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# Economic, financial, and fundamental global risk inside and outside the EMU

Wayne E. Ferson* and Campbell R. Harvey**

## Summary

■ We explore different factors that drive expected returns in world markets. Our research offers two innovations:

1. The introduction of the euro currency unit greatly reduces the complexity of including foreign-exchange risk in asset-pricing models. We use a synthetic euro excess return along with a Japanese yen (JPY) excess return to assess country-equity sensitivities to currency risk factors.
2. When combining the currency factors with a group of economic factors, we measure the incremental information in the factor proposed in Fama and French (1998). We find that a global price-to-book factor offers little additional explanatory power over and above a model that includes economic risk factors. ■

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# Economic, financial, and fundamental global risk inside and outside the EMU

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International asset-pricing research has taken two directions. On one hand, sensitivities to economic variables are used in the framework of a traditional, multibeta, *capital asset-pricing model* (CAPM) to explain the time series and cross-section of expected returns (see Ferson and Harvey, 1993, 1994b). On the other hand, the fundamental characteristics approach of Fama and French (1992, 1993) and others has been implemented in an international context (see Fama and French, 1998).

Ferson and Harvey (1998) argue that there is a link between the characteristics and the asset-pricing model approaches. They hypothesize that the characteristics are likely proxying for dynamic risk functions. Ferson and Harvey offer evidence that variables, such as price-to-book ratios, are important in explaining variation in betas.

This paper offers three insights that are relevant for asset allocation and risk analysis, inside and outside the EMU. First, we implement a multiple-beta, international-capital, asset-pricing model that is simplified by the introduction of the euro. In standard specifications, such as Adler and Dumas (1983), each currency unit enters the asset-pricing equation. As a result, studies such as Dumas (1994), Dumas and Solnik (1995), and De Santis, Gerard and Hillion (1999), can look at only a few countries at a time in conducting global asset-pricing tests.

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We combine a synthetic euro-currency excess return with a Japanese yen (JPY) excess return to conduct asset-pricing tests with two currency return factors. We present evidence that this three-factor model has advantages over a single-factor CAPM and that the euro risk factor is an important explanatory variable.

We use the model simplifications, allowed by the euro, to test the incremental ability of a world price-to-book factor to explain the cross-section and time series of expected returns. Fama and French (1998) find that the world price-to-book factor has ability to explain the cross-section of average returns over and above the traditional beta from a single-factor CAPM. But they do not test whether the price-to-book factor has incremental power to explain expected returns, over and above a model with additional economic factors.

We find that there is little difference in explanatory power between a model using the euro and other economic risk factors and one that includes a world price-to-book measure. This evidence suggests that the world price-to-book factor reflects risk that world economic variables also capture.

We explore the sources of the explanatory power of price-to-book factors. Griffin (1998) argues that the domestic price-to-book ratios drive the explanatory power of the Fama and French (1998) world price-to-book ratio. He concentrates on the cross-section of average stock returns. In Ferson and Harvey (1998), we propose a model where the price-to-book factor is an instrument for time-varying economic risk. We explore the relative information in local price-to-book ratios and the world price-to-book factor. We find that in several countries there is incremental information in price-to-book factors, both local and world, which helps explain variation in beta.

Our paper is organised as follows: Section 1 details the asset-pricing frameworks that we use. Section 2 describes the data. Section 3 presents our empirical results, and Section 4 offers some concluding remarks.

# 1. The asset-pricing framework

## 1.1. The risk factors

Much of the debate about international asset-pricing models concerns the specification of the relevant risk factors. We consider four groups of risk variables. The first is the world excess market return suggested by a world CAPM (Sharpe, 1964; and Lintner, 1965).

Our second model adds two currency excess returns, the euro and the JPY. This three-factor model is designed to capture the theoretical framework in Adler and Dumas (1983) and implemented in Dumas and Solnik (1995). With the advent of the euro, the number of currency risk factors is reduced, and the model is simplified. The currency excess returns are the change in the currency value in US dollars (USD), plus the foreign-deposit rate minus the US Treasury bill rate. The euro is constructed with weights that represent the 1996 GDP's weight of the member countries, as described in Section 2 and Appendix B.

The price-to-book issue motivates our third set of factors. This is the observation that stocks with low price-to-book ratios have earned higher returns than stocks with high ratios. Many US studies have tried to explain the result since Fama and French (1992) drew wide attention to it. Fama and French (1993, 1996) claim that price-to-book represents exposure to a risk factor. Lakonishok et al. (1994) claim it represents systematic pricing errors by the markets and therefore potential profit opportunities for investors. Others suggest that the price-to-book effect is a chance or spurious relation that was mined from the data. But out-of-sample evidence in the US (e.g., Davis, 1994; Davis, Fama and French, 1998) and evidence for markets outside the US (e.g., Chan et al., 1991; Capaul, Rowley and Sharpe, 1993; Arshanapalli, Coggin and Doukas 1998; and Fama and French, 1998), reduce the likelihood of pure data mining.

The appropriate role of price-to-book in an international asset-pricing model is not well understood. Fama and French (1998) find that it has explanatory power as a risk factor, relative to a CAPM that includes only the world-market portfolio and assumes constant betas. Griffin (1998) argues that the factor used by Fama and French adds explanatory power only through the local-country book-to-market effects. Ferson and Harvey (1998) show that local book-to-market factors contain information about time-varying exposures to a world-market risk factor.

The advent of the euro simplifies the currency risk factors in international asset-pricing models. Using the simpler models, we can explore the role of local-country and global price-to-book factors in asset-pricing models that account for currency risks. The global price-to-book factor is an excess return of low price-to-book stocks over high price-to-book stocks, similar to Fama and French (1998), as described in Section 2. We also study the aggregate price-to-book ratios for the stock markets of the individual countries as potential instruments for time-varying risk exposures.

The final group of risk factors is the set of global economic factors studied in Ferson and Harvey (1993, 1994 a or b). These include the weighted unexpected inflation in the G-7 countries, the change in weighted expected long-term inflation in the G-7 countries, the change in the euro-USD-Treasury yield spread, the weighted real interest rate in the G-7 countries, the change in the oil price, and the change in G-7 industrial production. Each weighted variable uses the GDP weights for the G-7 countries. We explore to what extent the price-to-book factors have marginal explanatory power for asset returns, in a model that includes these economic factors.

### 1.2. The unconditional framework

We conduct two exercises. First, we estimate linear factor models that examine the explanatory power of different groups of factors.

$$r_{i,t} = \beta_{i,1} f_{1,t} + \ldots + \beta_{i,k} f_{k,t} + \varepsilon_{i,t} \tag{1}$$

where $r_{i,t}$ represents the excess returns on country *i's* equity market, $f_{j,t}$ are the world risk factors, and $\varepsilon_{i,t}$ are the errors. Country stock returns are measured in a common currency (USD) and are net of a one-month Treasury bill return. We do not study bond returns. The $\beta_i$ are the country risk exposures (or betas) on the factors. The unconditional framework assumes that the betas are fixed parameters over time. We examine the explanatory power of different groups of factors and of each factor across the countries in our sample.

Next we test global asset-pricing models. A global asset-pricing model using a set of risk factors, $\{f_1, ,,, f_k\}$, asserts that the expected excess returns of the countries differ only as a function of their betas on those factors, $\{\beta_{i1}, ,,, \beta_{ik}\}$. Associated with each beta is a global risk premium, the increment to the expected return per unit beta.

In an unconditional model, the risk premiums, like the betas, are assumed to be fixed parameters over time. Following the framework of Ferson and Harvey (1994a), we report estimates of the unconditional betas and the unconditional risk premiums associated with each factor.

### 1.3. Price-to-book and conditional models

The assumption that risk exposures and risk premiums are constant parameters over time is probably restrictive. This motivates a conditional model in which they are time varying. Many studies found that conditional models provide a more accurate representation of expected returns in domestic and international markets (see, e.g., the review article by Ferson, 1995). In a conditional model, the betas and expected risk premiums are conditional moments, based on information that is available when prices are set at the period's start, say at time t-1, before the securities' returns are realised at time t. The price-to-book ratio, using prices at time t-1 and previous book values, is available information at each month's start. We are particularly interested in the price-to-book ratio's role in an asset-pricing model that includes the euro as a currency risk factor. We consider price-to-book value as a potential risk factor and as an instrument for risk. First, we consider the incremental power of adding a world price-to-book factor in the linear factor model. Then, we test whether price-to-book significantly affects the time variation in conditional betas.

The conditional beta model follows Ferson (1989) and Shanken (1990). We estimate a linear factor model with interaction terms. The one-factor version is

$$r_{i,t} = \beta_{i,0} + \left(b_{1,0} + b_{i,1} Z_{i,t-1}\right) f_{1,t} + \varepsilon_{i,t} \tag{2}$$

where $Z_{i,t-1}$ represents conditioning information that is available at time $t$-1.

Ferson et al. (1999) provide a recent discussion and analysis of the statistical properties of such models. In our application, the conditioning information is either the world price-to-book ratio or the country-specific (local) price-to-book ratio. The conditional beta is

$$\beta_{i,1,t} = b_{i,0} + b_{i,1} Z_{i,t-1} \tag{3}$$

We test whether there is significant variation in the betas that is related to the price-to-book ratios, by checking for significant $b_{i,1}$ coefficients. As explained by Ferson and Harvey (1998), the conditional model allows for time-varying factor risk premiums, but it does not restrict their functional form.

### 1.4. Testing conditional models

Preliminary regression diagnostics help determine the specification of the conditional models; that is, the choice of factors and lagged instruments, $Z_{t-1}$. We then move on to examine the empirical performance of the models. An asset-pricing model should explain differences in the average returns across countries. In addition, a conditional model should explain any predictability in the returns using the lagged instruments. Ferson and Harvey (1999) find that predictability using lagged instruments provides a powerful challenge for US models based on the Fama-French (1993) factors, which include the market return factor and a price-to-book factor. Our tests are designed to address average returns and the predictability in returns. Appendix A contains the details of the econometric methods.

To assess the ability of a model to explain differences in the average returns, we introduce $\alpha$, an average pricing error parameter, into the model for each country. The alpha is the difference between the average return for a country and the average return predicted by the model, using the country's betas and the global risk premiums.

To assess the ability of a model to explain the predictability in the returns, we form VR1, a ratio for each country. This measures the fraction of the predictable variance that a model explains. The numerator of the ratio is the variance of the time-varying expected return predicted by the model, using the time-varying country betas and global risk premiums. The denominator is the variance of the predictable part of the return, obtained without reference to an asset-pricing model by simply regressing the return on the lagged instruments. If the ratio is one, it says that the model can explain all of the variation in the statistically predicted expected returns. If the ratio is zero, none of the predictability is explained.

## 2. Data

We study equity returns for 18 developed markets from January 1975 through December 1997 from Morgan Stanley Capital International (MSCI). All returns are measured in USD and are calculated in excess of the 30-day US Treasury bill rate from Ibbotson Associates.

### 2.1. Specification of risk factors

Our measure of the world risk factor is the MSCI world-market excess return. Our first measure of currency risk is the euro risk factor. The euro risk factor is constructed back in time using the countries included in the euro on January 1, 1999. We use the 1996 GDP weights that Datastream used to synthetically create a historical euro series. Besides the currency change, we add a weighted euro-currency return, using the same weights as in the euro construction. Finally, we make this an excess return by subtracting the US 30-day Treasury bill rate. The excess JPY return factor is similarly constructed. The euro-JPY return is added to the currency change minus the short-term US-bill return. (See Appendix B for more details.)

Our price-to-book factor is the high minus low (HML) portfolio studied by Fama and French (1998). This variable is from Fama and French (1998) for the 1975-1989 period and updated through 1997 using MSCI data. In each country, high price-to-book and low price-to-book portfolios are constructed. Using each national market's total capitalisations, a value-weighted world price-to-book hedge return is then constructed. This is the return of the value-weighted portfolio of low price-to-book (high book-to-market) stocks minus the return of the portfolio of high price-to-book (low book-to-market) stocks. The price-to-book factor may be related to the firm size effect (e.g., Hawawini and Keim, 1997). But the stocks included in the MSCI database are primarily the large firms. For this reason, we do not separately study firm size.

Finally, we consider several macroeconomic risk factors that were studied in Ferson and Harvey (1993, 1994a or b). Appendix B describes these factors.

### 2.2. Specification of the instrumental variables

We follow Ferson and Harvey (1993) and consider two types of lagged instrumental variables (global and local) to represent the conditioning information. The global instrumental variables include the *lagged*: world dividend yield, Treasury-euro-USD spread, G-7-weighted term structure of interest rates (long-short spread), and G-7 short-term interest rate. We also include a lagged world price-to-book ratio. The lagged price-to-book is used as an instrument for time-series variation in US equity returns by Kothari and Shanken (1997) and Pontiff and Schall (1998). Its usefulness in a global asset-pricing model context has not been widely studied. Ferson and Harvey (1998) is one exception. They study local-country price-to-book ratios, not a world price-to-book ratio. We also consider a set of local instruments that mirror the world instruments. These include the *lagged local*: dividend yield, term structure, short-term interest rate, and price-to-book ratio.

## 3. Results

### 3.1. Summary statistics

Table 1 presents the summary statistics. The world risk factors, which are returns, are reported in monthly percentage terms. Notice that the world price-to-book excess return has a slightly lower mean than the world market return—but the standard deviation is almost half that of the world market return. Other notable features include the persistence, as reflected in the autocorrelations, of the change in long-term expected inflation and the G-7 real interest rate. Interestingly, there are no remarkable correlations between any of the world risk factors. The extreme value is -0.61 correlation between the change in G-7 unexpected inflation and the G-7 real interest rate.

Persistence is also evident in the instrumental variables. Notice that four of the five world instrumental variables have autocorrelation coefficients greater than 0.9. The autocorrelation patterns of the world price-to-book ratio and the world dividend yield are very similar. The world price-to-book ratio and the world dividend yield also have a Pearson correlation of -0.95, indicating that there is limited information on one ratio, given the other.

## Table 1. Summary statistics for the world risk factors ...

| Variable | Symbol | Mean x 100 | SD x 100 |
|---|---|---|---|
| *World risk factors* | | | |
| World excess return | wdret | .692 | 4.027 |
| Euro-currency excess return | euroret | .067 | 3.035 |
| JPY-currency excess return | yenret | .243 | 3.494 |
| World price-book high-low return | wrpbret | .527 | 2.132 |
| Change in euro-USD-Treasury yield | dted | -0.001 | .034 |
| Unexpected G7 inflation | dg7ui | -0.007 | .170 |
| Change in long-term G7 expected inflation | dg7elt | .484 | .199 |
| Change in oil price | doil | .345 | 7.035 |
| Change in G7 industrial production | dg7ip | .207 | .677 |
| G7 real interest rate | g7rtb | .206 | .264 |
| *Instrumental variables* | | | |
| Lagged world dividend yield | lwrdivy | .285 | .093 |
| Lagged Euro-dollar Treasury spread | lted | .049 | .047 |
| Lagged slope of US term structure | lterm | .131 | .123 |
| 30-day US Treasury bill rate | tb1 | .568 | .233 |
| Lagged world price-book ratio | lwrpb | 1.819 | .540 |

*Correlations among world risk factors*

| | wdret | euroret | yenret |
|---|---|---|---|
| wdret | 1.000 | | |
| euroret | .258 | 1.000 | |
| yenret | .327 | .593 | 1.000 |
| wrpbret | -0.190 | -0.136 | -0.127 |
| dted | -0.045 | -0.021 | -0.074 |
| dg7ui | -0.041 | -0.014 | -0.013 |
| dg7elt | .036 | -0.080 | -0.115 |
| doil | -0.179 | -0.015 | -0.045 |
| dg7ip | -0.140 | -0.070 | -0.053 |
| g7rtb | .052 | .057 | .001 |

*Correlations among world instruments*

| | lwrdivy | lted | lterm |
|---|---|---|---|
| lwrdivy | 1.000 | | |
| lted | .623 | 1.000 | |
| lterm | -0.440 | -0.402 | 1.000 |
| tb1 | .612 | .470 | -0.692 |
| lwrpb | -0.953 | -0.490 | .275 |

**... and instrumental variables, January 1975 - December 1997.**

| $\rho_1$ | $\rho_2$ | $\rho_3$ | $\rho_4$ | $\rho_{12}$ | $\rho_{24}$ |
|---|---|---|---|---|---|
| .029 | -0.032 | -0.029 | -0.039 | .011 | .082 |
| .031 | .118 | .039 | .014 | -0.000 | .016 |
| .096 | .061 | .105 | .054 | .089 | -0.057 |
| .137 | .063 | .044 | -0.115 | .153 | .066 |
| -0.080 | -0.092 | -0.061 | -0.126 | .042 | -0.085 |
| .108 | -0.028 | .002 | -0.045 | .046 | .104 |
| .978 | .962 | .951 | .937 | .846 | .746 |
| .368 | .021 | -0.021 | -0.050 | -0.069 | -0.051 |
| -0.063 | .154 | .231 | .078 | -0.053 | -0.128 |
| .576 | .389 | .393 | .442 | .618 | .445 |

| | | | | | |
|---|---|---|---|---|---|
| .982 | .967 | .955 | .942 | .844 | .749 |
| .839 | .683 | .554 | .496 | .372 | .282 |
| .942 | .854 | .784 | .722 | .487 | .200 |
| .939 | .889 | .854 | .819 | .672 | .399 |
| .976 | .956 | .933 | .913 | .762 | .617 |

| wrpbret | dted | dg7ui | dg7elt | doil | dg7ip | g7rtb |
|---|---|---|---|---|---|---|
| 1.000 | | | | | | |
| -0.011 | 1.000 | | | | | |
| .023 | -0.064 | 1.000 | | | | |
| .038 | -0.024 | -0.024 | 1.000 | | | |
| .059 | .015 | .268 | .078 | 1.000 | | |
| .037 | -0.033 | .029 | -0.092 | -0.012 | 1.000 | |
| -0.103 | -0.001 | -0.605 | -0.305 | -0.272 | -0.086 | 1.000 |

| tb1 | lwrpb |
|---|---|
| 1.000 | |
| -0.481 | 1.000 |

### 3.2. Linear-factor models

Table 2 presents estimates of regressions of each asset's excess return on all of the world risk factors. Interestingly, only one of the 18 intercepts is significantly different from zero (not more than would be expected by chance) and this lone intercept, for Spain, is only two standard errors from zero. When the factors are excess returns, the intercepts are the alphas, which measure the average mispricing. Thus, the regressions suggest that the collection of world risk factors we selected should be sufficient to capture the cross-section of the average returns of the national equity markets.

