AN INTERNATIONAL CAPM WITH CONSUMPTION EXTERNALITIES AND NON-FINANCIAL WEALTH*

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Abstract

We study an international asset pricing model where agents have preferences defined over their own consumption as well as the *contemporaneous* average or per capita consumption in their own country. These have been termed "keeping up with the Joneses" preferences. In the presence of non-diversifiable non-financial wealth, the model predicts that portfolio holdings of the representative investor differ across countries. In equilibrium we show that this gives rise to a multifactor CAPM where, together with the world market price of risk, there exists country-specific *negative* prices of risk associated with deviations from the country's average consumption. Empirical tests reveal strong support for the models predictions and show that the model is robust to a number of alternative specifications. The model is able to explain a sizable local bias in portfolio holdings even for low levels of non-diversifiable wealth.

Keywords

Keeping up with the Joneses, restricted market participation, international asset pricing, local risk, global risk.

JEL Classification Numbers

G15, G12, G11

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1 Introduction

We study an international asset pricing model where agents have preferences defined over their own consumption as well as the *contemporaneous* average consumption of a reference group (that in this paper we take as the country of the agent). These have been termed "keeping up with the Joneses" preferences. We analyze the theoretical and empirical implications of this assumption.

Theoretically, we show that under full stock market participation, all agents hold the same globally diversified portfolio and the Joneses behavior translates into a lower price of risk on the single global systematic risk factor. This is a natural extension of the closed-economy, symmetric equilibrium in Galí (1994). However, if some of the agents face constraints on stock market participation, two implications follow: First, portfolio holdings of the representative investor of each country differ across countries; second, in equilibrium, a multi-beta linear factor model arises where, together with the global systematic risk factor, there is an additional systematic risk factor per country *with negative expected price of risk*. We emphasize that, in our model, the previous two results (bias in portfolios and relevance of the individual countries' factors) arise only if there exists limited market participation *and* investors exhibit keeping up with the Joneses preferences.

Empirically, we perform two types of analysis. First, we test the multi-beta model on a sample of US and UK stocks. We find strong empirical support for the negative prices of risk on the country-specific factors that are predicted by the theory. Moreover, our results are robust to the inclusion of additional risk factors postulated by alternative models, additional countries (Germany and Japan), changes in test assets, and different sources for the stock market portfolio data. We interpret these results as evidence in favor of the joint hypothesis of limited market participation and keeping up with the Joneses preferences.

The second type of analysis takes the estimated prices of risk and backs out the investors' implicit "Joneses parameter." Throughout a range of plausible values for limited market participation, the Joneses parameter is shown to be relevant and within the theoretically admissible space. Additionally, the estimates are consistent with a substantial local bias in portfolio holdings even for low levels of undiversifiable wealth. We interpret these results as evidence in favor of the assumed Joneses behavior at the international level.

The contribution of the paper is multiple. First, we know of no other paper that considers *and tests* the asset pricing implications of "keeping up with the Joneses" preferences in an international setting.[1] Within a purely domestic setting, "*catching up* with the Jone-

[1] Two works should be mentioned at this point: Lauterbach and Reisman (2004) also derive a multi-factor asset pricing model in the presence of Joneses behavior. However, their model does not explain how these factors arise in equilibrium. More importantly, they do not specify how to test the model and neither do they perform any empirical work. Shore and White (2002) study and calibrate an international model with Joneses preferences. They concentrate on portfolio holdings and do not include any empirical test of the asset pricing implications.

ses" preferences have been used in Abel (1990, 1999), Ferson and Constantinides (1991), Campbell and Cochrane (1999), Boldrin, Christiano and Fisher (2001) and Chan and Kogan (2002), as a possible explanation of the equity risk premium puzzle. Head and Smith (2003) consider Joneses preferences, among others, in their attempt to explain interest rate persistence for a cross-section of countries.

The second contribution of the paper is to provide additional evidence on the portfolio holdings and asset pricing implications of non-financial wealth at the international level. In a recent paper, DeMarzo, Kaniel and Kremer (2004) show that even if there exists a community specific measure of aggregate wealth (like our Joneses behavior), no portfolio bias would ever arise in a frictionless setting. In this paper we explicitly consider the effect of non-financial wealth. Non-financial wealth may include labor income (see, for example, Campbell (2000) and Haliassos and Michaelides (2002)) and entrepreneurial income (see, for example, Heaton and Lucas (2000) and Polkovnichencko (2004)). These papers typically study how the hedging demand for non-financial wealth affects investors stock portfolios. In our model, we distinguish between two types of agents: *investors*, who have full access to international financial markets and *workers*, who are endowed with non-financial income wealth and cannot access financial markets. Thus, we use the term workers in a broad sense that also might include (among others) entrepreneurs.[2] We concentrate on the effect of non-financial wealth *that cannot be perfectly hedged in international financial markets*. In our model this effect arises "indirectly" through the Joneses behavior of unconstrained investors: they will bias their portfolio holdings towards those assets positively correlated with the workers non-financial income. Note that this is the opposite effect we would expect from a "direct" hedging demand for non-financial wealth: as shown in Viceira (2001), assets positively correlated with labor income would be "crowded-out" from the optimal portfolio.

To test the asset pricing implications of our model, we need to find a proxy for the return on the workers non-financial wealth. Heaton and Lucas (2000) show the existence of a significant positive correlation between the return on the US market portfolio and the income of self-employed workers. Black (1987) and Baxter and Jermann (1997) argue strongly that the return to human capital is highly correlated with the return on the domestic stock market. In an international setting, it makes sense to assume that local stocks will have a stronger correlation with the undiversifiable risk of the Joneses, be it labor income that can be spent discretionally or entrepreneurial risk, than foreign stocks. In the light of this evidence we will use the return on the domestic market portfolio in country k as a proxy for the return on the workers non-financial wealth in country k.[3]

[2] Mankiw and Zeldes (1991) present evidence on low stock market participation rates that suggests that many agents do not participate in stock markets and hence are undiversified. In the case of entrepreneurs endowed with human capital, it is reasonable to assume that moral hazard constraints prevent that endowment to be used as a collateral for asset trading.

[3] Note that Campbell, Cocco, Gomes, Maenhout and Viceira (1999) find a significant and positive correlation between labor income and the market portfolio lagged one year and Cocco, Gomes and Maenhout (2004) find a low correlation between labor income and the market portfolio.

In equilibrium, the Joneses effect predicts a negative price of risk on the country specific factors. The intuition for this is as follows: investors require a premium for holding stocks with no, or negative, correlation with the non-hedgeable labor or entrepreneurial income (generally foreign stocks). Symmetrically, investors are willing to pay a premium for those stocks which will have a stronger correlation with the unhedgeable risk of the Joneses (presumably, domestic stocks) since it is these stocks that keep them up with the Joneses. Equilibrium asset prices reflect this observation with the expected return on a local asset depending on its covariance with aggregate world wealth and its covariance with each local market's wealth. We find strong empirical support for this prediction and hence keeping up with the Joneses behavior in the presence of a constraint on some agents. Note that the model's predictions and the empirical results are in contrast to those that are predicted by models of partial integration which require a positive price of risk on the local factor (see Errunza and Losq (1985)).

The third contribution of the paper is to identify theoretically a specific domestic risk factor resulting from keeping up with the Joneses preferences that is shown in the empirical tests to have a strong effect on asset prices within an international context. This is important because, even though there are no barriers to trade in developed countries, empirically it appears that domestic asset pricing models are able to price local assets more accurately than international models, and international asset pricing models can be improved upon if domestic factors are also included.[4] For developed markets, models of partial integration should be becoming less important because various restrictions that investors used to face no longer apply. Transaction costs and taxes have been also studied and ruled out as relevant arguments (see Cooper and Kaplanis 1994, and Tesar and Werner 1995). Information costs could be a plausible explanation: Brennan and Cao (1997) study a model of international investment *flows* with asymmetric information between local and foreign investors. However, the paper's empirical findings yield no conclusive evidence in favor of the model.

We test the model's asset pricing predictions using stock returns from the US and the UK. The model performs considerably better than the international CAPM and statistically we are unable to reject the presence of keeping up with the Joneses behavior. In addition, the results are robust to the inclusion of currency risk, macroeconomic risk factors, the Fama and French (1998) HML risk factor, the choice of test assets, the choice of benchmark risk factors, and the introduction of stock returns from Japan and Germany.

