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Currency Risk Premiums in CEE Emerging Stock Markets

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Abstract

The paper addressees the issue of pricing currency risk as well as the importance of the size of the risk premium. We test the conditional version of an International Capital Asset Pricing Model using a multivariate GARCH process, taking the perspective of a E uropean investor. We conduct the analysis for three cases corresponding to three CEE emerging markets. We have chosen to analyze this group of countries due to the fact that we found many studies focusing on developed countries but much less evidence on emerging markets. Furthermore emerging countries have recently gone through a process of financial liberalization, especially in what concerns the foreign exchange market. Our findings show that the currency risk premiums for all the analysed emerging markets are statistically significant. Thus, the exchange rate risk premium represents a significant part of the total risk premium, the European investor demanding a reward for bearing the risk when investing in most of these markets.

1. Introduction

The increased opportunities of high returns and the distinct attributes of emerging markets did not escape for long the attention of both investors and researchers. The liberalization process of these markets together with the removal of control barriers over capital inflows led to a significant increase in foreign portfolio investments. In addition, the relationship between macroeconomic variables and stock prices has been of high interest for researchers in order to determine whether the financial markets are integrated or to evaluate what drives the returns on developed or emerging markets.

As correlations among international financial markets are usually lower than correlations among domestic assets, investors can earn significant benefits from international portfolio diversification. However, an internationally diversified portfolio is exposed to foreign exchange risk, which is one of the most important dimensions of foreign investments and international asset pricing. The existence of currency risk is one of the major issues facing international investors because exchange rate volatility may reduce the benefits of international diversification. This source of risk can play a very important role especially in small or emerging markets as their exchange rate mechanism often differs from that of developed markets.

Generally, an investment can be defined as a current commitment of money and other resources in the expectation of reaping future benefits. From a financial point of view, an investment is the commitment of funds by buying securities or other monetary or paper (financial) assets in the money markets or capital markets, or in fairly liquid real assets, such as gold or collectibles. Types of financial investments include shares, other equity investment and bonds (including bonds denominated in foreign currencies). These financial assets are then expected to provide income or positive future cash flows, and may increase or decrease in value yielding the investor capital gains or losses. These types of investments can be made in local or foreign assets, in this last case the total risk being compounded of the risk of the investment and the risk of the foreign currency. The risk of the investment represents the potential that the chosen action or activity (including the choice of inaction) will lead to a loss (an undesirable outcome). Therefore, the total risk in an international investment includes credit risk, liquidity risk, operational risk and market risk. The credit risk is also called default risk and occurs if the firm goes into default. The liquidity risk refers to the fact that the asset cannot be sold due to lack of liquidity in the market, leading to losses for the investor. An operational risk is, as the name suggests, a risk arising from execution of a company's business functions. It is a very broad concept which focuses on the risks arising from the people, systems and processes through which a company operates. It also includes other categories such as fraud risks, legal risks, physical or environmental risks.

Market risk is the risk that the value of a portfolio, either an investment portfolio or a trading portfolio, will decrease due to the change in value of the market risk factors. The four standard market risk factors are stock prices, interest rates, foreign exchange rates, and commodity prices and the associated market risks are:

- Equity risk, which is the risk that one's investment will depreciate because of stock market dynamics (the stock prices or the implied volatility will change)
- Interest rate risk, which is the risk that the interest rates or the implied volatility will change.
- Currency risk, which is the risk that foreign exchange rates or the implied volatility will change.
- Commodity risk, which is the risk that commodity prices or the implied volatility will change.

Generally, currency risk can be defined as the risk that arises from the change in price of one currency against another and it is considered a key element in foreign investments. This risk flows from differential monetary policy and growth in real productivity, which results in differential inflation rates. For example if an U.S. investor owns stocks in Hungary, the return he will realize is affected by both the change in the price of the stocks and the change of the Hungarian forint against the U.S. dollar. If he realized a return in the stocks of 10% but the Hungarian forint depreciated 10.5% against the U.S. dollar, he would make a small loss. Therefore, in order to compensate for this additional risk, the investor requires a risk premium which is the return in excess of the risk-free rate of return that an investment is expected to yield.

This foreign exchange risk premium has been investigated by researchers in a wide variety of frameworks. The difficulty in modelling this premium arises from a characteristic of international currency markets: the fact that the domestic currency tends to appreciate when domestic interest rates tend to exceed foreign rates (Hodrick, 1987). The mentioned deviations from the uncovered interest parity relationship are often interpreted as a risk premium from investing in a foreign currency by a rational and risk-averse investor. Apart from the negative correlation with the subsequent depreciation of the foreign currency, another well-documented property of these deviations includes extremely high volatility (Fama, 1984). Another paper that uses a GARCH in mean framework in order to determine time series properties of foreign exchange risk premium is conducted by Engle (1996). His study succeeded better in capturing empirical regularities observed in the excess return series but it is difficult to interpret the predictable components of the excess return as a measure of the risk premium. Poghosyan and Kocenda (2007) investigate macroeconomic sources of foreign exchange risk in new E.U. members, namely the Czeck Republic, Hungary, Poland and Slovakia by using the stochastic discount factor approach and a multivariate GARCH-in mean model. Their findings suggest that in these economies, real factors play a small role in determining foreign exchange risk, which contradicts the evidence coming from more developed countries, while nominal and monetary factors have a higher impact. Thus, the monetary policy adopted by these countries has an important effect on the evolution of the exchange rates and investors use this information in pricing.

The question we want to address in our study is whether there is a relationship between stock prices and exchange rates. This fact raises the issue of pricing currency risk and the importance of the size of the risk premium. In fact, an investment in a foreign asset is a combination of an investment in the performance of the foreign asset and an investment in the performance of the domestic currency relative to the foreign currency. Therefore, it is important to determine whether the currency risk is priced in international capital markets and the size of this risk premium, the compensation demanded by investors for bearing such risk. Moreover, if the exchange rate risk associated with a certain currency is fully diversifiable, then it does not command any risk premium but if this risk cannot be easily hedged, the investors should demand a risk premium.

We analyse this problem within the framework of the International Asset Pricing model developed by Solnik (1974i) and Adler and Dumas (1983). The paper relies methodologically and empirically on the work of De Santis and Gerard (1997) and De Santis and Gerard (1998). We use the conditional version of the International Asset Pricing model to assess the premiums associated with the international investments, from the perspective of a European investor (who has the Euro as a domestic currency). In particular, the ICAPM was estimated in three cases, each of them including the equity portfolios of one of the three emerging markets (Poland, Hungary and the Czech Republic), of the European Monetary Union, Japan, US, UK, the one month Eurodeposits for the Japanese Yen, the US Dollar, the UK Pound and for the currencies of the CEE countries (the Polish Zloty, the Hungarian Forint and respectively the Czech Koruna) and also the World portfolio.

We find that the currency risk premiums for all the analysed emerging markets are statistically significant, even when we don't allow for time variation of their prices. In two of the cases, namely for the Polish and the Hungarian market we find that the currency risk premium is positive, which implies that the European investor demands a currency risk premium for bearing the exchange rate volatility. The currency risk premium for the Hungarian market is slightly higher than the one found on the Polish market. On the other hand the risk premium for the US and Japanese markets is negative, which means that the European investor is willing to sacrifice part of his total risk premium in order to diversify on these developed markets. When we do not allow time variation in the price of market risk we find that the investors are not rewarded for bearing this risk in the case of Hungary. Thus, for this market we also test the model allowing the time variation of the price of the market risk.

The rest of the paper is organised as follows. Section II states the economic problem and its implications. Subsequently, Section III presents the International Asset Pricing model and the theoretical background. Section IV outlines the research methodology, while Section V describes the necessary data for the study. In section VI we analyze the empirical evidence while Section VII concludes the paper.

2. Economic Problem and Research Question

Emerging markets have drawn the attention of both investors and researchers given their increased opportunities of high returns and distinct characteristics. If investors' interest is mainly fuelled by the benefits that may be obtained from portfolio diversification in emerging markets, researchers have particularly studied their characteristics and the process of financial markets development in these countries. Although the emerging capital markets in Central and Eastern Europe (CEE) are more recent in the field of international investments, compared to Latin American or Asian countries, their accession to the European Union has spurred researchers' interest in investigating the diversification potential offered by these markets, the risk factors that affect the returns an also the degree of financial integration of CEE markets with the developed markets and other emerging markets. In terms of financial integration, exchange rates also play an important role, as their unpredictability and high volatility may be a sign of rather high market segmentation (Fratzescher, 2001). Also the high volatility translates into significant costs of hedging and implicitly higher risk premiums. For investors that place their money in developed markets, situations when they confront themselves with high losses due to exchange rates are rather seldom. In contrast, gains obtained by investors on emerging markets can be easily transformed into important losses when these markets face dramatic drops of exchange rates. The worst situations arise when both asset prices and exchange rates depreciate concomitantly. To cover currency risk investors may demand a premium, yet the existence and the size of this premium, is still subject of research.

In our paper we aim to study the relationship between stock prices and foreign exchange rates on the Central and Eastern European countries, namely The Czech Republic, Hungary and Poland. We have chosen to analyze this group of countries due to the fact that we found many studies focusing on developed countries but much less evidence on emerging markets. Furthermore emerging countries have recently gone through a process of financial liberalization, especially in what concerns the foreign exchange market. Moreover, these countries are interesting because their currencies (the Czech crown, the Hungarian forint and the Polish zloty) are more volatile especially compared to the currencies of developed countries. Therefore, the currency risk is relatively higher than in the case of developed countries and as a result investors should demand a higher risk premium. In addition we have chosen these three countries out of the group of Central and Eastern European markets as they are the most important in terms of stock market development and market capitalisation. More precisely, the Polish stock market represents 2.13% of the total European stock markets capitalisation, while the Czech market represents 0.51% and the Hungarian market 0.32%[1].

In our paper we take the perspective of a European investor and we seek to determine whether the global market risk is priced and we intend to explore whether currency risk is priced. By this mean we can further determine whether a European investor demands a risk premium when investing outside the Euro area. For this purpose we test four hypotheses. First we assume that none of the currency risk factors are priced, namely that $\delta_c = 0$, where c takes values from 1 to 4 (for each currency). This hypothesis implies that investors demand no risk premium for bearing the currency risk. The second hypothesis tests whether the prices of currency risk are constant while the third hypothesis is based on the assumption that the price of market risk is constant. Finally, we determine whether the price of the global market risk is time varying while the price of the currency risk stays constant. The above hypotheses are tested for each of the three cases, in which a European investor chooses in turn one of the emerging markets (Poland, The Czech Republic and Hungary).

3. Literature Review

The relationship between foreign exchange markets and asset pricing as well as the size of the exchange rate premium has drawn the attention of many researchers. However, most early studies on portfolio diversification have focused on the benefits of low return correlations (Solnik 1974i, ii, French and Poterba 1991) rather than on the role of foreign exchange risk. Solnik (1974i) tests several stochastic price processes in order to determine the international market structure of asset prices as a single world index model would not give a realistic description of the international structure because of the importance of national factors. So, his study uses a multi-index specification, taking into account both national and

[1] Federation of European Securities Exchanges, European Securities Exchange Statistics, June 2011, available at: www.fese.be

international factors. The results show that stock prices are strongly affected by domestic factors but also by international events both indirectly (by the foreign influence on the domestic market) and selectively among stocks (some stocks may be more sensitive to international factors due to the import-export patterns, their multinational characteristics, foreign competition). Therefore, securities are priced according to their international systematic risk but have also a large dependence on national factors. So, the domestic β of a security cannot be taken as a true measure of risk, the true systematic risk being much smaller.

Moreover, Solnik (1974ii) shows that the substantial risk reductions can be attained through portfolio diversification in foreign securities as well as in domestic stocks. The only problem that may arise is that some countries could unexpectedly impose exchange controls or freezing investment capital.

Furthermore, French and Poterba 1991 use a simple model of investor preferences and behaviour in order to show that investors tend to invest higher proportions of their portfolios in the domestic market because they expect that domestic returns are higher than returns in other markets and that the lack of diversification appears to be the result of investor choices rather than institutional constraints.

3.1. Emerging Markets

The rapid growth of emerging capital markets has lead to a series of questions arising both from global investors as well as from the developing countries themselves. If investors are mainly preoccupied by diversification benefits, developing countries closely study the effects that international capital flows might have on local markets and economic growth. In this context, researchers have analyzed the characteristics of emerging markets for a better understanding of the role that financial markets have in promoting economic growth (Barry, Peavy, Rodriguez, 1998).

Among the first authors to notice the rather different evolution of these markets as compared to developed markets we mention: Divecha, Drach and Stefek (1992), Harvey (1995), Barry, Peavy and Rodriguez (1998) as well as Bekaert (1998). These studies have shown that emerging markets have higher volatility, low correlations with both developed markets but also with the other emerging markets and at the same time higher long term returns. However these markets are more likely to be exposed to political shocks or exchange rates devaluations. Analyzing emerging markets, researchers have noticed that models implying full market integration, which are commonly used for developed markets, are no longer suitable due to the distinct characteristics of these markets (Harvey, 1995).

Starting with the 90's, developing countries gained access to foreign capital, which lead to a rapid increase of foreign investments, especially portfolio investments, towards emerging financial markets. As a consequence, especially in Europe, the new direction of research in the field refers to the process of economic integration and the implications it has on financial market integration in the region. A number of initiatives aimed at promoting financial market integration and removing barriers from free capital movements started in the early 80s. Financial market integration is a very important factor for the development of the European financial system, as it results in economic growth and efficiency improvement, it leads to a more dynamic business environment, it increases the liquidity and profitability of trade systems and it allows a better capital allocation (McAndrews and Stefanadis, 2002).

Baele et al. (2004) review the reasons for an expected increase of financial integration in Europe. First, the introduction of the common currency, the euro, has as effects the removal of exchange rates fluctuation within the euro zone, which significantly reduces the costs of currency hedging that were a barrier for international investments. Second, the home biasness is expected to decline, along with the elimination of barriers for international diversification, which induces a more active investing behaviour of institutional and individual investors, towards holding more European diversified portfolios. Third, once the exchange rate risk is eliminated, investors will most likely pay attention to other risks, such as the liquidity or political risk, thus pressuring authorities to adopt policies that would reduce these risks as well.

3.2. CAPM vs. ICAPM

The most widely used model in pricing risky securities is the capital asset pricing model which describes the relationship between risk and expected return. This model is based on Harry Markovitz's (1952) portfolio theory and was developed by Sharpe (1964), Lintner (1965) and Mossin (1966). The assumptions behind the CAPM model are: the investors are price-takers, all investors plan for one identical holding period, they may borrow or lend any amount at a fixed risk-free rate, they trade without transaction or taxation costs, they are rational mean-variance optimizers, have homogenous expectations or beliefs. The model shows that the risk premium can be determined, taking into account the risk free rate, the systematic risk and the market premium:

$E(r_i) - r_f = \beta_i * [E(r_{m)} - r_f]$, where $E(r_i)$ is the expected return on the capital asset, r_f is the risk free interest rate β_i is the systematic risk of the capital asset, which shows the sensitivity of the expected excess asset returns to the expected excess market return $\beta_i = \frac{cov(R_i,R_m)}{var(R_m)}$, and $E(r_{m)} - r_f)$ is the market premium, the difference between the expected market rate of return and the risk-free rate of return (Bodie, Kane, Marcus, 2003).

The CAPM model however is based on the assumption that investors have homogenous expectations and access to an identical risk free rate, disregarding the existence of purchasing power risk. This determined the need to develop a model that can be used in an international framework, namely the International Capital Asset Pricing Model, as a rational investor is preoccupied by the real rate of return which is affected by e xchange rate risk. Thus in our study, we also use a conditional international capital asset pricing model, originally developed by Adler and Dumas (1983) to investigate the existence and the size of the risk premium in emerging markets. Adler and Dumas (1983) derive a mean variance international asset pricing model (IAPM) in which investors coming from several different countries have different purchasing power indices. In the national context, the capital asset pricing model involves answering the question of what return a security must bring relative to another security so that investors are willing to hold both securities in their portfolios in the proportion in which they are available. However, in an international context this question cannot be answered for each security because of the PPP deviations which lead to heterogeneous perceptions of real returns. Therefore, as Dumas and Adler (1983) point out, in an international context, we have to take as given the expected rates of return of as many securities as there are countries (L+1) and price the other securities (n= (N+1) - (L+1)) relative to these. The intuition behind the IAPM is that a security must bring a nominal return in excess of the nominal interest rate which is made up of two premiums. The first one exists even if the investor has a zero risk aversion, so it is not a r isk premium. Actually, it reflects the fact that investors construct their portfolios by taking into account expected real returns which depend on the expected value of the nominal return, the expected value of inflation and the covariance between the nominal return and the inflation rate. So, Adler and Dumas (1983) suggest calling this premium, the inflation premium. Moreover, the second one is a risk premium proportional to the covariance of the security's nominal rate with the investor's real portfolio return. In the CAPM literature, the usual measure of the risk contributed by a security to a portfolio (its marginal risk) is the covariance with the portfolio. Therefore, investors relate the required nominal yield on each asset to the real returns on their benchmark portfolio, when concerned with their purchasing powers. The price of risk associated with each currency L is negative, zero or positive depending if the coefficient of risk aversion for the investor of country L is higher, equal or less than one. Also, the price of risk in absolute value is higher as the market capitalisation of country L is higher. As their study shows that the price of world market risk is a weighted average of the coefficients of risk aversion of all national investors, this price should be positive (due to the fact that most investors are risk averse).

3.3. Currency Risk

As for the studies that take into account the foreign exchange risk, the results are quite different from one research to another. For example, in order to determine an asset pricing model where foreign exchange risk is priced, Solnik (1974iii) assumes that there is a different consumption good in each country and as a result trade takes place in intermediate goods, that there is no inflation so that the price of the good is fixed and the exchange rate is simply the price of the domestic good in terms of the foreign good. He also assumes that the capital markets are perfect with no transaction costs, taxes or capital controls and always in equilibrium. In his paper, Solnik shows that the risk premium of a security over its national risk free rate is proportional to its international systematic risk and this coefficient of proportionality is the risk premium of the world bond market over a world bond rate. Moreover, Stulz (1981) criticizes the assumption made by his predecessors that the relative prices of the imports are perfectly correlated with the exchange rates. He develops an international asset pricing model based on the assumption that financial markets are fully integrated and on the existence of differences in consumption opportunity sets. However, such early tests (Solnik

1974i, Stehle 1977, Korajczyk and Viallet 1989) use the unconditional version of the international capital asset pricing model and deliver inconclusive results. For example, Stehle (1977) considers the model of segmented or integrated capital markets (CAPM) developed originally by Sharpe (1964) and Lintner (1965) and uses a multi-commodity model of an international capital market in order to determine whether a valuation model assuming no barriers to international capital flows predicts rates of return better than a model that assumes complete market segmentation. His findings are inconclusive and suggest that variations that are non-diversifiable in an international capital market demand higher returns while variations that are diversifiable internationally but not domestically do not demand a positive premium.

Another study, Korajczyk and Viallet (1989), finds that single-index CAPM-type models tend to be outperformed by multifactor models in both domestic and international contexts especially in their ability to explain seasonality in asset returns. Value-weighted CAPM is outperformed by APT, while equal-weighted CAPM performs as well as APT except in terms of explaining seasonality of asset returns. Also, such models are found to be affected by changes in the regulatory environment in international markets. However, there is found some evidence against all the models especially when it comes to pricing common stocks of small market-value firms.

Furthermore, Carrieri and Majerbi (2006) use cross sectional data at the market, portfolio and firm level for nine emerging markets to determine whether exchange risk is unconditionally priced and the measure of the risk premium. Their findings suggest that the exchange risk is globally priced and a significant unconditional risk premium in emerging stock markets. They also find that the significance of the exchange risk factor is affected by local market risk.

More recently, most studies have focused on the conditional approach: Dumas and Solnik (1995), De Santis and Gerard (1997), De Santis and Gerard (1998), De Santis, Gerard and Hillion (2003), Kim (2003), Antell and Vaihekoski (2007). Compared to the unconditional models which assume that expected risk and returns are constant in time, the conditional models describe the evolution of the risk – return assuming the two variables change in time.

A test of the conditional version of the international capital asset pricing model is contained in Dumas and Solnik (1995) which point out the importance of using such an approach as the econometrician should not ignore the conditioning information that is available to the investor such as interest rates and equity prices which must appear in the form of instrumental variables. They constrain the market prices of risk to be linear functions of the instrumental variables. The results show that there is only little evidence that global equity and foreign exchange markets deviate from full integration. They also find that there exists a risk premium significantly different from zero and therefore, models of international asset pricing should include the currency risk in addition to the market risk. However, De Santis and Gerard (1998) point out the limits of their approach: the difficulty in evaluating the economic magnitude of the exchange risk premiums relative to the market premium as they do not specify the dynamics of the conditional second moments, the difficulty in measuring correlations, betas and hedge ratios, the fact that it is not a direct test of the conditional model but rather a test of the unconditional implications of the conditional model.

