International Asset Pricing under Habit Formation and Idiosyncratic Risks

Yuming Li*
Department of Finance
College of Business and Economics
California State University, Fullerton
Fullerton, CA 92834, U.S.A.
E-mail: yli@fullerton.edu

and

Maosen Zhong
UQ Business School
The University of Queensland
Brisbane, QLD 4072, Australia
E-mail: m.zhong@business.uq.edu.au

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*Corresponding author.
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We present a consumption-based international asset pricing model to study the equity premiums, riskfree rates and the predictability of international asset returns. By entailing idiosyncratic consumption risk, the model helps lower the mean investor risk aversion needed to explain the international equity premiums. By featuring habit formation that disentangles intertemporal substitution from investor risk aversion in each country, the model explains the level of the U.S. short-term riskfree rate. Further, as the model takes into consideration of country-specific variations of investor risk aversion along with non-synchronized international business cycle movements, the model better explains the long-horizon predictability of the international equity markets than the world representative-agent model. Time-series variations of the exchange rates and inflation rates in the international markets also help explain the predictability of international asset returns.

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1. Introduction

One of the most prominent themes in finance is the pursuit of a unified rational asset pricing theory that explains the equity premiums, the riskfree rate and the long-horizon predictability of stock returns. Recently, researchers have attempted to resolve some of the puzzles by generalizing essential features of the consumption-based asset pricing model. They include alternative specifications of preferences [Constantinides (1990), Campbell and Cochrane (CC, 1999)], incomplete markets [Mankiw (1986), Constantinides and Duffie (1996), Heaton and Lucas (1996)], modified probability distributions [Mehra and Prescott (1988) and Rietz (1988)] and market imperfections [Constantinides, Donaldson, and Mehra (2002)]. For example, CC (1999) argue that the counter-cycle variation in expected stock returns can be understood by modifying the representative-agent consumption-based asset pricing model with a slow-moving external habit. Constantinides and Duffie (1996), Brav, Constantinides, and Geczy (2002) and Cogley (2002) find that idiosyncratic consumption risk in an incomplete-market economy helps explain the magnitude of the equity premium.

In this paper we develop a consumption-based international asset pricing model to study the asset pricing puzzles in domestic and international equity markets. As empirical evidence indicates that consumption growth rates are weakly correlated across countries our model incorporates country-specific consumption risk under the assumption of a complete within-country but incomplete cross-country consumption risk sharing. We also assume that the preferences of investors are described by country-specific external habit formation so the investor risk aversion in each country can vary with non-synchronized international business cycles.[1] To accommodate deviations from the purchasing power parity (PPP) documented in the international finance literature, our model accounts for country-specific exchange rate and inflation rate risks.[2]

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[1]See Lewis (1995, 1996) on evidence of lack of cross-country consumption risk sharing. See Artis, Kontolemis and Osborne (1997), Kose, Prasad and Terrones (2003), and Stock and Watson (2003) on evidence of nonsynchronization of international business cycles.
[2]Adler and Dumas (1983) emphasize the importance of the exchange rate and inflation rate risk based on theoretical reasons and empirical evidence against the PPP. For the empirical evidence on the pricing of the exchange rate risk

We study the international equity premiums using the incomplete-market version of the Hansen-Jagannathan (HJ, 1991) bound. We choose parameters and specifications of the model to match the maximum Sharpe ratio of all globally diversified portfolios in the international equity markets. We also verify that the heterogeneous-agent model is consistent with the U.S. short-term riskfree rate. Further assuming that the state of the business cycle in each country is described by the local consumption in surplus of habit, we study the predictability of long-horizon international stock returns that is explained by a cross-country average of surplus consumption using the chosen parameters and the observed consumption series from all countries. We also examine the predictability of returns explained by the cross-country averages of exchange rate changes and inflation rates.

We use our model to investigate the U.S. dollar-denominated returns from 13 developed countries' equity markets, a world market portfolio and the short-term U.S. riskfree rate. We find that our model which entails idiosyncratic consumption risk that is higher than the aggregate world consumption risk helps lower the investor risk aversion needed to explain the international mean equity premiums over the U.S. short-term Treasury bill rates. In addition, because country-specific habit formation disentangles intertemporal substitution from investor risk aversion in each country, our model is consistent with the realized real returns from the U.S. short-term Treasury bills traded by investors from U.S. and other developed countries. Further, as the model takes into consideration of country-specific variations of investor risk aversion along with non-synchronized international business cycle movements, the model explains larger portions of the long-horizon predictability of the international equity markets than the world representative-agent model. In addition, we find that time-series variations of exchange rates and inflation rates in the international markets also help explain the predictability of international asset returns.

This paper is related to the growing number of studies investigating the impact of idiosyncratic consumption risk on the U.S. equity markets [see Constantinides (2002) for a review of the literature]. By

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or inflation rate risk, see, e.g., Ferson and Harvey (1993), Dumas and Solnik (1995), and De Santis and Gerard (1997, 1998).

employing the standard preferences at a disaggregated level, the approach in the existing literature is to explain equity premiums by the covariance of an asset's returns with certain moments of the cross-sectional distribution of consumption growth. The approach of this paper differs significantly from the existing literature on incomplete markets in a variety of ways. First, we explain the equity premiums by focusing on the disaggregated consumption volatility instead of the cross-sectional moments of consumption growth. Second, we study the return predictability by using the habit-based preferences of heterogeneous agents. When our model is reduced to a simplified version under the standard preferences, we find that the model fails to explain the level of the U.S. riskfree rate. Unlike the cross-country moments of surplus consumption which are highly persistent, the cross-country moments of consumption growth rates are found to be weakly correlated and insignificant predictors of the predictability of returns in the international equity markets.

The theoretical framework of this paper shares common features employed in recent international finance literature. Sarkissian (2003) studies the impact of imperfect consumption risk sharing across countries on the formation of time-varying risk premium in the foreign exchange market and on their cross-sectional differences. Chue (2003) demonstrates that time-varying investor risk aversion can generate state dependence in the correlation between international stock returns. Several other studies use external, country-specific habit-based utility specification as an explanation for the home equity bias [e.g., Wheatley (2001), Gomez, Priestley, and Zapatero (2002), Chue (2002), Shore and White (2002)]. Unlike the present study, those papers are not mainly focused on the equity premium and the riskfree rate puzzles and the predictability of returns in the international equity markets. This paper is also related to Li and Zhong (2004), who investigate the time series and cross section of international stock returns using a world representative-agent model under complete integration and a country-by-country representative-agent model under partial integration.

The rest of the article is organized as follows. Section 2 presents the model and Section 3 describes data sources and the procedure for parameter selections. Section 4 evaluates the implications of the model for the mean equity premiums, the riskfree rate and predictability of returns. The last section concludes the paper.

2. The Model

2.1. The Economy

We start with assumptions about the structure of the world capital markets and the preferences of investors. We consider assets traded in the capital markets of N countries. All of these markets are perfect, without transaction costs and taxes. Investors from each country are assumed to have free, unrestricted access to the domestic and foreign capital markets. To admit differences in consumption opportunities and tastes and to allow incomplete consumption risk sharing across countries but not within each country, we assume that there exists a single consumption good and a single representative agent in each country.

The preference of the representative agent in country j is represented by the following:

$$E\left[\sum_{t=0}^{\infty} \mathrm{e}^{-\eta_j t} \frac{(C_{jt} - X_{jt})^{(1-\gamma_j)} - 1}{1-\gamma_j}\right], \tag{1}$$

where $\eta_j > 0$ and $\gamma_j > 0$ are the agent's subjective discount rate and the utility curvature parameter, respectively. The agent's consumption C_{jt} is measured in terms of the consumption good in her own country and the habit X_{jt} is assumed to be country specific and external (Abel 1990, 1999). Even though investors from all countries in our model are assumed to exhibit habit formation preferences, the time-series patterns of consumption across countries can be vastly different because investors in different countries are permitted to encounter imperfectly correlated country-specific shocks arising from differences in initial endowments, consumption opportunities and tastes, labor incomes, production technologies, and others.

For a given habit formation process, the local surplus consumption ratio $0 \le S_{jt} \equiv (C_{jt} - X_{jt})/C_{jt} \le 1$ is an indicator of the state of the local business cycle in country j. When S_{jt} decreases toward zero, consumption C_{jt} in country j declines to its habit level X_{jt} and the country's economy falls toward the trough of a recession. As S_{jt} increases toward unity, country *j*'s consumption far exceeds its substance level and the country's economy rises to the peak of an expansion. In the presence of the imperfect synchronization of international business cycles, S_{jt} can be weakly correlated across countries.

2.2. The equilibrium

To achieve asset pricing implications for nominal returns, let $R^{*}_{i,t+1}$ denote the local currency-denominated nominal return on an asset issued in country *i*. Without loss of generality, we convert nominal returns on assets from all countries into the U.S. dollars. To this end, let E_{it} denote the dollar value of the country *i*'s currency at time *t* and calculate dollar returns $R^{\$}_{i,t+1}$ as local currency returns multiplied by exchange rate changes:

$$R^{\$}_{i,t+1} \equiv R^{*}_{i,t+1} \cdot \left(\frac{E_{i,t+1}}{E_{it}} \right). \tag{2}$$

Consider the investor in country *j* where the price index of the consumption good at time *t* is I_{jt} and the inflation rate for the period *t*+1 is $\Pi_{j,t+1} \equiv I_{j,t+1} / I_{jt}$. To reflect the purchasing power for the consumption good in the investor's own country, we express the real return on asset *i* for the country *j*'s investor as

$$R^{j}_{i,t+1} \equiv R^{\$}_{i,t+1} \left(\frac{E_{j,t+1}}{E_{jt}} \right)^{-1} \Pi^{-1}_{j,t+1}. \tag{3}$$

In equation (3), asset *i*'s return converted into dollars is further translated into the country *j*'s currency and then deflated by the country *j*'s inflation rate. The product term

$$\Pi^{\$}_{j,t+1} \equiv \left(\frac{E_{j,t+1}}{E_{jt}} \right) \Pi_{j,t+1}, \tag{4}$$

is an exchange rate-adjusted inflation rate associated with dollar returns on all local and foreign assets held by the country *j*'s investor. It is high if there is a large cost-of-living increase in the investor's own country or there is a sharp appreciation of the investor's home currency against the dollars. Under the purchasing power parity (PPP), differences in the inflation rates between any two countries are offset by changes in the exchange rate between the two countries so all exchange rate-adjusted inflation rates are equalized to the U.S. inflation rate. We calculate real returns utilizing each investor's own exchange rate-adjusted inflation rate to allow deviations from the PPP.[3]

Given the country *j* investor's objective function (1) and her real return given by equation (3), a global capital market equilibrium can be characterized by the following set of Euler equations:

$$E_t\left[e^{-\eta_j}\left(\frac{S_{j,t+1}}{S_{jt}}\frac{C_{j,t+1}}{C_{jt}}\right)^{-\gamma_j}\frac{R^{\$}_{i,t+1}}{\Pi^{\$}_{j,t+1}}\right]=1 \tag{5}$$

for $i, j = 1, 2, \cdots, N$, where

$$M_{j,t+1} \equiv e^{-\eta_j}\left(\frac{S_{j,t+1}}{S_{jt}}\frac{C_{j,t+1}}{C_{jt}}\right)^{-\gamma_j}, \quad M^{\$}_{j,t+1} \equiv \frac{M_{j,t+1}}{\Pi^{\$}_{j,t+1}} \tag{6}$$

are respectively the country *j* investor's real and nominal intertemporal marginal rate of substitution (MRS). While each investor's real MRS serves as a valid stochastic discount factor for the country-specific real returns on the assets in the international markets, her nominal MRS acts as a valid stochastic discount factor for all dollar-denominated returns which are common to investors from all countries. In addition, using the nominal MRS for the common currency-denominated returns has the advantage that the set of Euler equations can be applied to portfolios of returns on assets within a single country as well as from different countries.

[3] In the absence of arbitrage in currency exchange markets, the exchange rate between country *i* and *j* at time *t* is $E_{ijt} = E_{it} / E_{jt}$. Substituting equation (2) into equation (3) implies that the real return for the country *j*'s investor from investing in the country *i*'s asset is $R^{j}_{i,t+1} = R^{*}_{i,t+1}(E_{ij,t+1} / E_{ijt})\Pi^{-1}_{j,t+1}$
and the Euler equations are $E_t\left[M_{j,t+1}R^{*}_{i,t+1}(E_{ij,t+1} / E_{ijt})\Pi^{-1}_{j,t+1}\right] = 1$ where $(E_{ij,t+1} / E_{ijt})\Pi^{-1}_{j,t+1}$ is the change in the real exchange rate between country *i* and *j* for the country *j*'s investors.

2.3. Risk aversion

Following Rubinstein (1973), we define the conditional relative risk aversion (RRA) for the agent in country *j* as

$$\mathrm{A}_{jt} \equiv -E_t\left[\frac{C_{j,t+1}U_{CC}(C_{j,t+1}, X_{j,t+1})}{U_C(C_{j,t+1}, X_{j,t+1})}\right] \tag{7}$$

where

$$U(C_{jt}, X_{jt}) \equiv [(C_{jt} - X_{jt})^{(1-\gamma_j)} - 1]/(1-\gamma_j) \tag{8}$$

is the period *t* utility for country *j*'s agent. Taking the first- and second-order derivatives (U_C and U_{CC}) of the utility with respect to consumption $C_{j,t+1}$ given the external habit $X_{j,t+1}$ implies that the RRA is

$$\mathrm{A}_{jt} = E_t\left[\frac{\gamma_j}{S_{j,t+1}}\right] \tag{9}$$

Since $0 \le S_{jt} \le 1$, $\mathrm{A}_{jt} \ge \gamma_j$. Hence the utility curvature parameter γ_j can be interpreted as the lower bound of investor risk aversion. With a slow-moving habit, $S_{j,t+1}$ is highly persistent. Thus equation (9) implies that the conditional risk aversion A_{jt} in country *j* should be inversely related to S_{jt}. The investor risk aversion differs across countries at any point in time because the surplus consumption ratio S_{jt} is country-specific.

2.4. Habit specification

To complete the preference specification, we adopt the infinite-horizon, nonlinear habit specification of CC (1999) for the sake of tractability.[4] Here and throughout the rest of the paper, we use a lower-case letter to denote the natural logarithm of an upper-case letter. Consumption growth in each country is an i.i.d. lognormal process:

[4] Alternative habit models include linear habit specifications where habit depends on consumption with various lags. See Sundaresen (1989), Constantinides (1990), Detemple and Zapatero (1991), Ferson and Constantinides (1991), Ferson and Harvey (1992), Heaton (1995), Li (2001), and Chan and Kogan (2002).

$$\Delta c_{j,t+1} = g_j + u_{j,t+1},\ u_{j,t+1} \sim N(0, \sigma_{jc}^2) \tag{10}$$

Here Δ is the first-order difference operator, g_j is the mean of the log consumption growth rate in country *j*, $u_{j,t+1}$ is an idiosyncratic shock to country *j*'s consumption growth with a mean of zero and a standard deviation of σ_{jc}. The correlation between $u_{j,t+1}$ and $u_{k,t+1}$ is ρ_{jk}. The log surplus consumption ratio s_{jt} follows a conditionally heteroskedastic AR(1) process:

$$s_{j,t+1} = (1-\varphi)\bar{s}_j + \varphi s_{jt} + \lambda_{jt}(\Delta c_{j,t+1} - g_j), \tag{11}$$

where for simplicity the habit persistence parameter $0 < \varphi < 1$ is assumed to be identical for all countries and

$$\lambda_{jt} = \max\left\{0,\ \frac{1}{\bar{S}_j}\sqrt{1-2(s_{jt}-\bar{s}_j)} - 1\right\} \tag{12}$$

is the sensitivity function of the surplus consumption ratio to consumption with

$$\bar{S}_j = \sigma_{jc}\sqrt{\frac{\gamma_j}{1-\varphi}}\ . \tag{13}$$

In this formulation each investor's habit, $X_{jt} = C_{jt}(1-S_{jt})$, increases with the contemporaneous and lagged domestic consumption in a nonlinear way.

Like A_{jt}, λ_{it} is inversely related to s_{it}. Indeed, for external-habit preferences given by equation (1), $\mathrm{A}_{jt} = \gamma_j(1+\lambda_{jt})$ (see Appendix). Equation (12) then implies

$$\mathrm{A}_{jt} = \max\left\{\gamma_j,\ \frac{\gamma_j}{\bar{S}_j}\sqrt{1-2(s_{jt}-\bar{s}_j)}\right\}. \tag{14}$$

Note that the lower bound of the RRA is attained ($\mathrm{A}_{jt} = \gamma_j$) only if $s_{jt} \geq s_{j,\max} \equiv \bar{s}_j + (1-\bar{S}_j^{\,2})/2$. At the steady state ($s_{jt} = \bar{s}_j$), the level of the risk aversion in country *j* is

$$\bar{\mathrm{A}}_j = \frac{\gamma_j}{\bar{S}_j} = \frac{1}{\sigma_{jc}}\sqrt{\gamma_j(1-\varphi)}\ . \tag{15}$$

Equation (15) implies that the steady-state RRA is heterogeneous across countries if the utility curvature, habit persistence, or consumption volatility varies among investors.