In this unconditional analysis, the world market return is by far the most important risk factor. The beta on the world market is significant in 17 of 18 countries; Austria is the exception. There are two other risk factors that are often significant: the euro excess return (12 of 18 countries) and the world price-to-book excess return (10 of 18 countries). The JPY excess return is significant for five countries (Canada, France, Japan, Norway, and the US). Only a few of the macroeconomic variables produce significant coefficients. The change in the oil price is significant in four countries. The change in the euro-USD-Treasury spread is significant in two countries.

One weakness of this analysis is that the coefficients are held constant over the 1975-1997 period. Repeating the regression analysis, using 60-month rolling regression estimates, partially addresses this. We test whether the beta coefficients are individually equal to zero and whether the beta coefficients taken jointly *across countries* are equal to zero. A risk factor will not be useful in explaining the cross-sectional variation in asset returns if the betas are zero. These tests confirm that the two most important factors are the world market return and the euro excess return. The JPY excess return is the third most important, closely followed by the world price-to-book excess return. Of the economic variables, the most significant are: the change in the oil price, the G-7 unexpected inflation, and the G-7 real short-term interest rate.

$R^2$s reported in the far column of Table 2 suggest that the world market factor drives most explanatory power. The currency factors add explanatory power in all but one country and sizable explanatory power in several countries. Interestingly, neither the world price-to-book excess return nor the macroeconomic variables add much explanatory power to these regressions. Figure 1 also shows this.

Table 3 presents the unconditional asset-pricing tests. Three models are presented: the world CAPM, a world CAPM with two currency factors, and a seven-factor model that nests the CAPM with two currency factors and adds the world price-to-book excess return and the three most important economic factors. The three most important economic factors, based on the evidence in Table 2, are the change in the price of oil, the change in long-term expected G-7 inflation, and the G-7 real interest rate.

None of the unconditional models in Table 3 is rejected at standard significance levels. By far, the dominant risk premium is the world market return. The currency excess returns enter with positive coefficients but are not significant at traditional levels (the JPY excess return is more than one standard error from zero, and the euro excess return is less than one standard error from zero). In the extended model with all seven factors, the world price-to-book return enters with a positive coefficient that is slightly greater than one standard error from zero. The real G-7 short-term interest rate is close to two standard errors from zero. The insignificant risk premiums in the unconditional models are similar to previous studies, and suggest a lack of statistical power in these models (see Ferson and Harvey, 1994a, for discussion).

*Table 2 notes:*

| **Factor** | **Denotes the ...** |
|---|---|
| wdret | world excess return |
| euroret | synthetic euro factor |
| yenret | JPY excess return |
| wrpbret | world price-to-book excess return |
| dted | change in the 90-day euro-USD deposit minus 90-day US-Treasury-bill rate |
| dg7ui | unexpected inflation for the G-7 countries |
| dg7elt | change in long-term expected inflation in the G-7 countries |
| doil | change in oil price |
| dg7ip | change in the G-7 countries' industrial production |
| dg7rtb | real short-term interest rate in the G-7 countries |

The factor models are: 1 factor (wdret), 3 factor (wrdret, euroret, yenret), 2 factor (wrdret, wrpbret), 9 factor (wrdret, euroret, yenret, dG7ui, dg7elt, dted, g7rtb, doil, dg7ip), 10 factor (9 factor plus wrpbret), 6-factor (wrdret, euroret, yenret, dg7elt, g7rtb, doil) and 7 factor (6 factor plus wrpbret). Columns 2-11 display regression coefficients, with standard errors on the second line.

## Table 2. Regressions of the asset returns on the ...

| | inter-cept | wdret | euroret | yenret | wrpbret | dg7ui | dg7elt | dted |
|---|---|---|---|---|---|---|---|---|
| Australia | .002 | 1.041 | -0.238 | .056 | .446 | 4.020 | -0.698 | 5.486 |
| | .012 | .166 | .143 | .133 | .184 | 3.046 | 1.944 | 16.464 |
| Austria | -0.003 | .388 | .758 | -0.049 | .456 | 2.835 | -1.123 | -27.854 |
| | .011 | .393 | .136 | .111 | .148 | 2.776 | 1.545 | 9.730 |
| Belgium | -0.001 | .794 | .601 | -0.099 | .306 | 1.300 | -0.497 | -0.987 |
| | .008 | .082 | .097 | .078 | .100 | 1.665 | 1.330 | 11.946 |
| Canada | -0.005 | 1.050 | -0.108 | -0.260 | .143 | -0.655 | .417 | -1.969 |
| | .008 | .073 | .106 | .098 | .105 | 2.030 | 1.411 | 1.200 |
| Denmark | .014 | .624 | .456 | -0.043 | .084 | -2.589 | -2.343 | .835 |
| | .009 | .066 | .113 | .086 | .143 | 2.003 | 1.396 | 9.651 |
| France | -0.008 | .992 | .632 | -0.077 | .258 | 1.958 | 1.375 | -1.197 |
| | .010 | .086 | .128 | .125 | .162 | 2.237 | 1.783 | 13.412 |
| Germany | -0.003 | .743 | .783 | -0.196 | .484 | -0.809 | .055 | -3.403 |
| | .009 | .089 | .115 | .097 | .145 | 1.997 | 1.388 | 11.343 |
| Hng Kng. | .013 | 1.244 | -0.197 | -0.028 | .731 | -2.251 | -0.622 | -28.917 |
| | .018 | .172 | .207 | .198 | .229 | 4.375 | 3.088 | 25.302 |
| Italy | -0.002 | .813 | .259 | -0.043 | .205 | -4.744 | -0.078 | -13.281 |
| | .014 | .094 | .195 | .142 | .225 | 3.348 | 2.230 | 14.720 |
| Japan | -0.006 | .949 | -0.247 | .911 | -0.002 | 1.236 | 1.010 | -5.707 |
| | .007 | .083 | .096 | .091 | .139 | 1.817 | 1.156 | 8.836 |
| Nthrlnds. | .000 | .968 | .360 | -0.132 | .345 | -0.589 | .139 | 1.463 |
| | .007 | .061 | .084 | .069 | .118 | 1.673 | 1.156 | 8.662 |
| Norway | .001 | 1.199 | .530 | -0.484 | .560 | 2.207 | -1.606 | 3.228 |
| | .011 | .107 | .143 | .141 | .171 | 2.978 | 2.038 | 19.755 |
| Singapore | .001 | 1.255 | -0.085 | -0.116 | .765 | -3.222 | .671 | -7.611 |
| | .012 | .166 | .159 | .149 | .241 | 3.073 | 1.995 | 17.048 |
| Spain | .023 | .772 | .365 | -0.068 | .083 | .743 | -4.909 | -4.389 |
| | .011 | .113 | .154 | .121 | .188 | 2.882 | 1.767 | 13.258 |
| Sweden | .004 | .919 | .094 | -0.034 | .171 | 1.198 | -0.914 | -24.623 |
| | .012 | .090 | .122 | .108 | .191 | 2.572 | 1.872 | 14.225 |
| Swtzrlnd. | .007 | .844 | .601 | -0.116 | .293 | -2.724 | -1.122 | -15.022 |
| | .008 | .072 | .095 | .079 | .128 | 1.756 | 1.196 | 8.493 |
| UK | -0.002 | 1.244 | .409 | -0.179 | .604 | -3.348 | 1.485 | 2.838 |
| | .008 | .139 | .113 | .103 | .256 | 3.157 | 1.505 | 16.843 |
| US | .006 | .960 | -0.149 | -0.349 | -0.167 | -0.939 | -0.676 | 3.402 |
| | .004 | .041 | .054 | .052 | .071 | .961 | .669 | 5.080 |
| $\chi^2$ ($\beta_i$=0, all 1) | | 82.562 | 16.441 | 184.304 | 94.230 | 15.793 | 18.186 | 19.873 |
| p-value | | .000 | .000 | .000 | .000 | .607 | .443 | .340 |

**... world risk factors, January 1975 - December 1997.**

| g7rtb | doil | dg7ip | 1 fac. | 3 fac. | 2 fac. | 9 fac. | 10 fac. | 6 fac. | 7 fac. |
|---|---|---|---|---|---|---|---|---|---|
| -0.320 | .096 | -0.056 | .273 | .277 | .291 | .292 | .302 | .291 | .305 |
| 1.976 | .055 | .544 | | | | | | | |
| 2.445 | -0.099 | .969 | .096 | .195 | .105 | .235 | .242 | .205 | .223 |
| 1.455 | .081 | .536 | | | | | | | |
| 1.905 | -0.060 | .406 | .391 | .467 | .397 | .479 | .482 | .473 | .485 |
| 1.283 | .037 | .368 | | | | | | | |
| -0.382 | .079 | .272 | .460 | .497 | .464 | .500 | .501 | .503 | .505 |
| 1.379 | .034 | .353 | | | | | | | |
| -0.170 | .059 | -0.006 | .265 | .322 | .262 | .321 | .320 | .325 | .324 |
| 1.413 | .041 | .411 | | | | | | | |
| .549 | -0.060 | .341 | .406 | .459 | .406 | .458 | .459 | .457 | .461 |
| 1.569 | .034 | .440 | | | | | | | |
| 1.097 | -0.084 | .122 | .315 | .415 | .331 | .430 | .462 | .424 | .452 |
| 1.402 | .045 | .435 | | | | | | | |
| -2.825 | .031 | -0.995 | .234 | .235 | .262 | .235 | .258 | .231 | .256 |
| 2.702 | .065 | .751 | | | | | | | |
| .851 | -0.090 | -0.121 | .205 | .206 | .204 | .217 | .218 | .218 | .219 |
| 1.988 | .065 | .565 | | | | | | | |
| .311 | -0.046 | -0.411 | .507 | .667 | .506 | .663 | .663 | .665 | .664 |
| 1.093 | .046 | .385 | | | | | | | |
| .854 | .050 | .147 | .566 | .591 | .581 | .595 | .608 | .591 | .612 |
| 1.186 | .028 | .314 | | | | | | | |
| .278 | .232 | .977 | .284 | .319 | .303 | .368 | .385 | .365 | .383 |
| 2.013 | .044 | .556 | | | | | | | |
| -3.686 | .135 | -0.957 | .313 | .315 | .360 | .350 | .383 | .340 | .381 |
| 2.135 | .059 | .616 | | | | | | | |
| .027 | -0.125 | -0.102 | .251 | .268 | .248 | .291 | .289 | .299 | .297 |
| 1.901 | .055 | .533 | | | | | | | |
| 1.554 | -0.057 | .254 | .321 | .317 | .320 | .319 | .320 | .317 | .317 |
| 1.833 | .059 | .490 | | | | | | | |
| .170 | .002 | -0.290 | .456 | .536 | .463 | .540 | .552 | .535 | .549 |
| 1.144 | .032 | .409 | | | | | | | |
| -1.796 | .056 | -0.517 | .464 | .476 | .492 | .482 | .511 | .480 | .511 |
| 1.847 | .042 | .632 | | | | | | | |
| .028 | .026 | .128 | .636 | .746 | .637 | .747 | .750 | .746 | .751 |
| .588 | .029 | .212 | | | | | | | |
| 66.944 | 5.658 | 15.601 | | | | | | | |
| .000 | .997 | .620 | | | | | | | |

## Table 3. Unconditional asset-pricing tests, ...

| | | One-factor model | | Three-factor model | | | |
|---|---|---|---|---|---|---|---|
| Country | Ave. return | $\beta$ wdret | Ave. pricing error | $\beta$ wdret | $\beta$ euroret | $\beta$ yenret | Ave. pricing error |
| Astrala. | .013 | 1.098 | -0.0002 | 1.036 | -0.266 | .024 | -0.0006 |
| | | .117 | .0610 | .136 | .122 | .115 | .0600 |
| Austria | .009 | .447 | .0007 | .316 | .781 | -0.016 | .0003 |
| | | .104 | .0610 | .118 | .134 | .111 | .0570 |
| Belgium | .014 | .942 | .0021 | .814 | .599 | -0.068 | .0015 |
| | | .065 | .0430 | .073 | .099 | .072 | .0400 |
| Canada | .011 | .994 | -0.0021 | 1.047 | -0.097 | -0.363 | -0.0023 |
| | | .073 | .0400 | .077 | .095 | .092 | .0380 |
| Dnmrk. | .013 | .661 | .0026 | .556 | .512 | -0.075 | .0023 |
| | | .057 | .0450 | .056 | .107 | .074 | .0430 |
| France | .014 | 1.183 | .0004 | 1.029 | .626 | -0.042 | -0.0003 |
| | | .078 | .0530 | .071 | .131 | .115 | .0500 |
| Grmny. | .013 | .867 | .0012 | .719 | .731 | -0.121 | .0009 |
| | | .090 | .0490 | .103 | .107 | .090 | .0450 |
| HgKng. | .021 | 1.208 | .0068 | 1.164 | -0.243 | .051 | .0061 |
| | | .145 | .0830 | .173 | .175 | .178 | .0820 |
| Italy | .012 | .870 | -0.0001 | .802 | .306 | -0.042 | -0.0008 |
| | | .096 | .0690 | .093 | .159 | .131 | .0690 |
| Japan | .012 | 1.039 | -0.0006 | .921 | -0.245 | .927 | -0.0032 |
| | | .082 | .0470 | .085 | .085 | .079 | .0390 |
| Nthlds. | .017 | 1.040 | .0043 | .935 | .361 | -0.116 | .0040 |
| | | .060 | .0340 | .067 | .073 | .053 | .0320 |
| Norway | .012 | 1.114 | -0.0011 | 1.045 | .612 | -0.594 | -0.0007 |
| | | .105 | .0640 | .117 | .130 | .106 | .0620 |
| Sgpore. | .014 | 1.143 | .0001 | 1.099 | -0.119 | -0.062 | -0.0004 |
| | | .150 | .0660 | .173 | .146 | .128 | .0650 |
| Spain | .010 | .818 | -0.0016 | .763 | .362 | -0.064 | -0.0023 |
| | | .102 | .0590 | .112 | .136 | .116 | .0580 |
| Sweden | .016 | .886 | .0044 | .894 | .034 | .052 | .0032 |
| | | .085 | .0540 | .094 | .093 | .100 | .0540 |
| Swzrld. | .015 | .923 | .0026 | .817 | .605 | -0.092 | .0020 |
| | | .065 | .0400 | .075 | .086 | .071 | .0370 |
| UK | .018 | 1.236 | .0036 | 1.209 | .378 | -0.221 | .0027 |
| | | .142 | .0520 | .151 | .101 | .098 | .0510 |
| US | .014 | .914 | .0015 | .986 | -0.168 | -0.339 | .0013 |
| | | .044 | .0260 | .047 | .053 | .046 | .0210 |
| | | $\lambda$ | $\chi^2$ | $\lambda$ | $\lambda$ | $\lambda$ | $\chi^2$ |
| | | wdret | p-value/df | wdret | euroret | yenret | p-value/df |
| | | .0069 | 18.795 | .0080 | .0013 | .0030 | 13.401 |
| | | .0004 | .405 | .0004 | .0021 | .0024 | .571 |
| | | | 18.000 | | | | 15.000 |

*Table 3 notes:*

| Symbol | Denotes the ... |
|---|---|
| $\beta$ | unconditional beta |
| $\lambda$ | unconditional risk premium from equations A.1 and A.2 |
| $\chi^2$ | value of Hansen's (1982) J-statistic for the over-identifying restrictions |
| df | degree of freedom |

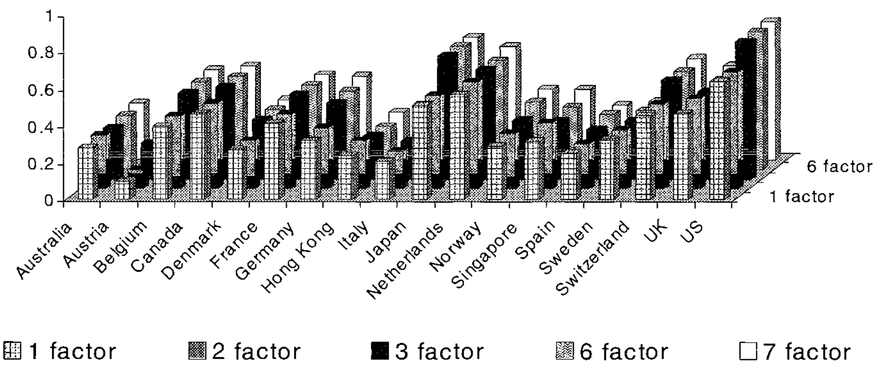
## … January 1975 – December 1997.

