Do Global Risk Factors Matter for International Cost of Capital Computations?

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Abstract

International financial markets are becoming integrated. Hence, global risk factor are increasingly important for portfolio selection and asset pricing. The recent empirical finance literature has confirmed that both the global market portfolio and exchange rate risk factors constitute important determinants of asset returns. We show, however, that global risk factors do not importantly affect estimates of the cost of equity capital for a remarkably wide variety of companies. We analyze almost 3,300 stocks from nine industrialized countries over the period 1980-1999. Incorporating global factors into cost of capital estimations leads to an adjustment of roughly 50 basis points per annum on average for the U.S. and 70 to 100 basis points for the other countries. Adjustments of this magnitude easily fall inside the margin of error associated with actual cost of capital computations. Specifically for U.S. companies, the amendment of the cost of capital estimate is generally very small. This suggests that global risk factors do not really matter for computing the cost of capital of U.S. firms.

Keywords

Cost of equity capital, exchange rate risk, capital budgeting, valuation

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1 Introduction

In the past decades, we have observed a continuing process of integration of international financial markets. Barriers to international investment among developed economies have slowly but steadily diminished. Hence, global factors are becoming more important for portfolio choice and asset pricing. Recent empirical evidence indicates that global factors, notably exchange rates, affect the pricing of stocks in industrialized countries. This suggests the use of an international CAPM (ICAPM) for computing a firm's cost of equity capital. In this paper we examine to what extent global factors have to be taken seriously in practical cost of capital computations.

In a world with perfectly integrated financial markets, assets have the same price regardless of where they are traded. In that case, a single factor ICAPM in which the world market portfolio is the only priced risk factor should be used for calculating the cost of equity capital. Recent empirical studies, e.g. Jorion and Schwartz (1986), Korajczyk and Viallet (1989), Harvey (1991), and De Santis and Gérard (1997), indicate that the world market factor is an important determinant of asset returns.

If investors in different countries face different good prices, however, risk premia based on the covariance of assets with exchange rates have to be incorporated in the asset pricing model. When the assumption of exact purchasing power parity is relaxed, a multifactor ICAPM including currency risk factors should be used for cost of capital computations. Dumas and Solnik (1995) and Vassalou (2000) find evidence in favor of priced currency risk factors in a large number of countries. De Santis and Gérard (1998) directly test the restrictions imposed by the conditional multifactor ICAPM using stock market indices of Germany, Japan, the United Kingdom, and the United States in the period 1973-1994. They find strong evidence in favor of a model that includes both global market risk and three exchange rate risk factors.

The fact that recent empirical literature provides clear evidence in favor of the hypothesis that global factors affect the pricing of domestic assets does not necessarily imply that a domestic version of the CAPM will provide an incorrect estimate of the cost of capital. The two asset pricing models will lead to the same cost of capital if the local stock market portfolio contains all the information that is relevant in order to price domestic assets internationally. Conversely, the domestic CAPM will underestimate the cost of equity capital of a firm if the risk that is specific according to the domestic CAPM contains additional systematic risk related to priced global factors. On the other hand, the domestic CAPM will lead to an overestimation of the cost of capital if a firm's stock exhibits risk that the CAPM indicates to be systematic, but that can be diversified in the global market.

This paper presents an empirical examination of the issue whether international and domestic asset pricing models really lead to a different estimate of the cost of capital. We analyze the difference in the estimates of a firm's cost of capital when computed with the domestic CAPM as compared to the single factor ICAPM of Grauer, Litzenberger, and Stehle (1976) – henceforth GLS. In the latter model, the world market portfolio is the only priced risk factor. We use monthly data on 3,293 stocks from nine different countries over the period 1980:02-1999:06. We show that for only around 4 percent of all firms in our sample the domestic CAPM yields a significantly different cost of capital than the single factor ICAPM of GLS at the 95% confidence level. This finding may be attributed to the fact that individual countries' local market indices are highly correlated with the world market portfolio.

