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Multiple-Country versus Single-Country Tests of International Asset Pricing Models

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Comments Welcome

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Abstract

In this article we examine empirically three nested international asset pricing models, namely those of Grauer, Litzenberger, and Stehle (1976), Solnik (1974) as revised by Sercu (1980), and Adler and Dumas (1983). We investigate the presence of exchange rate and inflation premia in equities through both single- and multiple-country tests and provide evidence from ten countries. Our empirical methodology allows us to show why these two testing approaches yield markedly different inferences with respect to risk premia. Single-country tests are proved to be inappropriate for the estimation of exchange rate and inflation risk premia, for reasons related to the cross-sectional variance of betas. Multiple-country tests suggest the presence of a strong country factor in exchange rate betas, and to some extent, also in world inflation betas. We find strong evidence of an unconditional exchange rate premium in equities. Our analysis raises important methodological questions with respect to tests of other asset pricing models.

Introduction

International Asset Pricing have long been the subject of numerous tests in International Finance. At the CAPM side, most of the work is focused on testing the hypothesis of complete capital markets integration - see for example, Stehle (1977), Jorion and Schwartz (1986), Korajczyk and Viallet (1989), and Harvey (1991). The existing evidence indicates that although the covariance of country returns with the world market portfolio can explain part of the behaviour of country returns, additional important sources of risk may also exist. Jorion (1991) examines the exposure of US industries to movements in the value of the US dollar using unconditional moments. His tests consider fifteen exchange rates against the US dollar, and he fails to reject the hypothesis of zero exchange rate premium during the period from January 1971 to December 1987. Dumas and Solnik (1993) also consider the pricing of exchange rate risk using a multiple-country methodology formulated in conditional terms. Contrary to Jorion (1991), their results support the presence of exchange rate premia in equities. Moreover, Chen, Roll, and Ross (1986) and Ferson and Harvey (1991) examine the pricing of inflation risk in the context of an empirical test of the domestic Arbitrage Pricing Theory (APT). Their conditional tests indicate that the unexpected inflation premium in the US can be important during certain periods. However, the unconditional multiple-country tests of Cooper and Kaplanis (1994) which reject the hypothesis that home bias in international portfolios is induced by investors' efforts to hedge against inflation, imply that an inflation risk premium may not be significant.

The choice to perform single- or multiple-country tests may not be independent of our inferences with respect to the pricing of sources of risk we consider. In this article, we show the effects that these two alternative testing approaches can have on the estimation of exchange rate and inflation premia. In particular, we test three nested international asset pricing specifications, namely those of Grauer, Litzenberger, and Stehle (GLS) (1976), Solnik (1974) as revised by Sercu (S-S) (1980), and Adler and Dumas (AD) (1983), and therefore we examine separately the existence of an inflation and/or exchange rate premium in equities, as well as their relative importance. Tests of the GLS and AD models have not previously appeared in the literature, whereas the results from empirical studies based on the

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the three specifications to be examined, and highlights their differences. In Section 2 we discuss our empirical methodology, and deal explicitly with the incorporation of multiple foreign exchange and inflation rates in the empirical tests. Section 3 presents the data and describes the portfolio construction approach. The empirical results from the single- and multiple-country tests are discussed in Section 4. Finally, in Section 5 we evaluate our findings from the previous Section by employing a simple relation that aims to provide an indication of the true cross-sectional and cross-country variance in betas.

1. The GLS, S-S, and AD Asset Pricing Models

In a world where Purchasing Power Parity (PPP) holds but inflation is stochastic, investors will seek to include in their portfolio holdings a hedge fund against this source of risk that will consist of assets which exhibit a nonzero correlation with inflation. However, the composition of the hedge fund will be identical across countries exactly because in the presence of PPP, investors in different countries will face the same inflation risk. This is the environment which characterizes the GLS model, and it illustrates that when PPP is assumed to prevail, all investors will hold a combination of the same funds.

When PPP is violated, the portfolio composition of investors becomes more complex. Solnik (1974) was the first to consider the effect of PPP deviations on international asset pricing. In fact, such deviations define the different national groups of investors in his model. He assumes that domestic inflation is zero, which makes PPP deviations perfectly collinear with exchange rate changes. His model has been revised by Sercu (1980) who relaxes an assumption imbedded in the original specification regarding the covariance structure of asset returns, according to which the returns of stocks and bonds were assumed independent. In the context of the revised specification (referred herewith as S-S), investors hold in addition to the world market portfolio, a hedge fund against exchange rate risk, which consists of their home riskless asset, and therefore is country specific.

A generalization of Solnik's model has been derived in AD, where domestic inflation is also allowed to be stochastic. The hedge fund against PPP deviations now includes both an exchange rate and an inflation component, It is made up of both stocks and bonds and it is investor's specific[2].

Consider L+1 countries and currencies, and all nominal asset returns expressed in terms of the L+1st currency (the reference currency). We can then formally state the three models as follows[3]:

The GLS model

$$(1) \quad \mu_k - r = \gamma_I \beta_{kI} + \gamma_w \beta_{kw}$$

The S-S model

$$\mu_k - r = \sum_{l=1}^{L} \gamma_{f_l} \beta_{kf_l} + \gamma_w \beta_{kw} \qquad (2)$$

The AD model

$$\mu_k - r = \sum_{l=1}^{L+1} \gamma_{I_l} \beta_{kI_l} + \gamma_w \beta_{kw} \qquad (3)$$

where

μ_k is the instantaneous expected value of the nominal rate of return on security k,

r is the instantaneous nominal interest rate of the L+1st riskless asset,

$\gamma_I = I_l - r$, $\forall l$, where $l=1,\ldots,L+1$, and $\gamma_{Il} = I_l - r$,

I_l is the expected return on a portfolio highly correlated with investor's l inflation rate π_l expressed in the L+1st currency, and $l=1,\ldots,L+1$,

$\gamma_{fl} = f_l - r$,

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[2] The hedge fund can become investor's specific because in the AD model investors in the same country are allowed to have different consumption preferences, and therefore use different deflators for calculating real returns from the same investment.

[3] Vassalou (1994) rederives the GLS specification in nominal terms using a continuous time set-up, and shows that the three models are nested, since the GLS and S-S specifications are special cases of the AD model.

f_l is the instantaneous expected exchange rate change between the reference currency L+1 and currency *l*,

$\gamma_w = \mu_w - r$,

μ_w is the instantaneous expected nominal rate of return on the world market portfolio,

$\beta_{kIl} = cov(\mu^*_k, I^*_l)/var(I^*_l)$, $\beta_{kfl} = cov(\mu^*_k, f^*_l)/var(f^*_l)$, and $\beta_{kw} = cov(\mu^*_k, \mu^*_w)/var(\mu^*_w)$, with the asterisk (*) denoting the actual random variables rather than their instantaneous expectations.

Note that the inflation rate of country *l* expressed in terms of the reference currency, I^{L+1}_l, is given by[4]

$$I_l^{L+1} = I_l^l + f_l^{L+1} \tag{4}$$

where,

I^l_l is the inflation of country *l*, expressed in local currency, and

f^{L+1}_l is the instantaneous expected exchange rate change between the L+1 and *l* currencies.

Relation (4) follows from the derivation of the S-S and AD models using a continuous-time framework. It is apparent that when domestic inflation is non-stochastic (as in the S-S model), its translation in the reference currency gives rise to a term that is perfectly collinear with the exchange rate change between the domestic (*l*) and reference (*L+1*) currencies. In this sense, the S-S model is nested with the AD specification. Furthermore, it is easy to verify that when PPP holds, and therefore all investors face the same inflation risk, relation (3) reduces to (1).

The results of this Section are used for the construction of our empirical methodology. In particular, we will present below a generalized empirical formulation that allows us to discriminate between the S-S and AD models with respect to *the sources of PPP deviations* implied by the two relations. Furthermore, our methodology accounts explicitly for *the number of inflation risk premia* included in the GLS and AD models.

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[4] To simplify notation, we denote by I_l both the inflation of country *l* in equation (4), and the expected return on a portfolio highly correlated with this inflation rate in equations (1) and (3). It should be noted, however, that since inflation cannot be perfectly hedged, the two variables may not be identical in practice. Superscripts are adopted here to emphasize the translation of inflation *l* in terms of the reference currency L+1, but they are dropped in other cases where their use is not considered necessary.

2. Empirical Methodology

Two aims are put forward in this section: first, to discriminate among the three nested models with respect to the testable hypotheses that each one of them implies, and second, to show why single- and multiple-country tests need not yield qualitatively similar results. We demonstrate our analysis using the most general of the three specifications, the AD model. Restating the model in terms of excess returns, we can denote as $E(R_k)=\mu_k-r$, $E(R_w)=\mu_w-r$, and $E(R_{Ii})=I_i-r$, the excess expected return of asset k, of the world market portfolio, and of a fund highly correlated with the inflation rate I_i, respectively. The AD model can be written in that case as follows:

$$E(R_k)=\sum_{i=1}^{L+1}\gamma_{I_{i,k}}\beta_{kI_i}+\gamma_w\beta_{kw} \tag{5}$$

or alternatively,

$$E(R_k)=\gamma_0+\sum_{i=1}^{L+1}\gamma_{I_{i,k}}\beta_{kI_i}+\gamma_w\beta_{kw} \tag{6}$$

where

$\gamma_0 = 0$, $\gamma_{Ii} = E(R_{Ii}-\gamma_0)$, $\gamma_w = E(R_w-\gamma_0)$,

$\beta_{Ii} = cov(R_k,R_{Ii})/var(R_{Ii})$, and $\beta_w = cov(R_k,R_w)/var(R_w)$.

Given that the three international asset pricing models we examine are nested, and since exchange rate changes and inflation rates are related through equation (4), we can introduce in equation (5) L exchange rate terms so that:

$$(7)\quad E(R_k)=\gamma_0+\sum_{j=1}^{L}\gamma_{f_j}\beta_{kf_j}+\sum_{i=1}^{L+1}\gamma_{I_{i,k}}\beta_{kI_i}+\gamma_w\beta_{kw}$$

where $\gamma_{fj} = E(R_{fj}-\gamma_0)$, $R_{fj} = f_j-r$, and $\beta_{fj} = cov(R_k,R_{fj})/var(R_{fj})$.

Equation (7) represents the formulation of the AD model which we aim to test empirically. The inclusion of the L exchange rate terms permits the simultaneous testing of the three models, while it can provide us with some indications of the relative importance of the inflation and exchange rate change components in the hedge funds implied by the AD model. In particular, if statistical significance is only attached to the γ_{fj} coefficients, then we would conclude that the S-S model is supported by the data, since β_{Ii}'s would be priced only to the extent that they represent exchange rate risk[5]. If however both β_{fj}'s and β_{Ii}'s carry a risk premium, (i.e., $\gamma_{fj} \neq 0$, for j=1,...,L, and $\gamma_{Ii} \neq 0$, for i=1,...,L+1), then that would constitute an indication that the AD model is validated, and therefore, the GLS and S-S models would be rejected. Finally, if only inflation risk appears to be priced, then we could conclude that the GLS model is satisfactory in explaining empirically average returns, since exchange rate uncertainty would not be priced[6]. In addition, we test the GLS and S-S separately, by imposing the relevant parameter restrictions on (7).