Away from the steady state, equation (14) suggests that the cross-country dispersion in investor risk aversion at any point in time can also be attributed to the degree of deviations of the log surplus consumption ratio from its steady state value. In this world economy, as country-specific consumption shocks are imperfectly correlated, time-varying risk aversion of investors from different countries reflect unsynchronized movements of international business cycles.

2.5. The Sharpe ratio and the riskfree rate

The set of Euler equations (5) imposes bounds on the Sharpe ratio – the ratio of the mean to standard deviation of dollar excess returns on each asset. To see this, let $R_{ft}^{\$}$ denote returns from a one-period riskless bond that pays a dollar at time t+1 and $R_{i,t+1}^{e} \equiv R_{i,t+1}^{\$} - R_{ft}^{\$}$ denote the dollar excess return on a portfolio of assets traded in the N countries. Then equation (5) implies[5]

$$\max_i \frac{E_t[R_{i,t+1}^e]}{\sigma_t\,[R_{i,t+1}^e]} = \min_{j\le J} \frac{\sigma_t\,[M_{j,t+1}^{\$}]}{E_t[M_{j,t+1}^{\$}]}\,. \tag{16}$$

The left hand side of equation (16) is the maximum Sharpe ratio attainable from investing in all portfolios of assets in the international markets. The right hand side is the HJ bound (1991) for the incomplete markets with heterogeneous agents. It is given by the minimized ratio of the standard deviation to the mean of the marginal rate of substitution of investors in all countries. Therefore equation (16) states that the slope of the mean-variance frontier – the maximum Sharpe ratio – is given by the HJ bound. Under the assumption of conditional lognormality, we can simplify the right hand side of equation (16) and obtain the upper bound on the maximum Sharpe ratio as follows (see Appendix):

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[5] $0 = E_t[M_{j,t+1}^{\$}R_{i,t+1}^{e}] = E_t[M_{j,t+1}^{\$}]E_t[R_{i,t+1}^{e}] + \rho_{ijt}(R,M)\sigma_t\,[M_{j,t+1}^{\$}]\sigma_t\,[R_{i,t+1}^{e}] \ge E_t[M_{j,t+1}^{\$}]E_t[R_{i,t+1}^{e}] - \sigma_t\,[M_{j,t+1}^{\$}]\sigma_t\,[R_{i,t+1}^{e}]$ where $\rho_{ijt}(R,M)$ is the conditional correlation coefficient between $R_{i,t+1}^{e}$ and $M_{j,t+1}^{\$}$.

$$\max_i \frac{E_t[R^e_{i,t+1}]}{\sigma_t[R^e_{i,t+1}]} \approx \min_{j\le J} \ \sigma_t\,[m^{\$}_{j,t+1}] \tag{17}$$

where $\sigma_t\,[m^{\$}_{j,t+1}] = \sqrt{\mathrm{A}^2_{jt}\sigma^2_{jc} + \sigma^2_t[\pi^{\$}_{j,t+1}] + 2\mathrm{A}_{jt}\,\mathrm{cov}_t(\Delta c_{j,t+1}, \pi^{\$}_{j,t+1})}$. $\pi^{\$}_{j,t+1} \equiv \ln[\Pi^{\$}_{j,t+1}] = \Delta e_{j,t+1} + \pi_{j,t+1}$ is the country j investor's log exchange rate-adjusted inflation rate for dollar returns. Equation (17) suggests that the HJ bound depends on the conditional risk aversion, the consumption volatility, as well as the second moments of exchange rates and inflation rates from all countries.

Under the assumption of homoskedasticity of returns, inflation rates and exchange rates, an unconditional version of the mean-variance frontier (17) can be written, approximately, as

$$\begin{aligned}\max_i \frac{E[R^e_i]}{\sigma[R^e_i]} &\approx \min_{j\le J} \ \sqrt{\bar{\mathrm{A}}^2_j\sigma^2_{jc} + \sigma^2_{j\pi^{\$}} + 2\bar{\mathrm{A}}_j\rho_{j,c\pi^{\$}}\sigma_{jc}\sigma_{j\pi^{\$}}} \\ &= \min_{j\le J}\sqrt{\gamma_j(1-\varphi) + \sigma^2_{j\pi^{\$}} + 2\rho_{j,c\pi^{\$}}\sigma_{j\pi^{\$}}\sqrt{\gamma_j(1-\varphi)}}\end{aligned} \tag{18}$$

where $\sigma^2_{j\pi^{\$}} = \sigma^2[\pi^{\$}_{j,t+1}]$ and $\rho_{j,c\pi^{\$}}$ is the correlation coefficient between $c_{j,t+1} - c_{jt}$ and $\pi^{\$}_{j,t+1}$. The right hand side of (18) depends on the utility curvature and the habit persistence parameters as well as the second moments of consumption growth, exchange rates and inflation rates.

In addition, the set of Euler equations implies that the country j investor's unconditional expected real return on the dollar-denominated riskless bond is (see Appendix):

$$\begin{aligned}r^{\$}_{ft} - E[\pi^{\$}_{j,t+1}] &= \eta_j + \gamma_j g_j - \frac{1}{2}\bar{\mathrm{A}}^2_j\sigma^2_{jc} - \frac{1}{2}\sigma^2_{j\pi^{\$}} - \bar{\mathrm{A}}_j\rho_{j,c\pi^{\$}}\sigma_{jc}\sigma_{j,\pi^{\$}} \\ &= \eta_j + \gamma_j g_j - \frac{1}{2}\gamma_j(1-\varphi) - \frac{1}{2}\sigma^2_{j\pi^{\$}} - \rho_{j,c\pi^{\$}}\sigma_{j\pi^{\$}}\sqrt{\gamma_j(1-\varphi)}.\end{aligned} \tag{19}$$

In the right hand side of equation (19), the first term is the investor's subjective discount rate. The second term reflects her intertemporal substitution. The third term measures precautionary savings, reflecting the investor risk aversion to uncertainty in her real consumption growth. The fourth term is the Jensen's inequality adjustment because inflation rates and exchange rates are expressed in logs. The last term represents a hedging premium for the correlation of real consumption growth with the exchange-rate-adjusted inflation rate. If the correlation is negative in a country, low real consumption growth in the country is associated with high domestic inflation rates or large appreciations of the domestic currency against dollars and consequently low real returns from the dollar-denominated riskless bond. As a result, the risk-averse investor in this country would require a positive hedging premium.

2.6. An international CCAPM

We now further discuss the implications of the set of Euler equations for expected excess returns on any portfolios in the world capital markets. Under conditional lognormality, we obtain the following expression (see Appendix):

$$E_t[r_{i,t+1}^e] = -\frac{\sigma_{it}^2}{2} + \mathrm{A}_{jt}\,\mathrm{cov}_t(r_{i,t+1}^e, \Delta c_{j,t+1}) + \mathrm{cov}_t(r_{i,t+1}^e, \Delta e_{j,t+1}) + \mathrm{cov}_t(r_{i,t+1}^e, \pi_{j,t+1}), \tag{20}$$

for $j = 1, 2, \cdots, N$. In equation (20), the left hand side is the expected dollar-denominated excess return on a portfolio of assets from a single country or multiple countries. On the right hand side, in addition to the Jensen's inequality adjustment given by minus half of the return variance, $\mathrm{cov}_t(r_{i,t+1}^e, \Delta c_{j,t+1})$ is the conditional covariance of excess returns on the portfolio with real consumption growth in country *j*, and $\mathrm{cov}_t(r_{i,t+1}^e, \pi_{j,t+1}^\$)$ is the conditional covariance of excess returns with the exchange rate-adjusted inflation rate in country *j*. It is important to note that only the price of covariance risk with real consumption growth is time-varying while the price of risk with the exchange rate-adjusted inflation rate always remains unity.

We now aggregate equation (20) on a cross-sectional basis. To this end, we replace the country subscript *j* with "a" to denote a cross-country average. For example, let $\omega_j\,(j = 1, \cdots, N)$ be weights with $\sum_{j=1}^N [\omega_j] = 1$. Define $\mathrm{A}_{at} \equiv E^N[\mathrm{A}_{jt}] \equiv \sum_{j=1}^N [\omega_j \mathrm{A}_{jt}]$ as a cross-country average investor risk aversion and define $\Delta c_{a,t+1}$ and $\pi_{a,t+1}^\$$ in the similar way. Averaging both sides of equation (20) across all countries, we obtain

$$E_t[r_{i,t+1}^e] \approx -\frac{\sigma_{it}^2}{2} + \mathrm{A}_{at}\,\mathrm{cov}_t(r_{i,t+1}^e, \Delta c_{a,t+1}) + \mathrm{cov}_t(r_{i,t+1}^e, \Delta e_{a,t+1}) + \mathrm{cov}_t(r_{i,t+1}^e, \pi_{a,t+1}), \tag{21}$$

where the approximation error is given by the cross-sectional covariance between A_{jt} and $\mathrm{cov}_t(r^e_{i,t+1}, \Delta c_{j,t+1})$. Here we assume that the high-order cross-sectional moment is negligible.[6] In equation (21), expected excess returns are related to the cross-country average of investor risk aversion and the conditional covariances of returns with the cross-country averages of real consumption growth, exchange rate changes and inflation rates. It should be noted that equation (21) is valid for any combinations of weights as long as the weights add to unity.

Since investor risk aversion in the world economy varies over time and across countries, countercyclical variation in the risk premium on the world market portfolio can be attributed to two sources of variation in risk aversion. First, during worldwide recessions, each investor faced with falling surplus consumption within her own country becomes more risk averse, requiring higher risk premiums on assets whose returns are positively correlated with her consumption. Second, as the more risk-averse investors tend to take less covariance risks in the world capital markets, the declines in the values of the more risky assets relative to the less risky assets at the tough times cause shifts of mass of the wealth distribution toward investors with higher risk aversion, further raising the risk premium on the world market portfolio.[7]

2.7. A world representative agent model in complete markets

In this section, we briefly discuss a world representative agent model with habit formation. Under the assumption that the world capital markets are complete, investors from all countries can use these markets to trade risks and insurance in all conceivable ways to achieve an optimal risk sharing within countries as well as across countries. As illustrated by Cochrane (2001, Chapter 3), in a complete market where investors can use securities to span the contingent claims associated with all states of nature, the marginal rate of substitution of every investor is equalized, state-by-state, to the price of the contingent claim

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[6] Note $E^N[\mathrm{A}_{jt}\,\mathrm{cov}_t(r^e_{i,t+1}, \Delta c_{j,t+1})] = E^N[\mathrm{A}_{jt}]E^N[\mathrm{cov}_t(r^e_{i,t+1}, \Delta c_{j,t+1})] + \mathrm{cov}^N[\mathrm{A}_{jt}, \mathrm{cov}_t(r^e_{i,t+1}, \Delta c_{j,t+1})]$. The last term is a higher-order cross-sectional moment and should be relatively small.

[7] The second point is similar to that made by Chan and Kogan (2002) who develop a complete-market model in which investors have constant but heterogeneous risk aversion coefficients to explain the countercyclical variation in asset returns.

divided by her subjective probability.[8] Therefore, under rational expectations, namely the subjective probabilities of investors from all countries are equal to the objective frequencies, complete world capital markets should ensure the uniqueness of a stochastic discount factor for returns denominated in a common currency.

Consider the preference of identical investors, or a world representative agent given by

$$E\sum_{t=0}^{\infty} e^{-\eta_w t} \frac{(C_{wt} - X_{wt})^{(1-\gamma_w)} - 1}{1-\gamma_w}. \tag{22}$$

Here C_{wt} and X_{wt} denote the world consumption index and the world habit, respectively. The log growth rate of the index is assumed to be a weighted average of logs of real consumption growth rates in all countries. Similar to the case of incomplete world markets, the level of world habit X_{wt} is given by the infinite-horizon nonlinear habit process of CC (1999). The world surplus consumption ratio,

$$0 < S_{wt} = (C_{wt} - X_{wt}) / C_{wt} < 1, \tag{23}$$

represents an indicator of the state of the world business cycle. A high value of S_{wt} is indicative of worldwide economic expansion while a low value of S_{wt} signals a worldwide recession.

Analogous to the definition of the world consumption growth, we assume that the world log exchange rate ($e_{w,t+1}$) and world log inflation rate ($\pi_{w,t+1}$) as the weighted averages of the individual countries' log exchange rates and log inflation rates, respectively. The log of the world exchange rate-adjusted inflation rate is then given by $\pi^{\$}_{w,t+1} = \Delta e_{w,t+1} + \pi_{w,t+1}$. Then the stochastic discount factor for dollar-denominated returns can be written as

$$M^{\$}_{w,t+1} \equiv e^{-\eta_w} \left(\frac{S_{w,t+1}}{S_{wt}} \frac{C_{w,t+1}}{C_{wt}} \right)^{-\gamma_w} \frac{1}{\Pi^{\$}_{w,t+1}}. \tag{24}$$

If the world capital markets are complete and investors have full information, the MRS given by equation (6) of the heterogeneous investors from all countries should be equal to the MRS of the world

[8] Cochrane (2001, p. 55) derives the result using time-separable and state-independent utility. It can be seen that his conclusion applies here because habit is assumed to be external. See also Constantinides (1982).

representative investor: $M^{\$}_{j,t+1} = M^{\$}_{w,t+1}$ for $j = 1, 2, \cdots, N$. Consequently, asset pricing implications of the world representative-agent economy should be equivalent to those of the heterogeneous-agent economy.

The conditional relative risk aversion for the world representative agent is

$$\mathrm{A}_{wt} = E_t\left[\frac{\gamma_w}{S_{w,t+1}}\right] = \max\left\{\gamma_w,\ \frac{\gamma_w}{\bar{S}_w}\sqrt{1-2(s_{wt}-\bar{s}_w)}\right\}. \tag{25}$$

Unlike the case of incomplete markets, investors in the complete-market world economy are only faced with the aggregate world consumption risk. The investor risk aversion in the economy varies over time as a result of shocks to the aggregate world consumption growth. In addition, in contrast to the incomplete-market model, the complete-market model implicitly assumes the synchronization of business cycles in international markets and the homogeneity of investor risk aversion across countries.

An unconditional version of the mean-variance frontier is given by

$$\begin{aligned}\max_p \frac{E[R_i^e]}{\sigma[R_i^e]} &\approx \min_{j\le J}\ \sqrt{\bar{\mathrm{A}}_w^2\sigma_{wc}^2 + \sigma_{w\pi^\$}^2 + 2\bar{\mathrm{A}}_w\rho_{w,c\pi^\$}\sigma_{wc}\sigma_{w\pi^\$}} \\ &= \min_{j\le J}\sqrt{\gamma_w(1-\varphi) + \sigma_{w\pi^\$}^2 + 2\rho_{w,c\pi^\$}\sigma_{w\pi^\$}\sqrt{\gamma_w(1-\varphi)}}\end{aligned} \tag{26}$$

where σ_{wc}^2 is variance of the world consumption growth, $\sigma_{w\pi^\$}^2$ is the variance of the log inflation rate and $\mathrm{cov}_{c\pi^\$}$ is the covariance between the world consumption growth and the log world inflation rate.

The expected real return on the dollar-denominated riskless bond is

$$\begin{aligned}r_{ft}^{\$} - E[\pi_{w,t+1}^{\$}] &= \eta_w + \gamma_w g_w - \frac{1}{2}\bar{\mathrm{A}}_w^2\sigma_{wc}^2 - \frac{1}{2}\sigma_{w\pi^\$}^2 - \bar{\mathrm{A}}_w\rho_{w,c\pi^\$}\sigma_{wc}\sigma_{w\pi^\$} \\ &= \eta_w + \gamma_w g_w - \frac{1}{2}\gamma_w(1-\varphi) - \frac{1}{2}\sigma_{w\pi^\$}^2 - \rho_{w,c\pi^\$}\sigma_{w\pi^\$}\sqrt{\gamma_w(1-\varphi)}.\end{aligned} \tag{27}$$

where g_w is the mean of the world consumption growth rate.

In addition, expected excess returns can be expressed as

$$E_t[r_{i,t+1}^e] = -\frac{\sigma_{it}^2}{2} + \mathrm{A}_{wt}\,\mathrm{cov}_t(r_{i,t+1}^e, \Delta c_{w,t+1}) + \mathrm{cov}_t(r_{i,t+1}^e, \Delta e_{w,t+1}) + \mathrm{cov}_t(r_{i,t+1}^e, \pi_{w,t+1})\,. \tag{28}$$

Unlike equation (21) in the incomplete-market model, where the aggregate world risk aversion is measured by aggregating individual countries' investor risk aversion based on the country-specific consumption and habit, expected excess returns in equation (28) depend on the world risk aversion based on the aggregate world consumption index and habit.

3. Data and Parameter Selections

3.1. The data

We use quarterly U.S. dollar-denominated returns on national stock market indices and a world stock market index from the Morgan Stanley Capital International (MSCI). We take the U.S. three-month Treasury bill as the dollar-denominated riskless bond. The sample period for stock returns and the bill rate spans from the first quarter of 1970 to the fourth quarter of 2000. For 13 countries included in the MSCI, quarterly consumption, exchange rates, Gross Domestic Products (GDP), and Consumer Price indices (CPI) are available from the International Financial Statistics (IFS) throughout most of the sample period. By interpolating the annual population data from IFS into quarterly observations, we calculate the per-capita seasonally-adjusted real consumption for each of the 13 countries. In addition, to study the complete-market, world representative agent model, we use a GDP-weighted world consumption index. The log growth rate of the index represents an average of real per-capita seasonally-adjusted log consumption growth rates of the 13 countries, weighted by these countries' relative GDP in U.S. dollars. As discussed in Harvey (1990), Sarkissian (2003) and Li and Zhong (2004), using this method of constructing world consumption index instead of simply aggregating the U.S. dollar values of consumption from all countries avoids the extra volatility in world consumption growth rate induced by fluctuations in exchange rates. Similarly, following Ferson and Harvey (1993) and Bekaert and Harvey (1995), we calculate the log world exchange rate and the log world inflation rate as the GDP-weighted average of the individual countries' log exchange rates and log inflation rates in studying the world representative-agent model.