**Seven-factor model**

| $\beta$ wdret | $\beta$ euroret | $\beta$ yenret | $\beta$ wrpbret | $\beta$ dg7elt | $\beta$ g7rtb | $\beta$ doil | Ave. pricing error |
|---|---|---|---|---|---|---|---|
| 1.111 | -0.267 | .064 | .452 | -0.749 | -2.016 | .113 | -0.0003 |
| .145 | .128 | .123 | .149 | 1.502 | .970 | .045 | .0586 |
| .355 | .702 | -0.001 | .404 | -2.019 | .486 | -0.094 | .0002 |
| .105 | .149 | .110 | .143 | 1.420 | .767 | .082 | .0554 |
| .803 | .578 | -0.100 | .309 | -0.688 | 1.165 | -0.067 | -0.0003 |
| .074 | .103 | .077 | .088 | 1.241 | .762 | .028 | .0394 |
| 1.050 | -0.118 | -0.259 | .117 | .100 | -1.050 | .062 | .0005 |
| .072 | .096 | .097 | .087 | 1.139 | .669 | .036 | .0376 |
| .615 | .445 | -0.041 | .075 | -1.971 | .725 | .055 | .0004 |
| .058 | .111 | .074 | .119 | 1.160 | .801 | .033 | .0425 |
| 1.006 | .584 | -0.083 | .242 | .928 | .799 | -0.043 | .0010 |
| .072 | .135 | .118 | .147 | 1.610 | .720 | .034 | .0496 |
| .762 | .749 | -0.196 | .424 | .306 | .945 | -0.083 | .0003 |
| .090 | .116 | .092 | .138 | 1.191 | .716 | .047 | .0433 |
| 1.367 | -0.227 | -0.057 | .725 | 1.294 | -1.104 | .052 | .0009 |
| .166 | .184 | .178 | .199 | 2.791 | 1.410 | .059 | .0805 |
| .809 | .282 | -0.056 | .123 | .800 | 1.372 | -0.142 | -0.0020 |
| .080 | .171 | .132 | .183 | 1.926 | 1.002 | .071 | .0677 |
| .949 | -0.204 | .864 | -0.020 | .860 | -0.434 | -0.041 | -0.0006 |
| .084 | .090 | .076 | .145 | 1.136 | .736 | .042 | .0384 |
| .993 | .328 | -0.115 | .314 | .364 | .755 | .043 | -0.0001 |
| .055 | .072 | .054 | .109 | .968 | .633 | .026 | .0314 |
| 1.196 | .472 | -0.453 | .504 | -2.622 | -1.654 | .226 | .0001 |
| .105 | .135 | .128 | .146 | 1.961 | 1.219 | .040 | .0587 |
| 1.315 | -0.065 | -0.143 | .780 | 2.246 | -2.469 | .138 | -0.0003 |
| .148 | .141 | .125 | .203 | 1.889 | 1.182 | .057 | .0617 |
| .783 | .361 | -0.084 | .109 | -4.251 | .288 | -0.123 | .0000 |
| .110 | .139 | .110 | .205 | 1.607 | 1.026 | .065 | .0562 |
| .957 | .089 | -0.067 | .185 | -2.026 | .375 | -0.040 | .0014 |
| .095 | .102 | .096 | .155 | 1.441 | .816 | .045 | .0539 |
| .868 | .579 | -0.120 | .291 | -0.008 | 1.014 | -0.003 | -0.0003 |
| .068 | .085 | .070 | .116 | 1.185 | .610 | .033 | .0361 |
| 1.308 | .385 | -0.167 | .667 | 3.373 | .015 | .052 | -0.0009 |
| .143 | .105 | .087 | .212 | 1.438 | .930 | .037 | .0494 |
| .956 | -0.159 | -0.338 | -0.161 | -0.711 | .545 | .024 | .0006 |
| .044 | .053 | .043 | .070 | .545 | .470 | .025 | .0208 |
| $\lambda$ | $\lambda$ | $\lambda$ | $\lambda$ | $\lambda$ | $\lambda$ | $\lambda$ | $\chi 2$ |
| wdret | euroret | yenret | wrpbret | dg7elt | g7rtb | doil | p-value/df |
| .0064 | -0.0068 | .0035 | .0120 | -0.0003 | .0046 | .0186 | 5.165 |
| .0012 | .0070 | .0055 | .0102 | .0010 | .0027 | .0245 | .923 |
| | | | | | | | 11.000 |

*Notes continued …* The average pricing error is the sample mean of the error term, $u_{it}$, from equations A.1 and A.2. The p-value is the right-tail probability value from the asymptotic distribution. See Appendix for definitions of the symbols for the risk factors.

**Figure 1. Proportion of unconditional variation explained by linear-factor models.**




*Notes:* $R^2$ from linear-factor model regressions. 1 factor = world market return; 2 factor = world market plus the world price-to-book return; 3 factor = world market return plus two currency excess returns; 4 factor = 3 factor plus the world price-to-book return; 6 factor = 3 factor plus three economic factors: change in long-term expected inflation; G-7, real, short-term, interest rate; and change in oil price; 7 factor = 6-factor model plus world price-to-book return.

To augment the unconditional asset-pricing tests, we report the average pricing errors and the standard deviations of these errors. These average error decreases for 12 of 18 countries when one moves from a one-factor model to a three-factor model. The errors are further reduced, relative to the three-factor model, in all but two countries when the seven-factor model is considered.

### 3.3. Time-varying risk

Table 4 examines a model that allows, in a simple way, for risk to shift through time. Figure 2 presents the rolling estimates of the betas for the three-factor model. These figures highlight important dates for our analysis:

- 1986 Single European Act
- July 1990, stage one of EMU begins
- February 1992, ratification of Maastricht
- January 1993, establishment of the single market
- January 1994, creation of the European Monetary Institute (forerunner of the European Central Bank)
- May 1998, Announcement of participating countries and target fixed rates specified.

Of course, another important date for our analysis is January 1999, when the irrevocable fixed rates take effect, the euro begins. But this date lies outside of our sample period.[1] Surprisingly, the figures present no evidence that any of these events are associated with shifts in the structure of equity markets' systematic risks.

While Figure 2 presents no evidence that any of the discrete events associated with EMU cause jumps in the risk exposures, the time-series plots suggests some patterns. The betas on the euro risk factor fall for all EMU countries (except Spain) from near unity in the early 1990s, to near zero at the end of the sample in 1998. For the European countries that have remained outside the EMU, there is little systematic change, and the euro betas remain sizeable in some cases (e.g., for Sweden and Norway in 1998, the beta is about 0.5). These patterns suggest that anticipation of the EMU and its membership has influenced equity risks in European markets. For countries outside Europe, such as the US and Canada, the euro beta is close to zero for much of the period.

[1] Another relevant date is January 2002, when euro notes and coins are introduced.

**Table 4. Proportion of times that the right-tail probability value is less than 10% for the statistical testing whether ...**

| Country | wdret | euroret | yenret | wrpbret | Dted |
|---|---|---|---|---|---|
| Australia | 1.000 | .245 | .255 | .454 | .000 |
| Austria | .389 | .713 | .097 | .412 | .389 |
| Belgium | 1.000 | .782 | .241 | .130 | .120 |
| Canada | 1.000 | .093 | .519 | .185 | .106 |
| Denmark | 1.000 | .639 | .065 | .065 | .065 |
| France | 1.000 | .764 | .222 | .065 | .310 |
| Germany | 1.000 | .991 | .171 | .523 | .389 |
| Hong Kong | .935 | .037 | .333 | .292 | .074 |
| Italy | .977 | .255 | .111 | .185 | .046 |
| Japan | 1.000 | .486 | 1.000 | .370 | .042 |
| Netherlands | 1.000 | .731 | .264 | .407 | .213 |
| Norway | 1.000 | .444 | .491 | .625 | .361 |
| Singapore | .968 | .000 | .264 | .269 | .079 |
| Spain | .704 | .259 | .417 | .199 | .014 |
| Sweden | .940 | .014 | .157 | .009 | .222 |
| Switzerland | 1.000 | .815 | .167 | .356 | .324 |
| UK | 1.000 | .523 | .097 | .634 | .250 |
| US | 1.000 | .222 | .995 | .449 | .000 |
| | | | | | |
| $\beta_\iota = 0$, all $\iota$ | 1.000 | 1.000 | .991 | .769 | .231 |
| $\beta_\iota = \beta$, all $\iota$ | .912 | .940 | .824 | .639 | .264 |

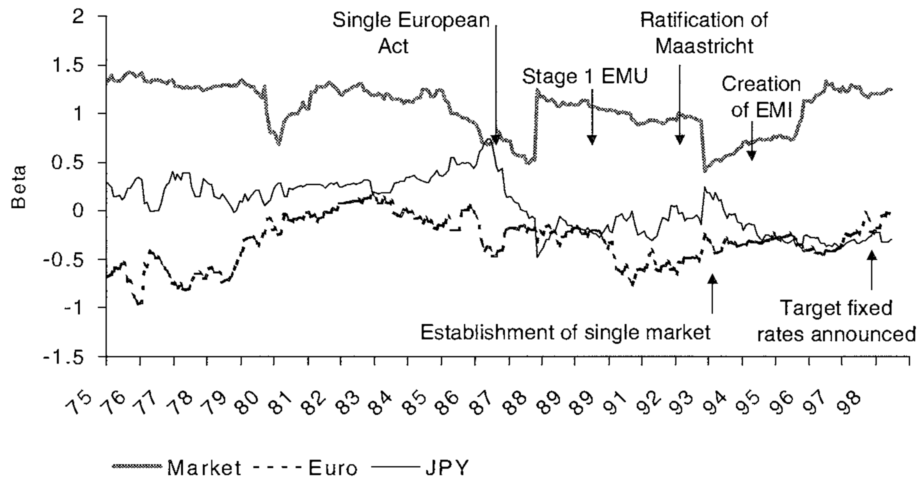
*Notes*: The beta coefficients are time-series regression coefficients for the excess stock return, regressed on the risk factors using 60-month rolling windows.

**... the beta coefficients are equal to zero or equal across all countries, January 1975 – December 1998.**

| dg7ui | dg7elt | doil | dg7ip | g7rtb | Adj. $R^2$ |
|---|---|---|---|---|---|
| .222 | .120 | .116 | .000 | .222 | .334 |
| .319 | .426 | .204 | .009 | .329 | .384 |
| .046 | .019 | .037 | .417 | .106 | .484 |
| .065 | .125 | .130 | .097 | .111 | .529 |
| .236 | .380 | .120 | .176 | .157 | .344 |
| .093 | .134 | .167 | .046 | .097 | .502 |
| .157 | .171 | .204 | .079 | .019 | .511 |
| .102 | .255 | .093 | .069 | .139 | .234 |
| .259 | .194 | .375 | .009 | .218 | .303 |
| .088 | .282 | .028 | .134 | .171 | .716 |
| .250 | .079 | .102 | .343 | .259 | .626 |
| .111 | .074 | .477 | .204 | .088 | .451 |
| .102 | .065 | .130 | .023 | .153 | .348 |
| .083 | .176 | .287 | .037 | .264 | .371 |
| .148 | .106 | .218 | .171 | .060 | .330 |
| .060 | .134 | .051 | .236 | .088 | .574 |
| .037 | .241 | .241 | .250 | .319 | .560 |
| .093 | .222 | .125 | .222 | .130 | .745 |
| | | | | | |
| .185 | .315 | .509 | .134 | .296 | |
| .190 | .273 | .509 | .134 | .255 | |

The Adj. $R^2$ is the average adjusted R-squared from these rolling regressions. See Appendix B for definitions of the risk factors.