After assuming rational expectations, equation (7) can be considered testable, in principle, either directly through the use of a two-stage estimator, or after some simple manipulations that will enable the estimation in one pass[7]. In that case, however, we could evaluate the performance of the models only through the value of the constant, γ_0. This is a direct consequence of the multicollinearity observed in the exchange rate and inflation variables. The discussion of the empirical results makes explicit that a test based only on γ_0 cannot always discriminate among the three models. Furthermore, it fails to provide an explanation for the inconsistencies in the results produced from single- and multiple-country tests, as we will see following sections. The three models imply more testable hypotheses than the constant of the regression model. These hypotheses can be exploited in order to increase the power of the empirical tests[8]. To this end, we need to receive reliable estimates of the

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[5] It should be noted however that, even in this case, the AD model cannot be rejected because it represents a more general specification than the S-S model.

[6] See later in this Section for the incorporation of inflation variables in the empirical model so as to account for the testable hypotheses with respect to the number of inflation premia implied by the GLS and AD specifications.

[7] see for example, Gibbons (1982).

[8] Testing methodologies that rely on Hansen's statistic in order to discriminate among alternative models may also be problematic. Newey (1985) shows that this statistic, along with every other GMM test, fail to detect misspecifications for reasons related to the shape of their asymptotic power curve.

exchange rate and inflation betas and gammas[9]. This additional information is subsequently used to compare empirically the three asset pricing relations, and the two alternative testing approaches (i.e., the single- versus multiple-country tests).

The Incorporation of Multiple Exchange Rates in the Empirical Tests

The inclusion of multiple exchange rate changes in an empirical model has appeared in a few studies so far - see Korajczyk and Viallet (1990), Jorion (1991), and Dumas and Solnik (1993). Our methodology aims to allow the inclusion of information from many exchange rate variables in a parsimonious empirical representation. One way to do that is to employ an index approach[10]. The use of an index entails the possibility of loss of information. This loss of information can be reduced if two indices instead of one are constructed in such a way so that the one includes, to a certain extent, the information that has been left out by the other. To do that, we decompose the changes in each exchange rate into a component that is explained by the other exchange rate changes and an idiosyncratic component. In practice, this can be achieved by regressing each of the L exchange rate changes on the remaining L-1 exchange rate changes, in the following way:

$$R_{fj_t} = \delta_0 + \sum_{j'=1}^{L-1} \delta_{fj'} R_{fj'_t} + \epsilon_{j_t} \qquad \textbf{(8)}$$

where ϵ_j represents the component of R_{fj} that is not explained by the L-1 exchange rate changes, or alternatively, the idiosyncratic component of R_{fj}. It holds that $E(\epsilon_{jt})=0$, and $cov(R_{fj'},\epsilon_{jt})=0$, for j'=1,...,L-1. We now regress each series of exchange rate changes on the residuals obtained from (8), so that

[9] Strictly speaking, the world, exchange rate, and inflation betas estimated in our tests have to be interpreted as factor loadings. For convenience, however, we will refer to them as betas.

[10] This approach has been adopted by Jorion (1991).

$$R_{fj_t} = \theta_0 + \theta_{fj} \epsilon_{j_t} + \eta_{j_t} \quad (9)$$

η_j defines the common (or systematic) component of the exchange rates changes considered as a deviation from its mean, and by construction, $E(\eta_{jt})=0$, and $cov(\epsilon_{jt},\eta_{jt})=0$. We have so far broken down the changes in each exchange rate considered into two orthogonal parts without leaving out any information. We can now proceed by constructing two equally weighted indices corresponding to the sets of residuals obtained from (8) and (9) in the following way:

$$e_{f_t} = \frac{1}{L}\sum_{k=1}^{L} \epsilon_{j_t} \quad (10)$$

and,

$$\lambda_{f_t} = \frac{1}{L}\sum_{j=1}^{L} \eta_{j_t} \quad (11)$$

The e_f variable denotes the average idiosyncratic component of all L exchange rate changes examined, whereas λ_f describes the average common part shared by the same exchange rate changes[11]. The above procedure has reduced the number of exchange rate variables that need to be included in the right-hand side of equation (7) to only two. Furthermore, given that the λ_f variable is almost identical to the return of an equally weighted index of the same exchange rates, the inclusion of e_f in our tests allows the use of *more* exchange rate information than previous methods[12]. Furthermore, it follows that in order to include more exchange rate information in our tests, it is not sufficient to consider changes in more

[11] The construction of indices does result in some loss of information, in general. Regressions of the single-exchange rate changes on the two constructed indices and an equally weighted index of all exchange rate changes revealed that, the combined use of the common and idiosyncratic component indices results always into including a higher proportion of exchange rate variation in the empirical model than it would otherwise be possible through the use of a single equally weighted index of all exchange rate changes.

[12] The correlation of λ_f with the equally weighted index of all exchange rates is around 0.98, while the correlation between λ_f and e_f is generally in the area of 0.2. λ_f and e_f are not orthogonal to each other, because the exchange rate changes included in the summation of (8) are inevitably not invariant to the exchange rate changes that appear as a dependent variable in the same regression.

exchange rates combined in a single index. This is because any information specific to a given exchange rate is diversified away during the construction of that index. It appears that the only way to reintroduce it in the regression model is by including the idiosyncratic component of the changes in this exchange rate, relative to its common component with the other exchange rates.

The above analysis allows us to express equation (7) as follows:

$$E(R_k) = \gamma_0 + \gamma_e \beta_{ke} + \gamma_\lambda \beta_{k\lambda} + \sum_{i=1}^{L+1} \gamma_{I_{i,k}} \beta_{kI_i} + \gamma_w \beta_{kw} \tag{12}$$

where

$\gamma_e = E(R_{ef} - \gamma_0)$, $R_{ef} = e_f - r$, $\gamma_\lambda = E(R_{\lambda f} - \gamma_0)$, $R_{\lambda f} = \lambda_f - r$, $\beta_{ek} = cov(R_{ef}, R_k)/var(R_{ef})$, and $\beta_{\lambda k} = cov(R_{\lambda f}, R_k)/var(R_{\lambda f})$. It is apparent that if exchange rate risk is not priced, then $\gamma_e = \gamma_\lambda = 0$.

The Inclusion of Multiple Inflation Risk Premia in the Empirical Test of the AD Model

Multiple inflation rates included simultaneously in a regression model can exhibit multicollinearity as a result of possible inflation transmissions across countries. To avoid shortcomings of that nature, we proceed as follows. If we consider that inflation is made up of an expected and unexpected component, then in case an inflation risk premium exists, it should be related to the unexpected inflation rate. This is because expected inflation is always known and therefore no risk premium should be attached to it. To break down inflation into its two components, we estimate the expected inflation for each of the L+1 inflation rates considered using an ARIMA(0,1,1) model[13]. The forecasting specification can be formally stated as follows:

[13] The effects of using alternative methods to forecast inflation on the estimation of inflation premia has also been examined. In particular, we estimated the GLS model for each single- country included in our sample, once using the forecast errors of the ARIMA (0,1,1) specification, and once with the forecast errors of an Error Correction Model that uses information from interest rates. Our findings with respect to the pricing of inflation risk premia were qualitatively the same. Furthermore, we examined alternative univariate specifications, without however achieving any significant improvement in the autocorrelations of the forecast errors. Details of the tests are provided in Vassalou (1994).

$$\Delta I_{l_t} = \phi_1 \Delta I_{l_{t-1}} + i_t \qquad (13)$$

where ΔI_{lt} denotes the differenced current inflation rate measured in local currency, and i_t is a random disturbance term[14].

If we were only testing the AD specification, we could simply construct an index of unexpected inflation rates, estimated from the class of models described in (13), to account for the possible pricing of inflation risk. Such a method however, would fail to discriminate, in our comparison of the three specifications, between the GLS and AD models with respect to the number of inflation variables that each one of them assumes. Therefore, we would have failed to address one testable hypothesis of the nested models. To discriminate between the GLS and AD models with respect to the inflation premia, we adopt the following approach. For the single-country tests, we keep the residuals from (13) that correspond to its unexpected inflation as they are, and calculate an equally weighted average of the rest of the residuals[15,16].

$$\pi^*_{w_t} = \frac{1}{L}\sum_{i'=1}^{L} i'_{i_t} \qquad (14)$$

We furthermore render the variables i_{L+1t} and π_{wt}^* orthogonal by running the regression:

[14] Expected inflation is estimated in the local currency of each country, but the forecast errors are subsequently translated in the measurement currencies that we use for our tests.

[15] The choice of the unexpected inflation that does not enter the calculation of the equally weighted index of the remaining unexpected inflations is completely arbitrary. This is because in the GLS model, all inflation rates, when expressed in terms of a common currency, collapse to a single rate. For convenience, therefore, we choose this single inflation to be the domestic rate.

[16] All unexpected inflation variables entering the calculation of the world inflation index have been expressed first in terms of a common currency.

$$\pi^*_{w_t} = \nu_0 + \nu_1 i_{L+1_t} + \pi_{w_t} \qquad (15)$$

where π_{wt} is the world unexpected inflation orthogonal to the domestic unexpected inflation i[17]. For the multiple-country tests, we use the same approach described above but the residuals that do not enter the summation in (14) are those that refer to the unexpected inflation of the country whose currency is used as a numeraire. Similarly to the previous data transformations, it follows that $E(i_{L+1,t}) = E(\pi_{wt}) = 0$.

The Empirical Models of the Three Nested Hypotheses

Using the structure imposed in the previous Sections, we may express equation (12) as follows:

$$E(R_k) = \gamma_0 + \gamma_e \beta_{ke} + \gamma_\lambda \beta_{k\lambda} + \gamma_i \beta_{ki} + \gamma_\pi \beta_{k\pi} + \gamma_w \beta_{kw} \qquad (16)$$

where $\gamma_i = E(R_{it} - \gamma_0)$, $R_{it} = i_{L+1,t} - r$, $\gamma_\pi = E(R_{\pi wt} - \gamma_0)$, $R_{\pi wt} = \pi_{wt} - r$, $\beta_{ik} = cov(R_{it}, R_{kt})/var(R_{it})$, and $\beta_{\pi k} = cov(R_{\pi wt}, R_{kt})/var(R_{\pi wt})$. If neither exchange rate nor inflation risk is priced, $\gamma_e = \gamma_\lambda = \gamma_i = \gamma_\pi = 0$.

An empirical test of the AD model can now be devised by decomposing the rate of return on asset k into an expected component $E(R_{kt})$ and a set of innovations so that[18]

$$R_{kt} = E(R_{kt}) + \beta_{kw}(R_{wt} - E(R_{wt})) + \beta_{ke} e_{ft} + \beta_{k\lambda} \lambda_{ft} + \beta_{ki} i_t + \beta_{k\pi} \pi_{wt} + \xi_{it} \qquad (17)$$

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[17] Rendering i_{L+1t} and π_{wt}^* orthogonal is necessary in order to discriminate between the two models. If the two variables are not orthogonal to each other, then in case that both are priced, we will be unable to tell to what extent this is so, because the two variables are correlated or, because the capital markets are less than perfectly integrated (as assumed in AD).

[18] The idea of formulating an empirical test by decomposing the rate of return on an asset into an expected component and a series of innovations as presented in this section was derived from Jorion and Schwartz (1986). They used this type of decomposition to include in their tests of integration of the Canadian stock market, a domestic factor which is orthogonal-to-their-definition-of-the-world factor.