These empirical results support the joint hypothesis of undiversifiable non-financial wealth and Joneses behavior. We point out that the relative wealth portfolio effects we

[4]For example, Cho, Eun and Senbet (1986) reject the international APT (see also Gultekin, Gultekin and Penati 1989, and Korajczyk and Viallet 1989). King, Sentana, and Wadhawani (1994) find that local risk is priced in an international multi factor model. Griffin (2002) claims that the world book-to-market factor is a proxy for a domestic factor. Chan, Karolyi and Stulz (1992) find support for the role of domestic factors in a conditional version of the International CAPM. Harvey (1991) finds that the international CAPM is rejected for developed markets. Dumas, Harvey and Ruiz (2003) reject market integration for 12 developed OECD countries.

derive could be the result of a purely non-behavioral friction as shown by DeMarzo, Kaniel and Kremer (2004): in their paper agents' concern for relative wealth arises endogenously when borrowing-constrained investors (our workers) compete for local resources within their community. They term this effect as a *community* effect as opposed to a *status*, or behavioral, effect. However, as they clearly state, "it is possible that both status and community effects are important. In this case the two effects will reinforce each other, increasing the tendency for investor herding" (footnote 26 in Section 5.3). The empirical test of our model allows us to quantify the relative size of each of the two effects. Moreover, we can measure the magnitude of the investors herding consistent with equilibrium prices of risk. To address these questions, we use the estimates of the prices of risk to back out the extent of the keeping up with the Joneses parameter. We find that under all sensible parameter choices for the ratio of constrained agents wealth to non-constrained agents wealth in the economy, the keeping-up with the Joneses effect is important. For example, in the US when the constrained agents wealth is 10% of the unconstrained agents wealth, the estimated Joneses parameter (confined by the theoretical model to be between 0 and 1) is 0.75 and the percentage of investment in the local stock market due to the joint effect of the friction and the Joneses is 30%. In other words, even if constrained non-financial wealth is relatively low, our model predicts a sizable local bias of 30% due to the Joneses effect. If we assume that the fraction of wealth held by the two types of agents is 50% each, then this leads to an estimate of the Joneses parameter of 0.35 and a local bias of 54%. The Joneses effect and the corresponding bias is even greater in the UK than the US.

The paper is organized as follows. In section 2 we introduce the model and derive its testable implications. Section 3 presents the data. The empirical results are reported in section 4 and section 5 offers a conclusion.

2 The model

Let us assume a one-period economy with two countries, $k \in \{l, f\}$. In each country there is a local firm. Call S_k the value of the firm. At time $t = 0$, each firm issues 1 share that will yield a random payoff. Payoffs are expressed in terms of the only good in the economy. Let r_k denote the random return at time $t = 1$ on a share of firm k. The vector $r = (r_l, r_f)'$ has a joint distribution function $F(r)$.

In each country we have two types of agents: "investors" and another type of agents that, for simplicity, we will call "workers." At time $t = 0$ all the country wealth S_k is in the hands of local workers and local investors. In our model, workers represent investors who hold non-tradable assets (their human capital, that will materialize into wage income or entrepreneurial income: workers with little human capital, who earn minimum wage, would not be included) which are positively correlated with the domestic firm. Let W_k represent the aggregate value of those claims. Workers face incomplete markets because they cannot trade their human capital and, therefore, they cannot hedge their income risk.

Investors are endowed with an utility function[5]

$$u(c, C) = \frac{c^{(1-\alpha)}}{1-\alpha} C^{\gamma\alpha}, \tag{1}$$

where C is the country average or *per capita* consumption; $\alpha > 0$ is the (constant) relative risk-aversion coefficient and $1 > \gamma \geq 0$ is the "Joneses parameter." For $\gamma > 0$, the constant *average consumption elasticity* of marginal utility (around the symmetric equilibrium), $\alpha\gamma$, is positive as well: increasing the average consumption per capita C makes the individual's marginal consumption more valuable since it helps her to "keep up with the Joneses." In short, we assume the country average consumption to be a *positive consumption externality.*

Since each investor takes C as exogenous and common, the typical aggregation property of the CRRA utility functions allows us to replace all the investors in a given country by a representative investor with utility function (1) endowed with the aggregated investors wealth without affecting the equilibrium prices. Let I denote the aggregate investors wealth.

2.1 The investors portfolio problem

The representative investor solves the following optimal portfolio problem:

$$\begin{aligned} x^* = \operatorname{argmax}_x \quad & E\,U(c, C) \\ \text{s.t.} \quad & c = Ir'x, \end{aligned} \tag{2}$$

where x^* represents the proportion of shares invested in firms l and f such that $(1,1)'x^* = 1$. Let portfolio X^i represent the average or per capita portfolio for investors. X^w denotes the factor mimicking portfolio for the workers non-hedgeable wage income. The first order condition from problem (2) can be stated as:

$$E\,U_c(Ir'x^*, Sr'X)'r = 0,$$

where $X = \frac{I}{S}X^i + \frac{W}{S}X^w$ denotes the *average* country portfolio. Call $\theta = \frac{W}{I}$ the ratio of workers to investors' initial wealth. Replacing X into the later equation we can rewrite the problem's first order condition as follows:

$$E\,U_c(Ir'x^*, Ir'(X^i + \theta X^w))'r = 0. \tag{3}$$

Condition (3) allows us to write the representative investor's optimal portfolio as a function of X^i, X^w and $F(r)$. Let $x^* = \Phi[X^i, X^w; F(r)]$ represent this mapping.

Following Galí (1994), given I and θ, for small values of $E(r)$, the mapping functional $\Phi[X^i, X^k; F(r)]$ can be *approximated* as a function of α, γ and the risk adjusted risk-premia

[5] To simplify the notation, we drop the country subindex k for the moment (thus, all variables to be introduced next apply to either country).

$\Omega^{-1}E(r)$, with $E(r)$ and Ω the mean return vector and covariance matrix of r, respectively:

$$\Phi[X^i, X^w; F(r)] \approx \gamma(X^i + \theta X^w) + (1/\alpha)\,\Omega^{-1}E(r).$$

In equilibrium, given $F(r)$, the optimal portfolio is a fixed point of the functional Φ, that is, $x^* = \Phi[x^*, X^w; F(r)]$. Thus, solving for x^* in the previous equation, the optimal portfolio of country k investor would be:

$$x_k^* = \bar{\gamma}_k X_k^w + \frac{1}{\alpha_k(1-\gamma_k)}\Omega^{-1}E(r), \tag{4}$$

with $\bar{\gamma}_k = \frac{\theta_k\gamma_k}{1-\gamma_k}$. Equation (4) shows the expected impact of our assumptions on the investor's portfolio holdings. In the first place, if all agents in the country hold a well diversified portfolio (that is, if absent any friction, $\theta_k = 0$), the alleged Joneses behavior of investors would translate into a redefinition of the representative agent's risk aversion parameter $\alpha_k(1-\gamma_k)$. The optimal portfolio would be accordingly re-scaled and the only asset pricing implication will be a lower expected market price of risk.

Even if there is a friction ($\theta_k > 0$) that prevents full risk-diversification for a set of agents (our workers), investors will hold well diversified portfolios *unless they exhibit some degree of Joneses behavior ($\gamma_k > 0$)*. Thus, it is important to emphasize that in our model, *investors' portfolios will be locally biased only if both keeping up with the Joneses behavior, and a market friction take place*

In the following section we analyze the equilibrium implications of both cases in detail.

2.2 Equilibrium asset pricing implications

Let x_M be the market portfolio. Since we normalized the number of outstanding shares for each company to one, $x_M = (\omega_l, \omega_k)'$, with $\omega_k = S_k/(S_l + S_f)$.

Market clearing in financial markets at time $t = 1$ requires that $\sum_k I_k x_k^* = (S_l + S_f)x_M$. Rearranging terms we arrive at the market clearing condition in equilibrium:

$$\sum_k \omega_k \frac{I_k}{S_k} x_k^* = x_M. \tag{5}$$

2.2.1 The symmetric equilibrium

We show now that if all agents in both countries hold well diversified portfolios ($\theta_k = 0$, $k = \{l, f\}$), we converge to a *symmetric equilibrium.*

According to (4), the optimal portfolio in country k will be approximately

$$x_k^* = (1/\alpha_k(1-\gamma_k))\,\Omega^{-1}E(r).$$

Optimal portfolios across countries (scaled by the corresponding modified risk-tolerance coefficient) coincide. By the market clearing condition (5), the standard CAPM risk return trade-off follows:

$$E(r) = H\,\Omega\,x_M, \tag{6}$$

with $H^{-1} = \sum_k \frac{\omega_k}{\alpha_k(1-\gamma_k)} \frac{I_k}{S_k}$, the market weighted risk-tolerance coefficient. In the symmetric equilibrium, $S_k = I_k$ and $H^{-1} = \sum_k \frac{\omega_k}{\alpha_k(1-\gamma_k)}$. According to (6) the assets' risk premium is linearly related to their covariance with the market portfolio. Pre-multiplying both terms in (6) by x'_M we obtain the market price of risk:

$$\lambda_M = H\,\sigma_M^2, \tag{7}$$

as a function of the market volatility, σ_M^2. We observe that: (i) keeping up with the Joneses preferences ($\gamma > 0$) leads to a reduction in the price of risk; (ii) in a symmetric equilibrium, the Joneses are *universal*, that is, common across countries; (iii) as a consequence, the only source of systematic risk is the covariance with the global market portfolio.