## Figure 2. Australia, January 1975 - June 1998.




## Figure 2. continued..., Austria.

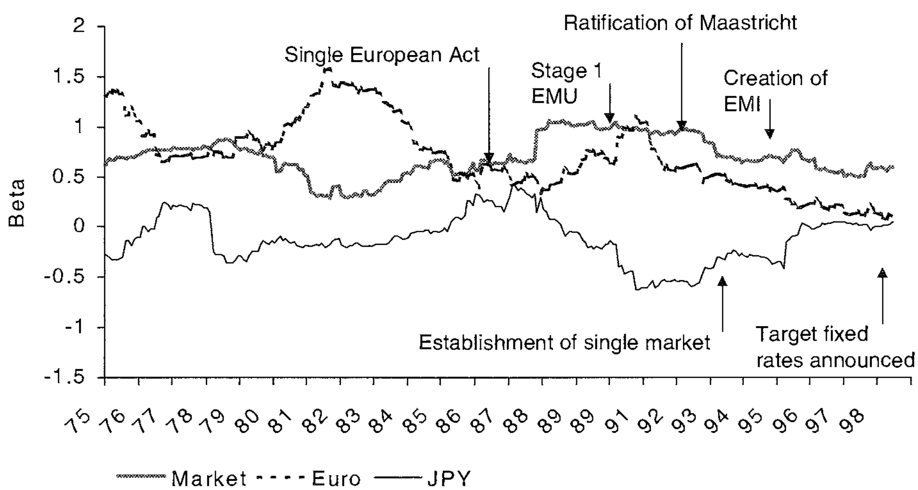


**Figure 2. continued..., Belgium.**

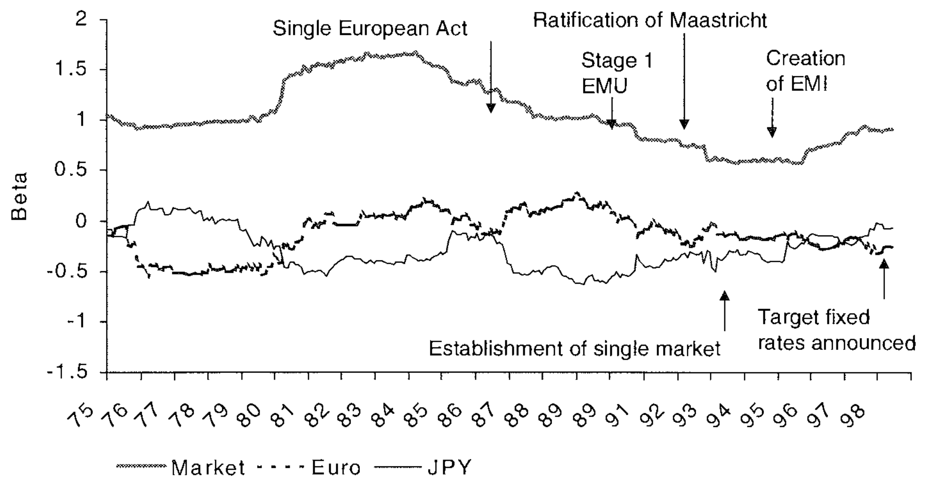



**Figure 2. continued..., Canada.**

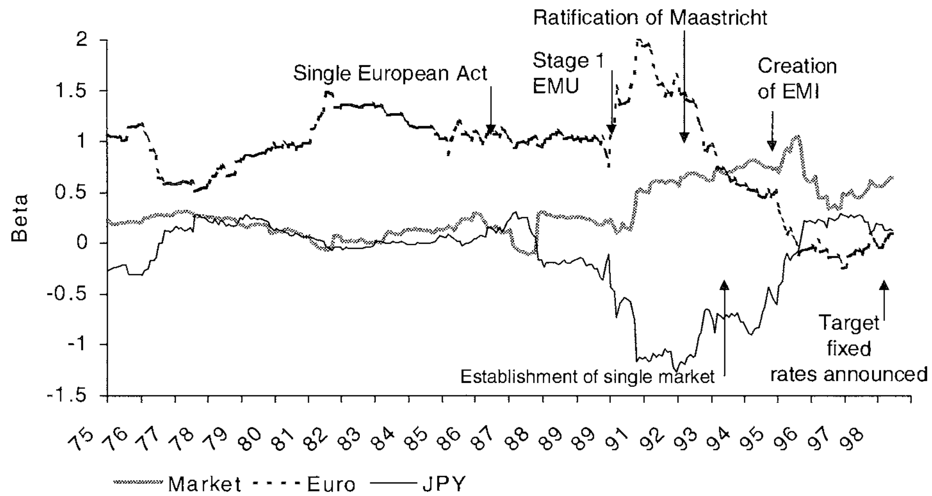


**Figure 2. continued..., Denmark.**

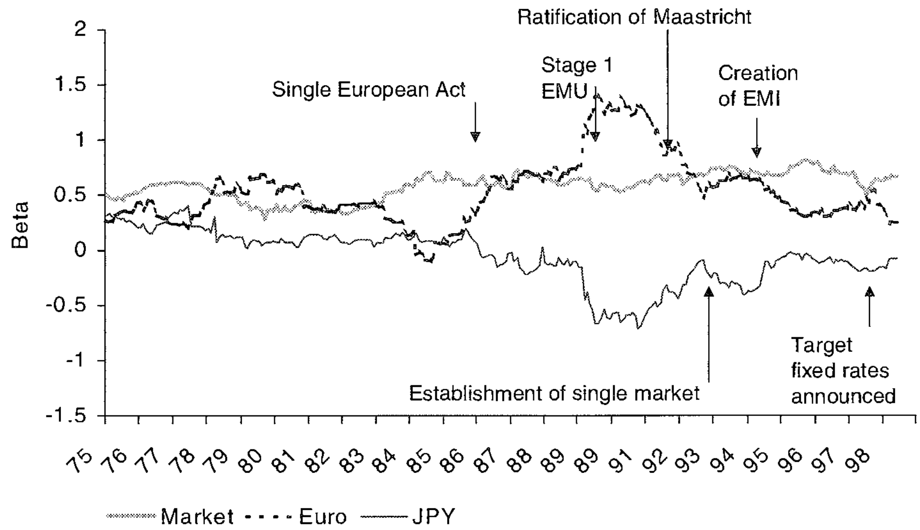



**Figure 2. continued..., France.**

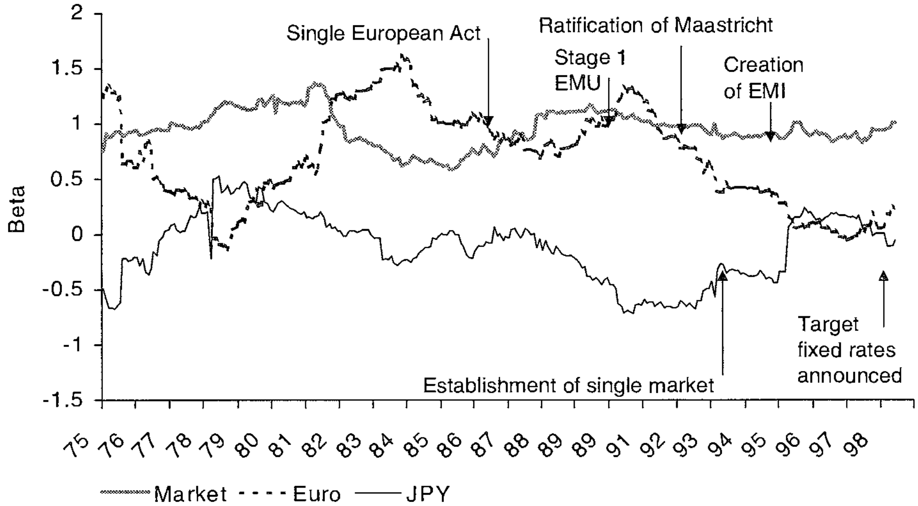


**Figure 2. continued..., Germany.**

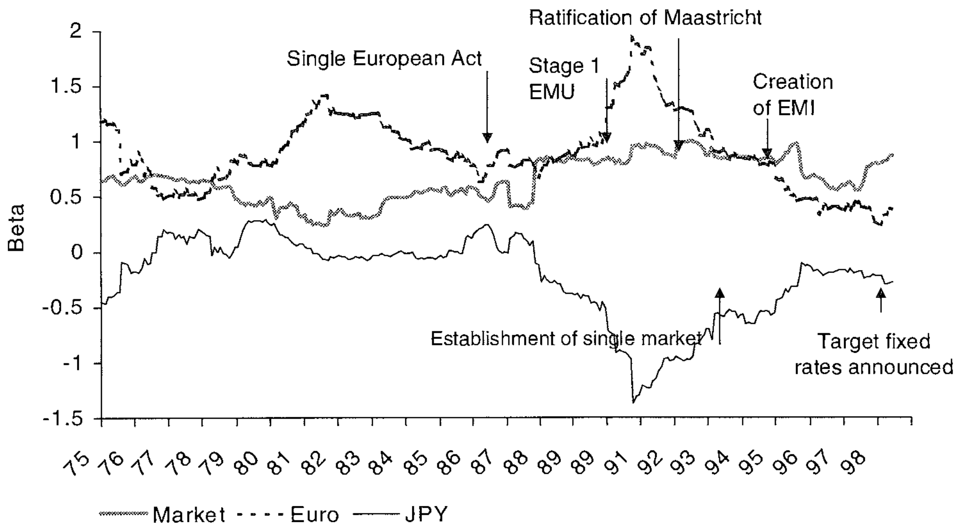
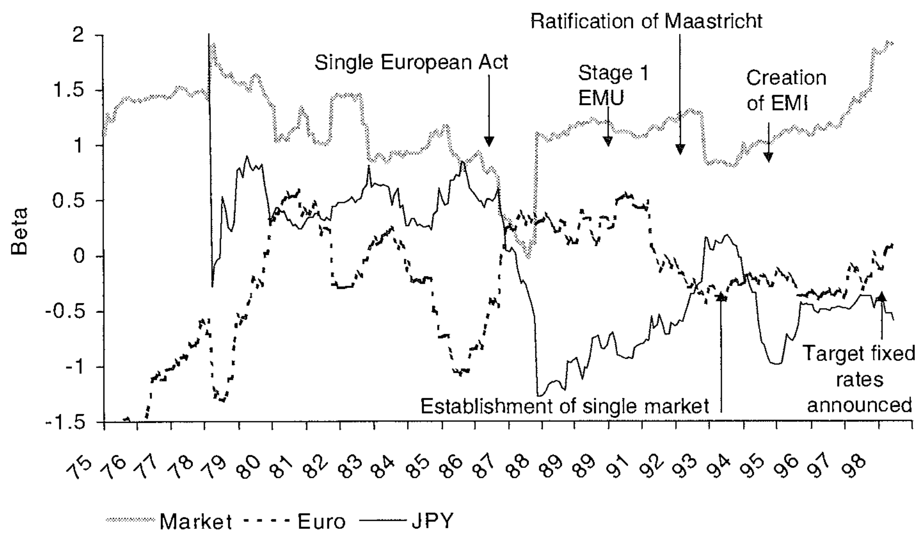
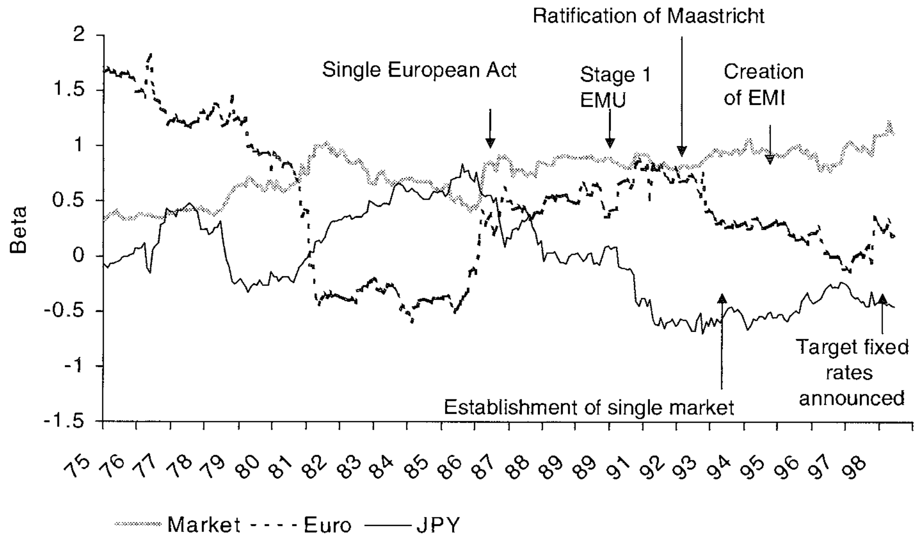


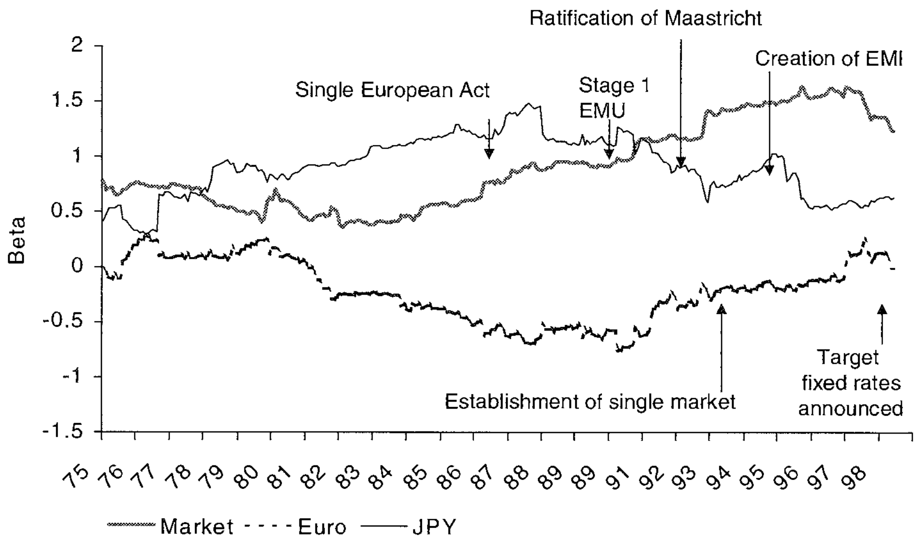

**Figure 2. continued..., Hong Kong.**



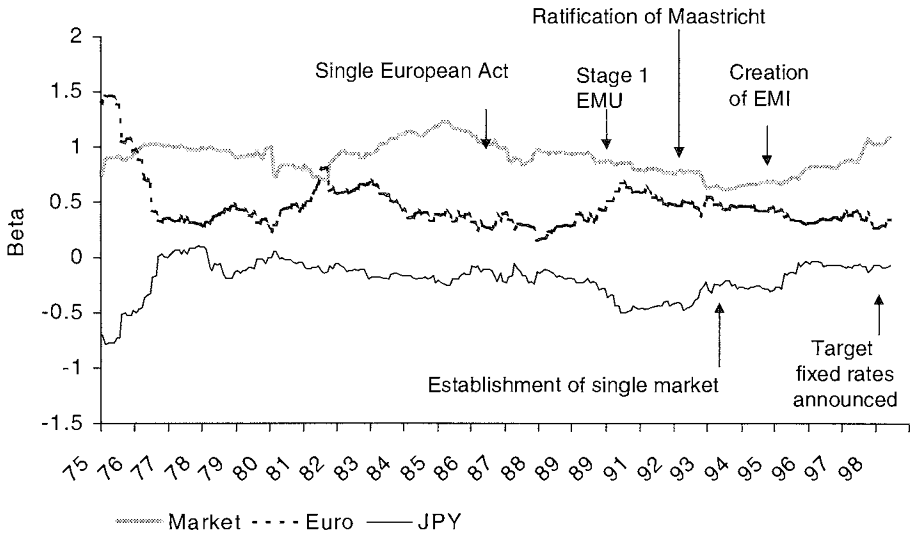
## Figure 2. continued..., Italy.