Substituting (16) into (17) yields

$$\begin{aligned}R_{kt}=&\gamma_0+\gamma_e\beta_{ke}+\gamma_\lambda\beta_{k\lambda}+\gamma_i\beta_{ki}+\gamma_\pi\beta_{k\pi}+\gamma_w\beta_{kw}+\beta_{kw}R_{wt}\\&-\beta_{kw}E(R_{wt})+\beta_{ke}e_{ft}+\beta_{k\lambda}\lambda_{ft}+\beta_{ki}i_t+\beta_{k\pi}\pi_{wt}+\xi_{kt}\\=&\gamma_0(1-\beta_{kw})+\beta_{kw}R_{wt}+\gamma_e\beta_{ke}+\beta_{ke}e_{ft}+\gamma_\lambda\beta_{k\lambda}+\beta_{k\lambda}\lambda_{ft}\\&+\gamma_i\beta_{ki}+\beta_{ki}i_t+\gamma_\pi\beta_{k\pi}+\beta_{k\pi}\pi_{wt}+\xi_{it}\end{aligned} \quad \textbf{(18)}$$

Equation (18) requires the estimation of both the beta and gamma coefficients. It combines cross-sectional with time series data so that k=1,2,...,N refers to a security (or portfolio) return, and t=1,2,...,T refers to the return of asset k at a specific point in time. This approach allows the simultaneous estimation of all coefficients in the system and avoids problems related to errors-in-the-variables inherent in two-step estimation methods[19].

A separate set of β's is estimated for each k while γ's are restricted to be equal across equations. The constraint imposed on γ's is not unreasonable; given that we test an equilibrium model, we are interested in whether specific sources of risk are priced on average for the cross-sectional sample rather than for the individual portfolios. Furthermore, we impose constant risk coefficients. Although the constancy of betas is consistent with the three static theoretical specifications examined, the risk premia parameters will only be constant under the additional assumption of constant relative risk aversion. This assumption is unnecessary for theoretical purposes, and it is used in this study in order to focus further our testable hypotheses. Our aim is not to determine the behaviour of exchange rate and inflation premia over time, but rather to answer a more fundamental question which has long been overdue; that is, whether exchange rate and inflation risk is indeed priced. In addition it should be noted that testing procedures which allow for time variation in a risk aversion coefficient cannot be easily generalized in the case of multiple risk premia without resulting in some loss of efficiency. There is obviously a trade-off between allowing for time variation

[19] See Gibbons (1982).

in risk premia and increasing the efficiency of our estimates[20]. For a system of eight equations, (18) implies the estimation of 5 betas times 8 equations plus 5 coefficients or 45 parameters.

Repeating the same methodology for the S-S and GLS models permits us to express their empirical specifications respectively as follows:

$$R_{kt}=\gamma_0(1-\beta_{kw})+\beta_{kw}R_{wt}+\gamma_{fe}\beta_{ke}+\beta_{ke}e_{ft}+\gamma_{f\lambda}\beta_{k\lambda}+\beta_{k\lambda}\lambda_{ft}+\zeta_{kt} \tag{19}$$

and,

$$R_{kt}=\gamma_0(1-\beta_{kw})+\beta_{kw}R_{wt}+\gamma_i\beta_{ki}+\beta_{ki}i_t+\psi_{it} \tag{20}$$

Again, for a system of eight equations, (19) and (20) imply the estimation of 27 and 18 parameters respectively. In (18), (19), and (20), ξ_{kt}, ζ_{kt}, and ψ_{kt} denote the forecasting errors of the respective models and if either of the specifications is correct, then the expectation of the corresponding error should be equal to zero. In the above models, the beta parameters denote systematic risk relative to a specific portfolio (e.g. β_w denotes the systematic risk of asset k relative to the world market portfolio), while each γ expresses a premium for the respective risk of the corresponding beta and reveals the investor's expected compensation per unit of risk exposure. Furthermore, according to the models, γ_0 should be equal to zero in all specifications.

The parameters in equations (18), (19), and (20) are estimated using a Nonlinear Seemingly Unrelated Regression Estimator (SURE), with Newey-West (1987) heteroskedasticity - and

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[20] Vassalou (1994) examines the predictability of world, exchange rate, and inflation betas and shows that they may not vary stochastically over time. Therefore, allowing them to vary in an unspecified manner, similar to the one prescribed in Harvey (1991), will not necessarily increase the power of our tests. Furthermore, it may increase the amount of noise present in the empirical model, since these risk coefficients, and in particular the exchange rate and inflation betas, are found to be very noisy at an individual security level and for portfolios of less than ten securities. We should also note the result of Ferson and Harvey (1991) which indicates that time variation in betas can be of limited importance.

autocorrelation - consistent standard errors[21]. This estimator is free of any distributional assumptions implied by the standard OLS approach[22].

3. Data, and Portfolio Construction

Data

This study makes use of monthly stock returns from ten countries namely, Australia, Canada, France, Italy, Switzerland, the Netherlands, Japan, Germany, UK, and USA. Our sample covers the period from January 1973 to December 1990, and all data have been extracted from "Datastream", except those referring to the UK and USA that have been taken from the London Share Price Database (LSPD) compiled at London Business School, and the files of the Centre for Research in Security Prices (CRISP) respectively[23]. As surrogate of the world market portfolio we use the Morgan Stanley Capital International (MSCI) index. Our empirical tests are carried out both from the perspective of a US investor and each country's domestic investor in order to avoid inferences from our empirical results that are specific to the choice of measurement currency. For the calculation of excess returns we used short-term interest rates (up to 6 months) obtained from the "Encorr" database. In the case of Italy and Switzerland, we used the 6-month Euro-rates available from the OECD files. Furthermore, stock returns were translated into US dollars and the home currency of each country using spot exchange rates taken again from the OECD files. Finally, inflation rates have been

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[21] The lag truncation parameter q has been assigned the value of six. Examination of the residuals from the estimated systems revealed that a $q=6$ would be sufficient to represent all significant autocorrelations at the 10% level. For a description of the data and the method used to construct portfolios, see the following Section.

[22] It therefore falls within the Generalized Methods of Moments (GMM) family of estimators proposed by Hansen (1982).

[23] It should be noted that it is only possible to download from Datastream monthly prices and dividend yields, and therefore, the total returns for eight of the ten countries in our sample have been calculated by spreading evenly the monthly dividend yields throughout each year. This method that represents the only option we had available, may smooth the series to a certain extent but it is not expected to affect the means in any meaningful way. Furthermore, the parameters estimates should also be unaffected given that dividends do not affect the values of betas in general. Sharpe and Cooper (1972) have shown that the estimates of betas remain the same independently of whether we employ total returns or simply capital gains for their estimation.

obtained from the IMF Series and are calculated out of each country's Consumer Price Index (CPI)[24]. Summary Statistics for the variables included in our tests are provided in Table 1.

Portfolio Construction

The independent variables of interest for our tests against which we need to gain dispersion are the return to the world market portfolio, the unexpected inflation variables, and the exchange rate changes indices. As instrumental variables for the classification of stocks into portfolios we use the world market portfolio beta, the world inflation beta, and the beta with respect to an equally weighted index of all exchange rate changes considered[25]. To avoid problems related to selection bias, the estimation of these beta coefficients should be independent of the beta estimates obtained in our tests. Since our sample spans the period from January 1973 to December 1990, each security has a total of 216 monthly observations. To construct the portfolios we use Chen's (1983) methodology, and therefore, we separate the observations into two groups of odd and even months. We use odd observations to estimate betas and even ones to calculate the returns of the portfolios. Furthermore, given that dispersion against three rather than one variable is required, we first classify securities according to the world betas into two portfolios, then each portfolio is subdivided into two portfolios according to the exchange rate betas, and finally, all portfolios are split into two according to the world inflation betas. The estimation of these betas was carried out according to the implications of the models examined. In particular, for each set of betas, we chose to estimate them according to the most general specification in which they appear. World and inflation betas were estimated jointly, as specified in the AD model. Exchange

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[24] A caveat exists for the case of Australia where only quarterly data are available. The monthly series is therefore computed by spreading evenly the quarterly inflation over the three months' period. Although the actual inflation series is less informative in the case of Australia, the performance of the ARIMA model is comparable to that obtained for other country inflations.

[25] The two inflation variables included in the estimation of the AD model are orthogonal to each other and therefore, classifying securities according to the beta coefficient of the world inflation index π^{*}_{wt} (not orthogonal to the domestic inflation) offers dispersion against both variables. Furthermore, correlations between the equally weighted and idiosyncratic indices, constructed in terms of alternative currencies, vary between 0.25 and 0.56, while those of the equally weighted and common component indices are almost invariably equal to 0.98. Therefore, the dispersion gained against the common component index will be higher than that against the idiosyncratic index, but again the variation of exchange rate changes explained in the first case is also considerably higher. The classification of stocks into portfolios has been carried out in terms of the local currency of each country.

rate betas were estimated together with the world betas, as it is implied by the S-S model[26]. A total of eight portfolios were formed. The procedure described above is repeated for the two subperiods of 108 total observations defined in our sample. The portfolio returns for the entire period are obtained by appending the portfolio returns of the first subperiod to those of the second subperiod. This is done in order to account for possible nonstationarities in betas, and it is equivalent to updating the membership of securities in the eight portfolios twice during the entire period[27].

[26] However, only the exchange rate betas were kept from those estimations.

[27] It should be noted that the assumption made by this classification procedure with respect to the stationarity of betas is weaker than the one required by the Black, Jensen, and Scholes (1972) grouping approach, since only stationarity between even and odd observations of the same period is assumed, rather than stationarity across time.

4. Empirical Results[28]

I The Single-Country Tests

A first interesting result from this category of tests refers to the constant of the regression models. Recall that values of γ_0 significantly different from zero in statistical terms, violate an important restriction of the theoretical models in question. The evidence presented in Table 2 suggests that, at least in the estimations executed in US$, γ_0 is significant in the case of the GLS model, at the 5% level, in four out of ten countries. It is furthermore significant at the 10% level in eight of the ten countries. The number of countries drops to five in the case of the S-S specification and to two for the AD model[29]. The single-country tests therefore *reject* at least the GLS and S-S models on the basis of the γ_0 coefficient in several countries considered. This is an important result which indicates that, either the models are not supported by the data or, that single-country tests are not robust enough to reveal the empirical validity of the theoretical specifications examined. The following Sections of this study will explore these two possibilities and underline the importance of being able to judge the empirical performance of the three models through more testable hypotheses than simply the value of the constant.

With respect to the exchange rate premia, a first observation that can be made from Table 3 is that, exchange rate risk is not consistently priced across countries, models, and currencies examined, as it would actually be expected. Furthermore, whenever exchange rate risk appears to receive a premium, this is generally attached to the idiosyncratic component index. In particular, indications for the presence of an exchange rate premium are given in nine out of ten countries in the S-S model. The number of countries drops to seven in the AD model. In all these cases, the idiosyncratic component equilibrium coefficient is statistically

[28] It should be noted that the results presented and discussed in this section refer to the entire period estimations. Tests for the two subperiods were also performed but the results obtained were qualitatively the same as those reported herewith. Their presentation is therefore considered redundant.

[29] However in the latter case, the fact that γ_0 appears statistically insignificant in most countries can be attributed to the relatively higher standard errors computed in the AD model which in turn can be due to the increased difficulties in estimating less parsimonious specifications.

significant, at least at the 10% level and one of the two currencies in which the tests were performed. In some countries, a significant common component equilibrium coefficient is also found in the estimates of the S-S model. Recall that the idiosyncratic component index includes information not captured by an equally weighted index of all exchange rate changes, which is almost identical to the common component index considered in this study. It therefore appears at this stage that, previous tests like those of Jorion (1991) which reject the hypothesis that exchange rate risk is priced may do so, simply because they omit the information of the idiosyncratic component index from their empirical specifications.

Similarly to the case of exchange rate premia, the results of Table 4 indicate that inflation appears to be priced, at least in one of the two currencies, in almost all countries when estimated as part of the GLS model. The number of countries is halved in the tests of the AD model, presumably as a result of the presence of more noise in estimations of less parsimonious models. In addition, all statistically significant inflation risk premia are associated with domestic inflation but in several cases, they exhibit economically large values, particularly in Australia, Japan, and Switzerland.