A large number of studies report evidence that substantial deviations from purchasing power parity are present at a monthly horizon, see e.g. Abuaf and Jorion (1990), Frankel and Rose (1995), Rogoff (1996), and Koedijk, Schotman, and van Dijk (1998). Moreover, as mentioned above, recent evidence indicates that exchange rate risk is priced in international asset markets. Therefore, the multifactor ICAPM including exchange rate factors may well be required to compute the cost of capital. We also examine whether the domestic CAPM yields a significantly different cost of capital when compared to the multifactor ICAPM of Solnik (1983) and Sercu (1980) including both the world market factor and currency factors. We find that the estimates cost of capital implied by the domestic CAPM and the multifactor ICAPM are significantly different for only approximately 5 percent of all firms in our sample. Without taking currency risk premia into account, the absolute difference in the cost of capital between the domestic CAPM and the multifactor ICAPM amounts to about 50 basis points for the U.S., about 75 basis points for Japan, and 70 to 100 basis points for European countries. Although cost of capital differentials of up to one percentage point are non-trivial, we argue that differences of this magnitude easily fall within the confidence interval around practical cost of capital estimates. Recent research confirms that practitioners needing estimates of a firm's cost of equity capital face great uncertainty about both risk loadings and risk premia.

The paper proceeds as follows. Section 2 reviews the international CAPM and shows the conditions under which the cost of capital calculated with the domestic CAPM does not differ from the cost of capital implied by the ICAPM. Section 3 describes the data and section 4 analyzes the empirical evidence. Section 5 concludes and discusses practical implications.

2 Methodology

The basic methodology is taken from Koedijk, Kool, Schotman, and van Dijk (2001). A related study is Karolyi and Stulz (2002). We refer to Stulz (1995) for an overview of the literature on the ICAPM. Assume a world with $N + 1$ countries (currencies). The loadings on the global risk factors in the ICAPM can be defined as the regression coefficients d_i in

$$R_i = a_{1i} + Z' d_i + u_i \,, \tag{1}$$

where R_i is the return on stock i and Z consists of the global priced risk factors. The specific risk u_i is orthogonal to Z. In the single factor ICAPM of GLS the global market factor is the only priced risk factor and $Z' = R_G$, where R_G is the return on the global market index. The ICAPM of Solnik (1983) and Sercu (1980) contains multiple priced factors and $Z' = [R_G, S']$, where S denotes the (N×1) vector of nominal exchange rate returns. In the latter model the risk loadings d_i consist of the global beta d_{i1} and the (multidimensional) exposure to the currency risk factors d_{i2}.

The beta of the domestic CAPM is defined as the regression slope in

$$R_i = a_{2i} + R_L b_i + e_i \,, \tag{2}$$

where R_L is the return of the local market index. Applying (1) to R_L we get

$$R_L = a_L + Z' d_L + u_L \,, \tag{3}$$

where u_L is orthogonal to Z. Substituting equation (3) into (2) yields

$$R_i = a_{3i} + Z' d_L b_i + u_L b_i + e_i \,, \tag{4}$$

where $a_{3i} = a_{2i} + b_i a_L$. Equations (1) and (4) lead to the same decomposition of systematic and specific risk if the local specific risk e_i in equation (2) is orthogonal to Z. In that case, the composite specific risk term $u_L b_i + e_i$ is orthogonal to Z and equations (1) and (4) are identical. But then the parameters in equations (1) and (4) must be the same too, implying

$$d_i = d_L b_i \,. \tag{5}$$

If the restrictions (5) hold, no pricing error results from using the domestic CAPM instead of the ICAPM. We call a test for this null-hypothesis a “pricing error” test. It tests the orthogonality between the global factors and the residuals from the domestic CAPM regression (2). A simple way to implement the test is to add the global instruments Z to the domestic CAPM regression,

$$R_i = a_{4i} + R_L\ b_i + Z'd_i + v_i\ , \tag{6}$$

and test the null hypothesis H_0: $d_i = 0$. If the restriction holds, the specific risk according to the domestic CAPM does not contain any systematic global risk factors. Consequently, the domestic market portfolio contains all the information that is relevant to price assets. On the other hand, if specific risk as indicated by the domestic CAPM does contain additional systematic risk related to the global factors, the domestic CAPM incorrectly ignores such risk. The ICAPM will require a risk premium, however. In that case, the domestic CAPM leads to a different cost of capital than the ICAPM.