## Figure 2. continued..., Japan.



## Figure 2. continued..., Netherlands.




## Figure 2. continued..., Norway.

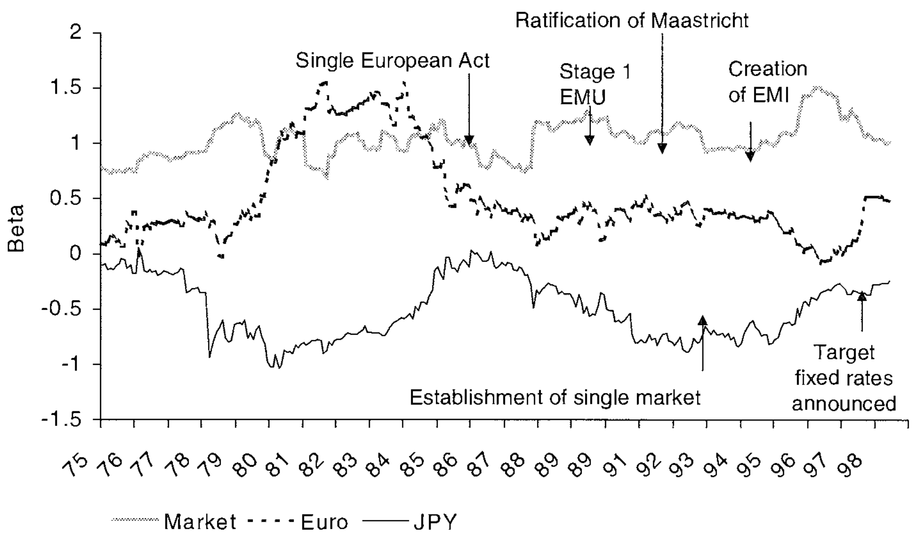


**Figure 2. continued..., Singapore.**

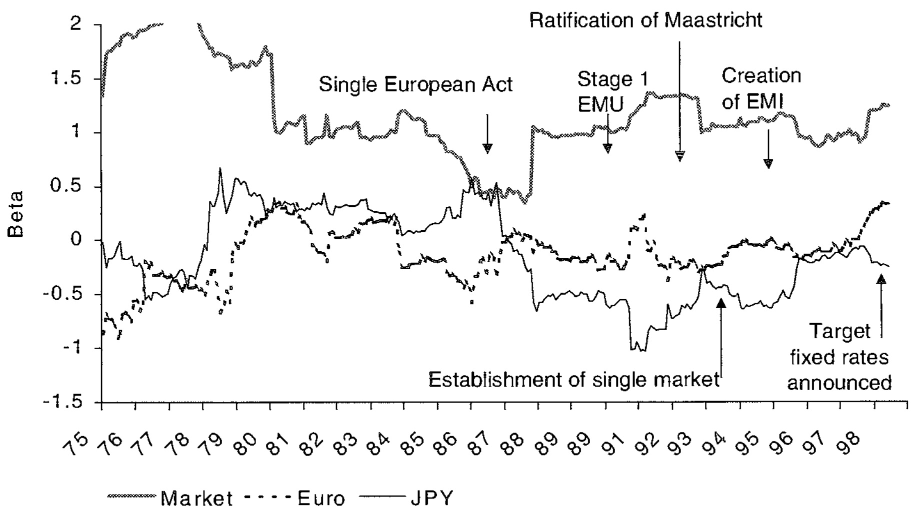



**Figure 2. continued..., Spain.**

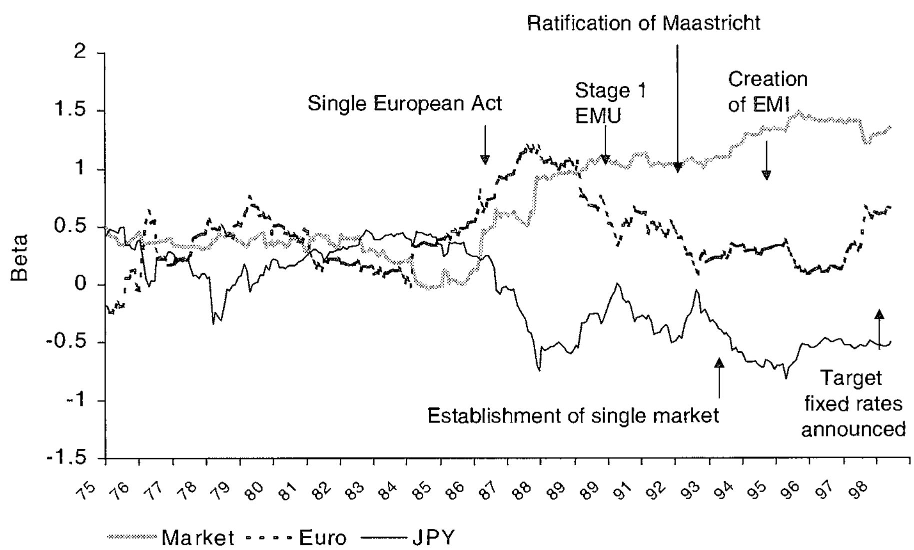


**Figure 2. continued..., Sweden.**

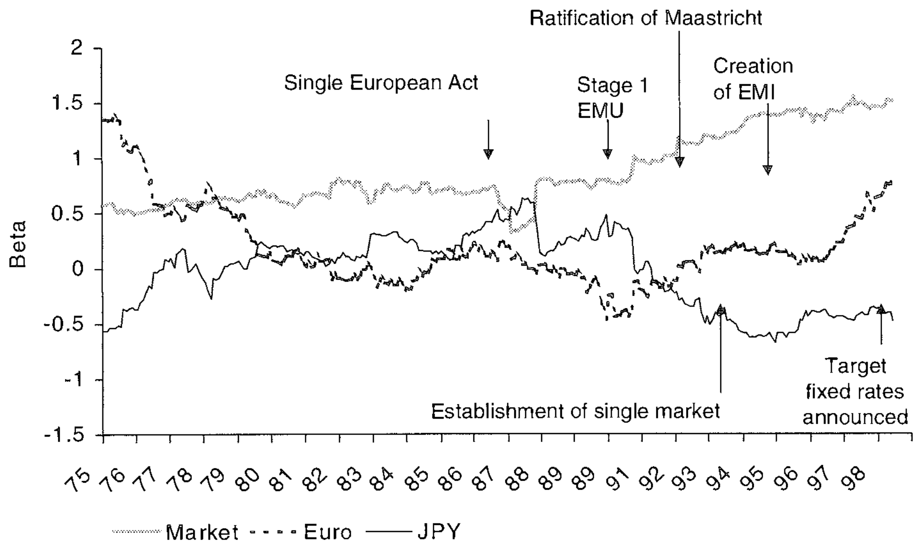
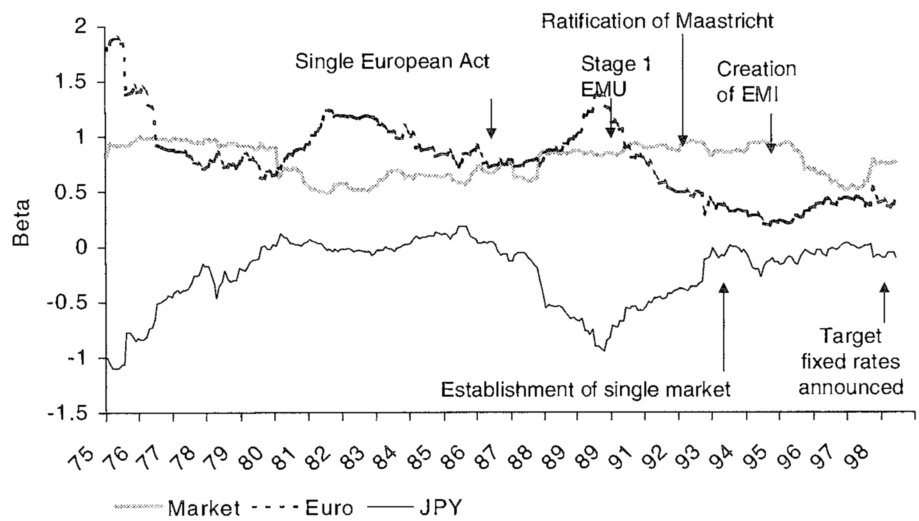
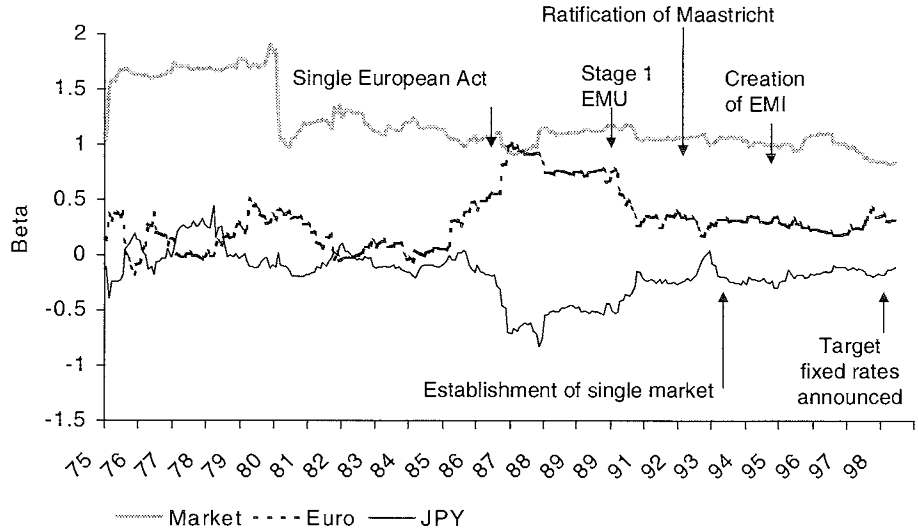



**Figure 2. continued..., Switzerland.**



## Figure 2. continued..., UK.




## Figure 2. continued..., US.

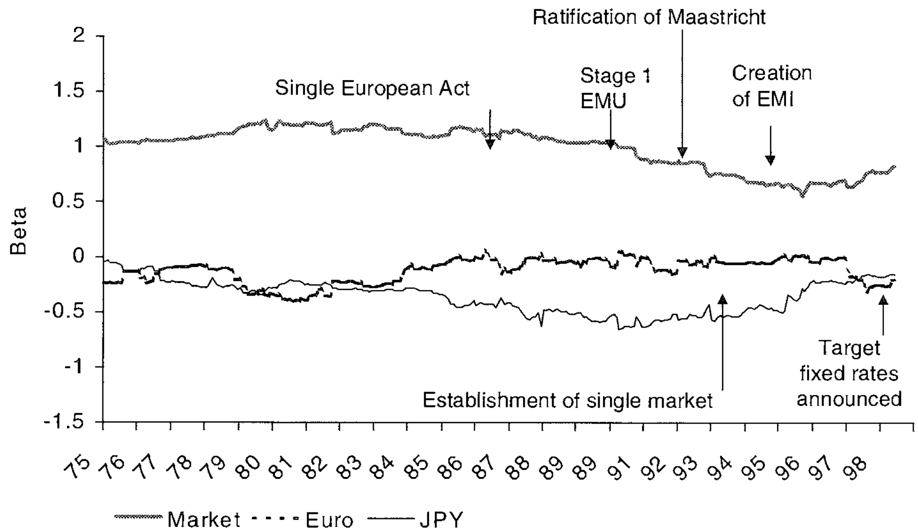


Table 5 more formally explores the variation in betas. In particular, we investigate the price-to-book ratios' role as instruments for the time-varying betas. We use three, different, price-to-book definitions; all three measures are lagged.

1. The world price-to-book excess return (which we also—but not lagged—use as a risk factor in the seven-factor model).
2. The world price-to-book ratio. As mentioned earlier, this is a highly persistent measure and has some similarity to dividend yields.
3. The local price-to-book ratio.

Panel A in Table 5 assumes that each of the conditional betas in the three-factor model is a linear function of the lagged price-to-book factor's excess return. In the far right columns, we report the adjusted $R^2$s of these regressions along with the $R^2$ from Table 2 for the three-factor model, without the lagged instrument.

The increments to the $R^2$s may be evaluated, as in a step-down F-test, for the significance of the additional variables. Because the power of the test may vary with the number of factors, we compare the alternative specifications for price-to-book using the three-factor model.

The world price-to-book return contributes little to the explanatory power of the factor model. The adjusted $R^2$s increase in only four countries. Even in these cases, the magnitudes of the increases are very small. For example, Hong Kong increases from 0.235 to 0.244.

## Table 5. Price-to-book value and ...

*Panel A. Using high-low, ...*

| | intercept | $wdret_t$ | ($wdret_t$ x $wrpbret_{t-1}$) | $euroret_t$ |
|---|---|---|---|---|
| Australia | .001 | .809 | 11.928 | -0.176 |
| | .004 | .104 | 7.604 | .143 |
| Austria | .001 | .344 | 4.786 | .739 |
| | .004 | .144 | 3.797 | .159 |
| Belgium | .003 | .710 | 6.575 | .611 |
| | .002 | .075 | 2.510 | .098 |
| Canada | -0.002 | .994 | .099 | -0.099 |
| | .002 | .086 | 2.244 | .106 |
| Denmark | .003 | .590 | 2.130 | .490 |
| | .003 | .077 | 2.547 | .115 |
| France | .001 | .938 | .901 | .598 |
| | .003 | .074 | 3.264 | .129 |
| Germany | .002 | .702 | 2.980 | .766 |
| | .003 | .114 | 4.073 | .124 |
| Hong Kong | .008 | .941 | 19.005 | -0.132 |
| | .005 | .164 | 5.354 | .210 |
| Italy | -0.000 | .855 | .612 | .222 |
| | .004 | .118 | 3.442 | .202 |
| Japan | -0.002 | 1.044 | -3.356 | -0.280 |
| | .002 | .082 | 2.504 | .101 |
| Netherlands | .005 | .875 | 1.063 | .354 |
| | .002 | .062 | 2.109 | .086 |
| Norway | .001 | .999 | 6.549 | .555 |
| | .004 | .118 | 4.051 | .163 |
| Singapore | .000 | .908 | 13.036 | -0.077 |
| | .004 | .133 | 6.045 | .165 |
| Spain | -0.001 | .783 | 7.015 | .393 |
| | .003 | .115 | 3.958 | .149 |
| Sweden | .004 | .908 | 2.462 | .111 |
| | .003 | .118 | 3.329 | .128 |
| Switzerland | .003 | .762 | 3.790 | .600 |
| | .002 | .073 | 2.501 | .090 |
| UK | .004 | .978 | 9.025 | .370 |
| | .003 | .074 | 3.887 | .109 |
| US | .002 | .946 | 1.606 | -0.112 |
| | .001 | .050 | 1.325 | .056 |

*Notes*: The regression model is a three-factor version of equation (2) where the factors are wdret, the world market excess return, euroret, the synthetic euro excess return and yenret, the yen excess return. The lagged instrument $Z_{t-1}$ is replaced by various versions of a lagged price-to-book variable; a different one in each panel.

## ... time-varying risk, January 1975 – December 1997.

*... world price-to-book return*

| ($euroret_t$ x $wrpbret_{t-1}$) | $yenret_t$ | ($yenret_t$ x $wrpbret_{t-1}$) | Adj. $R^2$ with lagged instruments | Adj. $R^2$ no lagged instruments |
|---|---|---|---|---|
| -6.403 | .096 | -6.611 | .276 | .277 |
| 5.799 | .122 | 6.591 | | |
| 3.293 | -0.051 | -2.428 | .192 | .195 |
| 6.658 | .128 | 5.413 | | |
| 2.185 | -0.090 | -5.107 | .459 | .467 |
| 3.899 | .079 | 3.437 | | |
| -4.463 | -0.247 | -0.311 | .481 | .497 |
| 3.928 | .101 | 3.853 | | |
| 1.518 | -0.064 | .046 | .315 | .322 |
| 6.384 | .088 | 4.135 | | |
| .313 | -0.046 | -2.224 | .435 | .459 |
| 6.176 | .126 | 5.673 | | |
| -3.100 | -0.185 | .792 | .403 | .415 |
| 5.029 | .102 | 4.164 | | |
| -9.417 | .075 | -11.820 | .244 | .235 |
| 8.295 | .195 | 7.767 | | |
| 8.999 | -0.037 | -6.454 | .198 | .206 |
| 9.017 | .146 | 6.602 | | |
| 1.958 | .886 | 4.200 | .675 | .667 |
| 3.667 | .091 | 3.556 | | |
| -0.115 | -0.121 | -2.081 | .572 | .591 |
| 3.280 | .070 | 3.248 | | |
| -1.250 | -0.500 | -1.127 | .313 | .319 |
| 5.230 | .136 | 4.947 | | |
| -4.187 | -0.014 | -9.618 | .307 | .315 |
| 6.652 | .149 | 7.001 | | |
| 12.140 | -0.080 | -11.265 | .289 | .268 |
| 7.627 | .117 | 5.350 | | |
| -0.606 | -0.013 | -5.357 | .309 | .317 |
| 4.809 | .116 | 4.337 | | |
| 5.925 | -0.076 | -1.337 | .531 | .536 |
| 4.021 | .076 | 3.259 | | |
| 3.366 | -0.114 | -4.843 | .484 | .476 |
| 4.351 | .099 | 4.532 | | |
| -2.160 | -0.341 | -2.077 | .740 | .746 |
| 1.998 | .051 | 1.704 | | |

*Notes continued ...*

The regression coefficients are on the first line and their standard errors are on the second line. The first R-squared is the model with the lagged instruments (time-varying conditional betas) and the second R-squared is from a model without the instruments (constant beta).

**Table 5. continued...**

*Panel B. Using world ...*

| | intercept | $wdret_t$ | ($wdret_t$ x $wrpbret_{t-1}$) | $euroret_t$ |
|---|---|---|---|---|
| Australia | .001 | .603 | .167 | .385 |
| | .004 | .493 | .289 | .529 |
| Austria | .001 | -0.141 | .253 | 1.233 |
| | .004 | .203 | .129 | .548 |
| Belgium | .004 | .491 | .133 | 1.389 |
| | .002 | .221 | .114 | .342 |
| Canada | -0.001 | 1.596 | -0.322 | .331 |
| | .002 | .263 | .130 | .409 |
| Denmark | .002 | .296 | .166 | .025 |
| | .003 | .190 | .096 | .418 |
| France | .002 | .897 | .026 | 1.229 |
| | .003 | .303 | .139 | .510 |
| Germany | .002 | .111 | .316 | .991 |
| | .003 | .210 | .119 | .437 |
| Hong Kong | .007 | .708 | .233 | .205 |
| | .005 | .689 | .337 | .915 |
| Italy | -0.001 | .457 | .203 | -0.190 |
| | .004 | .292 | .144 | .697 |
| Japan | -0.002 | .453 | .285 | -0.611 |
| | .002 | .258 | .141 | .344 |
| Netherlands | .005 | 1.082 | -0.093 | .648 |
| | .002 | .259 | .123 | .339 |
| Norway | .001 | .905 | .059 | 1.178 |
| | .004 | .375 | .184 | .627 |
| Singapore | -0.000 | 1.241 | -0.058 | .107 |
| | .004 | .814 | .389 | .722 |
| Spain | -0.002 | -0.523 | .702 | -0.155 |
| | .003 | .280 | .134 | .538 |
| Sweden | .004 | .291 | .338 | -0.336 |
| | .003 | .252 | .133 | .464 |
| Switzerland | .004 | .657 | .068 | 1.422 |
| | .002 | .273 | .133 | .316 |
| UK | .004 | 1.900 | -0.379 | .342 |
| | .003 | .703 | .312 | .442 |
| US | .002 | 1.188 | -0.125 | .059 |
| | .001 | .121 | .064 | .193 |

...