De Santis and Gerard (1997) test the conditional version of the international capital asset pricing model and analyze its implications for international portfolio diversification. They investigate cross-sectional and time-series restrictions of the model and the changes in the benefits of international diversification in response to changing conditions in international security markets by taking the perspective of an US investor. Their results show that the world price of covariance risk is equal across countries and time-varying in a predictable way while the price of country-specific risk is not significantly different from zero supporting the hypothesis of international market integration. However, the predictability of the price of the returns disappears when the price of market risk is not restricted to be positive. Therefore, they conclude that a more adequate model of international asset pricing should include additional factors and in international markets currency risk is priced in addition to market risk.

Moreover, De Santis and Gerard (1998) estimate a conditional version of the International Capital Asset Pricing Model to test whether the exchange risk premium has a significant impact on international returns. The study analyses a number of developed international equity markets (Germany, Japan, United Kingdom and the United States) together with Eurocurrency deposits, allowing the variables to be time varying. By this mean the magnitude and the dynamics of the market and currency risk premium are assessed, this fact being an important innovation brought by this study, as the two issues have been only separately addressed before. They test whether the currency risk factors are priced, whether the price of currency risk is constant or time-varying and whether the price of market risk is constant or time-varying by using a set of information variables such as the dividend yield on the world market index in excess of the one-month Eurodollar rate, the change in the US term premium, the change in the one-month Eurodollar deposit rate and the US default premium. The results show that the components of the risk premium vary significantly over time and across markets. The premium for the currency risk is found to represent in average only a small fraction of the total premium, when taking into account the total sample. In addition, they find that on average the premium for market risk is consistently higher than the premiums for currency risk. They also point out that an unconditional approach would not detect the dynamics of the risk premiums and would lead to the misleading conclusion that currency risk is not an important pricing factor.

Using a similar methodology, Honek (2007) evaluates the impact of the Euro adoption for Czech investors. More precisely the study determines whether the Euro risk is priced in the Czech market and if the Czech based investor demands a risk premium when holding Euro denominated assets. The premium for currency risk is found to be statistically significant but the value is negative, which denotes that the Czech investor is willing to sacrifice part of his total risk premium in order to diversify on the European market.

De Santis, Gerard and Hillion (1999) study the impact of currency risk and of the adoption of the euro on international portfolio choices by using a parsimonious GARCH parameterization in order to estimate a conditional version of the International Capital Asset Pricing Model. It can be observed that investors have a reluctance to invest to internationally diversify their portfolios as adding an additional source of risk raises several problems such as whether the exchange rate risk can be diversified away or systematically affects international asset returns, whether currency risk has a systematic component and is priced as well as the compensation required by investors for bearing such risk. If currency risk is priced, then currencies become an important asset class, so investors have to develop their portfolio strategies based on assets and currencies. Therefore, the adoption of a single currency- the euro brings the necessity of modifying such strategies. Their results suggest that strategies that include both equities and currencies outperform strategies that include only equities and that the portfolio trade-offs for international investors are not highly affected by the introduction of the euro as most economically significantly currency risk is associated with non-EMU currencies and especially with the British Pound, Japanese Yen and US Dollar.

Kim (2003) investigates the existence of long-run equilibrium relationships among the stock price and macroeconomic variables, including real exchange rate in the United States using Johansen's cointegration analysis. The article finds evidence of a negative relationship of the S&P500 with the real exchange rate for the period 1974 – 1998. Another study, conducted by Murinde and Poshakwale (2004) investigates price interactions between the foreign exchange market and stock market on t hree European emerging countries, by applying a bivariate vector autoregressive model and the Granger methodology, using daily observations. They find evidence that stock prices unidirectionally Granger cause exchange rates only for one of the analyzed markets, while for the other two countries the authors find that there are mutually reinforcing interactions between the variables. In what concerns pricing of the currency risk, Carrieri et. al. (2006) conduct empirical tests in a conditional setting both for developed and emerging markets to assess whether emerging market currency risk is priced and its impact on the developed financial markets. The results showed that emerging market currency risk is priced separately from other local risk factors and it has a high contribution in driving the returns for both developed and emerging markets. Antell and Vaihekoski (2007) use the model of De Santis and Gerard (1998) to study the pricing of global, local market risk and currency risk on the Finnish stock market. Their study is made from the perspective of an US investor and it aims to determine whether global market risk and currency risk are priced on the Finnish stock market, whether these risks are time-varying and the size of the required risk premium. Their findings show that the price of world risk is time-varying, the price of currency risk is significantly different from zero and the currency risk is not time-varying in the case of the Finnish financial market.

De Santis, Gerard and Hillion (2003) analyze how the removal of exchange risk on European markets may affect international financial markets. For an international investor, the introduction of the single currency reduces the number of sources of risk affecting financial assets but not necessarily the risk exposure of the assets. As the study emphasis, when introducing the single currency, the exchange rate risk for investors in Euro area no longer exists, but this does not mean that currency risk is removed as the investors might still be affected by the devaluation of the Euro. They find a positive premium for EMU risk and associated with exposures to the French, Italian and Spanish currencies and a negative premium for non-EMU risk which accounts for most of the aggregate currency premiums

Lustig and Verdelhan (2007) study the relationship between foreign currency risk premiums and consumption growth risk, the latter explaining why low interest rate currencies do not appreciate as much as the interest rate differential and why high interest rate currencies do not depreciate as much as the interest rate differential. Domestic investors earn negative excess returns on low interest rate currency portfolios and positive excess returns on high interest rate currency portfolios. When domestic consumption growth is low, low interest rate currencies appreciate on average, so they provide domestic investors with a hedge against domestic aggregate consumption growth risk. Their findings suggest that aggregate consumption growth risk explains a large fraction of the changes in the exchange rate and thus this growth risk is priced in currency markets. Furthermore, in a reply to their study Lustig and Verdelhan (2010) use currency portfolios sorted by interest rates, which show the idiosyncratic risk in exchange rate changes. Their results suggest that low interest rate currency portfolios have low consumption growth betas and high interest rate currency portfolios have high consumption growth betas, so the forward premium puzzle has a risk-based explanation.

4. Methodology

The model we use in our paper is based on the conditional international capital asset pricing model, originally developed by Adler and Dumas (1983). This model starts from the assumption that investors form expectations taking into consideration the risk and return as computed in the home currency. In an international framework however, the global portfolio cannot be considered the only source of risk, being necessary to include additional risk factors, the currency risk being one of the most important. A risk premium is added to these models, in order to reflect the covariance between the assets and different exchange rates.

Based on the importance given to the time variation of the variables, there are two approaches developed by researchers: conditional and unconditional. The unconditional models assume that expected risk and returns are constant in time, while conditional approaches describe the evolution of the risk – return assuming the two variables change in time. Conditional models are usually ARCH and GARCH models, where the investors' expectations regarding asset prices, interest rates or exchange rates are known.

In order to study the impact of global, local and currency risk on the analyzed emerging markets we use the framework of De Santis and Gerard (1998). Thus we also assume that PPP is violated so that investors across countries have different expectations regarding the real returns on assets, which must include a market premium along with a currency premium. The conditional version of the model as specified by De Santis and Gerard (1998) is the following:

$$E_{t-1}(r_{it}) = \delta_{m,t-1} cov_{t-1}(r_{it}, r_{mt}) + \sum_{c=1}^{L} \delta_{c,t-1}\, cov_{t-1}(r_{it}, \pi_{ct}), \qquad i = 1, \dots, M,$$

and $\delta_{c,t-1} = \theta_{t-1}\left(\frac{1}{\theta_c} - 1\right)\frac{W_{c,t-1}}{W_{t-1}}$

and $\delta_{m,t-1} = \theta_{t-1} = \frac{1}{\sum_{c=1}^{L+1}\frac{W_{c,t-1}}{W_{t-1}} * \frac{1}{\theta_c}}$,

where $E_{t-1}(r_{it})$ and $cov_{t-1}(r_{it}, r_{mt})$ represent moments, conditional on the information available to investors at the end of time t-1. θ_c is the coefficient of the relative risk aversion for investors from country c, while θ_{t-1} is an average of the risk aversion coefficients for each country weighted by wealth denoted with $\frac{W_{c,t-1}}{W_{t-1}}$. π_{ct} represents the inflation of country c, measured in the reference currency, while r_{mt} stands for the excess return on the world portfolio. The article assumes that domestic inflation is non stochastic, therefore $cov_{t-1}(r_{it}, \pi_{ct})$ measures the exposure of the asset to the currency risk of the analyzed country, c, and the coefficient $\delta_{c,t-1}$ measures the risk premium demanded by investors for bearing currency risk.

It has been empirically proved in many studies that foreign exchange risk is priced in developed markets and the premium demanded by investors to compensate this risk is an important component of expected return. However, although emerging markets have drawn the attention of many researchers, in this area we found much less evidence. Studies that employ an unconditional approach, except for Carrieri et. al. (2006), have found an exchange risk premium that is not statistically different from zero. Carrieri et.al. (2006) showed that exchange risk is globally priced but the significance of the currency risk factor might be affected by the model specification. Our intention is to employ a conditional model to study whether the world and currency risk factors are time-varying and to what extent these sources of risk account for the risk premium. In order to accomplish that we will use the methodology employed by De Santis and Gerard (1998).

$$E_{t-1}(r_{it}) = \delta_{m,t-1} cov_{t-1}(r_{it}, r_{mt}) + \sum_{c=1}^{L} \delta_{c,t-1}\, cov_{t-1}(r_{it}, r_{q+c,t}),$$

$i = 1, \dots, M$, where $\delta_{m,t-1}$ and $\delta_{c,t-1}$ are the conditional prices of world market risk and currency risk for country c.

As we take the perspective of an European investor, we assume he invests in each of the analyzed markets. Thus we estimate the model by employing a system of equations in which the first 5 equations will price each of the analyzed countries in turn, the next 4 equations in the system impose currency restrictions on the following currency deposits: Euro Yen, Euro US, Euro CZK and Euro Pound and the last equation is used to determine the price of the world equity portfolio.

$$E_{t-1}(r_{1t}) = \delta_{m,t-1} cov_{t-1}(r_{1t}, r_{mt}) + \sum_{c=1}^{L} \delta_{c,t-1} cov_{t-1}(r_{1t}, r_{q+c,t}),$$

.

.

$$E_{t-1}(r_{q-1,t}) = \delta_{m,t-1} cov_{t-1}(r_{q-1,t}, r_{mt}) + \sum_{c=1}^{L} \delta_{c,t-1} cov_{t-1}(r_{q-1,t}, r_{q+c,t}),$$

$$E_{t-1}(r_{q+1,t}) = \delta_{m,t-1} cov_{t-1}(r_{q+1,t}, r_{mt}) + \sum_{c=1}^{L} \delta_{c,t-1} cov_{t-1}(r_{q+1,t}, r_{q+c,t}),$$

.

.

$$E_{t-1}(r_{q+L,t}) = \delta_{m,t-1} cov_{t-1}(r_{q+L,t}, r_{mt}) + \sum_{c=1}^{L} \delta_{c,t-1} cov_{t-1}(r_{q+L,t}, r_{q+c,t}),$$

$$E_{t-1}(r_{mt}) = \delta_{m,t-1} cov_{t-1}(r_{mt}) + \sum_{c=1}^{L} \delta_{c,t-1} cov_{t-1}(r_{mt}, r_{q+c,t}),$$

Furthermore, we use r_t to denote the s×1 vector of excess returns which includes 1≤ n ≤L national equity portfolios, L currency deposits and the worldwide market portfolio. Thus, we use the following system of equations to estimate the conditional version of the ICAPM:

$$r_t = \delta_{m,t-1}h_{m,t} + \sum_{c=1}^{L}\delta_{c,t-1}h_{n+c,t} + \varepsilon_t,\ \varepsilon_t|\zeta_{t-1} \sim \mathrm{N}(0,H_t),$$

Where ζ_{t-1} is the set of information variables available at time t-1, H_t is the s×s conditional covariance matrix of asset returns, $h_{n+c,t}$ is the (n+c)th column of matrix H_t and $h_{m,t}$ is the last column of H_t. As the (n+c)th column of matrix H_t contains the conditional covariances between each asset and the return on the cth currency deposit, it shows the exposure to foreign exchange risk with respect to currency c. In the same manner, the last column of H_t measures the exposure to market risk.

The next step involves using a parsimonious GARCH process such as the one used in Ding and Engle (1996), Engle and Kroner (1995) and then generalized by De Santis and Gerard (1997). We use a multivariate GARCH as the extension from a univariate GARCH model to an n-variate model requires allowing the conditional variance-covariance matrix of the n-dimensional zero mean random variables t, to depend on elements of the information set.

A first GARCH (1,1) model for H_t is:

$H_t = C'C + A'\varepsilon_{t-1}\ \varepsilon_{t-1}'A + B'H_{t-1}B$, where C is an (N×N) symmetric matrix and A, B are (N×N) matrices of constant coefficients. However, this specification has a large number of unknown parameters and thus, is difficult to estimate. In addition most studies in the field impose several restrictions such as the fact that both A and B are diagonal matrices (Bollerslev, Engle and Wooldridge (1988)). This means that each element of the covariance matrix depends only on past values of itself and an autoregressive component. Then, the model adds the assumption that the process is covariance stationary and as Ding and Engle suggest, we replace C'C in the above equation with $H_0 * (\iota\iota' - aa' - bb')$ as in the following equation:

$H_t = H_0 * (\iota\iota' - aa' - bb') + aa' * \varepsilon_{t-1}\ \varepsilon_{t-1}' + b'H_{t-1}b$, where H_0 is the unconditional variance covariance matrix of the residuals, ι is an s×1 vector of ones, a and b are s×1 vectors of unknown parameters and * denotes the Hadamard matrix product.

The GARCH-M process uses a log likelihood function, which can be written as follows, under the assumption of conditional normality:

$\ln L\,(\theta) = -\frac{Ts}{2}\ln 2\pi - \frac{1}{2}\sum_{t=1}^{T} ln|H_t(\theta)| - \frac{1}{2}\sum_{t=1}^{T}\epsilon_t(\theta)'\,H_t(\theta)^{-1}\epsilon_t(\theta)$, where θ is a vector of unknown parameters. Then, we use a qvasi-maximum likelihood (QML) approach proposed by Bollerslev and Wooldridge (1992) because the assumption of conditional normality is often violated when using financial data. A QML estimate is an estimate of a parameter θ in a statistical model that is formed by maximizing a function that is related to the logarithm of the likelihood function, but is not equal to it. In contrast, the maximum likelihood estimate maximizes the actual log likelihood function for the data and model. The function that is maximized to form a QML is often a simplified form of the actual log likelihood function.

The above methodology is implemented using a Gauss code, developed by Bruno Gerard and utilized in Gerard and De Santis (1997) as well as in Gerard and De Santis (1998). The Gauss code was slightly modified by the authors to fit the purpose of this paper.

5. Data

Our study uses monthly logarithmic returns derived from stock market indices for seven markets, out of which four developed and three Central and Eastern European emerging capital markets plus a value weighted World index. The stock market indices for the European Monetary Union area, USA, UK, Japan, the Czech Republic, Hungary and Poland are the Morgan Stanley Capital International (MSCI) indices and have been collected from DataStream. Our estimation period covers data starting with January 1995 until December 2010, a number of 192 observations. Given that the three CEE markets are relatively young financial markets the data set is somewhat shorter as compared to other similar studies that focus on developed markets.

In our study we take the perspective of a European investor, thus all returns are denominated in Euro. Our aim is to determine the premium for currency risk demanded by the European investor for each of these countries, with a focus on the emerging markets and conditioned on three countries with the largest market capitalisation (Japan, United States, United Kingdom) and the World. We use Eurocurrency rates offered in the interbank market in London for one-month deposits in euro, Japanese yen, US dollars and British Pound. For the three emerging economies, we use the reference interest rates offered in the interbank market on each of these countries, the main source for this data being DataStream. We employ continuously compounded returns (in percentages, not decimals) due to the fact that these describe price changes during volatile periods more accurately. For the conditionally risk free asset for an European investor, measured in euro, we use a one-month holding period return on the one-month Euro-Euro interbank money market rate.

To represent economic risk, we employ two types of risk in our international asset pricing model: global market risk and exchange rate risk. The global market risk is measured by the global market portfolio returns proxied by the total return on the Morgan Stanley Capital International (MSCI) World equity market index. In order to quantify exchange rate risk we incorporate the forward premiums on the foreign currencies (US Dollar, Japanese Yen, British Pound and each of the currencies of CEE markets: Czech Koruna, Hungarian Forint and Polish Zloty) among the instruments as they have explanatory power for both equity and currency returns (Bakaert and Hodrick 1992).

The pricing restrictions imposed by the conditional ICAPM model include a set of information variables that are used to account for the new information which determines investors the change their strategies. These variables are chosen to match those used by De Santis and Gerard (1998) and on the basis of previous studies (Dumas and Solnik 1995). Therefore, the information set contains a constant, the dividend yield on the world market index derived from the world total return index and price appreciation index, the change in the US term premium, the change in the one-month Euro-Euro rate (the same as for the risk free asset) and the US default premium. The change in the US term premium is measured by the yield on the ten-year constant maturity bond in excess of the one-month Eurodollar deposit rate while the US default premium represents the yield difference between Moody's BAA and AAA rated bonds. The US term premium and the US default premium are computed using data from the Federal Reserve Economic Database. As the US market has the highest weight in the world portfolio, we consider that the US term premium and default premium are relevant information variables for a European investor as they are for a US investor.

Looking at the risk-return profile of the analyzed markets over the 1995 - 2010 period we can notice that the developed markets, with the exception of Japan, are characterised by positive although smaller returns as compared to the emerging markets. Given that our analyzed period of time incorporates the recent financial crises we can notice extremely high volatility in the data. However, as expected the highest standard deviations are achieved by the emerging markets. As it can be observed in Appendix A.1, table 1 the highest return is achieved by the Hungarian market (0.94%) along with the highest volatility (10.91%). The US market and the EMU market show similar risk return characteristics, with average returns of 0.49% respectively 0.39% and standard deviations of 5.6%. The British market, with a return of 0.28% and a standard deviation of 4.45% is close to the evolution of the world market, the MSCI World index bringing a return of 0.34%. Interestingly, when looking at the forward returns one can note that in the case of the Polish market an investor would have been better off in terms of risk return ratios by placing his money in a less riskier asset (with a standard deviation of 1.96%) rather than in the stock market. In what regards the distribution of the returns, most of the analyzed equity markets present negative skewness, which means that the distribution is asymmetric, with a long left tail. Also, except for the Japanese market, the kurtosis values for all the indices are higher than three – the value for the normal distribution, indicating leptokurtic distributions of returns. Jarque-Bera is a test statistic for testing whether the series is normally distributed. The null hypothesis tested is that the series has a normal distribution. The reported probability is zero or very close to zero in most cases, with the exception of the Japanese index, leading to the rejection of the null hypothesis at all three levels of significance (10%, 5%, 1%).

Appendix A.1, Table 2 shows the unconditional correlation between the analyzed equity markets along with the deposits. The tendency towards financial integration can be observed from the correlation matrix, as all three emerging markets present higher correlations especially with the EMU market but also with the World market. Lower correlations are still attained with the Japanese market, the Czech market being the less correlated. Keeping the analysis from the perspective of the European investor it can be seen that the diversification benefits tend to decrease as the financial markets become more and more integrated. The high correlation with the World index does not come as a surprise given the high integration of the European market with the global market and the fact that the European market represents a high percentage in the composition of the World index. However, as we would be expecting the correlation between the stock market and the returns on the Eurodeposits is still very small, in some cases even negative.

Hungary was among the first countries to establish a stock market in Central and Eastern Europe, in 1990, followed by Poland in 1991 and the Czech Republic two years later in 1993. Appendix A.2 and Appendix A.3 present the evolution of the three emerging markets in terms of market capitalisation and index growth over the analysed period of time. The appendices also show the evolution of the developed markets used in our study in order to ease the comparison among these markets. In what concerns the emerging markets it can be seen an increase in the stock market indices, especially after 2002, when the European Council announced the decision that ten CEE countries would join the European Union in 2004. On the other hand, the developed markets exhibit a decrease in the stock market indices in 2001 – 2002. This might be due to the events that took place in the US, where the series of frauds affecting companies such as Enron or WorldCom along with 9/11 events caused serious turmoil on the financial markets. The recent financial crisis is highly observable on all the analysed stock markets, the value of the indices falling in 2007. Looking closely to the evolution of the indices one may note the lag between the developed markets and the emerging markets as the latter did not adjust quite immediately.

In what concerns the market capitalisation, out of the analysed emerging markets, the highest was attained by the Polish market in the early 2000s, the Hungarian and the Czech market displaying a relatively similar evolution. The Polish market was also the most affected by the recent financial crises.

Appendix A.4 presents the evolution of the Eurodeposit rates as well as the interbank deposit rates for the three emerging markets. As it can be seen the rates have constantly decreased in the emerging markets since the beginning of the analysed period of time, while the Eurodeposit rates have varied across time. Also the Eurodeposit rates have significantly dropped when the markets collapsed due to the financial crises. The impact of the crises is less observable in the evolution of the interest rates for the emerging markets.