3 Data

We use monthly data for nine industrialized countries: Australia, Canada, France, Germany, Japan, the Netherlands, Switzerland, the United Kingdom, and the United States. Nominal exchange rates for all countries are taken from the International Financial Statistics (IFS) tape (line ae). We consider the period 1980:02-1999:06. The market weighted local equity indices and the market weighted global market index are from Morgan Stanley Capital International (MSCI).

Data on individual stocks are obtained from Datastream. We have downloaded stock prices, dividend yields, and dividends of firms that are included in the Datastream equity lists. If dividends are unavailable, the dividend yield is used. If neither dividend data nor dividend yields are available, the stock is excluded from the sample. We also exclude stocks that have not been continuously listed over the whole period and stocks that are denominated in a currency different from the local currency of the country where they are listed. Furthermore, stocks with outlier observations and illiquid stocks are excluded from the sample. The first column of table 1 reports the number of stocks for each country. The total sample consists of 3,293 stocks with a complete series of returns for the period 1980:02-1999:06.

4 Empirical Results

This section presents the results obtained by applying the testing methodology introduced in section 2 to the sample of 3,293 stocks. We investigate the magnitude and significance of the pricing error for each individual firm in order to assess what the impact of the global factors is on the estimation of the cost of equity capital of an individual company. We analyze the pricing error between the domestic CAPM as compared to both the single factor ICAPM and the multifactor ICAPM.

The second column of table 1 presents the rejection percentage of the pricing error test per country. That is, this column shows the percentage of stocks per country for which the single factor ICAPM (without exchange rate risk) yields a significantly different cost of capital estimate compared to the domestic CAPM at the 95% confidence level. We reject the hypothesis that the global market factor does not significantly affect the estimated cost of equity capital as indicated by the domestic CAPM for approximately 4 percent of the firms. The small magnitude of the pricing error between the single factor ICAPM and the domestic CAPM may be related to the fact that the domestic market portfolio is highly correlated with the world market portfolio. Correlations between the local market indices of the nine countries in our sample and the MSCI world index lie between 0.56 (Australia) and 0.80 (U.S.).

As asserted in the introduction, the multifactor ICAPM may well be required for cost of capital computations, as exchange rate risk is priced in industrialized economies. The pricing error between the domestic CAPM and the multifactor ICAPM including currency risk factors could be large for individual firms, because in general the (multidimensional) exposure to the global risk factors in the multifactor ICAPM cannot be expected to be captured in the international pricing of the local stock market index. The third column of table 1 depicts rejection frequencies of the test for the null-hypothesis that no pricing error exists between the multifactor ICAPM (including currency risk factors) and the domestic CAPM. The hypothesis that taking into account global market risk and nine exchange rate risk factors does not lead to a significantly different estimate of the cost of capital is rejected very infrequently for each country. The highest rejection percentage is 7.32 percent for the Netherlands, while the lowest is 3.10 percent for Switzerland. For the total sample of 3,293 firms, the pricing error test rejects in only 5.16 percent of the cases (170 companies).[1]

Table 2 supports the finding that for the vast majority of firms the multifactor ICAPM does not lead to a markedly different estimate of the cost of capital than the domestic CAPM.

[1] Rejection frequencies for subperiods are similar. They are not reported in this paper but are available from the authors on request. As estimation results for subperiods are very similar, we reckon that possible survivorship bias in our sample as well as the assumption that betas are not time-varying have little influence on our findings.

This table presents summary statistics for the difference between the "indirect beta" and the "direct beta" of a firm. The direct beta is the firm's multifactor ICAPM beta d_{i1}, while the indirect estimate of a firm's global beta can be calculated by multiplying the global beta of the local market as represented by the first element of the vector d_L and the firm's CAPM beta b_i. The absolute pricing error in terms of betas within each country varies from 0.076 (Germany and the U.S.) to 0.123 (France) and is thus relatively small in beta terms.[2] In the absence of currency risk premia the expression $(d_{L1}b_i - d_{i1})E[R_G - r]$, where r denotes the nominal return on the risk-free asset, provides an estimate of the cost of capital difference between the domestic and the international CAPM. The (discrete) return on the global market portfolio over the period 1980-1999 was 15.2 percent annually when expressed in U.S. dollars. Over the same period, the average one-month risk free rate was 7.8 percent, resulting in an excess market return of 7.4 percent. Consequently, the implied cost of capital difference between the two models amounts to 0.56 percent on average for U.S. firms. For Australia, France, Germany, Japan, and the Netherlands the average implied cost of capital differential amounts to, respectively, 0.93, 1.01, 0.71, 0.78, and 0.90 percent.