To examine the predictability of international stock returns, we use three world information variables and two local information variables in our empirical analysis. The world information variables are: 1) the U.S. log consumption-wealth ratio; 2) the term spread, calculated as the U.S. 10-year bond yield minus the 3-month U.S. bill rate; and 3) the relative Eurodollar rate, defined as the three-month Eurodollar rate minus a one-year moving average. The local information variables are: 1) the domestic log consumption-price ratio and 2) the domestic relative short-term rate, defined as the domestic short-term rate minus a one-year moving average.[9] The U.S. log consumption-wealth ratio is provided by Lettau and Ludvigson (2001). The U.S. 10-year Treasury bond yield and the U.S. three-month T-bill rate used to calculate the U.S. term spread are from the Federal Reserve Bank. The Eurodollar rate and local short-term interest rates are obtained from IFS.

The choice of the information variables is motivated by asset pricing theories as well as empirical evidence on the predictability of returns. Campbell (1993) shows that the consumption-wealth ratio reflects the present value of future consumption growth discounted at future returns on invested wealth. CC (1999) and Chan and Kogan (2002) point out that the consumption-price ratio, like the dividend-price ratio, should vary with the underlying consumption-habit ratio according to the stochastic discount model. Lettau and Ludvigson (2001) provide empirical evidence that the log consumption-wealth ratio is a stronger predictor of U.S. excess returns than default spreads, dividend yields, and earning yields. The other world and local information variables are similar to those used by Ferson and Harvey (1993), Bekaert and Harvey (1995), among others.

3.2. Parameter selections

We choose the parameters based on the time series properties of data. In Table 1, we report the summary statistics for real consumption growth, exchanger rates, inflation rates and exchange rate-adjusted inflation rates for every country in panel A for the incomplete-market model and the cross-country GDP-weighted averages of these variables in panel B for the complete-market model. The moments of

[9] For Germany, Italy, Spain and Switzerland, the local short-term rates are not available for the full sample. We use the short-term rate of France as a proxy for these countries' short-term rates.

consumption growth reveal substantial variability of the means and especially the standard deviations across the different consumption indices. The mean growth rate of the world consumption index is similar to the cross-country average of consumption growth rates. But the volatility of the world consumption growth is much less than that of each individual country, with a standard deviation of 0.66 percent compared with the cross-country average standard deviation of 1.47 percent, reflecting low correlations of consumption growth rates. The finding is consistent with the evidence on a lack of consumption risk sharing across countries (Lewis, 1995, 1996).

Similarly, we observe the cross-country dispersion in the means and especially the standard deviations of the exchange rate-adjusted inflation rates. In particular, as the exchange rates exhibit, on average, close to four times the volatilities of the inflation rates and are weakly correlated with the inflation rates, the volatilities of the exchange rate-adjusted inflation rates reflect mostly those of the exchange rates. It is noteworthy that the cross-country average volatility of the exchange rate-adjusted inflation rates is approximately twice the size of the volatility of the GDP-weighted average of the exchange rate-adjusted inflation rates. The difference is indicative of low correlations of the exchange rate-adjusted inflation rates across countries, underscoring the importance of modeling deviations from the PPP to reflect differences in real returns deflated from dollar-denominated units. Finally, we note that the exchange rate-adjusted inflation rates co-vary very little with real consumption growth for most countries, with an equal-weighted average correlation coefficient of -0.06 and a GDP-weighted average of -0.08.

We now turn our attention to characteristics of international stock returns. To obtain an estimate of the maximum Sharpe ratio, i.e., the ratio of expected excess returns to the standard deviations of returns, we plot on Figure 1 the mean-variance efficient frontier representing the capital allocation line tangent to the minimum-variance frontier of the risky portfolios of the country indices. The maximum Sharpe ratio given by the slope of the efficient frontier is 0.31. It is noteworthy that the maximum Sharpe ratio exceeds considerably the Sharpe ratios for individual countries and the world equity index in our sample, consistent with the benefits of global diversification.

We now discuss the selection procedure for the habit persistence and utility curvature parameters in the incomplete-market model. Our objective is to identify each country's lowest level of the mean risk aversion that explains the observed maximum Sharpe ratio. This can be achieved by equalizing the standard deviation of each country's log MRS given by the right hand side of equation (18) to the maximum Sharpe ratio in the data. The pairs of the persistence and utility curvature parameters that satisfy the condition are not unique for each country. To be consistent with the literature that has documented some success of habit formation utility in explaining the time-series behavior of returns in the U.S. and other markets [See CC (1999), Li (2001), Chue (2003), and Li and Zhong (2004)], we set the U.S. utility curvature parameter $\gamma_j = 2$. The resulting habit persistence parameter is $\varphi = 0.951$. With this parameter assumed to be identical for all countries, we then solve for the values of the utility curvature parameters for the rest of the countries. Interestingly, we find that they all fall within a narrow range (1.81-2.05) with a mean of 1.91, reflecting differences in the volatility of the exchange rate-adjusted inflation rates across countries. For the complete-market model, we solve the curvature parameter of the world representative agent using the same level of the persistence parameter and find the value of the curvature parameter to be 1.95, close to the mean of the parameters in the incomplete-market model. The results presented in the paper are not sensitive to the particular pairs of the utility curvature and persistence parameters.

4. Evaluation of the Model

4.1. Equity premiums and the risk-free rate

4.1.1 The general model

Let us first discuss the implication of the incomplete-market model for the international equity premiums. Panel A of Table 2 reports the implied mean surplus consumption ratios given by equations (13) and mean risk aversion given by equation (15) for individual countries and the world representative agent. Each investor's mean risk aversion, like the associated mean surplus consumption ratio, depends on her habit persistence, utility curvature and the volatility of consumption growth. Given the common habit persistence and the similarity of the utility curvature parameters for all countries, the cross-country difference in the investor risk aversion mostly reflect the variation in consumption volatility. The mean risk aversion is low for Germany (13), Norway and Sweden (15), but relatively high for U.S. (36), Australia (34) and Canada (31). Averaged over all countries, the risk aversion is 23, much less than that in U.S. [10]

In contrast, the mean risk aversion in the complete-market model needed to explain the maximum Sharpe ratio in the data is 47, given the level of the consumption volatility of the world consumption index. This indicates that the implied mean investor risk aversion in the incomplete-market model is notably lower than that in the complete-market model. The difference can be explained by the fact that the consumption volatility of each individual country is higher than that of the world consumption index due to low correlations of consumption growth rates across countries. [11] Therefore, accounting for the uninsurable, weakly correlated, idiosyncratic consumption risks helps explain the international equity premiums with a reduced level of investor risk aversion.

We now turn to the results pertaining to the dollar-denominated riskfree rate. If the model can successfully explain the riskfree rate, the subjective discount rate of each investor should be positive. Panel A of Table 3 reports the real returns from the three-month U.S. T-bills, calculated using each country's own exchange rate-adjusted inflation rate. Also reported in the table are the subjective discount rates needed to explain the real returns given by equation (19), and the remaining components of the real returns. The real returns are small, averaging 0.36 percent per quarter. The implied subjective discount rates for investors from individual countries and the world representative agent stay within a narrow range

[10] This result is in accord with the finding of Howell (1992) who reports that U.S. investors maintain a larger cash position (10%) than those in other countries including Germany, Japan, U.K. where cash reserves account for 4-6% of their portfolios. Under the restriction that the mean investor risk aversion is homogeneous across countries: $\bar{A}_j = \bar{A}$., the U.S. mean risk aversion prevails because of its lowest consumption volatility. There is also more cross-country variation in the curvature parameters but other conclusions of the paper remain unchanged.

[11] To be consistent with data from other countries, the U.S. consumption data used here are the total household consumption. When we use the U.S. nondurable plus service consumption, the U.S. consumption volatility turns out to be lower and the mean risk aversion higher than those reported here.

of 3-5 percent. Overall, the results here imply that the models under habit formation can explain the U.S. riskfree rate with economically plausible subjective discount factor for each of the countries studied here.

4.1.2 Comparison with power utility

How do the models under power utility $U(C_{jt}) \equiv [C_{jt}^{(1-\mathrm{A}_j)} - 1]/(1-\mathrm{A}_j)$ explain the equity premiums and the riskfree rate? We note that in this case, $X_{jt} = 0$, $S_{jt} = 1$ and the conditional relative risk aversion $\mathrm{A}_{jt} = E_t[\mathrm{A}_j / S_{jt}] = \mathrm{A}_j$ is a constant. We have the following approximate HJ bound:

$$\max_i \frac{E[R_i^e]}{\sigma[R_i^e]} \leq \min_{j \leq N} \sqrt{\mathrm{A}_j^2 \sigma_{jc}^2 + \sigma_{j,\pi^\$}^2 + 2\mathrm{A}_j \rho_{j,c\pi^\$} \sigma_{jc} \sigma_{j,\pi^\$}} \tag{29}$$

and the following equation for the riskfree rate

$$r_{ft}^\$ - E[\pi_{j,t+1}^\$] = \eta_j + \mathrm{A}_j g_j - \frac{1}{2}\mathrm{A}_j^2 \sigma_{jc}^2 - \frac{1}{2}\sigma_{j,\pi^\$}^2 - \mathrm{A}_j \rho_{j,c\pi^\$} \sigma_{jc} \sigma_{j,\pi^\$} . \tag{30}$$

As reported in panel B of Table 2, the risk aversion coefficient of each investor in the power utility model needed to explain the maximum Sharpe ratio is identical to the mean risk aversion required under the habit formation utility. This implies that external habit utility formulation does not contribute to the reduction in the mean risk aversion needed to explain the equity premiums. However, the implied subjective discount rates as reported in panel B of Table 3 under power utility are drastically different from those under habit formation. Indeed, the discount rates are negative for investors from every country and the world representative agent. The finding suggests that under the power utility, the level of the dollar-denominated riskfree rate is not only inconsistent with the U.S. consumption and inflation data, as reported by Weil (1989) and Epstein and Zin (1989), but also at odds with the consumption, inflation and exchange rate data from other countries. Overall, the results here imply that idiosyncratic, country-specific consumption risk helps lower the average risk aversion coefficients needed to explain the equity premiums under either the power or the habit-based utility but habit formation is the essential feature for explaining the riskfree rate puzzle.

To gain further insight, we examine the five components of the real returns on the riskfree rate, representing the subjective discount rate, effects of intertemporal substitution and precautionary savings, adjustments for inflation and exchange rate uncertainty, and the interactions of the real and nominal terms. Given that each investor's mean risk aversion coefficient needed to explain the maximum Sharpe ratio under the power utility is the same as that under habit formation, the last three terms are independent of the utility specifications. The difference in the ability of the models to explain the riskfree rate lies in the second terms associated with intertemporal substitution. Under habit formation, each investor's sensitivity of expected consumption growth to expected real returns is measured by the reciprocal of her utility curvature, whereas the sensitivity is entangled with the investor risk aversion in the power utility model. Finally, it is noteworthy that the last two components of the real returns on the riskfree rate arising from the uncertainty of exchange rates and inflation rates are almost negligible compared with the magnitude of other components, indicative of the dominant roles of the real effects on the volatility of the stochastic discount factors.

4.2. Predictability

4.2.1. Incomplete- vs. complete-market models

In the incomplete-market asset pricing equation (21), time-varying expected excess returns in the international markets, apart from a return variance term ($-\sigma_{it}^2/2$), are explained by the business-cycle related variation in the cross-country average of investor risk aversion (A_{at}) and time variation in the conditional covariances of returns with cross-country averages of consumption growth ($c_{a,t+1}$) and exchange-rate adjusted inflation rates ($\pi_{a,t+1}^{\$} = \pi_{a,t+1} + \Delta e_{a,t+1}$). Under the assumption that consumption and dividend growth, exchange rate changes and inflation rates from all countries are i.i.d., the expectations in the model are conditional on a state vector which contains the surplus consumption ratios from all countries, $\mathbf{s}_t = (s_{1t}, s_{2t}, \cdots, s_{Nt})$. For simplicity, we first consider the case where the weights in equation (21) are all equal and employ an equal-weighted average of the log surplus consumption ratios,

s_{at}, as a summary statistic of the state variables. Assuming that all conditional moments in equation (21) are constant, we use the following approximation:

$$\mathrm{A}_{at} \approx \overline{\mathrm{A}}_a + b_a(s_{at} - \overline{s}_a). \tag{31}$$

Then equation (21) can be approximately written as

$$E_t[r^e_{i,t+1}] = \alpha_{i0} + \boldsymbol{\alpha}^{'}_{\mathbf{i1}}(\mathbf{z_t} - \overline{\mathbf{z}}) + \beta_{ia}(s_{at} - \overline{s}_a) \quad \text{for} \quad i = 1, 2, \cdots, N. \tag{32}$$

Here $\alpha_{i0} \equiv \overline{r}^e_{i,t+1}$ and $\beta_{ia} \equiv b_a \operatorname{cov}_t(r^e_{i,t+1}, \Delta c_{a,t+1})$ are constants, $\boldsymbol{\alpha}_{\mathbf{i1}}$ is an $L \times 1$ constant vector, and $\mathbf{z_t} - \overline{\mathbf{z}}$ is an $L \times 1$ demeaned information vector. If $b_a < 0$ and $\operatorname{cov}_t(r^e_{i,t+1}, \Delta c_{a,t+1}) > 0,$ we expect $\beta_{ia} < 0.$ The term $\boldsymbol{\alpha}^{'}_{\mathbf{i1}}(\mathbf{z_t} - \overline{\mathbf{z}})$ measures the specification error of the model.

If the cross-country average log surplus consumption ratio s_{at} is highly persistent, it should have higher predictive power for multi-period excess returns: $r^e_{i,t+K}(K) = r^e_{i,t+1} + ... + r^e_{i,t+K}$ for $K = 1, 2, \cdots.$ To forecast the *K*-period returns, we write

$$E_t[r^e_{i,t+K}(K)] = \alpha_{i0}(K) + \boldsymbol{\alpha}^{'}_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}}) + \beta_{ia}(K)(s_{at} - \overline{s}_a). \tag{33}$$

The variance of expected returns is then decomposed into:[12]

$$\operatorname{var}\left[E_t[r^e_{i,t+K}(K)]\right] = \operatorname{var}\left[\boldsymbol{\alpha}^{'}_{\mathbf{i1}}(K)\mathbf{z_t}\right] + \operatorname{var}\left[\beta_{ia}(K)s_{at}\right] + \operatorname{cov}_t[\boldsymbol{\alpha}^{'}_{\mathbf{i1}}(K)\mathbf{z_t}, \beta_{ia}(K)s_{at}]. \tag{34}$$

Equation (34) implies that the portion of the variation of expected *K*-period excess returns that is explained by the cross-country average log surplus consumption ratio can be measured by the following variance ratio:

$$\mathrm{VR}_{ia}(K) = \frac{\operatorname{var}\left[\beta_{ia}(K)s_{at}\right]}{\operatorname{var}\left[\boldsymbol{\alpha}^{'}_{\mathbf{i1}}(K)\mathbf{z_t}\right] + \operatorname{var}\left[\beta_{ia}(K)s_{at}\right] + \operatorname{cov}[\boldsymbol{\alpha}^{'}_{\mathbf{i1}}(K)\mathbf{z_t}, \beta_{ia}(K)s_{at}]} \geq 0. \tag{35}$$

[12] To avoid enlarging the dimension of the parameter space, we do not make the information vector z_t in the right hand side of (33) orthogonal to s_{at}. Further, the unconditional means of all variables are to be estimated instead of assumed to known in advance to avoid the bias in the standard errors of the parameter vector, as articulated by Jagannathan and Wang (2002).

If $\beta_{ia}(K)$ increases with the return horizon *K*, the variance of expected returns that is explained by s_{at} and the variance ratio given by equation (35) should be higher for long-horizon returns than for short-horizon returns. Similarly, we define $\mathrm{VR}_{iz}(K)$ and $\mathrm{VR}_{i,az}(K)$ as the portions of the variation of expected *K*-period excess returns that are associated with the information vector $\mathbf{z_t}$ and interaction of s_{at} and $\mathbf{z_t}$.