2.2.2 Non-symmetric equilibria

Let $\theta_k > 0$ for $k = \{l, f\}$. Workers cannot diversify their income risk by investing internationally. This implies that the factor mimicking portfolios will be $X_l^w = (1,0)'$ and $X_f^w = (0,1)'$. As a result, the return on the country k workers portfolio will be $r'X_k^w = r_k$, the return on country k firm. Let r_M denote the return on the world market portfolio. After these definitions, the parameter $\bar{\gamma}_k$ can be interpreted as the percentage of local bias in the investor's portfolio induced by the joint effect of the friction and the alleged Joneses behavior.

We regress r_k onto the world market portfolio return plus a constant:

$$r_k = a_k + \beta_k\,r_M + \xi_k$$

Portfolio $\beta_k\,x_M$ represents the projection of the workers wealth onto the security market line spanned by the global market portfolio x_M. Define the portfolio $o_k \equiv X_k^w - \beta_k\,x_M$ as a "residual" portfolio with return $or_k = r'o_k$. By construction, this portfolio has zero covariance with the global market portfolio. Additionally, it has expected excess return $E(or_k) = E(a_k) = E(r_k) - \beta_k E(r_M)$. The net investment in this portfolio is $(1 - \beta_k)$. For any $\beta_k \neq 1$, let $\frac{o_k}{(1-\beta_k)}$ be the normalized (i.e., unit net investment) zero beta portfolio for country k. After these definitions, the workers portfolio can be represented by the following *orthogonal decomposition*:

$$X_k^w = \begin{cases} (1-\beta_k)\frac{o_k}{1-\beta_k} + \beta_k\, x_M & \text{if } \beta_k \neq 1, \\ \\ o_k + x_M & \text{otherwise.} \end{cases} \tag{8}$$

Equation (8) says that the workers' portfolio can be expressed as a linear combination of the market portfolio and a zero-beta (orthogonal) portfolio. We replace X_k^w in (4) by (8):

$$x_k^* = \bar{\gamma}_k o_k + \bar{\gamma}_k \beta_k\, x_M + \frac{1}{\alpha_k(1-\gamma_k)}\Omega^{-1}E(r).$$

This portfolio has three components. Portfolio o_k is country-specific and can be interpreted as a *hedge portfolio*: for each country k, portfolio o_k hedges investors from the risk involved in keeping up with the (domestic) non-diversifiable Joneses risk. Given the orthogonality conditions, this portfolio plays the role of a *country-specific, zero-beta asset.*

The *projection component*, $\beta_k x_M$, corresponds to that part of the workers wage income perfectly correlated with the global market portfolio. The *standard component*, $\Omega^{-1}E(r)$, is the highest global Sharpe-ratio portfolio, and it is common across countries.

After imposing market clearing (5), we solve for the equilibrium expected returns:

$$E(r) = H\,\Omega\left[\left(1-\sum_k \Gamma_k\beta_k\right)x_M - \Gamma_l o_l - \Gamma_f o_f\right], \tag{9}$$

with $\Gamma_k = \omega_k\,\frac{W_k}{S_k}\,\frac{\gamma_k}{1-\gamma_k}$. Define the matrix $\boldsymbol{o}$ of dimension $N\times 3$ as the column juxtaposition of the market portfolio and the orthogonal portfolios, $\boldsymbol{o} \equiv (x_M, o_l, o_f)$. Additionally, define the *wealth vector* $\boldsymbol{W}$ as follows:

$$\boldsymbol{W} \equiv H\begin{pmatrix} 1-\sum_k \Gamma_k\beta_k \\ -\Gamma_l \\ -\Gamma_f \end{pmatrix}.$$

Given these definitions, the equilibrium condition (9) can be re-written as follows:

$$E(r) = \Omega\,\boldsymbol{o}\boldsymbol{W}. \tag{10}$$

Pre-multiplying both terms of the previous equation by the transpose of matrix $\boldsymbol{o}$ we obtain the equilibrium condition for the vector of prices of risk, $\boldsymbol{\lambda}$, with the market price of risk, λ_M, as the first component:

$$\boldsymbol{\lambda} = \boldsymbol{o}'\Omega\,\boldsymbol{o}\,\boldsymbol{W}, \tag{11}$$

where $\boldsymbol{o}'\Omega\,\boldsymbol{o}$ is a matrix of dimension 3×3 whose first column (row) includes the market return volatility and a vector of 2 zeros and the remaining elements are the covariances between o_l and o_f.

The price of risk on the market and the two zero-beta portfolios will be:

$$\begin{aligned}\lambda_M &= H\left(1-\sum_k \Gamma_k\beta_k\right)\sigma_M^2,\\ \lambda_l &= -H\left(\Gamma_l\,\mathrm{Var}(or_l)+\Gamma_f\mathrm{Cov}(or_l,or_f)\right),\\ \lambda_f &= -H\left(\Gamma_l\mathrm{Cov}(or_l,or_f))+\Gamma_f\,\mathrm{Var}(or_l)\right).\end{aligned} \tag{12}$$

This system of equations will allow us to test the model's predictions. In the first place, the model predicts that all prices of risk should be increasing (in absolute value) in the aggregate risk aversion coefficient H.

Furthermore, if investors in both countries keep up with the Joneses *and* workers wage income is not diversifiable (i.e., if $\Gamma_k > 0$), there should be two additional risk factors together with market risk factor. Regarding their sign, *the model predicts that if* $cov(or_l, or_f) > 0$, *then* λ_l *and* λ_f *will be negative.*[6] To understand this result, suppose for the moment that the zero-beta portfolios were orthogonal ($\mathrm{Cov}(or_l, or_f) = 0$). Then, the price of risk would be easily isolated and strictly negative. The intuition for the negative sign would be as follows: An asset that has positive covariance with portfolio o_k will hedge the investor in country k from the risk of deviating from the non-diversifiable (domestic) income of the Joneses. This investor will be willing to pay a higher price for that asset thus yielding a lower return in equilibrium. In equilibrium, the price of risk for o_k would be, in absolute terms, increasing in Γ_k and the volatility of the hedge portfolio. If the covariance between both zero-beta portfolios is positive, this just increases the absolute value of the negative prices of risk for every country's hedge portfolio.

Finally, solving for $\boldsymbol{W}$ in (11) and replacing it in (10) we obtain:

$$E(r) = \boldsymbol{\beta}\,\boldsymbol{\lambda}, \tag{13}$$

where $\boldsymbol{\beta} = \Omega\,\boldsymbol{o}\,(\boldsymbol{o}'\Omega\,\boldsymbol{o})^{-1}$ denotes the 2×3 (in general $N \times (1+K)$, with N the number of assets and K the number of countries) matrix of betas, with the first column as the market betas for both assets. More concretely, for a given asset $i \in 1, 2, .., N$, the model predicts *three betas*: the standard (global) market beta and two additional, country-specific betas:

$$\begin{pmatrix}\beta_i^l\\ \beta_i^f\end{pmatrix} = \frac{1}{D}\begin{pmatrix}\mathrm{Var}(or_f)\mathrm{Cov}(r_i,or_l) & - & \mathrm{Cov}(or_l,or_f)\mathrm{Cov}(r_i,or_f)\\ \mathrm{Var}(or_l)\mathrm{Cov}(r_i,or_f) & - & \mathrm{Cov}(or_l,or_f)\mathrm{Cov}(r_i,or_l)\end{pmatrix},$$

with $D = \mathrm{Var}(or_l)\mathrm{Var}(or_f) - \mathrm{Cov}^2(or_l, or_f) > 0$.

[6] In the empirical tests reported in the following section, the monthly covariance between the UK and the USA orthogonal portfolios is positive and equal to 0.74.