Figure 1 presents a histogram of the percentage pricing errors in terms of the cost of capital of all individual firms for four specific countries in the sample: Germany, Japan, the Netherlands, and the U.S. The histograms show that the distribution of pricing errors is concentrated around zero. For each country, most firms have an absolute pricing error smaller than 1 percent (on an annual basis) and a very large majority of companies exhibit a pricing error less than 2 percent. Our evidence that the pricing error is relatively unimportant is especially manifest for the U.S. For almost 60 percent of the U.S. corporations in our sample, incorporating the global factors into the cost of capital computation would lead to a difference of less than 0.5 percent. Roughly 85 percent of U.S. stocks display a pricing error below 1 percent, while only 4 percent have a pricing error exceeding 2 percent.

While we acknowledge that changing the cost of equity capital by one percentage point could have a substantial impact on capital budgeting decisions and valuation issues, we argue

[2] Note that market weighted average pricing error is equal to zero by construction. This means that for an individual firm the CAPM and the ICAPM might give different cost of capital but on average, (value-weighted) domestic pricing provides the correct cost of capital. Note that the above characteristics only hold in a world where both local and global market indexes are measured perfectly including all individual stocks. Non-zero average pricing errors arise in the first column of table 2 because we do not use all stocks included in the local and global MSCI indices, and because we present equally weighted averages.

that a pricing error of 1 percent is relatively small in light of the large uncertainties in estimating the cost of equity capital for an individual firm. Fama and French (1997) show that standard errors of more than 3 percent per year are typical when the single factor domestic CAPM is used to estimate the cost of equity capital for 48 U.S. industries. Cost of capital estimates for individual firms are likely to be even less accurate. The large standard errors arise because of imprecise estimates of both factor risk premia and risk loadings. Ferson and Locke (1998) find that the great majority of the error in estimating the cost of equity capital stems from the estimation of the risk premia, not from measuring the risk loadings. Furthermore, Fama and French (1997) show that pricing errors of 2 percent between the single factor domestic CAPM and the three-factor model of Fama and French (1993) per year are common. Griffin (2002) reports pricing errors between domestic and world Fama-French three-factor models ranging from 6.1 percent to 9.4 percent per year for Canada, Japan, the U.K., and the U.S.

Table 2 and figure 1 show that the pricing error in terms of beta is statistically insignificant and also remarkably unimportant in economic terms. The histograms reveal that the absolute pricing error (in cost of capital terms) between the multifactor ICAPM and the CAPM generally amount to less than 100 basis points. We argue that our findings may be due to strong country factors in the data, consistent with the evidence of Heston and Rouwenhorst (1994) and Griffin and Karolyi (1998). A tentative explanation is a lack of *real* capital market integration (as opposed to *financial* capital market integration) caused by cyclical, structural, and institutional country-specific factors. De Ménil (1999) presents evidence that these country-specific factors play a significant role in explaining corporate returns in Europe. We contend that for most firms in our sample the domestic market factor effectively captures the stock's exposure to the global factors. Consequently, for a large majority of firms the cost of equity capital can be adequately estimated using the single factor domestic CAPM.

5 Conclusions and Practical Implications

International financial markets are becoming more and more integrated. In the past decades, barriers to international investments have been gradually reduced among developed economies and have dramatically fallen among many emerging markets. Global factors have become increasingly important for portfolio selection and asset pricing. A number of recent empirical studies demonstrate that both the global market portfolio and exchange rate risk factors affect the pricing of assets in industrialized countries.

This paper presents evidence indicating that global risk factors are, nevertheless, not vitally important for practical cost of capital calculations for a remarkably wide variety of companies. We analyze a sample of almost 3,300 stocks from nine industrialized countries over the period 1980-1999. We find that for approximately 95 percent of the firms in our sample the domestic CAPM does not lead to a significantly different estimate of the cost of equity capital than the ICAPM. This holds for both the single factor ICAPM of GLS and the multifactor ICAPM of Solnik-Sercu including currency risk premia. For the vast majority of companies in our sample the local stock market portfolio contains all the information that is relevant in order to capture the stock's exposure to the global risk factors. We attribute our findings to a lack of real capital market integration in the sense of De Ménil (1999).

