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The Relevance of Currency Risk in the EMU*

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Abstract

We investigate how the elimination of intra-european exchange risk may affect international financial markets. To this end, we identify and measure the EMU and non-EMU components of aggregate currency risk using a conditional version of the International CAPM. We document significant exposures to and premiums for both sources of currency risk. The premium for EMU risk is positive and associated primarily with exposure to the French, Italian and Spanish currencies. Not surprisingly, exposures to Austrian, Belgian and Dutch currency risk and associated premiums are negligible. The premium for non-EMU risk is consistently negative and accounts for most of the aggregate currency premium. In the nineties, exposures to EMU risk have significantly declined while exposures and premiums associated with non-EMU risk have significantly increased. This suggests that the adoption of the euro is unlikely to have a large impact on aggregate currency risk premiums.

JEL classification: C32; F30; G12; G15

Keywords: International asset pricing; Currency risk; EMU; Multivariate Garch

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January 1, 1999, marked the beginning of the last stage in the creation of the European Monetary Union (EMU) established by the Maastricht Treaty in 1991. On that date the exchange rates between the EMU participants were irrevocably fixed to start the transition toward a unique currency, the euro. By the year 2002, the euro is expected to become the sole legal tender for EMU participants.

Although the topic of widespread discussion in the press and the political arena, the impact of the adoption of a single European currency on world financial markets has received little formal analysis in the international finance literature. In this paper, we estimate a conditional version of the international CAPM of Sercu (1980) and Adler and Dumas (1993) to assess the exposures (as well as the associated risk premiums) associated with the exchange risk of the EMU currencies. We take the perspective of a German investor to investigate the economic and statistical relevance the EMU and non-EMU components of currency risk and what the elimination of the former implies for international financial markets.

For the international investor, the launch of the euro raises two related issues. Will the currency change-over reduce the risk exposures of international financial markets? And will it be beneficial? Consider first the issue of risk. Although the substitution of a common currency to 11 preexisting currencies clearly reduces the number of sources of risk affecting financial assets, it is not obvious that it will reduce the risk exposure of these assets. Take, for example, a German investor. After the currency change-over, her investments will no longer be affected by exchange rate variability within the EMU countries. However the variability of the euro with respect to non-EMU countries may be substantially higher and affect her investments more than the variability of the Deutsche mark (DEM) with respect to the same non-EMU currencies.

The issue of whether the elimination of several sources of risk is beneficial is similarly complex. Beyond the obvious benefits of simplifying the risk management of international portfolios, it depends on whether risk is fully diversifiable and, to the extent it is not, on the reward investors receive for bearing it, as measured by the reward-to-risk ratio. The adoption of a single European currency could have no impact, a positive impact or even, more surprisingly, a negative impact on international investors' risk-return trade-off. For example, the single currency will have limited benefits for international portfolio investors if EMU currency risk is fully diversifiable. On the other hand, if EMU currency risk is not diversifiable and commands a premium, the adoption of a single currency will reduce the menu of assets available to investors and affect the expected returns of international portfolios. The changeover would be clearly beneficial only if it eliminates sources of systematic risk that are not rewarded in equilibrium and cannot easily be hedged.

Recent papers by Dumas and Solnik, 1995, and De Santis and Gerard, 1998, show that currency risk is priced, and that exchange risk premiums are economically significant and time-varying. However, these papers focus on a small number of countries and do not disaggregate currency risk premiums into their EMU and non-EMU components. Yet, it is only upon finding whether international investors are rewarded with an economically significant premium for exposure to EMU risk that meaningful conjectures can be made about the impact of the transition to a single currency on financial markets

In the context of the EMU, we focus on two issues. First, how important is the EMU currency risk compared to its non-EMU counterpart. Second, how much international investors have been rewarded for their exposure to EMU currency risk. Our results indicate that investors are significantly exposed to and rewarded for both sources of exchange risk. However the premiums for EMU and non-EMU exchange risk display significantly different characteristics. The premium for EMU risk is mostly positive. Not surprisingly, we find that most of the EMU currency risk premium is accounted for by the French franc, Italian lira and Spanish peseta. The exposure to Austrian shilling, Belgian franc and Dutch guilder risk is very small and the premiums indistinguishable from zero. The non-EMU risk premium is consistently negative and much larger in absolute value than its EMU counterpart. Lastly while the exposures to EMU risk have significantly declined during the nineties, the exposures and the premiums associated with the non-EMU currencies have increased significantly over the same period. This suggests that the adoption of a single currency is likely to have a limited impact. International financial markets will remain exposed to the large and dominant impact of the non-EMU currency risk.

An important caveat is in order. The adoption of a single currency is likely to have many other implications in addition to those discussed in this paper. One of them is an increase in market liquidity due to the elimination of conversion costs and exchange rate risk. The harmonization of monetary policy within Europe could also affect the correlation structure of European equity markets and change the risk/return trade-off faced by international investors. These topics are left for future research.

The paper is organized as follows. In Section 1, we briefly review a model of international asset pricing that has been used in a number of recent studies. Section 2 describes the empirical methods. We describe the data set in Section 3. The empirical evidence and its implications are presented in Section 4. Section 5 concludes.

1 The Model

For an international investor, the return on any foreign stock fluctuates not only because of asset-specific risk, but also because of unpredictable fluctuations in currency exchange rates. Loosely speaking, the latter effect is often referred to as currency risk. The practical relevance of currency risk can be appropriately measured only within the context of an international asset pricing model. For example, we know that asset-specific volatility is not a proper measure of risk in the domestic CAPM, since a possibly significant part of it can be diversified when the asset is included in a portfolio. In that framework, the appropriate measure of risk–usually referred to as systematic risk–is given by the covariance of each asset return with the return on the market portfolio. In equilibrium, investors should be rewarded for their exposure to systematic risk with a premium in excess of the risk free rate. Intuition suggests that a similar idea should apply when investors can purchase assets traded in different national markets. The volatility of the return on a foreign asset (or market index) contains a country-specific component and a currency component. However, neither component should be interpreted as a measure of risk, since they can be diversified, at least in part, by including the asset in an internationally diversified portfolio. In this section we build on this intuition to discuss an international version of the traditional CAPM (ICAPM) which is derived in Sercu (1980) and generalized in Adler and Dumas (1983).

The model is based on a set of standard assumptions. Investors in all countries maximize the expected utility of future real consumption while both nominal returns on risky assets and domestic inflation in each country follow standard Brownian motions. Formally, if p_i^c is the price of asset i measured in the reference currency c, then the nominal rate of return on the asset is described by the following expression

$$R_i^c dt \equiv \frac{dp_i^c}{p_i^c} = E\left(R_i^c\right) dt + \sigma_i^c dz_i^c \qquad i = 1, \cdots, n \tag{1}$$

where $E\left(R_i^c\right)$ and σ_i^c denote the instantaneous first and second moments of the nominal return on asset i, and the variable z_i^c follows a standard Wiener process. Since there are n assets with risky nominal returns defined by equation (1) it is useful to denote with Σ the instantaneous covariance matrix of returns, with generic element $\sigma_{ij}^c = \sigma_i^c \sigma_j^c \rho_{ij}^c$, and with R_f^c the return on the nominally risk-free asset, which corresponds to a bill with payoffs denominated in the reference currency. Finally, the inflation rate of each country, measured in the reference currency, also follows a standard Brownian motion

$$\pi_k^c dt \equiv \frac{dI_k^c}{I_k^c} = E\left(\pi_k^c\right) dt + \sigma_{k\pi}^c dz_{k\pi}^c \qquad k = 1, \cdots, l+1 \tag{2}$$

where I_k^c is the general price index in country k measured in the reference currency, and $E\left(\pi_k^c\right)$ and $\sigma_{k\pi}^c$ are the instantaneous expected value and standard deviation of the inflation rate. Obviously, π_k^c is stochastic for at least one of two reasons; its variations can reflect variations in the local inflation of country k and/or variations in the exchange rate between the currency of country k and the reference currency.

Denoting with C the nominal consumption flow, the optimization problem for any investor can be written as follows:[1]

$$\begin{aligned} & \max_{C,\omega} E \int_t^T U\left(C, I, \tau\right) d\tau \qquad (3) \\ \text{s.t. } dW^c &= \left[\sum_{i=1}^n \omega_i \left(E(R_i^c) - R_f^c\right) + R_f^c\right] W^c dt - C dt + W^c \sum_{i=1}^n \omega_i \sigma_i^c dz_i^c \end{aligned}$$

where W^c is the level of nominal wealth, ω_i is the fraction of wealth invested in asset i, and $U\left(C, I, \tau\right)$ is assumed to be homogeneous of degree zero in C and I to rule out money illusion.

Solving the problem delivers the optimal portfolio allocation for each investor and, therefore, the demand for assets. Assuming that the supply is fixed one can derive the premium that each national investor requires to hold any risky asset. Finally, a set of pricing restrictions are derived by aggregating individual demands over all investors and

[1] All the variables in the following expression, except R_j^c and R_f^c, should be labeled with the country index k. We omit that index to simplify the notation.

imposing the equilibrium condition that, for each asset, demand equal supply. Formally, the premium on asset i must satisfy the following restriction in equilibrium:

$$E\left(R_i^c\right) - R_f^c = \gamma\ cov\left(R_i^c, R_M^c\right) + \sum_{k=1}^{l+1} \delta_k\ cov\left(R_i^c, \pi_k^c\right) \quad \forall i \tag{4}$$

where

$$\frac{1}{\gamma} = \sum_{k=1}^{l+1} \frac{W_k^c}{W^c} \times \frac{1}{\gamma_k} \qquad \text{and} \qquad \delta_k = \gamma(\frac{1}{\gamma_k} - 1)\frac{W_k^c}{W^c}.$$

R_M^c is the return on the world-wide market portfolio, γ is the world aggregate risk aversion coefficient while γ_k is the country k investor risk aversion coefficient and W_k^c is country k market capitalization. Compared to the traditional CAPM, which states that the premium on any asset is proportional to its exposure to market risk, the international version of the model includes an additional component, which is proportional to the covariance of R_i^c with the inflation rate of all the countries. Obviously, changes in π_k^c can be due to changes in the domestic inflation of country k and/or to changes in the exchange rate between currency k and the reference currency. In this sense, for any asset i the term $cov(R_i^c, \pi_k^c)$ is a measure of both inflation and currency risk with respect to country k[2].

In the rest of the paper we assume that inflation is non stochastic, based on the evidence that inflation volatility in many developed countries is almost negligible compared to exchange rate volatility. The advantage of introducing this assumption is that we can focus on the relevance of currency risk alone. Formally, if π_k measured in local currency is non stochastic, then equation (4) can be written as follows:

$$E\left(R_i^c\right) - R_f^c = \gamma\ cov\left(R_i^c, R_M^c\right) + \sum_{k=1}^{l} \delta_k\ cov\left(R_i^c, \nu_k^c\right) \quad \forall i \tag{5}$$

where ν_k^c measures the change in the price of currency k in terms of currency c[3]. As in the traditional CAPM, the coefficient γ measures the trade-off between the expected return on asset i and its market risk. γ can be interpreted as the shadow price of market risk and, under the assumption of risk aversion, should always be positive. On the other hand, each coefficient δ_k links the expected return on asset i to its covariance risk with currency k. For this reason, δ_k can be interpreted as the price of exchange rate risk for currency k[4]. Note that under the assumption of risk aversion, the price of exchange risk is not restricted to be positive. On the contrary, δ_k becomes more negative as the risk aversion and the wealth of country k investors increase.

Equation (5) implies that both market and currency risk contribute to the total premium on asset i. Since our main objective is to identify the EMU and non-EMU

[2] Except for the country of the currency of reference in which case it only measures inflation.

[3] When inflation is non stochastic, the term $cov(R_i^c, \pi_c^c)$ is zero and drops out of equation (5).

[4] If it is further assumed that PPP holds, Solnik (1973a, 1973b) has shown that the model simplifies to the Sharpe (1964) and Lintner (1965) CAPM.

components of currency risk, we order the l non-reference currencies in the model so that the first l_1 correspond to the EMU-countries and rewrite the pricing equation as

$$E\left(R_i^c\right) - R_f^c = \gamma\ cov\left(R_i^c, R_M^c\right) + \sum_{k=1}^{l_1} \delta_k\ cov\left(R_i^c, \nu_k^c\right) + \sum_{k=l_1+1}^{l} \delta_k\ cov\left(R_i^c, \nu_k^c\right) \quad \forall i (6)$$

where $\sum_{k=1}^{l_1} \delta_k\ cov(R_i^c, \nu_k^c)$ measures the EMU-specific currency risk premium and $\sum_{k=l_1+1}^{l} \delta_k\ cov(R_i^c, \nu_k^c)$ measures the premium due to non-EMU currency risk.

2 Empirical Methods

The ICAPM described in the previous section is derived under the assumption that the investment opportunity set faced by all investors is non stochastic. As a consequence, all the moments in equations (5) and (6) can be interpreted as unconditional moments. In recent studies, however, Hodrick (1981), Ferson and Harvey (1993), Dumas and Solnik (1995) and De Santis and Gerard (1997, 1998) show that is important to model the time-variation in the return distribution, especially when investigating the relevance of currency risk. For example, in a study of the four largest markets in the world, De Santis and Gerard (1998) find that while currency risk is priced and economically relevant, it carries a highly variable premium over the 1973-1994 period. Interestingly, they estimate that the average premium for currency risk is close to zero for most markets when looking at the overall sample, but it becomes persistently positive (or negative) and large in absolute value over sufficiently long subperiods. This suggests that a conditional analysis of the model is more likely to provide useful insights into the issues that we want to address.

The assumption of a stochastic investment opportunity set can be introduced by allowing the return distribution to change over time as a function of one of more state variables. This generalization has two consequences for the pricing restrictions of the model discussed earlier. First, all the moments, as well as the prices of risk can vary over time and, therefore, must be indexed with a time variable. Second, the model will include additional sources of risk, measured by the covariance of the asset return with each of the state variables. To make the model empirically tractable, we focus on the time-variation of the conditional moments, while assuming that the additional sources of covariance risk are empirically negligible, at least relative to market and currency risk[5]. Formally, equation (5) can be modified as follows:

$$E_{t-1}\left(R_{i,t}^c\right) - R_{f,t}^c = \gamma_{t-1}\ cov_{t-1}\left(R_{i,t}^c, R_{M,t}^c\right) + \sum_{k=1}^{l} \delta_{k,t-1}\ cov_{t-1}\left(R_{i,t}^c, \nu_{k,t}^c\right) \quad \forall i \quad (7)$$

Since the model does not restrict the dynamics of either first or second conditional moments, we have to introduce some auxiliary assumptions to proceed with the estimation. Because the asset pricing model postulates a relation between expected returns

[5]When additional factors are priced, this assumption introduces a missing variable bias. However, Ferson and Harvey (1993) find that, in a multi-risk factor model of international returns, market and currency risk are the two dominant factors. This suggest that this bias is unlikely to be significant.

and covariances, one can freely parameterize only the first or the second moments. In the discussion that follows, we model the dynamics of the second moments using the parsimonious generalized autoregressive conditional heteroskedasticity (GARCH) specification proposed in De Santis and Gerard (1997, 1998).