The results from the single-country tests imply that the pricing of both exchange rate and inflation risk can be granted *some* empirical justification. Nevertheless, our findings are not uniform across countries, and currencies of denomination, and they cannot be considered strongly significant. Furthermore, the values obtained for the constant and the risk premia considered are often economically implausible. A need therefore arises to verify the validity of these results. As a starting point, we will turn our attention to the evidence obtained from the multiple-country estimations. If our results differ substantially, it follows that rejections of the testable hypotheses are specific to whether a single- or multiple-country test is employed. In that case, however, it is imperative to determine which of the two testing approaches yield reliable results.

II The Multiple-Country Tests

The formulation of the tests presented in this Section differ from those of the previous one only to the extent that they use information from all country samples simultaneously rather than individually. They are conducted in the following way. All low risk portfolios, with respect to the world, exchange rate, and inflation betas from the ten country samples are used as the ten left-hand-side (LHS) assets in three systems corresponding to the GLS, S-S, and AD empirical specifications. As a result, the LHS variables in these empirical models share the same risk characteristics but differ in nationality, since the first equation uses as LHS variable the low risk Australian portfolio return while the tenth equation the low risk US portfolio return. The same procedure is repeated for the other seven portfolios of each country sample[30]. In addition, we calculate the average return of all eight portfolios in the ten country samples, and use them to create three additional systems in the same manner described above[31]. For each of the three empirical models, a total of nine systems have resulted from this approach. Our tests are repeated both in terms of US$ and DM. The domestic inflation premia estimated in these tests correspond to the unexpected inflation of the currency of denomination, i.e., to the US or German inflation, and it follows that the world inflation is orthogonal to that country's inflation whose currency is used as a numeraire for the tests.

Our evidence with respect to this category of tests is summarized in the last row of the multiple-country Tables, (labelled as "Average"), which refer to the systems that used as LHS assets the average returns of the ten countries. However, the results from the rest of the multiple-country tests are also reported.

Contrary to what was found in the single-country tests, the equilibrium coefficients γ_0, reported in Table 5, are not statistically significant in the multiple-country tests. Although their signs may vary across models and currencies, their absolute magnitudes are always fairly small and range in plausible levels[32]. We cannot therefore reject any of the competing

[30] The reason we adopted this approach was in order to account for possible differences in the pricing of assets across countries depending on their risk characteristics. No such conclusions can finally be drawn from our results. However, repeating our multiple-country tests for the different risk portfolios has an additional benefit to offer; it decreases the probability that our results are subject to sampling errors, and therefore, it increases the power of our tests.

[31] The results from these tests are reported in the rows of the Tables labelled as "Average".

[32] In the AD model, γ_0 is marginally significant at the 10% level in the DM results of "Portfolios 3", and the US$ results of "Portfolios 5". These cases can be attributed to sampling errors.

models on the basis of our estimates for γ_0, as the three specifications cannot be distinguished from their estimates of the constant. This is an interesting observation which lies in sharp contrast to our findings from the single-country tests. In addition, it indicates that the two testing procedures may not yield consistent results.

Table 6 presents the estimates obtained for the two equilibrium exchange rate premia. As the t-values in parentheses reveal, both exchange rate premia are almost always priced at the 5% level, with a few exceptions applying to the common component exchange rate premium. Once more, our evidence from the multiple-country tests is not consistent with those of the previous Section where only the idiosyncratic component of exchange rate changes received a premium, to the extent that exchange rate changes were priced. Inconsistencies across models have also been alleviated since the levels of risk premia for the tests conducted in the same currency do not vary between the S-S and AD models, as it was the case in the single-country tests. In addition, they always assume economically reasonable values.

Finally, the results for the inflation risk premia appear in Table 7. These coefficients, however, do not exhibit the same level of significance and stability across models that we found for the exchange rate prices of risk. In particular, domestic and world unexpected inflation risk seems to be priced at the 5% level in some cases, and similarly to what we saw in the single-country tests, those premia may not be present in both the US$ and DM tests. A comparison between the GLS and AD empirical results with regard to the γ_i coefficient reveal that the value of the risk premium can also vary considerably between the two models.

Two main differences are observed with respect to the results obtained from the single- and multiple-country tests. These are related to the constant of the regression models, and the exchange rate premia. In particular, we saw that the multiple-country tests provide more consistent evidence across specifications, and reference currencies than the single-country tests. It is conceivable that the level of dispersion in betas across equations of the same model is notably different between the two testing approaches, and not necessarily sufficient in all cases so as to render the estimation of equilibrium coefficients feasible. It is apparent that rejections of the hypothesis of zero risk premia based on trivial dispersion of the corresponding betas can only be meaningless. This possibility is explored in the following

Section with the help of a simple relation.

5. The "True" Cross-Sectional Variation of International Betas

The observed variation in betas across equations of a regression system may result from true dispersion in the risk measures, the presence of noise in the assessments of risk, or both. Although the existence of true variation in betas is imperative for the estimation of risk premia, a proportionally large amount of noise in these estimates can decrease dramatically the power of a test of asset pricing. To separate out these two effects, we make use of a simple relation that follows from Vasicek's (1973) Bayesian adjustment of sample estimate betas, and has been adapted for cross-sectional variances in Dimson and Marsh (1983). It amounts to expressing the true cross-sectional variance as equal to the cross-sectional variance of beta estimates, minus the average standard error of those estimates, i.e.,

$$\sigma_\beta^2 = \sigma^2(w_j b_j) - \sum_{j=1}^{n} w_j \sigma^2(\epsilon_j) \tag{21}$$

where w_j is the weight for security j, $\sigma^2(w_j b_j)$ is the weighted cross-sectional variance of the beta estimates, and $\sigma^2(\epsilon_j)$ is the standard error of b_j. It is apparent that relation (21) holds exactly only when all securities have the same error variance, a condition that does not generally apply for the betas examined. In this study, we use it as a means to obtain an approximate measure of the "true" cross-sectional and cross-country variances in international betas[33].

The results from the single-country tests are presented in Table 8. We observe that the mean standard error of all beta estimates is generally very large compared to the cross-sectional variance of the estimates. As a result, the difference of these two quantities reveals typically a small "true" cross-sectional variance which is furthermore often negative, exactly because the formula used for its computation holds only approximately when securities do not have the same error variance. This effect is more pronounced in the case of the exchange rate and

[33] Note that, because of space constraints, the beta estimates from the various tests performed in this study have not been reported. However, they can be made available to the reader, on request.

inflation betas than in the world risk measures, and indicates that there is generally very little, if any, remaining variance in these risk coefficients to be used for the estimation of the corresponding risk premia.

We apply relation (21) to the country betas of the multiple-country tests referring to the mean portfolio returns of each country, (i.e., the models labelled as "Average" in Tables 5 to 7). The results appear in Table 9. The world betas have generally a rather low cross-country variance and the "true" variance appears both in the tests conducted in US$ and DM as slightly negative. However, the exchange rate betas with respect to the common and idiosyncratic components seem to have substantial remaining variation after accounting for noise in the estimates. Some variation is also present in the world inflation betas but the domestic inflation risk measures have in three out of four cases a negative "true" cross-sectional variance[34].

It appears, therefore, that the cross-country variation in exchange rate and world inflation betas is much higher than the cross-sectional variation in the same risk measures within each single-country[35]. As a result, the single-country tests lack the power to deliver meaningful estimates of the γ coefficients since the observed dispersion in the corresponding betas comes mainly from noise. On the other hand, the presence of a strong country factor appears to substantially differentiate these betas in the multiple-country tests. It should be noted, however, that if the observed within-country variation in portfolio betas comes primarily from noise, then the data sample size in multiple-country tests is also reduced to simply the number of countries included in the tests. This is because any cross-sectional information within each country cannot be utilized.

The results of this section have interesting implications also for tests of other asset pricing

[34] Recall that the domestic inflation in those tests refers to the inflation rate of the country whose unit of account is used as a numeraire for the test.

[35] Note that the limited "true" cross-sectional variation found within each individual country is not an artifact of the procedure used to group stocks into portfolios. Cross-classification is considered to maximize dispersion - see Haitovsky (1967). Furthermore, Chen's grouping methodology requires only predictability of betas between odd and even observations (of the same time-period) rather than predictability of betas across time.

models. It may well be the case that other variables which have been widely considered in the literature as possible economic risk factors, possess similar characteristics to the ones found for exchange rate changes and inflation. If a variable has no true cross-sectional variation, then single-country tests may produce misleading results. If on the other hand, it has a trivial true variation even at a cross-country level, then its inclusion in an asset pricing test may only be problematic. Further research in this direction is required in order to clarify such issues.

The Cross-Sectional Restrictions in the Tests of the Nested Models

The tests presented in the previous sections imposed equality of the equilibrium coefficients across equations of the same system. These restrictions are tested in Table 10 using a chi-square test.

The general hypothesis of equality in the equilibrium coefficients is never rejected in the single-country tests. This result, however, has to be interpreted with caution given the shortcomings observed in this category of tests. On the other hand, the same hypothesis is consistently rejected for all models in the multiple-country tests. This result can imply differences across countries in either the constants of the regression model, the levels of risk premia, or both. Differences in the constant of the regression model suggest the presence of additional factors, such as a domestic factor, which are not addressed by the models examined. Furthermore, possible differences in the levels of risk premia can be interpreted as differences in the risk aversion coefficients across countries, and are consistent only with the AD model. The limited empirical support of an inflation premium in equities may not be enough to stand as a convincing explanation for the rejection of the cross-sectional restrictions. The expansion of the AD model to accommodate other risk factors, suggested by economic theory, can throw some light on this question.

Conclusions

In this article we examined empirically three nested international asset pricing models, using both single- and multiple-country tests. The presence of an unconditional exchange rate premium in equities renders support to the S-S model, although the cross-sectional restriction on the equilibrium coefficients does not appear to hold. The GLS model is consequently rejected, while the AD model cannot be rejected. The limited variation of inflation betas within a country as well as across countries explains the inconsistencies in the results referring to the pricing of inflation risk.

Our analysis revealed that single-country tests are inappropriate for the estimation of exchange rate and inflation premia, due to the trivial cross-sectional variation in the corresponding betas. A strong country factor was observed in exchange rate betas, and to some extent, also in world inflation betas. As a result, multiple-country tests can yield reliable results, so long as dispersion in the betas against the country factor is obtained.

Table 1 Summary Statistics for the Variables Used in the Empirical Tests

The statistics are based on the even monthly observations from 1973:2-1990:12 (108 observations). All stock returns (including the World MSCI index) are calculated in US dollars in excess of the holding period return on the US 30-day Treasury Bill. The exchange rate and inflation variables are expressed in local currencies and in excess of the local short-term interest rate. Portfolio 1 for a given country represents the portfolio with the lowest betas against the world market portfolio, the equally weighted index of all exchange rate changes, and the world unexpected inflation rate while portfolio 8 the one with the highest betas against all three variables. Since only even observations are used in our tests, the autocorrelation ρ_2, for example, refers to the autocovariance of the current even month return (at time t) with the lagged by two even months return, divided by the variance computed from all even observations.