*... price-to-book return*

| ($euroret_t$ x $wrpbret_{t-1}$) | $yenret_t$ | ($yenret_t$ x $wrpbret_{t-1}$) | Adj. $R^2$ with lagged instruments | Adj. $R^2$ no lagged instruments |
|---|---|---|---|---|
| -0.318 | .932 | -0.488 | .299 | .277 |
| .279 | .459 | .262 | | |
| -0.244 | .548 | -0.328 | .208 | .195 |
| .337 | .329 | .225 | | |
| -0.422 | .086 | -0.100 | .480 | .467 |
| .175 | .258 | .138 | | |
| -0.272 | -0.387 | .078 | .514 | .497 |
| .202 | .347 | .183 | | |
| .269 | .440 | -0.284 | .324 | .322 |
| .218 | .285 | .155 | | |
| -0.334 | .477 | -0.296 | .472 | .459 |
| .256 | .450 | .221 | | |
| -0.093 | .789 | -0.542 | .447 | .415 |
| .265 | .278 | .172 | | |
| -0.206 | 1.248 | -0.700 | .251 | .235 |
| .453 | .795 | .397 | | |
| .273 | 1.056 | -0.619 | .213 | .206 |
| .349 | .414 | .224 | | |
| .217 | 1.030 | -0.066 | .674 | .667 |
| .189 | .264 | .160 | | |
| -0.167 | .001 | -0.077 | .594 | .591 |
| .178 | .259 | .141 | | |
| -0.351 | -0.470 | -0.011 | .316 | .319 |
| .312 | .517 | .261 | | |
| -0.121 | .873 | -0.545 | .331 | .315 |
| .360 | .571 | .298 | | |
| .376 | 1.144 | -0.697 | .322 | .268 |
| .276 | .345 | .187 | | |
| .271 | .707 | -0.417 | .326 | .317 |
| .253 | .344 | .182 | | |
| -0.439 | .254 | -0.198 | .559 | .536 |
| .178 | .261 | .147 | | |
| -0.015 | -0.039 | -0.079 | .487 | .476 |
| .219 | .448 | .216 | | |
| -0.111 | -0.265 | -0.047 | .752 | .746 |
| .103 | .146 | .092 | | |

**Table 5. continued...**

*Panel C. Using local ...*

| | intercept | $wdret_t$ | ($wdret_t$ x $wrpbret_{t-1}$) | $euroret_t$ |
|---|---|---|---|---|
| Australia | .002 | -0.087 | .675 | .202 |
| | .004 | .466 | .304 | .768 |
| Austria | .002 | -0.386 | .421 | .057 |
| | .003 | .251 | .163 | .492 |
| Belgium | .004 | .543 | .160 | 1.197 |
| | .002 | .208 | .150 | .290 |
| Canada | -0.002 | 1.048 | -0.026 | -0.944 |
| | .002 | .414 | .265 | .877 |
| Denmark | .003 | .312 | .196 | .569 |
| | .003 | .122 | .067 | .224 |
| France | .002 | .959 | .014 | .685 |
| | .003 | .261 | .149 | .480 |
| Germany | .002 | .272 | .240 | .693 |
| | .003 | .323 | .190 | .571 |
| Hong Kong | .008 | .654 | .264 | .293 |
| | .005 | .459 | .216 | .698 |
| Italy | -0.000 | .791 | .036 | .154 |
| | .004 | .296 | .203 | .603 |
| Japan | -0.002 | .815 | .053 | .099 |
| | .002 | .229 | .078 | .318 |
| Netherlands | .005 | .972 | -0.054 | .551 |
| | .002 | .163 | .111 | .214 |
| Norway | .000 | 1.298 | -0.140 | .855 |
| | .004 | .318 | .152 | .519 |
| Singapore | .001 | .844 | .164 | .453 |
| | .004 | 1.291 | .616 | .915 |
| Spain | -0.002 | .587 | .188 | .387 |
| | .004 | .262 | .229 | .372 |
| Sweden | .004 | .563 | .219 | -0.171 |
| | .003 | .163 | .092 | .277 |
| Switzerland | .003 | .800 | -0.002 | 1.029 |
| | .002 | .214 | .134 | .263 |
| UK | .004 | 1.929 | -0.467 | .408 |
| | .003 | .582 | .298 | .362 |
| US | .002 | 1.194 | -0.128 | .052 |
| | .001 | .094 | .046 | .152 |

▫▫▫

*... price-to-book ratio*

| $(euroret_t$ x $wrpbret_{t-1})$ | $yenret_t$ | $(yenret_t$ x $wrpbret_{t-1})$ | Adj. $R^2$ with lagged instruments | Adj. $R^2$ no lagged instruments |
|---|---|---|---|---|
| -0.282 | 1.467 | -0.986 | .328 | .277 |
| .576 | .530 | .356 | | |
| .452 | 1.177 | -0.776 | .231 | .195 |
| .325 | .379 | .269 | | |
| -0.463 | .041 | -0.113 | .477 | .467 |
| .207 | .222 | .164 | | |
| .542 | .418 | -0.449 | .498 | .497 |
| .580 | .531 | .358 | | |
| -0.035 | .119 | -0.138 | .327 | .322 |
| .144 | .157 | .110 | | |
| -0.038 | .359 | -0.338 | .462 | .459 |
| .322 | .391 | .262 | | |
| .064 | .544 | -0.411 | .424 | .415 |
| .339 | .332 | .211 | | |
| -0.286 | .652 | -0.343 | .244 | .235 |
| .369 | .815 | .411 | | |
| .068 | -0.095 | .034 | .198 | .206 |
| .427 | .405 | .321 | | |
| -0.146 | .695 | .099 | .666 | .667 |
| .123 | .287 | .126 | | |
| -0.175 | -0.190 | .041 | .589 | .591 |
| .153 | .155 | .108 | | |
| -0.199 | -0.569 | .034 | .316 | .319 |
| .276 | .365 | .203 | | |
| -0.295 | -0.530 | .206 | .311 | .315 |
| .469 | .845 | .423 | | |
| .034 | .350 | -0.471 | .274 | .268 |
| .335 | .249 | .244 | | |
| .206 | .337 | -0.250 | .324 | .317 |
| .158 | .200 | .110 | | |
| -0.295 | .025 | -0.091 | .544 | .536 |
| .180 | .205 | .136 | | |
| -0.075 | -0.024 | -0.091 | .505 | .476 |
| .199 | .351 | .179 | | |
| -0.106 | -0.463 | .059 | .750 | .746 |
| .075 | .118 | .060 | | |

Panel B in Table 5 examines the world price-to-book ratio. This ratio may have some advantages as an instrumental variable for risk, because a ratio of market price to the magnitude of earnings potential is related to risk in most models as emphasized by Berk (1995). Using the ratio instead of the lagged factor return is analogous to using a yield to maturity as an instrumental variable rather than a bond return. Indeed, using the world price-to-book ratio as an instrument for time-varying betas increases the explanatory power of all the country factor regressions except for Norway.

Panel C in Table 5 examines the importance of the local price-to-book ratio. Compared to the constant beta regression, explanatory power increases in 13 of 18 countries. Compared to the world price-to-book ratio, the local version produces a smaller improvement in the explanatory power for 13 of 18 countries. We conclude that a lagged price-to-book ratio may be a good instrument for time-varying, systematic risk. Of the three specifications, the world ratio appears to be the most promising, but this varies across countries.

### 3.4. Predictability

Regressions of the asset returns over time on the instrumental variables are presented in Table 6. The explanatory power, as measured by R-squared, ranges from less than 1% (Austria, Denmark, France, Hong Kong and Sweden) to more than 9% (Singapore). In general, the degree of predictability is less than reported in Ferson and Harvey (1993). This is likely explained by the different sample. Their sample began in 1970 and ended in 1989. It is also the case that we use a slightly different instrument set. We do not include a dummy variable for January. In addition, we replace the lagged world return in their study with the lagged world price-to-book ratio.

Table 7 examines incremental information contained in the local instrumental variables and the role of the price-to-book variable in the regressions. Columns 2 and 3 show the impact of including the world price-to-book variable in the prediction regressions.

There is no country where the adjusted $R^2$ decreases when the world price-to-book ratio is added. But the improvement in explanatory power is minor. The average adjusted $R^2$ increases from 0.032 to 0.035. The weak additional explanatory power is also reflected in the F-test reported in column 8. Columns 4 and 5 investigate the role of the local price-to-book ratio in the predictability regressions. In each country, the explanatory power increases when the local price-to-book ratio joins the local instruments in the regressions. But in contrast to the previous case, the change in $R^2$ is more substantial. The average $R^2$ increases from 0.026 to 0.035. This is also evident in the F-tests where we can reject the null hypothesis that the coefficient on the local price-to-book ratio is zero in 10 countries at the 5% level of significance.

### 3.5. Conditional asset-pricing models

Several different asset-pricing specifications are examined in Table 8: the one-factor world CAPM (Panel A), a three-factor model with the world return plus the two currency factors (Panel B), a two-factor model (the world return plus price-to-book return), a four-factor model (three factors plus the world price-to-book return), a six-factor model (the three-factor model plus three, macroeconomic, factor-mimicking portfolios), and a seven-factor model (the six-factor model plus the world price-to-book return).

Panel A (the world CAPM) presents more detail than the other panels. In particular, we do tests on the specification of the conditional beta functions. We examine a beta that is a function of local information, the local information plus the world price-to-book return and the local information plus the local price-to-book ratio. $\chi^2$ tests of whether the coefficients on the non-constant part of the beta function are zero are presented. In addition, we present the analysis of variance ratios measuring how much of the predictability is accounted for by the asset-pricing model and the average pricing errors. Regarding the conditional beta function, the evidence in Panel A supports a specification with the local information variables only.

**Table 6. Time-series regression of asset returns on world instrumental variables, January 1975 - December 1997.**

| | intercept | lwrdivy | lted | lterm | tb1 | lwrpb | Adj. $R^2$ |
|---|---|---|---|---|---|---|---|
| Australia | .206 | -.284 | 27.072 | -6.919 | -6.383 | -.047 | .020 |
| | .144 | 23.493 | 13.671 | 7.034 | 3.380 | .038 | |
| Austria | -.045 | 4.123 | -3.719 | 3.575 | .816 | .016 | .006 |
| | .103 | 18.442 | 11.497 | 4.843 | 2.392 | .029 | |
| Belgium | .135 | -25.327 | 26.960 | 5.372 | -1.711 | -.035 | .040 |
| | .090 | 15.820 | 1.789 | 4.679 | 2.398 | .025 | |
| Canada | .065 | -3.469 | 26.855 | -6.147 | -7.119 | -.008 | .050 |
| | .099 | 17.406 | 9.253 | 4.707 | 2.551 | .027 | |
| Denmark | .009 | -5.142 | 13.869 | 1.616 | -.298 | .003 | .003 |
| | .088 | 15.773 | 7.375 | 3.594 | 2.173 | .024 | |
| France | -.034 | 14.055 | .630 | .814 | -3.794 | .012 | .008 |
| | .139 | 27.083 | 16.502 | 5.317 | 3.303 | .037 | |
| Germany | .044 | -4.301 | -.809 | 1.213 | -1.570 | -.010 | .010 |
| | .113 | 2.051 | 12.588 | 4.657 | 2.461 | .031 | |
| Hong Kong | .202 | -17.500 | 7.131 | -9.022 | -8.056 | -.046 | .005 |
| | .195 | 33.459 | 21.655 | 8.341 | 4.680 | .054 | |
| Italy | -.052 | 11.693 | 7.493 | 2.163 | -2.330 | .017 | .013 |
| | .146 | 26.595 | 12.441 | 5.700 | 3.192 | .039 | |
| Japan | .254 | -39.834 | 18.823 | 1.746 | -1.387 | -.075 | .027 |
| | .117 | 21.552 | 11.080 | 4.276 | 2.495 | .032 | |
| Nthrlnds. | .022 | 3.381 | 12.737 | .825 | -4.756 | -.000 | .019 |
| | .100 | 17.627 | 11.642 | 4.323 | 2.608 | .027 | |
| Norway | .037 | -5.485 | 5.814 | -5.395 | -1.765 | -.000 | .012 |
| | .125 | 22.292 | 14.742 | 6.374 | 3.453 | .033 | |
| Sngpre. | .263 | -29.782 | 49.826 | -16.789 | -12.711 | -.055 | .094 |
| | .153 | 25.749 | 18.068 | 6.431 | 4.044 | .042 | |
| Spain | .171 | -41.721 | 17.102 | -.027 | 2.822 | -.040 | .012 |
| | .118 | 21.251 | 9.848 | 4.688 | 2.808 | .033 | |
| Sweden | .170 | -33.078 | 26.096 | -2.720 | -.372 | -.040 | .001 |
| | .119 | 21.868 | 13.303 | 5.173 | 2.796 | .033 | |
| Switzerland | .105 | -14.012 | 13.781 | .087 | -3.813 | -.023 | .014 |
| | .100 | 17.620 | 12.265 | 4.614 | 2.520 | .027 | |
| UK | -.050 | 22.395 | 22.780 | -2.869 | -8.722 | .022 | .037 |
| | .106 | 18.347 | 2.584 | 5.697 | 4.106 | .028 | |
| US | .062 | -8.239 | 23.429 | -.328 | -3.739 | -.011 | .040 |
| | .085 | 14.976 | 8.764 | 3.608 | 1.809 | .024 | |

*Notes:* Lagged instrumental variables:

**lwrdivy** lagged world dividend yield

**lted** lagged spread between 90-day euro-USD deposit rates and 90-day Treasury bill rates

**lterm** lagged spread between the 10-year US Treasury bond yield and the 90-day US Treasury bill rate

**tb1** 30-day US Treasury bill rate

**lwrpb** lagged world price-to-book ratio

**Table 7. Incremental explanatory power of local information variables in predicting 18 countries' excess returns, January 1975 - December 1997.**

| | Adj. $R^2$ | Adj. $R^2$ | Adj. $R^2$ | Adj. $R^2$ | F-test | F-test | F-test |
|---|---|---|---|---|---|---|---|
| Australia | .031 | .038 | .018 | .026 | 1.879 | 5.100 | 2.449 |
| | | | | | .172 | .025 | .119 |
| Austria | .011 | .012 | .011 | .011 | .273 | .652 | .027 |
| | | | | | .602 | .420 | .869 |
| Belgium | .052 | .058 | .014 | .016 | 1.777 | 3.928 | .523 |
| | | | | | .184 | .049 | .470 |
| Canada | .067 | .068 | .024 | .035 | .116 | .259 | 3.202 |
| | | | | | .734 | .611 | .075 |
| Denmark | .015 | .015 | .003 | .005 | .027 | .272 | .545 |
| | | | | | .869 | .602 | .461 |
| France | .010 | .010 | .014 | .014 | .136 | 4.234 | .027 |
| | | | | | .712 | .041 | .868 |
| Germany | .008 | .008 | .008 | .012 | .109 | 1.685 | 1.290 |
| | | | | | .742 | .195 | .257 |
| HngKng. | .020 | .024 | .071 | .083 | .995 | 17.043 | 3.755 |
| | | | | | .319 | .000 | .054 |
| Italy | .005 | .006 | .017 | .030 | .190 | 5.583 | 3.603 |
| | | | | | .663 | .019 | .059 |
| Japan | .026 | .045 | .023 | .023 | 5.456 | 3.850 | .000 |
| | | | | | .020 | .051 | 1.000 |
| Nether-lands | .037 | .037 | .042 | .044 | .000 | 4.961 | .397 |
| | | | | | 1.000 | .027 | .529 |
| Norway | .007 | .007 | .001 | .009 | .000 | 2.011 | 2.435 |
| | | | | | 1.000 | .157 | .120 |
| Sngpore. | .103 | .110 | .070 | .081 | 2.245 | 9.462 | 3.184 |
| | | | | | .135 | .002 | .075 |
| Spain | .025 | .030 | .022 | .053 | 1.448 | 1.455 | 8.697 |
| | | | | | .230 | .001 | .003 |
| Sweden | .013 | .019 | .004 | .008 | 1.513 | 3.299 | 1.011 |
| | | | | | .220 | .070 | .316 |
| Swtzrland. | .029 | .031 | .003 | .009 | .753 | .747 | 1.640 |
| | | | | | .386 | .388 | .201 |
| UK | .053 | .055 | .111 | .142 | .429 | 35.819 | 9.566 |
| | | | | | .513 | .000 | .002 |
| US | .057 | .058 | .016 | .023 | .315 | .284 | 1.998 |
| | | | | | .575 | .594 | .159 |

*Notes:*

| Col. | Displays the ... |
|---|---|
| 2 | world, excluding lwrpb |
| 3 | world, including lwrpb |
| 4 | local, excluding llocpb |
| 5 | local, including llocpb |
| 6 | world, excluding lwrpb |
| 7 | world + local (no pbs), excluding local |
| 8 | local, excluding llocpb |

## Table 8. A decomposition of the predictable variation in ...

| | Average return | Average pricing error (alpha) | Variance ratio (VR1) | $\chi^2$ constant beta (local info.) | Average pricing error (alpha) |
|---|---|---|---|---|---|
| Australia | .0130 | .0013 | .855 | 8.766 | .0021 |
| | | .0033 | .176 | .033 | .0034 |
| Austria | .0094 | .0007 | .000 | 1.126 | .0005 |
| | | .0041 | .011 | .771 | .0043 |
| Belgium | .0140 | .0024 | .689 | .474 | .0029 |
| | | .0029 | .215 | .925 | .0029 |
| Canada | .0110 | -0.0007 | .749 | 12.661 | -0.0013 |
| | | .0021 | .168 | .005 | .0021 |
| Denmark | .0130 | .0025 | .124 | .322 | .0027 |
| | | .0028 | .294 | .956 | .0027 |
| France | .0140 | .0004 | .297 | 1.500 | .0011 |
| | | .0032 | .526 | .682 | .0033 |
| Germany | .0130 | .0016 | .216 | .850 | .0011 |
| | | .0029 | .372 | .837 | .0030 |
| Hong Kong | .0210 | .0098 | .700 | 5.357 | .0083 |
| | | .0048 | .425 | .147 | .0051 |
| Italy | .0120 | -0.0001 | .605 | 1.159 | -0.0003 |
| | | .0041 | .631 | .763 | .0041 |
| Japan | .0120 | -0.0020 | .554 | 5.268 | -0.0019 |
| | | .0029 | .245 | .153 | .0029 |
| Netherlands | .0170 | .0052 | .772 | 4.444 | .0046 |
| | | .0019 | .175 | .217 | .0019 |
| Norway | .0120 | -0.0002 | .016 | .356 | .0006 |
| | | .0048 | .173 | .949 | .0047 |
| Singapore | .0140 | .0010 | .732 | 2.354 | .0001 |
| | | .0036 | .230 | .502 | .0038 |
| Spain | .0098 | -0.0020 | .126 | 15.089 | -0.0009 |
| | | .0035 | .216 | .002 | .0036 |
| Sweden | .0160 | .0041 | .465 | 6.186 | .0042 |
| | | .0030 | .367 | .103 | .0032 |
| Switzerland | .0150 | .0029 | .572 | 1.376 | .0026 |
| | | .0026 | .220 | .711 | .0026 |
| UK | .0180 | .0036 | .725 | 7.117 | .0030 |
| | | .0028 | .239 | .068 | .0027 |
| US | .0140 | .0021 | .919 | 2.656 | .0023 |
| | | .0015 | .086 | .448 | .0014 |

*Notes:*

**All cols.** *Panel A. One factor: wdret*

**Col. 3** Beta is the function of local information

**Col. 6** Beta is the function of wrpbret and local information.

Average return is the sample mean excess returns on the local stock market, measured in USD. Standard errors are shown on the second line, for average pricing errors and VR1.