To understand the model's prediction in terms of these betas, assume first that both zero-beta portfolios are pairwise orthogonal, $\mathrm{Cov}(or_l, or_f) = 0$. In this case, an asset positively correlated with country l non-diversifiable Joneses risk ($\mathrm{Cov}(r_i, or_l) > 0$) and with no, or negative, correlation with country f non-diversifiable Joneses risk ($\mathrm{Cov}(r_i, or_f) \leq 0$) will have $\beta_i^l > 0$ and $\beta_i^f \leq 0$ (the symmetric result follows for an asset i with $\mathrm{Cov}(r_i, or_l) \leq 0$ and $\mathrm{Cov}(r_i, or_f) > 0$). Notice that if $\mathrm{Cov}(or_l, or_f) > 0$ (as it is the case in our empirical test) this result is just reinforced.

The sign of these betas together with that of the expected price of risk on the orthogonal portfolios in (12) explains the equilibrium expected returns in our model. Besides the global market risk premium, investors require a premium for holding stocks with no, or negative, correlation with the non-hedgeable local labor or entrepreneurial income (generally foreign stocks). Symmetrically, investors are willing to pay a premium for those stocks which will have a stronger correlation with the unhedgeable risk of the domestic Joneses (presumably, domestic stocks) since it is these stocks that keep them up with the Joneses. Equilibrium asset prices reflect this observation with the expected return on a local asset depending on its covariance with aggregate world wealth and its covariance with each local market's non-diversifiable wealth.

We name this model as KEEPM, standing for "KEEping up Pricing Model." The rest of the paper deals with testing the asset pricing implications of the model.

3 Data

We present a brief discussion of the data used in the empirical section of the paper, focusing on the test assets and the different risk factors.

3.1 Test Assets

The test assets that we use are a random sample of 50 individual stock returns from the US and 50 individual stock returns from the UK. This set of N =100 test assets is the primary focus of the empirical work. We also include a second set of 80 test assets (40 UK, 40 US) which we use for robustness tests of the model on both an independent set of assets and on whether the number of assets (i.e. 100 or 80) is important in the analysis. The choice of a maximum of 100 test assets is limited due to the large nonlinear system that needs to be estimated.

Monthly stock prices for the period January 1980 to December 2000 are collected. This sample period is chosen due to the existence of capital controls in the UK in the 1970s. Total excess returns are calculated by subtracting the three month US T-bill rate from the total returns. Even though the stocks were chosen randomly the cross sectional variation in the individual asset returns is impressive. The mean return is 0.86% per month with a standard deviation of 0.57 and minimum and maximum values of -0.49 and 2.98% per month respectively. Thus it is not a concern in our paper that the use of individual securities does not give a decent spread of risk and return. All data are denominated in US dollars.

It is usual to use portfolios of stocks in tests of asset pricing models.[7] This stems from the desire to reduce the errors-in-variables problem that is inherent in the Fama and MacBeth (1973) two-step estimation technique which is often used to estimate asset pricing models and to give a decent spread of risk and return. As we have seen already, this later issue is no relevant for our individual stocks. With respect to the EIV problem, our empirical models are estimated using a one-step estimation procedure and consequently there is no errors-in-variables problem and hence no need to form portfolios for this reason. This is why we use individual stocks. Furthermore, the formation of portfolios raises a number of problems in its own right related to data-snooping biases (see Brennan, Chorida and Subrahmanyam (1998)) and spreads of risk and return.[8] Notwithstanding this, as a robustness check, we also estimate our model using portfolios which are not affected by survivorship bias. The results are robust to the use of either individual stocks that have survived the whole sample, or portfolios of stocks that have no survivorship bias.

3.2 Risk Factors

The risk factors are the excess return on the world market portfolio and the excess returns on the US and UK market portfolios (orthogonalized relative to world market portfolio). The respective market portfolios are the total market portfolios provided by Datastream International. These indices include a wider selection of stocks than the Morgan Stanley indices. In the robustness tests we use the Morgan Stanley indices as well.

In order to rule out the possibility that our local portfolios are proxying for some omitted international risk factor, we include a set of international macroeconomic and financial risk factors in the empirical analysis. To proxy exchange rate risk we use a currency basket which is a trade weighted index of the US dollar. Other risk factors based on macroeconomic factors are: world unexpected inflation (derived from the IMF world consumer price index), world unexpected industrial production (derived from the OECD aggregate industrial production index), and the return on world money markets (derived from Salomon Brothers world money market index). The unexpected inflation and industrial production factors are the residuals from autoregressions whilst all other factors are return-based. We also consider the international high minus low book-to-market factor (HML). All data used in the paper are collected from Datastream except for the HML factor which is kindly provided by Ken French.

[7] Exceptions to this are, for instance, Burmeister and McElroy (1988), Priestley (1997), and Brennan, Chorida, and Subrahmanyam (1998) who all use individual securities.

[8] The data snooping biases studies focus on the lack of power of tests because portfolios are formed on some empirical characteristic found to be relevant in earlier empirical work (Lo and Mackinley (1990) and Berk (2000)) or because portfolio formation may eliminate important return characteristics by averaging into portfolios (Roll (1977)).

Table 1 provides summary statistics on the risk factors. We report the mean and standard deviation of the factors, the 1st order autocorrelation coefficient and p-values for a test that this is zero. A correlation matrix of the risk factors is also included. The mean excess return on the world market portfolio is 0.63% per month. The currency basket is positive, indicating that the USD appreciated over the sample period. The unexpected inflation and industrial production factors both have zero means and their autocorrelation coefficients are also zero, which confirms that they are unexpected. The money market factor has a positive mean of 0.62% per month. The HML factor has a mean return of 0.48% per month. The lower half of table 1 reports a correlation matrix of the factors and shows that multicollinearity is unlikely to be a problem.

4 Empirical Results

In the empirical tests we consider the performance of the KEEPM in terms of whether the model's risk factors are priced and have the correct sign, as well as the model's ability to capture the cross-sectional variation in average returns. In addition, we compare the KEEPM against a set of alternative models that differ in terms of the source of priced risk. Assessment of pricing errors and analysis of the specification of the models residuals also make up part of our investigation.

We begin by examining two countries, the UK and the US. Japan and Germany are introduced into the analysis later. From equation (13), this implies a three-factor model with the world market price of risk, the US orthogonal stock market price of risk, and the UK orthogonal stock market price of risk:

$$E(r_{i,t}) = \lambda^w \beta_i^w + \lambda^{ous} \beta_i^{ous} + \lambda^{ouk} \beta_i^{ouk},$$

where $E(r_{i,t})$ is the expected excess return on asset $i \in 1, ..., N$ at time $t \in 1, ..., T$, β_i^w is stock i's β with respect to the world stock market portfolio, λ^w is the world stock market price of risk, β_i^{ous} is stock i's β with respect to the orthogonalized US stock market portfolio, λ^{ous} is the US orthogonalized stock market price of risk, β_i^{ouk} is stock i's β with respect to the orthogonalized UK stock market portfolio, and λ^{ouk} is the UK orthogonalized stock market price of risk.

The model predicts that $\lambda^{ous} < 0$, and $\lambda^{ouk} < 0$. We test these predictions and examine whether the model can explain the cross-section of average returns. Note that for this model and each of the subsequent models we set $\lambda^{ous} = \beta_i^{ous} = \lambda^{ouk} = \beta_i^{ouk} = 0$ and test these restrictions with a likelihood ratio test. This amounts to testing whether there is evidence of any “keeping-up with the Joneses” behavior irrespective of the choice of international risk factors.

All our models are estimated using a one-step, simultaneous, non-linear seemingly unrelated regression approach (NLSUR) (see McElroy, Burmeister, and Wall (1985)). This methodology has the advantage over the traditional Fama and MacBeth (1973) two step methodology in that it avoids the errors in variables problem of estimating betas in one step and then the prices of the risk in a second step.[9] Moreover, using NLSUR allows for correlations in the residual variance-covariance matrix which will lead to more efficient estimates (both asymptotically and in most small samples, see Shaken and Zhou (2000)).[10]

The main empirical results of the paper are presented in panel A of table 2, where we report estimates of the KEEPM using the 100 individual stock returns. The world stock market price of risk is estimated at 0.610 and is statistically significant at the 1% level. The orthogonal US market price of risk is estimated to be -0.135 and the orthogonal UK market price of risk is estimated to be -0.458. Both have the correct sign, and the t-ratios indicate that the price of risk associated with the UK price of risk is statistically significant at the 5% level. The price of risk associated with the US price of risk is not statistically significant. However, it has the correct sign and is an economically meaningful 1.5% per year.