Given that our focus is on the exchange rate risk and its implications for the returns on the selected markets in the following section we provide a short historic and description of the currencies of each analysed country. In addition we briefly analyse the evolution of the exchange rate between the Euro and the three currencies.

5.1. The Czech Republic

The koruna (CZK) has been the currency of the Czech Republic since 1993 when, together with the Slovak currency, it replaced the Czechoslovak koruna at par. At that moment, the role of the exchange rate became much more important than the one required by a centrally planned economy. Moreover, in order to promote exports, foreign direct investments and favourable economic development during the transition to a free market economy, a certain decrease in the relative volatility of exchange rates was desirable. Therefore, a fully free exchange rate system which requires that there are no restrictions on financial capital movement would have been too prematurely to introduce. Thus, the exchange rates of the CZK were fixed to a currency basket when the transition process started.

Initially, the currency basket consisted of five different currencies and later of the US Dollar and German Mark, the weights of each currency in the basket depending on the importance of a particular currency in the turnover of the Czech balance of payments (excluding banking operations). In the first period the DEM had the highest weight (45.52%), then the US Dollar had a weight of almost 50%, while in the third period, the DEM represented 65% of the basket (see Appendix A.5, table 1). The currency basket was meant to be a nominal anchor that ensures a relatively stable nominal exchange rate with limited volatility. The width of the band was initially set at ±0.5% from central parity, but it was changed in February 1996 to ±7.5%. By allowing a wider fluctuation band, the Central Bank let the exchange rate fluctuate more freely, thus reducing its potential nominal stability. Also, the Central Bank had to intervene in the currency market in order to sustain the basket peg. Furthermore the central parity was not constant, but it was changed each month. Moreover, in October 1, 1995 full convertibility of the crown was implemented but this step was not accompanied by a change in the exchange rate regime, so the crown remained pegged to the currency basket. In May 1997, the Czech Republic abandoned the peg and introduced a managed float with DEM as the reference currency, being the first Central European country to adopt a floating exchange rate regime. This exit took place in a severe exchange rate crisis.

The CZK was one of the most stable Central and Eastern European currencies in the period January 1995 - December 2010 with volatility of approximately 4% over the analyzed period. Appendix A.6, Figure 5 displays the evolution of the EUR to CZK exchange rate. The maximum rate a European based investor had to pay for one unit of CZK was reached in June 2008 (0.0418 EUR for CZK) while the minimum value was in March 1999 (0.0260). The average exchange rate is 0.0322 EUR/CZK. The graph shows the appreciation of the CZK relative to the EUR from the beginning of the analyzed period and especially starting with 1996 after the transition to a floating exchange rate regime.

5.2. Hungary

The forint (HUF), the official currency of Hungary was introduced in 1946 after the currency pengõ experienced a period of great hyperinflation in the year before. This introduction was an important step of the post World War II stabilization of the Hungarian economy and the forint remained relatively stable until the 1980s. However, the value of the forint deteriorated during the transition to the market economy at the beginning of 1990s and inflation peaked at 35% in 1991. Looking at the Central and Eastern European countries, Hungary has experienced the largest number of different exchange rate regimes during the period 1990-2008. During the transition to a market economy, the Hungarian monetary policy was directed to the stability of the exchange rates in order to bring inflationary expectations under control. Fears that the inflationary pressures might lead to an overvalued forint if the monetary authorities adopt a less flexible peg, made these adopt a more flexible regime: an adjustable peg relative to a basket of currencies weighted by their importance in the Hungarian trade (see Appendix A.5, Table 2). This basket was composed in 1990 of 11 currencies, the USD having the highest weight (42.6%). Moreover, in 1991, the basket was composed of 9 currencies and the USD weighted slightly more than 50% while at the end of the year in the basket included the USD, with a 50% weight and ECU. However, in 1994, the weight of the USD decreased to only 30%. By 1995, a more flexible regime has replaced the adjustable peg: a ± 2.25% crawling band which allowed market forces to influence the exchange rates. Also, a slowly devaluation of the forint was designated to keep it competitive for exports. Another change was made to the components of the basket: DEM, followed by the EUR (1999) accounted for 70% of the basket while at the beginning of year 2000 EUR was the only currency the forint was crawling against. Then, in 2001, the band was widened to a ± 15.00%, resulting in an appreciation of the HUF. In the need for a stronger forint that the band would have allowed, the Hungarian monetary authority chose to abandon the target zone against the EUR and to let the HUF float freely on the market. The objective of this change in the exchange rate regime was the appreciation of the HUF against the EUR.

The EUR/HUF exchange rate had a very low volatility in the period January 1995 - December 2010, below 1%. The maximum exchange rate was of 0.007 Euro for one unit of Hungarian forint just at the beginning of 1995 the following years showing a depreciation of the HUF against the Euro (see Appendix A.6, Figure 6). The average exchange rate is 0.004178 Euro for one unit of HUF.

5.3. Poland

The Zloty (PLN) is the official currency of Poland. Like Hungary, Poland has also experienced various changes in the exchange rates regime especially during the period 1990-2000. It had a crawling peg system from October 1991 until April 2000, where the zloty was linked to a basket of currencies containing the US dollar (45%), the German mark (35%), the British pound (10%), the French franc (5%) and the Swiss franc (5%). The monthly depreciation rate was reduced in several stages from 1.8% to 0.3% while the band was widened from ± 1% in 1993 to ± 12.5% at the end of 1998. Between 1 January 1999 and April 2000, the basket of currencies to which the zloty was linked was made up of the Euro (55%) and the USD (45%). Moreover, in April 2000, a floating exchange rate regime was adopted which shows the fact that the Polish policy evolved in the direction of gradual flexibility (see Appendix A.5, Table 3).

The EUR/PLN exchange rate had a very high volatility of approximately 25% especially compared to the volatility of EUR/HUF exchange rate during the period January 1995 - December 2010 (see Appendix A.6, Figure 4). The maximum exchange rate for the Polish currency was also reached in the very beginning of the analyzed period, during the crawling peg regime, when one unit of PLN was worth 0.3279. The following period shows a relatively high volatility in the exchange rate with periods of appreciation and depreciation of the PLN against the Euro. Starting with the year 2004 after the transition to a floating regime the graphs shows a depreciation of the PLN against the EUR with a minimum value of 0.20470 in February 2004. The average exchange rate for the entire analyzed period is approximately 0.25EUR/PLN.

6. Estimation Results

We test the ICAPM for each of the three emerging countries: Poland, the Czech Republic and Hungary by us ing the equity indexes of four developed markets: European Monetary Union, Japan, USA and the United Kingdom which cover more than three quarters of the MSCI world portfolio. Given that we take the perspective of a European investor, all the returns are measured in Euro and we consider four sources of currency risk in each of the cases: the US Dollar, the Japanese Yen, the British Pound and the currency of the analysed emerging market. In order to determine the currency risk premiums, we include the forward returns on Eurocurrency deposits for the above mentioned markets. Thus, our model specification includes a total of ten variables.

6.1. Poland

We start by analyzing a version of the ICAPM in which both the price of market and currency risk are assumed to be constant and not time-varying for the following markets: European Monetary Union, Japan, USA, Poland and the United Kingdom. Thus, we estimate the following system of mean equations:

$r_{it} = \delta_m cov_{t-1}(r_{it}, r_{mt}) + \sum_{c=1}^{4} \delta_c \, cov_{t-1}(r_{it}, r_{q+c,t}) + \varepsilon_{it}$, where i=1,....10, $\delta_{m,}$ is the price of market risk and $\delta_{c,}$ is the world price of foreign exchange risk for currency c.

The conditional volatility, which is estimated simultaneously, is described with a GARCH (1, 1) process. Appendix A.7, Table 1 contains the estimation results for the four prices of currency risk and one price of market risk. The table also displays the coefficients for the second moments. The price of market risk is equal to 0.0160[2] with a relatively large standard error (0.0306) while its t-statistic value (0.5210) shows that it is not statistically significant for any level of significance. Moreover, three of the currency risk premiums are statistically significant for a 10% significance level in the case of the Japanese Yen (-0.0469) and US Dollar (-0.0970) and for a 5 % significance level for the risk premium associated to the Polish Zloty (0.0798). The premium for the UK Pound (0.0710) is not significantly different from zero at any reasonable probabilistic level. As the risk premiums for the Yen and the US Dollar are negative and significant, a European investor is willing to give up part of his total risk premium in order to diversify its portfolio on the Japanese and respectively American markets. On the other hand, when investing on the Polish market he demands a currency risk premium for being exposed to the exchange rate volatility. This fact is in accordance with our expectations, the currency risk having a significant impact on the performances of investments on the polish market which leads to an increase in the overall volatility associated to the investment thus determining the investor to demand a risk premium. Most of the coefficients for the second moments are significantly different from zero at a 1% level (ten coefficients), at a 5% and respectively at a 10% significance level which shows that the GARCH (1,1) specification performed relatively well when predicting the second moments.

Appendix A.7, Table 2 di splays the results of the Wald tests of joint parameter significance. In the case of the Wald test for the hypothesis that all the constant prices of currency risk are jointly equal to zero the null is rejected for a 5% significance level. Thus, the reward for bearing the currency risk is an important component in the international asset pricing. The finding differs from the conclusion of Gerard and De Santis (1998) who found that the null hypothesis, of the price of market risk and the three prices of exchange risk to be simultaneously equal to zero is not rejected at any conventional level. However, as the results show, the first hypothesis tested by the Wald confirms the fact that our model performs poorly in explaining the price of the market risk.

In addition to the reported coefficients, Appendix A. 7, Table 3 contains statistics of excess returns for each market along with the standard deviation of the returns, while the following tables (Appendix A.7, Tables 4 a nd 5) display statistics of the residuals and the squared residuals. Table 3 outlines the average,

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[2] The coefficients reported in the table should be multiplied by 100 as initial data was given in percentages

maximum, minimum and standard deviation for the excess returns. It can be observed that the highest returns are on the US equity market (0.47) and for the EURPLN deposits (0.58). The worst performing were the Japanese assets; the excess return on Yen deposits was –0.62 and for the Japanese equity market -0.53. However, the Polish equity market has the highest standard deviation (10.98), the equity assets being riskier than the deposits as expected. In what regards the standardized residuals, which should be normally distributed, Appendix A.7, Table 4 displays the summary statistics along with the results of Jarque-Bera test of normality and the Ljung-Box test. In addition we analyse whether the skewness and kurtosis (the third and fourth moments of statistical distribution) are in accordance with the standardized normal distribution which should be symmetric (the skewness has to be zero) and mesokurtic (zero excess kurtosis). All the observations, except the Japanese Eurodeposit rate which has a relatively high positive skewness (the right tail is longer showing that the mass of the distribution is concentrated on the left of the figure), have skewness values close to zero. By performing the Jarque-Bera test of normality which has under the null hypothesis that the test statistics asymptotically follows the χ^2 distribution with 2 degrees of freedom, we find that the null can be rejected on a 10% significance level in all but three cases (Japan equity market, the USD and GBP Eurodeposits). This violation of normality shows that a Quasi Maximum Likelihood estimation procedure should be used. The Ljung-Box tests the residuals for the presence of autocorrelation up to a certain lag, 12 in our case. With the exception of the USD Eurodeposit all the other series of residuals are white noise series.

Next, Appendix A.7 shows a series of graphs presenting the risk premium decomposition both in terms of exposure to market risk and currency risk and also the total risk premium as a sum of the two components. The total risk premium on each of the assets is calculated as it follows:

$TP_{i,t} = \delta_m cov_{t-1}(r_{i,t}, r_{m,t}) + \sum_{c=1}^{4} \delta_c cov_{t-1}(r_{i,t}, r_{n+c,t})$, where the conditional covariances are obtained from the estimated covariance matrix H_{t-1}. Since the last asset in the covariance matrix is the market portfolio the first covariance term in the above expression represents the covariance between the return on asset i with the return on the market portfolio. $\delta_c cov_{t-1}(r_{i,t}, r_{n+c,t})$ is the covariance between the return on asset i and the return on each of the four deposits. The currency risk premium is measured by:

$CP_{it} = \sum_{c=1}^{4} \delta_c \, cov_{t-1}(r_{it}, r_{n+c,t})$ while the market risk premium is computed as it follows:

$MP_{it} = \delta_m cov_{t-1}(r_{it}, r_{mt})$.

Appendix A. 7, Figure 1, shows the decomposition of the risk premium for the world market portfolio. As it can be seen the market risk premium is positive for the entire sample and varies over time but not to a great extent. The total risk premium is also positive but its value is offset by the negative value of the currency risk premium which stays negative for almost the entire period of time.

As Gerard and De Santis (1998) point out the premium for exposure to currency risk is aggregated for investors from different countries who consume goods priced in the currency of their home country, thus there is a premium for currency risk for the European market as well, although the returns are measured in Euro. Figure 2 in Appendix A. 7 displays the risk premium decomposition for the European market, namely for the EMU portfolio. As it can be seen the total risk premium is positive for the entire sample but much higher than in the case of the US market. This is due to the positive currency risk premium that adds up to the market risk premium. A completely different scenario is observable for the Japanese market, the total risk premium being negative over the whole sample even though the market risk premium is positive. The graph displaying the risk premium decomposition for the US market is very similar to the World risk premium decomposition graph. This fact does not come as a surprise given that the US market represents a large share of the World market portfolio. The currency risk premium is negative over the sample except for a small period in 2001. This may be due to an appreciation of the US dollar in the interval 2000 – 2001. In the case of Poland, the graph in Appendix A. 7, Figure 6 confirms the above findings, the currency risk premiums being positive for almost the whole 1995 - 2010 period. Moreover for some intervals the currency risk premium is larger than the market risk premium showing that investors demanded a large compensation for bearing the volatility of the exchange rate.

The following two graphs present the risk premium decomposition for the USD and PLN Eurodeposits and, as expected, the currency risk premium has the highest share of the total risk premium since the expected return on the deposits denominated in foreign currency depend mostly on the evolution of the exchange rate. For the USD denominated deposits investors did not demand a positive risk premium while the situation for the PLN Eurodeposits is exactly the opposite, the currency risk premium and implicitly the total risk premium being positive.

Table 6 in Appendix A. 7 shows the descriptive statistics for total and decomposed risk premiums. It can be seen that the currency risk premium represents approximately 18% of the total risk premium for the European Monetary Union market portfolio and approximately 35% of the total risk premium for the world market portfolio. In the case of the Polish market the currency risk premium represents almost 40% of the total risk premium. In what concerns the Eurodeposits, the descriptive statistics of the risk premium decomposition confirms that the currency risk premium is the dominant component, representing about 72% of the total risk premium for the Polish deposit.

6.2. The Czech Republic

The subsequent set of results derived using the same approach as above, present the situation in which a European investor would choose the Czech market instead of the Polish market. Thus Appendix A.8, Table 1 contains the estimation results for The Czech Republic, namely four prices of the USD, YEN, GBP and CZK currency risk and one price of market risk. The coefficients for the second moments are also displayed by the table. The price of market risk equals 0.0479, and as opposed to the results obtained when including the Polish market in the model, the premium in this case is statistically significant for a 5 % level of significance. However the t-statistic equals 1.7590, the relatively small value indicating that the constant price of market risk has little explanatory power. Two of the currency risk premiums are statistically significant for a 5% significance level, namely the premium for the Japanese Yen, with a coefficient of -0.0730 and the risk premium associated to the Czech Crown (-0.1540). In this case neither the US Dollar premium nor the risk premiums associated to the British Pound are significantly different from zero at any reasonable probabilistic level. Given that the risk premium for the Yen is negative and significant, a European investor is willing to give up part of his total risk premium in order to diversify its portfolio on the Japanese market. The situation is similar for the Czech market, where we found a negative and significant currency risk premium as opposed to the Polish market. Thus a European investor is willing to sacrifice part of his total risk premium in order to invest in the Czech market. The descriptive statistics in

Appendix A.1 Table 1 show that the Czech market had a higher return than the Polish market and a lower standard deviation, therefore this may be a reason why the currency risk premium demanded by investors is lower. In addition the negative return on the Czech deposit may also have a influence in obtaining a negative currency risk premium. Most of the coefficients for the second moments are significantly different from zero at a 10% level which shows that the GARCH (1,1) specification performed relatively well when predicting the second moments.

Appendix A. 8, Table 2 displays the results of the Wald tests of joint parameter significance. The first tested hypothesis, namely that the price of market risk and the prices of currency risk are jointly equal to zero is in this case rejected at a 10% level of significance, thus, as opposed to the case where we included Poland in our model, this specification of the model does not perform as poorly in explaining the price of the market risk. Therefore the Wald test confirms the above findings, a significant and positive market risk premium. In the case of the Wald test for the hypothesis that all the constant prices of currency risk are jointly equal to zero the null is rejected for a 1% significance level. This underlines the fact that investors are rewarded for bearing the currency risk when investing in international markets.

As in the case of Poland, the following tables in Appendix A. 8 present the statistics of the residuals and the squared residuals. The excess return statistics for the Czech equity market and deposit rate show that the Czech market recorded the highest return (0.83) but also, as expected, the highest standard deviation (8.39). The deposit performed weak, the excess return having a negative value (-0.51). The rest of the table contains the same values for the developed market as the one presented in Appendix A. 7. The statistics of the standardised residuals presented in Appendix A. 8, Table 3, show that the residuals are not normally distributed. The Jarque-Bera test shows that for a 10% level of significance the null of normality is rejected in all cases except for the Japanese equity market, the US Dollar and British Pound Eurodeposits. The Ljung-Box tests the residuals for the presence of autocorrelation up to the 12^{th} lag. With the exception of the CZK deposit all the other series of residuals are white noise series.

The following series of graphs in Appendix A. 8 show the risk premium decomposition in terms of exposure to market risk and currency risk and also the total risk premium as a sum of the two components.

The first graph shows the risk premium decomposition for the world market portfolio. The total risk premium is positive for the entire sample with the exception of a small period of time in 2001, when the currency risk premium offsets the value of the market risk premium. The mean value for the total risk premium over the analysed period of time is 0.29 while the mean value for the currency risk premium is -0.93. The market risk premium varies very little over the period and is positive with an average of 1.23. The graph showing the risk premium decomposition for the EMU market is similar to the graph for the world market risk premium, the total risk premium being positive for the whole sample, with a mean value of 0.49. The currency risk premium is negative while the market risk premium stays positive for the analysed period. As it can be seen in Appendix A. 8, Figure 3, the total risk premium is negative, being driven by the negative value of the currency risk premium (an average of -1.29). The graph showing the risk premium decomposition for the Czech equity market confirms the fact that over the sample the currency risk premium is negative, with an average of -1.09. The market risk premium, although positive does not offset the negative value of the currency risk premium, thus the total risk premium is also negative. In what regards the risk premium decomposition for the deposits, the graphs in Appendix A. 8 confirm again the expectations, the total risk premium being driven by the currency risk premium. This fact is highly observable in the case of the Czech market, where the average value of the total risk premium (-0.51) is almost equal to the average value of the currency risk premium (-0.54).

From Table 5 in Appendix A. 8 which shows the descriptive statistics for the total risk premium as well as for the decomposed risk premiums it can be observed that the currency risk premium for the EMU market represents 37% of the total risk premium while in the case of the World market portfolio the currency risk premium represents a smaller percentage, about 10% of the total risk premium. For the Czech market, the currency risk premium represents 62% of the total risk premium.

6.3. Hungary

In the case of Hungary we also start by analyzing a version of the ICAPM in which both the price of market and currency risk are assumed to be constant and not time-varying for the following markets: European Monetary Union, Japan, USA, Hungary and the United Kingdom. Therefore, we estimate the following system of mean equations:

$r_{it} = \delta_m cov_{t-1}(r_{it}, r_{mt}) + \sum_{c=1}^{4} \delta_c \, cov_{t-1}(r_{it}, r_{q+c,t}) + \varepsilon_{it}$, where i=1,....10, $\delta_{m,}$ is the price of market risk and $\delta_{c,}$ is the world price of foreign exchange risk for currency c.

Appendix A. 9, Table 1 contains the estimation results for the four prices of currency risk and one price of market risk. Again the second part of the table displays the coefficients for the second moments. The price of market risk is equal to 0.0258 with a standard error of 0.0246 while its t-statistic value (1.047) shows that it is statistically significant only for a 15% level of significance. The value is higher than in the case of Poland (0.0160), but the latter is not statistically significant. Furthermore, two of the currency risk premiums are statistically significant for a 5% significance level in the case of the Japanese Yen (-0.0586), US Dollar (-0.0919) and for a 10 % significance level for the risk premium associated to the UK Pound (0.0715). The premium for the Hungarian Forint (0.2403) is statistically significant for a 1% significance level and is considerably higher than in the case of the Polish Zloty (0.0798). As the risk premiums for the Yen and the US Dollar are negative and significant in this case also, a European investor is willing to give up part of his risk premium in order to diversify its portfolio on the Japanese and respectively American markets. On the other hand, when investing on the Hungarian market he demands a relatively high currency risk premium for being exposed to the exchange rate volatility. A positive risk premium is also encountered on the UK market. Most of the coefficients for the second moments are significantly different from zero at a 1% level (twelve coefficients), at a 5% and respectively at a 10% significance level which shows again that the GARCH (1, 1) specification performed relatively well when predicting the second moments.