			Autocorrelations											
	Mean	S.D.	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}	ρ_{11}	ρ_{12}
A. Equity Returns														
Australian Portfolios														
Portfolio 1	-.0012	0.0746	-.049	-.055	-.070	0.074	-.019	-.037	-.144	0.244*	-.154	0.075	-.232*	0.004
Portfolio 2	-.0015	0.0742	-.195	0.034	-.079	0.100	-.079	-.037	-.098	0.190	-.078	0.039	-.159	0.011
Portfolio 3	-.0070	0.0794	-.009	0.083	-.117	0.026	0.048	-.072	-.039	0.058	-.019	-.003	-.100	0.073
Portfolio 4	-.0068	0.0827	-.088	0.062	-.003	0.052	-.092	0.015	-.136	0.154	-.151	-.021	-.089	-.002
Portfolio 5	-.0062	0.0892	-.085	0.109	-.114	0.127	-.128	-.038	-.173	0.235*	-.208*	0.050	-.117	0.008
Portfolio 6	-.0154	0.1046	-.051	0.198*	-.053	0.169	-.105	0.123	-.134	0.152	-.218*	0.025	-.127	-.027
Portfolio 7	0.0008	0.0831	-.115	0.092	-.013	0.034	-.041	-.025	-.079	0.206*	-.186	0.076	-.080	0.011
Portfolio 8	-.0094	0.1019	-.068	0.215*	-.198	0.112	-.144	0.031	-.150	0.244*	-.083	0.144	-.153	0.068
Canadian Portfolios														
Portfolio 1	-.0012	0.0555	0.071	0.055	-.019	-.079	0.002	-.075	0.021	-.003	-.074	-.070	-.187	-.141
Portfolio 2	0.0022	0.0473	-.081	0.107	-.079	0.030	-.102	-.019	-.082	0.119	-.210	-.067	-.040	0.048
Portfolio 3	-.0024	0.0408	0.037	0.010	0.143	-.121	-.142	-.020	0.028	0.022	0.052	-.113	-.049	0.033
Portfolio 4	0.0001	0.0626	-.078	0.080	-.046	-.157	-.146	0.019	-.195	0.215*	-.100	0.033	-.005	0.113
Portfolio 5	-.0037	0.0703	-.101	0.076	-.051	-.050	-.080	0.049	-.040	0.047	-.064	-.149	-.120	0.049
Portfolio 6	0.0072	0.0708	0.004	0.057	0.071	-.006	-.118	0.012	-.017	0.086	-.153	-.003	-.063	-.106
Portfolio 7	0.0002	0.0710	-.168	0.090	-.194	-.163	-.073	-.017	-.040	0.107	0.017	-.073	-.129	0.053
Portfolio 8	-.0044	0.0638	0.028	0.006	0.023	0.046	-.082	0.082	-.089	0.084	-.243*	-.107	-.193	0.048
French Portfolios														
Portfolio 1	0.0087	0.0688	-.000	0.013	-.010	-.013	-.008	-.103	-.038	-.155	-.106	-.023	0.033	0.141
Portfolio 2	0.0045	0.0705	0.039	-.072	0.097	0.089	-.071	0.088	0.041	0.031	-.029	0.017	-.040	0.040
Portfolio 3	0.0068	0.0594	0.008	0.123	0.002	0.059	-.168	0.021	-.174	-.078	-.181	0.003	-.022	0.197*
Portfolio 4	0.0038	0.0614	0.112	0.038	0.006	0.013	-.084	0.042	-.019	0.013	-.078	-.035	-.010	0.128
Portfolio 5	0.0009	0.0777	0.019	-.027	0.000	0.034	0.024	-.037	-.059	-.186	-.096	-.058	-.026	0.113
Portfolio 6	0.0134	0.0814	0.001	-.028	0.063	-.019	-.001	0.061	0.039	-.122	-.031	-.019	0.011	0.180
Portfolio 7	0.0021	0.0752	-.006	-.022	0.001	-.031	-.081	-.100	-.056	-.196	-.097	0.047	0.024	0.114
Portfolio 8	0.0050	0.0793	-.069	0.009	0.061	-.005	0.057	0.005	0.044	-.107	-.015	-.011	-.032	0.124
German Portfolios														
Portfolio 1	0.0120	0.0505	0.065	0.213*	0.030	0.095	0.057	-.128	-.198*	-.125	-.080	-.047	-.091	0.023
Portfolio 2	0.0098	0.0564	0.031	0.069	-.058	0.094	0.029	-.097	-.141	-.081	-.092	-.018	-.044	-.037
Portfolio 3	0.0075	0.0501	0.154	0.050	-.112	0.161	0.096	-.061	-.118	-.084	-.079	0.017	-.011	-.004
Portfolio 4	0.0097	0.0537	0.065	0.044	-.209*	0.108	0.035	-.016	-.238*	-.000	-.068	0.108	-.071	-.023
Portfolio 5	0.0114	0.0594	-.078	0.086	-.103	0.115	0.135	-.158	-.042	-.113	0.019	-.062	-.034	0.001
Portfolio 6	0.0077	0.0630	0.038	-.059	-.031	0.146	0.074	-.135	-.160	-.036	-.115	-.088	0.016	0.030
Portfolio 7	0.0096	0.0596	-.003	0.046	-.076	0.140	0.148	-.086	-.030	-.116	0.038	-.014	0.064	-.030
Portfolio 8	0.0118	0.0589	0.015	0.008	-.007	0.114	0.086	-.143	-.064	-.072	0.014	-.051	-.054	-.087
Italian Portfolios														
Portfolio 1	-.0004	0.0746	-.062	-.044	0.227*	-.092	0.014	0.075	-.157	-.182	0.077	-.124	-.160	0.087
Portfolio 2	-.0014	0.0846	-.046	-.001	0.266*	-.047	-.073	0.135	-.079	-.149	0.065	-.086	-.164	0.105
Portfolio 3	0.0035	0.0635	0.098	0.037	0.122	-.035	-.005	0.097	-.040	0.040	0.069	-.164	-.193	-.024
Portfolio 4	0.0034	0.0808	-.090	0.028	0.222*	-.059	0.008	-.003	0.063	-.015	0.060	-.143	-.028	0.019
Portfolio 5	0.0037	0.0919	-.011	0.065	0.168	-.060	0.063	-.038	-.062	-.013	0.020	-.145	-.068	0.025
Portfolio 6	0.0026	0.0892	-.024	0.071	0.203*	-.141	-.014	0.060	-.140	0.009	0.069	-.184	-.005	-.018
Portfolio 7	0.0047	0.0824	-.046	0.069	0.266*	-.162	0.067	-.064	-.139	-.064	-.098	-.052	-.054	-.059
Portfolio 8	-.0009	0.0759	0.011	0.047	0.234*	-.004	-.002	0.106	-.036	-.120	0.078	-.069	-.052	0.046
Japanese Portfolios														
Portfolio 1	0.0055	0.0676	0.001	-.003	-.112	0.050	0.067	0.020	0.074	0.014	0.064	0.047	0.002	0.047
Portfolio 2	0.0073	0.0674	0.005	0.033	-.121	-.051	-.015	0.020	-.028	-.102	0.066	-.008	-.024	0.093
Portfolio 3	0.0086	0.0669	-.100	0.021	-.089	0.097	-.056	0.044	0.070	0.045	0.009	0.100	-.055	-.027
Portfolio 4	0.0040	0.0600	-.108	0.033	0.003	0.051	-.002	0.003	0.003	-.008	0.013	0.031	0.009	0.010
Portfolio 5	0.0149	0.0647	-.137	0.044	-.084	-.111	-.020	0.053	0.004	-.192	0.064	-.040	0.001	0.092
Portfolio 6	0.0087	0.0710	-.058	-.001	-.138	0.043	-.038	0.078	0.005	-.052	0.078	-.069	-.029	0.029
Portfolio 7	0.0150	0.0715	-.191	0.023	-.144	0.046	[illegible]	-.015	-.029	-.077	-.064	0.060	0.059	0.036
Portfolio 8	0.0095	0.0673	-.146	0.038	-.185	-.028	0.013	0.094	0.045	-.150	0.010	-.012	-.066	0.103
Dutch Portfolios														
Portfolio 1	0.0140	0.0641	-.145	0.005	0.045	-.040	0.159	-.055	-.001	0.049	-.187	0.101	0.064	0.004
Portfolio 2	0.0060	0.0524	-.008	-.055	0.020	-.025	0.181	0.073	-.143	-.094	-.108	-.002	0.169	-.044
Portfolio 3	0.0050	0.0605	-.009	-.028	-.084	0.085	0.240*	-.003	-.081	-.162	-.127	0.040	-.071	0.033
Portfolio 4	0.0088	0.0592	-.015	0.039	-.044	0.066	0.176	0.099	-.069	0.016	-.081	0.105	0.111	0.017
Portfolio 5	0.0052	0.0626	-.061	-.009	-.019	-.047	0.077	-.027	-.116	-.074	-.123	-.069	0.009	-.041
Portfolio 6	0.0042	0.0585	0.068	-.146	-.069	-.086	0.148	0.029	-.134	-.106	-.218*	-.027	0.109	0.004
Portfolio 7	0.0028	0.0668	0.067	0.001	0.010	0.047	0.106	-.018	-.068	-.142	-.143	-.073	-.101	-.124
Portfolio 8	0.0081	0.0557	-.093	-.119	-.020	-.015	0.185	-.034	-.002	-.183	-.113	-.021	0.004	0.101
Swiss Portfolios														
Portfolio 1	0.0107	0.0484	-.015	0.0115	-.132	0.072	-.014	0.084	-.011	-.037	0.000	-.044	-.033	-.017