Consider a world with $L+1$ countries, one of which is used to identify the reference currency. For each country, we focus on two assets: a risky portfolio of stocks obtained from a country index (which plays the role of an index fund for the country) and a short-term deposit, denominated in the local currency. To estimate the model, all returns must be translated into the reference currency c. Since the short-term deposits are riskless when measured in the local currency, their only risk component, when measured in the reference currency, is the relative change in the exchange rate between the reference and the local currency. In this sense, the term $cov_{t-1}(R^c_{i,t}, \nu^c_{k,t})$ which appears in equation (7) can be replaced with the term $cov_{t-1}(R^c_{i,t}, R^c_{k,t})$ where $R^c_{k,t}$ denotes the return on the short-term deposit denominated in currency k and measured in the reference currency. For convenience, we organize all asset returns in a vector R^c_t of dimension $m \times 1$, where $m = 2L+2$. The first $L+1$ elements in the vector include the returns on all the stock indices, the next L elements include the returns on the deposits in the non-reference countries, and the last element includes the return on the world portfolio. If we denote with $r_{i,t}$ the return[6] on asset i, in excess of the return on the deposit denominated in the reference currency, then the whole system of pricing restrictions in equation (7) can be written as follows:

$$\begin{aligned}
E_{t-1}(r_{1,t}) &= \gamma_{t-1} cov_{t-1}(R_{1,t}, R_{M,t}) + \textstyle\sum_{k=1}^{L} \delta_{k,t-1} cov_{t-1}(R_{1t}, R_{L+1+k,t}) \\
&\vdots \\
E_{t-1}(r_{L+1,t}) &= \gamma_{t-1} cov_{t-1}(R_{L+1,t}, R_{M,t}) + \textstyle\sum_{k=1}^{L} \delta_{k,t-1} cov_{t-1}(R_{L+1,t}, R_{L+1+k,t}) \\
E_{t-1}(r_{L+2,t}) &= \gamma_{t-1} cov_{t-1}(R_{L+2,t}, R_{M,t}) + \textstyle\sum_{k=1}^{L} \delta_{k,t-1} cov_{t-1}(R_{L+2,t}, R_{L+1+k,t}) \\
&\vdots \\
E_{t-1}(r_{2L+1,t}) &= \gamma_{t-1} cov_{t-1}(R_{2L+1,t}, R_{M,t}) + \textstyle\sum_{k=1}^{L} \delta_{k,t-1} cov_{t-1}(R_{2L+1,t}, R_{L+1+k,t}) \\
E_{t-1}(r_{M,t}) &= \gamma_{t-1} var_{t-1}(R_{M,t}) + \textstyle\sum_{k=1}^{L} \delta_{k,t-1} cov_{t-1}(R_{M,t}, R_{L+1+k,t})
\end{aligned} \tag{8}$$

The first $L+1$ equations in the system are used to price equity portfolios, the next L equations impose pricing restrictions on the currency deposits and the last equation is used to price the world portfolio. In this sense, the system implies that the first $L+1$ assets (the equity portfolios) are priced relative to the market and to the currency deposits. As we argue later, this feature of the model is useful during estimation.

Adding a disturbance term orthogonal to the information available at the end of time $t-1$, the system of equations in (8) can be written more compactly

$$r_t = \gamma_{t-1}\sigma_{M,t} + \sum_{k=1}^{L} \delta_{k,t-1}\sigma_{L+1+k,t} + \varepsilon_t \qquad \varepsilon_t | \Im_{t-1} \sim N(0, \Sigma_t) \tag{9}$$

[6]Henceforth, we will use superscripts to denote measurement currencies only when necessary to avoid confusion.

where $\Im_{t-1}$ is the set of information available at time $t-1$, Σ_t is the conditional covariance matrix of asset returns, $\sigma_{L+1+k,t}$ is the $(L+1+k)^{th}$ column of matrix Σ_t and $\sigma_{M,t}$ is the last column of Σ_t. Obviously, given the order of the equations in (8), the $(L+1+k)^{th}$ column of Σ_t contains the conditional covariances between each asset and the return on the k^{th} currency deposit; in this sense it measures the exposure to foreign exchange risk with respect to currency k. Similarly, the last column of Σ_t includes the conditional covariances between each asset and the market portfolio and, therefore, measures the exposure to market risk.

As implied by the notation, we also allow both the price of market risk (γ_{t-1}) as well as all the prices of currency risk ($\delta_{k,t-1}$) to change over time. In particular, we assume that γ_{t-1} and $\delta_{k,t-1}$ are functions of a number of instrumental variables. We discuss this issue in detail in the empirical section of the paper.

Finally, we make the following assumptions about the dynamics of Σ_t. First, we impose that the conditional second moments follow a diagonal GARCH process in which the variances in Σ_t depend only on past squared residuals and an autoregressive component, while the covariances depend upon past cross–products of residuals and an autoregressive component (see, for example, Bollerslev, Engle and Wooldridge ,1988, and Engle and Kroner, 1995). Second, we assume that the system is covariance stationary so that the process for the Σ_t matrix can be written as follows

$$\Sigma_t = \Sigma_0 * (\iota\iota' - \mathbf{aa}' - \mathbf{bb}') + \mathbf{aa}' * \varepsilon_{t-1}\varepsilon_{t-1}' + \mathbf{bb}' * \Sigma_{t-1}. \tag{10}$$

where Σ_0 is the unconditional variance–covariance matrix of the residuals, ι is a vector of ones, $\mathbf{a}$ and $\mathbf{b}$ are vectors of unknown parameters and $*$ denotes the Hadamard (element by element) matrix product.

In practice, estimation of the model becomes hard if the number of assets included into the system is large. However, the econometrician can gain some flexibility from the fact that the first $L+1$ assets in the model (the equity portfolios in our case) are priced relative to the market and to the currency deposits, which represent the relevant pricing factors. As long as the system includes equations for the relevant pricing factors, one can focus on any subset of the first $L+1$ assets. Obviously, the cost of eliminating securities is that information on cross-correlations is lost and tests of the asset pricing restrictions imposed by the model have less power. Therefore, in general the econometrician can estimate any subset of s equations with $L+1 \leq s \leq 2(L+1)$.

Under the assumption of conditional normality, the log–likelihood function for a system of s equations can be written as follows:

$$\ln L(\Psi) = -\frac{Ts}{2}\ln 2\pi - \frac{1}{2}\sum_{t=1}^{T}\ln|\Sigma_t(\Psi)| - \frac{1}{2}\sum_{t=1}^{T}\varepsilon_t(\Psi)'\Sigma_t(\Psi)^{-1}\varepsilon_t(\Psi) \tag{11}$$

where Ψ is the vector of unknown parameters. Since the assumption of conditional normality is often violated when using financial time series, we estimate the model and compute all our tests using the quasi–maximum likelihood (QML) approach proposed by Bollerslev and Wooldridge (1992).

3 Data

We use monthly returns on stock indices for 10 countries (Austria, Belgium, France, Germany, Italy, Japan, Netherlands, Spain, U.K. and U.S.) plus a value–weighted world index. All the indices are obtained from Morgan Stanley Capital International (MSCI) and the sampling period covers 288 observations from January 1974 through December 1997. Returns are computed based on the last closing prices of each month. All MSCI indices are available with and without dividends reinvested so that we can compute returns that include both capital gains and dividend yields.

To estimate the currency risk component of the model, we use euro-currency rates offered in the interbank market in London for one–month deposits in U.S. dollars, Japanese yen, Austrian shillings, Belgian francs, French francs, Italian lira, Dutch guilder, Spanish peseta and British pounds. The euro-deposit rates are from Data Resources Incorporated (DRI) and the Bank of International Settlements (B.I.S.).

Returns on both equity and euro-deposits are measured in DEM, based on the closing European interbank currency rates from MSCI. We compute the monthly excess returns by subtracting the conditionally risk-free rate from the monthly return on each security. Given the choice of the measurement currency, an obvious candidate for the conditionally riskless asset is the one–month euro-DEM deposit quoted in London on the last day of the month.

The geographical composition of our sample is the result of a compromise between two objectives: first, we want to cover a non negligible fraction of the international equity markets, both within and outside the EMU; second, we want to limit the size of the system to keep the estimation feasible. However, estimation of a system of 20 assets (10 country equity indices, the world index and 9 euro-deposits) is not feasible with current technology. To reduce the dimension of the estimation, we form two value weighted portfolios of the equity indices of the 6 EMU-countries beside Germany. The first portfolio, denoted EqPA combines the equity indices of Austria, Belgium and the Netherlands. The second portfolio, EqPB, combines the equity indices of France, Italy and Spain.[7] The relative capitalization of each country index in the MSCI world index are used as weights.[8] Similarly, we form 2 portfolios of one month euro-deposits, EurA and EurB, which are value weighted portfolios of respectively the one month euro-shilling, one month euro Belgian franc and one month euro-guilder deposits and of the one month euro French franc, euro-lira and euro-peseta deposits.

The summary statistics reported in Table 1 reveal a number of interesting facts. The excess returns on the stock indices have higher means, but also higher volatility than the excess returns on the euro-deposits. In most cases the index of kurtosis and the Bera–Jarque test statistic strongly reject the hypothesis of normally distributed returns, which supports our decision to use QML to estimate and test the model. Panel

[7] The groupings are based on a ranking of the 6 countries, based on the volatility of their local currency/DEM exchange rate. The countries with the lowest DEM exchange rate volatility, the Netherlands, Austria and Belgium also had explicit exchange rate policies closely aligned on the Bundesbank policies.

[8] We thank Philippe Jorion for making this data available to us.

b in the table contains also the unconditional correlations among markets. The values are relatively low, especially if compared to the average correlation among sectors of the U.S. market.[9]

Panel c in the table reports autocorrelations for the excess returns and panel d autocorrelations for the excess returns squared. The predominant lack of autocorrelation in the return series reveals that, in our analysis, we do not need to correct for the possibility of autocorrelation in the market indices. On the other hand, autocorrelation is detected, at short lags, in the squared returns, thus suggesting that a GARCH specification for the second moments might be appropriate, at least for the stock return series. Further, when we analyze the cross–correlations of squared returns with at most two leads and two lags, 18 out of 264 are statistically significant at the 5% level. In this sense, the GARCH parameterization that we use is not too restrictive.

In choosing the instruments that describe the investor's information set, we are guided by previous research (Ferson and Harvey (1993), Dumas and Solnik (1995), De Santis and Gerard (1998)) and by economic intuition. The instruments include: a constant, the dividend price ratio on the world equity index in excess of the one-month euro-DEM rate, the change in the one-month euro-dollar deposit rate, the U.S. default premium, measured by the yield difference between Moody's Baa and Aaa rated bonds, and the U.S. term premium, measured by the yield difference between the 3 month T-Bill and the 10 year T-Bond. In addition to the global variables, we also use one country specific variable to predict changes in currency risk premiums. Korajczyk (1985) suggests that the relative attractiveness of each currency and the reward required to bear its associated risk is affected by the difference between the real return on the local short term deposit and the real return on the short term deposit in the reference currency, which we refer to as the real risk-free rate differential. Real returns are computed by deflating local nominal one-month euro-currency rates by the change in the local CPI index. Inflation data are from the International Financial Statistics (IFS) database. All instrumental variables are used with a one–month lag, relative to the excess return series. The summary statistics displayed in Table 2 show that the correlations among the instruments are low, which indicates that our proxy of the information set does not contain redundant variables.

4 Empirical Evidence

Although the main objective of our study is to provide a measure of the relative importance of EMU currency risk, it is obvious at this point that a sensible measure of such risk can only be obtained within a specific model of asset pricing. For this reason, in our empirical analysis we proceed in two steps. First we compute a number of specification tests on the conditional ICAPM discussed above. Second, having established that the data support the restrictions of the model, we proceed to measure the implied risk and

[9]For example, Elton and Gruber (1992) document that during the 1980-1988 period, the correlation between the value-weighted index of the 1000 largest stocks traded in the U.S. and the value-weighted index of the next 2000 largest stocks is 0.92.

premiums associated with the EMU and non-EMU factors.

Our first set of specification tests is focused on the prices of market and currency risk. We assume that all prices of risk are time-varying and that their dynamics are driven by a number of instrumental variables. For each price of risk, we choose the set of relevant instruments and the functional form based on the extensive evidence discussed in De Santis and Gerard (1997, 1998). For the price of market risk the vector of instruments $z_{M,t-1}$ includes a constant, the dividend price ratio of the world equity index in excess of the one-month euro-DEM rate ($XDPR$), the change in the one-month euro-dollar rate ($\Delta Euro\$$) and the U.S. default premium ($USDP$), measured by the yield difference between Moody's Baa and Aaa rated bonds. In choosing the functional form for γ_{t-1}we take into consideration the implications of the theoretical model. The price of market risk is a weighted average of the coefficients of risk aversion of all national investors; therefore, under the assumption that investors are risk averse, γ_{t-1} must be always positive. To guarantee that this restriction is satisfied[10], we assume that $\gamma_{t-1}$is an exponential function of the instruments in $z_{M,t-1}$[11]

$$\gamma_{t-1} = \exp\left(\kappa_M' z_{M,t-1}\right).$$

On the other hand, the theory does not yiels any restriction on the sign of the prices of currency risk. For this reason, we adopt a linear specification for each $\delta_{k,t-1}$ in the model

$$\delta_{k,t-1} = k_k' z_{k,t-1}.$$

The vector $z_{k,t-1}$ includes a constant, three variables which are common to all prices of currency risk($\Delta USTP$, $\Delta Euro\$$ and $USDP$, as defined above) and a currency specific variable, measured by the difference between the real interest rate of country k and the real euro-DEM rate.[12]

4.1 Specification Tests

Table 3 contains parameter estimates and a number of diagnostic tests for the ICAPM discussed earlier in the paper. In panel a we report point estimates and QML standard errors for the parameters of the mean equation: panel b reports the parameters of the covariance process; panel c contains a number of robust Wald test statistics to evaluate joint hypotheses on the prices of market and currency risk; finally, panel d contains a variety of diagnostics tests on the estimated residuals. Here we focus mostly on the Wald tests in panel c, because they provide direct evidence on some of the key restrictions of the model.

[10] See Merton (1980) for an argument in favor of imposing this restriction ex-ante in the estimation.

[11] Other specifications of the functional relation between instruments and the price of market risk satisfy the positivity requirement, e.g. a square function $\gamma_{t-1} = (\kappa_M' z_{M,t-1})^2$. We duplicated all the estimations and tests using a square function specification of the price of risk: all the results are similar.

[12] We use the term country k to indicate the country whose goods are denominated in currency k.

Given the specification of the price of market risk, γ_{t-1} is constant under the null hypothesis that the k_M coefficients are simultaneously equal to zero. The test statistic in the table indicates that this hypothesis is rejected at any standard level.

For the prices of currency risk we compute seven different tests that exploit the linear specification of $\delta_{k,t-1}$. The first two tests apply to all the prices of currency risk and their aim is to determine whether such prices are simultaneously equal to zero and, if not, whether they are constant. Both hypothesis are rejected by the robust Wald statistics. Having established the empirical relevance of currency risk, in the other two tests, we examine the significance of its EMU and non-EMU components. Obviously, since the DEM is used as the measurement currency, the sources of currency risk which are bound to disappear with the inception of the EMU are the Austrian shilling, Belgian franc and Dutch guilder risk as well as French franc, Italian lira and Spanish peseta risk. On the other hand, currency risk associated with the U.S. dollar, the Japanese yen and the British pound is not going to be eliminated by the adoption of the unique currency. Under the null hypothesis that EMU (non-EMU) currency risk is not priced, all the κ_k coefficients for the relevant currencies must be equal to zero. The results for these test show that only non-EMU currency risk is priced at the 5% level. When we consider individually, the components of EMU and non-EMU currency risk, we find that, although the prices of EMU currency risk are not jointly significant, exchange risk associated with the French franc, Italian lira and Spanish peseta is priced, at least at the 6.5% level. Not surprisingly, the exchange risk associated with the currencies most closely aligned with the DEM is not priced. Among non-EMU currencies, only the price of US$ risk is significantly different from zero.

Before proceeding to a detailed analysis of the risk premiums implied by the model, we consider a number of robustness tests. Our first goal is to determine whether the cross-section of the expected returns is explained by other factors, besides the market and currency premiums defined in equation (9). To address this issue, we would like to estimate an augmented version of the pricing equation which includes: a country–specific constant, the instrumental variables z_{t-1} and country–specific risk as additional explanatory variables and then test whether their coefficients are zero for all markets.

The inclusion of these additional components into the model is justified by various considerations. The country–specific constants can be interpreted as a measure of mild market segmentation, or as an average measure of other factors that cannot be captured by our model, like differential tax treatment across countries. Market–specific volatility is also a measure of potential market segmentation; in fact, country risk would be the only factor to be priced if markets were fully segmented. Finally, the inclusion of the information variables can be justified by the need to account for the intertemporal features of the model,[13] or more simply as a way to test whether the instruments have any predictive power for returns, beyond their use to model the dynamics of the prices of risk.

Unfortunately, estimating the entire model with the addition of 86 parameters is

[13]As mentioned in Section 2, in this case the covariances with the relevant state variables should also be priced. In our specification, the components in $\phi' z_{t-1}$ could be interpreted as proxies for those covariances.

extremely hard and, therefore, we address this issue using a two–stage approach. First, we obtain risk–adjusted returns from the benchmark model in (9), then we estimate a system of equations in which the instruments are used to predict the risk–adjusted returns while the conditional covariance matrix from the first stage is used to correct for conditional heteroskedasticity and cross–equation correlations. We estimate the following system

$$\text{Step 1} \quad r_{it} = \gamma_{m,t-1} cov_{t-1}(r_{it}, r_{mt}) + \sum_{k=1}^{5} \delta_{k,t-1} cov_{t-1}(r_{it}, r_{n+k,t}) + \varepsilon_{it}$$

$$\text{Step 2} \quad \varepsilon_{it} = \alpha_i + \phi_i' z_{t-1} + \lambda_i \mathbf{1}_{i=s} var_{t-1}(r_{it}) + \eta_{it}$$

where $\mathbf{1}_{i=s}$ is an indicator variable which takes the value 1 is asset i is a country equity index and 0 otherwise. At this point a variety of tests can be computed on the parameters of the system. Our results, reported in Table 4, indicate that none of the additional factors mentioned above is priced. Neither the intercepts nor the market specific returns volatility are significant at any conventional level. Similarly, the null hypothesis that the 68 parameters of the information variables are simultaneously equal to zero cannot be rejected at any standard level. Further, the null hypothesis of no predictability is never rejected even on an equation by equation basis. Finally, the restriction that the parameters are equal across equations cannot be rejected. In summary the tests show that the model performs very well with respect to standard tests of residual predictability[14].