The Wald test (Appendix A. 9, Table 2) does not reject the first hypothesis that all the constant prices of currency risk and the price of market risk are jointly equal to zero for any conventional level. This confirms the fact that our model performs poorly in explaining the price of the market risk as it does not allow time-variation of the price of risk. The second hypothesis, which tests whether the prices of currency risk are jointly equal to zero is rejected for a 1% level of significance, which underlines the above findings, namely that the currency risk premium is an important component in pricing international assets.

Moreover, Appendix A. 9, Table 3 analyzes the information about the residuals and appendix A. 9, Table 4 presents statistics for the squared residuals. The descriptive statistics for the excess returns show that the highest returns are on the Hungarian equity market (1.53) and for the EURHUF deposits (0.38), lower than in the case of EURPLN deposits (0.58). The Hungarian equity market has the highest standard deviation (10.78), the equity assets being riskier than the deposits as expected. The summary statistics for standardized residuals, which should be distributed according to the standardized normal distribution are presented in Appendix A.9, Table 3 ($\epsilon_t\sqrt{^\wedge\sigma^2}$, where $\sqrt{^\wedge\sigma^2}$ is the estimates standard error). We then test whether the skewness and kurtosis (the third and fourth moments of statistical distribution) are in accordance with the standardized normal distribution which should be symmetric (the skewness has to be zero) and mesokurtic (zero excess kurtosis). All the observations, except the EURJPY deposit rate which has a relatively high positive skewness (the right tail is longer showing that the mass of the distribution is concentrated on the left of the figure), have skewness values close to zero. By performing a Jarque-Bera test of normality we find that the null can be rejected at a 10% significance level in all but three cases (Japan equity market, EURUSD and EURP deposits). This violation of normality shows that a Quasi Maximum Likelihood estimation procedure should be used. Moreover, we perform the Ljung-Box statistics which tests the joint hypothesis that up to a cer tain lag all the correlation coefficients are simultaneously zero. The test is performed for 12 l ags and follows the χ^2 distribution with 12 degrees of freedom. We find that on a 10% significance level all the residuals are white noise except for the EURHUF deposit residuals. By analyzing the autocorrelations we observe in the EURHUF series a relatively larger correlation coefficient at lag 8 (-0.229). Furthermore, Appendix A.9, Table 4 presents the statistics for the standardized residuals squared. After performing the Ljung-Box statistics we find that all the residuals except for one (UK equity market) are independently distributed for a 1% significance level. This fact shows that the model was successful in capturing the conditional heteroscedasticity in the data.

As far as the prices of currency risk are concerned, we found that all the four coefficients are statistically significant for a 10% significance level. Two of them (the price of Japanese Yen and US Dollar) are significantly negative leading to the message that a European investor is willing to forgo part of his market premium in order to hold Japanese and US assets. These are a desirable addition in order to diversify a domestic portfolio but the benefit of further diversification has an important cost: the negative risk premium. On the other hand, the prices of Hungarian Forint and UK Pound are significantly positive and the investors are rewarded for holding them.

The total risk premium can be decomposed to the premium for the exposure to the market risk and to the currency risk thanks to the direct estimates of the conditional second moments. Appendix A. 9, Figures 1 to 10 plot the total risk premium decomposed into the covariance risk premium and the currency risk premium. Also Table 5 in Appendix A. 9 shows the descriptive statistics for the total risk premium and its components.

Figure 1 (appendix A.9) shows the composition of the risk premium for holding the EMU market portfolio. It can be observed that the market premium (with an average of 0.672) as well as the total risk premium (0.711) vary throughout the time, but remain positive for the entire sample, while the currency risk premium takes also negative values but its average remains positive (0.039). The currency risk premium takes even more negative values in the case of Japan, as it can be seen from Figure 2 (Appendix A. 9). Here, the currency premium sometimes offsets the market premium and as a r esult, the total risk premium takes both positive and negative values. Figure 3 (Appendix A. 9) plots the decomposition for the case of the US portfolio and shows a constantly positive total and market risk premium for the analyzed period, while the currency premium takes only negative values except for the period 2000-2002 which represents the decline of the dot-com bubble. A possible economic explanation of this is the fact that during the US stock market crash, a European investor would have asked for a positive risk premium for holding US assets (which became riskier during that period). Both the market and currency risk premiums are positive for holding Hungarian assets, which shows the fact that a European investor would only include this type of assets in its portfolio if he receives a positive compensation for bearing a higher risk. The currency risk premium takes sometimes negative values in the case of UK (Appendix A.9, Figure 5) but it does not offset the market risk premium, so the total premium remains positive with an average of 0.475. The next figure presents the decomposition of the risk premium for the World portfolio and shows the market premium varies throughout the time, but remains positive for the entire sample, which corresponds well with the theory while the currency risk premium is mostly negative but does not offset the other component. The next figures confirm the assumption that the expected return on the foreign currency denominated deposits will depend largely on the exchange rate exposure. The total premiums for the Eurocurrency deposits are lower than the corresponding premiums for the equity markets as the premium for market risk has higher values in the latter case. The total risk premium earned on the Yen deposit was negative throughout the whole period even though the market risk premium consistently had positive values. This was also the case of the US deposit (Appendix A. 9, Figure 8). On the other hand, for holding a Hungarian and British deposit, the total risk premiums and its components had only positive values confirming the fact that the price of currency risk associated with the Hungarian Forint and British Pound is significantly positive.

The average values of the currency risk premium for the analyzed period are negative as expected in the case of more stable currencies Japan, US, UK, EuroYen deposit and EuroUSD deposits and positive in the case of Hungarian assets and EuroGBP deposits. The average values reach -0.720 for the EuroYen deposit and an extreme 1.150 for the Hungarian equity market. Interestingly, the lowest market risk premium is in the case of the EuroHUF deposit (0.071) while the highest value is in the case of the Hungarian equity market (0.789), highlighting the high risk which must be bear for holding Hungarian equities. As a consequence of positive market risk premiums, total risk premiums are also positive except the cases of Japanese assets and the EuroUSD deposits. The largest total premium over this period is associated with the Hungarian market. This is because all the investments in Hungarian assets have the highest market and currency risk premiums.

The portion of the total risk premium represented by the currency risk is higher in the case of Japan, about 50%, and in the case of Hungary is about 59%. For the US market, the market risk represents a larger share, the currency risk being 23% of the total risk premium while in the case of the British market the currency risk represents only a small fraction of about 7% of the total risk premium.

When we do not allow time variation in the price of market risk we find that the investors are not rewarded for bearing this risk. Thus, for this market we also test the model allowing the time variation of the price of the market risk.

6.3.2. International CAPM with time-varying prices of risk

The next step is to test the hypothesis that the price of market risk varies over time while the prices of currency risk are constant. We need to modify the benchmark model in order to allow the time-variation of the price of market risk δ_m as it follows:

$$r_{it} = \delta_{m,t-1} cov_{t-1}(r_{it}, r_{mt}) + \sum_{c=1}^{4} \delta_c \, cov_{t-1}(r_{it}, r_{q+c,t}) + \varepsilon_{it}$$

As the price of market risk in the ICAPM is a weighted average of the coefficients of risk aversion of the national investors, this price has to be positive as long as all investors are risk averse. Thus, by following the methodology used by De Santis and Gerard (1998), we employ an exponential function to model the dynamics of δ_m :

$\delta_{m,t-1} = \exp(\kappa'_m z_{t-1})$, where z_{t-1} is a vector of instrumental variables observed at the end of time $t-1$. The instruments include the world index dividend yield in excess of the one-month EuroEuro rate, the change in the US term premium, the change in the one-month EuroEuro rate and the US default premium.

Appendix A. 10, Table 1 contains the estimation results for the four prices of currency risk and one price of market risk. Next the second part of the table displays the coefficients for the second moments. Only one of the point estimates on the κ'_m coefficients used to model the dynamics of the price of market risk is statistically significant for a 1% significance level. Furthermore, one of the currency risk premiums is statistically significant for a 5% significance level - the Japanese Yen (-0.0489) and for a 10 % significance level - the risk premium associated to the US Dollar (-0.0723). The premium for the Hungarian Forint (0.2722) is statistically significant for a 1% significance level and is considerably higher than in the case of the ICAPM with constant prices of risk (0.2403). The risk premium for the UK Pound is not statistically significant for any level of significance. Our findings do no s ignificantly differ from the case of constant prices of risk: the currency risk premium for investing in the Hungarian market is positive while the risk premiums for the Yen and the US Dollar are negative and significant showing that an European investor is willing to give up part of his risk premium in order to diversify its portfolio on the Japanese and respectively American markets. Furthermore, most of the coefficients for the second moments are highly significantly different from zero at a 1% level (eleven coefficients), at a 5% and respectively at a 10% significance level which shows that the GARCH (1, 1) specification performed relatively well when predicting the second moments.

The Wald test (Appendix A. 10, Table 2) rejects the hypothesis that all the conditioning variables of the price market covariance risk are jointly equal to zero at a 10% significance level. Then, we test the hypothesis that none of the currency risk factors are priced:

H_0: $\delta_c = 0$, for c=1,2.3,4. As the p-value for this hypothesis is equal to 0.00049, we can reject the null for any conventional level. This shows that currency risk factors are priced and these prices are constant. Thus, the Wald test confirms the fact that this model performs better than the ICAPM with constant prices of risk as it allows time-variation of the price of market risk.

In addition to the reported coefficients appendix A. 10, Table 3 presents the summary statistics of standardized residuals ($\epsilon_t\sqrt{^\wedge\sigma^2}$, where $\sqrt{^\wedge\sigma^2}$ is the estimates standard error) which should be distributed according to the standardized normal distribution. We then test whether the skewness and kurtosis are in accordance with the standardized normal distribution. All the observations, except the EURJPY deposit rate which has a relatively high positive skewness (the right tail is longer showing that the mass of the distribution is concentrated on the left of the figure), have skewness values close to zero. By performing a Jarque-Bera test of normality we find that the null can be rejected on a 10% significance level in half of the cases (the EMU and the Hungarian markets, the EURJPY and EURHUF deposits and the World). This violation of normality shows that a Quasi Maximum Likelihood estimation procedure should be used. Moreover, we perform the Ljung-Box statistics which tests the joint hypothesis that up to a certain lag all the correlation coefficients are simultaneously zero. The test is performed for 12 lags and follows the χ^2distribution with 12 degrees of freedom. Furthermore, Appendix A. 10, Table 4 presents the statistics for the standardized squared residuals. After performing the Ljung-Box statistics we find that all the residuals except for two (Japanese and UK equity markets) are independently distributed for a 10% significance level. This fact shows that the model was successful in capturing the conditional heteroscedasticity in the data.

As far as the prices of currency risk are concerned, we found that three of the four coefficients are statistically significant for a 10% significance level. Two of them (the price of Japanese Yen and US Dollar) are significantly negative leading to the message that a European investor is willing to forgo part of his market premium in order to hold Japanese and US assets while the price of Hungarian Forint is significantly positive and the investors demand a reward for investing in this market. These findings do not differ much from the results in the case of the ICAPM with constant prices of risk.

7. Conclusion

The question addressed in our paper has important implications for investor decisions in terms of asset allocation and managing international portfolio risk, especially taking into account the changes that have occurred in the exchange rate regimes on emerging markets. Exchange rates also play an important role in what concerns the financial integration process in Europe. Unpredictable exchange rates that are characterized by high volatility are translated into higher costs of hedging and implicitly higher risk premiums.

In order to determine the price of currency risk, we test a conditional version of the International Capital Asset Pricing Model in which the market and currency risk appear as independent pricing factors. In particular, the ICAPM was estimated in three cases, each of them including the equity portfolios of one of the three emerging markets (Poland, Hungary and the Czech Republic), of the European Monetary Union, Japan, US, UK, the one month Eurodeposits for the Japanese Yen, the US Dollar, the UK Pound and for the currencies of the CEE countries (the Polish Zloty, the Hungarian Forint and respectively the Czech Koruna) and the World portfolio. By taking the perspective of a European investor, our aim was to determine whether the exchange risk associated to these currencies was priced.

The estimation of the model showed that the currency risk premium is a non-negligible part of the total risk premium. For two of the analyzed developed market the currency risk premium is negative showing that a European investor is willing to forgo part of his market premium in order to hold Japanese and US assets. These are a desirable addition in order to diversify a domestic portfolio but the benefit of further diversification has an important cost: the negative risk premium. In the case of the British market, the currency risk premium is found to be negative in two cases and positive when the model includes the Hungarian market. This proves the conditionality of the currency risk premiums, which are influenced by the markets included in the model.

The risk associated with the EURPLN, EURHUF and respectively EURCZK exchange rates are statistically significant. For the Polish and Hungarian markets, the currency risk premiums are positive therefore investors require a risk premium for holding these assets and for bearing an additional risk. Moreover, the premium for the Hungarian Forint is considerably higher than in the case of the Polish Zloty, showing a higher risk of the EUR-HUF exchange rate or the fact that investors are less willing and demand higher reward for investing on the Hungarian market. On the other hand the risk premium for the Czech market is negative. Although the Czech market is an emerging market, it has a better risk return profile as compared to the other two markets and this fact could justify a lower, even negative risk premium.

Employing the model with constant prices of risk we found that investors are not rewarded for bearing the market risk. Thus we tested the model allowing for time variation of the price of market risk which depends on a set of four information variables, namely the world index dividend yield in excess of the one-month EuroEuro rate, the change in the US term premium, the change in the one-month EuroEuro rate and the US default premium. We found that the model performs better according to the Wald test, which in this case r ejects the hypothesis that all prices of risk (both currency and market risk) are jointly equal to zero.

After the introduction of the Euro in the above mentioned emerging markets, the risk associated to the exchange rate with respect to the Hungarian forint, Polish Zloty and Czech Koruna will disappear. The common currency will eliminate a so urce of risk that systematically affects negatively the returns of investments from the Euro Area in the CEE markets. Yet, a possible consequence could be the fact that the elimination of the risk associated to the three currencies (PLN, HUF, CZK) could lead to larger fluctuations of the EUR in respect to the other currencies (for example the USD, the JPY or the GBP) than in the case of the local currencies.

Moreover, investors in both the EMU and the three above mentioned CEE markets will have an access to a wider range of assets that will be denominated in their new home currency — the Euro. Also, after the introduction of the common currency, the integration of these emerging markets with the European financial market will be increased.

Most of the previous studies conducted in this area of research have focused on the case of the US based investor, determining the existence and the value of the currency risk premiums. Thus our study brings a fresh perspective to this field of research, offering the European investor an overview of the possibilities of return when investing both in other developed markets and in emerging markets. In what concerns emerging markets, most studies have focused on the high return opportunities, paying little attention to the currency risk. Yet given the relatively high volatility of the exchange rates of these countries the currency risk represents an important component for the international asset pricing. However for a better understanding of the impact of the currency risk associated to investments in emerging markets it is important to study further this aspect. For instance, in the case of the European investor, it would be interesting to add in the model emerging markets that are not part of the European Union, especially in the context of the enlargement of the Euro zone.

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Appendix

A. 1 Descriptive statistics of data

	European Monetary Union	Japan	USA	United Kingdom	Czech Rep.	Poland	Hungary	World Index	EUR-JPY	EUR-USD	EUR-GBP	CZK Deposit	PLN Deposit	HUF Deposit
Mean	0.39	-0.19	0.49	0.28	0.80	0.47	0.94	0.34	-0.09	0.06	0.14	-0.03	0.61	0.47
Std. Dev.	5.63	5.69	5.17	4.45	8.06	10.58	10.91	4.73	3.75	2.97	2.43	1.96	2.74	2.11
Skewness	-0.75	0.12	-0.48	-0.57	-0.63	-0.30	-0.74	-0.64	1.39	0.18	-0.98	-0.82	-0.61	-0.88
Kurtosis	4.19	2.74	3.24	3.27	4.61	4.82	7.15	3.29	7.63	3.92	9.35	5.60	3.76	8.03
Jarque-Bera	29.17	0.98	7.78	10.91	33.24	29.31	155.57	13.93	233.23	7.86	353.41	75.40	16.38	227.47
Probability	0.0000	0.6124	0.0204	0.0043	0.0000	0.0000	0.0000	0.0009	0.0000	0.0197	0.0000	0.0000	0.0003	0.0000

Table 1. Descriptive statistics of monthly returns on equity indices and Eurodeposit rates denominated in Euro, January 1995 – December 2010

	European Monetary Union	Japan	USA	United Kingdom	Czech Rep.	Poland	Hungary	EUR-JPY	EUR-USD	EUR-GBP	CZK Deposit	PLN Deposit	HUF Deposit	World Index
European Monetary Union	1.00													
Japan	0.49	1.00												
USA	0.78	0.58	1.00											
United Kingdom	0.83	0.56	0.82	1.00										
Czech Rep.	0.46	0.25	0.35	0.39	1.00									
Poland	0.62	0.38	0.51	0.50	0.64	1.00								
Hungary	0.64	0.31	0.53	0.56	0.68	0.74	1.00							
EUR-JPY	-0.10	0.42	0.18	0.05	-0.19	-0.08	-0.17	1.00						
EUR-USD	0.06	0.31	0.44	0.26	-0.06	-0.02	-0.05	0.50	1.00					
EUR-GBP	0.06	0.24	0.31	0.39	0.05	-0.03	0.06	0.24	0.61	1.00				
CZK Deposit	0.11	-0.04	0.01	0.01	0.38	0.22	0.19	-0.08	-0.09	-0.06	1.00			
PLN Deposit	0.50	0.28	0.47	0.50	0.49	0.61	0.52	-0.04	0.13	0.18	0.38	1.00		
HUF Deposit	0.34	0.17	0.28	0.30	0.41	0.43	0.54	-0.19	-0.05	0.03	0.25	0.52	1.00	
World Index	0.88	0.70	0.96	0.89	0.42	0.58	0.59	0.15	0.34	0.27	0.03	0.50	0.31	1.00

Table 2. Correlation matrix of equity indices and Eurodeposit rates denominated in Euro, January 1995 – December 2010

