td>Portfolio share of equity in tradeable</td>
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<td>Portfolio share of foreign bonds</td>
<td>$n_F$</td>
<td>0.313</td>
<td>0.278</td>
<td>1.422</td>
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</table>
Figure 1: Model 3 with Benchmark Degree of the SC
Figure 2: Model 3 with High Degree of the SC
Figure 3: Model 3 with Low Degree of the SC