4.2 The Economic Relevance of Currency Risk

The fact that currency risk is a priced factor, both in its EMU and non-EMU components, has interesting implications. In fact, as long as exposure to exchange rate fluctuations is rewarded by the market in the form of a risk premium, it may not be optimal to eliminate multiple currencies, since this would only eliminate potentially attractive assets from the menu of choices available to investors. A more educated assessment of this issue requires an explicit measure of the premium associated with each source of risk, which can be easily done using our approach. Specifically, the premium for market risk for asset i is simply computed as the product between the price of market risk γ_{t-1} and the conditional covariance $cov_{t-1}\left(R_{i,t}^{DM}, R_{M,t}^{DM}\right)$. Since both quantities are explicitly parameterized in the model, the premium for market risk can be computed for any asset included in the system of equations (9). For the same asset, the aggregate measure of currency risk, as well as its components, can be obtained from the expression $\sum_{k=1}^{l} \delta_{k,t-1}\, cov_{t-1}\left(R_{i,t}^{DM}, \nu_{k,t}^{DM}\right)$. Table 5 and Figures 1a-12b report information on the estimated premiums for each asset, using the following definitions:

- Market Premium (MP): $\gamma_{t-1}\, cov_{t-1}\left(R_{i,t}^{DM}, R_{M,t}^{DM}\right)$
- Aggregate Currency Premium (ACP): $\sum_{k=1}^{l} \delta_{k,t-1}\, cov_{t-1}\left(R_{i,t}^{DM}, \nu_{k,t}^{DM}\right)$

[14] Of course the power of the tests may be low if there is enough noise in the $\widehat{\varepsilon}_{it}$ from the first stage. Alternatively, we perform GMM tests on the residuals, equation by equation. Similar results obtain.

  - EMU Currency Premium (ECP): $\sum_{k=1}^{l_1} \delta_{k,t-1}\ cov_{t-1}\left(R_{i,t}^{DM}, \nu_{k,t}^{DM}\right)$
  - Non-EMU Currency Premium (NECP): $\sum_{k=l_1+1}^{l} \delta_{k,t-1}\ cov_{t-1}\left(R_{i,t}^{DM}, \nu_{k,t}^{DM}\right)$

- Total Premium (TP): $MP + ACP$

where we assume that of the l sources of currency risk in the model, the first l_1 are EMU-specific.

Consider first the equity markets. The data in panel a of Table 5 show that for both the U.S. and the World equity index, the average premium for currency risk is negative and, in absolute terms, represents a non negligible fraction of the total premium. For example, the average market premium for holding U.S. equities over the 1974–1997 period is equal to 9.07 per cent on an annual basis. Yet, since the average aggregate currency premium over the same period is equal to -2.14 per cent, the total premium is reduced to 6.93 per cent. For the remaining equity markets in our sample, the statistics in the table should be interpreted more carefully. In all instances, the average market premium is the dominant component of the average total premium. In 3 cases, Japan, Germany and U.K., the aggregate currency premium is not significantly different from zero. However, using this evidence to conclude that currency risk is economically negligible in most markets could be misleading, for at least two reasons. First, as argued earlier, the average premium can be close to zero when computed over the entire sample, while oscillating between positive and negative values for relatively long subperiods. Second, the cross-sectional aggregation over different sources of currency risk may fail to reflect currency-specific premiums of different sign which are economically significant.

Figures 1a-7a can be used to address the first issue. For the EMU countries equity indices, the graphs indicate that the aggregate currency premium fluctuates around zero within a rather narrow band. On the other hand, for the U.K. the same premium is often large in absolute value and persistent in sign. In Figure 13a we provide an alternative way of summarizing our findings by plotting the average aggregate currency premiums and the corresponding confidence intervals, obtained using Newey-West (NW, 1987) standard errors. The average premium for the U.S. is clearly large and negative and more than two standard deviations away from zero. It is also significantly negative for EqPA, although much smaller. The average currency premium is significantly positive for EqPB and close to zero, instead, for the other equity indices in our sample.

Figures 1b-7b are helpful to address the second issue. They reveal two interesting regularities in the decomposition of the aggregate currency premium into EMU and non-EMU components. First, the premium for exposure to EMU currency risk is mostly positive whereas the premium for non-EMU risk is negative. Second, the premium for non-EMU risk is usually larger in absolute value. These findings are confirmed by the average disaggregated premiums reported in Table 5 and by the confidence intervals plotted in Figures 13b and 13c. The numbers in the table indicate that, for all equity indices, the EMU component is significantly positive and that for all cases, except Japan, the non-EMU component is significant, and in some cases attains rather large values. For example, the average non-EMU premium is equal -4.00 per cent per year for the U.S. equity market, -2.27 per cent for the World index, while the EMU premiums for those two indices are 1.86 per cent and 1.64 per cent respectively. For all equity indices the average EMU currency premium is 1.41 per cent while the average non-EMU premium is -1.52 per cent. In the German case, both components are small and of similar magnitude, due to the fact that the DEM is the reference currency.

Next, consider the five euro-currency markets in panel b. Figures 7a-12a clearly show that, in this case, the total risk premium is mostly driven by reward for exposure to currency risk. Interestingly, the size of the market premium is rather small for both EMU euro-currency portfolios, but it is significantly larger for the deposits in the three non-EMU currencies (the British pound, the U.S. dollar and the Japanese yen). The sample averages and the disaggregation of the currency premium reported in panel b and plotted in Figures 13a-13c confirm the patterns uncovered for the equity markets: the average aggregate premium for currency risk is negative for the US$, positive for EMU-currencies and the Pound, and insignificantly different from zero for the Yen. Note that the currency premiums for the euro-currency portfolio A (Belgian franc, Austrian shilling and Dutch guilder) are economically insignificant.

4.3 The decomposition of the currency risk premium.

The large negative premium for non-EMU currency risk is an interesting finding which requires an explanation. The definitions of risk premiums introduced earlier in the paper imply that each premium is affected by two components: covariance risk and the corresponding shadow price. Unlike the price of market risk, the prices of the different exchange risks are not restricted to be positive. According to the model of Adler and Dumas (1983), the price of risk associated with currency l is negative, zero, or positive, depending on whether the coefficient of risk aversion for the investor of country l is higher, equal, or less than one, respectively. Further, the larger the market capitalization of country l, the higher the price of risk in absolute value.

In Table 6 we report summary statistics for the estimated prices of risk. For the three non-EMU currencies it is obvious that the most relevant risk factor is the U.S. dollar, since the average price of dollar risk is statistically significant and negative. The prices of either British pound or Japanese yen risk are not significantly different from zero. As a consequence, the negative premium for non-EMU currency risk stems from positive average covariance risk and negative average shadow prices and is driven mainly by US $ risk. This suggests that investors are willing to forgo part of the market premium to hold assets whose DEM-denominated return is positively correlated with the relative change of the DEM/U.S. dollar exchange rate. Stated differently, investors pay a premium to hold assets that provide a good hedge against fluctuations in the U.S. dollar. For both EMU currencies portfolios, the average price of risk is positive and highly significant.

To complete the picture, we report summary statistics about the exposure of equity assets to currency risk in Table 7 and Figure 15. Except for the German equity index's exposure to the currencies of Austria, Belgium and Netherlands, all currency risk exposure are significant and positive. Strikingly, for all equity assets, the exposure to the EMU currency portfolio B of French franc, Italian lira and Spanish peseta is 2 to 3 times smaller as the exposure to US$ risk while the exposure to EMU currency portfolio A is more than 10 times smaller as the exposure to US$.

To summarize, the decomposition into price of risk and covariance risk suggests that the large negative currency risk premium observed for the U.S. dollar is explained by a combination of a large negative price of risk and a large positive covariance. In contrast, the negligible risk premium obtained for currencies included in Euro portfolio A from a combination of a high and statistically significant positive price of risk and a very small risk exposure.

4.4 European Liberalization and Currency premiums

The European Community set July 1, 1990 as the deadline for its country-members to complete the process of financial liberalization.[15] Further the adoption of the Maastricht treaty in 1991 and the subsequent effort of the signatory countries to satisfy the EMU membership requirement suggest that the nineties may be different from the earlier subperiod. It would be difficult to implement a direct test of structural change within the ICAPM that we estimate; therefore, in Tables 5, 6 and 7 and Figures 14a-14c we propose a simple, albeit not as general, test for the hypothesis that financial liberalization has affected the average premiums for currency risk. We split the sample in two subperiods from January 1974 until June 1990, and July 1990 until December 1997, respectively. For each asset, we test the null hypothesis of a structural change in the average currency premium and in the average currency risk exposure.

The results can be summarized as follows. The change in the average aggregate currency premium is statistically significant in eight out of twelve cases. Seven of the eight significant changes are negative and all are rather large. In the most extreme cases, the average currency premium for the U.S. and Japanese equity market and for the euro-dollar and euro-yen deposit reaches values from -4.5 to -7 per cent per year after June 1990. The disaggregation between EMU and non-EMU currency premium is equally interesting. The average EMU premium is positive, but mostly rather low and in nine out of twelve cases it is statistically larger after June 1990 relative to the earlier period. Interestingly, the two largest and significant changes in the EMU premium are associated with two euro-currencies which are external to the EMU. On the other hand, the non-EMU component of the premium is negative and significantly more so in the last part of the sample for nine of the twelve assets.

These findings are better understood after looking at the evidence on the changes in the prices of and in the exposures to currency risk, reported in Table 6 and Table 7 respectively. The prices of both U.S. dollar and Japanese yen risk are significantly more negative in the post 1990 period, whereas the prices of the two EMU currency portfolios and the British pound risk are significantly more positive. In absolute terms, the change in prices are of similar magnitude for all currencies and is slightly larger for EMU-currency portfolio A. Yet, our results show that the change in premium associated with the EMU currencies is relatively smaller. The reason is made clear by the results in Table

[15] See Carrieri (1997) for a study of the effects of European liberalization on the price of currency risk.

7. For all equity assets except the German index, the exposure to both EMU currency portfolios significantly decreases in the nineties. On the other hand, all equity assets display an increase in US$ exposure. This increase is the largest and most significant for both EMU equity portfolios and the German index. Given the definition of currency risk, this suggests that while risk exposure to the EMU currencies has declined in the nineties, it has been either partially or completely been offset by a concomitant increase in exposure to US$ risk. From this perspective also, the elimination of EMU-specific currency risk appears to be of relatively little relevance to investors.

5 Conclusion

In this study, we attempt to measure how the adoption of a single currency in the European Monetary Union will affect international equity and euro-deposit markets. In this context, the relevant issues are: how important is the exposure to EMU currency risk, compared to its non-EMU counterpart, and by how much international investors have been rewarded for their exposure to EMU currency risk. Three main results emerge from our investigation of equity and euro-deposit markets over the last 24 years:

1. Currency fluctuations induce a systematic source of risk in returns. However, the EMU component is small relative to the non-EMU component (Dollar, Yen and Pound). The most relevant currency risk factor is linked to the US dollar.

2. Currency risk is priced. EMU currency risk commands a positive but small risk premium, and not surprisingly, is mostly associated to exposure to the three currencies with the largest DEM/exchange rate volatility, that is, France, Italy, and Spain. The premium associated with the currencies most closely aligned with the DEM, the Austrian shilling, Belgian franc and Dutch guilder is insignificantly different from zero. The non-EMU currency risk premium is negative, which suggests that investors are willing to forgo part of their expected returns to hold assets that provide a hedge against currency risk.

3. Currency risk and its impact on returns varies over time as a function of changes in economic conditions and the institutional environment. In particular, although the magnitude of both EMU and non-EMU risk premiums is larger in the nineties, the exposure of international markets to the non-EMU currencies has increased significantly in that period, while exposure to EMU risk has decreased.

What are the implications of our findings for the transition to a single currency? First, to the extent that exposure to EMU currency risk is systematic, asset return volatility is likely to decrease, both for European and non-European equity markets. However the experience of the nineties suggest that the elimination of EMU risk is likely to be offset at least partially by an increase in non-EMU risk. Second, since investors are rewarded with a positive premium for being exposed to the EMU currency risk, its elimination may also reduce expected returns on international equities. The case remains that all markets, and in particular European equity markets, will still be subject to the large and dominant impact of the non-EMU currency risk. When combined with the recent decline in the EMU component of exchange risk, these results suggest that the adoption of a single currency is likely to have a limited impact on international asset prices, risk and expected returns.

This study raises interesting questions. For example, we document that investors are willing to forego part of their expected returns, in the form of a negative risk premium, to hold assets that provide a hedge against fluctuations in the U.S. dollar and to a lesser extent the Japanese yen. Though the issue deserves further attention, this could be related to the currency risk induced by the consumption of foreign goods. A natural hedge for this risk is provided by an investment in foreign assets. The negative risk premium observed for the U.S dollar and the yen could stem from the fact that dollar- and yen-denominated goods constitute a significant fraction of the agents' consumption basket.

Overall, the investigation leads us to believe that, beyond the benefits of enhanced liquidity, lower transactions costs and improved transparency in cross-country investments, the adoption of the single currency will have limited impact on international asset prices, risk and expected returns. However, expected returns and risk could also be affected by changes in the correlation structure of European equity markets due to the harmonization of European monetary policies fostered by the adoption of the EMU. This issue is left for future research.

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Table 1: Summary Statistics of Asset Excess Returns

Monthly Deutsche mark (DEM) returns on the equity indices of 10 countries and the value-weighted world index are from MSCI. The eurocurrency one-month deposit rates for the Austrian shilling, Belgian franc, French franc, Italian lira, Dutch guilder, Spanish peseta, German mark, Japanese yen, British pound and U.S. dollar are from DRI Inc and the B.I.S. EqPA and EqPB are value-weighted portfolio of the equity indices of Austria, Belgium and the Netherlands and of France, Italy and Spain respectively. EurA and EurB are value-weighted portfolio of the one month eurodeposit rates for the Austrian shilling, Belgian franc and the Dutch guilder and for the French franc, Italian lira and Spanish peseta respectively. The weights are the monthly weights of the respective country indices in the MSCI world index. Excess returns are obtained by subtracting the euro-DEM one-month rate. All returns are continuously compounded and expressed in percentage per month. The sample covers the period January 1974 through December 1997 (288 observations).

Panel a: Summary Statistics

	Mean	Std. Dev.	Skewness	Kurtosis[a]	B-J[b]	Q^c_{12}	Weights[d]
U.S.	0.434	5.63	-0.74**	3.21**	144**	0.778	0.453
Japan	0.246	6.45	-0.13	1.03**	12.5**	0.733	0.224
Austria	0.102	5.61	0.21	5.13**	305**	0.002	0.001
Belgium	0.503	5.03	-0.07	4.55**	238**	0.250	0.007
France	0.393	6.45	-0.31*	1.54**	31.3**	0.553	0.028
Germany	0.453	5.25	-0.77**	3.27**	150**	0.643	0.042
Italy	0.022	7.96	0.14	0.54	3.95	0.382	0.012
Netherl.	0.796	4.93	-0.51**	3.68**	168**	0.292	0.017
Spain	0.023	6.92	-0.59**	3.07**	125**	0.247	0.012
U.K.	0.569	7.10	0.02	5.57**	357**	0.230	0.095
EqPA	0.649	4.51	-0.74**	4.63**	273**	0.363	0.025
EqPB	0.085	5.51	-0.37*	1.74**	40.5**	0.262	0.052
EurAs	0.038	0.48	3.45**	38.06**	332**	0.031	
EurBf	0.118	1.25	-0.97**	8.54**	386**	0.127	
EurFr	0.140	1.23	-0.68**	4.58**	263**	0.037	
EurIl	0.055	2.29	-1.63**	8.48**	355**	0.399	
EurNl	0.028	0.53	-0.21	3.95**	180**	0.002	
EurSp	0.081	2.45	-2.86**	21.84**	591**	0.208	
EurA	0.051	0.59	-1.06**	6.12**	484**	0.015	
EurB	0.079	1.37	-1.77**	9.25**	1137**	0.010	
Eur£	0.151	2.68	0.26	1.44**	26.4**	0.191	
Eur$	0.020	3.39	0.18	0.67*	6.50*	0.454	
EurY	0.072	3.04	0.32*	0.28	5.77	0.180	
World	0.367	4.67	-0.82**	3.11**	142**	0.147	1.000

[a]Equal to zero for the normal distribution; [b]Bera-Jarque test statistic for normality; [c]P-values for Ljung-Box test statistic of order 12; [d]Monthly average over the 1/74-12/97 period.
* and ** denote statistical significance at the 5% and 1% levels, respectively.