	Mean	S.D.	Autocorrelations ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}	ρ_{11}	ρ_{12}
A. Equity Returns														
Portfolio 2	0.0084	0.0488	0.043	0.076	-.067	0.158	0.041	0.061	-.072	-.090	-.060	-.065	0.020	-.044
Portfolio 3	0.0050	0.0473	0.113	0.083	-.084	0.102	0.034	0.137	0.094	0.017	0.034	-.070	-.046	-.,082
Portfolio 4	0.0085	0.0447	0.108	0.142	-.139	0.111	0.072	0.016	0.048	-.124	0.002	-.037	0.071	-.073
Portfolio 5	0.0070	0.0573	-.011	0.061	-.023	0.100	0.054	0.014	0.028	-.018	-.063	0.019	-.033	0.027
Portfolio 6	0.0095	0.0643	-.017	0.023	-.043	0.064	0.081	0.001	-.069	-.041	-.119	-.110	0.077	-.081
Portfolio 7	0.0022	0.0565	0.045	-.042	-.160	0.067	0.018	0.133	-.117	0.007	-.176	-.096	0.030	0.031
Portfolio 8	0.0099	0.0591	0.003	0.157	-.112	0.199*	0.071	0.090	-.014	-.061	-.133	-.052	0.080	-.081
UK Portfolios														
Portfolio 1	0.0041	0.0666	-.008	-.032	0.086	-.047	0.123	0.012	-.056	0.047	-.059	0.015	0.042	0.009
Portfolio 2	0.0038	0.0675	0.018	-.069	0.045	-.039	0.109	-.002	-.089	0.042	-.079	0.001	0.038	0.041
Portfolio 3	0.0036	0.0536	0.123	-.002	0.068	-.028	0.124	-.026	-.062	0.068	-.056	0.039	0.021	0.077
Portfolio 4	0.0008	0.0582	0.062	0.006	0.058	-.042	0.142	0.002	-.057	0.032	-.100	0.028	0.049	0.062
Portfolio 5	0.0045	0.0779	-.043	0.045	0.001	-.079	0.124	0.009	-.106	0.086	-.104	0.020	0.026	0.028
Portfolio 6	0.0027	0.0806	-.094	-.014	0.036	-.087	0.114	0.027	-.129	0.096	-.074	0.010	0.045	-.001
Portfolio 7	0.0018	0.0706	-.015	-.041	0.059	-.078	0.089	0.048	-.084	0.036	-.111	-.001	0.039	0.030
Portfolio 8	0.0038	0.0713	-.053	-.046	0.035	-.092	0.059	-.006	-.067	0.070	-.144	0.053	0.002	-.021
US Portfolios														
Portfolio 1	-.0026	0.0493	0.021	0.084	-.008	-.059	0.043	0.132	0.025	0.067	-.130	0.007	-.031	0.113
Portfolio 2	-.0188	0.1961	-.058	-.007	-.016	-.019	-.025	0.000	-.038	-.028	-.026	-.032	0.113	-.009
Portfolio 3	0.0018	0.0439	-.030	0.104	-.015	0.024	-.056	0.094	-.042	0.068	-.093	0.019	0.025	0.073
Portfolio 4	0.0008	0.0471	-.085	0.087	-.091	0.031	-.043	0.223*	-.189	0.126	-.082	-.014	-.048	0.202*
Portfolio 5	0.0002	0.0694	-.140	0.118	-.021	-.031	-.086	0.131	-.121	0.094	-.062	-.038	-.137	0.022
Portfolio 6	0.0023	0.0630	-.059	0.132	0.018	-.025	-.072	0.212*	-.034	0.093	-.086	-.036	-.112	0.045
Portfolio 7	0.0018	0.0630	-.117	0.033	-.036	-.054	-.087	0.234*	-.024	0.101	-.134	-.028	-.078	0.053
Portfolio 8	0.0010	0.0704	-.005	0.188	0.085	0.042	0.099	0.219*	-.065	0.060	-.071	-.064	-.021	-.123
World Index	0.0053	0.0428	-.134	0.126	-.004	0.013	-.010	0.057	-.045	-.039	-.032	-.029	-.028	0.051
B. Other Variables														
Short-Term Interest Rates														
Australia	0.0094	0.0029	0.903*	0.815*	0.723*	0.668*	0.579*	0.522*	0.430*	0.366*	0.320*	0.310*	0.296*	0.285*
Canada	0.0085	0.0026	0.917*	0.798*	0.694*	0.622*	0.560*	0.492*	0.430*	0.374*	0.322*	0.258*	0.208*	0.172
France	0.0085	0.0022	0.932*	0.823*	0.703*	0.597*	0.508*	0.427*	0.361*	0.310*	0.283*	0.278*	0.264*	0.237*
Germany	0.0052	0.0024	0.434*	0.802*	0.451*	0.533*	0.421*	0.331*	0.323*	0.172	0.172	0.003	0.059	-.114
Italy	0.0014	0.0364	0.911*	0.776*	0.647*	0.529*	0.420*	0.328*	0.270*	0.263*	0.284*	0.319*	0.347*	0.352*
Japan	0.0057	0.0022	0.940*	0.856*	0.757*	0.634*	0.525*	0.417*	0.317*	0.235*	0.159	0.080	0.076	-.034
Netherlands	0.0057	0.0026	0.798*	0.573*	0.373*	0.203*	0.156	0.105	0.075	0.046	0.061	0.083	0.099	0.113
Switzerland	0.0005	0.0267	0.903*	0.806*	0.672*	0.517*	0.377*	0.248*	0.145	0.062	0.005	-.064	-.115	-.173
U.K.	0.0092	0.0019	0.869*	0.704*	0.552*	0.401*	0.278*	0.166*	0.080	0.033	-.078	-.075	-.136	-.188
U.S.A.	0.0065	0.0021	0.805*	0.707*	0.687*	0.689*	0.606*	0.532*	0.474*	0.451*	0.401*	0.294*	0.242*	0.270*
Unexpected Inflation														
Australia	-.0086	0.0309	0.099	-.106	0.022	0.097	0.120	-.105	-.002	0.100	-.083	0.057	0.076	0.030
Canada	-.0087	0.0123	-.127	0.051	-.008	-.024	0.088	-.086	0.115	0.071	0.091	-.094	0.051	-.007
France	-.0045	0.0316	-.111	0.067	-.224*	0.105	-.043	-.007	0.065	0.043	0.074	-.025	-.006	-.009
Germany	0.0004	0.0368	-.100	-.070	-.279*	0.096	0.012	-.102	-.031	0.087	0.114	0.083	-.098	-.145
Italy	0.0018	0.0251	-.117	0.017	-.202*	0.071	-.049	-.122	0.096	0.007	0.130	0.029	-.066	-.055
Japan	-.0031	0.0342	-.149	-.034	-.227*	0.031	-.108	0.060	-.070	-.042	0.174	0.073	-.041	-.028
Netherlands	0.0004	0.0364	0.020	-.161	-.214*	0.072	0.062	-.110	-.025	0.050	0.196*	0.100	-.132	-.199*
Switzerland	0.0031	0.0364	-.048	-.064	-.307*	-.112	0.000	-.105	0.116	0.073	0.229*	-.006	-.045	-.156
U.K.	-.0066	0.0312	-.030	-.154	0.011	-.095	0.024	0.112	-.042	0.048	0.201*	-.006	-.139	-.100
U.S.A.	-.0005	0.0029	0.159	-.065	0.014	-.086	0.229*	0.226*	0.071	0.074	-.229*	-.051	0.027	-.004
Foreign Exchange Common Component Indices Constructed in Terms of Alternative Currencies														
Australia	-.0078	0.0275	0.177	-.046	-.112	-.104	0.094	-.088	0.008	0.262*	0.002	0.008	-.247*	-.119
Canada	-.0056	0.0225	0.154	0.148	-.051	0.084	0.109	0.046	0.030	0.052	0.092	0.059	0.039	-.005
France	-.0097	0.0145	-.142	0.254*	-.114	0.157	-.044	0.025	0.024	0.026	-.042	-.139	0.039	0.023
Germany	-.0074	0.0154	0.059	-.087	-.231*	0.094	0.128	-.076	-.080	0.041	0.078	0.082	-.123	-.090
Italy	-.0021	0.0141	0.059	0.205*	-.056	0.002	0.126	0.095	0.045	0.020	0.057	0.109	0.060	0.096
Japan	-.0059	0.0218	0.051	0.158	-.034	0.121	-.040	0.025	-.215*	-.045	-.071	-.150	-.124	-.043
Netherlands	-.0078	0.0147	0.120	-.073	-.173	-.075	0.077	-.150	-.055	-.030	0.081	0.118	-.078	-.044
Switzerland	-.0023	0.0208	0.017	0.077	-.158	-.121	0.046	-.057	0.072	-.057	0.144	-.051	0.114	-.202*
U.K.	-.0076	0.0196	0.064	-.076	0.036	-.049	-.005	-.154	-.063	0.042	0.067	-.026	0.094	-.031
U.S.A.	-.0065	0.0233	0.151	0.098	-.099	0.119	0.066	-.007	0.077	0.008	0.149	0.097	0.007	-.050
Foreign Exchange Idiosyncratic Component Indices Constructed in Terms of Alternative Currencies														
Australia	-.0096	0.0039	0.526*	0.395*	0.353*	0.326*	0.267*	0.157	0.121	0.141	0.101	-.001	0.055	0.044
Canada	-.0086	0.0048	0.310*	0.273*	0.241*	0.217*	0.172	0.057	-.007	0.078	0.057	-.050	-.051	-.076
France	-.0086	0.0043	0.092	0.229*	0.125	0.256*	0.179*	0.128	-.051	0.068	0.115	0.064	-.001	-.080
Germany	-.0053	0.0039	0.254*	0.146	0.164	0.257*	0.243*	0.113	-.058	0.057	0.071	-.077	-.076	-.133
Italy	-.0016	0.0034	0.126	0.032	0.049	0.085	0.110	-.023	-.137	-.031	0.032	-.102	-.065	-.092
Japan	-.0059	0.0039	0.247*	0.150	0.232*	0.173	0.195*	0.048	0.070	0.105	0.091	0.138	-.003	-.038
Netherlands	-.0058	0.0044	0.296*	0.160	0.140	0.119	0.112	0.005	-.178	-.029	0.060	-.002	-.053	-.032
Switzerland	-.0005	0.0033	0.047	0.003	-.015	0.175	0.025	-.068	-.187	0.069	-.069	-.071	-.129	-.155
U.K.	-.0091	0.0038	0.247*	0.208*	0.175	0.076	0.135	0.008	-.200*	-.041	-.097	-.153	-.114	-.110
U.S.A.	-.0065	0.0038	0.283*	0.193	0.235*	0.172	0.283*	0.104	-.044	0.101	0.021	0.048	-.116	-.022

* Significant at the 5% level based on an approximate standard error of $1/\sqrt{108}=0.0962$

Table 2 Equilibrium Coefficients γ_0: Single-Country Tests

T-values calculated out of standard errors corrected for White (1980) heteroskedasticity and serial correlation appear in parentheses.

Country	GLS		S - S		A D	
	US$	Local	US$	Local	US$	Local
Australia	-.0107 (-2.08)	-.0597 (-3.10)	0.0214 (0.56)	-.0445 (-1.14)	0.0140 (0.29)	0.0552 (0.88)
Canada	0.0205 (1.29)	-.0256 (-1.15)	0.0022 (0.63)	-.0016 (-.35)	-.0261 (-.67)	-.0140 (-.58)
France	0.0244 (2.07)	-.0139 (-1.12)	0.0011 (0.17)	-.0314 (-.93)	0.0220 (1.01)	-.0102 (-.66)
Germany	0.0094 (3.66)	0.0037 (1.70)	0.0095 (3.43)	0.0109 (1.53)	0.0083 (1.21)	0.0256 (0.63)
Italy	-.0013 (-.26)	0.0004 (0.11)	-.0024 (-.48)	0.0007 (0.19)	0.0010 (0.19)	-.0009 (-.08)
Japan	0.0184 (2.41)	0.0044 (1.07)	0.0144 (2.00)	-.0206 (-.92)	0.0131 (0.83)	0.0172 (0.92)
Netherlands	0.0028 (1.15)	0.0094 (1.73)	0.0045 (1.69)	0.0045 (0.79)	-.0012 (-.17)	-.0033 (-.08)
Switzerland	-.0063 (-1.55)	-.0048 (-1.39)	0.0023 (0.33)	-.0119 (-1.12)	-.0005 (-.04)	0.0017 (0.06)
UK	-.0025 (-1.04)	-.0017 (-.75)	-.0253 (-.30)	0.0107 (0.40)	-.0251 (-.31)	0.0218 (0.24)
USA	-.0015 (-.94)	0.0007 (0.08)	-.0018 (-.75)	0.0020 (0.25)	0.0009 (0.25)	0.0008 (0.04)

Table 3. Equilibrium Coefficients γ_λ, and γ_c: Single-Country Tests

T-values calculated out of standard errors corrected for White (1980) heteroskedasticity and serial correlation appear in parentheses.