A. 2 Market Capitalisation (milliards Euro) Annual data: 1995 – 2010

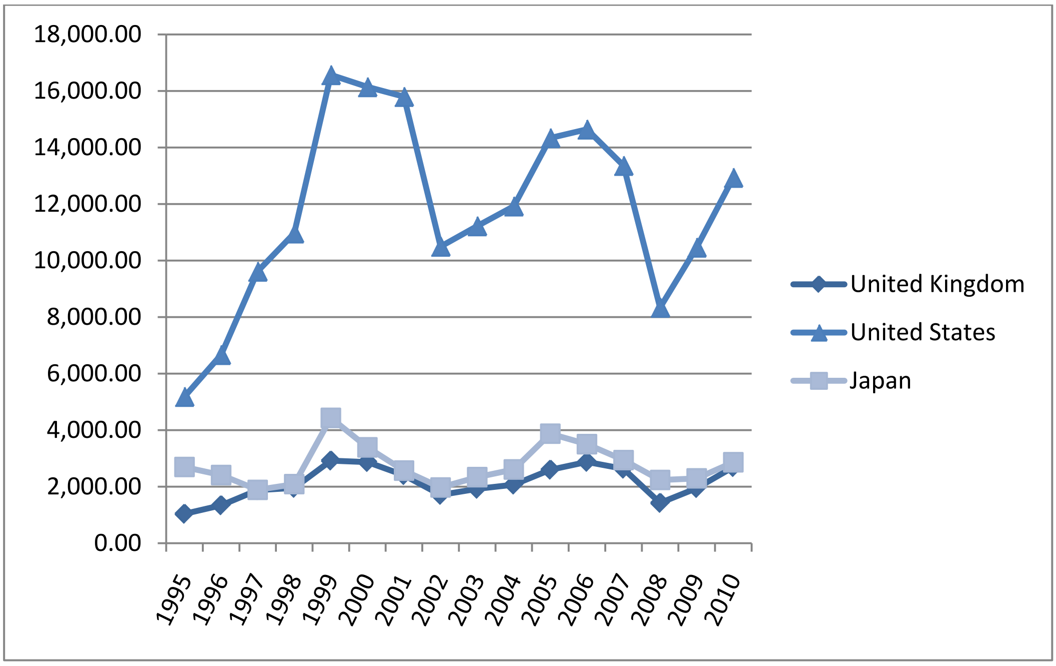

Figure 1. Market Capitalisation of developed markets

Source: Eurostat Database

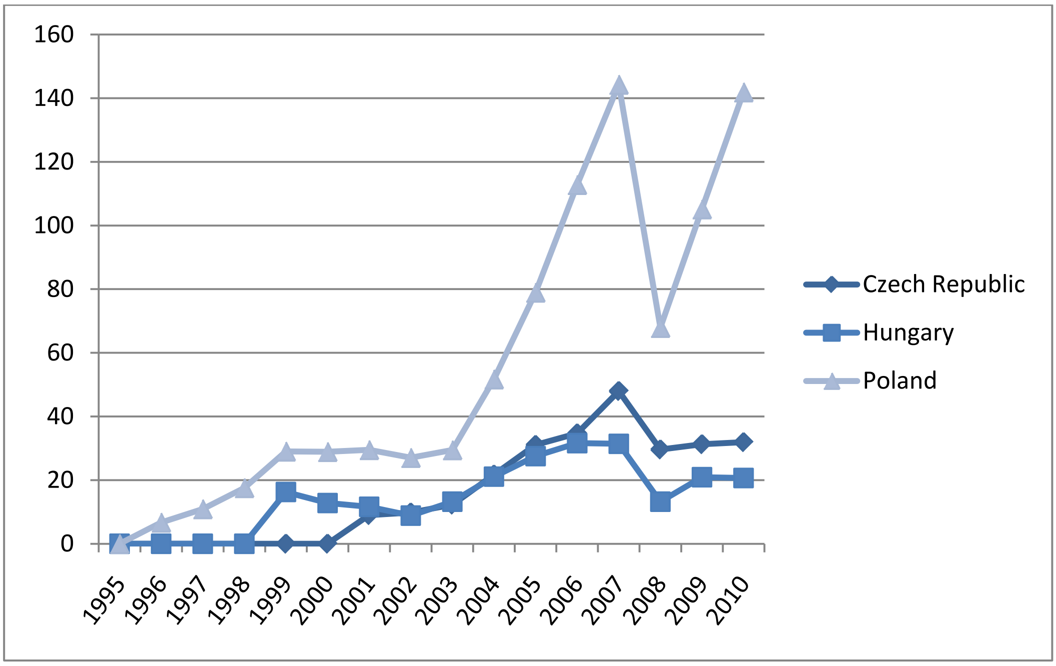

Figure 2. Market Capitalisation of CEE emerging markets

Source: Eurostat Database

A. 3 Equity indices in Euro, monthly data: 1995 – 2010

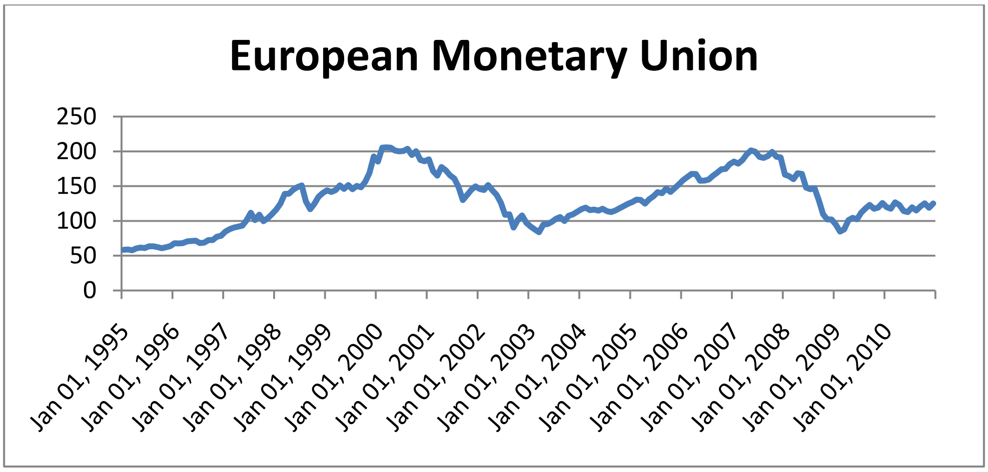

Figure 1 . Evolution of the MSCI EMU index

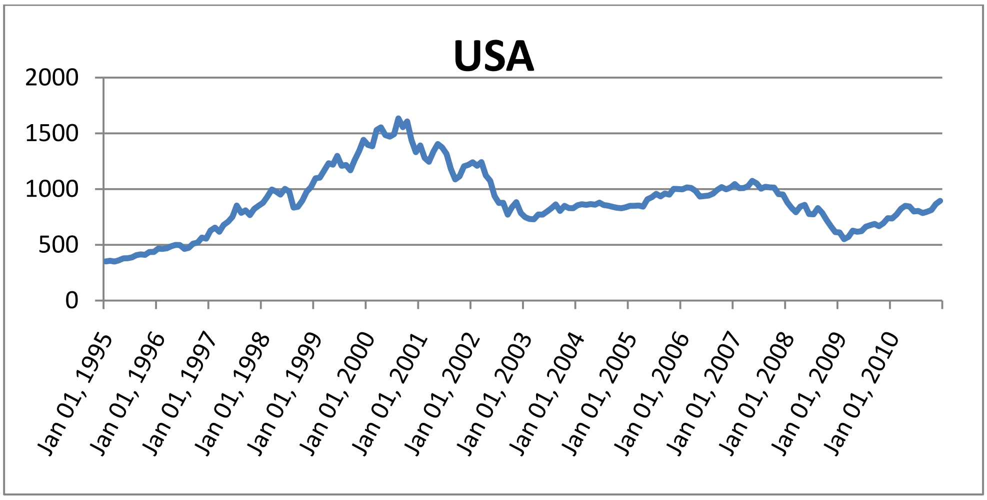

Figure 2. Evolution of the MSCI USA index

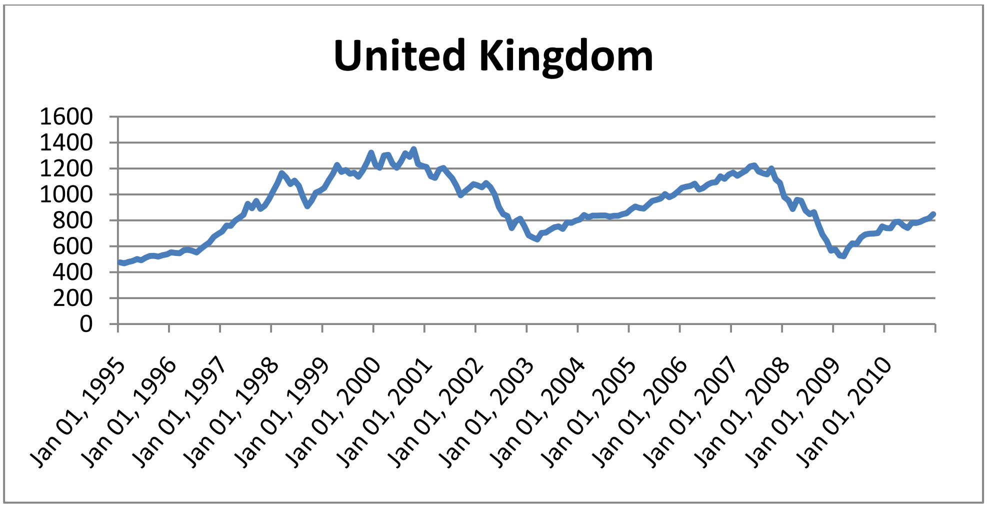

Figure 3. Evolution of the MSCI UK index

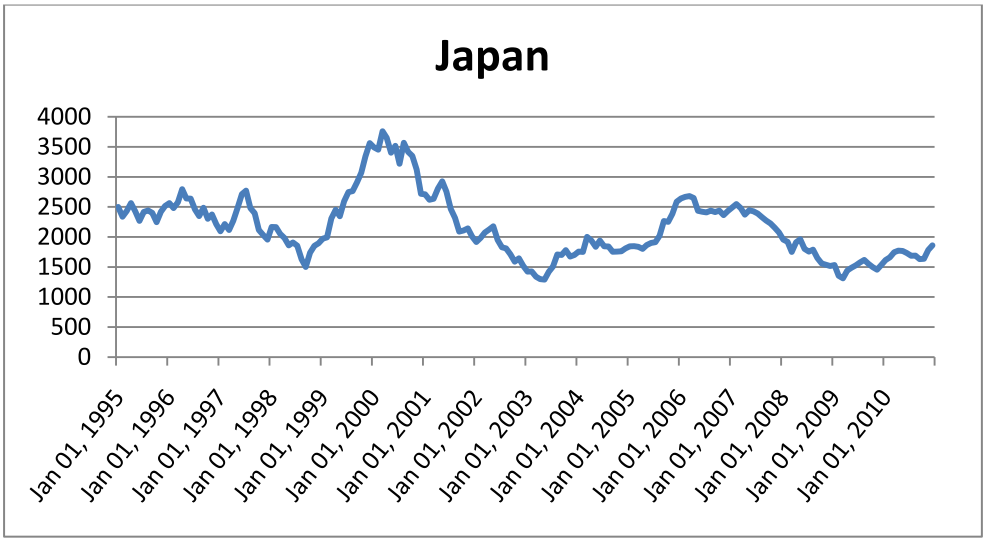

Figure 4. Evolution of the MSCI Japan index

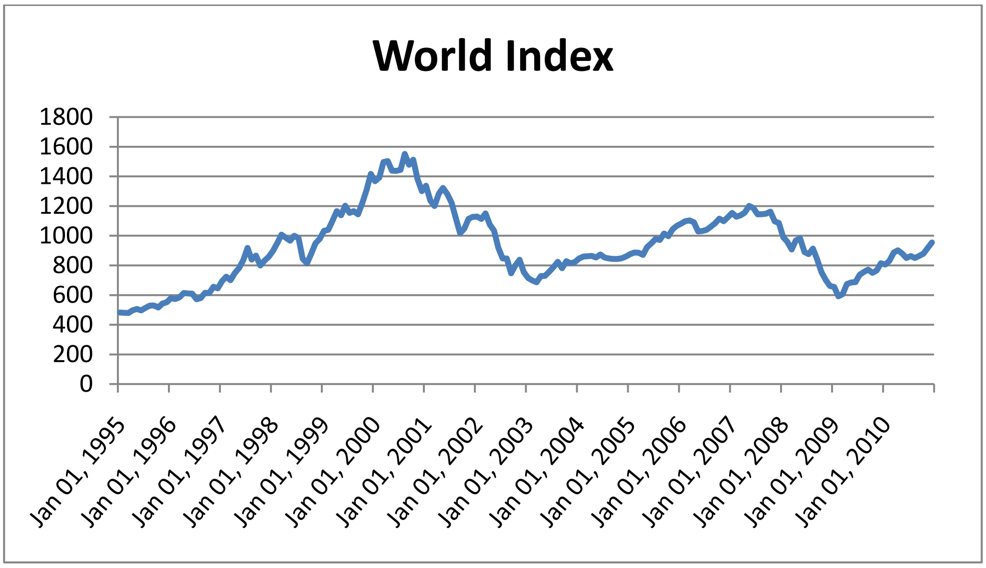

Figure 5. Evolution of the MSCI World index

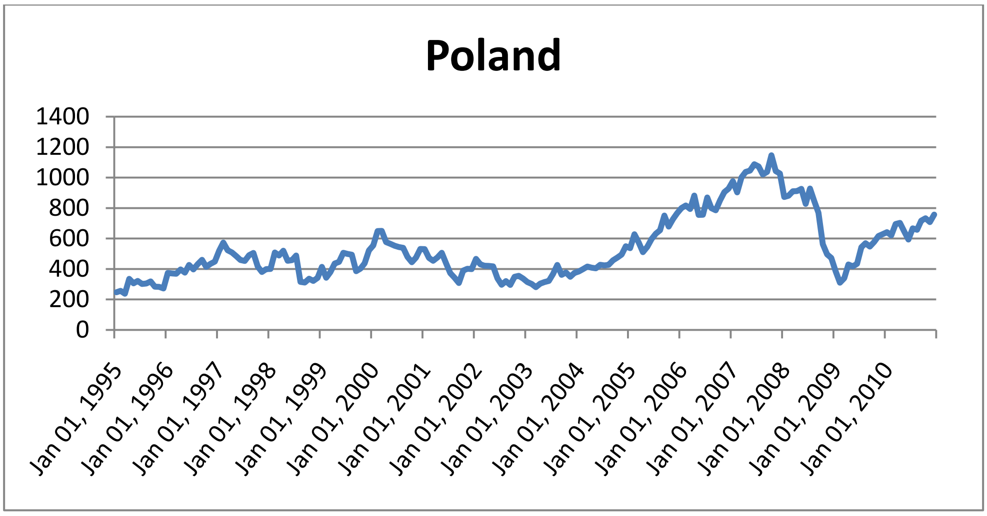

Figure 6. Evolution of the MSCI Poland index

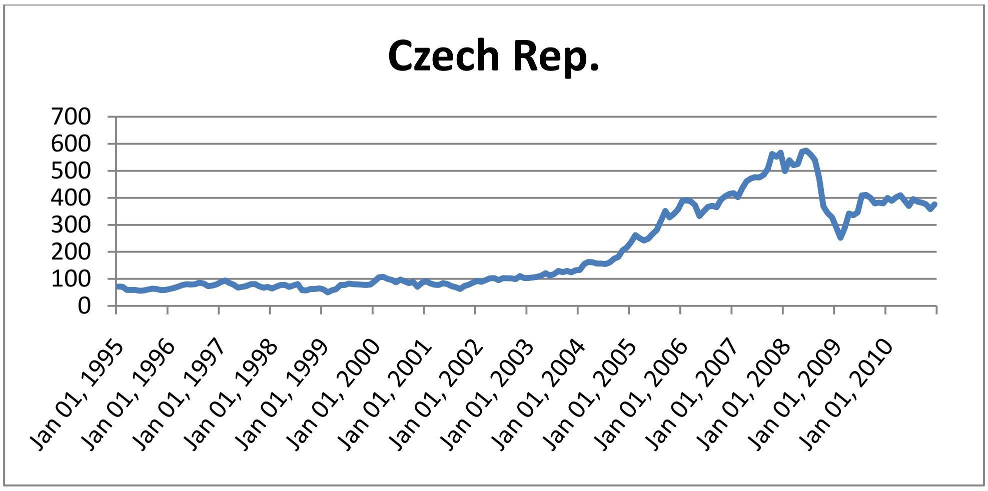

Figure 7. Evolution of the MSCI Czech index

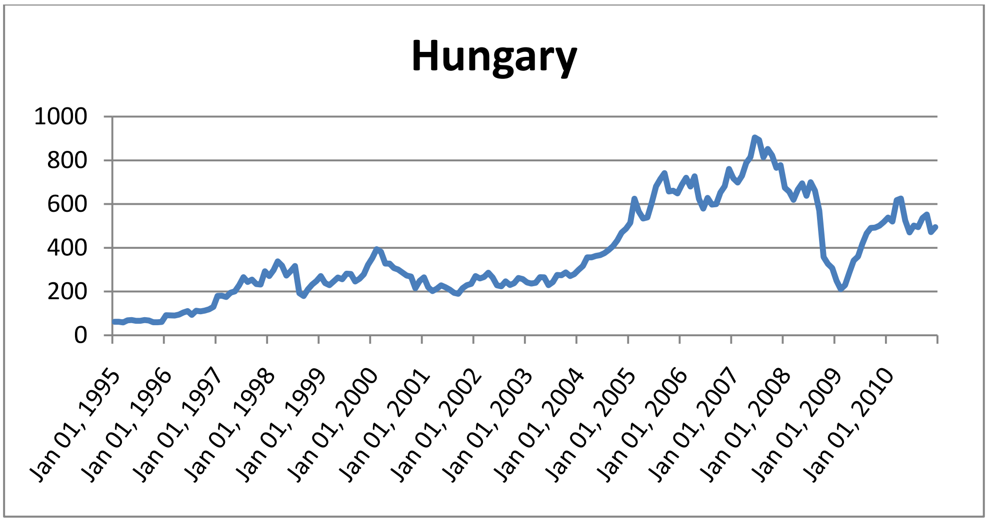

Figure 8. Evolution of the MSCI Hungary index

Source: Morgan Stanley Capital International Database and authors' analysis

A. 4 Deposit rates in Euro, monthly data: 1995 – 2010

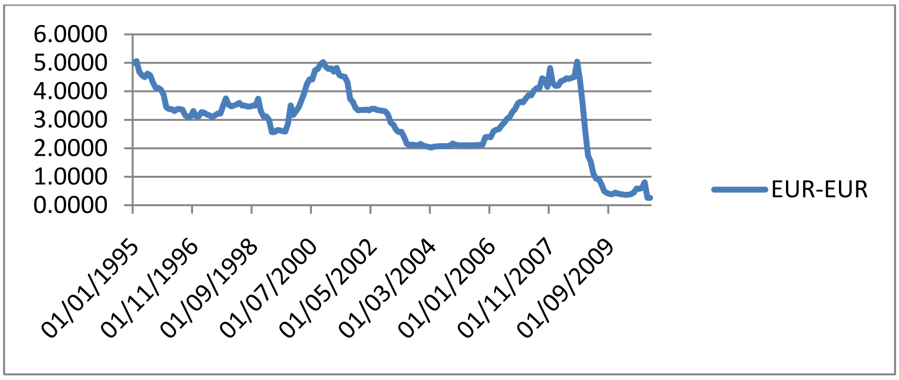

Figure 1. Evolution of the Eur-Eur deposit rate

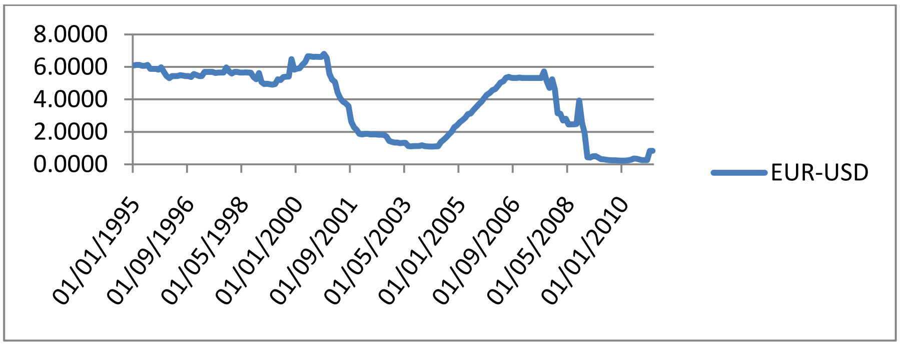

Figure 2. Evolution of the Eur-Usd deposit rate

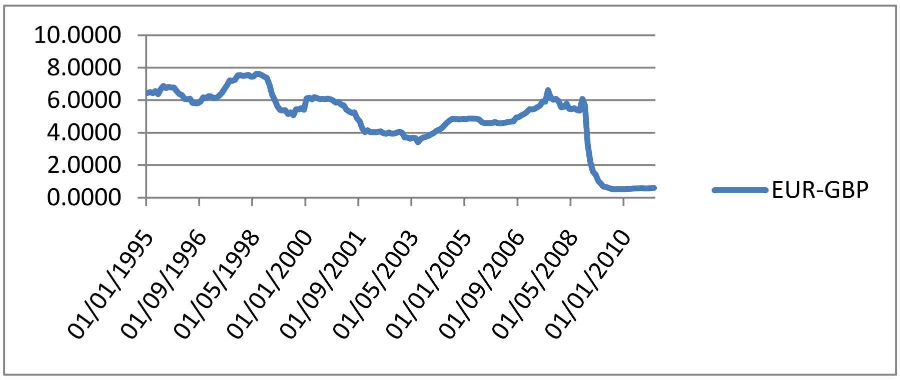

Figure 3. Evolution of the Eur-Gbp deposit rate

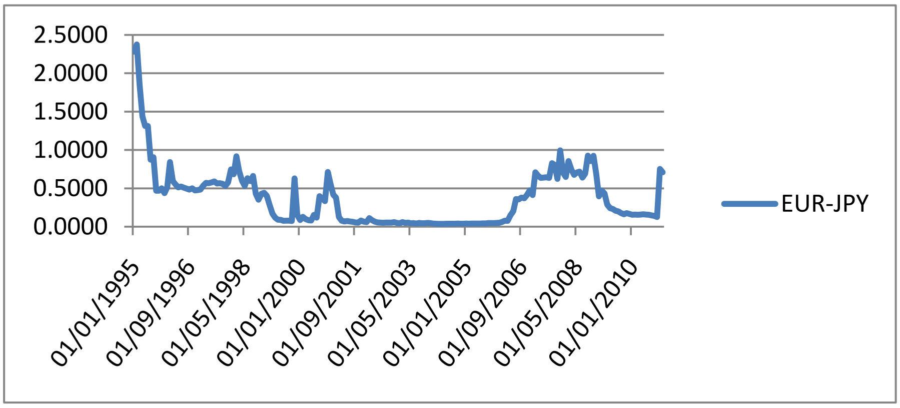

Figure 4. Evolution of the Eur-Yen deposit rate

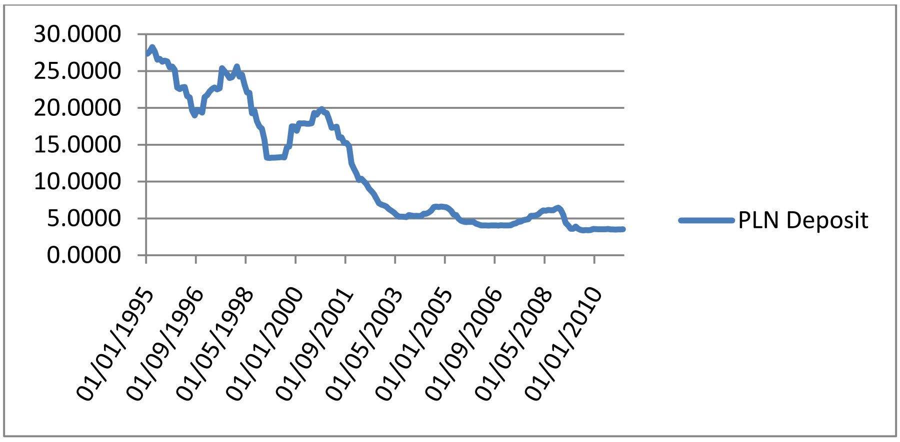

Figure 5. Evolution of the Polish market deposit rate

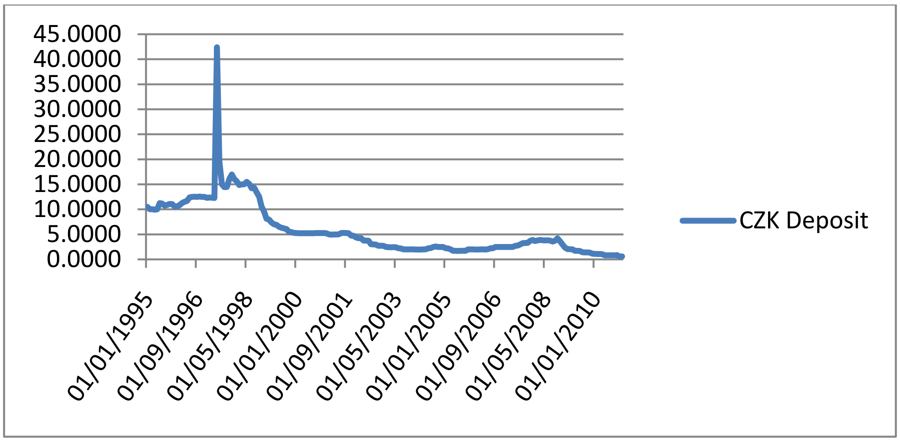

Figure 6. Evolution of the Czech market deposit rate

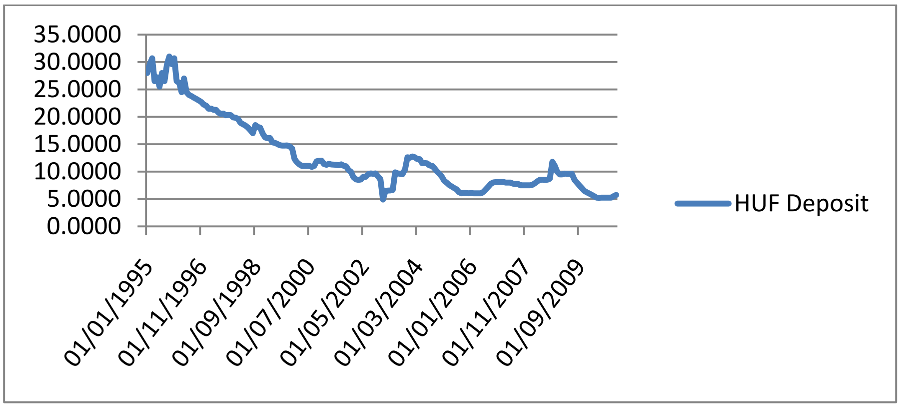

Figure 7. Evolution of the Hungarian market deposit rate

Source: DataStream and authors' analysis

A. 5 Exchange rate regimes, basket composition and currency rates

Period		**ATS**	**DEM**	**USD**	**CHF**	**FRF**	**GBP**
1 Jan 1991 - 1 Jan 1992	Weight	0.1235	0.4552	0.3134	0.0655	-	0.042 4
2 Jan 1992 - 2 May 1993	Weight	0.0807	0.3615	0.4907	0.0379	0.0292	-
	Base rate	2.61	18.35	27.84	20.57	5.37	-
8 February 1993	Split of Czechoslovak currency – Czech koruna. No change in basket composition or band width						
3 May 1993 - 30 Sept 1994	Weight	-	0.6500	0.3500	-	-	-
	Base rate	-	17.995	28.443	-	-	-
	Band	±0.5%					
28 February 1996	Band	±7.5%					
26 May 1997	Introduction of managed float with reference currency DEM and later EUR						

Table 1. Basket composition, currency rates and base rates for Czech Koruna

Source: Kočenda, E. (1997) *The Czech Crown's volatility under modified exchanger regimes*

Period	**Basket Composition**
26 Feb 1990	Adjustable peg, USD 42,6%, DEM 25,6%, ATS 10,4%, CHF 4,9 %, ITL 3,8%, FRF 3,5 %, GBP 2,9%, SEK 2,0%, NLG 1,7%, FIM 1,5%, BEC 1,1%
14 Mar 1991	USD 50,9%, DEM 23,1%, ATS 8,1%, CHF 3,9%, ITL 3,5%, FRF 3,6%, GBP 2,7 %, SEK 1,5%, NLG 2,7%
9 Dec 1991	USD 50% , ECU 50%
1 July 1992	Band width ± 0.3%
2 Aug 1993	USD 50% , DEM 50%
16 May 1994	USD 30% , ECU 70%
1 Jun 1995	Band width ± 0.5%
5 Aug 1994	Band width ± 1.25%
22 December 1994	Band width ± 2.25%
1 January 1997	USD 30% , DEM 70%