The final column of the panel reports the probability values from a likelihood ratio test (distributed Chi-Square) of the null hypothesis that Joneses behavior is not important, that is, $\lambda^{ous} = \beta_i^{ous} = \lambda^{ouk} = \beta_i^{ouk} = 0$. The probability value is less than 0.01, and thus we clearly reject the null hypothesis at any reasonable significance level. The model explains 23% of the cross-sectional variation in excess returns. This is reasonable when we consider that we use excess stock returns of individual assets within the context of an international asset pricing model. Overall, the empirical results provide provide strong evidence consistent with the theoretical model's predictions.

Panel B of table 2 presents the estimates of the three betas for each asset. The estimated betas with respect to the world market portfolio are all positive. The US stocks have positive betas with respect to the US orthogonal market portfolio and negative (some small positive) betas with respect to the UK orthogonal market portfolio. Similarly, UK stocks have positive betas with respect to the UK orthogonal market portfolio and negative betas with respect to the US orthogonal market portfolio.

The evidence so far confirms our model's prediction that investors are willing to give up return for those stocks that are positively correlated with their local market since it keeps them up with their Joneses. Stocks that do not keep them up with their Joneses (stock which have a negative beta) are foreign stocks and a positive risk premium is required to hold them. This effect seems to be stronger in the UK than the US. The patterns of the betas with respect to the orthogonalized country market portfolios are illustrated in Figure 1. The top panel reports the betas with respect to the US index. The first 50 betas are for

[9] When estimating the models with the orthogonal market portfolios we do omit the estimation error which arises from their construction.

[10] Connor and Korajczyk (1993) argue that residuals may be cross correlated due to industry specific factors that are not pervaisve across the whole cross section.

the UK stocks and the second 50 are for the US stocks. Here, we clearly see the pattern of positive and negative betas in each country. Nearly all the UK betas with respect to the US orthogonal portfolio are negative. All of the US betas are positive with respect to the US orthogonal portfolio. The bottom panel of figure 1 reports the UK betas and US betas with respect to the UK orthogonal portfolio. In this case the UK betas are positive and the US betas either negative or around zero.

Panel B of table 2 also contains a test for the null hypothesis of no serial correlation and homoscedastic errors for each of the estimated equations. The null of homoscedastic errors is rejected in only 4 cases and we find evidence against the null of no serial correlation in seven cases. Thus, the models residuals are well specified which should allow for straightforward interpretations of the estimates and their corresponding standard errors. Pricing errors (not reported) for each individual asset are not significantly different from zero at the 5% level more than would be expected by chance.

4.1 Robustness tests

This section examines the robustness of the results to alternative risk factors, test assets and sourcing of the stock market portfolio data.

Whilst our central concern is with testing our theoretical model, we also consider its performance and robustness relative to a class of other international asset pricing models. The first model is the international CAPM -(ICAPM), see Black (1974). This model assumes complete integration of capital markets and that purchasing power parity (PPP) holds:

$$E(r_{i,t}) = \lambda^{ICAPM} \beta_i^{ICAPM},$$

where λ^{ICAPM} is the ICAPM market price of risk and β_i^{ICAPM} is stock $i's$ β with respect to the excess return on the world stock market portfolio. Comparing the KEEPM and the ICAPM, it is clear that the ICAPM is nested within the KEEPM for $\gamma = 0$. This permits the use of a likelihood ratio test to examine whether the restrictions that KEEPM places on the ICAPM are valid.

Since it is well known that PPP does not hold, at least in the short and medium term (see, for example, Grilli and Kaminsky (1991), Wu (1996) and Papell (1997)) investors may be exposed to real exchange rate risk. Theoretical models that incorporate currency risk include Solnik (1974), Stulz (1981), Adler and Dumas (1983). In addition to exchange rates other macroeconomic factors have been used in international asset pricing models (see, for example, Ferson and Harvey (1994)). Along with the currency basket we also include three macroeconomic based factors: world unexpected inflation, world unexpected industrial production, and the return on world money markets.

$$E(r_{i,t}) = \lambda^{w}\beta_i^{w} + \lambda^{ous}\beta_i^{ous} + \lambda^{ouk}\beta_i^{ouk} + \lambda^{ui}\beta_i^{ui} + \lambda^{uip}\beta_i^{uip} + \lambda^{wm}\beta_i^{wm} + \lambda^{cb}\beta_i^{cb},$$

where λ^{ui} is the inflation price of risk, β_i^{ui} is the β with respect to unexpected inflation, λ^{uip} is the industrial production price of risk, β_i^{uip} is the β with respect to unexpected industrial production, λ^{wm} is the world money market price of risk, and β_i^{wm} is the β with respect to the return on the world money market, λ^{cb} is the currency basket price of risk and β_i^{cb} is the β with respect to the currency basket.

A final model we consider is that of Fama and French (1998) who suggest a two factor model for international asset pricing that includes the excess return on the world stock market portfolio and the international high minus low book-to-market factor (HML):

$$E(r_{i,t}) = \lambda^{w}\beta_i^{w} + \lambda^{ous}\beta_i^{ous} + \lambda^{ouk}\beta_i^{ouk} + \lambda^{HML}\beta_i^{HML},$$

where λ^{HML} is the price of risk associated with the HML risk factor and β_i^{HML} is the β with respect to the HML risk factor. We test whether our model is robust to the inclusion of the HML risk factor.

The estimation results of models with alternative risk factors are presented in Panel A of table 3. To provide a general benchmark for our model, we report in the first row an estimate of the International CAPM. The world market price of risk is estimated to be positive at 0.558% per month, and it is statistically significant at the 1% level. The ICAPM is able to explain 15% of the cross sectional variation in average excess returns. Therefore, our model is able to explain 35% more of the cross sectional variation in average excess returns than the ICAPM.

The rest of the models in Panel A are extensions of the KEEPM to include additional risk factors. The purpose behind this analysis is that we want to rule out the possibility that the Joneses factors are proxying some omitted factor from the basic asset pricing model. The second row of panel B reports an estimate that includes a currency basket of the US dollar, unexpected inflation, unexpected industrial production and the return on world money markets. The estimated price of currency risk is -0.654% per month, and it is statistically significant at the 5% level. The unexpected industrial production factor has a statistically significant price of risk whilst the money market price of risk and the inflation price of risk are not statistically significant. In this model the $\overline{R}^2$ increases to 38% and therefore, it seems that the two risk factors that are statistically significant are important in explaining the cross section of international asset returns.

Whilst the macroeconomic variables are important in explaining the cross section of average excess returns, they do not have a statistical or economic impact on the prices of risk associated with the orthogonalized country portfolios (or the world market portfolio) and the likelihood ratio test indicates the KEEPM factors can not be omitted.

The final model presented in panel A includes the HML factor along with the factors in our model. The estimate of the HML price of risk is statistically significant at the 1% level and is estimated at -0.559% per month. Of the 50 UK firms, 39 of the HML betas are positive. Of the 50 US firms, 35 of the HML betas are positive. In total, thirty percent of the HML betas are statistically significant, the majority of which are positive. Whilst the HML factor appears to be important in terms of explaining the cross-section of UK and US asset returns, its inclusion has no material impact on the prices of risk associated with the two orthogonal country portfolios. The $\overline{R}^2$ is actually slightly lower than in our model and, once again, it is easy to reject the restrictions that the KEEPM factors are jointly zero.

Panel B of table 3 reports estimates of the model when using the MSCI indices rather than the Datastream indices. There is little change in the results when employing the MSCI indices, both in terms of the size of the estimated coefficients or the cross-sectional $\overline{R}^2$. Panel C of table 3 reports the results from estimating our model using 80 new assets, 40 of which are from the US and 40 from the UK. The model is robust to both the use of a new set of independent test assets and a reduction of the number of equations in the system from 100 to 80. The $\overline{R}^2$ is higher for this set of assets than the first 100 test assets, 35% as opposed to 23%.

A final check we undertake is to estimate the model using portfolio data in order to examine if the survivorship bias present in using stocks that have survived the period affects the estimates. We have data on portfolios of UK stocks sorted on size and beta and data on portfolios of US stocks sorted by size.[11] The UK portfolios are formed from the London Business School data base. Stocks are ranked into deciles based on size and then sorted again into 5 beta portfolios, providing a total of 50 portfolios. The US stocks are formed into 50 size portfolio. The data are from CRSP. The portfolio data span the shorter time period of 1980 to the end of 1995. In order to avoid using the smallest stocks in each country, which are unlikely to be traded internationally, we undertake the analysis omitting the smallest 10 portfolios from each country, leaving us with 80 portfolios.