The difference in the estimates of the cost of capital implied by the CAPM and the ICAPM is also small in economic terms. The domestic and the international version of the CAPM lead to a difference in the cost of capital estimate amounting to roughly 50 basis points on average for the U.S., 75 basis points for Japan and 70 to 100 basis points for European countries. A very large majority of stocks exhibit a cost of capital differential smaller than 2 percent (expressed annually). The results are especially compelling for U.S. corporations. For almost 85 percent of the U.S. firms in our sample taking account of the global factors would lead to a difference in the estimate of the cost of equity capital that does not exceed 100 basis points.

While in theory a difference of one percentage point in the estimate of the cost of capital could have considerable implications in the context of capital budgeting or valuation issues, in practice a divergence of 100 basis points easily falls inside the margin of error associated with actual cost of capital computations. Risk loadings and particularly risk premia are notoriously hard to measure and recent studies show that standard errors of more 3 percent per year around estimates of U.S. industry costs of capital are common. Our investigation indicates that for a large number of firms global risk factors do not materially affect estimates of the cost of capital based on the local market factor. For analyzing U.S. companies in particular we can generally rely on the domestic CAPM for the computation of the cost of capital. Further research should shed light on the issue which characteristics identify the companies for which the global risk factors do lead to a significantly different cost of capital.

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Table 1
Pricing Error Test Results

This table presents the number of stocks in our sample as well as the rejection frequencies for of the pricing error tests for each individual country. The pricing error test for the single factor ICAPM focuses on the beta error of the domestic CAPM versus the single factor ICAPM (excluding currency risk factors).The pricing error test for the multifactor ICAPM examines whether a pricing error exists between the domestic CAPM and the multifactor ICAPM. The asymptotic Wald tests are Chi-squared distributed and robust to heteroskedasticity. Rejection frequencies are defined as the percentage of firms in a country for which the null-hypothesis is rejected at the 5% significance level. "Total" respectively depicts the total number of stocks in the sample and a weighted average of the percentages of firms in each individual country for which the null-hypothesis is rejected. The weights of the rejection frequencies are the weights of each country in the sample as shown in the first column. The sample period is 1980:02-1999:06.

Country	# stocks in sample	Pricing Error Test for the single factor ICAPM percentage rejections	Pricing Error Test for the multifactor ICAPM percentage rejections
Australia	108	8.33	4.63
Canada	219	3.65	4.11
France	127	3.94	5.51
Germany	178	3.37	6.74
Japan	829	8.93	5.79
Netherlands	123	0.81	7.32
Switzerland	129	6.20	3.10
United Kingdom	1,051	2.57	4.19
United States	529	0.19	6.05
Total	3,293	4.22	5.16