## ... international equity returns, Jan. 1975 – Dec. 1997.

| Variance ratio (VR1) | $\chi^2$ constant beta (lagged lwrpbret) | Average pricing error (alpha) | Variance ratio (VR1) | $\chi^2$ constant beta (lagged local pb) |
|---|---|---|---|---|
| .836 | 2.031 | .0022 | .935 | 4.230 |
| .172 | .154 | .0035 | .120 | .040 |
| .006 | .365 | .0008 | .020 | .398 |
| .070 | .546 | .0041 | .145 | .528 |
| .698 | 2.842 | .0025 | .699 | .002 |
| .205 | .092 | .0029 | .216 | .966 |
| .744 | .125 | -0.0014 | .751 | .015 |
| .173 | .724 | .0022 | .175 | .903 |
| .068 | .220 | .0026 | .084 | .811 |
| .242 | .639 | .0028 | .263 | .368 |
| .290 | .020 | .0011 | .282 | .460 |
| .543 | .889 | .0034 | .535 | .498 |
| .082 | .130 | .0013 | .098 | .026 |
| .257 | .718 | .0030 | .273 | .873 |
| .579 | 4.081 | .0077 | .586 | 2.804 |
| .637 | .043 | .0049 | .623 | .094 |
| .488 | .218 | -0.0002 | .491 | .011 |
| .752 | .640 | .0041 | .760 | .916 |
| .450 | .779 | -0.0015 | .476 | .006 |
| .258 | .377 | .0029 | .255 | .939 |
| .713 | .296 | .0047 | .722 | .029 |
| .210 | .586 | .0019 | .206 | .864 |
| .009 | 4.346 | -0.0009 | .004 | 1.507 |
| .128 | .037 | .0048 | .090 | .220 |
| .611 | .782 | .0028 | .566 | 5.032 |
| .271 | .377 | .0035 | .278 | .025 |
| .022 | 4.304 | -0.0015 | .037 | .845 |
| .108 | .038 | .0035 | .136 | .358 |
| .305 | .055 | .0043 | .377 | 2.940 |
| .372 | .814 | .0031 | .387 | .086 |
| .555 | .004 | .0026 | .541 | .140 |
| .237 | .947 | .0026 | .234 | .708 |
| .509 | .817 | .0028 | .520 | 2.078 |
| .299 | .366 | .0028 | .301 | .149 |
| .882 | 1.075 | .0021 | .910 | .458 |
| .101 | .300 | .0015 | .098 | .499 |

*Notes continued ...*

**Col. 9** Beta is the function of locpb and local information.

Right-tail probability values are shown on the second lines under $\chi^2$. The $\chi^2$ statistics test the hypothesis that the lagged variables indicated may be excluded from the model.

## Table 8. continued ...

| | Average return | Average pricing error (alpha) | Variance ratio (VR1) | $\chi^2$ constant beta (local info.) |
|---|---|---|---|---|
| Australia | .0130 | .0015 | .910 | 24.862 |
| | | .0033 | .214 | .003 |
| Austria | .0094 | .0029 | .791 | 19.202 |
| | | .0038 | .951 | .024 |
| Belgium | .0140 | .0040 | .720 | 26.562 |
| | | .0023 | .201 | .002 |
| Canada | .0110 | .0000 | .904 | 28.889 |
| | | .0021 | .117 | .001 |
| Denmark | .0130 | .0027 | .622 | 12.977 |
| | | .0027 | .549 | .164 |
| France | .0140 | .0013 | .631 | 19.400 |
| | | .0028 | .558 | .022 |
| Germany | .0130 | .0039 | .772 | 23.429 |
| | | .0028 | .575 | .005 |
| Hong Kong | .0210 | .0114 | .952 | 26.448 |
| | | .0048 | .155 | .002 |
| Italy | .0120 | -0.0005 | .613 | 32.591 |
| | | .0038 | .704 | .000 |
| Japan | .0120 | -0.0026 | .854 | 2.724 |
| | | .0023 | .149 | .014 |
| Netherlands | .0170 | .0058 | .921 | 23.779 |
| | | .0018 | .142 | .005 |
| Norway | .0120 | .0009 | .880 | 4.000 |
| | | .0044 | .361 | .911 |
| Singapore | .0140 | .0001 | .871 | 17.784 |
| | | .0037 | .197 | .038 |
| Spain | .0098 | -0.0012 | .672 | 39.723 |
| | | .0035 | .516 | .000 |
| Sweden | .0160 | .0046 | .835 | 15.188 |
| | | .0030 | .284 | .086 |
| Switzerland | .0150 | .0041 | .956 | 26.600 |
| | | .0023 | .139 | .002 |
| UK | .0180 | .0025 | .906 | 14.322 |
| | | .0028 | .150 | .111 |
| US | .0140 | .0024 | .979 | 24.180 |
| | | .0013 | .038 | .004 |

*Notes:*

**Col. 2-5** *Panel B. Three factor: wdret, euroret, yenret*

Average return is the sample mean excess returns on the local stock market, measured in USD. Standard errors are shown on the second line, for average pricing errors and VR1.

...

| Average pricing error (alpha) | Variance ratio (VR1) | $\chi^2$ constant beta (local info.) | Average pricing error (alpha) | Variance ratio (VR1) | $\chi^2$ constant beta (local info.) |
|---|---|---|---|---|---|
| -0.0009 | .856 | 12.593 | -0.0010 | .937 | 34.778 |
| .0034 | .171 | .050 | .0034 | .148 | .001 |
| -0.0008 | .225 | 14.100 | .0001 | .970 | 36.800 |
| .0041 | .516 | .029 | .0038 | .267 | .000 |
| .0012 | .704 | 4.105 | .0022 | .727 | 33.999 |
| .0029 | .254 | .662 | .0022 | .247 | .001 |
| -0.0021 | .773 | 17.672 | -0.0009 | .954 | 35.719 |
| .0022 | .158 | .007 | .0022 | .108 | .000 |
| .0021 | .329 | 1.785 | .0019 | .961 | 17.713 |
| .0030 | .522 | .938 | .0028 | .238 | .125 |
| -0.0003 | .435 | 8.897 | .0001 | .696 | 29.769 |
| .0031 | .589 | .179 | .0027 | .497 | .003 |
| -0.0004 | .326 | 3.667 | .0014 | .871 | 22.402 |
| .0030 | .502 | .722 | .0027 | .701 | .033 |
| .0054 | .689 | 7.486 | .0068 | .991 | 37.687 |
| .0049 | .470 | .278 | .0047 | .086 | .000 |
| -0.0018 | .641 | 4.484 | -0.0025 | .693 | 52.243 |
| .0044 | .752 | .611 | .0041 | .633 | .000 |
| -0.0029 | .591 | 15.884 | -0.0033 | .883 | 31.379 |
| .0032 | .216 | .014 | .0024 | .121 | .002 |
| .0035 | .849 | 13.931 | .0040 | .924 | 49.326 |
| .0019 | .196 | .030 | .0018 | .149 | .000 |
| -0.0034 | .058 | 8.309 | -0.0029 | .910 | 1.965 |
| .0049 | .336 | .216 | .0046 | .345 | .532 |
| -0.0023 | .891 | 7.332 | -0.0027 | .995 | 22.731 |
| .0039 | .137 | .291 | .0040 | .034 | .030 |
| -0.0027 | .438 | 23.093 | -0.0019 | .800 | 57.628 |
| .0033 | .329 | .001 | .0034 | .300 | .000 |
| .0028 | .524 | 12.719 | .0032 | .886 | 2.361 |
| .0034 | .376 | .048 | .0033 | .300 | .061 |
| .0017 | .591 | 4.729 | .0024 | .948 | 33.138 |
| .0028 | .262 | .579 | .0025 | .146 | .001 |
| .0030 | .894 | 12.165 | .0017 | .992 | 19.253 |
| .0031 | .214 | .058 | .0030 | .074 | .083 |
| .0027 | .953 | 2.955 | .0035 | .980 | 34.640 |
| .0016 | .089 | .814 | .0012 | .043 | .001 |

*Notes continued ...*

**Col. 6-8** *Panel C. Two factor: wdret, wrpbret*

**Col. 9-11** *Panel D. Four factor: wdret, euroret, yenret, wrpbret*

Right-tail probability values are shown on the second lines under $\chi^2$. The $\chi^2$ statistics test the hypothesis that the lagged variables indicated may be excluded from the model.

## Table 8. continued ...

| | Average return | Average pricing error (alpha) | Variance ratio (VR1) | $\chi^2$ constant beta (local info) |
|---|---|---|---|---|
| Australia | .0130 | -0.0002 | .959 | 15.865 |
| | | .0037 | .149 | .198 |
| Austria | .0094 | .0030 | .907 | 18.093 |
| | | .0037 | .623 | .113 |
| Belgium | .0140 | .0057 | .973 | 24.798 |
| | | .0027 | .075 | .016 |
| Canada | .0110 | -0.0021 | .995 | 28.506 |
| | | .0023 | .029 | .005 |
| Denmark | .0130 | .0026 | .946 | 31.505 |
| | | .0027 | .365 | .002 |
| France | .0140 | .0005 | .877 | 39.388 |
| | | .0028 | .492 | .000 |
| Germany | .0130 | .0057 | .771 | 22.648 |
| | | .0027 | .711 | .031 |
| Hong Kong | .0210 | .0119 | .968 | 25.139 |
| | | .0051 | .153 | .014 |
| Italy | .0120 | .0017 | .976 | 39.637 |
| | | .0041 | .245 | .000 |
| Japan | .0120 | -0.0029 | .975 | 28.066 |
| | | .0025 | .118 | .005 |
| Netherlands | .0170 | .0048 | .923 | 25.217 |
| | | .0020 | .175 | .014 |
| Norway | .0120 | -0.0068 | .824 | 25.383 |
| | | .0033 | .441 | .013 |
| Singapore | .0140 | -0.0021 | .995 | 37.473 |
| | | .0040 | .054 | .000 |
| Spain | .0098 | -0.0006 | .604 | 47.526 |
| | | .0033 | .779 | .000 |
| Sweden | .0160 | .0056 | .837 | 14.030 |
| | | .0034 | .384 | .299 |
| Switzerland | .0150 | .0050 | .990 | 19.980 |
| | | .0023 | .075 | .067 |
| UK | .0180 | .0020 | .936 | 17.099 |
| | | .0029 | .314 | .146 |
| US | .0140 | .0029 | .981 | 3.858 |
| | | .0014 | .061 | .002 |

*Notes:*

**Col. 2-5** *Panel E. Six factor: wdret, euroret, yenret, economic mimicking*

Average return is the sample mean excess returns on the local stock market, measured in USD. Standard errors are shown on the second line, for average pricing errors and VR1.

...

| Average pricing error (alpha) | Variance ratio (VR1) | $\chi^2$ constant beta (local info) |
|---|---|---|
| -0.0024 | .975 | 32.001 |
| .0036 | .131 | .006 |
| .0001 | .960 | 54.452 |
| .0041 | .245 | .000 |
| .0039 | .971 | 32.462 |
| .0025 | .076 | .006 |
| -0.0026 | .999 | 42.649 |
| .0021 | .010 | .000 |
| .0018 | .958 | 34.716 |
| .0027 | .225 | .003 |
| -0.0008 | .894 | 53.254 |
| .0027 | .395 | .000 |
| .0028 | .864 | 27.781 |
| .0028 | .679 | .023 |
| .0061 | .999 | 39.523 |
| .0052 | .030 | .001 |
| -0.0005 | .994 | 87.213 |
| .0043 | .124 | .000 |
| -0.0032 | .987 | 4.739 |
| .0025 | .046 | .000 |
| .0031 | .929 | 61.984 |
| .0017 | .135 | .000 |
| -0.0097 | .866 | 52.947 |
| .0035 | .275 | .000 |
| -0.0038 | .999 | 49.000 |
| .0039 | .001 | .000 |
| -0.0018 | .648 | 76.230 |
| .0033 | .419 | .000 |
| .0041 | .874 | 19.625 |
| .0034 | .350 | .187 |
| .0035 | .995 | 34.511 |
| .0026 | .069 | .003 |
| .0012 | .994 | 25.007 |
| .0029 | .066 | .050 |
| .0038 | .988 | 42.935 |
| .0014 | .290 | .000 |

*Notes continued ...*

**Col. 6-8** *Panel F. Seven factor: wdret, euroret, yenret, economic mimicking, wrpbret*

Right-tail probability values are shown on the second lines under $\chi^2$. The $\chi^2$ statistics test the hypothesis that the lagged variables indicated may be excluded from the model.

The addition of the world price-to-book return increases the variance ratio in only two of 18 countries. The specification that adds the local price-to-book ratio increases the explanatory power in only four of 18 countries.

Now consider the one-factor model versus the three-factor model. Variance ratios dramatically increase with the three-factor model. The average variance ratio for the world CAPM is 0.506, and it increases to 0.822 with the addition of the two currency factors. The variance ratio increases in each of the 18 countries, which is evident in Figure 3.

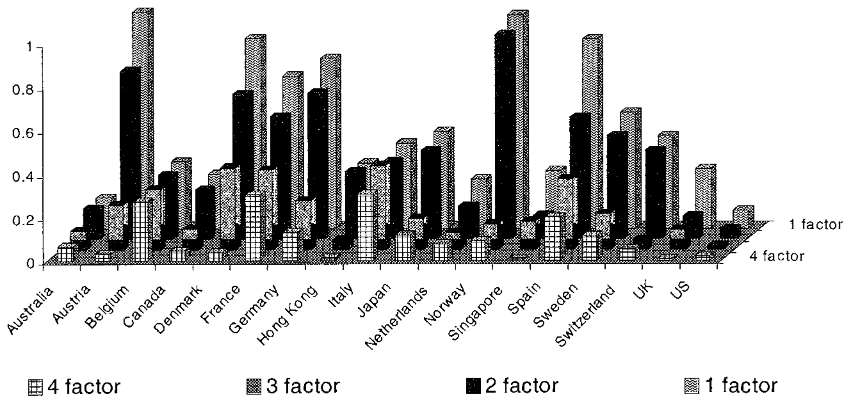
Panel C in Table 8 shows the impact of the world book-to-market return as an additional factor in the world CAPM. Variance ratios increase from 0.506 with the one-factor model to 0.598 when the world price-to-book return is added as an additional factor. The marginal explanatory power is small compared to the increase associated with the currency factors.

The next question is whether the information in the world price-to-book return is subsumed by the two currency risk factors. When a four-factor model is estimated, the average variance ratio increases to 0.895 from the three-factor base case of 0.822. Hence, the incremental information in the world price-to-book return is small. Given the standard errors, the difference is not significant.

Our final tests ask how well the macroeconomic risk factors fare. Including these factors, the average variance ratio is 0.913 compared to 0.822 for the three-factor model. Again, we can test whether the information in the world price-to-book return is accounted for by the economic factors. When the world price-to-book return is added to the specification, the variance ratio increases to 0.938 (compared to 0.913). While the variance ratios increase in all but one country, the increment is economically small. This suggests that most of the information in the world price-to-book return is being captured by other economic variables.

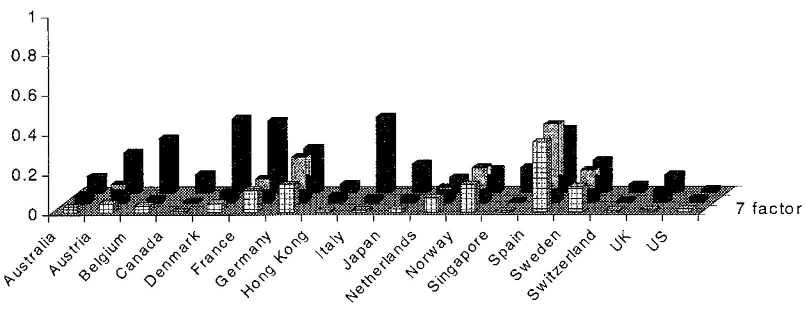
The conditional tests show that most of the explanatory power of the asset-pricing models is driven by the world market return and the two currency factors. The extra information in the world price-to-book return and other economic factors is small. The analysis of average pricing errors in Table 3 and Figure 4 also supports this conclusion. The pricing errors decrease moving from one to three factors. The incremental reduction in pricing errors when going to additional factors is limited.