Table 1 (continued)

Panel b: Unconditional Correlations of r_{it}

	Jpn.	Ger.	EqPA	EqPB	U.K.	EurA	EurB	Eur£	Eur$	Eur¥	Wrld
U.S.	.329	.405	.685	.541	.570	.094	.266	.259	.614	.247	.888
Jpn.	1	.272	.411	.459	.347	.086	.186	.216	.217	.578	.666
Ger.		1	.682	.553	.405	-.070	.032	.084	.124	.039	.511
EqPA			1	.672	.673	.099	.136	.211	.289	.171	.782
EqPB				1	.549	.090	.376	.226	.265	.237	.696
U.K.					1	.212	.254	.468	.258	.204	.699
EurA						1	.368	.251	.119	.105	.125
EurB							1	.431	.447	.307	.288
Eur£								1	.427	.304	.342
Eur$									1	.435	.512
Eur¥										1	.393

Panel c: Autocorrelations of r_{it}

Lag.	1	2	3	4	5	6	12
U.S.	0.039	0.049	-0.007	-0.012	0.084	-0.096	0.035
Jpn.	0.076	0.010	0.071	0.059	0.020	-0.007	-0.050
Ger.	0.042	-0.025	0.054	0.056	-0.079	-0.042	-0.029
EqPA	0.096	-0.010	0.004	-0.073	0.020	-0.038	0.056
EqPB	0.107	0.018	0.106	0.053	0.046	0.026	0.039
U.K.	0.107	-0.093	0.038	-0.025	-0.134*	-0.024	-0.044
EurA	0.022	0.050	-0.013	-0.117	-0.087	-0.008	0.100
EurB	0.100	0.089	-0.014	-0.115	-0.016	-0.130*	0.022
Eur£	0.160*	-0.004	-0.008	0.013	-0.037	-0.010	0.017
Eur$	0.018	0.099	0.018	-0.015	0.041	-0.073	0.008
Eur¥	0.092	0.083	0.063	0.041	0.065	-0.113	-0.059
World	0.107	0.052	0.008	-0.006	0.087	-0.061	-0.011

Table 2: Summary Statistics of the Information Variables

The information set includes the world dividend price ratio in excess of the one-month euro-DEM rate (XDPR), the one month change in the U.S. term premium (ΔUSTP), the change in the one-month euro-dollar deposit rate (ΔEuro$), the U.S. default premium (USDP), and the difference between the local currency one month euro deposits real return and the real return on the one month euro-DEM deposit (EurARRD, EurBRRD, £RRD, $RRD, ¥RRD). The world price ratio is the DEM denominated dividend price ratio on the MSCI world index. The U.S. term premium is the yield difference between the T-bond or T-note with maturity closest to 10 years and the 3 month T-bill. The U.S. default premium is the yield difference between Moody's Baa and Aaa rated bonds. The real return on one month eurodeposits is equal to the difference between the quoted nominal deposit rate and the previous month change in consumer price index. Inflation rates are obtained from the IFS database. The sample covers the period January 1974 through December 1998 (288 observations).

	Mean	Median	Std. Dev.	Min.	Max.
XDPR	-0.240	-0.191	0.210	-0.946	0.191
ΔUSTP	0.005	-0.016	0.528	-1.717	2.982
ΔEuro$	-0.002	-0.005	0.111	-0.544	0.553
USDP	1.159	1.080	0.479	0.530	2.690
$RRD	-0.009	-0.024	0.370	-0.987	0.959
¥RRD	-0.095	-0.050	0.675	-3.113	1.473
EARRD	0.029	0.018	0.397	-1.324	1.613
EBRRD	0.048	0.097	0.511	-4.269	2.263
£RRD	0.031	0.104	0.629	-3.123	2.618

	Autocorrelations						
Lag	1	2	3	4	5	6	12
XDPR	0.915	0.898	0.901	0.849	0.834	0.810	0.597
ΔUSTP	0.041	-0.091	-0.001	-0.099	-0.091	-0.109	-0.220
ΔEuro$	-0.233	-0.079	0.199	-0.312	0.045	0.001	0.092
USDP	0.958	0.902	0.862	0.832	0.802	0.756	0.554
$RRD	0.350	0.234	0.180	0.082	0.169	0.109	0.305
¥RRD	0.180	-0.130	-0.130	-0.076	0.144	0.206	0.418
EARRD	0.285	0.033	-0.120	-0.074	0.140	0.241	0.479
EBRRD	0.075	0.136	0.199	0.110	0.195	0.197	0.230
£RRD	0.242	0.031	-0.016	0.034	0.107	0.233	0.468

	Correlations							
	XDPR	ΔUSTP	ΔEuro$	USDP	$RRD	¥RRD	EARRD	EBRRD
ΔUSTP	-0.109	1						
ΔEuro$	-0.059	-0.329	1					
USDP	-0.023	0.121	-0.126	1				
$RRD	0.179	-0.086	0.012	0.278	1			
¥RRD	0.081	-0.072	0.044	0.167	0.335	1		
EARRD	0.032	-0.068	-0.079	0.018	0.455	0.464	1	
EBRRD	-0.045	-0.059	0.114	-0.036	0.418	0.251	0.476	1
£RRD	-0.048	-0.159	0.044	-0.055	0.221	0.306	0.338	0.318

Table 3: Quasi-Maximum Likelihood Estimates of the Conditional International CAPM with Time-Varying Prices of Risk.

Estimates are based on monthly DEM-denominated continuously compounded returns from January 1974 through December 1997. Data for the country equity indices and the world portfolio are from MSCI. One-month euro-currency deposit rates are from DRI Inc and the B.I.S. Each mean equation relates the asset excess return r_{it} to its world covariance risk $cov_{t-1}(r_{it}, r_{mt})$ and its currency risk $cov_{t-1}(r_{it}, r_{6+c,t})$. The prices of risk are functions of a number of instruments, z_{t-1}, included in the investors' information set. The instruments include a constant, the world index dividend price ratio in excess of the one-month euro-DEM rate (XDPR), the change in the one month euro-dollar rate (ΔEuro$), the U.S. default premium (USDP), the one month change in U.S. term premium (ΔUSTP), as well as the difference between the 1 month real rates for the local currency euro-deposits and the DEM euro-deposits (Loc RRD).

$$r_{it} = \gamma_{t-1} cov_{t-1}\left(r_{it}, r_{mt}\right) + \sum_{k=1}^{5} \delta_{k,t-1} cov_{t-1}\left(r_{it}, r_{6+k,t}\right) + \varepsilon_{it}$$

where $\gamma_{t-1} = \exp(\kappa_m' z_{t-1})$, $\delta_{k,t-1} = \kappa_k' z_{t-1}$ and $\varepsilon_t | \Im_{t-1} \sim N\left(0, \Sigma_t\right)$. The conditional covariance matrix Σ_t is parameterized as follows

$$\Sigma_t = \Sigma_0 * (\mathbf{ii}' - \mathbf{aa}' - \mathbf{bb}') + \mathbf{aa}' * \varepsilon_{t-1}\varepsilon_{t-1}' + \mathbf{bb}' * \Sigma_{t-1}$$

where * denotes the Hadamard matrix product, **a** and **b** are 12× 1 vector of constant, and Σ_0 is the unconditional.covariance matrix of the residuals. Robust standard errors are reported in parentheses.

Panel a: Parameter Estimates - Mean Equations

	Const		XDPR		ΔEuro$		USDP			
κ_m	-4.665	(1.26)	3.156	(2.36)	-2.783	(0.88)	1.325	(0.68)		
	Const		ΔUSTP		ΔEuro$		USDP		Loc RRD	
κ_{CDA}	0.225	(.358)	0.163	(.169)	0.563	(1.86)	-0.104	(.219)	0.005	(.061)
κ_{CDB}	0.116	(.123)	0.048	(.099)	0.555	(.443)	-0.055	(.105)	0.121	(.068)
$\kappa_{£}$	0.136	(.080)	0.043	(.050)	0.292	(.256)	-0.109	(.075)	-0.033	(.039)
κ_{Y}	-0.088	(.064)	-0.085	(.047)	-0.167	(.251)	0.085	(.052)	0.023	(.037)
$\kappa_{\$}$	-0.080	(.057)	0.007	(.044)	0.191	(.242)	0.043	(.045)	0.105	(.051)

Panel b: Parameter Estimates - Covariance Process

	U.S.	Jap.	Ger.	EqPA	EqPB	U.K.	Eur$	Eur¥	EurA	EurB	Eur£	Wrld
a_{ii}	.197	.163	.169	.168	.155	.223	.216	.205	.263	.170	.199	.182
	(.036)	(.046)	(.081)	(.032)	(.049)	(.038)	(.135)	(.041)	(.073)	(.040)	(.071)	(.033)
b_i	.963	.979	.961	.965	.973	.960	.889	.917	.961	.975	.911	.968
	(.012)	(.011)	(.036)	(.015)	(.022)	(.015)	(.196)	(.054)	(.024)	(.009)	(.050)	(.011)

Table 3 (continued)

Panel c: Specification Tests

Null Hypothesis	χ^2	df	p-value
Is the price of market risk constant?			
$H_0 : \kappa_{m,j} = 0 \quad \forall j > 1$	11.441	3	0.009
Are the prices of currency risk equal to zero?			
$H_0 : \kappa_{k,j} = 0 \quad \forall k, j$	92.898	25	0.000
Are the prices of currency risk constant?			
$H_0 : \kappa_{k,j} = 0 \quad \forall k, j > 1$	73.623	20	0.000
Are the prices of risk of non-EMU currencies equal to zero?			
$H_0 : \kappa_{k,j} = 0 \quad \forall j, k = 3, 4, 5$	28.257	15	0.020
Are the prices of risk of EMU currencies equal to zero?			
$H_0 : \kappa_{k,j} = 0 \quad \forall j, k = 1, 2$	15.731	10	0.107
Is the price of risk of currency k equal to zero? ($H_0 : \kappa_{k,j} = 0 \quad \forall j$)			
$k = 1$, EMU currency portfolio A (Au+B+Nl)	1.098	5	0.895
$k = 2$, EMU currency portfolio B (Fr+It+Sp)	10.368	5	0.065
$k = 5$, US$	11.956	5	0.035

Panel d: Summary Statistics and Diagnostics for the Residuals

	U.S.	Jap.	Ger.	EqPA	EqPB	U.K.	Eur$	Eur¥	EurA	EurB	Eur£	Wrld
Avg (r_{it})	0.43	0.25	0.45	0.65	0.09	0.57	0.02	0.07	0.05	0.08	0.15	0.37
Avg $(\widehat{\varepsilon}_{it})$	-0.15	-0.43	0.14	0.16	-0.57	-0.37	-0.06	-0.11	-0.00	-0.06	0.07	-0.27
RMSE	5.59	6.32	5.23	4.46	5.52	7.11	3.33	3.01	0.58	1.34	2.64	4.60
R^2_m [a]	2.39	1.80	0.57	2.59	-0.30	1.90	-0.08	0.57	0.05	-0.03	-1.21	3.56
R^2_{m+c} [b]	1.23	3.82	0.92	2.38	-0.42	-0.25	3.41	1.90	3.50	4.15	2.48	2.89
Kurt.[c]	3.23*	1.34*	3.40*	5.31*	2.05*	3.72*	0.83*	0.13	5.25*	6.94*	1.56*	3.81*
B-J[d]	143*	20.4*	159*	357*	54.0*	170*	8.10+	3.10	392*	712*	31.8*	199*
$Q_{12}(z)$[e]	0.68	0.75	0.66	0.43	0.10	0.86	0.70	0.38	0.12	0.20	0.20	0.28
$Q_{12}(z^2)$[e]	0.93	0.84	0.22	0.97	0.86	0.79	0.61	0.90	0.94	0.96	0.98	0.99
EN-LM[f]	0.45	0.46	0.43	0.68	0.88	0.98	0.47	0.75	0.07	0.10	0.07	0.55
Likelihood Function:						-7694.39						

[a]Pseudo-R^2 when market risk is the only pricing factor; [b]pseudo-R^2 when both market and currency risk are pricing factors; [c]zero for the normal distribution; [d]Bera-Jarque test statistic for normality; [e]p–values for Ljung-Box test statistic of order 12; [f]p–values of Engle-Ng test of predictability of conditional second moments using the instruments. $^+$and * denote statistical significance at the 5% and 1% levels, respectively.

Table 4: Robustness Tests for the Conditional ICAPM

The table contains robust Wald test statistics for the predictability of the residuals obtained from the estimation of the conditional ICAPM. The tests are conducted by performing joint GLS estimation of the regression of the ICAPM maximum likelihood residuals on a constant, and a set of instruments. The weighting matrices for the residuals are the time varying covariance matrices of residuals estimated jointly with the pricing model. The instruments include a constant, the world index dividend price ratio in excess of the one-month euro-DEM rate (XDPR), the change in the one-month euro-dollar rate (ΔEuro$), the U.S. default premium (USDP), the one month change in U.S. term premium (ΔUSTP), and the difference betweeen the local currency one month euro deposits real return and the real return on the DEM one month eurodeposit (EARRD, EBRRD, £RRD, $RRD, ¥RRD) and the equity indices own residual variance.

$$\widehat{\varepsilon}_{it} \quad = \quad \alpha_i + \varphi_{ij} Z_{t-1} + \lambda_i 1_e \widehat{var}_{t-1} \left(\widehat{\varepsilon}_{it}\right) + \eta_{it}$$

where 1_e is an indicator variable which takes the value of 1 when $\widehat{\varepsilon}_{it}$ is a country equity index residual and zero for eurodeposits and the world index residuals and $\widehat{\varepsilon}_t | \Im_{t-1} \sim N\left(0, \widehat{\Sigma}_t\right)$. The conditional covariance matrix $\widehat{\Sigma}_t$ is parameterized as follows

$$\Sigma_t = \Sigma_0 * (\mathbf{ii}' - \mathbf{aa}' - \mathbf{bb}') + \mathbf{aa}' * \varepsilon_{t-1}\varepsilon_{t-1}' + \mathbf{bb}' * \Sigma_{t-1}$$

where * denotes the Hadamard matrix product, $\mathbf{a}$ and $\mathbf{b}$ are 12×1 vectors of constant, and Σ_0 is the unconditional.covariance matrix of the residuals. Robust standard errors are reported in parentheses.

Null Hypothesis	χ^2	df	p-value
Are intercepts all equal to zero?			
$\mathrm{H}_0 : \alpha_i = 0 \quad \forall i$	10.040	12	0.612
Are the asset specific coefficients of the information variables jointly equal to zero?			
$\mathrm{H}_0 : \varphi_{ij} = 0 \quad \forall i, j$	58.295	68	0.793
Is the price of country specific risk equal to zero?			
$\mathrm{H}_0 : \lambda_i = 0 \quad \forall i$	5.714	6	0.456

Table 5: Average Estimated Risk Premiums.

The table reports the average and standard errors of the risk premiums estimated for the overall sample period, the subperiod prior to June 1990, as well as the mean difference between periods before and after June 1990. The pre-1990 average premiums and the change in premiums are estimated by regressing the estimated premiums on a constant and a dummy variable for the post June 1990 period ($D_t = 1$, if $t >$ June 1990). The total risk premium is measured as the sum of the market risk premium and the aggregate currency premium . The currency premium is the sum of the premium associated with the EMU currencies, i.e., Austrian shilling, Belgian franc, French franc, Italian lira, Dutch guilder and Spanish peseta, and the premium associated with the currencies not included in the EMU, i.e., the British pound, the U.S. dollar and the Japanese yen. Standard errors are computed using the Newey-West heteroskedasticity and autocorrelation robust procedure. All estimates are reported in percent per year.