Panel D reports the estimates of the model using the portfolio data. The prices of risk associated with the orthogonal local market portfolios are both estimated to be negative. Thus survivorship bias does not appear to be important. Notice that with this set of test assets the price of risk associated with US orthogonal portfolio is now statistically significant. The $\overline{R}^2$ is low in this model which is probably a consequence of sorting on size but not including size as a risk factor. Our aim, however, is not to find a high $\overline{R}^2$, but rather to see if the theoretical model we present is empirically robust to the use of portfolio data, which it is.

[11] We thank Gareth Morgan for providing the UK stock portfolios and Øyvind Norli for providing the US stock portfolios.

4.2 Additional Countries

The next consideration we make is to include more countries into the analysis. Japan and Germany are chosen because they have large developed equity markets that have been relatively free from restrictions over the sample period. We collect a random sample of twenty five stocks from each of the four markets to provide a system of one hundred equations.

Table 4 reports the estimates for the four countries. The prices of risk for the orthogonal components of the local market indices are all negative and all but the Japanese price of risk are statistically significant, lending strong support to our model. The $\overline{R}^2$ is 46%, thus the model performs better in the cross section with the introduction of additional countries. Therefore, the model is robust to the inclusion of the two additional countries.

4.3 Inference on the model parameters

In this section of the paper we attempt to assess how important "keeping-up with the Joneses" behavior is in the UK and US. Given the three estimated prices of risk, from (12) we can solve for H, Γ_{US} and Γ_{UK} as a function of $\{\lambda_k, \omega_k, \theta_k, \beta_k\}_{k=US,UK}$, the global market portfolio volatility, σ_M^2, and the covariance matrix of the orthogonal portfolios.

The values for the estimated betas, β_k, are $(\beta_{US}, \beta_{UK}) = (0.802, 0.955)$. The monthly variances for the orthogonal portfolios are $(\mathrm{Var}(or_{US}), \mathrm{Var}(or_{UK})) = (0.07, 0.14)$ and the monthly covariance is $\mathrm{Cov}(or_{US}, or_{UK}) = 0.74$. The global market portfolio volatility is $\sigma_M^2 = 0.178$. The prices of risk are taken from panel A of table 2. Finally, the weights of each country in total market value are $(\omega_{US}, \omega_{UK}) = (0.55, 0.09)$, as reported by Morgan Stanley International in 2001.

From this parametrization, and using the equations in (12), we obtain estimates of H, Γ_{US} and Γ_{UK}. The global, capitalization weighted, relative risk aversion coefficient is $H = 4.004$ which is clearly in the admissible range of estimates for risk aversion coefficients. We find that $\Gamma_{US} = 0.1487$ and $\Gamma_{UK} = 0.0312$. Finally, from these parameters, we can work out the implied values of the Joneses effect given by γ for different values of θ. Recall that θ is the ratio of workers to investor wealth. Whilst this is unobservable it is possible to obtain a feel for its extent. We know that about 85% of the wealth in the US is owned by 20% of the population. If we assume that this 20% of the population has access to equity markets this puts the estimate of θ_{US} around 18%.[12] Whilst this may give us a ball-park figure, in the table we consider values ranging from 10% to 100% and consequently, should cover the actual level of θ. Using θ and γ we also calculate $\bar{\gamma} = \frac{\theta\gamma}{1-\gamma}$ in equation (4). $\bar{\gamma}$ is the implied bias towards local assets in portfolio holdings due to the the friction and the Joneses joint effect.

[12] Mankiw and Zeldes (1991) report that in 1984, 24% of households owned equities. Polkovnichenko (2004) finds that income is an important determinant of stock market participation. Therefore, it seems reasonable to assume that those who own 85% of US wealth are the participators in the stock market.

Table 5 reports the results of this exercise for both countries. For all values of θ considered, the estimate of the Joneses parameter γ for both countries is strictly positive and within the admissible range $(0, 1)$. γ declines as the ratio of wealth increases, but is still important even when the ratio is 1.00. The estimates for the local bias in the US portfolio holdings, $\bar{\gamma}_{US}$, range from 30% when $\theta_{US} = 0.1$ and 54% when $\theta_{US} = 1.00$. That is, according to our model, a bias towards local assets in the US of 30% could be explained even if undiversifiable non-financial wealth represents only 9% of the country's *total wealth*, implying an estimated Joneses parameter of 0.75. The bias rises to 54% when constrained investors hold 50% of the economy's wealth. In the UK the effect of keeping up with the Joneses preferences is even greater, given that the price of risk is larger in the UK. For example, the implied bias in portfolio holdings ranges from 38% to 70%. Although we cannot claim that our model offers a complete explanation for the home bias puzzle, these results suggest that a sizable part of it can be accounted for by keeping up with the Joneses preferences.

5 Conclusion

This paper derives a theoretical international asset pricing model by modifying the standard representative agent, consumption-based asset pricing model. In this model, equilibrium asset prices reflect the notion that agents care about both absolute wealth and the wealth of their countrymen and that some agents face undiversifiable non-financial wealth risk. This gives rise to investors paying a premium for stocks which have a high correlation with domestic wealth as it is these stocks that "keep them up with the Joneses." Investors require a premium for holding stocks with no, or negative correlation with domestic wealth. Thus, the expected return on a local asset will depend on its covariance with aggregate world wealth and covariances with different local market wealths.

We test the model's asset pricing predictions and find that the price of risk associated with the local risk factors are negative and the world price of risk is positive, as predicted by the model. Statistically and economically we cannot reject the theoretical models predictions. These results are robust to a host of specification tests.

In an international setting, when we introduce preferences of the type "keeping-up with the Joneses" in conjunction with a constraint on diversification, we can account for the puzzling feature that even though there are no restrictions on cross-border investment, the performance of international asset pricing models tend to improve when domestic factors are included. We also show that under plausible values for the ratio of wealth held by constrained agents to that held by unconstrained agents, estimates of the Joneses effect are considerable and imply substantial home bias in investors' portfolios.

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Table 1

Summary Statistics

	R_w	CB	I	IP	WM	HML
Mean	0.632	0.086	0.000	0.000	0.620	0.476
	(4.23)	(1.34)	(0.18)	(0.85)	(2.34)	(2.93)
AR(1)	0.039	0.303	-0.035	-0.004	0.070	0.158
	[0.53]	[0.00]	[0.57]	[0.95]	[0.27]	[0.01]
Correlations						
R_w	1.000					
CB	-0.314	1.000				
I	-0.078	-0.069	1.000			
IP	-0.055	0.097	0.044	1.000		
WM	0.096	-0.614	0.065	-0.137	1.000	
HML	-0.169	0.137	0.046	0.095	0.021	1.00

The table presents summary statistics of the risk factors over the sample period 1980-2000. The data are sampled monthly and are collected from Datastream except for the HML factor which is kindly provided by Ken French. In the first row the table lists the risk factors: R_w is the excess return on the Datastream world value weighted market portfolio, CB is the currency basket, I is inflation, IP is industrial production, WM is the world money market and HML is the Fama and French international high minus low book-to-market portfolio. The second row of the table records the mean of the factor with its standard deviation below in parenthesis. The third row of the table reports the first order autocorrelation coefficient with a probability value in brackets below for a test that the first order autocorrelation coefficient is significantly different from zero. The rest of the table reports correlation coefficients between the risk factors.