1 January 1999	USD 30% , EUR 70%
1 January 2000	Horizontal peg, EUR 100%
4 May 2001	Band width ± 15.00%
Feb 2008	Floating regime with reference currency EUR

Table 2. Basket composition for the Hungarian Forint

Period	Exchange regime
1 Jan 1990	Exchange rate fixed to dollar. 1USD=9500 ZLP
16 May 1991	Exchange rate fixed to a currency basket (45% USD, 35% DEM, 10%GBP, 5% FRF, 5% CHF), devaluation to 1USD=11100ZLP (16.84%)
14 Oct 1991	Crawling peg to the currency basket: crawling rate 1.8% monthly, NBP margin +/- 0.6%
26 Feb 1992	Devaluation by 12% + maintain crawling peg 1.8%
27 Aug 1993	Devaluation by 7.4% + Crawling rate 1.6%
13 Sept 1994	Crawling peg 1.5 % monthly
30 Nov 1994	Crawling peg 1.4%
16 Feb 1995	Crawling peg 1.2 %
6 Mar 1995	NBP margin ± 2%
16 May 1995	Introduction of crawling band +/-7%, crawling rate 1.2%, interbank rates subject to free market forces and NBP intervention
22 Dec 1995	Revaluation by 6%
8 Jan 1996	Crawling peg 1.0%
26 Feb 1998	Crawling peg 0.8% and band +/- 10%
17 July 1998	Crawling peg 0.65%
10 Sept 1998	Crawling peg 0.5%
28 Oct 1998	Band +/- 12.5%
1 Jan 1999	Change in currency basket: euro 55%, USD 45%
25 Mar 1999	Crawling peg 0.3%, band +/- 15%
12 Apr 2000	Floating exchange rate

Table 3. Changes in exchange regime for the Polish Zloty

Source: Kočenda, E., Valachy, J.- *Exchange rates regimes and volatility: Comparison of the Snake and Visegrad*

A. 6 Exchange rates evolution, monthly data: 1995 – 2010

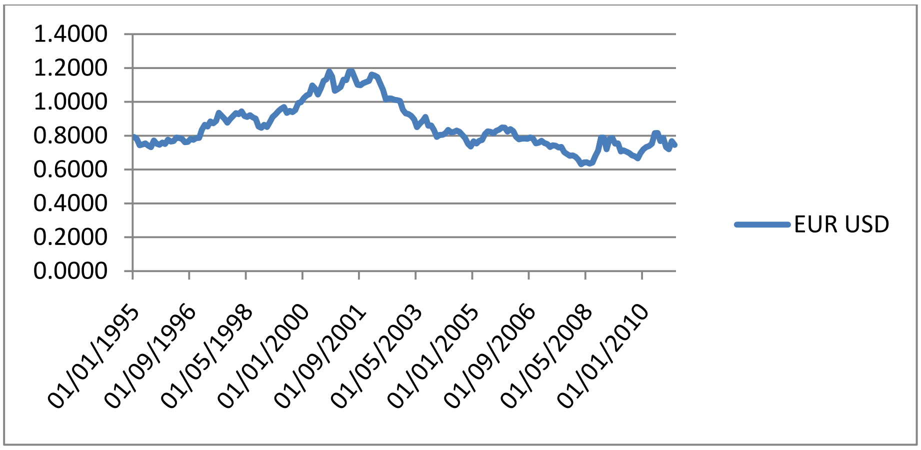

Figure 1. Evolution of the Euro to the US Dollar exchange rate

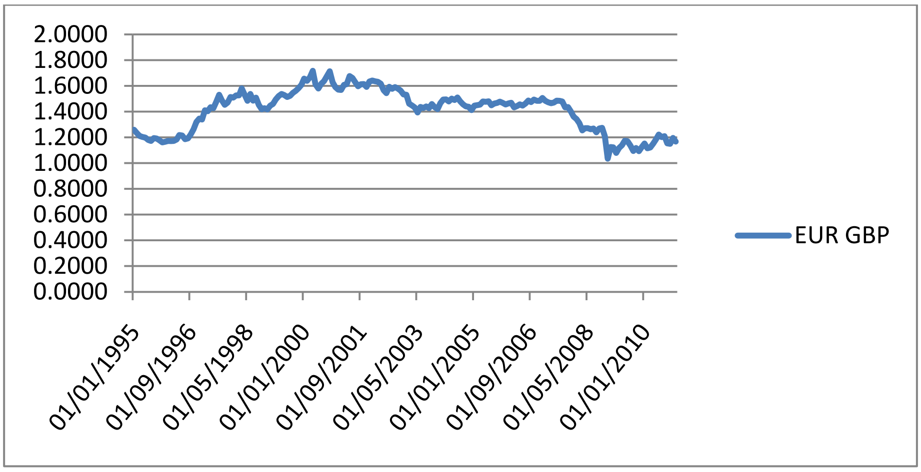

Figure 2. Evolution of the Euro to the British Pound exchange rate

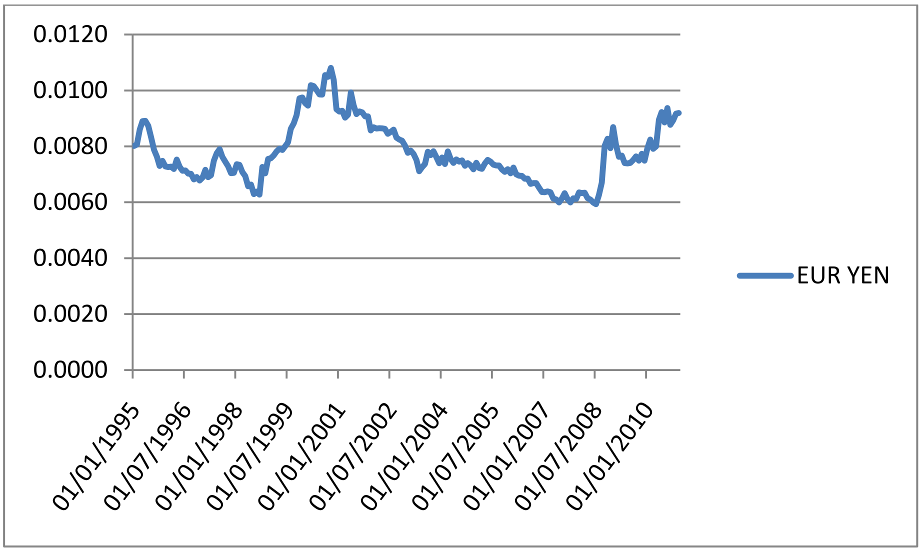

Figure 3. Evolution of the Euro to the Japanese Yen exchange rate

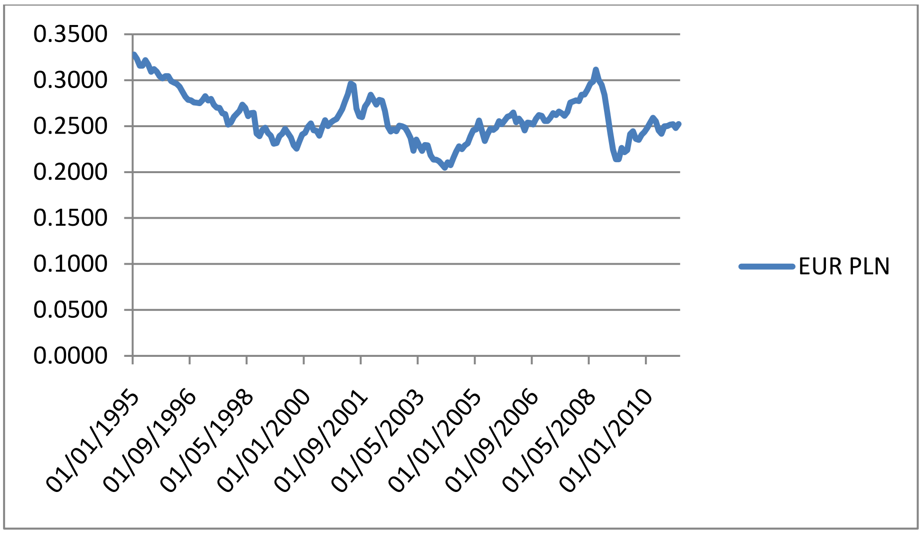

Figure 4. Evolution of the Euro to the Polish Zloty exchange rate

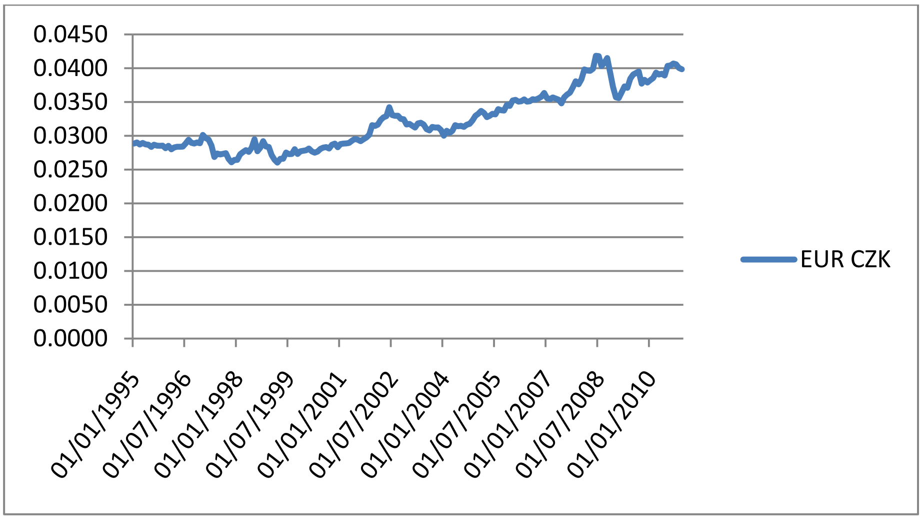

Figure 5. Evolution of the Euro to the Czech Koruna exchange rate

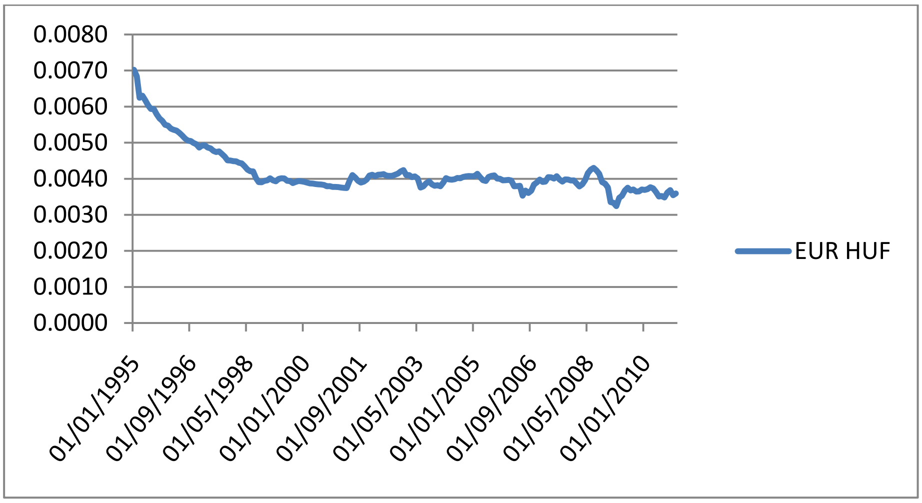

Figure 6. Evolution of the Euro to the Hungarian Forint exchange rate

Source: DataStream and authors' analysis

A. 7 Results for the conditional ICAPM with constant prices of risk – Poland

We used monthly returns denominated in Euro for the period January 1995 - December 2010. Data for the country indexes and for the world portfolio are from MSCI while Eurocurrency deposit rates are collected from DataStream. We used the following mean equation:

$r_{it} = \delta_m cov_{t-1}(r_{it}, r_{mt}) + \sum_{c=1}^{4} \delta_c \, cov_{t-1}(r_{it}, r_{q+c,t}) + \varepsilon_{it}$, which expresses the asset excess return r_{it} as a function of its covariance risk $cov_{t-1}(r_{it}, r_{mt})$ and of its currency risk $cov_{t-1}(r_{it}, r_{q+c,t})$. $\delta_{m,}$ is the price of market risk and $\delta_{c,}$ is the world price of foreign exchange risk for currency c. The conditional covariance matrix H_t is:

$H_t = H_0 * (\iota\iota' - aa' - bb') + aa' * \varepsilon_{t-1}\, \varepsilon_{t-1}' + b'H_{t-1}b$, where H_0 is the unconditional variance covariance matrix of the residuals, ι is an 10×1 vector of ones, a and b are 10×1 vectors of unknown parameters and * denotes the Hadamard matrix product.