Panel a: Equity portfolios

	U.S.	Jap.	EqPA	EqPB	Ger.	U.K.	Wrld
			Total Premiums				
Overall	6.93	7.95	5.65	7.98	4.05	10.78	7.62
	(1.62)	(1.37)	(0.92)	(1.02)	(0.57)	(1.45)	(1.39)
Pre-90	11.27	11.43	7.93	10.52	5.31	13.87	11.24
	(1.82)	(1.63)	(1.08)	(1.20)	(0.70)	(1.82)	(1.60)
∇Post-90	-13.88	-11.15	-7.28	-8.15	-4.02	-9.87	-11.57
	(2.24)	(1.79)	(1.29)	(1.43)	(0.85)	(2.05)	(1.89)
			Market Premiums				
Overall	9.07	6.70	6.17	6.82	4.25	9.74	8.25
	(1.21)	(0.81)	(0.83)	(0.88)	(0.53)	(1.53)	(1.10)
Pre-90	11.95	8.39	8.03	8.81	5.39	12.97	10.75
	(1.51)	(1.04)	(1.05)	(1.10)	(0.67)	(1.97)	(1.38)
∇Post-90	-9.22	-5.40	-5.95	-6.38	-3.65	-10.33	-7.98
	(1.55)	(1.11)	(1.08)	(1.15)	(0.71)	(2.00)	(1.43)
			Total Currency Premiums				
Overall	-2.14	1.25	-0.52	1.16	-0.20	1.04	-0.63
	(0.64)	(0.69)	(0.22)	(0.37)	(0.13)	(0.56)	(0.48)
Pre-90	-0.69	3.04	-0.10	1.71	-0.08	0.90	0.49
	(0.65)	(0.79)	(0.20)	(0.44)	(0.12)	(0.74)	(0.50)
∇Post-90	-4.67	-5.75	-1.32	-1.78	-0.37	0.46	-3.60
	(1.25)	(0.93)	(0.54)	(0.72)	(0.34)	(1.06)	(0.92)
			EMU Currency Premiums				
Overall	1.86	1.29	0.79	2.42	0.36	2.22	1.64
	(0.22)	(0.16)	(0.09)	(0.30)	(0.07)	(0.27)	(0.19)
Pre-90	1.72	1.17	0.64	2.13	0.21	2.10	1.47
	(0.31)	(0.21)	(0.12)	(0.42)	(0.08)	(0.38)	(0.26)
∇Post-90	0.45	0.40	0.50	0.90	0.49	0.38	0.52
	(0.36)	(0.30)	(0.16)	(0.47)	(0.14)	(0.42)	(0.31)
			Non-EMU Currency Premiums				
Overall	-4.00	-0.04	-1.31	-1.26	-0.56	-1.18	-2.27
	(0.66)	(0.73)	(0.23)	(0.33)	(0.14)	(0.38)	(0.50)
Pre-90	-2.41	1.88	-0.74	-0.42	-0.30	-1.25	-0.98
	(0.69)	(0.86)	(0.19)	(0.34)	(0.12)	(0.48)	(0.52)
∇Post-90	-5.11	-6.15	-1.82	-2.68	-0.85	0.21	-4.12
	(1.19)	(0.97)	(0.47)	(0.58)	(0.32)	(0.79)	(0.86)

Table 5 (continued)

Panel b: Eurocurrency deposits

	Eur$	Eur¥.	EurA	EurB	Eur£
Total Premiums					
Overall	0.87	2.23	0.30	1.75	2.64
	(0.87)	(0.88)	(0.06)	(0.24)	(0.33)
Pre-90	3.07	4.71	0.37	1.99	2.28
	(0.93)	(0.99)	(0.08)	(0.32)	(0.39)
∇Post-90	-7.04	-7.95	-0.23	-0.76	1.15
	(1.42)	(1.14)	(0.09)	(0.39)	(0.69)
Market Premiums					
Overall	2.98	2.05	0.20	0.77	1.75
	(0.34)	(0.28)	(0.05)	(0.10)	(0.23)
Pre-90	3.83	2.65	0.28	1.02	2.28
	(0.41)	(0.35)	(0.07)	(0.12)	(0.29)
∇Post-90	-2.74	-1.92	-0.26	-0.80	-1.69
	(0.44)	(0.36)	(0.07)	(0.13)	(0.30)
Total Currency Premiums					
Overall	-2.10	0.17	0.10	0.98	0.88
	(0.64)	(0.67)	(0.04)	(0.21)	(0.44)
Pre-90	-0.76	2.06	0.10	0.97	-0.01
	(0.71)	(0.74)	(0.06)	(0.28)	(0.52)
∇Post-90	-4.30	-6.03	0.03	0.04	2.84
	(1.20)	(0.91)	(0.07)	(0.36)	(0.75)
EMU Currency Premiums					
Overall	1.61	0.91	0.16	1.38	1.21
	(0.18)	(0.12)	(0.05)	(0.19)	(0.13)
Pre-90	1.31	0.83	0.16	1.28	0.93
	(0.23)	(0.16)	(0.04)	(0.28)	(0.16)
∇Post-90	0.96	0.26	0.00	0.35	0.92
	(0.28)	(0.17)	(0.05)	(0.30)	(0.21)
Non-EMU Currency Premiums					
Overall	-3.71	-0.74	-0.05	-0.40	-0.33
	(0.68)	(0.71)	(0.04)	(0.10)	(0.34)
Pre-90	-2.07	1.23	-0.06	-0.31	-0.94
	(0.73)	(0.80)	(0.04)	(0.13)	(0.41)
∇Post-90	-5.26	-6.29	0.03	-0.30	1.93
	(1.18)	(0.98)	(0.04)	(0.18)	(0.59)

Table 6: Averages Estimated Prices of Risk

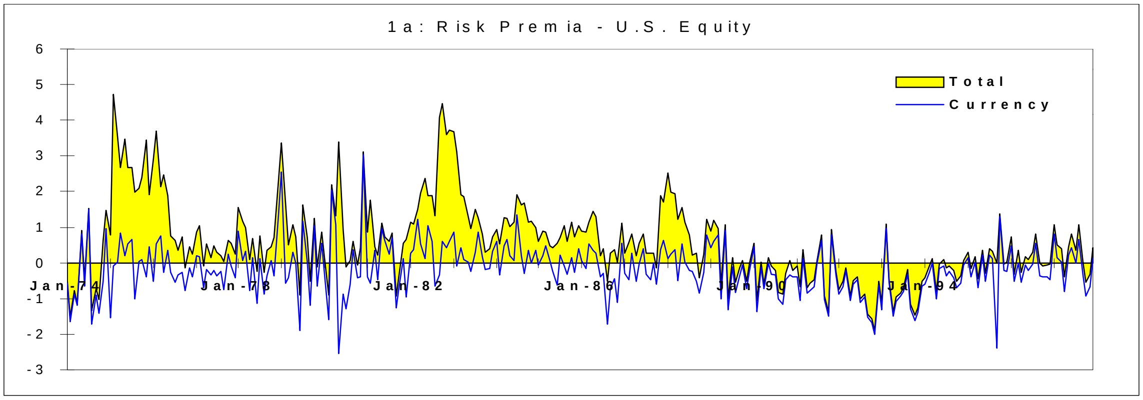
The table contains the average and standard errors of the prices of risk estimated from the model with time varying risk as well as the parameter estimates from the regressions of these estimated prices on a constant and a dummy variable for the post June 1990 period ($D_t = 1$, if t > June 1990). The price of market risk, γ, is estimated as an exponential function of a constant, the world index dividend price ratio in excess of the one-month euro-DEM rate, the change in one month euro-dollar rate and the U.S. default premium. The prices of currency risk, (δ_k, k=1,...,5;) are estimated as a linear function of the change in one monthe euro-dollar rate, the U.S. default premium, the one month change in the U.S. term premium, and the difference between the one month real rates for the local currency eurodeposits and the DEM eurodeposit. Standard errors are computed using the Newey-West heteroskedasticity and autocorrelation robust procedure.

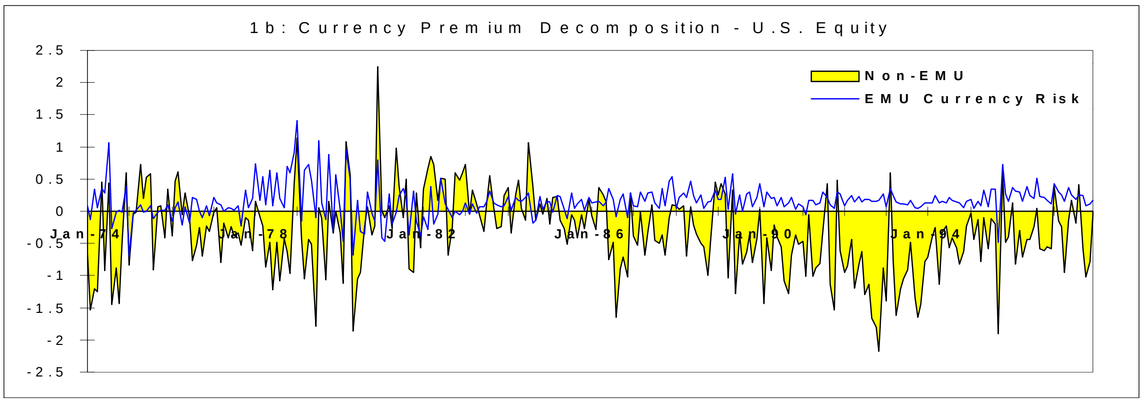
	Overall		$\delta_t = b_0 + b_1 D_{(t>6/90)} + \upsilon_t$			
Prices of	Avg.	s.e.	b_0	s.e.	b_1	s.e.
Market Risk	3.36	0.44	4.37	0.56	-3.24	0.58
Emu Curr. A Risk	10.40	0.75	8.55	0.91	5.90	1.04
Emu Curr. B Risk	5.66	0.66	4.04	0.78	5.18	0.95
British Pound Risk	0.82	0.74	-0.98	0.89	5.79	1.06
U.S. Dollar Risk	-3.17	0.52	-1.92	0.60	-4.01	0.79
Japanes Yen Risk	0.82	0.61	2.37	0.72	-4.95	0.81

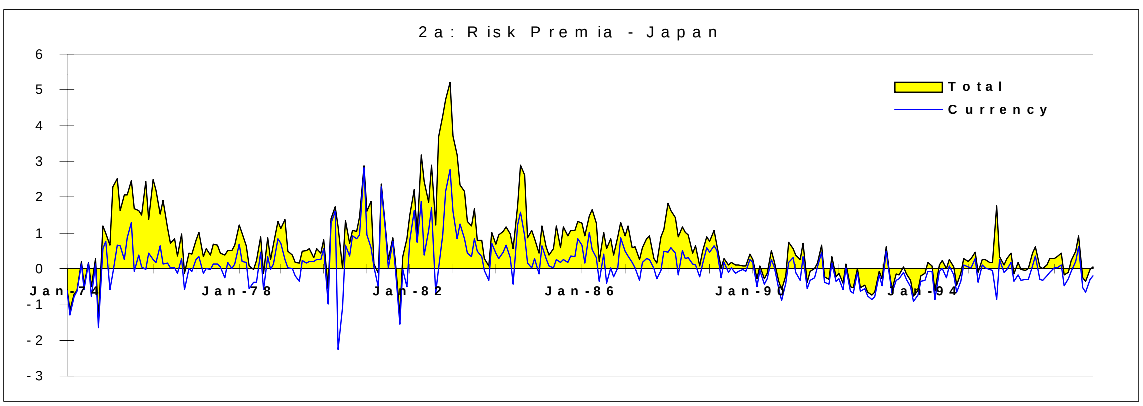
Table 7: Average Exposure to Currency Risk.

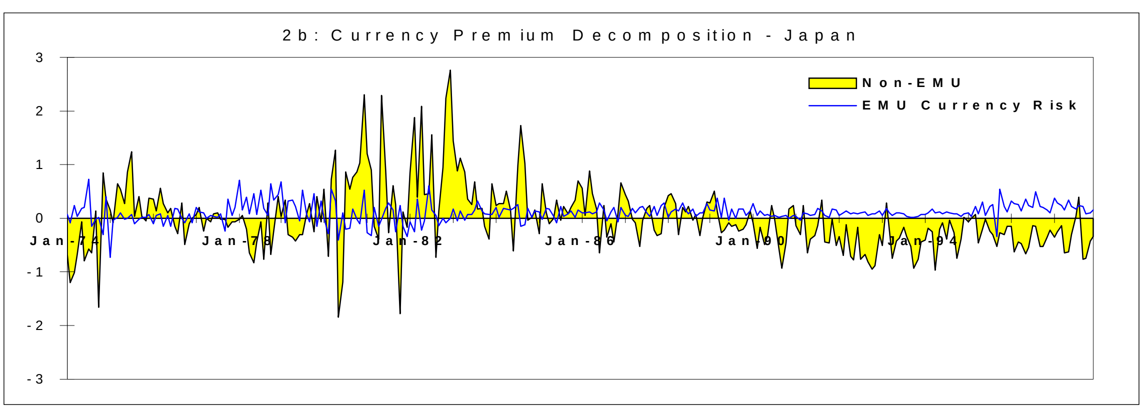
The table reports the average and standard errors of the estimated conditional covariances of the equity indices with different sources of currency risk for the overall sample period, the subperiod prior to June 30 1990, as well as the mean difference between periods before and after June 1990. The pre-1990 average estimated covariances and the change in covariances are estimated by regressing the estimated covariances on a constant and a dummy variable for the post June 1990 period (D_t = 1, if t > June 1990). EWEMU is the equally weighted portfolio of all the EMU countries equity indices (Germany, France, Italy, Spain, Austria, Belgium and Netherlands). EQNEMU is the equally weighted portfolio of all the non-EMU countries equity indices (Japan, U.S. and U.K.). Standard errors are computed using the Newey-West heteroskedasticity and autocorrelation robust procedure. All estimates are reported in percent per month squared.

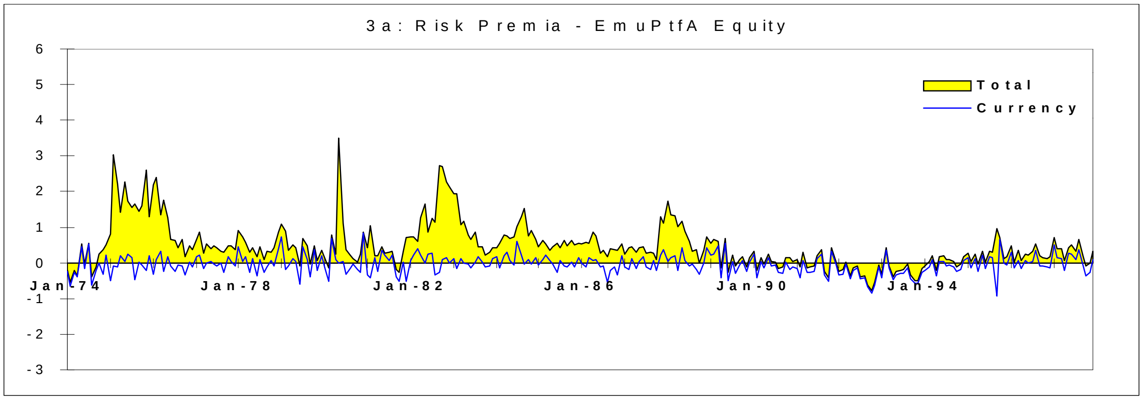
	U.S.	Jap.	EqPA	EqPB	Ger.	U.K.	Wrld	EWEMU	EWNEMU
Euro-$ Exposure									
Overall	11.50	4.15	4.17	4.84	1.97	6.18	7.85	3.66	7.27
	(0.32)	(0.16)	(0.18)	(0.15)	(0.19)	(0.23)	(0.20)	(0.16)	(0.20)
Pre-90	11.43	3.96	3.92	4.53	1.67	6.13	7.70	3.37	7.17
	(0.45)	(0.21)	(0.23)	(0.18)	(0.23)	(0.32)	(0.27)	(0.19)	(0.27)
∇Post-90	0.23	0.60	0.83	0.99	0.94	0.13	0.46	0.92	0.32
	(0.55)	(0.26)	(0.29)	(0.26)	(0.36)	(0.40)	(0.34)	(0.27)	(0.33)
EMU-currencies Portfolio A (As+Bl+Nl) Exposure									
Overall	0.34	0.37	0.29	0.34	-0.20	0.95	0.38	0.15	0.56
	(0.05)	(0.05)	(0.03)	(0.04)	(0.04)	(0.12)	(0.04)	(0.03)	(0.06)
Pre-90	0.43	0.50	0.37	0.41	-0.25	1.24	0.48	0.17	0.72
	(0.06)	(0.06)	(0.04)	(0.06)	(0.05)	(0.15)	(0.05)	(0.04)	(0.07)
∇Post-90	-0.28	-0.41	-0.22	-0.23	0.16	-0.92	-0.32	-0.09	-0.54
	(0.06)	(0.07)	(0.04)	(0.06)	(0.06)	(0.15)	(0.06)	(0.04)	(0.07)
EMU-currencies Portfolio B (Fr+It+Sp) Exposure									
Overall	2.12	1.56	0.85	2.91	0.24	2.98	1.89	1.33	2.12
	(0.14)	(0.09)	(0.06)	(0.19)	(0.07)	(0.19)	(0.10)	(0.08)	(0.13)
Pre-90	2.35	1.75	0.85	3.21	0.11	3.07	2.07	1.39	2.39
	(0.18)	(0.09)	(0.06)	(0.26)	(0.09)	(0.25)	(0.13)	(0.11)	(0.16)
∇Post-90	-0.72	-0.59	-0.00	-0.95	0.40	-1.21	-0.59	-0.18	-0.84
	(0.21)	(0.17)	(0.10)	(0.28)	(0.11)	(0.26)	(0.16)	(0.13)	(0.19)