We use the generalized method of moments (GMM) to estimate equations (33) along with the variance ratio given by (35) simultaneously for each portfolio, in order to obtain consistent standard errors for the betas as well as the variance ratios. For example, similar to Ferson and Harvey (1993), Li (2001), and Li and Zhong (2004), we construct the orthogonality conditions:

$$u_{s,t+1} = s_{a,t+1} - \overline{s}_a - \phi_s(s_{at} - \overline{s}_a) \perp (1, s_{at}), \tag{36}$$

$$u_{l,t+1} = z_{l,t+1} - \overline{z}_l - \phi_l(z_{lt} - \overline{z}_l) \perp (1, z_{lt}),\ l = 1, \cdots, L, \tag{37}$$

$$u_{1,t+K}(K) = r^e_{i,t+K}(K) - \alpha_{i0}(K) - \boldsymbol{\alpha}^{'}_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}}) - \beta_{ia}(K)(s_{at} - \overline{s}_a) \perp (1, \mathbf{z_t}, s_{at}) \tag{38}$$

$$u_{2t}(K) = \left([\boldsymbol{\alpha}^{'}_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}}) + \beta_{ia}(K)(s_{at} - \overline{s}_a)]^2\right)\mathrm{VR}_{ia}(K) - [\beta_{ia}(K)(s_{at} - \overline{s}_a)]^2 \perp 1. \tag{39}$$

Since many of the forecasting variables we use are highly persistent, we include the first-order autoregressive term of each forecasting variable in equations (36) and (37) so the resulting disturbance terms $u_{s,t+1}$ and $u_{l,t+1}$ are not highly autocorrelated and the variance-covariance matrix of the estimated parameter vector is not singular. Taken in isolation, equations (36) and (37) are used to exactly identify the unconditional means $(\overline{s}_a, \overline{\mathbf{z}})$ and the first-order autoregressive coefficients $(\phi_s, \phi_{1,} \cdots, \phi_L)$ of s_{at} and $\mathbf{z_t}$. With these coefficients given, equation (38) helps identify the parameters $(\alpha_{i0}(K), \boldsymbol{\alpha}_{\mathbf{i1}}(K), \beta_{ia}(K))$, and finally equation (39) helps identify the additional parameter $\mathrm{VR}_{ia}(K)$. When the entire system (36)-(39) is employed jointly, the system is exactly identified and the minimized value of the GMM objective function attains a value of zero. Using the GMM system, we calculate standard errors for the betas and variance ratios that are consistent with the heteroskedasticity and the autocorrelations of residuals up to the lag (K-1) as a result of overlapping observations.

The complete-market, world representative agent model (28) is estimated in a similar fashion. First we note that the world risk aversion A_{wt} in equation (25) varies inversely with the world log surplus consumption ratio s_{wt} . Using a linear approximation like equation (29), equation (28) can be approximately written as

$$E_t[r^e_{i,t+1}] = \alpha_{i0} + \boldsymbol{\alpha}^{'}_{\mathbf{i1}}(\mathbf{z_t} - \overline{\mathbf{z}}) + \beta_{iw}(s_{wt} - \overline{s}_w)\,. \tag{40}$$

We conduct an empirical analysis of the complete-market model (40) and the extension of the model for long-horizon returns in the same manner as before by replacing the subscript 'a' with 'w' in disturbance terms (36)-(39). The discrepancy in the explanatory power of the incomplete- and complete-market models, as measured by VR_{ia} and VR_{iw}, is attributable to the differences in the underlying assumptions of the models about the non-synchronization of business cycles and the heterogeneity of investor risk aversion across countries.

We first summarize evidence on the predictability of international stock returns. Because the forecasting variables are persistent predictors of returns and indicators of world and local business cycles, long-horizon returns should be more predicable than short-horizon returns. Due to the limitation of the sample size, we restrict return horizons to three years. As documented by Hodrick (1992), inferences from long horizon regressions could be biased in favor of rejecting no predictability of returns when the predictors are extremely persistent and behaving like a non-stationary variable. To take this issue into consideration, we perform long-horizon regressions with a full and a restricted sets of forecasting variables. The full set includes all of the world and local information variables plus the cross-country average of the log surplus consumption ratios and the restricted set contains only the world information variables which are relatively less persistent (with a maximum autocorrelation of 0.87) than local information variables and the cross-country average of the log surplus consumption ratios. In panels A and B of Table 4, we report the adjusted R^2s and exclusion (Wald) tests of predictability from long-horizon regressions based on the two sets of the forecasting variables, respectively. For the MSCI world index, the forecasting variables exclude local information variables in panel A.

The results in panel A indicates that the adjusted R^2 for each index is increasing with the horizon of returns and attains an average of 49 percent for all country stock indices and 51 percent for the MSCI world stock index at the three-year return horizon. Exclusion tests indicate that the forecasting variables are jointly and statistically significant predictors of returns from most countries at one-year and longer horizons. The results in panel B suggest that the evidence of predictability of international stock returns by only the world information variables is still pervasive at the two-year and longer horizons although the adjusted R^2s are noticeably lower. Averaging over all countries, the adjusted R^2 for three-year returns is 31 percent. The results extend the evidence of predictability of the international stock returns [Ferson and Harvey (1993), Bekaert and Harvey (1995)] to long horizons.[13]

The results of estimating the incomplete and complete models using disturbance terms (36)-(39) are presented in panels A and B of Table 5, respectively. In this and subsequent tables, the information vector $\mathbf{z}$ refers to the three world plus two local information variables when they are used to forecast country index returns or the three world information variables only when they are used to forecast world index returns. The estimated betas and the variance ratios in this and subsequent tables are highlighted in bold whenever they are significant at the 5 percent level. To save space, the standard errors of the estimated coefficients are not reported.

Consider first the results in panel A. If the time-varying expected returns are mostly induced by changing investor risk aversion, it is essential that expected returns from each stock index be inversely related to the lagged log surplus consumption ratio averaged over all countries; $\beta_{ia} < 0$ for each country *i*. The estimated betas in Table 5 are mostly negative and often significant for long-horizon returns. For the quarterly returns, β_{ia} s are negative for eight countries and the MSCI world index. The betas associated with annual returns become negative for all countries except Austria and two standard deviations away

[13] See Li and Zhong (2004) for evidence on the predictability of non-overlapping annual returns in the international stock markets.

from zero for Sweden and the MSCI world index. The number of country indices plus the world index where we observe negative and significant betas increases to nine at the two-year horizon and 11 at the three-year horizon. This suggests that the results are largely consistent with the inverse relation between the surplus consumption ratios and future stock returns in the international markets.

We now consider the variance ratios VR_{ia} reported in panel A. The average variance ratio increases from 13 percent for quarterly returns to 24 for three-year returns. For the world portfolio, the estimated variance ratio is 55 percent at the 3-year return horizon. The relatively high variance ratio for the world index is mostly attributed to the fact that the forecasting variables here exclude local information variables. These variance ratios, unfortunately, are estimated with little precision. Figure 2 plots the beginning-of-period realized three-year excess returns from the world index as well as the corresponding total predicted and the model's predicted returns. The total predicted returns are the returns predicted by the cross-country average of the log surplus consumption ratios and the world information variables. The model's predicted returns are the component predicted by the cross-country average of the log surplus consumption ratios only (plus the intercept). The plot shows that the variation of the long-horizon expected returns from the world index tracks the variation of the total returns, and more importantly, the variation of expected returns is explained to a fairly large degree by that of the cross-country average of the log surplus consumption ratios. The results suggest that habit formation of consumption helps explain part of long-horizon predictability of returns in the international equity markets.

It should be noted that the estimates of the variance ratio VR_{iz} associated with the information vector are large and often statistically significant. While the variance ratio $\mathrm{VR}_{i,az}$ associated with the interaction of the information vector and the cross-country average of the log surplus consumption ratio are relatively small, the sum of VR_{iz} and $\mathrm{VR}_{i,az}$ exceeds VR_{ia} for every country's stock index, implying that the model leaves considerable portions of return predictability unexplained.

We now discuss the results under the assumption of complete markets. First consider betas β_{iw} associated with the log surplus consumption ratio calculated with the world consumption index. If the time-varying risk aversion of the world representative agent can explains the predictability of international stock returns, β_{iw} should be negative for each country index and the world index. The estimated β_{iw} s are negative for many countries' long-horizon returns but most of them are not two standard errors away from zero. The reductions in the magnitude of the variance ratio for two and three-year returns are also fairly noticeable for most portfolios. For example, while on average 24 percent of the predictable variation of three-year returns from all countries is explained by the model assuming incomplete markets, only four percent of that is accounted for by the model assuming complete markets. The complete-market assumption also shrinks the explanatory power of the model for the predictability of the world index from 55 percent to 25 percent. Figure 3 illustrates the difference between the variance ratios estimated with three-year returns under the assumptions of the incomplete and complete markets respectively. It is fairly evident that the relaxation of the complete market assumption adds significantly to the explanatory power of the habit-based model for long-horizon predictability of returns from most countries' equity markets and the world market index.

4.2.2 Risk Aversion in the incomplete- vs. complete-market models

The preceding empirical analysis of the incomplete- and complete-market models is based on the surplus consumption ratios. In this section, we report the direct evidence on the explanatory power of the risk aversion measures in the incomplete- and complete-market models. To conduct this analysis for the incomplete-market model, we simply estimate a system analogous to equations (36)-(39), where the cross-country average log surplus consumption ratio, s_{at}, is replaced with the cross-country average risk aversion, A_{at}. The complete-market model is estimated in a similar way.

The results of estimation suggest that expected stock returns in the international markets tend to be positively related to the cross-country average of investor risk aversion and the relation is statistically significant for most countries' two- and three-year returns. Compared with the results in Table 5, where the cross-country average log surplus consumption ratio is used instead, we observe that explanatory power of the average investor risk aversion is remarkably similar to that of the average log surplus consumption ratio. For the complete-market model, there is also a positive relation between expected stock returns and the risk aversion of the world representative investor but the statistical significance of the relation is weak. The explanatory power of the investor risk aversion as given by the variance ratio, VR_a or VR_w, also match closely the corresponding value in Table 5. The results are suggestive that most of time-varying expected returns in the international markets associated with consumption in surplus of habit reflect changing investor risk aversion.

4.2.4 Explaining return predictability with multiple state variables

The preceding empirical work on the predictability has been based on a single variable – the cross-country average log surplus consumption ratio. In this section, we extend the analysis by considering several other state variables.

First of all, the incomplete-market pricing model, under the assumption of joint normality, implies that time-varying expected excess returns are attributed to the conditional covariance of returns with each country's and hence the cross-sectional mean of the log marginal rate of substitution (see Appendix). By relaxing the assumption of joint lognormality and using a higher-order Taylor expansion, expected excess returns can also be related to the conditional covariances of returns with the cross-sectional variance, and higher-order moments of the log marginal rate of substitution. In the special case of power utility without stochastic inflation and exchange rates, the log marginal rate of substitution is proportional to consumption growth, and hence expected excess returns are determined by the conditional covariances of returns with the cross-sectional moments of consumption growth [see, e.g., Mankiw (1986), Constantinides and Duffie (1996)]. When the power utility is generalized to the external habit utility and the log marginal rate of substitution becomes a weighted sum of consumption growth and the log surplus consumption ratio, expected returns should also be associated with the conditional covariances of returns with the cross-country mean ($s_{a,t+1}$) and variance ($\sigma^2_{s,a,t+1}$) of the log surplus consumption ratio, in addition to the cross-country mean ($\Delta c_{a,t+1}$) and variance ($\sigma^2_{a,t+1}$) of the log consumption growth. Here we utilize the moments of the log surplus consumption ratio instead of the change in the ratio because consumption shocks presumably exert only a transitory effect on the ratio while having a permanent effect on consumption. Under stochastic inflation and exchange rates, expected excess returns in the international markets should be further related to the conditional covariances of returns with the cross-country means of the inflation rate ($\pi_{a,t+1}$) and the exchange rate change ($\Delta e_{a,t+1}$). To avoid using an excessive large number of factors, we concentrate on the first two cross-country moments of consumption growth and the log surplus consumption ratio and the first cross-country moments of the inflation rate and the exchange rate change.

What are the conditions for any of the lagged cross-country moments to be predictors of returns? We note that if expected excess returns are related to the conditional covariance of returns with a cross-country moment (y_{t+1}) which is persistent and conditionally heteroskedastic in a particular way, then the moment should be a predictor of long-horizon returns. To illustrate, we express y_{t+1} as

$$y_{t+1} = E_t[y_{t+1}] + \nu(y_t)\varepsilon_{t+1}, \tag{41}$$

where $E_t[\varepsilon_{t+1}] = 0$, $\sigma_t[\varepsilon_{t+1}] = 1$, and $\nu(y_t)$ is the conditional standard deviation of y_{t+1}. Then the conditional covariance of excess returns with y_{t+1} is

$$\mathrm{cov}_t(r^e_{i,t+1}, y_{t+1}) = \nu(y_t)\,\mathrm{cov}_t(r^e_{i,t+1}, \varepsilon_{t+1}), \tag{42}$$

which implies that y_t is a conditioning variable for the conditional covariance and one-period-ahead expected excess returns. Moreover, if y_t is persistent, it should forecast long-horizon excess returns.

The preceding discussions suggest that if the cross-country moments including $\Delta c_{a,t+1}$, $\sigma^2_{c,a,t+1}$, $s_{a,t+1}$, $\sigma^2_{s,a,t+1}$, $\pi_{a,t+1}$ and $\Delta e_{a,t+1}$ are persistent, they could be predictors of long-horizon returns. In Table 7 we report the summary statistics of these variables.

We first note that the cross-country mean, $\Delta c_{a,t+1}$, and more noticeably, the cross-country variance, $\sigma^2_{c,a,t+1}$, of log consumption growth have lower standard deviations than other cross-country moments. Second, the two cross-country moments of consumption growth exhibit negligible first-order autocorrelation and moderate second and third-order autocorrelations, although they have a low cross correlation of -0.08. Since these moments are not persistent they are unlikely to be effective predictors of long-horizon returns. In contrast, the cross-country mean, $s_{a,t+1}$, and variance, $\sigma^2_{s,a,t+1}$, of the log surplus consumption ratio are much more persistent with high and slow decaying autocorrelations. The magnitude of the cross correlation of the two moments (-0.76) suggests that the cross-country dispersion of the surplus consumption ratio, unlike its cross-country average, should be high during worldwide business-cycle troughs and low during worldwide business-cycle peaks. Third, the cross-country average of the exchange rate change, $\Delta e_{a,t+1}$, has moderate autocorrelations of no more than 0.30 but the cross-country average of the inflation rate, $\pi_{a,t+1}$, is persistent with a first-order autocorrelation of 0.91. Both $\Delta e_{a,t+1}$ and $\pi_{a,t+1}$ are positively correlated with $s_{a,t+1}$, with cross correlations of 0.25 and 0.66, respectively, suggesting that $\pi_{a,t+1}$, and to a less extent $\Delta e_{a,t+1}$, tend to move along with worldwide economic expansions and contractions. All together, the foregone analysis suggests that the lagged cross-country moments, especially $\sigma^2_{s,a,t+1}$ and $\pi_{a,t+1}$, which are persistent and imperfectly correlated with one another and imperfectly correlated with $s_{a,t+1}$ may help explain the time-series variation of long-horizon international stock returns.[14]

In panel A of Table 8 we summarize the results of regressions with multiple state variables, s_{at}, σ^2_{sat}, Δe_{at}, and π_{at}. The coefficients, $\beta_{is}(K)$, $\beta_{is\sigma}(K)$, $\beta_{ie}(K)$, and $\beta_{i\pi}(K)$ are associated with these

[14] We also test whether the conditional covariances of returns with the cross-sectional moments are time varying under the assumption that the conditional covariances are linear in the lagged cross-country moments and the lagged information variables. The tests in general lack the power to reject the hypothesis of constant conditional covariances. Under other nonlinear specifications of the conditional covariances, the results are mixed.

variables in regressions with excess returns over *K* quarters. All beta coefficients are multiplied by the standard deviations of the corresponding forecasting variables. The last four columns report the "unexplained" portions of the variance of expected returns; the portions associated with the information variables and the interactions of these variables with the state variables. The estimation results suggest that the lagged cross-country average inflation rate, π_{at}, is a significant predictor of short- and long-horizon excess returns from many countries. The cross-country variance σ^2_{sat} seldom enters significantly possibly because of its high correlation with the cross-country mean s_{at}. As a result of moderate autocorrelations, the significance of Δe_{at}, however, also is limited to few countries for each of the return horizons.[15] The unexplained portions of the model with multiple cross-sectional variables are relatively smaller and less significant than those of the single cross-sectional- variable model reported in Table 5 and 6.

While the cross-country moments of inflation rates and exchange rate changes are explanatory variables in both power and external habit utility models, the cross-country moments, s_{at} and σ^2_{sat}, are excluded as explanatory variables in the power utility model. Instead, the cross-country moments, $\Delta c_{a,t+1}$, $\sigma^2_{c,a,t+1}$, are prominent factors under power utility. In panel B of Table 8, we report the results of regressions in which s_{at} and σ^2_{sat} are replaced with $\Delta c_{a,t+1}$ and $\sigma^2_{a,t+1}$. We find that very little evidence that expected returns vary significantly with $\Delta c_{a,t+1}$ or $\sigma^2_{c,a,t+1}$. The unexplained portions of the variance of expected returns become statistically significant for more countries at each return horizon than those in panel A. For example, the unexplained portions for the three-year expected returns from the U.S. and world stock markets are respectively 46 and 62 percent in regressions with s_{at} and σ^2_{sat} as part of the predictors, they rise to 97 and 91 percent when s_{at} and σ^2_{sat} are replaced with $\Delta c_{a,t+1}$ and $\sigma^2_{c,a,t+1}$.

[15] The results are similar when Δe_{at} is replaced with e_{at} although the autocorrelations of e_{at} is much higher than those of Δe_{at}.