	European Monetary Union	Japan	USA	Poland	United Kingdom	EURJPY	EURUSD	EURPLN	EURGBP	World Index
δ_m										0.0160
s.e.										0.0306
t-stat.										0.5210
p-val.										0.3013
δ_c						-0.0469	-0.0970	0.0798	0.0710	
s.e.						0.0306	0.0603	0.0392	0.0604	
t-stat.						-1.5320	-1.6080	2.0350	1.1750	
p-val.						0.0628	0.0539	0.0209	0.1200	

	European Monetary Union	Japan	USA	Poland	United Kingdom	EURJPY	EURUSD	EURPLN	EURGBP	World Index
a_i	0.1366	0.0440	0.1488	0.1639	0.1143	-0.1739	0.2792	0.2959	-0.0158	0.1316
s.e.	0.0670	0.0639	0.0624	0.0687	0.0870	0.0965	0.1008	0.0324	0.0323	0.0583
p-val.	0.0207	0.2453	0.0086	0.0086	0.0944	0.0357	0.0028	0.0000	0.3118	0.0119
b_i	0.8422	0.5882	0.8604	0.9433	0.4849	0.5551	0.3077	0.9447	1.0208	0.8453
s.e.	0.1050	0.7177	0.0739	0.0490	0.3494	0.5682	0.2946	0.0152	0.0176	0.0726
p-val.	0.0000	0.2062	0.0000	0.0000	0.0826	0.1643	0.1481	0.0000	0.0000	0.0000

Table 1.Estimated coefficients for the conditional ICAPM model with constant prices of risk

Wald tests of joint parameter significance
Are the coefficients of all the conditioning variables of the price of market covariance risk jointly equal to zero? χ^2 Stat = 0.271 df = 1 p-level = 0.60262
Are the constant prices of currency risk jointly equal to zero? χ^2 Stat = 9.563 df = 4 p-level = 0.04848

Table 2. Wald test results

	European Monetary Union	Japan	USA	Poland	U.K.	EUR JPY	EUR USD	EUR PLN	EUR GBP	World Index
Avg.	0.38	-0.53	0.47	0.44	0.22	-0.62	-0.18	0.58	0.06	0.22
Max.	12.89	14.36	12.48	34.18	9.33	15.20	6.15	5.56	5.33	9.37
Min.	-19.56	-14.30	-16.20	-44.07	-12.17	-10.79	-7.56	-8.19	-6.35	-15.53
Std.	5.81	6.36	5.69	10.98	4.41	3.54	2.68	2.63	2.14	5.08

Table 3. Excess Returns Statistics

Summary statistics	**EMU**	**Japan**	**USA**	**Poland**	**U.K.**	**EUR JPY**	**EUR USD**	**EUR PLN**	**EUR GBP**	**World Index**
Avg:	-0.021	-0.032	0.056	-0.033	-0.015	-0.010	0.035	0.103	0.005	0.010
med:	0.148	-0.024	0.155	-0.053	0.089	-0.081	0.002	0.179	-0.113	0.111
min:	-3.370	-2.190	-2.930	-4.170	-2.840	-2.890	-2.720	-3.480	-3.010	-3.150
max:	2.160	2.310	2.160	3.100	2.060	4.510	2.500	1.970	2.470	1.820
std:	0.990	1.000	1.000	1.010	1.000	1.000	1.010	1.020	1.010	1.000
skw:	-0.770	0.160	-0.570	-0.230	-0.530	1.030	-0.140	-0.710	-0.110	-0.720
Kurt[3]	1.200	-0.580	0.250	2.600	-0.140	3.240	-0.050	0.930	-0.010	0.220
BJ[4]	17.120	2.280	6.410	30.130	5.460	65.410	0.420	13.080	0.250	9.950
pval	0.000	0.319	0.041	0.000	0.065	0.000	0.812	0.001	0.881	0.007
L-B[5]	17.420	12.310	15.040	12.640	15.560	5.000	18.680	14.120	13.490	14.770
pval[6]	0.135	0.421	0.239	0.395	0.212	0.958	0.097	0.293	0.335	0.254

Auto-corr. order	**EMU**	**Japan**	**USA**	**Poland**	**U.K.**	**EUR JPY**	**EUR USD**	**EUR PLN**	**EUR GBP**	**World Index**
1	0.07	0.15	0.07	-0.05	0.19	0.01	0.15	0.24	0.05	0.12
2	0.13	0.07	0.06	-0.03	0.07	0.13	0.03	-0.02	0.01	0.07
3	0.05	0.07	0.07	-0.04	0.04	-0.04	0.07	0.03	0.04	0.04
4	-0.03	-0.07	-0.05	-0.19	0.11	0.00	-0.11	-0.02	-0.04	-0.05
5	0.01	0.12	0.09	0.01	0.01	-0.02	0.06	-0.06	0.06	0.07
6	0.13	-0.06	-0.01	-0.04	0.00	-0.01	0.05	0.06	-0.01	-0.01
7	-0.07	0.02	0.05	0.06	0.03	0.07	0.11	0.15	0.15	0.01
8	0.18	0.08	0.15	-0.14	0.18	0.03	0.16	0.03	0.09	0.17
9	-0.04	0.17	0.15	0.09	0.12	0.06	0.11	0.04	0.18	0.13
10	0.17	-0.03	0.18	0.11	0.10	0.06	0.17	0.14	-0.12	0.18

[3] The kurtosis is equal to zero for the normal distribution
[4] Bera-Jarque test statistics for normality
[5] Ljung-Box test statistic of order 12
[6] p-values for Ljung-Box test statistic of order 12

11	0.03	-0.08	-0.02	0.03	0.00	0.02	0.12	0.08	-0.03	-0.03
12	0.16	0.02	0.10	0.13	0.12	0.08	0.10	-0.03	-0.13	0.10

Table 4. Standardized residuals statistics

Summary statistics	**EMU**	**Japan**	**USA**	**Poland**	**U.K.**	**EUR JPY**	**EUR USD**	**EUR PLN**	**EUR GBP**	**World Index**
Avg:	0.97	0.99	0.99	1.00	0.99	1.00	1.02	1.04	1.01	0.98
med:	0.32	0.68	0.42	0.29	0.44	0.30	0.45	0.50	0.52	0.47
min:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
max:	11.40	5.40	8.60	17.40	8.00	20.30	7.40	12.10	9.10	9.90
std:	1.73	1.17	1.42	2.13	1.35	2.25	1.40	1.67	1.41	1.44
skw:	3.59	1.94	2.62	5.06	2.47	6.12	2.12	4.20	2.93	3.26
Kurt[7]	15.62	3.71	8.49	32.43	7.64	48.15	4.85	22.63	11.26	14.44
BJ[8]	1328	132	449	5173	373	11055	188	2614	724	1128
pval	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L-B[9]	18.66	16.83	13.17	8.28	28.91	4.36	9.64	9.50	9.19	15.49
pval[10]	0.10	0.16	0.36	0.76	0.00	0.98	0.65	0.66	0.69	0.22

Auto-corr. order	**EMU**	**Japan**	**USA**	**Poland**	**U.K.**	**EUR JPY**	**EUR USD**	**EUR PLN**	**EUR GBP**	**World Index**
1	0.15	-0.10	-0.05	-0.07	0.15	-0.07	-0.15	-0.02	0.07	0.05
2	0.21	0.01	0.07	-0.11	0.06	0.06	-0.07	0.06	0.02	0.10
3	0.15	-0.05	0.27	0.04	0.39	-0.01	0.01	0.01	-0.01	0.26
4	-0.06	-0.08	-0.06	-0.06	0.13	-0.04	-0.03	-0.11	0.13	-0.10
5	0.05	0.11	0.04	-0.01	-0.02	0.09	0.15	0.01	-0.02	0.01
6	0.01	-0.16	0.07	0.15	0.09	-0.07	0.03	-0.02	0.18	0.02
7	0.07	0.17	-0.06	-0.07	0.11	0.00	-0.08	-0.07	0.05	0.00
8	-0.10	-0.02	0.06	-0.02	0.02	-0.08	0.02	0.12	-0.04	-0.04
9	0.00	0.11	0.02	0.09	-0.01	0.07	-0.03	-0.01	0.03	0.04
10	0.06	-0.04	0.04	0.05	0.10	0.00	-0.13	0.17	-0.07	0.12
11	-0.07	-0.13	-0.07	-0.08	-0.09	-0.05	0.02	0.08	-0.10	-0.08
12	0.17	0.13	0.02	0.00	-0.07	-0.02	-0.06	-0.06	-0.01	0.11

Table 5. Squared standardized residuals statistics

[7]The kurtosis is equal to zero for the normal distribution
[8]Bera-Jarque test statistics for normality
[9]Ljung-Box test statistic of order 12
[10]p-values for Ljung-Box test statistic of order 12

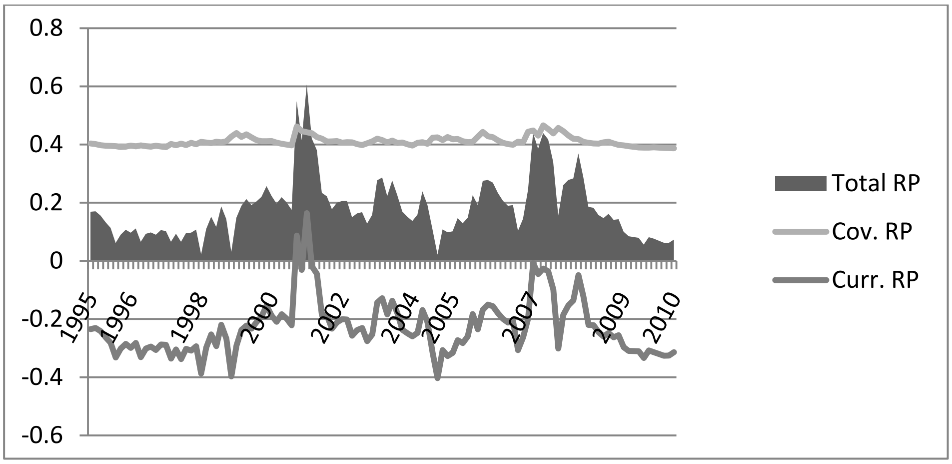

Figure 1. Risk premium decomposition - World market portfolio

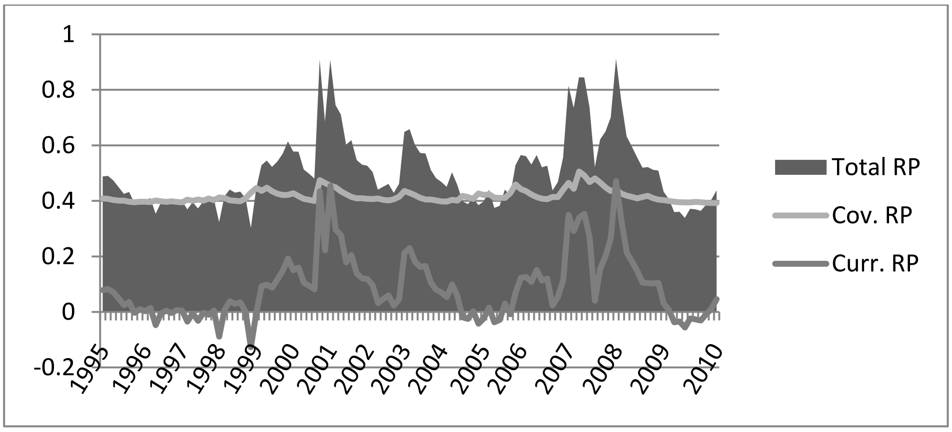

Figure 2. Risk premium decomposition - EMU equity market

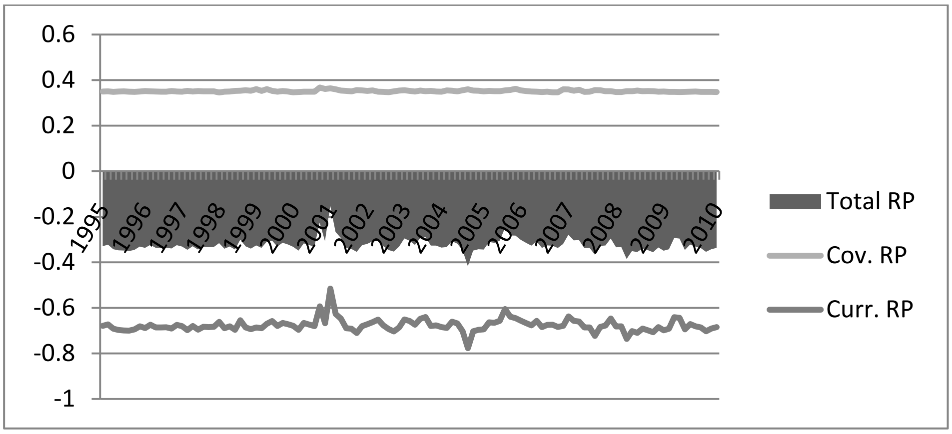

Figure 3. Risk premium decomposition - Japan equity market

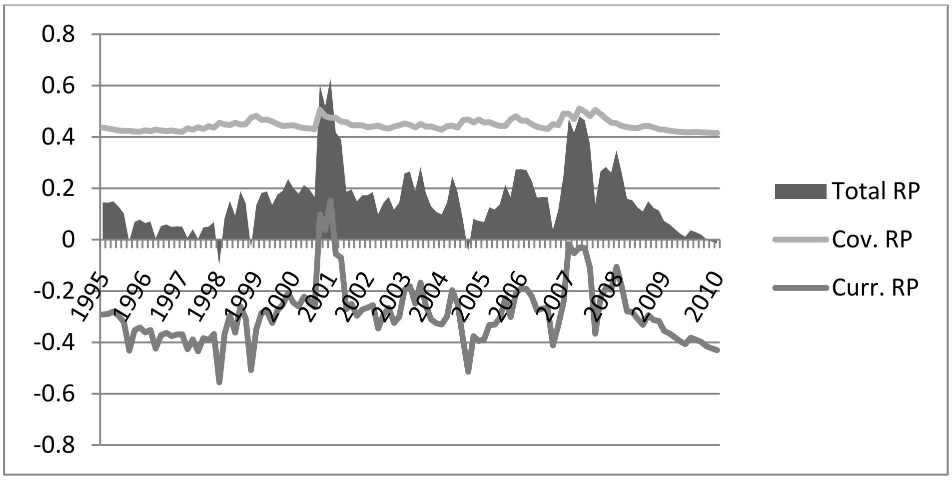

Figure 4. Risk premium decomposition - USA equity market

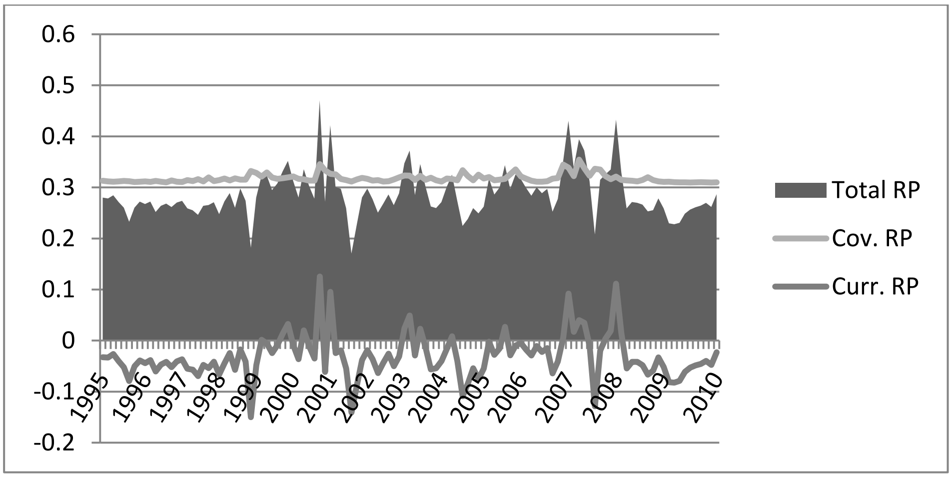

Figure 5. Risk premium decomposition - UK equity market

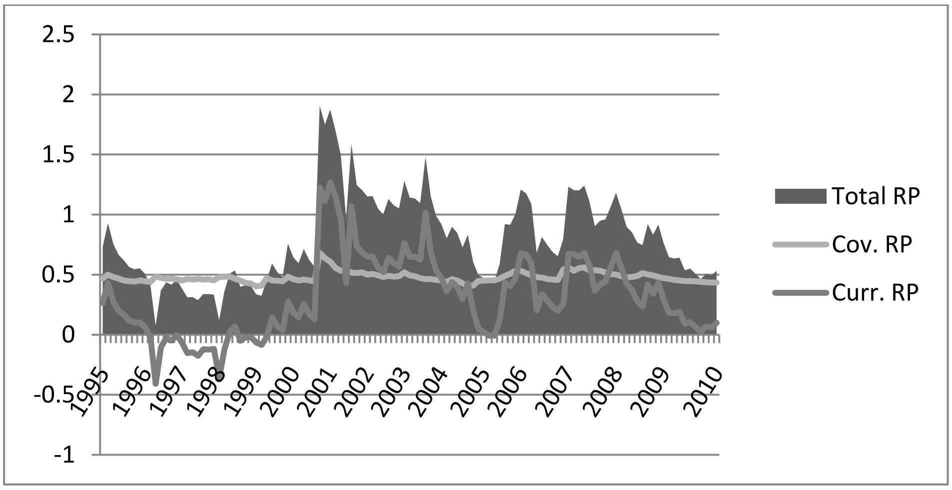

Figure 6. Risk premium decomposition - Poland equity market

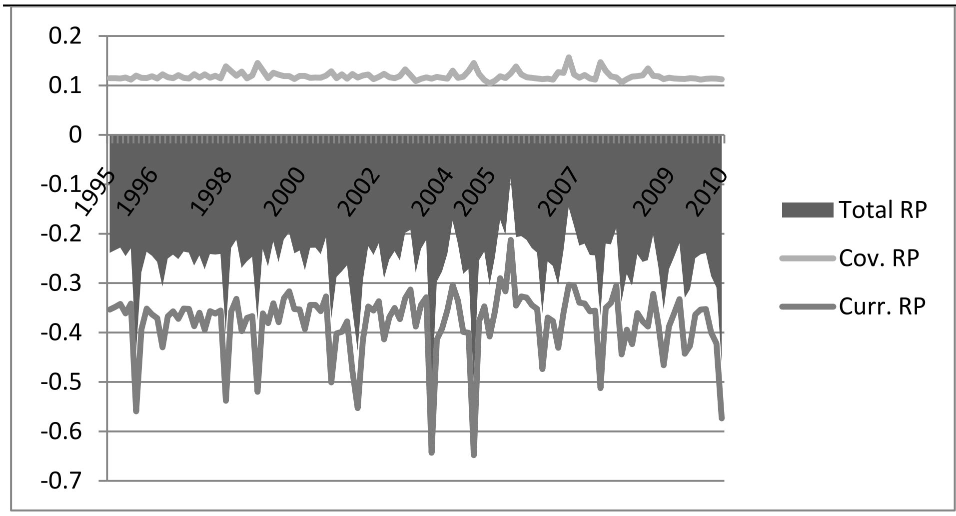

Figure 7. Risk premium decomposition – USD Eurodeposit

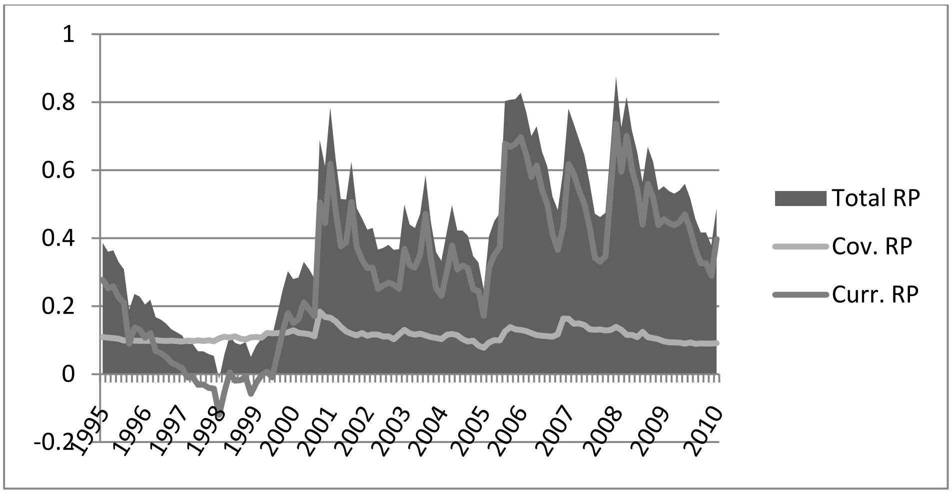

Figure 8. Risk premium decomposition – PLN Eurodeposit

	TP	MP	CP		TP	MP	CP
EMU				***EURYEN***			
Mean	0.506	0.417	0.089	**Mean**	-0.581	0.117	-0.698
St Dev	0.131	0.023	0.115	**St Dev**	0.077	0.007	0.075
Japan				***EURUSD***			
Mean	-0.325	0.352	-0.677	**Mean**	-0.261	0.119	-0.380
St Dev	0.029	0.004	0.028	**St Dev**	0.065	0.008	0.066
US				***EURPLN***			
Mean	0.158	0.446	-0.288	**Mean**	0.416	0.114	0.302
St Dev	0.130	0.021	0.117	**St Dev**	0.221	0.019	0.212
Poland				***EURGBP***			
Mean	0.790	0.479	0.311	**Mean**	0.047	0.061	-0.014
St Dev	0.367	0.043	0.335	**St Dev**	0.011	0.001	0.011
UK				***World***			
Mean	0.287	0.318	-0.031	**Mean**	0.181	0.411	-0.230
St Dev	0.046	0.008	0.043	**St Dev**			

Table 6. Descriptive statistics for total and decomposed risk premiums

A. 8 Results for the conditional ICAPM with constant prices of risk – The Czech Republic

We used monthly returns denominated in Euro for the period January 1995 - December 2010. Data for the country indexes and for the world portfolio are from MSCI while Eurocurrency deposit rates are collected from DataStream. We used the following mean equation:

$r_{it} = \delta_m cov_{t-1}(r_{it}, r_{mt}) + \sum_{c=1}^{4} \delta_c \, cov_{t-1}(r_{it}, r_{q+c,t}) + \varepsilon_{it}$, which expresses the asset excess return r_{it} as a function of its covariance risk $cov_{t-1}(r_{it}, r_{mt})$ and of its currency risk $cov_{t-1}(r_{it}, r_{q+c,t})$. $\delta_{m,}$ is the price of market risk and $\delta_{c,}$ is the world price of foreign exchange risk for currency c. The conditional covariance matrix H_t is:

$H_t = H_0 * (\iota\iota' - aa' - bb') + aa' * \varepsilon_{t-1}\, \varepsilon_{t-1}' + b' H_{t-1} b$, where H_0 is the unconditional variance covariance matrix of the residuals, ι is an 10×1 vector of ones, a and b are 10×1 vectors of unknown parameters and * denotes the Hadamard matrix product.