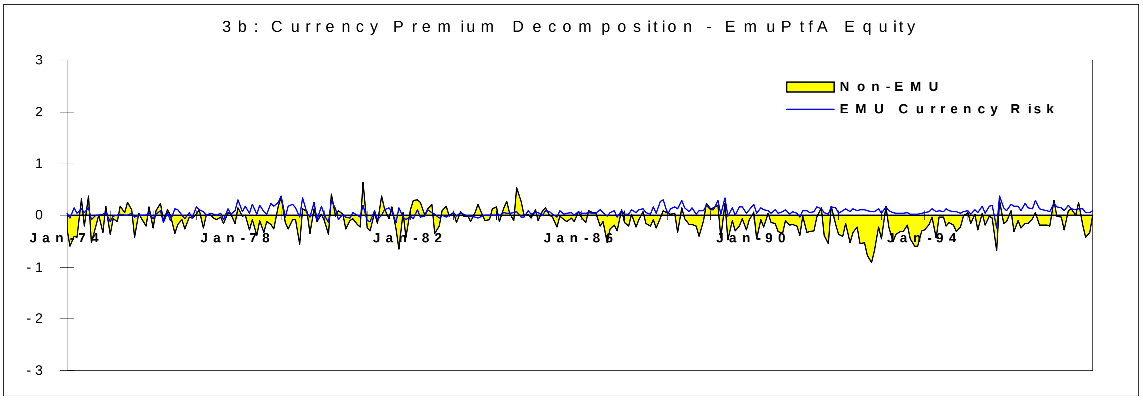

1a: Risk Premia - U.S. Equity
Total
Currency
6
5
4
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

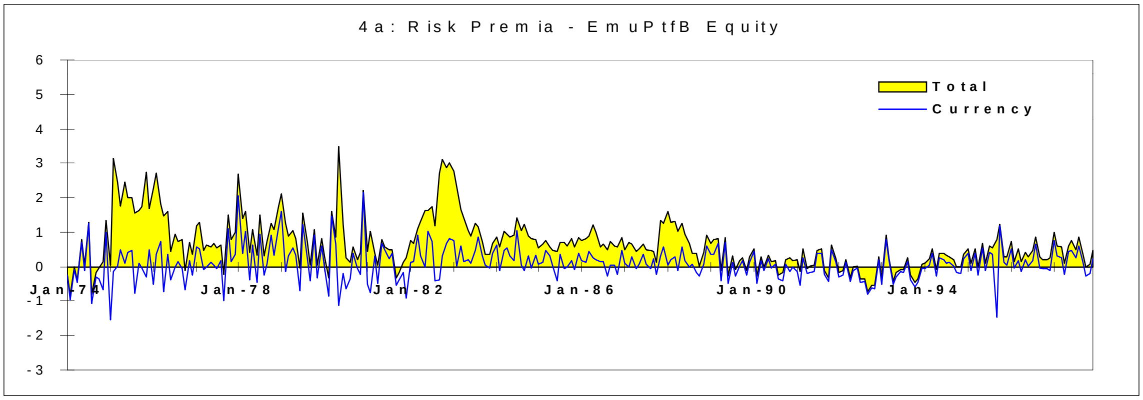

1b: Currency Premium Decomposition - U.S. Equity
Non-EMU
EMU Currency Risk
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

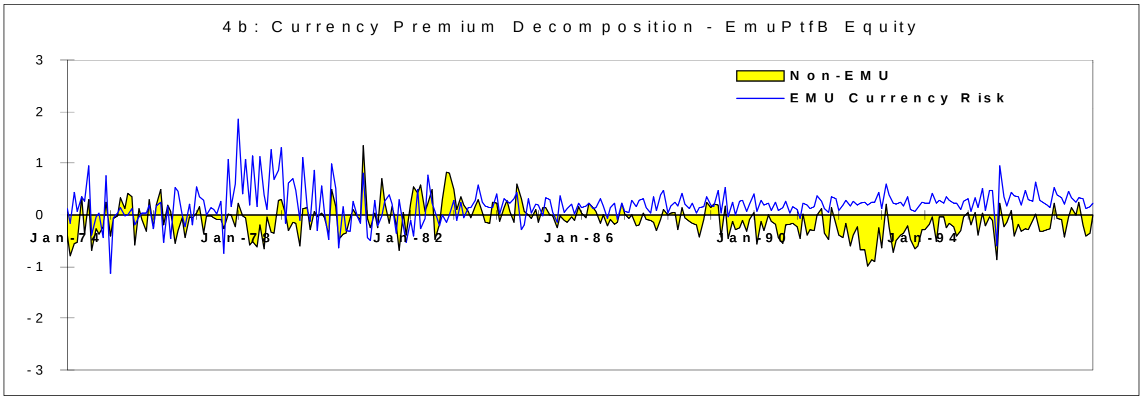

2a: Risk Premia - Japan
Total
Currency
6
5
4
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

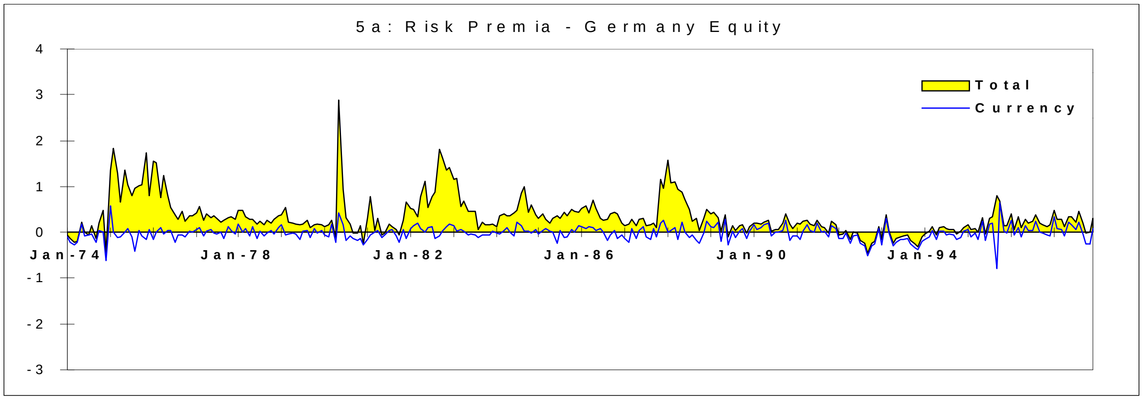

2b: Currency Premium Decomposition - Japan
Non-EMU
EMU Currency Risk
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

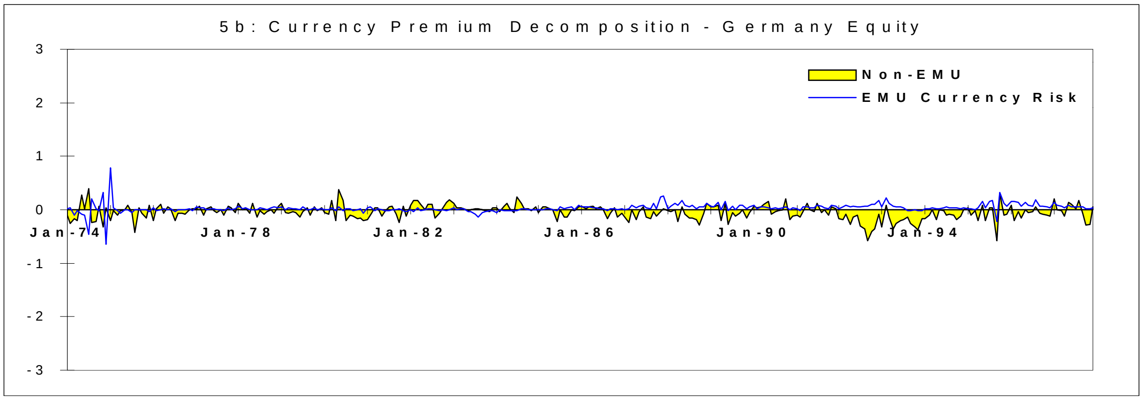

3a: Risk Premia - EmuPtfA Equity
Total
Currency
6
5
4
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

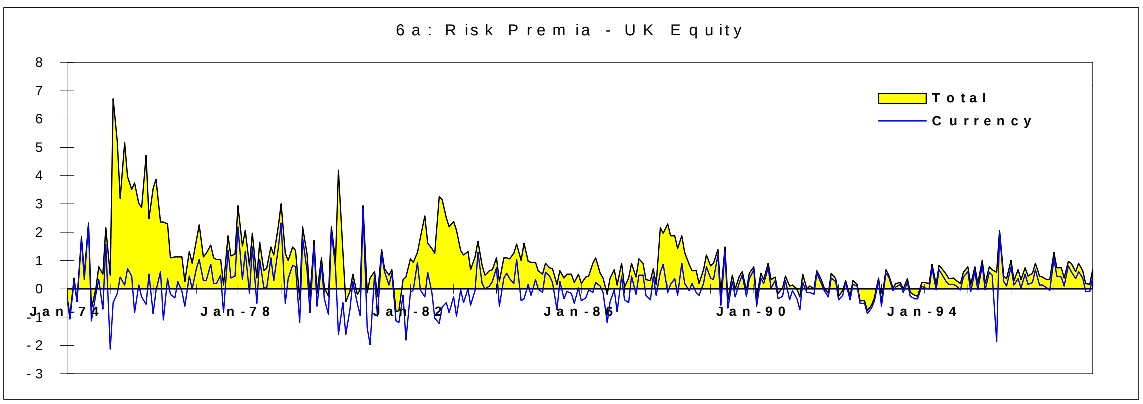

3b: Currency Premium Decomposition - EmuPtfA Equity
Non-EMU
EMU Currency Risk
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

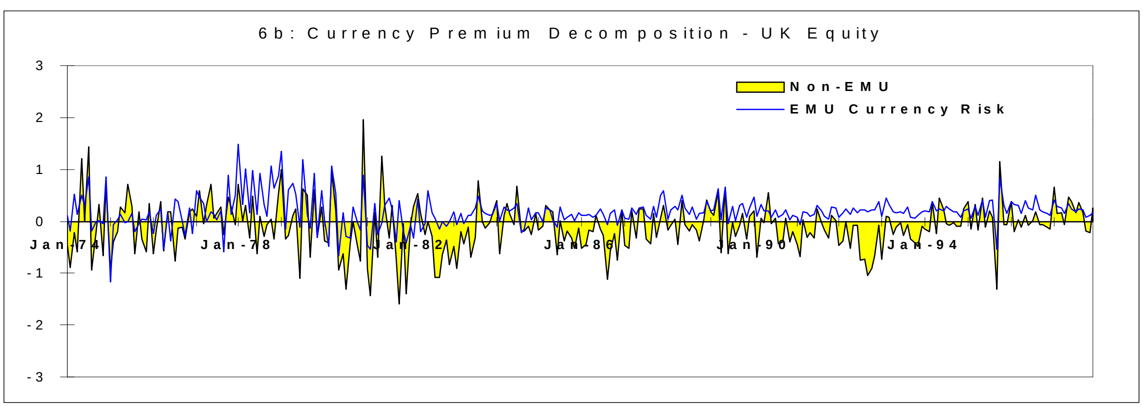

4a: Risk Premia - EmuPtfB Equity
Total
Currency
6
5
4
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

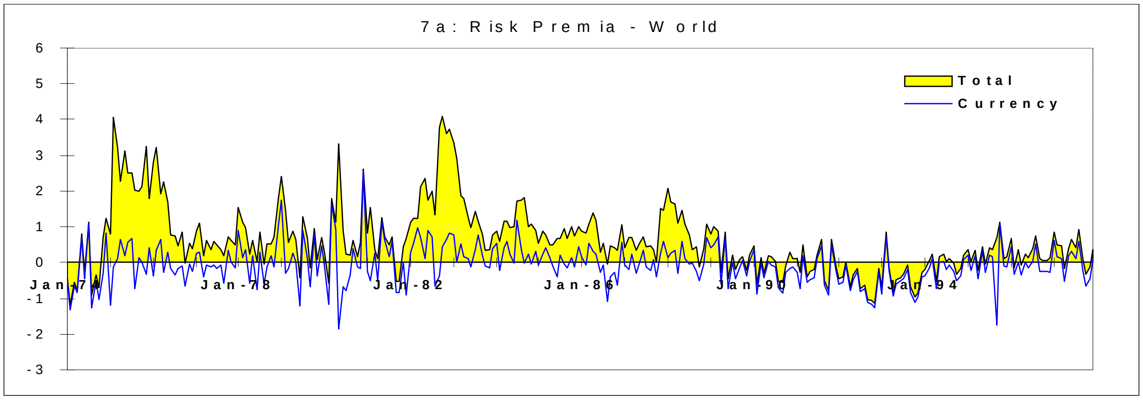

4b: Currency Premium Decomposition - EmuPtfB Equity
Non-EMU
EMU Currency Risk
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

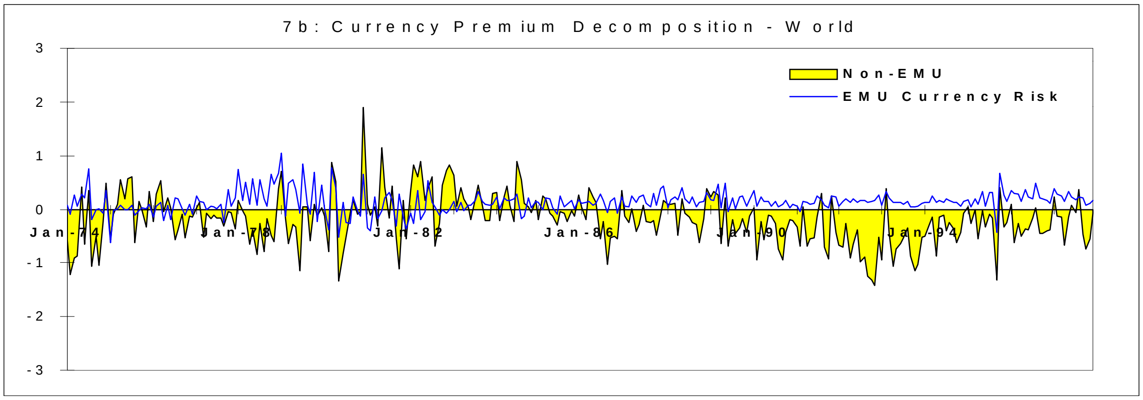

5a: Risk Premia - Germany Equity
Total
Currency
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

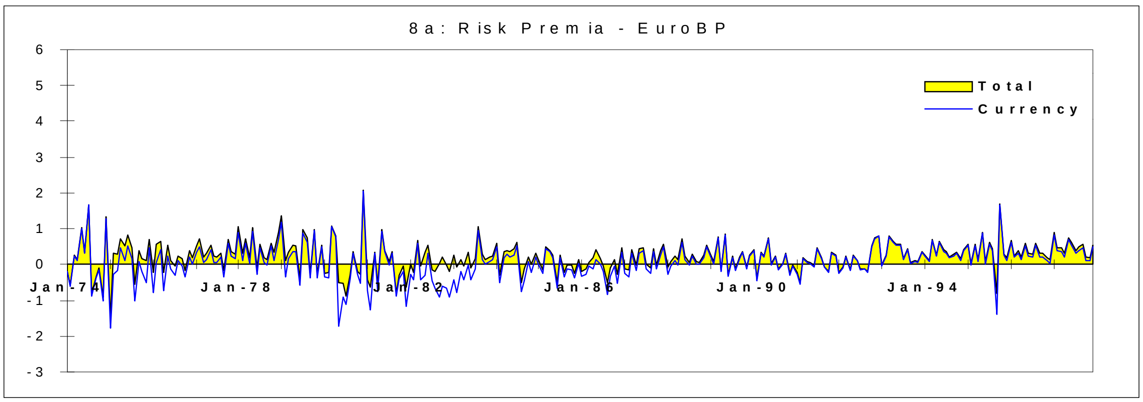

5b: Currency Premium Decomposition - Germany Equity
Non-EMU
EMU Currency Risk
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