4.2.5. Robustness to model parameters

The above empirical analysis of predictability is based on a single set of common utility curvature parameters for all countries, implying heterogeneous steady-state risk aversion in the incomplete-market model. To check the robustness of the assumption, we re-estimate the long-horizon regressions presented in Table 5-6 with the alternative sets of the utility curvature parameters. The results (available upon request) under the alternative assumptions are similar in terms of the estimated betas and magnitudes of the variance ratios in each horizon.

It may be argued that the long-horizon regression results can be spurious because of the high autocorrelation of the log surplus consumption ratios. What are the effects of changes in habit persistence on the model's explanatory power? To address the issue, we re-estimating the system in Tables 5-6 for two alternative habit persistence levels of φ = 0.80 and φ = 0.90. Again, we find results being consistent with the hypothesis that the incomplete-market model explains more long-horizon predictability of international stock returns than the complete-market model.

5. Conclusion

In this paper, we incorporate both habit formation and uninsurable idiosyncratic risks into an international consumption-based asset pricing model to study the behavior of returns from developed countries' equity markets and a world market index. In this model, the Sharpe ratios, the riskfree rate and expected excess returns on the international asset returns are determined by the marginal rates of substitution of investors from all countries. Consequently, the model accounts for idiosyncratic, country-specific risks associated with consumption growth, exchange rates and inflation rates. With country-specific habit formation, the model features heterogeneous variation of investor risk aversion along with non-synchronized movements of international business cycles. Countercyclical variation in the equity risk premiums are explained by in part by the time-series and cross-sectional variations of investor risk aversion in the world economy.

Unlike the representative-agent model under habit formation and the heterogeneous-agent model under standard preferences, our model fits both the international equity premiums and the U.S. riskfree rate with relatively low investor risk aversion. We also find that the heterogeneous model incorporating country-specific habit formations in the world equity markets explains the predictability of international stock returns better than the representative-agent model with only world habit formation and the heterogeneous-agent model under power utility. The results of this paper offer hope that a unified consumption-based asset pricing model incorporating habit formation and investor heterogeneity can potentially go a long way toward explaining the stylized facts in the domestic and international financial markets.

Appendix

Marginal rate of substitution

From equation (6), we obtain

$$m_{j,t+1} = -\eta_j - \gamma_j (s_{j,t+1} - s_{jt} + \Delta c_{j,t+1}) . \tag{A1}$$

Given $\pi^{\$}_{j,t+1} = \Delta e_{j,t+1} + \pi_{j,t+1}$, we have

$$\begin{aligned} m^{\$}_{j,t+1} &= m_{j,t+1} - \pi^{\$}_{j,t+1} \\ &= -\eta_j - \gamma_j (s_{j,t+1} - s_{jt} + \Delta c_{j,t+1}) - \pi^{\$}_{j,t+1} \\ &= -\eta_j - \gamma_j (s_{j,t+1} - s_{jt} + \Delta c_{j,t+1}) - \Delta e_{j,t+1} - \pi_{j,t+1} \end{aligned} . \tag{A2}$$

Risk aversion

From equation (8), $U_C(C_{jt}, X_{jt}) = (C_{jt} S_{jt})^{-\gamma_j}$ and $M_{j,t+1} = U_C(C_{j,t+1}, X_{j,t+1}) / U_C(C_{jt}, X_{jt})$. Thus the RRA given by equation (7) is

$$\begin{aligned} \mathrm{A}_{jt} &= -E_t \left[\partial \ln U_C(C_{j,t+1}, X_{j,t+1}) / \partial \ln C_{j,t+1} \right] \\ &= -E_t \left[\partial \ln M_{j,t+1} / \partial \ln C_{j,t+1} \right] \\ &= -E_t \left[\partial m_{j,t+1} / \partial c_{j,t+1} \right] \\ &= \gamma_j (1 + \lambda_{jt}) \end{aligned} \tag{A3}$$

where the last equality follows from equation (A1) and $\lambda_{jt} = E_t \left[\partial s_{j,t+1} / \partial c_{j,t+1} \right]$ is the sensitivity function.

Sharpe ratios and the riskfree rate

Assume that $C_{j,t+1}$, $M_{j,t+1}$ and $\Pi^{\$}_{j,t+1}$ given by equation (4) are conditionally lognormal. Similar to CC (1999),

$$\frac{\sigma_t [M^{\$}_{j,t+1}]}{E_t [M^{\$}_{j,t+1}]} = \sqrt{\exp(\sigma_t^2 [m^{\$}_{j,t+1}]) - 1} \approx \sigma_t [m^{\$}_{j,t+1}] \tag{A4}$$

Since $m^{\$}_{j,t+1} = m_{j,t+1} - \pi^{\$}_{j,t+1}$,

$$\sigma_t^2 [m^{\$}_{j,t+1}] = \sigma_t^2 [m_{j,t+1}] + \sigma_t^2 [\pi^{\$}_{j,t+1}] - 2 \operatorname{cov}_t (m_{j,t+1}, \pi^{\$}_{j,t+1}) . \tag{A5}$$

Under the conditional joint lognormality, Stein’s lemma implies

$$\sigma_t^2[m_{j,t+1}] = \left(E_t\left[\partial m_{j,t+1} / \partial c_{j,t+1}\right]\right)^2 \sigma_{jc}^2 = \mathrm{A}_{jt}^2 \sigma_{jc}^2, \tag{A6}$$

$$\mathrm{cov}_t(m_{j,t+1}, \pi_{j,t+1}^{\$}) = E_t\left[\partial m_{j,t+1} / \partial c_{j,t+1}\right] \mathrm{cov}_t(\Delta c_{j,t+1}, \pi_{j,t+1}^{\$}) = -\mathrm{A}_{jt}\, \mathrm{cov}_t(\Delta c_{j,t+1}, \pi_{j,t+1}^{\$}). \tag{A7}$$

Plugging (A6)-(A7) into (A5) implies

$$\sigma_t^2[m_{j,t+1}^{\$}] = \mathrm{A}_{jt}^2 \sigma_{jc}^2 + \sigma_t^2[\pi_{j,t+1}^{\$}] + 2\mathrm{A}_{jt}\, \mathrm{cov}_t(\Delta c_{j,t+1}, \pi_{j,t+1}^{\$}). \tag{A8}$$

Under the assumption of the conditional joint lognormality, the dollar denominated riskfree rate is

$$\begin{aligned} r_{ft}^{\$} &= -E_t\,[m_{j,t+1}^{\$}] - \frac{1}{2}\sigma_t^2[m_{j,t+1}^{\$}] \\ &= -E_t\,[m_{j,t+1}] + E_t\,[\pi_{j,t+1}^{\$}] - \frac{1}{2}\sigma_t^2[m_{j,t+1}^{\$}]. \end{aligned} \tag{A9}$$

Plugging (A8) into (A9) and rearranging, we have

$$r_{ft}^{\$} - E_t\,[\pi_{j,t+1}^{\$}] = -E_t\,[m_{j,t+1}] - \frac{1}{2}\mathrm{A}_{jt}^2\sigma_{jc}^2 - \frac{1}{2}\sigma_t^2[\pi_{j,t+1}^{\$}] - \mathrm{A}_{jt}\, \mathrm{cov}_t(\Delta c_{j,t+1}, \pi_{j,t+1}^{\$}). \tag{A10}$$

Following CC (1999), we can simplify the first two terms in the right hand side of equation (A10) to obtain equation (19).

An international CCAPM

Under joint normality, the set of Euler equations implies

$$\begin{aligned} E_t[r_{i,t+1}^e] &= -\frac{1}{2}\sigma_{it}^2 - \mathrm{cov}_t(r_{i,t+1}^e, m_{j,t+1}^{\$}) \\ &= -\frac{1}{2}\sigma_{it}^2 + \gamma_j\, \mathrm{cov}_t(r_{i,t+1}^e, \Delta c_{j,t+1}) + \gamma_j\, \mathrm{cov}_t(r_{i,t+1}^e, s_{j,t+1}) \\ &\qquad + \mathrm{cov}_t(r_{i,t+1}^e, \Delta e_{j,t+1}) + \mathrm{cov}_t(r_{i,t+1}^e, \pi_{j,t+1}) \\ &= -\frac{1}{2}\sigma_{it}^2 + \mathrm{A}_{jt}\, \mathrm{cov}_t(r_{i,t+1}^e, \Delta c_{j,t+1}) + \mathrm{cov}_t(r_{i,t+1}^e, \Delta e_{j,t+1}) + \mathrm{cov}_t(r_{i,t+1}^e, \pi_{j,t+1}). \end{aligned} \tag{A11}$$

where the second equality follows from (A2) and third equality follows from equation (A3) and the fact: $\mathrm{cov}_t(r_{i,t+1}^e, s_{j,t+1}) = \lambda_{jt}\, \mathrm{cov}_t(r_{i,t+1}^e, \Delta c_{j,t+1})$ by Stein’s lemma.

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Table 1. Summary Statistics

The sample period is from the 1970:Q1 to 2000:Q4. The table reports means (E, %), standard deviations (σ , %) and correlation coefficients (ρ). In panel A, Δc_j is the real log consumption growth for country j, Δe_j is the change in the log exchange rate in terms of the U.S. dollars of the country j's currency, and $\pi_{j,t+1}$ the log inflation rate in country j and $\pi^{\$}_{j,t+1} \equiv \Delta e_{j,t+1} + \pi_{j,t+1}$ is the exchange rate-adjusted inflation rate. In panel B, the summary statistics are for the GDP-weighted average of real consumption growth, exchange rate changes, inflation rates and exchange rate-adjusted inflation rates from all countries.

Index	$E[\Delta c_j]$	$\sigma[\Delta c_j]$	$E[\pi^{\$}_j]$	$\sigma[\pi^{\$}_j]$	$\rho_{j,c\pi^{\$}}$	$E[\pi_j]$	$\sigma[\pi_j]$	$E[\Delta e_j]$	$\sigma[\Delta e_j]$	$\rho_{j,\pi e}$
					Panel A. Incomplete-market model					
Australia	0.45	0.90	1.04	4.03	0.03	1.64	1.20	-0.60	3.93	-0.06
Austria	0.63	1.91	1.39	4.88	0.03	0.99	0.81	0.40	4.90	-0.11
Canada	0.42	1.00	0.99	1.87	0.00	1.27	0.90	-0.28	1.66	-0.02
France	0.43	1.26	1.16	4.69	0.15	1.41	1.05	-0.25	4.75	-0.16
Germany	0.49	2.34	1.23	4.92	-0.02	0.81	0.69	0.42	4.95	-0.12
Italy	0.70	1.16	1.11	4.60	0.14	2.13	1.52	-1.03	4.72	-0.24
Japan	0.56	1.61	1.92	5.26	-0.14	0.97	1.37	0.96	5.15	-0.06
Norway	0.53	2.11	1.30	4.28	-0.07	1.50	1.05	-0.21	4.14	0.01
Spain	0.58	1.14	1.40	4.77	0.09	2.21	1.51	-0.81	4.75	-0.15
Sweden	0.39	2.06	1.01	4.67	-0.26	1.53	1.20	-0.52	4.68	-0.13
Switzerland	0.33	1.28	1.58	5.44	0.03	0.84	0.83	0.74	5.48	-0.13
U. K.	0.57	1.42	1.43	5.00	-0.17	1.83	1.58	-0.41	4.72	0.02
U. S.	0.46	0.87	1.24	0.80	-0.60	1.24	0.80	0.00	0.00	0.00
Average	0.50	1.47	1.29	4.25	-0.06	1.41	1.12	-0.12	4.14	-0.09
					Panel B. Complete-market model					
World	0.47	0.66	1.29	2.21	-0.08	1.20	0.81	0.09	2.11	-0.08

Table 2. Assumed and Implied Parameters for Models

In the external habit model, φ and γ_j are respectively habit persistence and utility curvature parameters, $\bar{S}_j$ is the steady-state surplus consumption ratio, and $\bar{\mathrm{A}}_j$ is the mean relative risk aversion. In the power utility model, the mean relative risk aversion $\bar{\mathrm{A}}_j$ is the same as the utility curvature parameter A_j. HJ bound is the Hansen-Jagannathan (1991) bound. The row labeled "world" refers to the complete-market, world representative-agent model while the other rows are results from the incomplete-market model.

Index	φ	γ_j	$\bar{S}_j$	$\bar{\mathrm{A}}_j$	HJ bound
			Panel A. External Habit Utility		
Australia	0.951	1.89	0.056	33.8	0.307
Austria	0.951	1.87	0.119	15.8	0.307
Canada	0.951	1.93	0.063	30.6	0.307
France	0.951	1.81	0.077	23.5	0.307
Germany	0.951	1.90	0.146	13.0	0.307
Italy	0.951	1.82	0.071	25.6	0.307
Japan	0.951	1.97	0.103	19.2	0.307
Norway	0.951	1.94	0.133	14.5	0.307
Spain	0.951	1.84	0.070	26.3	0.307
Sweden	0.951	2.05	0.134	15.3	0.307
Switzerland	0.951	1.86	0.079	23.4	0.307
U. K.	0.951	1.99	0.091	21.9	0.307
U. S.	0.951	2.00	0.056	36.0	0.307
Average	0.951	1.91	0.092	23.0	0.307
World	0.951	1.95	0.042	46.6	0.307
			Panel B. Power Utility		
	φ	A_j	$\bar{S}_j$	$\bar{\mathrm{A}}_j$	HJ bound
Australia	0	33.8	1	33.8	0.307
Austria	0	15.8	1	15.8	0.307
Canada	0	30.6	1	30.6	0.307
France	0	23.5	1	23.5	0.307
Germany	0	13.0	1	13.0	0.307
Italy	0	25.6	1	25.6	0.307
Japan	0	19.2	1	19.2	0.307
Norway	0	14.5	1	14.5	0.307
Spain	0	26.3	1	26.3	0.307
Sweden	0	15.3	1	15.3	0.307
Switzerland	0	23.4	1	23.4	0.307
U. K.	0	21.9	1	21.9	0.307
U. S.	0	36.0	1	36.0	0.307
Average	0	23.0	1	23.0	0.307
World	0	46.6	1	46.6	0.307

Table 3. Components of the Real Returns on Dollar-Denominated U.S. Treasury Bills

The “the riskfree rate puzzle” refers to the negative subjective discount rate, $\eta_j < 0$. The row labeled “world” refers to the complete-market, world representative-agent model while the other rows are results from the incomplete-market model. All values are in percent per quarter. $g_j = E[\Delta c_j]$. $\sigma_{jc} = \sigma[\Delta c_j]$. $\sigma_{j,\pi^\$} = \sigma[\pi_j^\$]$.

Panel A. External Habit Utility

Index	$r_f^\$ - E[\pi_j^\$]$	η_j	$\gamma_j g_j$	$-\bar{A}_j^2\sigma_{jc}^2/2$	$-\sigma_{j,\pi^\$}^2/2$	$-\bar{A}_j\rho_{j,c\pi^\$}\sigma_{jc}\sigma_{j,\pi^\$}$
Australia	0.61	4.47	0.85	-4.60	-0.08	-0.03
Austria	0.26	3.80	1.17	-4.56	-0.12	-0.04
Canada	0.66	4.55	0.82	-4.70	-0.02	0.00
France	0.49	4.43	0.77	-4.40	-0.11	-0.21
Germany	0.42	4.20	0.94	-4.62	-0.12	0.03
Italy	0.54	3.97	1.28	-4.42	-0.11	-0.19
Japan	-0.27	3.34	1.10	-4.80	-0.14	0.22
Norway	0.35	4.03	1.03	-4.71	-0.09	0.09
Spain	0.25	3.89	1.07	-4.47	-0.11	-0.13
Sweden	0.64	4.54	0.81	-4.99	-0.11	0.39
Switzerland	0.07	4.17	0.61	-4.52	-0.15	-0.05
U. K.	0.22	3.80	1.13	-4.85	-0.13	0.26
U. S.	0.41	4.21	0.91	-4.86	0.00	0.15
Average	0.36	4.11	0.96	-4.65	-0.10	0.04
World	0.36	4.16	0.92	-4.74	-0.02	0.05

Panel B. Power Utility

Index	$r_f^\$ - E[\pi_j^\$]$	η_j	$A_j g_j$	$-A_j^2\sigma_{jc}^2/2$	$-\sigma_{j,\pi^\$}^2/2$	$-A_j\rho_{j,c\pi^\$}\sigma_{jc}\sigma_{j,\pi^\$}$
Australia	0.61	-9.84	15.16	-4.60	-0.08	-0.03
Austria	0.26	-4.92	9.89	-4.56	-0.12	-0.04
Canada	0.66	-7.60	12.97	-4.70	-0.02	0.00
France	0.49	-4.81	10.01	-4.40	-0.11	-0.21
Germany	0.42	-1.26	6.40	-4.62	-0.12	0.03
Italy	0.54	-12.77	18.02	-4.42	-0.11	-0.19
Japan	-0.27	-6.28	10.71	-4.80	-0.14	0.22
Norway	0.35	-2.66	7.72	-4.71	-0.09	0.09
Spain	0.25	-10.34	15.30	-4.47	-0.11	-0.13
Sweden	0.64	-0.67	6.02	-4.99	-0.11	0.39
Switzerland	0.07	-2.89	7.67	-4.52	-0.15	-0.05
U. K.	0.22	-7.50	12.43	-4.85	-0.13	0.26
U. S.	0.41	-11.26	16.38	-4.86	0.00	0.15
Average	0.36	-6.37	11.44	-4.65	-0.10	0.04
World	0.36	-16.82	21.90	-4.74	-0.02	0.05

Table 4. Regressions of Excess Returns on a Constant, the World and Local Information Variables plus an Cross-Country Average of Surplus Consumption Ratios

The equal-weighted average of surplus consumption ratios is calculated with the parameters in table 2. The world information variables include: the U.S. log consumption-wealth ratio (CWR), the spread between the U.S. ten-year T-bond yield and the three-month U.S. bill rate (TRM), and the relative three-month Euro dollar rate (EUR), calculated as the three-month Euro dollar rate minus a one-year backward moving average. The local information variables are the domestic log consumption-price ratio (LCP), calculated as local consumption divided by the local stock market index and the domestic relative short-term rate (LRR), calculated as the short-term rate minus a one-year backward moving average. For the world portfolio, only the world information variables are included. Regressions use non-overlapping quarterly returns and overlapping returns over one to three years. *P*-values are for the χ^2 test of joint significance of all variables except the constant. *P*-values that are less than 5 percent are highlighted in bold. The sample period ends in the last quarter of 2000.