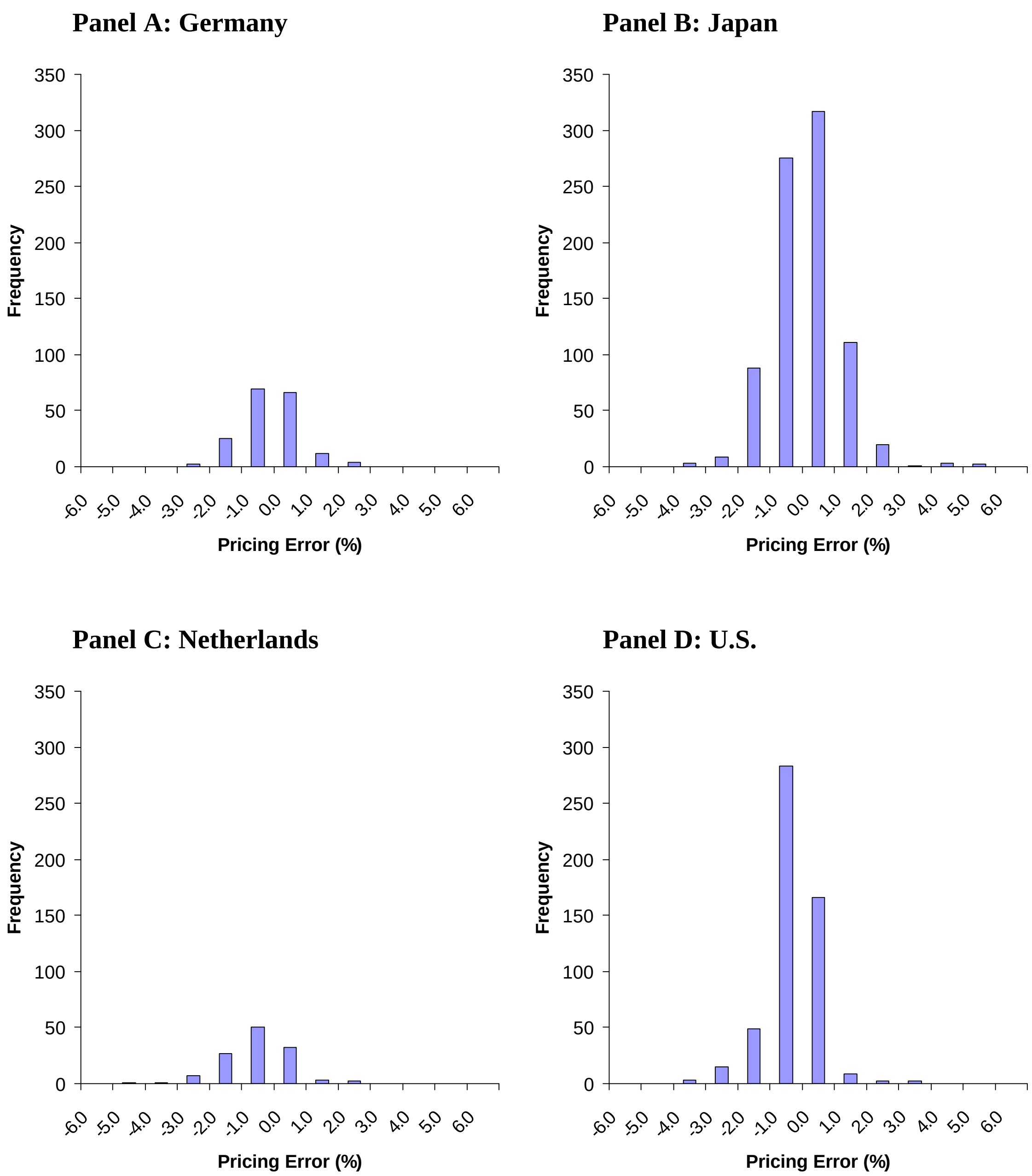
Table 2
Summary Statistics of the Beta Error

This table shows summary statistics of the beta error for all firms in the sample. The beta error is computed as the difference between the "indirect" beta (the global beta of the local market d_{L1} multiplied by the CAPM beta b_i) and the "direct" beta (the multifactor ICAPM beta d_{i1}) of a firm. The columns present the mean, the mean of the absolute value, the standard deviation, the minimum, and the maximum value of the beta errors, respectively. The sample period is 1980:02-1999:06.

Country	Mean	Abs	StDv	Min	Max
Australia	-0.010	0.116	0.160	-0.693	0.487
Canada	-0.037	0.121	0.155	-0.489	0.616
France	-0.038	0.123	0.149	-0.497	0.384
Germany	-0.014	0.076	0.099	-0.310	0.306
Japan	0.018	0.118	0.155	-0.495	0.853
Netherlands	-0.057	0.097	0.111	-0.441	0.276
Switzerland	-0.080	0.104	0.110	-0.426	0.158
United Kingdom	-0.004	0.091	0.123	-0.642	0.577
United States	-0.037	0.076	0.105	-0.478	0.457

Figure 1
Histograms of the Pricing Error

This figure shows a histogram of the pricing errors (in % per annum) for all firms in each of four countries. The pricing error for an individual firm is determined as the product of the beta error and the historical risk premium of the global market portfolio (expressed in local currency) over a local one-month risk-free rate. The beta error is computed as the difference between the "indirect" beta (the global beta of the local market d_{L1} multiplied by the CAPM beta b_i) and the "direct" beta (the multifactor ICAPM beta d_{i1}) of a firm. Panels A, B, C, and D depict a histogram of the pricing errors of all individual firms in, respectively, Germany, Japan, the Netherlands, and the U.S. The sample period is 1980:02-1999:06.



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