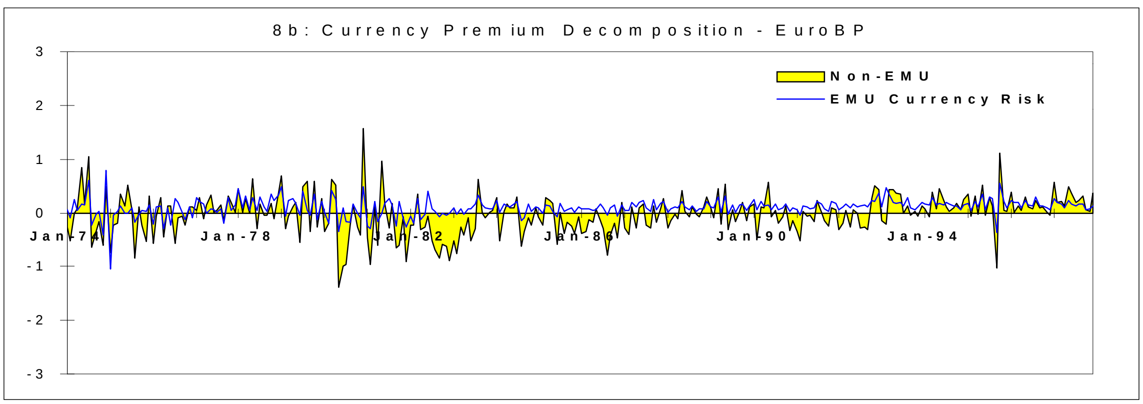

6a: Risk Premia - UK Equity
Total
Currency
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

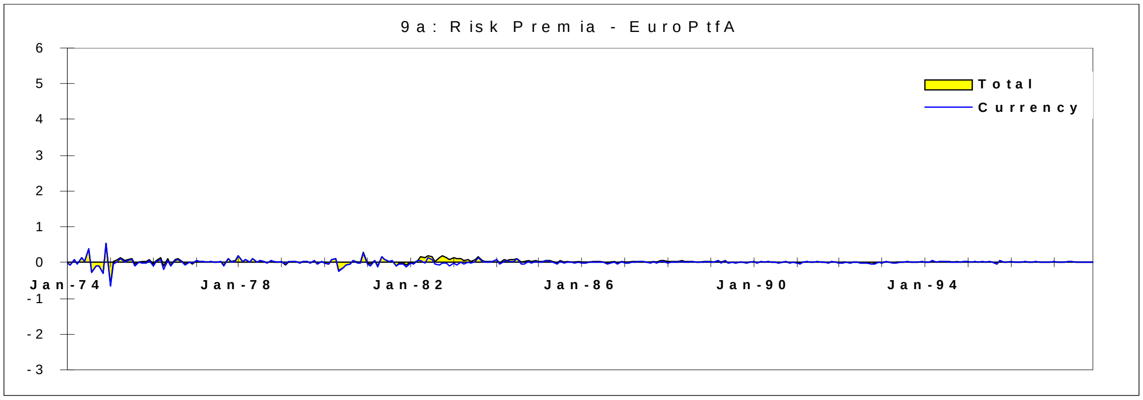

6b: Currency Premium Decomposition - UK Equity
Non-EMU
EMU Currency Risk
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

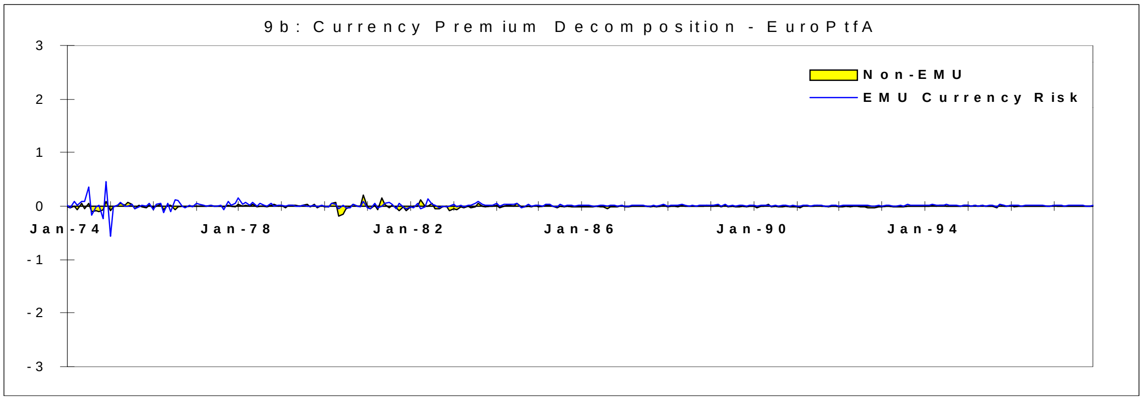

7a: Risk Premia - World
Total
Currency
6
5
4
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

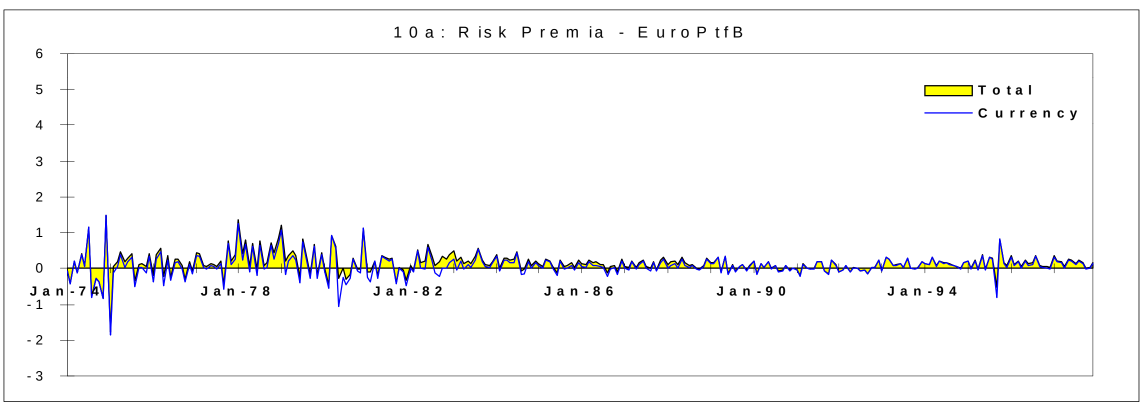

7b: Currency Premium Decomposition - World
Non-EMU
EMU Currency Risk
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

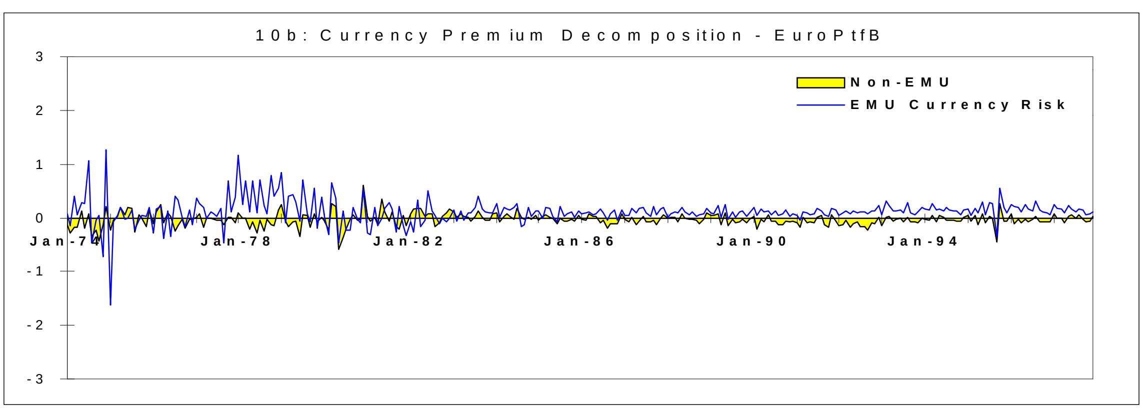

8a: Risk Premia - EuroBP
Total
Currency
6
5
4
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

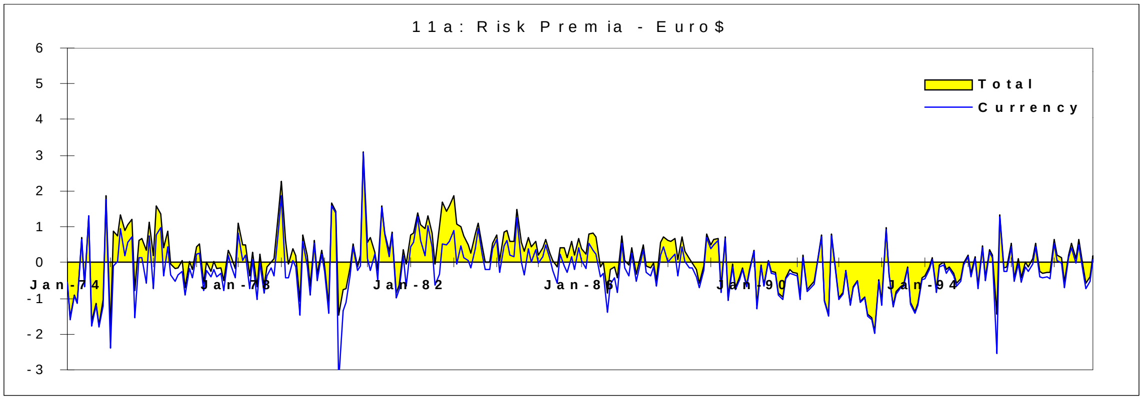

8b: Currency Premium Decomposition - EuroBP
Non-EMU
EMU Currency Risk
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

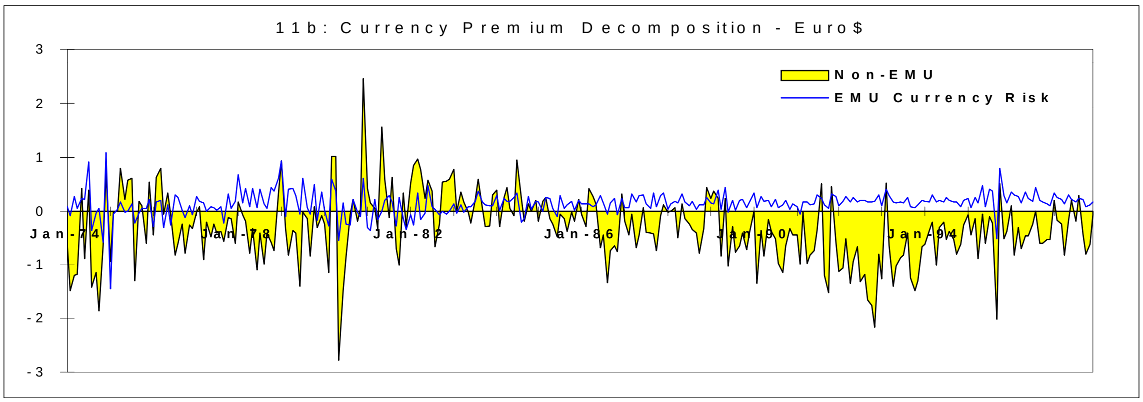

9a: Risk Premia - EuroPtfA
Total
Currency
6
5
4
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

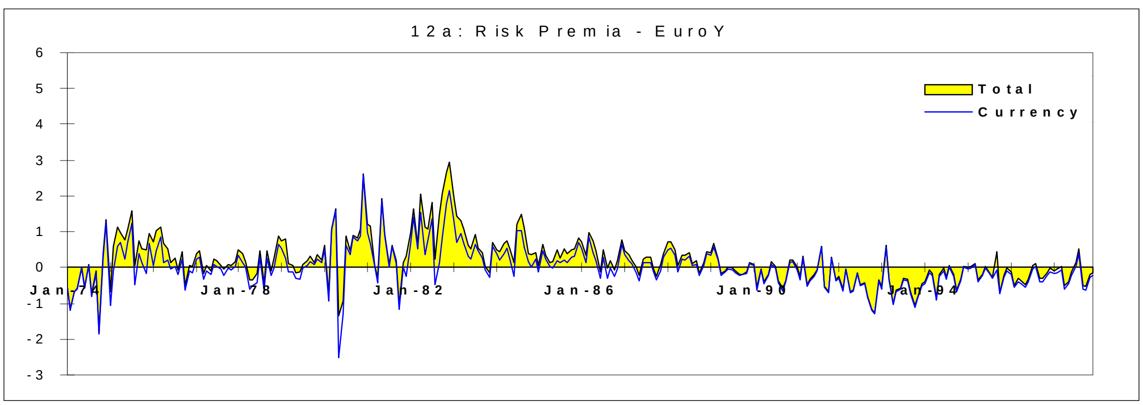

9b: Currency Premium Decomposition - EuroPtfA
Non-EMU
EMU Currency Risk
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

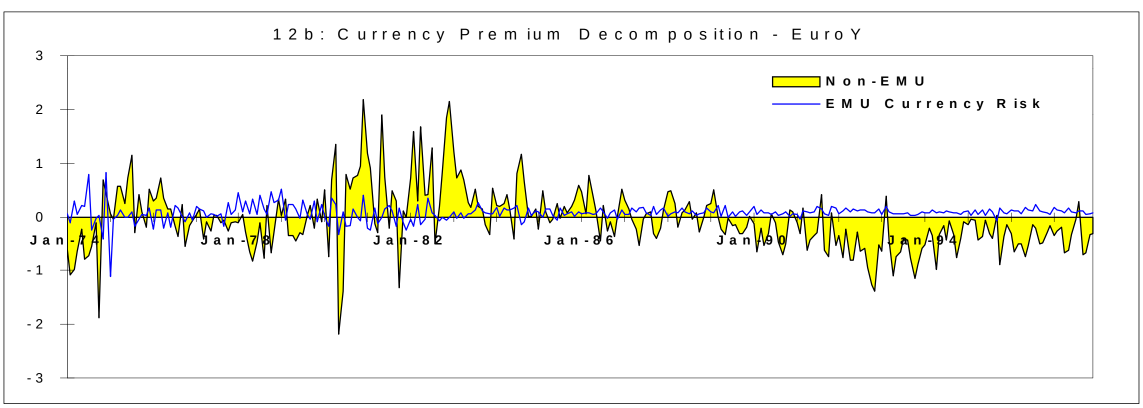

10a: Risk Premia - EuroPtfB
Total
Currency
6
5
4
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94


10b: Currency Premium Decomposition - EuroPtfB
Non-EMU
EMU Currency Risk
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94


11a: Risk Premia - Euro$
Total
Currency
6
5
4
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94


11b: Currency Premium Decomposition - Euro$
Non-EMU
EMU Currency Risk
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94


12a: Risk Premia - EuroY
Total
Currency
6
5
4
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94


12b: Currency Premium Decomposition - EuroY
Non-EMU
EMU Currency Risk
3
2
1
0
-1
-2
-3
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94

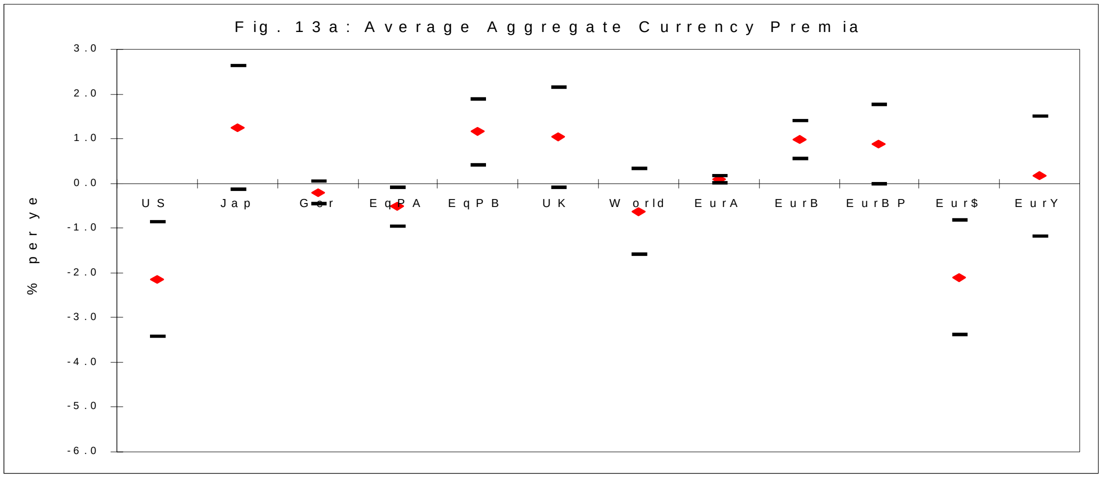


Fig. 13a: Average Aggregate Currency Premia
% per ye
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
US
Jap
Ger
EqPA
EqPB
UK
World
EurA
EurB
EurBP
Eur$
EurY