**Figure 3a. Proportion of predictable variation unexplained by models.**



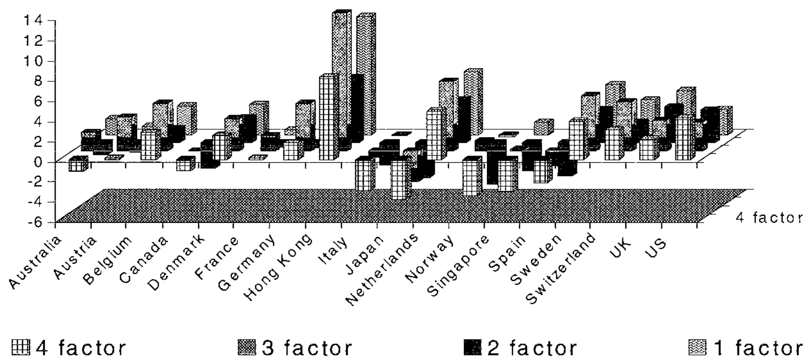

*Notes:* Bars represent annualised percentage average pricing errors reported in Table 8. 1 factor = world market return; 2 factor = world market plus the world price-to-book return; 3 factor = world market return plus two currency excess returns; 4 factor = 3 factor plus the world price-to-book return.

**Figure 3b. Proportion of predictable variation unexplained by models.**



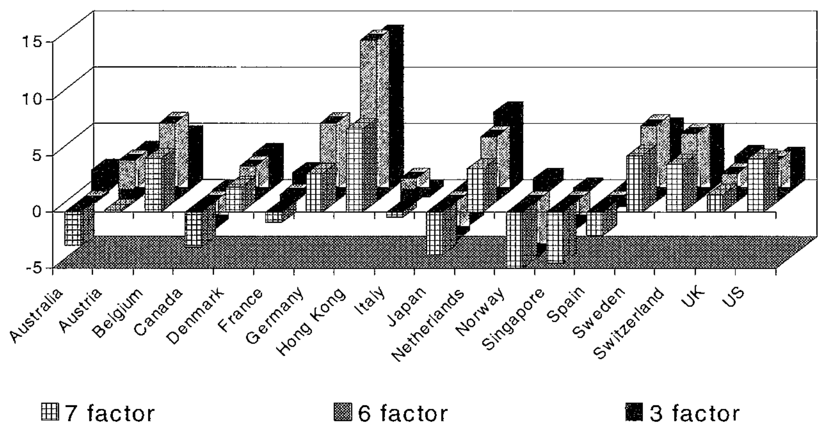

*Notes*: Bars represent annualised percentage average pricing errors reported in Table 8. 3 factor = world market return plus two currency excess returns; 6 factor = 3 factor plus three economic factors; 7 factor = 6-factor model plus world price-to-book return.

**Figure 4a. Average pricing errors of conditional asset-pricing models.**




*Notes:* Bars represent annualised percentage average pricing errors reported in Table 8. 1 factor = world market return; 2 factor = world market plus the world price-to-book return; 3 factor = world market return plus two currency excess returns; 4 factor = 3 factor plus the world price-to-book return.

**Figure 4b. Average pricing errors of conditional asset-pricing models.**




*Notes:* Bars represent annualised percentage average pricing errors reported in Table 8. 3 factor = world market return plus two currency excess returns; 6 factor = 3 factor plus three economic factors; 7 factor = 6-factor model plus world price-to-book return.

## 4. Conclusions

We study the global forces that determine both the cross-section and time series of average returns and the predictability in national equity market returns. With the advent of the euro, currency risk modelling is simplified. This allows us (for the first time) to explore the role of book-to-market in a model that accounts for currency risks inside and outside the EMU. We assess the importance of two world currency factors (euro-based and JPY-based) relative to a simple CAPM. We also study a model that includes a world price-to-book return and a model that includes additional world economic risk factors.

Our results suggest that most of the improvement over the CAPM comes from the model that includes the world-market portfolio and the two currency excess returns. After the world-market factor, the euro currency risk factor is the next most important source of global risk in the world equity markets. While the price-to-book return offers some incremental explanatory power, our results suggest that world economic-risk variables mostly capture the information in the world price-to-book return.

## Appendix A. Econometric methods

### A.1. Unconditional models

We estimate the unconditional asset-pricing models by the Generalized Method of Moments (GMM, see Hansen, 1982). This allows for non-normality and conditional heteroskedasticity, both likely features of the country stock return data. The unconditional models follow the econometric framework set out in Ferson and Harvey (1994a). There are two formulations. One is used when the risk factors are excess returns on traded assets. The second is used when the factors are macroeconomic variables.

When the world risk factors are excess returns, we estimate a system of equations, each representing a country. For example, with the world CAPM, we estimate with the generalised method of moments the following:

$$u_{i,t} = r_{i,t} - \beta_i r_{m,t} \tag{A.1}$$

where $u_{i,t}$ is a disturbance term, with $E(u_{i,t}) = E(u_{i,t} r_{m,t}) = 0$. When the factors are not traded assets, we estimate

$$u_{i,t} = r_{i,t} - \beta_{1,i} r_{m,t} - \beta_{2,i}(f_{j,t} + \lambda_j) \tag{A.2}$$

where $f_{j,t}$ is the demeaned value of the factor and $\lambda_j$ is the unconditional risk premium associated with the factor. In equation (A.2), the moment conditions are

$$E(u_{i,t}) = E(u_{i,t} r_{m,t}) = E(u_{i,t} f_{j,t}) = 0$$

We report estimates of the unconditional risk exposures, the $\beta_i$'s, the unconditional risk premiums, and a test of the over-identifying conditions. The regressions are over-identified because the intercepts, or alphas, are restricted to be zero according to the asset-pricing models.

### A.2. Conditional models

Our conditional asset-pricing tests focus on the following system. For simplicity, we present the one-factor version:

$$\begin{aligned}
u_{1,t} &= r_t - \alpha - (b_0 + b_1 Z_{t-1}) r_{m,t} \\
u_{2,t} &= (b_0 + b_1 Z_{t-1}) r_{m,t} - \delta Z_{t-1} \\
u_{3,t} &= r_t - \delta_r Z_{t-1} \\
u_{4,t} &= \delta_r Z_{t-1} + c_0 - c_1 \delta Z_{t-1} \\
u_{5,t} &= r_t - \mu \\
u_{6,t} &= \sigma_u^2 - u_{4,t}^2 \\
u_{7,t} &= \sigma_r^2 - (\delta_r Z_{t-1} - \mu)^2
\end{aligned} \tag{A.3}$$

The system is estimated by the GMM. The first equation defines the linear factor model with time-varying betas. We make $u_{1,t}$ orthogonal to $Z_{t-1}$, which includes a vector of ones, and $r_{m,t}$. The second equation defines the asset-pricing model's expected return. We impose that $u_{2,t}$ is orthogonal to $Z_{t-1}$. The third equation tells us the statistically expected returns by regressing the asset returns on the information variables. We impose that $u_{3,t}$ is orthogonal to $Z_{t-1}$. The fourth equation measures the relation between the statistically fitted returns and the expected returns from the asset-pricing restrictions. We impose that $u_{4,t}$ is orthogonal to the fitted values from the asset-pricing model and a constant. The fifth equation simply measures the unconditional mean return. The disturbance is orthogonal to a vector of ones. The sixth equation defines the variance of the part of the statistical expected returns that cannot be explained by the asset-pricing model. This disturbance, $u_{6,t}$, is also orthogonal to a vector of ones. Finally, the last equation defines the variance of the statistical model predictions. As with the previous equation, this disturbance, $u_{6,t}$, is also orthogonal to a vector of ones. Interestingly, each of these equations is exactly identified. Hence, we can estimate the parameter in this system of equations sequentially.

We are interested in the variance ratio:

$$VR1 = 1 - \frac{\sigma_u^2}{\sigma_r^2} \tag{A.4}$$

This tells us what fraction of the variance in the statistical expected returns the asset-pricing model expected returns are explaining. We calculate a standard error for the variance ratio using the delta method. Ratios similar to VR1 are presented in Ferson and Harvey (1993). Our formulation refines their approach to insure that $0 \leq VR1 \leq 1$. Ferson and Harvey found estimates of $VR1 > 1$, which are difficult to interpret.

# Appendix B. Data sources

## B.1. World risk factors

| Factor | Is the ... |
|---|---|
| wdret | arithmetic return on the MSCI world equity index less the Ibbotson Associates one-month US Treasury bill rate. |
| dted | difference between the 90-day euro-USD yield (from Federal Reserve Bank of St. Louis, FRED) and the 90-day T-bill yield (from FRED, secondary market, converted from discount to true yield to maturity). |
| euroret | euro currency excess return based on the synthetic euro-to-JPY-USD exchange rate created by Datastream. Documentation for the construction of their synthetic euro is available at: www.datastream.com. The synthetic euro/USD exchange rate is constructed as follows: The EMU-in national currencies are weighted by 1996 national GDP levels and then expressed in DEM terms using the bilateral rates set by the EU (implicitly taken as the best approximation to the fixed bilateral rates that will prevail on December 31, 1998). The individual components are each converted to DEM at current exchange rates using the Reuters Closing Spot Rates. Finally, by multiplying the series by the fixed DEM/euro rate, we have a DEM/euro exchange rate that reflects the changing relative strengths of the EMU-in countries over time and the presumed fixed local to euro bilateral rates. By converting the series using the appropriate USD/DEM rate, also taken from Reuters, we have a synthetic euro/USD rate. To construct a currency return, we take the change in the USD/euro exchange rate and add it to an appropriately (as above) weighted average of the EMU-in countries' local one-month rates, and then convert it to an excess return by the subtracting the one-month Ibbotson and Associates US Treasury bill rate. The one-month local rates used in the construction of the appropriately weighted "euro" interest rate are: |

- Austria Treasury bill (IFS 60C)
- Belgium Treasury bill (IFS 60C) 1975-1981 and Datastream London euro-currency 1981-1997
- Finland Treasury bill 1975-1987 and HELIBOR rate (1987-1997)
- France Lombard Odier & Cie 1975-1979 and Datastream London euro-currency 1980-1997
- Germany France Lombard Odier & Cie 1975-1979 and Datastream London euro-currency 1980-1997
- Ireland Treasury bill (IFS 60C) 1975-1979 and Datastream London euro-currency 1980-1997
- Italy Treasury bill (IFS 60C) 1975-1992) and Datastream London euro-currency 1992-1997
- Netherlands Lombard Odier & Cie 1975-1979 and Datastream London euro-currency 1980-1997
- Portugal Treasury bill (IFS 60C) 1975-1992 and Datastream London euro-currency 1992-1997
- Spain Treasury bill (IFS 60C)

| **Factor** | **Is the ...** |
|---|---|
| yenret | currency return based on the JPY/USD exchange rate from Reuters. As previously noted, the change in the USD/JPY exchange rate is added to the one-month euro-JPY interest rate (Lombard Odier & Cie 1975-1979 and Datastream London euro-currency 1980-1997), and then converted to an excess return by the subtracting the one-month Ibbotson and Associates US Treasury bill rate. |
| dg7ui | factor derived from a time-series model applied to the log difference of the G-7 weighted CPIs. The time-series model is a VAR on the G-7 weighted CPIs, the G7 weighted real bill rates (G7RTB), and the log change in the G-7 weighted industrial production index (dG7IP, specified below) The residuals from the first equation in this estimation structure are taken as unanticipated inflation (dG7UI). *Source*: OECD. |
| dg7elt | result of projecting the four-year, moving average of the G-7 inflation on the lagged global information variables specified below. |
| g7rtb | factor calculated by aggregating individual countries' short-term interest rates (same as those in country-specific information variables—weighted by using countries' previous quarters share in G-7 GDP, then subtract the G-7 inflation rate to get a real rate). These interest rates are used: Canada 90-day Treasury bill (IFS 60C), France 90-day bill (IFS 60C), Germany 90-day bill (IFS 60C), Italy 180-day bill (IFS 60B), Japan commercial paper from 1975-1976 (IFS 60B) and the Gensaki rate from 1977-1997 (IFS GBD3M), the UK 90-day bill (IFS 60C), and the US 90-day bill (IFS 60C). |
| doil | log change in the price (USD) per barrel at the well head, from Datastream. |
| dg7ip | log difference in the G-7 aggregate industrial production index. *Source*: OECD. |
| wrpbret | return from a portfolio long in the first fractile (low b/m assets) and short in the third fractile (high b/m assets) from Fama for the 1975-90 period and updated using FACTSET for the 1990-97 period. |

## B.2. Global instruments

| **Instrument** | **Is the ...** |
|---|---|
| lted | lagged spread between the euro-USD and Treasury yield used in the construction of dTED above. |
| lterm | lagged spread (slope of the term structure) between the US 10-year Treasury bond yield and the 90-day-bill yield. *Source*: FRED. |
| tb1 | US Treasury bill one-month yield. This variable is not lagged because the nominal one-month yield is known at the end of the previous month. |
| lwrdivy | lagged dividend yield on the MSCI world index. The numerator is a 12-month moving sum of the dividends, and the denominator is the current index level. |
| lwrpb | lagged price-to-book ratio on the MSCI world index. |
| ldeltb3 | lagged difference between the three-month T-bill rate. *Source*: FRED. |

### B.3. Local instruments (country specific)

| Instrument | Is the ... |
|---|---|
| ldivy | lagged local MSCI dividend yield. The numerator is a 12-month moving sum of the dividends, and the denominator is the current index level. |
| lshort | lagged local short interest rate. The short-term interest rates for the various countries are listed together with their series codes from IFS. These are: |

- Australia 13-week T-bill (IFS 60C)
- Austria money market rate (IFS 60B)
- Belgium 3-month bill (IFS 60C)
- Canada 3-month bill (IFS 60C)
- Denmark call money rate (IFS 60B)
- France 3-month interbank (IFS 60B)
- Germany Frankfurt 90-day rate (IFS 60B)
- Hong Kong, no data; US 3-month bill used
- Italy 6-month bill (IFS 60C)
- Japan commercial paper from 1975-1976 (IFS 60B) and the Gensaki rate from 1977-1997 (IFS GBD3M)
- Netherlands call money rate 1975-1978 (IFS 60B) and 3-month bill 1978-1997 (IFS 60C)
- Norway call money rate (IFS 60B)
- Singapore, no data; US 3-month bill used
- Spain call money rate (IFS 60B)
- Sweden 3-month bill (IFS 60C)
- Switzerland call money rate (IFS 60B)
- UK 3-month bill (IFS 60C)
- US 3-month bill (IFS 60C)

| Instrument | Is the ... |
|---|---|
| ltermloc | lagged local term premium: the difference between the long-term interest rates and the above short-term interest rates. These are: |

- Australia 15-year Treasury bond (IFS 61)
- Austria government bond (IFS 61)
- Belgium government bond (IFS 61)
- Canada government bond (IFS 61)
- Denmark government bond (IFS 61)
- France government bond (IFS 61)
- Germany government bond (IFS 61)
- Hong Kong, no data; US Treasury bond used
- Italy government bond (IFS 61)
- Japan government bond (IFS 61)
- Netherlands government bond (IFS 61)
- Norway call money rate (IFS 61)
- Singapore, no data, US Treasury bond used
- Spain government bond (IFS 61)
- Sweden government bond (IFS 61)
- Switzerland government bond (IFS 60B)
- UK government bond (IFS 61)
- US Treasury bond (IFS 61)

### B.4. Euro construction

DATASTREAM uses this formula for the euro:

DEM/euro = (.03139*7.03552*DEM/AUSTSCH + .03866*20.6255*DEM/BELGLUX + .02339*3.04001*DEM/FINMARK + .22064*3.35386*DEM/FRENFRA +.01132*.0402676*DEM/IPUNTER+.20039*990.002*DEM/ITALIRE +.05596*1.12674*DEM/NLG+.01255*102.505*DEM/PORTESC +.09257*85.07722*DEM/SPANPES + .31315)*1.97738

For each currency item, the first figure is the 1996 GDP EMU-in country weighting (percentage of GDP to total EMU-in GDP), i.e., .03139 is the GDP weighting of Austria, .22064 is the weighting of France, and .31315 is the weighting of Germany. The second factor is the fixed exchange rate to DEM 1, i.e., 7.03552 Austrian shillings and 3.35386 French francs. This formula gives DEM to one euro. It is important to understand how they do this. They take the exchange rates for each of these countries to the ECU for May 4, 1998 (instead of Jan. 1, 1999), imagining that the monetary union took place on that day with those rates as the official/announced rates. These fixed cross-rates, the second weighting factor above, are computed from the currency to ECU for May 4, for example, the DEM to euro is 1.99738 and the AUSTSCH to euro is 13.9119, so the imagined 'fixed' cross-rate is the 7.03552 used above. The idea is that because one ECU will become one euro on January 1, 1999, those rates are the best guess as to what the official conversion rates will be. Finally, the rates such as DEM/AUSTSCH are the actual historical exchange rates between these two countries for the time period of interest.

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