Table 2

Estimates of the KEEPM

Panel A: Price of Risk Estimates

λ^w	λ^{us}	λ^{uk}	$\overline{R}^2$	LR
0.610 (2.89)	-0.135 (0.85)	-0.458 (2.08)	23	< 0.01

Panel B: Betas and Specification Tests (Part I: UK Stock returns)

Stock	β_w	β_{ous}	β_{ouk}	Heter	SC	Stock	β_w	β_{ous}	β_{ouk}	Heter	SC
r_1	0.721 (4.94)	−0.019 (0.09)	0.788 (4.55)	2.74	1.68*	r_{26}	0.768 (8.38)	−0.351 (2.44)	0.787 (7.24)	7.89*	1.89
r_2	1.079 (4.18)	−0.932 (2.30)	0.861 (2.81)	4.25	1.94	r_{27}	0.862 (9.68)	−0.468 (3.35)	1.056 (10.00)	0.23	2.12
r_3	1.316 (8.01)	−0.281 (1.09)	1.277 (6.55)	7.37	1.97	r_{28}	0.652 (6.93)	−0.387 (2.62)	0.938 (8.41)	3.59	2.24
r_4	0.675 (7.23)	−0.236 (1.61)	0.925 (8.34)	0.12	2.24	r_{29}	0.892 (9.09)	−0.399 (2.60)	0.893 (7.67)	1.91	2.11
r_5	0.805 (5.39)	−0.446 (1.90)	1.074 (6.06)	4.07	2.11	r_{30}	0.832 (4.91)	−0.039 (0.15)	0.821 (4.04)	1.53	1.86
r_6	0.932 (6.05)	−0.339 (1.40)	1.081 (5.90)	2.87	1.96	r_{31}	0.402 (5.77)	−0.261 (2.39)	0.469 (5.68)	3.81	1.82
r_7	0.241 (1.54)	−0.066 (0.27)	0.262 (1.41)	4.42	1.78	r_{32}	0.754 (3.98)	−0.173 (0.58)	0.400 (1.78)	2.75	2.15
r_8	0.949 (4.58)	−0.234 (0.88)	0.706 (3.49)	2.33	1.72*	r_{33}	1.286 (8.19)	−0.007 (0.03)	1.061 (5.69)	2.35	1.89
r_9	0.855 (5.70)	−0.533 (2.26)	1.061 (5.95)	7.03	2.18	r_{34}	1.021 (7.05)	−0.075 (0.33)	1.104 (6.42)	4.44	2.10
r_{10}	0.773 (6.27)	−0.175 (0.91)	0.981 (6.69)	3.77	1.91	r_{35}	0.928 (6.31)	−0.535 (2.32)	1.021 (5.85)	2.06	2.13
r_{11}	1.031 (8.90)	−0.071 (0.39)	0.868 (6.31)	4.59	2.33	r_{36}	0.659 (6.22)	−0.399 (2.39)	0.606 (4.81)	7.20	1.95
r_{12}	0.543 (3.07)	−0.256 (0.92)	0.602 (2.87)	2.12	2.02	r_{37}	0.968 (9.03)	0.135 (0.85)	1.108 (9.15)	1.87	1.71*
r_{13}	1.041 (5.35)	−0.645 (2.11)	0.857 (3.71)	3.57	1.73*	r_{38}	0.969 (9.47)	−0.394 (2.34)	0.979 (7.70)	2.14	2.22
r_{14}	0.843 (6.65)	−0.086 (0.44)	0.995 (6.78)	2.77	2.00	r_{39}	1.219 (3.85)	−0.504 (1.01)	1.358 (0.85)	4.30	2.06
r_{15}	0.838 (4.83)	−0.723 (2.65)	0.518 (2.51)	0.66	1.97	r_{40}	0.549 (6.01)	−0.550 (3.83)	0.563 (5.19)	0.12	1.86
r_{16}	1.053 (10.21)	−0.161 (0.99)	0.945 (7.72)	3.49	2.41	r_{41}	0.397 (3.90)	−0.397 (2.48)	0.516 (4.26)	0.20	2.09
r_{17}	0.923 (3.40)	−0.236 (0.56)	0.396 (1.23)	2.69	1.66*	r_{42}	0.416 (3.17)	−0.151 (0.73)	0.509 (3.27)	0.28	1.68*
r_{18}	0.747 (4.04)	−0.457 (1.57)	0.751 (3.41)	1.05	2.00	r_{43}	0.536 (5.73)	−0.075 (0.51)	0.968 (8.73)	0.43	2.15
r_{19}	0.753 (3.99)	−0.431 (1.45)	0.921 (4.10)	4.93	2.19	r_{44}	0.845 (5.76)	−0.424 (1.84)	0.615 (3.53)	5.66	1.79
r_{20}	0.832 (8.16)	−0.289 (1.81)	1.018 (8.42)	5.19	2.04	r_{45}	0.717 (5.29)	0.107 (0.50)	0.821 (5.10)	3.38	2.26
r_{21}	0.574 (4.11)	−0.527 (2.40)	0.436 (2.63)	6.18	1.75	r_{46}	0.642 (6.58)	−0.473 (3.09)	0.815 (7.04)	4.09	1.79
r_{22}	0.617 (4.81)	−0.356 (1.77)	0.938 (6.17)	1.49	2.21	r_{47}	0.840 (7.75)	0.076 (0.45)	0.827 (6.43)	8.28*	2.12
r_{23}	0.889 (3.58)	−0.222 (0.57)	1.151 (3.98)	2.16	1.91	r_{48}	0.987 (10.56)	0.159 (1.09)	1.208 (10.92)	3.12	2.30
r_{24}	0.655 (3.91)	−0.549 (2.08)	0.806 (4.04)	3.24	2.06	r_{49}	0.684 (7.12)	−0.157 (1.04)	1.057 (9.29)	1.98	2.06
r_{25}	1.174 (7.68)	−0.754 (3.14)	1.177 (6.50)	11.47*	1.65*	r_{50}	0.916 (4.49)	0.094 (0.29)	0.639 (2.64)	0.33	1.98

Panel B: Betas and Specification Tests (Part II: US Stock Returns)

Stock	β_w	β_{ous}	β_{ouk}	Heter	SC	Stock	β_w	β_{ous}	β_{ouk}	Heter	SC
r_{51}	0.906 (7.26)	0.552 (2.81)	0.045 (0.30)	3.01	2.31	r_{76}	0.741 (7.73)	0.933 (6.20)	−0.071 (0.62)	1.28	2.11
r_{52}	1.078 (6.20)	1.727 (6.33)	−0.403 (1.96)	5.55	1.92	r_{77}	0.268 (1.43)	0.661 (2.25)	0.141 (0.64)	4.48	2.22
r_{53}	0.282 (2.83)	0.651 (4.14)	−0.011 (0.09)	4.10	2.05	r_{78}	0.483 (10.26)	0.517 (7.00)	0.015 (0.27)	2.58	2.27
r_{54}	1.484 (8.67)	2.097 (7.81)	0.241 (1.19)	3.28	1.98	r_{79}	0.301 (4.02)	0.340 (2.90)	0.142 (1.60)	2.10	2.07
r_{55}	1.050 (7.80)	0.625 (2.96)	0.144 (0.90)	5.27	2.38	r_{80}	0.650 (6.58)	0.845 (5.45)	0.136 (1.16)	0.11	2.24
r_{56}	0.799 (8.03)	1.072 (6.86)	−0.008 (0.07)	2.28	1.92	r_{81}	0.591 (4.05)	0.562 (2.45)	0.272 (1.57)	8.54	2.32
r_{57}	0.787 (4.64)	0.911 (3.42)	−0.111 (0.55)	1.67	1.97	r_{82}	1.198 (4.91)	1.453 (3.79)	−0.073 (0.27)	1.62	2.25
r_{58}	0.648 (5.83)	0.646 (3.69)	0.107 (0.81)	1.54	1.98	r_{83}	0.868 (3.75)	0.978 (2.69)	−0.696 (2.53)	1.89	2.04
r_{59}	0.273 (3.68)	0.261 (2.23)	0.067 (0.75)	3.87	2.22	r_{84}	0.756 (1.84)	0.479 (0.74)	−0.685 (1.40)	0.33	1.94
r_{60}	0.154 (1.48)	0.166 (1.01)	−0.191 (1.54)	6.97	2.19	r_{85}	0.592 (5.58)	0.861 (5.17)	−0.354 (2.82)	0.90	1.83
r_{61}	0.900 (5.45)	1.387 (5.35)	−0.090 (0.46)	3.78	2.06	r_{86}	0.814 (6.12)	1.267 (6.07)	0.051 (0.32)	5.55	1.93
r_{62}	0.788 (5.02)	0.966 (4.03)	0.196 (1.05)	1.63	2.07	r_{87}	0.595 (5.40)	0.931 (5.38)	0.183 (1.40)	2.22	2.38
r_{63}	0.624 (5.66)	0.702 (4.05)	0.157 (1.20)	1.73	2.25	r_{88}	0.449 (4.14)	0.699 (4.11)	0.047 (0.37)	0.83	2.38
r_{64}	0.991 (10.61)	1.228 (8.39)	0.075 (0.68)	3.53	1.93	r_{89}	0.851 (8.38)	0.995 (6.22)	0.015 (0.13)	6.29	2.07
r_{65}	0.905 (3.95)	0.561 (1.56)	0.031 (0.12)	0.69	1.96	r_{90}	1.077 (4.17)	1.166 (2.87)	−0.292 (0.95)	0.89	1.87
r_{66}	0.498 (3.22)	1.003 (4.12)	−0.040 (0.22)	3.80	2.29	r_{91}	0.392 (2.09)	0.581 (1.97)	0.225 (1.01)	0.53	2.11
r_{67}	0.683 (2.22)	1.169 (2.42)	0.146 (0.40)	1.66	1.96	r_{92}	1.012 (5.14)	1.873 (6.06)	0.088 (0.38)	0.95	2.18
r_{68}	0.669 (6.86)	0.866 (5.66)	0.152 (1.32)	1.48	2.29	r_{93}	0.663 (5.71)	0.778 (4.27)	0.201 (1.46)	0.67	2.16
r_{69}	1.725 (4.31)	1.221 (1.94)	−0.603 (1.27)	0.74	2.23	r_{94}	0.641 (3.71)	0.827 (3.04)	0.194 (0.95)	2.26	2.12
r_{70}	0.478 (3.56)	0.802 (3.81)	0.449 (2.81)	0.59	2.05	r_{95}	0.617 (5.57)	0.371 (2.13)	0.075 (0.57)	2.74	1.99
r_{71}	0.576 (5.85)	0.958 (6.19)	0.002 (0.02)	12.05*	2.01	r_{96}	0.573 (5.32)	0.615 (3.64)	0.071 (0.55)	2.80	2.30
r_{72}	0.836 (5.71)	1.171 (5.09)	0.276 (1.59)	2.82	2.00	r_{97}	0.688 (4.51)	0.793 (3.30)	0.121 (0.66)	1.49	1.97
r_{73}	0.859 (5.02)	0.643 (2.39)	−0.090 (0.43)	5.82	1.93	r_{98}	0.174 (0.59)	1.675 (3.85)	−0.087 (0.27)	6.57	2.14
r_{74}	0.566 (4.93)	0.681 (3.78)	−0.048 (0.36)	6.91	2.19	r_{99}	0.705 (2.81)	0.564 (1.43)	0.046 (0.16)	1.02	2.08
r_{75}	0.927 (3.12)	0.615 (1.32)	−0.537 (1.52)	0.80	2.02	r_{100}	0.532 (5.68)	0.746 (5.07)	−0.195 (1.76)	4.88	2.09