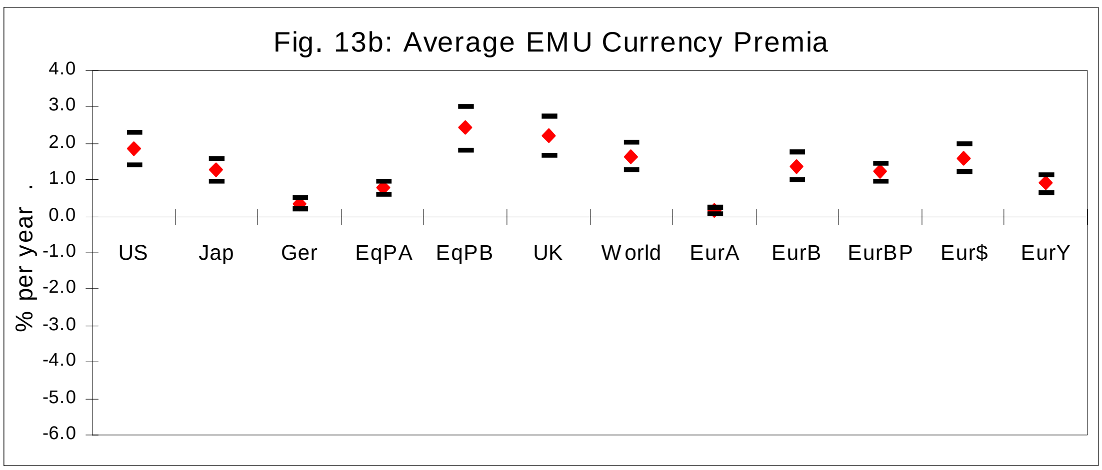


Fig. 13b: Average EMU Currency Premia
% per year
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
US
Jap
Ger
EqPA
EqPB
UK
World
EurA
EurB
EurBP
Eur$
EurY

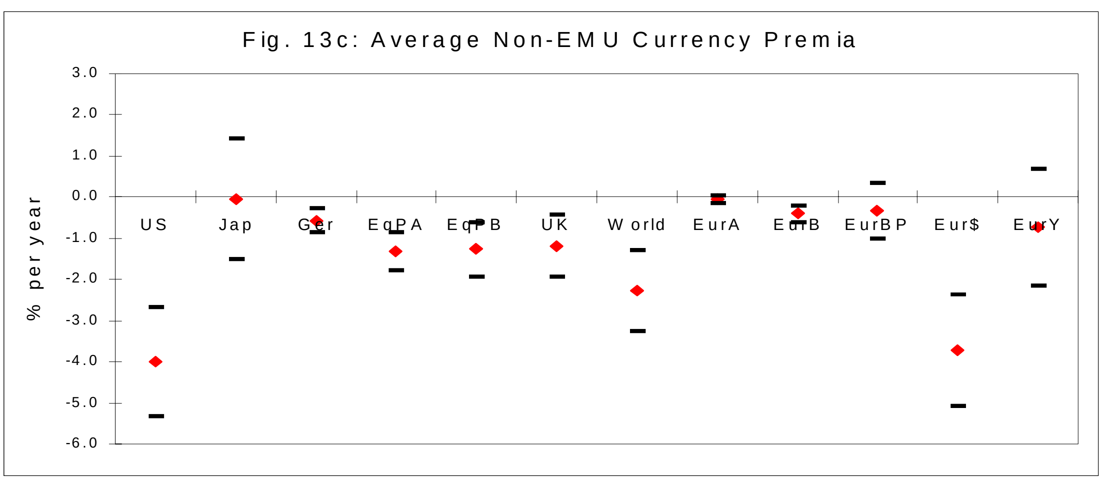


Fig. 13c: Average Non-EMU Currency Premia
% per year
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
US
Jap
Ger
EqPA
EqPB
UK
World
EurA
EurB
EurBP
Eur$
EurY

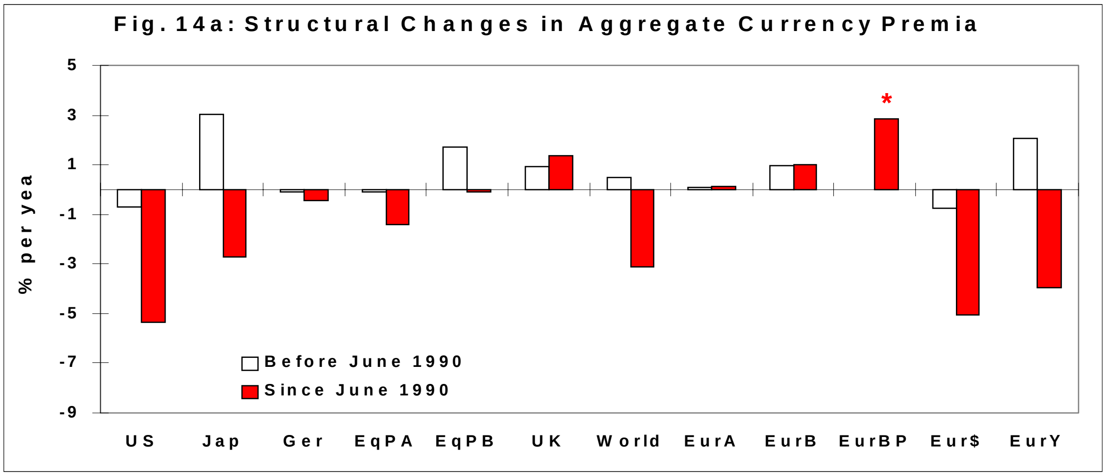


Fig. 14a: Structural Changes in Aggregate Currency Premia
% per yea
5
3
1
-1
-3
-5
-7
-9
*
Before June 1990
Since June 1990
US
Jap
Ger
EqPA
EqPB
UK
World
EurA
EurB
EurBP
Eur$
EurY

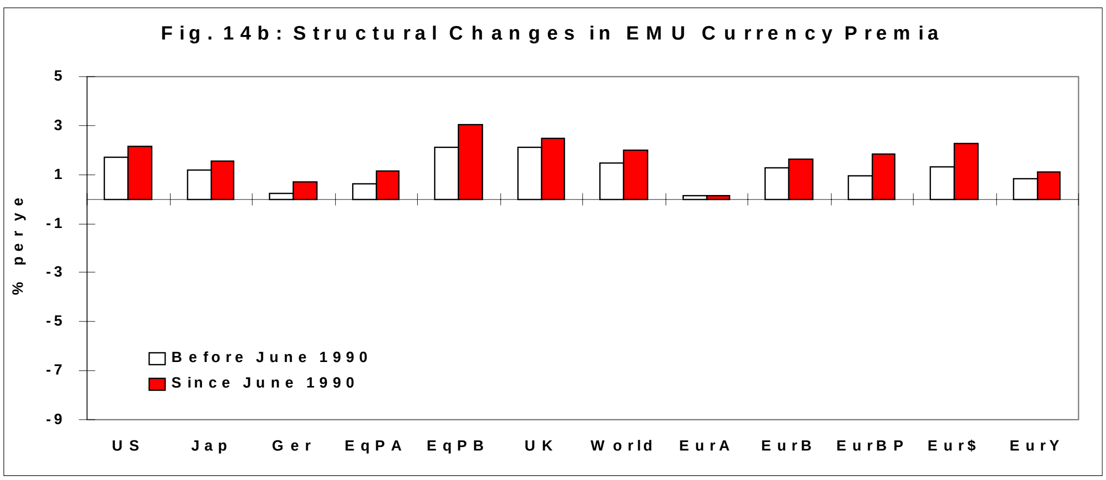


Fig. 14b: Structural Changes in EMU Currency Premia
% per ye
5
3
1
-1
-3
-5
-7
-9
Before June 1990
Since June 1990
US
Jap
Ger
EqPA
EqPB
UK
World
EurA
EurB
EurBP
Eur$
EurY

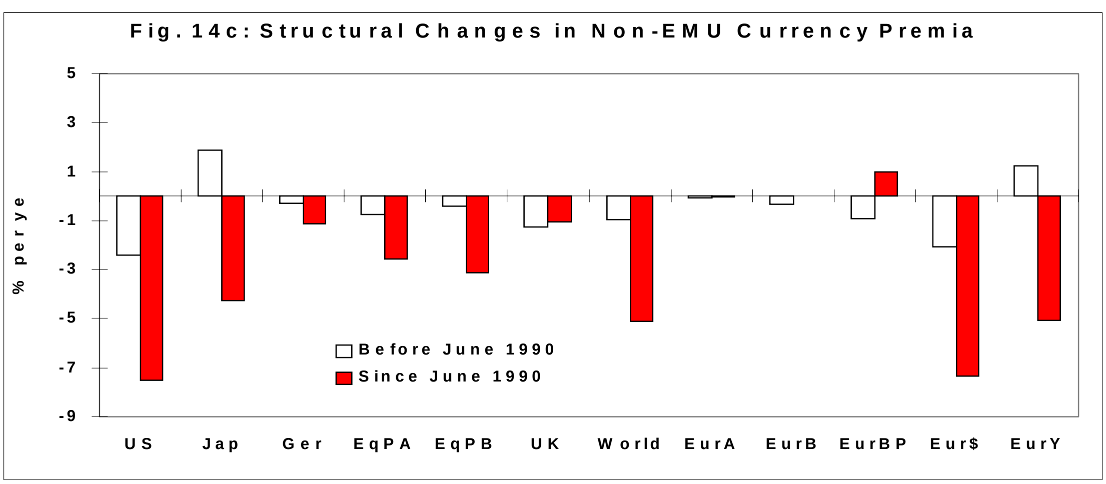


Fig. 14c: Structural Changes in Non-EMU Currency Premia
% per ye
5
3
1
-1
-3
-5
-7
-9
Before June 1990
Since June 1990
US
Jap
Ger
EqPA
EqPB
UK
World
EurA
EurB
EurBP
Eur$
EurY

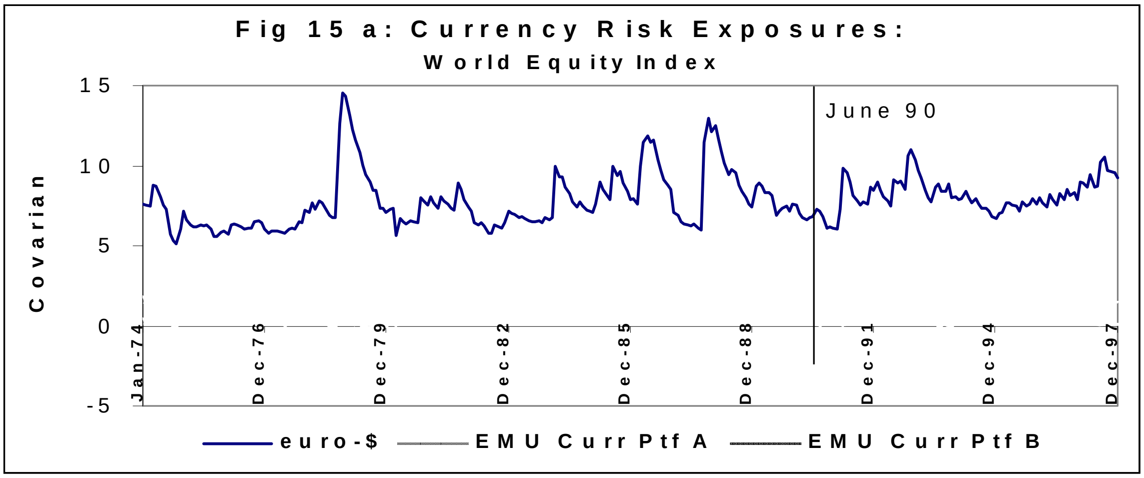


Fig 15 a: Currency Risk Exposures:
World Equity Index
Covarian
15
10
5
0
-5
June 90
Jan-74
Dec-76
Dec-79
Dec-82
Dec-85
Dec-88
Dec-91
Dec-94
Dec-97
euro-$
EMU Curr Ptf A
EMU Curr Ptf B

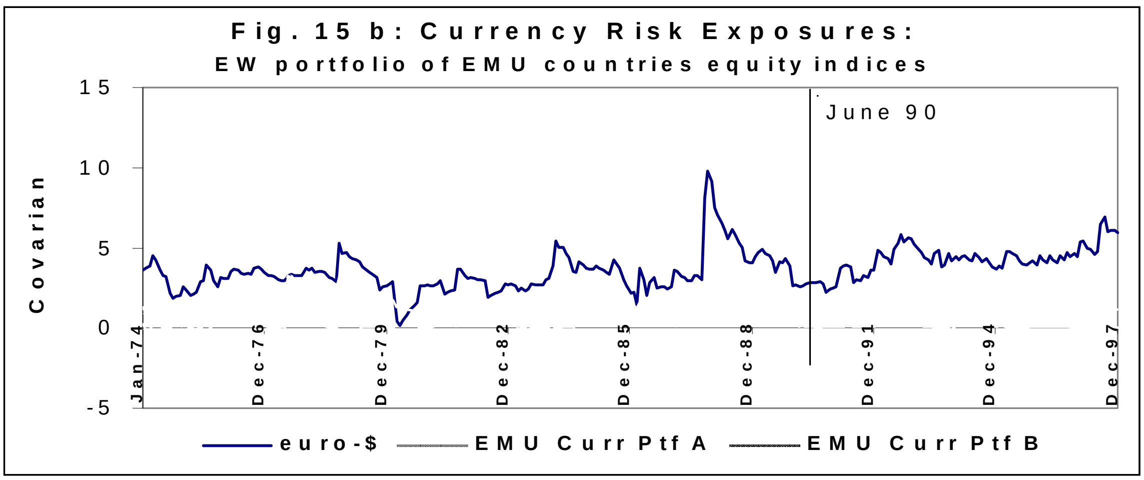


Fig. 15 b: Currency Risk Exposures:
EW portfolio of EMU countries equity indices
Covarian
15
10
5
0
-5
June 90
Jan-74
Dec-76
Dec-79
Dec-82
Dec-85
Dec-88
Dec-91
Dec-94
Dec-97
euro-$
EMU Curr Ptf A
EMU Curr Ptf B

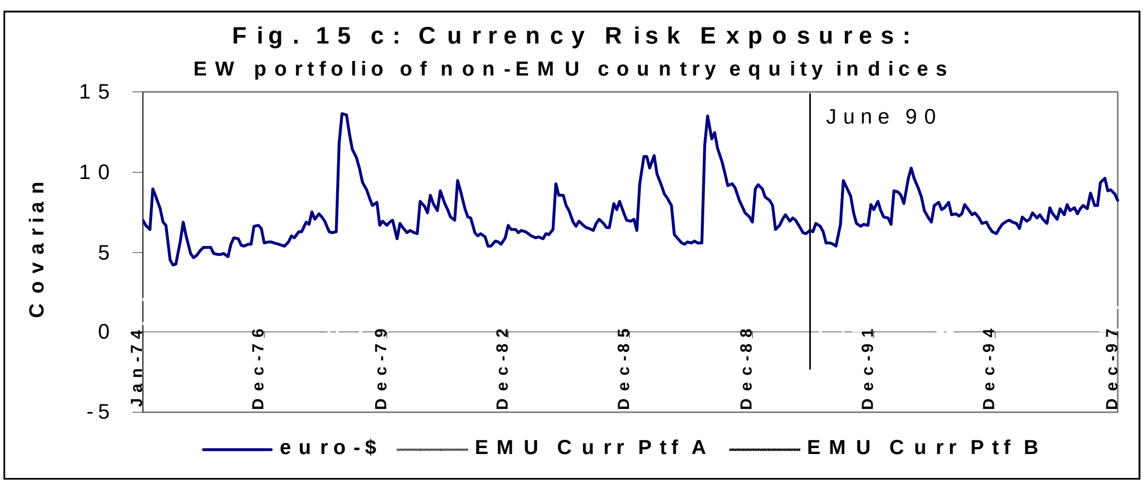


Fig. 15 c: Currency Risk Exposures:
EW portfolio of non-EMU country equity indices
Covarian
15
10
5
0
-5
June 90
Jan-74
Dec-76
Dec-79
Dec-82
Dec-85
Dec-88
Dec-91
Dec-94
Dec-97
euro-$
EMU Curr Ptf A
EMU Curr Ptf B