	Adj. R^2 for Return Horizons				*P*-Value for Wald (χ^2) Test			
Index	1 qtr.	1 year	2 years	3 years	1 qtr.	1 year	2 years	3 years
Panel A. All forecasting variables								
Australia	0.022	0.178	0.319	0.562	0.133	**0.004**	**0.000**	**0.000**
Austria	-0.005	0.145	0.397	0.474	0.296	**0.007**	**0.000**	**0.000**
Canada	-0.006	0.052	0.133	0.418	0.490	0.293	0.075	**0.000**
France	0.016	0.112	0.218	0.429	0.175	0.215	**0.020**	**0.000**
Germany	-0.012	0.105	0.216	0.366	0.326	0.114	**0.029**	**0.000**
Italy	0.004	0.164	0.406	0.618	0.322	**0.000**	**0.000**	**0.000**
Japan	0.075	0.249	0.328	0.486	**0.009**	**0.000**	**0.000**	**0.000**
Norway	0.013	0.180	0.379	0.595	0.336	**0.001**	**0.000**	**0.000**
Spain	0.035	0.208	0.338	0.540	**0.044**	**0.000**	**0.000**	**0.000**
Sweden	-0.040	0.040	0.202	0.321	0.924	0.216	**0.001**	**0.000**
Switzerland	0.049	0.299	0.385	0.522	0.097	**0.000**	**0.000**	**0.000**
U. K.	0.042	0.223	0.311	0.448	0.060	**0.014**	**0.000**	**0.000**
U.S.	0.065	0.244	0.488	0.609	**0.002**	**0.001**	**0.000**	**0.000**
Average	0.020	0.169	0.317	0.491	0.247	0.067	**0.010**	**0.000**
World	0.039	0.169	0.297	0.509	0.070	0.077	**0.000**	**0.000**
Panel B. World Information Variables only								
Australia	0.020	0.098	0.149	0.334	0.131	0.081	**0.005**	**0.000**
Austria	-0.006	0.060	0.239	0.349	0.376	0.090	**0.000**	**0.000**
Canada	-0.003	0.030	0.056	0.292	0.544	0.613	0.125	**0.000**
France	0.021	0.102	0.200	0.369	0.186	0.053	**0.010**	**0.000**
Germany	0.014	0.110	0.181	0.222	0.105	**0.017**	**0.038**	**0.028**
Italy	-0.015	0.051	0.176	0.415	0.767	0.252	**0.026**	**0.000**
Japan	0.026	0.131	0.201	0.306	0.120	**0.012**	**0.004**	**0.002**
Norway	-0.006	0.033	0.180	0.388	0.441	0.190	**0.000**	**0.000**
Spain	-0.014	0.041	0.105	0.229	0.530	0.184	**0.038**	**0.000**
Sweden	-0.023	-0.003	0.019	0.084	0.958	0.761	0.673	**0.020**
Switzerland	0.057	0.301	0.365	0.375	**0.020**	**0.000**	**0.000**	**0.000**
U. K.	0.059	0.233	0.303	0.412	**0.007**	**0.006**	**0.000**	**0.000**
U.S.	0.068	0.165	0.224	0.312	**0.009**	0.068	**0.015**	**0.002**
Average	0.015	0.104	0.185	0.314	0.322	0.179	0.072	**0.004**
World	-0.008	0.003	0.043	0.128	**0.035**	0.065	**0.000**	**0.000**

Table 5. The Explanatory Power of Incomplete- and Complete-Market Models for Predictability of Returns

Panel A. Incomplete Markets

	$\beta_{ia}(K)$				$\mathrm{VR}_{ia}(K)$				$\mathrm{VR}_{iz}(K)$				$\mathrm{VR}_{i,az}(K)$				$\mathrm{VR}_{iz}(K)+\mathrm{VR}_{i,az}(K)$			
Index	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.
Australia	-0.03	-0.19	**-0.47**	**-0.57**	0.02	0.05	0.14	0.15	**1.14**	**1.19**	1.20	**1.11**	-0.16	-0.24	-0.35	-0.26	**0.98**	**0.95**	**0.86**	**0.85**
Austria	0.10	0.32	0.43	0.11	0.61	0.31	0.11	0.01	0.86	**0.99**	**1.03**	**1.01**	-0.47	-0.30	-0.14	-0.02	0.39	0.69	**0.89**	**0.99**
Canada	0.02	-0.24	**-0.60**	**-0.66**	0.03	0.13	0.01	0.02	**0.95**	0.78	**1.06**	0.92	0.02	0.09	-0.06	0.06	**0.97**	**0.87**	**0.99**	**0.98**
France	0.02	-0.06	**-0.44**	**-0.84**	0.01	0.00	0.08	0.20	**1.03**	**0.97**	0.82	0.63	-0.04	0.02	0.10	0.17	**0.99**	**1.00**	**0.92**	**0.80**
Germany	0.00	-0.15	**-0.45**	**-0.87**	0.00	0.02	0.10	0.39	1.01	0.93	0.82	0.53	-0.01	0.05	0.08	0.08	**1.00**	**0.98**	0.90	0.61
Italy	-0.06	-0.28	**-0.72**	**-1.19**	0.14	0.15	0.21	**0.29**	**0.88**	**0.78**	**0.73**	**0.59**	-0.02	0.07	0.06	0.12	**0.86**	**0.85**	**0.79**	**0.71**
Japan	0.11	0.16	-0.09	-0.48	0.33	0.05	0.00	0.06	0.91	**0.92**	**1.02**	**1.08**	-0.25	0.04	-0.02	-0.14	0.67	**0.95**	**1.00**	**0.94**
Norway	-0.06	-0.28	-0.60	**-0.80**	0.12	0.16	0.22	0.23	**1.25**	**1.21**	**1.06**	**1.00**	-0.37	-0.38	-0.28	-0.23	**0.88**	**0.84**	**0.78**	**0.77**
Spain	-0.08	-0.38	**-0.96**	**-1.68**	0.14	0.27	0.46	0.41	**0.96**	0.72	0.47	0.65	-0.10	0.01	0.08	-0.05	**0.86**	0.73	0.54	0.59
Sweden	-0.09	**-0.50**	**-0.71**	**-1.09**	0.20	0.23	0.96	0.60	0.58	0.64	0.27	0.35	0.22	0.13	-0.23	0.05	0.80	0.77	0.04	0.40
Switzerland	-0.09	-0.21	-0.42	**-0.85**	0.05	0.06	0.16	0.40	0.82	**0.80**	**0.65**	0.50	0.13	0.14	0.18	0.11	**0.95**	**0.94**	**0.84**	**0.60**
U. K.	-0.06	-0.16	-0.37	-0.58	0.02	0.02	0.01	0.00	1.14	**1.08**	**1.05**	**1.03**	-0.16	-0.10	-0.06	-0.03	**0.98**	**0.98**	**0.99**	**1.00**
U.S.	-0.01	-0.13	**-0.37**	**-0.65**	0.00	0.05	0.17	0.39	**1.01**	**0.97**	0.71	0.38	-0.02	-0.02	0.12	0.23	**1.00**	**0.95**	**0.83**	0.61
Average	-0.02	-0.16	-0.44	-0.78	0.13	0.12	0.20	0.24	0.96	0.92	0.84	0.75	-0.09	-0.04	-0.04	0.01	0.87	0.88	0.80	0.76
World	-0.03	**-0.18**	**-0.46**	**-0.68**	0.13	0.29	0.57	0.55	**0.90**	**0.72**	0.36	**0.34**	-0.03	-0.01	0.07	0.12	**0.87**	**0.71**	0.43	0.45

Panel B. Complete Markets

	$\beta_{iw}(K)$				$\mathrm{VR}_{iw}(K)$				$\mathrm{VR}_{iz}(K)$				$\mathrm{VR}_{i,wz}(K)$				$\mathrm{VR}_{iz}(K)+\mathrm{VR}_{i,wz}(K)$			
Index	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.
Australia	0.01	0.00	0.00	0.02	0.01	0.00	0.00	0.00	**0.94**	**1.00**	**1.00**	**0.99**	0.05	0.00	0.00	0.00	**0.99**	**1.00**	**1.00**	**1.00**
Austria	**0.07**	**0.31**	**0.47**	**0.29**	0.85	**0.65**	0.37	0.10	0.33	**0.63**	**0.86**	**0.99**	-0.18	-0.28	-0.23	-0.10	0.15	0.35	**0.63**	**0.90**
Canada	0.01	-0.06	-0.13	**-0.18**	0.03	0.08	0.01	0.03	**0.93**	**1.12**	**1.01**	**0.98**	0.04	-0.20	-0.01	-0.01	**0.97**	**0.92**	**0.99**	**0.97**
France	0.02	0.10	0.06	-0.13	0.02	0.11	0.01	0.03	**0.98**	**0.96**	**1.00**	**0.92**	0.00	-0.06	-0.01	0.04	**0.98**	**0.89**	**0.99**	**0.97**
Germany	0.01	0.02	0.00	-0.20	0.01	0.00	0.00	0.19	**0.98**	**1.01**	**1.00**	**0.76**	0.01	-0.02	0.00	0.05	**0.99**	**1.00**	**1.00**	**0.81**
Italy	-0.01	0.04	0.03	-0.22	0.01	0.01	0.00	0.04	**1.01**	**1.00**	**1.01**	**0.91**	-0.02	-0.02	-0.01	0.05	**0.99**	**0.99**	**1.00**	**0.96**
Japan	**0.08**	0.16	0.16	0.07	0.38	0.12	0.05	0.00	**0.89**	**0.98**	**1.05**	**1.03**	-0.27	-0.10	-0.09	-0.03	0.62	**0.88**	**0.95**	**1.00**
Norway	0.02	0.05	-0.01	**-0.16**	0.06	0.01	0.00	0.03	0.80	**0.92**	**1.01**	**1.01**	0.15	0.06	-0.01	-0.04	**0.94**	**0.99**	**1.00**	**0.97**
Spain	0.01	0.02	-0.07	-0.32	0.01	0.00	0.01	0.07	**0.95**	**0.98**	**1.01**	**0.96**	0.04	0.02	-0.02	-0.03	**0.99**	**1.00**	**0.99**	**0.93**
Sweden	-0.04	-0.19	-0.10	-0.14	0.15	0.62	0.01	0.03	0.92	0.60	**0.96**	**0.94**	-0.07	-0.22	0.03	0.04	0.85	0.38	**0.99**	**0.97**
Switzerland	-0.01	0.02	0.13	-0.02	0.01	0.00	0.03	0.00	**1.02**	**0.99**	**1.03**	**0.99**	-0.03	0.00	-0.06	0.01	**0.99**	**1.00**	**0.97**	**1.00**
U. K.	-0.03	-0.04	-0.01	-0.03	0.03	0.01	0.00	0.00	**1.03**	**1.00**	**0.99**	**1.00**	-0.06	0.00	0.01	0.00	**0.97**	**0.99**	**1.00**	**1.00**
U.S.	-0.04	-0.09	-0.06	-0.10	0.13	0.06	0.01	0.02	**0.95**	**0.90**	**0.95**	**0.93**	-0.08	0.04	0.04	0.06	**0.87**	**0.94**	**0.99**	**0.98**
Average	0.01	0.03	0.04	-0.09	0.13	0.13	0.04	0.04	0.90	0.93	0.99	0.96	-0.03	-0.06	-0.03	0.00	0.87	0.87	0.96	0.96
World	0.00	-0.04	-0.12	**-0.23**	0.00	0.05	0.18	0.25	**1.00**	**0.95**	**0.80**	**0.70**	0.00	0.01	0.02	0.05	**1.00**	**0.95**	**0.82**	**0.75**

Notes to Table 5:

The incomplete-market model is estimated jointly by the generalized method of moments:

Disturbance terms	Orthogonal to
$u_{s,t+1} = s_{a,t+1} - \bar{s}_a - \phi_s(s_{at} - \bar{s}_a)$	1, s_{at}
$u_{l,t+1} = z_{l,t+1} - \bar{z}_l - \phi_l(z_{lt} - \bar{z}_l)$, $l = 1, \cdots, L$	1, z_{lt}
$u_{1,t+K}(K) = r^e_{i,t+K}(K) - \alpha_{i0}(K) - \boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \bar{\mathbf{z}}) - \beta_{ia}(K)(s_{at} - \bar{s}_a)$	1, s_{at} and $\mathbf{z_t}$
$u_{2t}(K) = \left([\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \bar{\mathbf{z}}) + \beta_{ia}(K)(s_{at} - \bar{s}_a)]^2\right)\mathrm{VR}_{ia}(K) - [\beta_{ia}(K)(s_{at} - \bar{s}_a)]^2$	1

$r^e_{i,t+K}(K)$ represents the *K*-quarter dollar excess return with continuous compounding for index *i*. s_{at} is an equal-weighted average of the log surplus consumption ratios from all countries calculated with the parameter values given in table 2 and $\mathbf{z_t}$ is an $L \times 1$ information vector. $\mathrm{VR}_{ia}(K)$ is the portion of the variance of the *K*-quarter excess returns for country *i* that is explained by s_{at} The complete-market model is estimated analogously with the subscript 'a' replaced with 'w' and s_{wt} is the log surplus consumption ratio calculated from a world consumption index. The information vector $\mathbf{z_t}$ includes world information variables and local information variables described in notes to Table 4. For the world portfolio, the information vector $\mathbf{z_t}$ includes only world information variables. Statistical inferences are based on standard errors consistent with heteroskedasticity and autocorrelations of residuals up to lags *K*-1. The coefficients significant at the 5% level are highlighted in bold.

In separate estimations, the last disturbance term is replaced with one of the following:

$u_{3t}(K) = \left([\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \bar{\mathbf{z}}) + \beta_{ia}(K)(s_{at} - \bar{s}_a)]^2\right)\mathrm{VR}_{iz}(K) - [\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \bar{\mathbf{z}})]^2$,

$u_{4t}(K) = \left([\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \bar{\mathbf{z}}) + \beta_{ia}(K)(s_{at} - \bar{s}_a)]^2\right)\mathrm{VR}_{i,az}(K) - 2[\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \bar{\mathbf{z}})][\beta_{ia}(K)(s_{at} - \bar{s}_a)]$, or

$u_{5t}(K) = \left([\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \bar{\mathbf{z}}) + \beta_{ia}(K)(s_{at} - \bar{s}_a)]^2\right)[\mathrm{VR}_{iz}(K) + \mathrm{VR}_{i,az}(K)] - [\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \bar{\mathbf{z}})]^2 - 2[\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \bar{\mathbf{z}})][\beta_{ia}(K)(s_{at} - \bar{s}_a)]$.