Country	γ_λ				γ_c			
	Solnik-Sercu		Adler-Dumas		Solnik-Sercu		Adler-Dumas	
	US$	Local	US$	Local	US$	Local	US$	Local
Australia	0.0727 (0.99)	0.0513 (1.08)	0.0707 (0.43)	0.0786 (0.83)	0.0016 (0.16)	0.0501 (1.13)	-.0011 (-.07)	0.0259 (0.84)
Canada	0.0029 (0.20)	0.0077 (0.49)	0.0302 (0.56)	0.0348 (0.55)	0.0028 (1.61)	0.0027 (0.83)	0.0063 (1.17)	0.0017 (0.24)
France	-.0053 (-.31)	0.0031 (0.16)	-.0031 (-.20)	0.0012 (0.09)	0.0129 (4.90)	0.0295 (1.27)	0.0121 (1.98)	0.0157 (1.54)
Germany	0.0014 (0.30)	0.0180 (2.35)	0.0003 (0.03)	0.0410 (0.72)	0.0063 (4.76)	0.0005 (0.109)	0.0033 (0.95)	0.0017 (0.18)
Italy	0.0157 (1.75)	0.0105 (2.93)	-.0032 (-.10)	0.0108 (0.75)	0.0087 (4.55)	0.0082 (5.24)	0.0088 (2.60)	0.0023 (0.18)
Japan	-.0118 (-.78)	-0.0159 (-.63)	-.0115 (-.66)	-.0092 (-.35)	0.0111 (2.61)	-.0059 (-.59)	0.0107 (1.66)	0.0137 (1.43)
Netherlands	0.0093 (1.95)	0.0036 (0.50)	0.0163 (1.53)	-.0385 (-.40)	0.0092 (11.93)	0.0072 (4.73)	0.0060 (1.70)	0.0149 (0.92)
Switzerland	0.0148 (2.51)	-.0381 (-.93)	-.0062 (-.35)	0.0127 (0.12)	0.0025 (1.31)	0.0069 (1.71)	0.0093 (2.08)	-.0006 (-.03)
UK	0.0143 (0.39)	0.0187 (0.49)	0.0158 (0.11)	0.0431 (0.26)	0.0314 (0.35)	-.0077 (-.27)	0.0318 (0.39)	-.0185 (-.18)
USA	0.0045 (0.63)	0.0039 (0.82)	0.0147 (1.23)	0.0092 (0.66)	0.0051 (4.06)	0.0045 (3.67)	0.0068 (3.64)	0.0057 (2.04)

Table 4. Inflation Equilibrium Coefficients, γ_i and γ_π: Single-Country Tests

T-values calculated out of standard errors corrected for White (1980) heteroskedasticity and serial correlation appear in parentheses.

Country	γ_i				γ_π	
	GLS		AD		AD	
	US$	Local	US$	Local	US$	Local
Australia	0.0308 (2.30)	0.0638 (2.93)	0.0270 (0.28)	0.0078 (0.16)	0.0113 (0.37)	0.0340 (1.10)
Canada	-.0388 (-1.15)	0.0449 (1.33)	0.0606 (0.77)	0.0410 (0.74)	0.0115 (0.22)	0.0068 (0.67)
France	-.0622 (-1.76)	0.0903 (1.60)	-.0726 (-1.17)	0.0627 (1.04)	0.0353 (1.34)	0.0002 (0.02)
Germany	-.0277 (-3.34)	-.0127 (-2.35)	-.0349 (-1.87)	-.0451 (-.60)	0.0044 (0.37)	-.0096 (-.32)
Italy	0.0057 (0.35)	-.0284 (-1.34)	-.0702 (-.46)	-.0790 (-.61)	0.0178 (0.61)	0.0061 (1.50)
Japan	-.0504 (-1.90)	0.0006 (0.05)	-.0504 (-.89)	-.0187 (-.43)	-.0183 (-.58)	0.0020 (0.20)
Netherlands	-.0061 (-.50)	-.0207 (-1.80)	-.0038 (-.12)	0.0184 (0.19)	0.0008 (0.05)	0.0485 (0.61)
Switzerland	0.0305 (2.04)	0.0524 (1.91)	-.0634 (-.77)	0.0388 (0.33)	-.0181 (-1.48)	0.0472 (0.56)
UK	0.0150 (1.70)	0.0100 (1.44)	0.0751 (0.41)	-.0058 (-.07)	-.0059 (-.03)	0.0073 (0.22)
USA	0.0050 (3.87)	0.0049 (4.69)	0.0046 (2.59)	0.0060 (2.07)	0.0207 (0.91)	-.0020 (-.17)

Table 5. The Equilibrium Coefficients γ_0: Multiple-Country Tests

The row labelled "Portfolios 1" refers to the results from the tests performed using as LHS assets in each of the ten equations the low risk portfolios of each country (i.e., all ten Portfolios 1 constructed for the ten country samples). Similarly, the row labelled "Portfolios 8" refers to the γ_0 coefficients for the three models obtained from the tests that used as LHS assets the ten high risk portfolios of the ten countries. The row labelled "Average" refers to the γ_0 coefficients obtained by performing the tests using as LHS assets the ten mean portfolio returns of the ten countries. T-values corrected for White (1980) heteroskedasticity and autocorrelation appear in parentheses.

	GLS		Solnik-Sercu		Adler-Dumas	
	US$	DM	US$	DM	US$	DM
Portfolios 1	0.0040 (0.72)	-.0005 (-.37)	-.0001 (-.07)	-.0003 (-.13)	-.0002 (-.07)	-.0015 (-.53)
Portfolios 2	0.0016 (0.43)	-.0003 (-.31)	-.0019 (-.86)	0.0002 (0.15)	-.0014 (-.58)	-.0009 (-.40)
Portfolios 3	0.0003 (0.21)	-.0012 (-.98)	0.0010 (0.54)	-.0004 (-.25)	0.0010 (0.54)	-.0025 (1.17)
Portfolios 4	0.0017 (0.53)	-.0007 (-.55)	-.0011 (-.88)	0.0001 (0.05)	-.0004 (-.31)	-.0018 (-.61)
Portfolios 5	0.0006 (0.60)	-.0002 (-.14)	0.0010 (0.85)	0.0003 (0.25)	0.0017 (1.02)	-.0008 (-.28)
Portfolios 6	0.0008 (0.64)	-.0005 (-.32)	0.0002 (0.14)	0.0015 (0.82)	0.0003 (0.24)	-.0032 (-.84)
Portfolios 7	-0.0001 (-.05)	-.0007 (-.42)	0.0017 (0.88)	-.0000 (-.01)	0.0005 (0.30)	-.0108 (-.67)
Portfolios 8	0.0001 (0.05)	-.0011 (-.83)	-.0001 (-.07)	-.0005 (-.39)	-.0002 (-.11)	-.0016 (-.68)
Average	-.0002 (-.12)	-.0008 (-.65)	-.0005 (-.36)	-.0001 (-.04)	-.0006 (-.41)	-.0012 (-.61)

Table 6. The Exchange Rate Equilibrium Coefficients, γ_λ, and γ_e

Multiple-Country Tests

The same comments as in Table 5 apply.

	γ_λ				γ_e			
	Solnik-Sercu		Adler-Dumas		Solnik-Sercu		Adler-Dumas	
	US$	DM	US$	DM	US$	DM	US$	DM
Portfolios 1	0.0147 (5.31)	0.0035 (3.34)	0.0115 (2.57)	0.0029 (1.81)	0.0058 (5.79)	0.0054 (4.89)	0.0060 (4.43)	0.0053 (3.98)
Portfolios 2	0.0150 (4.46)	0.0041 (2.08)	0.0140 (2.90)	0.0041 (1.69)	0.0069 (8.89)	0.0051 (8.32)	0.007 (6.17)	0.0052 (7.89)
Portfolios 3	0.0096 (3.84)	0.0022 (2.51)	0.0096 (2.96)	0.0030 (2.56)	0.0047 (3.720	0.0050 (5.47)	0.0047 (3.80)	0.0055 (5.58)
Portfolios 4	0.0135 (6.66)	0.0035 (4.59)	0.0118 (3.92)	0.0039 (3.33)	0.0063 (7.36)	0.0050 (6.25)	0.0055 (4.38)	0.0052 (5.79)
Portfolios 5	0.0100 (3.50)	0.0030 (2.10)	0.0115 (2.97)	0.0047 (2.39)	0.0057 (6.52)	0.0051 (5.72)	0.0062 (5.34)	0.0046 (3.72)
Portfolios 6	0.0107 (4.40)	0.0029 (2.40)	0.0119 (4.01)	0.0035 (1.71)	0.0072 (7.55)	0.0043 (5.21)	0.0079 (6.23)	0.0046 (3.56)
Portfolios 7	0.0074 (1.72)	0.0028 (2.09)	0.0112 (2.61)	0.0013 (0.25)	0.0051 (4.13)	0.0052 (5.70)	0.0071 (4.44)	0.0070 (1.99)
Portfolios 8	0.0141 (4.35)	0.0024 (1.13)	0.0145 (4.50)	0.0008 (0.31)	0.0064 (7.39)	0.0051 (5.23)	0.0065 (6.68)	0.0044 (3.48)
Average	0.0132 (5.13)	0.0033 (3.27)	0.0138 (4.65)	0.0032 (2.52)	0.0063 (7.61)	0.0051 (7.20)	0.0066 (6.85)	0.0051 (7.25)

Table 7. The Inflation Equilibrium Coefficients, γ_i, and γ_π Multiple-Country Tests

The same comments as in Table 5 apply.

	γ_i				γ_π	
	GLS		Adler-Dumas		Adler-Dumas	
	US$	DM	US$	DM	US$	DM
Portfolios 1	.0044 (-.42)	0.0035 (1.19)	0.0043 (1.82)	0.0001 (0.02)	0.0100 (1.069)	-.0000 (-.01)
Portfolios 2	-.0007 (-.11)	0.0059 (1.43)	0.0064 (2.24)	0.0026 (0.48)	0.0165 (1.68)	0.0031 (1.37)
Portfolios 3	0.0034 (1.28)	0.0008 (0.36)	0.0056 (3.40)	-.0020 (-.52)	0.0101 (1.18)	0.0051 (2.48)
Portfolios 4	0.0009 (0.18)	0.0041 (2.09)	0.0039 (1.45)	0.0002 (0.02)	0.0160 (2.02)	0.0033 (1.07)
Portfolios 5	0.0073 (6.38)	0.0023 (0.73)	0.0081 (5.88)	0.0007 (0.11)	0.0217 (2.68)	0.0122 (2.53)
Portfolios 6	0.0089 (7.87)	0.0025 (0.81)	0.0090 (6.52)	-.0059 (-.76)	0.0077 (0.93)	0.0035 (0.66)
Portfolios 7	0.0081 (5.47)	0.0018 (0.49)	0.0092 (5.19)	-.0260 (-.65)	0.0181 (2.18)	-.0214 (-.69)
Portfolios 8	0.0084 (6.01)	0.0014 (0.30)	0.0068 (4.79)	-.0053 (-.59)	0.0164 (2.37)	0.0071 (1.74)
Average	0.0090 (5.54)	0.0036 (1.35)	0.0071 (5.55)	0.0012 (0.26)	0.0176 (2.39)	0.0037 (1.36)

Table 8. The "True" Cross-Sectional Variance of International Betas

$s^2(b_j)$ refers to the cross-sectional variance, $s^2(\epsilon_j)$ is the variance of b_j, and $s^2(\beta_j)$ is the "true" cross-sectional variance.