This table reports estimates of the prices of risk, along with the cross-sectional $\overline{R}^2$ from the KEEPM model. LR reports the probability value from a likelihood ratio test that tests whether the KEEPM risk factors can be jointly restricted to zero ($\lambda^{ous} = \beta^{ous} = \lambda^{ous} = \beta^{ous} = 0$). Panel A reports estimates of prices of risk from the KEEPM: λ^{w} is the world stock market price of risk, λ^{us} is the orthogonal US stock market price of risk, λ^{uk} is the orthogonal UK stock market price of risk. Panel B reports estimates of the betas with respect to the risk factors: β_{w} is the beta with respect to the world market portfolio, β_{ous} is the beta with respect to the orthogonal US market portfolio, β_{ouk} is the beta with respect to the orthogonal UK market portfolio. Part I of panel B reports the betas for the UK stock returns and Part II reports the betas for the US stock returns. Also reported in Panel B are tests for heteroscedasticity (Heter) and serial correlation (SC) of each equation's residuals. The data are sampled monthly over the period January 1980 to December 2000. t-ratios are in parentheses.

Table 3

Robustness Tests

λ^w	λ^{us}	λ^{uk}	λ^{cb}	λ^i	λ^{ip}	λ^m	λ^{bm}	$\overline{R}^2$	LR
Panel A: Alternative Models									
0.558 (3.57)								15	
0.786 (3.12)	−0.161 (0.89)	−0.597 (2..25)	−0.654 (4..48)	0.028 (1.53)	0.186 (2.07)	−0.237 (0.92)		38	< 0.01
0.575 (2.73)	−0.115 (0.72)	−0.446 (2.01)					−0.559 (2.68)	22	< 0.01
Panel B: MSCI Market Indices									
0.662 (3.44)	−0.178 (1.18)	−0.432 (1.97)						21	< 0.01
Panel C: New Assets: 40 UK and 40 US									
0.939 (3.93)	−0.153 (0.84)	−0.490 (2.02)						35	< 0.01
Panel D: Portfolio Data: 1980- 1995									
0.423 (2.17)	−0.414 (2.97)	−0.529 (2.45)						10	< 0.01

Panel A of this table reports estimates of the prices of risk, along with the cross-sectional $\overline{R}^2$ from alternative, unconditional versions of the KEEPM model. LR reports the probability value from a likelihood ratio test that tests whether the KEEPM risk factors can be jointly restricted to zero ($\lambda^{ous} = \beta^{ous} = \lambda^{ous} = \beta^{ous} = 0$). λ^w is the world stock market price of risk, λ^{us} is the orthogonal US stock market price of risk, λ^{uk} is the orthogonal UK stock market price of risk, λ^{cb} is the currency basket price of risk, λ^i is the inflation price of risk, λ^{ip} is the industrial production price of risk, λ^m is the money market price of risk, and λ^{bm} is the book-to-market price of risk. Panel B estimates the model using MSCI market portfolio data, Panel C introduces a new set of individual asset returns and Panel D reports estimates using portfolio data. The data are sampled monthly over the period January 1980 to December 2000. t-ratios are in parentheses.

Table 4

Estimates of the Prices of Risk: US, UK, Japan, Germany

λ^w	λ^{us}	λ^{uk}	λ^{jp}	λ^{ge}	$\overline{R}^2$	LR
0.372 (3.98)	−0.253 (2.37)	−0.236 (1.81)	−0.161 (1.22)	−0.231 (2.19)	46	< 0.01

This table reports a set of estimates of the prices of risk, along with the cross-sectional $\overline{R}^2$ and likelihood ratio test (LR), from the basic model using 25 excess stock returns from each of the following countries: US, UK, Japan and Germany. The data are sampled monthly over the period 1980 to end 2000. t-ratios in parentheses.

Table 5

The Extent of the Joneses Effect and Local Bias

θ_k	γ_{US}	$\overline{\gamma}_{US}$	γ_{UK}	$\overline{\gamma}_{UK}$
0.10	0.75	29.74%	0.79	38.13%
0.20	0.62	32.44%	0.68	41.60%
0.30	0.54	35.15%	0.60	45.07%
0.40	0.49	37.85%	0.55	48.53%
0.50	0.45	40.55%	0.51	52.00%
0.60	0.42	43.26%	0.48	55.47%
0.70	0.40	45.96%	0.46	58.93%
0.80	0.38	48.67%	0.44	62.40%
0.90	0.36	51.37%	0.42	65.87%
1.00	0.35	54.07%	0.41	69.33%

This table reports estimates of the Joneses effect, $\gamma_k(k = US, UK)$ and the estimated bias towards local assets, $\overline{\gamma}_k$. The first column reports various levels of the ratio of constrained to unconstrained wealth, θ_k.

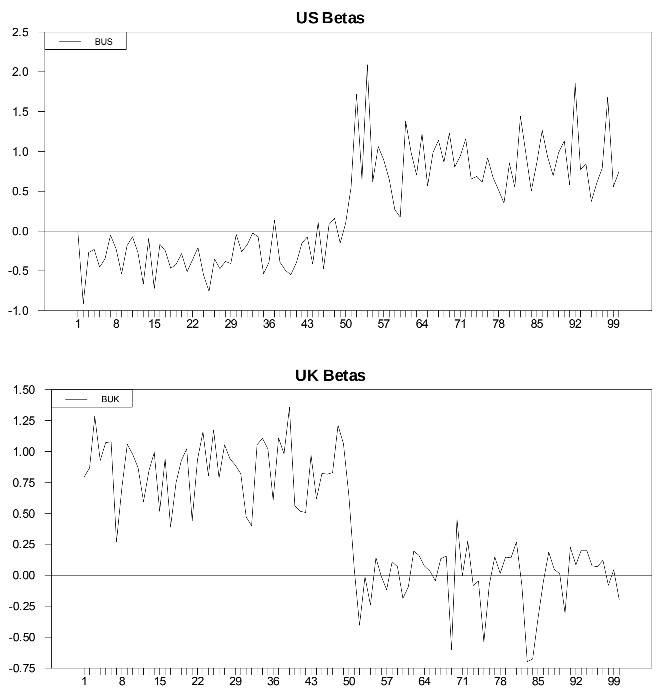

Figure 1: Estimated Betas With Respect to Orthogonal Portfolio: The top figure plots the US stock returns estimated betas with respect to the UK orthogonal portfolio (first 50 data points) and the US orthogonal portfolio (second 50 data points). The bottom figure plots the UK stock returns estimated betas with respect to the UK orthogonal portfolio (first 50 data points) and the US orthogonal portfolio (second 50 data points).

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