Table 6. The Explanatory Power of Risk Aversion in Incomplete- and Complete-Market Models for Predictability of Returns

Panel A. Incomplete Markets

	Beta $\beta_{ia}(K)\times 100$				Variance Ratio $\mathrm{VR}_{ia}(K)$				Variance Ratio $\mathrm{VR}_{iz}(K)$				Interaction $\mathrm{VR}_{i,az}(K)$				$\mathrm{VR}_{iz}(K)+\mathrm{VR}_{i,az}(K)$			
Index	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.
Australia	0.27	1.10	**2.06**	**2.16**	0.14	0.10	0.19	0.17	1.36	1.22	1.20	1.11	-0.50	-0.32	-0.38	-0.29	0.86	**0.90**	0.81	**0.83**
Austria	**-0.45**	**-1.35**	-1.65	-0.47	0.82	0.41	0.13	0.01	0.80	**0.98**	**1.04**	**1.01**	-0.62	-0.40	-0.17	-0.02	0.18	0.59	**0.87**	**0.99**
Canada	-0.03	1.06	**2.48**	**2.32**	0.01	0.15	0.01	0.02	**1.02**	0.83	**1.04**	0.92	-0.03	0.02	-0.05	0.06	**0.99**	**0.85**	**0.99**	**0.98**
France	-0.09	0.22	1.39	**2.56**	0.01	0.00	0.08	0.18	**1.04**	**0.97**	0.80	0.61	-0.05	0.03	0.12	0.20	**0.99**	**1.00**	**0.92**	**0.82**
Germany	-0.09	0.24	1.18	**2.72**	0.04	0.01	0.12	0.39	1.09	**0.94**	0.74	0.51	-0.13	0.05	0.14	0.10	**0.96**	**0.99**	0.88	0.61
Italy	0.20	0.92	**2.56**	**4.20**	0.11	0.13	0.22	**0.30**	**0.88**	**0.77**	**0.69**	**0.55**	0.01	0.09	0.09	0.15	**0.89**	**0.87**	**0.78**	**0.70**
Japan	-0.38	-0.32	0.64	1.79	0.30	0.01	0.02	0.07	**0.91**	**0.96**	**1.03**	**1.08**	-0.21	0.03	-0.05	-0.15	0.70	**0.99**	**0.98**	**0.93**
Norway	0.06	0.65	2.02	**2.78**	0.01	0.07	0.20	0.23	**1.07**	**1.12**	**1.03**	**0.97**	-0.08	-0.19	-0.23	-0.20	**0.99**	**0.93**	**0.80**	**0.77**
Spain	0.28	1.32	**3.31**	**5.78**	0.15	0.28	0.47	0.46	**0.97**	0.72	0.45	0.59	-0.12	0.00	0.08	-0.05	**0.85**	0.72	0.53	0.54
Sweden	0.28	1.78	**2.68**	**4.34**	0.07	0.24	0.96	0.55	0.76	0.71	0.34	0.45	0.17	0.05	-0.30	-0.01	**0.93**	0.76	0.04	0.45
Switzerland	0.21	0.50	1.01	**2.34**	0.04	0.04	0.09	**0.29**	**0.82**	**0.84**	**0.72**	**0.53**	0.14	0.12	0.18	0.18	**0.96**	**0.96**	**0.91**	**0.71**
U. K.	0.35	0.76	1.39	1.64	0.05	0.02	0.01	0.00	1.21	**1.07**	**1.03**	**1.02**	-0.26	-0.09	-0.04	-0.02	**0.95**	**0.98**	**0.99**	**1.00**
U.S.	0.03	0.60	**1.41**	**2.09**	0.00	0.11	0.20	0.33	**1.01**	0.85	0.61	0.42	-0.02	0.05	0.18	0.25	**1.00**	**0.89**	**0.80**	0.67
Average	0.05	0.58	1.57	2.64	0.14	0.12	0.21	0.23	1.00	0.92	0.82	0.75	-0.13	-0.04	-0.03	0.02	0.86	0.88	0.79	0.77
World	0.01	0.38	**1.35**	**1.85**	0.00	0.10	0.39	0.34	**0.99**	**0.73**	0.35	**0.37**	0.01	0.17	**0.26**	0.28	**1.00**	**0.90**	**0.61**	**0.66**

Panel B. Complete Markets

	Beta $\beta_{iw}(K)\times 100$				Variance Ratio $\mathrm{VR}_{iw}(K)$				Variance Ratio $\mathrm{VR}_{iz}(K)$				Interaction $\mathrm{VR}_{i,wz}(K)$				$\mathrm{VR}_{iz}(K)+\mathrm{VR}_{i,az}(K)$			
Index	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.
Australia	-0.01	0.04	0.10	0.05	0.00	0.00	0.01	0.00	**0.96**	**1.02**	**1.03**	**1.00**	0.04	-0.02	-0.03	-0.01	**1.00**	**1.00**	**0.99**	**1.00**
Austria	**-0.16**	**-0.62**	**-0.85**	-0.49	0.85	**0.63**	0.30	0.07	0.33	**0.60**	**0.84**	**0.97**	-0.18	-0.23	-0.14	-0.04	0.15	0.37	**0.70**	**0.93**
Canada	-0.03	0.09	0.28	**0.33**	0.06	0.05	0.01	0.02	**0.94**	**1.08**	**1.00**	**0.98**	0.01	-0.13	-0.01	0.00	**0.94**	**0.95**	**0.99**	**0.98**
France	-0.06	-0.17	0.02	0.34	0.04	0.07	0.00	0.06	**0.99**	**1.00**	**1.00**	**0.87**	-0.02	-0.07	0.00	0.07	**0.96**	**0.93**	**1.00**	**0.94**
Germany	0.00	0.02	0.15	**0.53**	0.00	0.00	0.03	0.30	**1.00**	**0.99**	**0.95**	**0.65**	0.00	0.01	0.02	0.05	**1.00**	**1.00**	**0.97**	**0.70**
Italy	0.00	-0.04	0.12	0.58	0.00	0.00	0.01	0.07	**1.00**	**1.01**	**0.98**	**0.85**	0.00	-0.01	0.01	0.08	**1.00**	**1.00**	**0.99**	**0.93**
Japan	**-0.14**	-0.21	-0.04	0.14	0.31	0.05	0.00	0.00	**0.84**	**0.97**	**1.00**	**0.98**	-0.15	-0.03	-0.01	0.02	**0.69**	**0.95**	**1.00**	**1.00**
Norway	-0.09	-0.22	-0.02	**0.34**	0.16	0.07	0.00	0.04	0.65	**0.80**	**0.99**	**1.02**	0.19	0.13	0.01	-0.05	**0.84**	**0.93**	**1.00**	**0.96**
Spain	0.00	0.04	0.32	0.85	0.00	0.00	0.06	0.11	**1.01**	**1.02**	**0.99**	0.93	-0.01	-0.02	-0.05	-0.04	**1.00**	**1.00**	**0.94**	0.89
Sweden	0.06	0.33	0.25	0.39	0.13	0.53	0.02	0.06	0.91	0.62	**0.95**	**0.88**	-0.04	-0.15	0.03	0.06	0.87	0.47	**0.98**	**0.94**
Switzerland	0.01	0.02	-0.03	0.28	0.00	0.00	0.00	0.04	**1.01**	**1.00**	**1.01**	**0.91**	-0.02	0.00	-0.01	0.05	**1.00**	**1.00**	**1.00**	**0.96**
U. K.	0.07	0.15	0.20	0.17	0.03	0.01	0.02	0.00	**1.01**	**0.99**	**0.95**	**1.00**	-0.04	0.00	0.03	0.00	**0.97**	**0.99**	**0.98**	**1.00**
U.S.	0.06	0.20	0.24	0.24	0.10	0.09	0.03	0.02	**0.91**	**0.84**	**0.86**	**0.89**	-0.02	0.08	0.10	0.08	**0.90**	**0.91**	**0.97**	**0.98**
Average	-0.02	-0.03	0.06	0.29	0.13	0.12	0.04	0.06	0.89	0.92	0.97	0.92	-0.02	-0.03	0.00	0.02	0.87	0.88	0.96	0.94
World	0.01	0.10	0.31	**0.43**	0.00	0.07	0.23	0.20	**0.99**	**0.89**	**0.64**	**0.61**	0.00	0.04	0.12	0.20	**1.00**	**0.93**	**0.77**	**0.80**

Notes to Table 6:

The incomplete-market model is estimated jointly by the generalized method of moments:

Disturbance terms	Orthogonal to
$u_{\mathrm{A},t+1} = \mathrm{A}_{a,t+1} - \overline{\mathrm{A}}_a - \phi_s(\mathrm{A}_{at} - \overline{\mathrm{A}}_a)$	1, A_{at}
$u_{l,t+1} = z_{l,t+1} - \overline{z}_l - \phi_l(z_{lt} - \overline{z}_l)$, $l = 1,\cdots,L$	1, z_{lt}
$u_{1,t+K}(K) = r^e_{i,t+K}(K) - \alpha_{i0}(K) - \boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}}) - \beta_{ia}(K)(\mathrm{A}_{at} - \overline{\mathrm{A}}_a)$	1, A_{at} and $\mathbf{z_t}$
$u_{2t}(K) = \left([\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}}) + \beta_{ia}(K)(\mathrm{A}_{at} - \overline{\mathrm{A}}_a)]^2\right)\mathrm{VR}_{ia}(K) - [\beta_{ia}(K)(\mathrm{A}_{at} - \overline{\mathrm{A}}_a)]^2$	1

$r^e_{i,t+K}(K)$ represents the K-quarter dollar excess return with continuous compounding for index i. A_{at} is an equal-weighted average of the risk aversions from all countries calculated with the parameter values given in table 2 and $\mathbf{z_t}$ is an $L \times 1$ information vector. $\mathrm{VR}_{ia}(K)$ is the portion of the variance of the K-quarter excess returns for country i that is explained by A_{at}. The complete-market model is estimated analogously with the subscript 'a' replaced with 'w' and A_{wt} is the world risk aversion calculated from a world consumption index. The information vector $\mathbf{z_t}$ includes world information variables and local information variables described in notes to Table 4. For the world portfolio, the information vector $\mathbf{z_t}$ includes only world information variables. Statistical inferences are based on standard errors consistent with heteroskedasticity and autocorrelations of residuals up to lags K-1. The coefficients significant at the 5% level are highlighted in bold.

In separate estimations, the last disturbance term is replaced with one of the following:

$$u_{3t}(K) = \left([\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}}) + \beta_{ia}(K)(\mathrm{A}_{at} - \overline{\mathrm{A}}_a)]^2\right)\mathrm{VR}_{iz}(K) - [\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}})]^2 ,$$

$$u_{4t}(K) = \left([\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}}) + \beta_{ia}(K)(\mathrm{A}_{at} - \overline{\mathrm{A}}_a)]^2\right)\mathrm{VR}_{i,az}(K) - 2[\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}})][\beta_{ia}(K)(\mathrm{A}_{at} - \overline{\mathrm{A}}_a)] \text{ or}$$

$$u_{5t}(K) = \left([\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}}) + \beta_{ia}(K)(\mathrm{A}_{at} - \overline{\mathrm{A}}_a)]^2\right)[\mathrm{VR}_{iz}(K) + \mathrm{VR}_{i,az}(K)] - [\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}})]^2 - 2[\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}})][\beta_{ia}(K)(\mathrm{A}_{at} - \overline{\mathrm{A}}_a)] .$$

Table 7. Summary Statistics for Cross-Sectional Variables

$\Delta c_{a,t+1}$, s_{at} , $\Delta e_{a,t+1}$ and $\pi_{a,t+1}$ are the equal-weighted cross-sectional means of consumption growth, the log surplus consumption ratios, exchange rate changes and inflation rates, respectively. $\sigma^2_{c,a,t+1} = \sum_{j=1}^{N}[(\Delta c_{j,t+1} - \Delta c_{a,t+1})^2]/N$ and $\sigma^2_{s,a,t+1} = \sum_{j=1}^{N}[(s_{j,t+1} - s_{a,t+1})^2]/N$ are the cross-sectional variances of consumption growth and log surplus consumption ratio, respectively.

	$\Delta c_{a,t+1}$	$\sigma^2_{c,a,t+1}$	$s_{a,t+1}$	$\sigma^2_{s,a,t+1}$	$\Delta e_{a,t+1}$	$\pi_{a,t+1}$
Means (%)	0.48	0.02	0.24	12.56	-0.12	1.41
Standard Deviations (%)	0.60	0.03	19.76	7.26	3.28	0.84
Autocorrelations						
Lag 1	0.00	0.03	0.97	0.83	0.30	0.91
Lag 2	0.09	-0.07	0.94	0.72	0.06	0.86
Lag 3	0.23	-0.05	0.90	0.65	0.15	0.86
Correlations						
$\sigma^2_{c,a,t+1}$	-0.08					
$s_{a,t+1}$	0.11	0.06				
$\sigma^2_{s,a,t+1}$	-0.09	-0.08	-0.76			
$\Delta e_{a,t+1}$	0.13	-0.05	0.25	-0.19		
$\pi_{a,t+1}$	-0.12	0.16	0.66	-0.45	-0.05	

Table 8. The Explanatory Power of the Incomplete-Market Model for Predictability of Returns

Panel A. External Habit Utility

	$\beta_{is}(K)$				$\beta_{is\sigma}(K)$				$\beta_{ie}(K)$				$\beta_{i\pi}(K)$				$\mathrm{VR}_{iz}(K)+\mathrm{VR}_{i,az}(K)$			
Index	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.
Australia	-0.03	-0.05	-0.07	-0.05	**-0.04**	**-0.04**	-0.02	0.03	-0.01	0.02	0.02	-0.02	-0.05	**-0.18**	**-0.28**	**-0.20**	0.14	0.69	0.45	0.56
Austria	**0.07**	**0.19**	**0.17**	0.08	0.03	0.05	-0.02	0.00	-0.02	**-0.07**	-0.05	-0.03	**-0.04**	**-0.13**	**-0.17**	-0.10	0.00	0.30	0.71	**0.95**
Canada	0.00	-0.07	**-0.13**	**-0.11**	-0.02	-0.03	-0.03	0.01	-0.01	0.02	0.02	0.00	**-0.05**	**-0.15**	**-0.24**	**-0.13**	**0.94**	0.72	0.96	0.98
France	**0.05**	**0.10**	0.04	-0.04	**0.04**	**0.10**	0.10	**0.11**	-0.01	-0.03	-0.05	-0.06	**-0.10**	**-0.19**	**-0.24**	**-0.20**	0.94	0.95	**0.93**	**0.78**
Germany	0.03	0.05	-0.06	**-0.17**	**0.04**	0.08	0.01	-0.03	**-0.02**	**-0.05**	**-0.06**	**-0.05**	-0.02	-0.02	-0.01	0.01	0.93	**0.95**	0.84	0.52
Italy	0.05	0.08	0.04	-0.08	**0.05**	0.10	0.06	0.06	0.00	-0.01	-0.03	-0.02	**-0.05**	**-0.13**	**-0.27**	**-0.24**	0.06	0.38	0.37	0.51
Japan	0.03	0.05	0.13	0.13	-0.02	-0.02	0.08	**0.18**	-0.02	0.05	-0.01	-0.04	**-0.07**	**-0.19**	**-0.32**	**-0.29**	0.44	0.49	0.49	0.64
Norway	0.02	0.06	-0.03	**-0.11**	0.00	-0.03	**-0.08**	-0.06	0.00	-0.02	0.01	-0.03	**-0.06**	**-0.27**	**-0.32**	**-0.20**	0.19	0.05	0.04	0.55
Spain	0.02	0.00	-0.04	**-0.19**	0.03	0.06	0.08	0.03	0.01	0.05	0.06	0.03	-0.03	-0.08	**-0.19**	**-0.25**	0.39	0.41	0.22	0.43
Sweden	-0.02	**-0.13**	**-0.18**	**-0.27**	0.00	-0.03	-0.05	-0.07	0.02	0.03	0.03	0.02	**-0.04**	**-0.09**	**-0.14**	**-0.20**	0.93	0.80	0.73	0.73
Switzerland	0.00	0.01	-0.05	**-0.14**	0.02	0.07	0.03	0.02	-0.02	**-0.03**	**-0.04**	**-0.06**	-0.02	-0.01	-0.01	-0.03	**0.90**	**0.88**	0.80	0.54
U. K.	-0.02	-0.02	-0.06	-0.08	0.00	0.03	0.03	0.04	0.00	-0.02	-0.02	-0.04	**-0.07**	**-0.18**	**-0.18**	-0.11	0.93	0.96	0.99	1.00
U.S.	0.00	-0.02	**-0.07**	**-0.14**	0.00	0.01	0.01	-0.01	0.00	0.01	0.01	0.01	-0.02	-0.03	-0.03	-0.02	0.48	0.67	0.68	0.46
Average	0.01	0.02	-0.02	-0.09	0.01	0.03	0.02	0.02	-0.01	-0.01	-0.01	-0.02	-0.05	-0.13	-0.19	-0.15	0.56	0.63	0.63	0.67
World	0.00	-0.01	-0.05	**-0.12**	0.01	0.03	0.06	**0.08**	-0.01	0.01	0.00	-0.01	-0.03	-0.05	-0.07	-0.05	0.54	0.74	0.57	0.62