	Grauer-Litzenberger-Stehle			Solnik-Sercu			Adler-Dumas		
	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$
Panel A1: World Betas in US Dollars									
Australia	0.047	0.049	**-.002**	0.058	0.077	**-.019**	0.056	0.039	**0.017**
Canada	0.017	0.014	**0.003**	0.023	0.017	**0.006**	0.018	0.014	**0.004**
France	0.016	0.020	**-.004**	0.025	0.023	**0.002**	0.025	0.020	**0.005**
Germany	0.005	0.019	**-.014**	0.006	0.022	**-.016**	0.008	0.022	**0.017**
Italy	0.012	0.021	**-.009**	0.013	0.023	**-.009**	0.013	0.020	**0.004**
Japan	0.008	0.024	**-.016**	0.006	0.041	**-.035**	0.006	0.030	**-.024**
Netherlands	0.010	0.025	**-.015**	0.015	0.025	**-.010**	0.014	0.025	**-.011**
Switzerland	0.017	0.019	**-.002**	0.018	0.019	**-.001**	0.017	0.020	**-.002**
U.K.	0.022	0.023	**-.001**	0.021	0.019	**0.002**	0.020	0.023	**-.002**
U.S.A.	0.039	0.015	**0.024**	0.054	0.046	**0.008**	0.049	0.047	**0.002**
Panel B1: Common Component Exchange Rate Betas in US Dollars									
Australia				0.023	0.128	**-.105**	0.306	0.975	**-.669**
Canada				0.021	0.047	**-.026**	0.545	0.546	**-.001**
France				0.007	0.062	**-.054**	0.331	0.907	**-.669**
Germany				0.019	0.041	**-.022**	0.224	0.695	**-.471**
Italy				0.019	0.131	**-.112**	0.217	1.802	**-1.586**
Japan				0.027	0.037	**-.009**	0.071	0.851	**-.780**
Netherlands				0.036	0.060	**-.024**	0.095	0.634	**-.539**
Switzerland				0.024	0.043	**-.019**	0.156	0.297	**-.141**
U.K.				0.007	0.039	**-.032**	0.074	0.603	**-.528**

	Grauer-Litzenberger-Stehle			Solnik-Sercu			Adler-Dumas		
	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$
Panel A2: World Betas in Local Currencies*									
Australia	0.013	0.021	**-.008**	0.050	0.043	**0.007**	0.054	0.045	**0.009**
Canada	0.015	0.017	**-.002**	0.019	0.017	**0.002**	0.018	0.050	**-.032**
France	0.019	0.024	**-.005**	0.026	0.020	**0.006**	0.026	0.021	**0.005**
Germany	0.006	0.018	**-.012**	0.008	0.023	**-.015**	0.008	0.021	**-.013**
Italy	0.012	0.021	**-.009**	0.014	0.025	**-.011**	0.013	0.024	**-.011**
Japan	0.007	0.028	**-.020**	0.006	0.024	**-.018**	0.006	0.024	**-.017**
Netherlands	0.011	0.021	**-.010**	0.014	0.027	**-.013**	0.014	0.026	**-.012**
Switzerland	0.015	0.017	**-.002**	0.015	0.018	**-.003**	0.016	0.020	**-.004**
U.K.	0.018	0.020	**-.002**	0.019	0.021	**-.002**	0.020	0.020	**-.000**
U.S.A.	0.054	0.014	**0.040**	0.062	0.015	**0.047**	0.068	0.018	**0.050**
Panel B2: Common Component Exchange Rate Betas in Local Currencies*									
Australia				0.067	0.116	**-.049**	0.035	0.109	**-.074**
Canada				0.029	0.048	**-.018**	0.036	0.036	**-.000**
France				0.129	0.171	**-.042**	0.261	0.553	**-.292**
Germany				0.042	0.095	**-.053**	0.035	0.418	**-.383**
Italy				0.132	0.392	**-.262**	0.147	0.535	**-.388**
Japan				0.031	0.066	**-.035**	0.053	0.061	**-.008**
Netherlands				0.029	0.127	**-.098**	0.225	0.656	**-.431**
Switzerland				0.005	0.025	**-.020**	0.021	0.092	**-.071**
U.K.				0.030	0.072	**-.041**	0.008	0.078	**-.071**

	Grauer-Litzenberger-Stehle			Solnik-Sercu			Adler-Dumas		
	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$
U.S.A.				0.058	0.033	**0.025**	0.776	0.666	**0.110**
Panel C1: Idiosyncratic Component Exchange Rate Betas in US Dollars									
Australia				0.350	3.032	**-2.682**	0.579	3.601	**-3.021**
Canada				0.810	1.351	**-.542**	1.247	1.232	**0.015**
France				0.231	1.769	**-1.538**	0.479	2.449	**-1.970**
Germany				0.199	1.043	**-.844**	0.345	1.999	**-1.654**
Italy				0.643	3.950	**-3.307**	0.658	3.990	**-3.332**
Japan				0.214	2.441	**-2.227**	0.158	2.395	**-2.237**
Netherlands				1.367	1.213	**0.154**	3.095	3.582	**-.486**
Switzerland				0.109	0.638	**-.529**	0.304	0.646	**-.342**
U.K.				0.025	1.607	**-1.582**	0.034	1.661	**-1.627**
U.S.A.				1.135	1.789	**-.654**	1.705	1.802	**-.098**
Panel D1: Domestic Inflation Betas in US Dollars									
Australia	0.004	0.014	**-.010**				0.013	0.043	**-.030**
Canada	0.013	0.018	**-.004**				0.093	0.097	**-.004**
France	0.001	0.006	**-.005**				0.035	0.106	**-.071**
Germany	0.002	0.003	**-.001**				0.022	0.058	**-.036**
Italy	0.004	0.027	**-.023**				0.015	0.207	**-.192**
Japan	0.002	0.005	**-.003**				0.001	0.046	**-.045**
Netherlands	0.004	0.005	**-.001**				0.012	0.063	**-.051**
Switzerland	0.002	0.003	**-.001**				0.005	0.018	**-.013**
U.K.	0.002	0.034	**-.032**				0.007	0.058	**-.051**
U.S.A.	0.481	1.020	**-.539**				0.782	1.132	**-.350**
Panel E1: World Inflation Betas in US Dollars									
Australia							0.060	0.339	**-.280**
Canada								0.173	**0.040**
France							0.213	0.254	**-.156**
Germany							0.061	0.171	**-.110**

	Grauer-Litzenberger-Stehle			Solnik-Sercu			Adler-Dumas		
	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$
U.S.A.				0.159	0.144	**0.015**	0.554	0.963	**-.409**
Panel C2: Idiosyncratic Component Exchange Rate Betas in Local Currencies*									
Australia				0.012	0.059	**-.047**	0.195	0.533	**-.338**
Canada				0.336	0.744	**-.408**	0.355	0.801	**-.446**
France				0.072	0.943	**-.871**	0.475	1.488	**-1.013**
Germany				0.071	0.737	**-.067**	0.208	1.479	**-1.271**
Italy				0.608	4.050	**-3.442**	0.810	4.895	**-4.085**
Japan				0.031	0.066	**-.034**	0.300	1.742	**-1.442**
Netherlands				0.820	0.729	**0.091**	1.290	1.291	**-.001**
Switzerland				0.294	0.483	**-.189**	0.216	0.524	**-.308**
U.K.				0.018	0.956	**-.938**	0.019	1.097	**-1.078**
U.S.A.				0.735	1.071	**-.336**	1.024	2.110	**-1.086**
Panel D2: Domestic Inflation Betas in Local Currencies*									
Australia	0.003	0.013	**-.010**				0.023	0.057	**-.034**
Canada	0.021	0.053	**-.032**				0.060	0.092	**-.032**
France	0.004	0.021	**-.017**				0.027	0.078	**-.051**
Germany	0.008	0.011	**-.003**				0.010	0.050	**-.040**
Italy	0.005	0.059	**-.053**				0.006	0.109	**-.103**
Japan	0.008	0.037	**-.029**				0.011	0.027	**-.016**
Netherlands	0.007	0.014	**-.007**				0.032	0.069	**-.037**
Switzerland	0.003	0.005	**-.002**				0.015	0.019	**-.003**
U.K.	0.018	0.019	**-.002**				0.013	0.023	**-.010**
U.S.A.	0.022	0.024	**-.002**				0.028	0.155	**-.127**
Panel E2: World Inflation Betas in Local Currencies*									
Australia							0.104	0.369	**-.265**
Canada							0.325	0.305	**0.020**
France							0.248	0.860	**-.613**
Germany							0.094	0.452	**-.359**

	Grauer-Litzenberger-Stehle			Solnik-Sercu			Adler-Dumas			Grauer-Litzenberger-Stehle			Solnik-Sercu			Adler-Dumas		
	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta_j)$
Italy							0.101	0.599	**-.498**							0.822	1.880	**-1.058**
Japan							0.018	0.357	**-.339**							0.164	0.232	**-.068**
Netherlands							0.138	0.289	**-.151**							0.336	0.483	**-.147**
Switzerland							0.028	0.086	**-.058**							0.035	0.117	**-.083**
U.K.							0.031	0.184	**-.153**							0.032	0.542	**-.510**
U.S.A.							0.490	0.195	**0.295**							0.955	0.384	**0.570**

*** The results for the USA refer to the tests conducted in terms of Deutch-Marks**

Table 9. The "True" Cross-Country Variances of International Betas

The same comments as in Table 8 apply, but the quantities now refer to the cross-country variances. They have been calculated using the betas obtained from the tests that had as LHS assets the ten mean portfolio returns of the ten countries.

	GLS			S - S			A D		
	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta)$	$s^2(b_j)$	$s^2(\epsilon_j)$	$s^2(\beta)$
Panel A: World Betas									
AVERAGE IN US$	0.010	0.018	**-.007**	0.016	0.021	**-.005**	0.016	0.023	**-.006**
AVERAGE IN DM	0.019	0.019	**-.000**	0.017	0.024	**-.007**	0.016	0.025	**-.009**
Panel B: Common Component Exchange Rate Betas									
AVERAGE IN US$				0.397	0.047	**0.356**	1.325	0.513	**0.812**
AVERAGE IN DM				1.245	0.132	**1.113**	1.364	1.075	**0.288**
Panel C: Idiosyncratic Component Exchange Rate Betas									
AVERAGE IN US$				3.532	1.404	**2.127**	3.817	1.545	**2.272**
AVERAGE IN DM				2.974	1.141	**1.834**	4.434	2.033	**2.401**
Panel D: Domestic Inflation Betas									
AVERAGE IN US$	0.533	1.104	**-.571**				0.887	1.311	**-.424**
AVERAGE IN DM	0.211	0.024	**0.187**				0.183	0.185	**-.002**
Panel E: World Inflation Betas									
AVERAGE IN US$							0.186	0.140	**0.046**
AVERAGE IN DM							0.393	0.245	**0.145**

Table 10. A Chi-Squared Test of the Cross-Sectional Restrictions

The critical values for the chi-squared test at the 5% significance level are a follows:

χ^2_6: 12.59, χ^2_5: 11.01, χ^2_3: 7.81, χ^2_8: 15.51, and χ^2_7: 14.07. The row labelled "Average" in Panel B refers to the tests that use for each country's equation, the average return of its eight portfolios.

Panel A: Individual-Country Tests						
	GLS: χ^2_6		**S-S: χ^2_5**		**A-D: χ^2_3**	
Country	**US$**	**Local**	**US$**	**Local**	**US$**	**Local**
Australia	6.29	4.53	2.53	2.67	3.48	3.25
Canada	2.98	1.85	2.95	2.87	4.46	4.42
France	5.95	6.89	2.99	3.29	1.49	0.82
Germany	4.52	3.90	5.16	2.09	1.81	1.45
Italy	3.60	1.44	2.77	2.88	2.16	2.21
Japan	2.81	12.51	3.80	4.31	3.46	2.26
Netherlands	6.27	5.23	3.23	6.26	1.69	1.29
Switzerland	8.05	5.56	8.62	2.15	4.41	5.57
UK	8.72	9.62	3.34	1.43	5.33	3.09
USA	**US$**	**DM**	**US$**	**DM**	**US$**	**DM**
	3.18	4.17	3.99	4.26	2.67	3.44
Panel B: Multiple-Country Tests						
	GLS: χ^2_8		**S-S: χ^2_7**		**A-D: χ^2_5**	
	US$	**DM**	**US$**	**DM**	**US$**	**DM**
Average	43.93	25.37	49.09	32.86	49.50	31.49

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