Panel B. Power Utility

	$\beta_{ic}(K)$				$\beta_{ic\sigma}(K)$				$\beta_{ie}(K)$				$\beta_{i\pi}(K)$				$\mathrm{VR}_{iz}(K)+\mathrm{VR}_{i,az}(K)$			
Index	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.	1 qtr.	1 yr.	2 yrs.	3 yrs.
Australia	-0.02	-0.01	-0.02	-0.02	0.00	0.00	0.01	0.01	0.00	0.02	0.02	**-0.02**	-0.05	**-0.18**	**-0.30**	**-0.23**	0.61	0.74	0.49	0.62
Austria	0.01	0.02	0.02	0.02	-0.01	0.01	0.01	0.02	-0.01	-0.03	-0.01	-0.01	0.00	-0.03	-0.03	-0.04	0.46	**0.84**	**0.98**	**0.98**
Canada	-0.01	-0.01	0.00	-0.01	0.00	0.01	-0.01	0.00	0.00	0.01	0.00	-0.02	**-0.05**	**-0.16**	**-0.26**	**-0.15**	**0.96**	0.66	**0.99**	**0.98**
France	-0.01	0.01	0.01	0.00	0.00	0.02	0.00	-0.01	0.00	-0.02	**-0.05**	**-0.08**	**-0.09**	**-0.20**	**-0.27**	**-0.26**	**0.96**	**0.95**	0.91	0.73
Germany	-0.01	0.00	-0.01	0.00	0.00	0.01	-0.02	-0.01	-0.01	**-0.05**	**-0.08**	**-0.09**	-0.01	-0.01	-0.03	-0.07	0.93	0.90	**0.70**	**0.66**
Italy	-0.01	0.02	0.04	**0.07**	-0.01	0.02	-0.02	0.01	0.00	0.00	-0.04	**-0.06**	**-0.04**	**-0.14**	**-0.30**	**-0.36**	0.12	0.25	0.25	0.41
Japan	0.00	0.01	0.03	0.04	0.00	-0.02	-0.01	0.00	-0.01	**0.06**	0.00	-0.04	-0.03	**-0.14**	**-0.28**	**-0.34**	0.64	0.51	0.44	0.57
Norway	0.01	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.01	-0.04	**-0.05**	**-0.21**	**-0.31**	**-0.24**	0.06	-0.09	0.04	**0.59**
Spain	0.00	0.03	0.05	**0.10**	0.00	0.02	-0.01	-0.02	0.01	0.04	0.04	-0.03	**-0.04**	**-0.13**	**-0.30**	**-0.45**	0.35	0.20	-0.04	0.31
Sweden	-0.01	0.00	0.00	0.00	0.00	0.00	**-0.04**	-0.01	0.01	0.01	0.00	-0.02	**-0.05**	**-0.11**	**-0.15**	**-0.23**	**0.91**	0.62	-0.21	0.26
Switzerland	-0.01	-0.01	-0.01	-0.01	**-0.01**	0.00	-0.02	-0.02	-0.02	-0.03	**-0.05**	**-0.07**	-0.02	-0.02	-0.02	-0.05	**0.88**	**0.93**	**0.91**	**0.90**
U. K.	-0.01	-0.01	-0.01	-0.03	-0.01	0.01	-0.02	-0.02	0.00	-0.02	-0.03	**-0.05**	**-0.06**	**-0.18**	**-0.16**	-0.08	0.94	**0.96**	**0.99**	**1.00**
U.S.	-0.01	0.00	-0.01	**-0.04**	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	-0.03	-0.03	-0.02	-0.03	0.58	**0.93**	**0.99**	**0.97**
Average	-0.01	0.01	0.01	0.01	0.00	0.01	-0.01	0.00	0.00	0.00	-0.02	-0.04	-0.04	-0.12	-0.19	-0.19	0.65	0.64	0.57	0.69
World	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	-0.01	0.01	-0.01	-0.02	-0.03	-0.05	-0.07	-0.05	0.71	0.69	0.69	**0.91**

Notes to Table 8:

For panel A, the following system is estimated jointly by the generalized method of moments:

Disturbance terms	Orthogonal to
$u_{s,t+1} = s_{a,t+1} - \overline{s}_a - \phi_{is}(s_{at} - \overline{s}_a)$	1, s_{at}
$u_{v,t+1} = \sigma^2_{s,a,t+1} - \sigma^2_{sa} - \phi_{i\sigma}(\sigma^2_{sat} - \sigma^2_{sa})$	1, $\sigma^2_{c,a,t}$
$u_{e,t+1} = \Delta e_{a,t+1} - \overline{\Delta e_a} - \phi_{ie}(\Delta e_{at} - \overline{\Delta e_a})$	1, Δe_{at}
$u_{\pi,t+1} = \pi_{a,t+1} - \overline{\pi}_a - \phi_{i\pi}(\pi_{at} - \overline{\pi}_a)$	1, π_{at}
$e_{l,t+1} = z_{l,t+1} - \overline{z}_l - \phi_l(z_{lt} - \overline{z}_l)$, $l = 1, \cdots, L$	1, z_{lt}
$u_{1,t+K}(K) = r^e_{i,t+K}(K) - \alpha_{i0} - \boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}}) - \beta_{is}(K)(s_{at} - \overline{s}_a) - \beta_{is\sigma}(K)(\sigma^2_{sat} - \sigma^2_{sa}) - \beta_{ie}(K)(\Delta e_{at} - \overline{\Delta e_a}) - \beta_{i\pi}(K)(\pi_{at} - \overline{\pi}_a)$	1, s_{at}, σ^2_{cat}, Δe_{at}, π_{at} and $\mathbf{z_t}$
$u_{2t}(K) = \left([\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}}) + \beta_{is}(K)(s_{at} - \overline{s}_a) + \beta_{is\sigma}(K)(\sigma^2_{sat} - \sigma^2_{sa}) + \beta_{ie}(K)(\Delta e_{at} - \overline{\Delta e_a}) + \beta_{i\pi}(K)(\pi_{at} - \overline{\pi}_a)]^2\right)[\mathrm{VR}_{iz}(K) + \mathrm{VR}_{i,az}(K)]$ $- [\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}})]^2 - 2[\boldsymbol{\alpha}'_{\mathbf{i1}}(K)(\mathbf{z_t} - \overline{\mathbf{z}})][\beta_{is}(K)(s_{at} - \overline{s}_a) + \beta_{is\sigma}(K)(\sigma^2_{sat} - \sigma^2_{sa}) + \beta_{ie}(K)(\Delta e_{at} - \overline{\Delta e_a}) + \beta_{i\pi}(K)(\pi_{at} - \overline{\pi}_a)]$	1

$r^e_{i,t+K}(K)$ represents the *K*-quarter excess return with continuous compounding for index *i*. s_{at} and σ^2_{sat} are the equal-weighted cross-country mean and variance of log surplus consumption ratios. Δe_{at} and π_{at} are the equal-weighted cross-country averages of exchange rate changes and inflation rates, respectively. $\mathbf{z_t}$ is an information vector. The sum, $\mathrm{VR}_{iz}(K) + \mathrm{VR}_{i,az}(K)$, measures the portion of the variance of the *K*-quarter excess returns that is explained by $\mathbf{z_t}$ and interactions of $\mathbf{z_t}$ with other explanatory variables. Statistical inferences are based on standard errors consistent with heteroskedasticity and autocorrelations of residuals up to lags *K*-1. All beta coefficients are multiplied by the standard deviations of the corresponding forecasting variables. The coefficients significant at the 5% level are highlighted in bold. For panel B, s_{at} and σ^2_{sat} are replaced with Δc_{at} and σ^2_{cat}, the equal-weighted cross-country mean and variance of consumption growth, respectively.

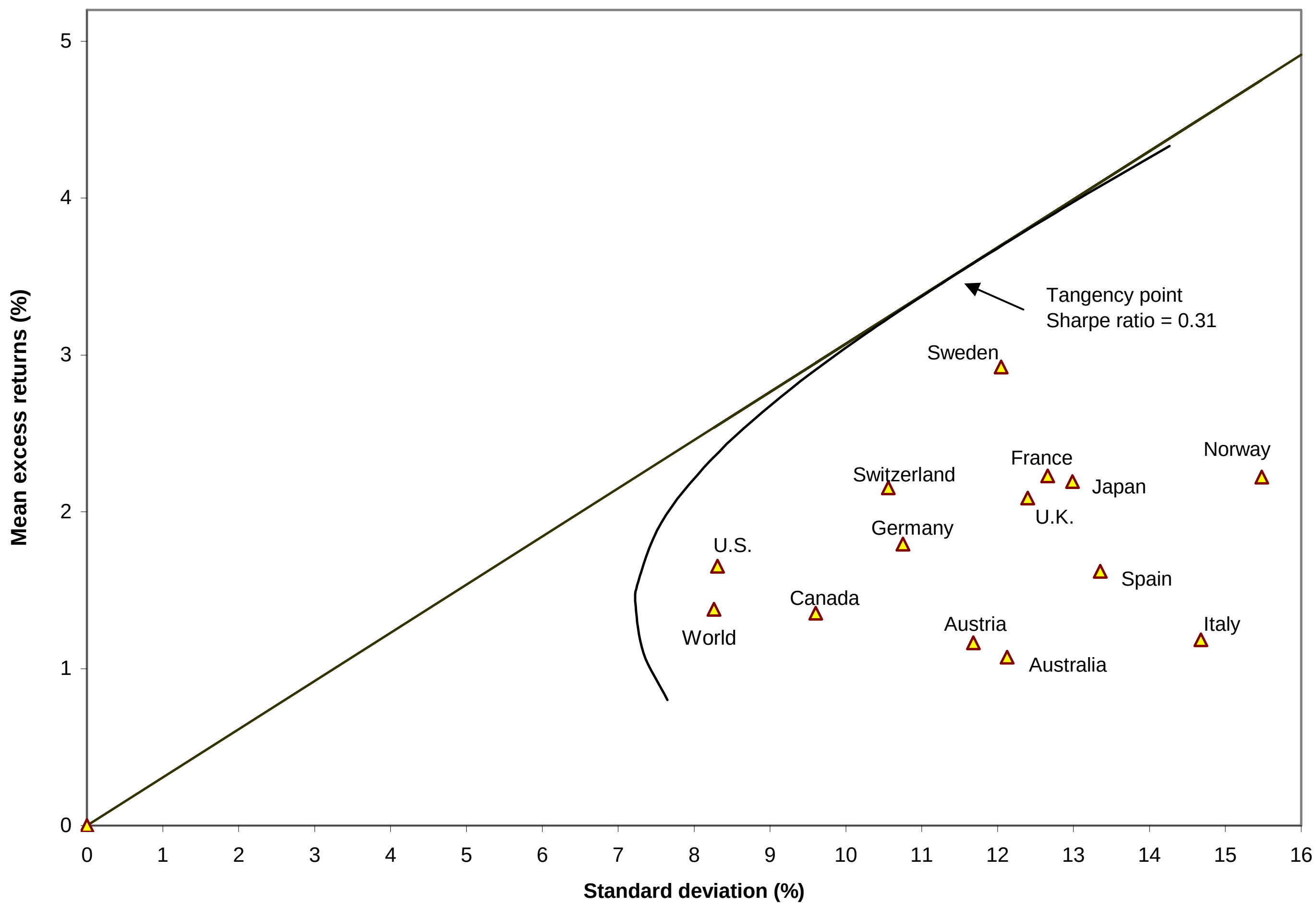

Figure 1. The Mean-Variance Frontier. The scatter points plot the pairs of means and standard deviations for quarterly excess returns from the country and world stock indices for the period 1970:Q1-2000:Q4. The solid line illustrates the mean-variance frontier with a slope given by the maximum Sharpe ratio among all diversified portfolios of country indices. The curve is the minimum-variance frontier of risky portfolios of country indices.

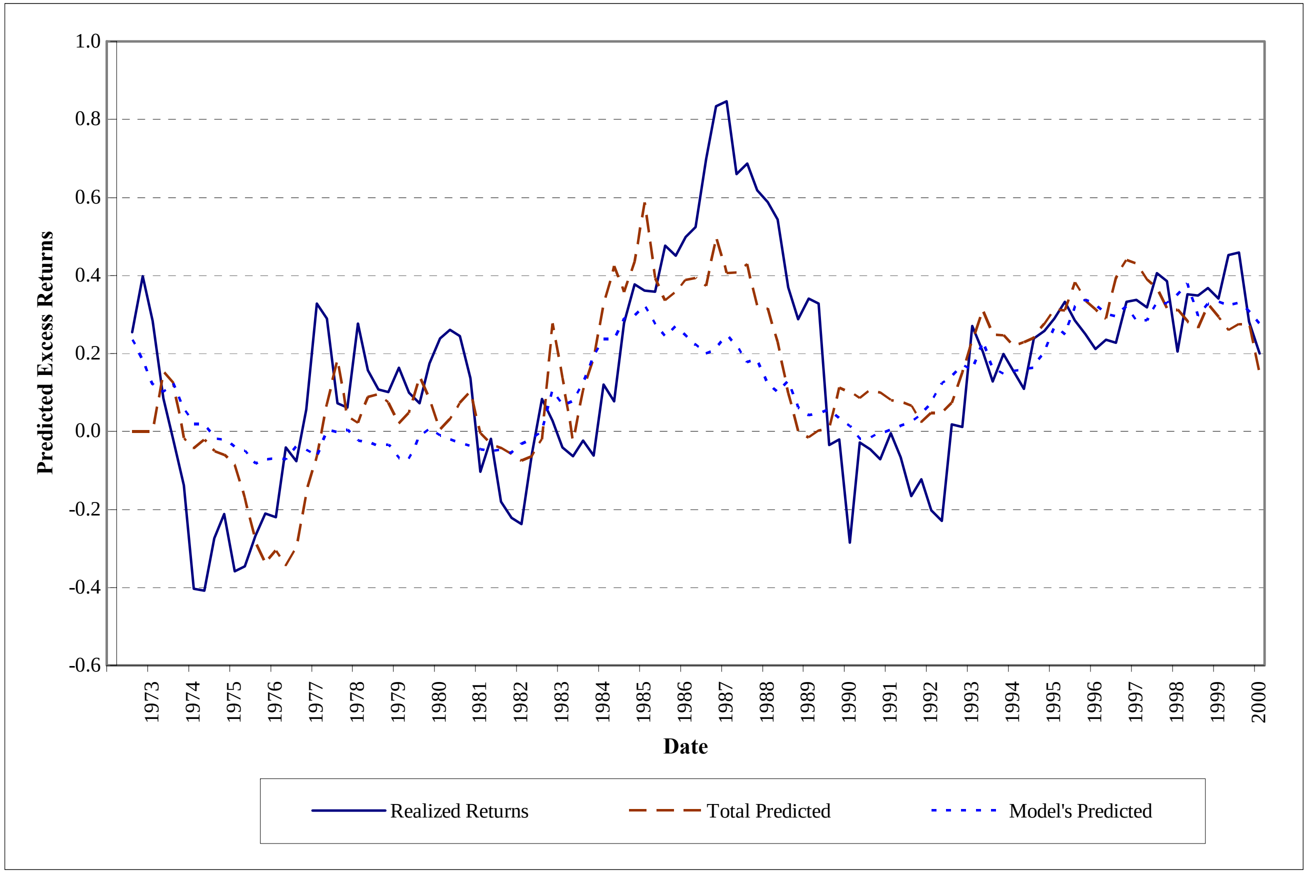

Figure 2. The Realized, Total Predicted and Model's Predicted three-Year Excess Returns from the World Market Index. The realized returns are end-of-period values. The total predicted returns are the returns predicted by a cross-country average of the log surplus consumption ratios and the world information variables. The model's predicted returns are the component predicted by the cross-country average of the log surplus consumption ratios only, as reported in Table 5.

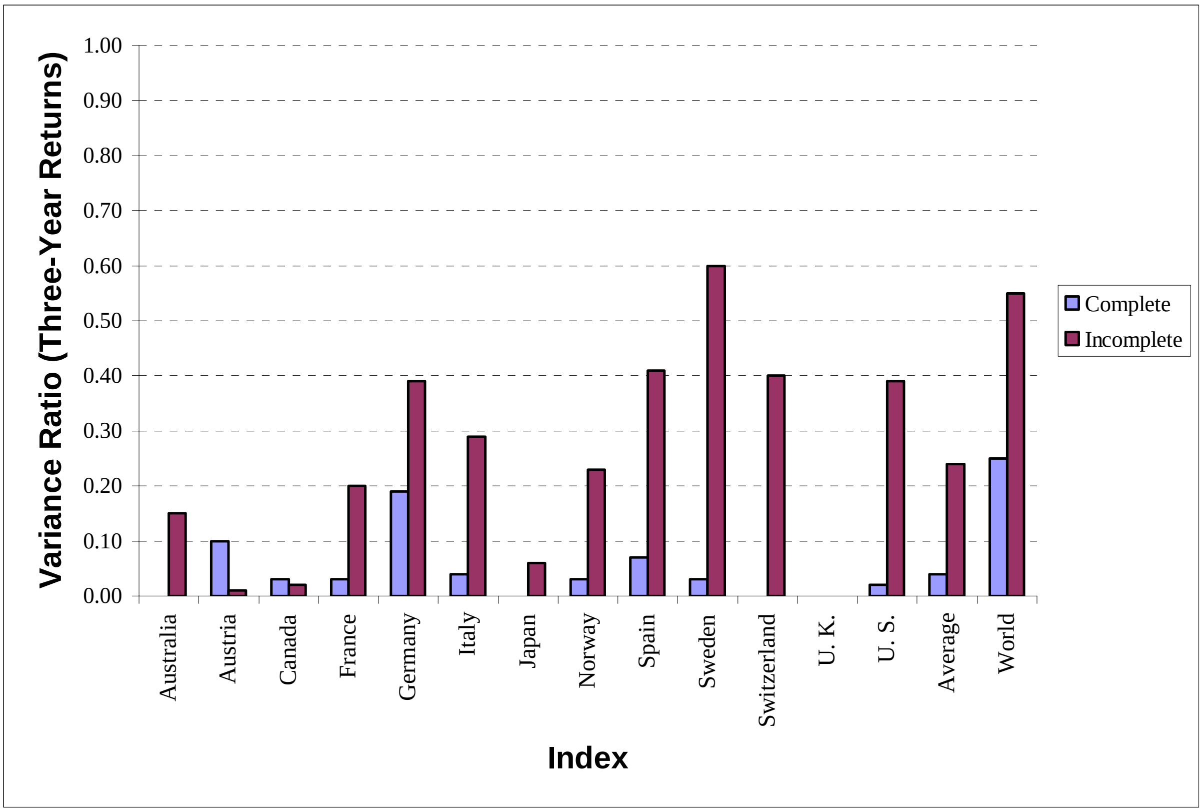

Figure 3. The Variance Ratios from the Incomplete- and Complete-Market Models. The variance ratio for each index is the portion of the variance of the expected three-year excess returns that is explained by the a cross-country average of the log surplus consumption ratios under the assumption of incomplete markets or by the log surplus consumption ratio based on a world consumption index under the assumption of complete markets, as reported in Table 5.