	European Monetary Union	Japan	USA	Czech	United Kingdom	EURJPY	EURUSD	EURCZK	EURGBP	World Index
δ_m										0.0479
s.e.										0.0272
t-stat.										1.7590
p-val.										0.0393
δ_c						-0.0730	-0.0544	-0.1540	0.0281	
s.e.						0.0315	0.0553	0.0500	0.1202	
t-stat.						-2.3190	-0.9840	-3.0780	0.2340	
p-val.						0.0102	0.1625	0.0010	0.4076	

	European Monetary Union	Japan	USA	Czech	United Kingdom	EURJPY	EURUSD	EURCZK	EURGBP	World Index
a_i	0.1084	0.0545	0.0688	0.4259	0.1853	0.2163	0.0632	0.4144	0.0361	0.0886
s.e.	0.0706	0.0514	0.0642	0.0875	0.0632	0.0898	0.1285	0.0738	0.1033	0.0573
p-val.	0.0625	0.1444	0.1420	0.0000	0.0017	0.0080	0.3115	0.0000	0.3634	0.0609
b_i	-0.7061	0.4620	0.0601	0.4567	-0.6215	0.6791	0.4391	0.7594	0.8984	-0.3145
s.e.	0.1960	0.7664	0.8119	0.2057	0.3207	0.3572	0.7429	0.0925	0.3905	0.3076
p-val.	0.0002	0.2733	0.4705	0.0132	0.0263	0.0286	0.2772	0.0000	0.0107	0.1533

Table 1.Estimated coefficients for the conditional ICAPM model with constant prices of risk

Wald tests of joint parameter significance
Are the coefficients of all the conditioning variables of the price of market covariance risk jointly equal to zero? χ^2 Stat = 3.093 df =1 p-level = 0.07862
Are the constant prices of currency risk jointly equal to zero? χ^2 Stat =18.692 df = 4 p-level = 0.00090

Table 2. Wald test results

Summary statistics	EMU	Japan	USA	Czech	U.K.	EUR JPY	EUR USD	EUR CZK	EUR GBP	World Index
Avg:	-0.020	-0.045	0.020	0.132	-0.040	0.001	-0.007	0.022	-0.011	-0.014
med:	0.144	-0.032	0.110	0.248	0.059	-0.095	-0.039	0.069	-0.127	0.083
min:	-3.440	-2.220	-2.920	-3.930	-2.870	-2.870	-2.760	-3.770	-3.010	-3.130
max:	2.150	2.300	2.140	2.650	2.080	4.540	2.360	2.850	2.450	1.810
std:	0.990	1.000	1.000	1.010	0.990	1.010	1.000	1.000	1.000	1.000
skw:	-0.750	0.160	-0.560	-0.780	-0.500	1.040	-0.160	-0.360	-0.110	-0.710
Kurt[11]	1.260	-0.580	0.190	1.820	-0.140	3.250	-0.090	1.730	0.010	0.200
BJ[12]	17.190	2.250	5.980	25.530	4.970	66.210	0.570	14.930	0.230	9.550
pval	0.000	0.324	0.050	0.000	0.083	0.000	0.752	0.001	0.892	0.008
L-B[13]	16.920	12.350	14.430	14.490	15.390	5.440	18.290	19.650	13.660	14.270
pval[14]	0.153	0.418	0.274	0.271	0.221	0.942	0.107	0.074	0.323	0.284

Auto-corr. order	EMU	Japan	USA	Czech	U.K.	EUR JPY	EUR USD	EUR CZK	EUR GBP	World Index
1	0.06	0.15	0.07	0.00	0.18	0.01	0.15	-0.04	0.05	0.11
2	0.13	0.07	0.06	-0.10	0.07	0.13	0.03	0.03	0.00	0.07
3	0.04	0.07	0.07	-0.14	0.04	-0.03	0.07	0.12	0.04	0.04
4	-0.03	-0.07	-0.06	-0.15	0.10	0.00	-0.11	-0.20	-0.04	-0.06
5	0.00	0.12	0.09	0.05	0.02	-0.02	0.06	0.25	0.06	0.06
6	0.13	-0.06	-0.01	0.14	0.00	-0.01	0.05	0.09	-0.01	-0.01
7	-0.07	0.02	0.06	0.09	0.04	0.07	0.11	0.13	0.15	0.01
8	0.18	0.08	0.14	-0.02	0.18	0.03	0.16	0.02	0.10	0.16
9	-0.05	0.17	0.15	-0.04	0.12	0.06	0.11	-0.12	0.18	0.13
10	0.16	-0.03	0.18	0.13	0.10	0.08	0.17	-0.04	-0.12	0.18
11	0.03	-0.08	-0.03	-0.10	0.00	0.03	0.12	0.01	-0.03	-0.03
12	0.16	0.02	0.10	-0.08	0.12	0.09	0.09	0.02	-0.13	0.10

Table 3. Standardized residuals statistics

[11] The kurtosis is equal to zero for the normal distribution
[12] Bera-Jarque test statistics for normality
[13] Ljung-Box test statistic of order 12
[14] p-values for Ljung-Box test statistic of order 12

Summary statistics	EMU	Japan	USA	Czech	U.K.	EUR JPY	EUR USD	EUR CZK	EUR GBP	World Index
Avg:	0.98	0.99	0.99	1.04	0.98	1.01	0.99	1.00	0.99	0.99
med:	0.32	0.67	0.38	0.55	0.45	0.30	0.46	0.31	0.49	0.51
min:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
max:	11.80	5.30	8.50	15.40	8.20	20.60	7.60	14.20	9.10	9.80
std:	1.76	1.17	1.44	1.88	1.36	2.28	1.36	1.89	1.39	1.47
skw:	3.62	1.94	2.59	4.97	2.55	6.13	2.19	4.23	2.98	3.17
Kurt[15]	16.01	3.68	8.09	31.99	8.20	48.24	5.48	23.09	11.73	13.24
BJ[16]	1387	130	416	5031	420	11097	223	2712	778	968
pval	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L-B[17]	20.59	17.39	14.69	14.34	28.79	4.78	7.40	7.07	9.50	18.20
pval[18]	0.06	0.14	0.26	0.28	0.00	0.97	0.83	0.85	0.66	0.11

Auto-corr. order	EMU	Japan	USA	Czech	U.K.	EUR JPY	EUR USD	EUR CZK	EUR GBP	World Index
1	0.15	-0.10	-0.01	-0.04	0.13	-0.08	-0.10	0.08	0.08	0.06
2	0.23	0.01	0.09	0.01	0.05	0.05	-0.07	-0.11	0.02	0.12
3	0.18	-0.05	0.30	0.07	0.39	-0.01	0.00	0.00	-0.01	0.29
4	-0.05	-0.08	-0.05	-0.10	0.12	-0.04	-0.01	0.05	0.12	-0.09
5	0.05	0.11	0.04	-0.02	-0.02	0.09	0.13	0.08	-0.02	0.02
6	0.01	-0.17	0.08	0.15	0.09	-0.08	0.03	0.08	0.18	0.02
7	0.08	0.17	-0.04	0.03	0.10	0.01	-0.06	-0.07	0.04	0.01
8	-0.10	-0.03	0.05	-0.02	0.02	-0.08	0.01	-0.05	-0.05	-0.04
9	0.00	0.10	0.03	0.26	0.00	0.08	-0.04	0.02	0.03	0.04
10	0.06	-0.03	0.04	0.05	0.11	0.01	-0.13	0.01	-0.07	0.12
11	-0.07	-0.13	-0.07	0.02	-0.09	-0.04	0.03	-0.10	-0.10	-0.08
12	0.17	0.14	0.02	-0.02	-0.07	-0.01	-0.06	-0.06	-0.01	0.12

Table 4. Squared standardized residuals statistics

[15]The kurtosis is equal to zero for the normal distribution
[16]Bera-Jarque test statistics for normality
[17]Ljung-Box test statistic of order 12
[18]p-values for Ljung-Box test statistic of order 12

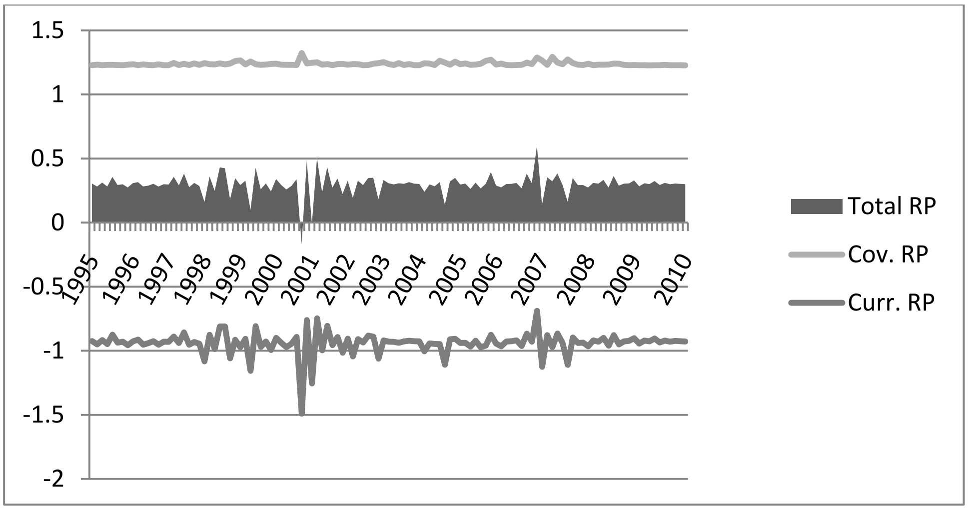

Figure 1. Risk premium decomposition - World market portfolio

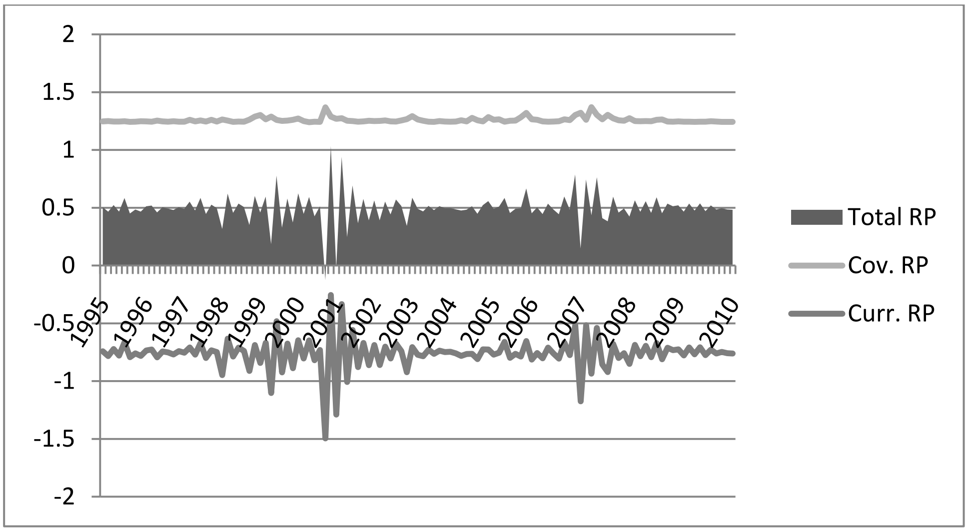

Figure 2. Risk premium decomposition - EMU equity market

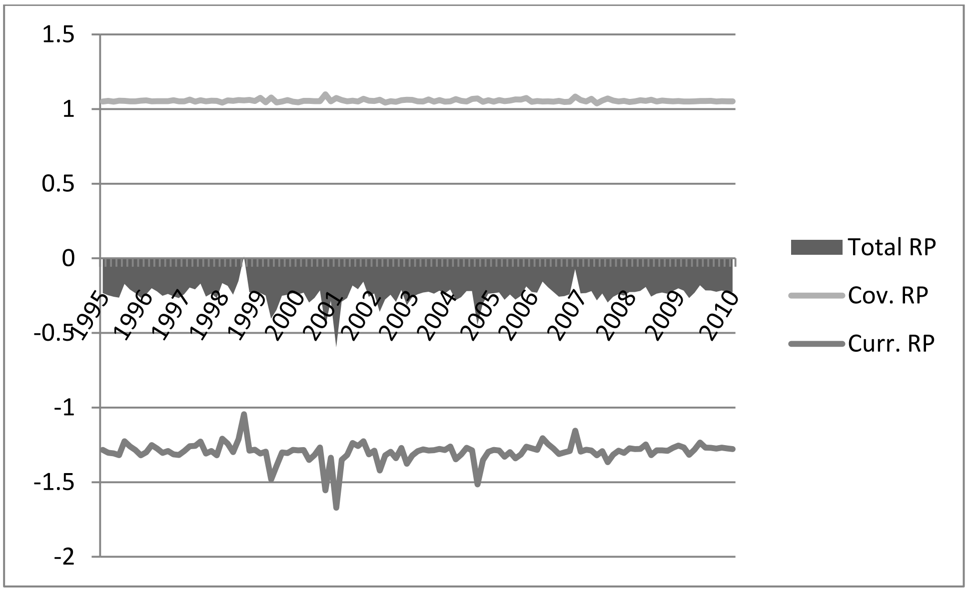

Figure 3. Risk premium decomposition - Japan equity market

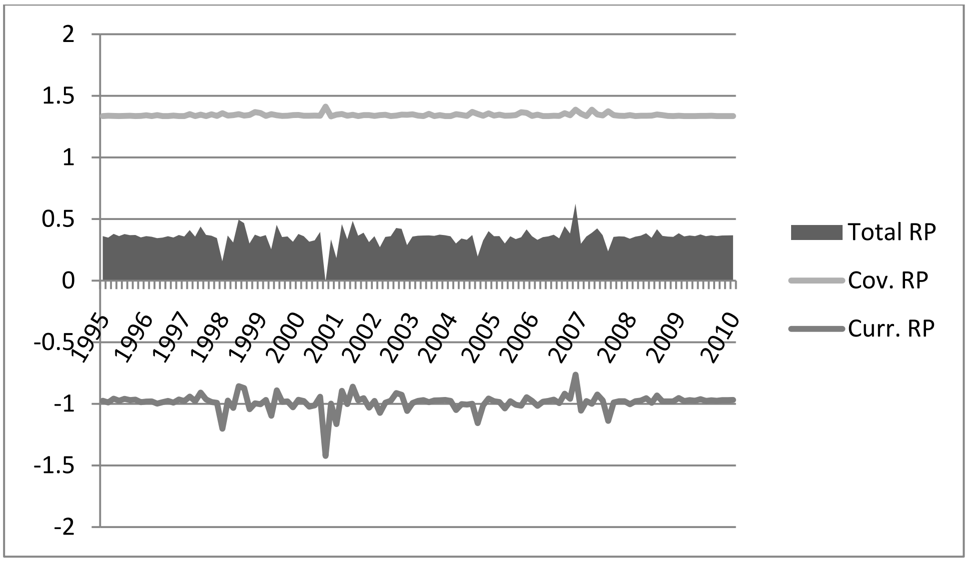

Figure 4. Risk premium decomposition - USA equity market

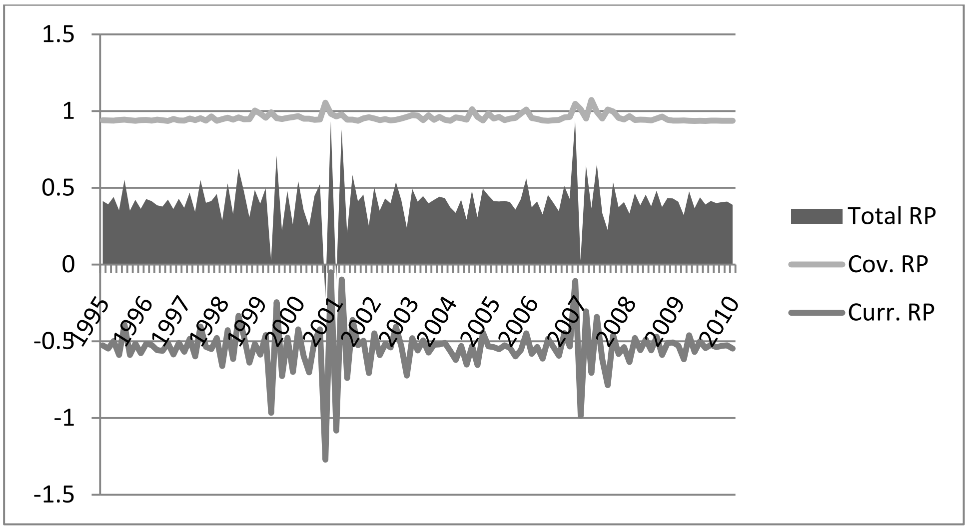

Figure 5. Risk premium decomposition - UK equity market

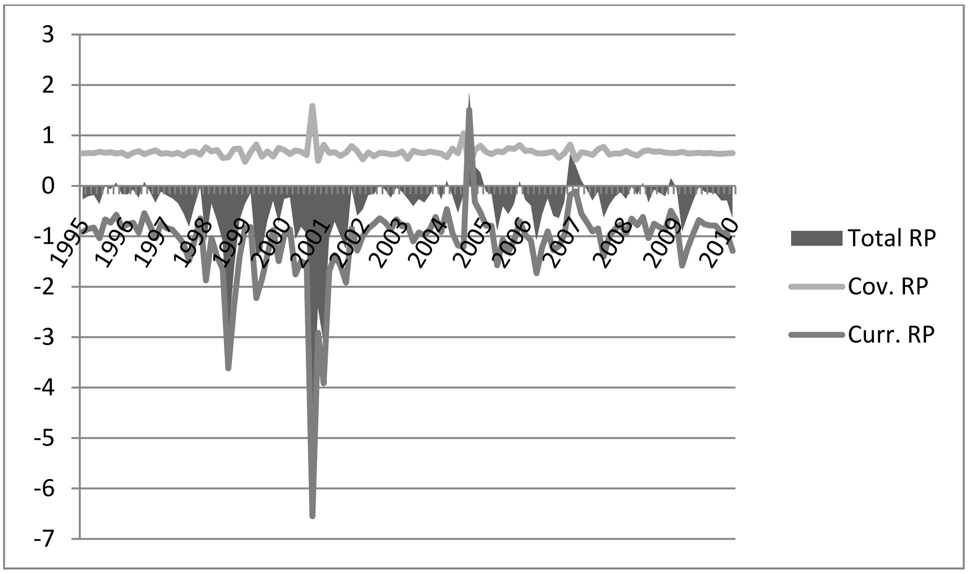

Figure 6. Risk premium decomposition - Czech equity market

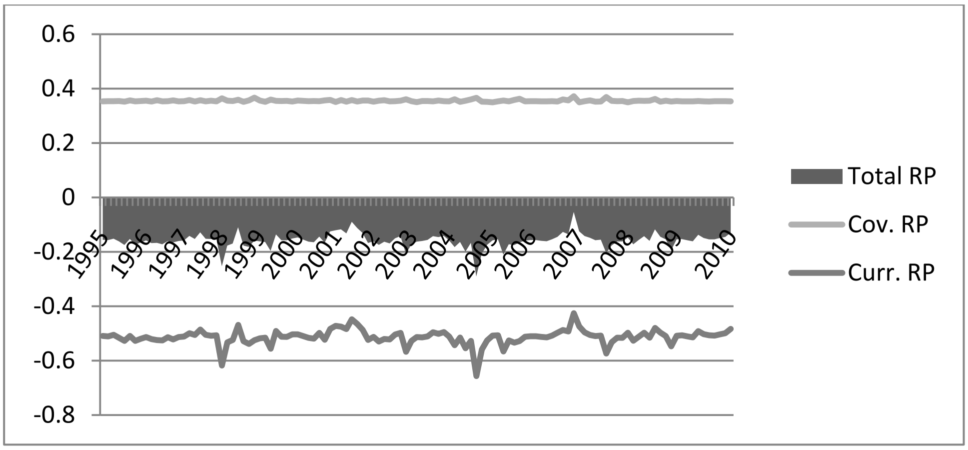

Figure 7. Risk premium decomposition – USD Eurodeposit

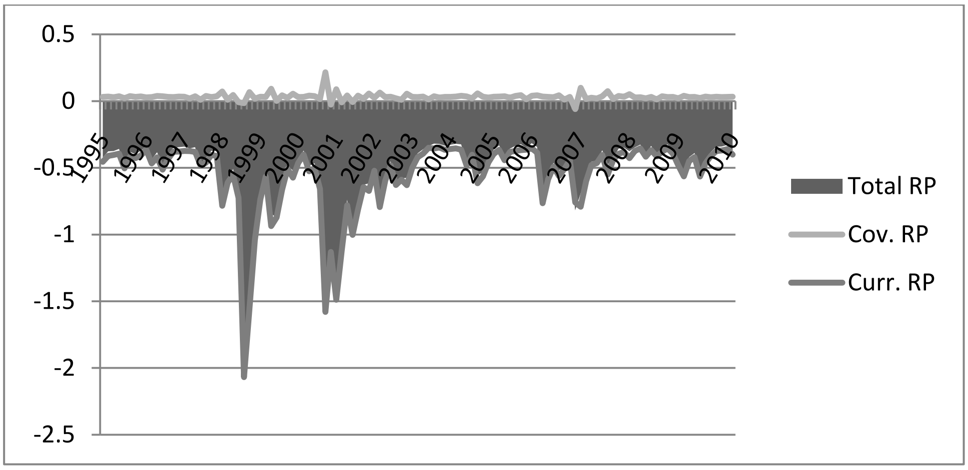

Figure 8. Risk premium decomposition – CZK Eurodeposit

	TP	MP	CP		TP	MP	CP
EMU				***EURYEN***			
Mean	0.497	1.259	-0.761	**Mean**	-0.624	0.353	-0.977
St Dev	0.013	0.002	0.013	**St Dev**	0.207	0.016	0.213
Japan				***EURUSD***			
Mean	-0.241	1.056	-1.297	**Mean**	-0.158	0.355	-0.513
St Dev	0.006	0.001	0.006	**St Dev**	0.002	0.000	0.003
US				***EURCZK***			
Mean	0.357	1.344	-0.986	**Mean**	-0.516	0.033	-0.549
St Dev	0.065	0.012	0.068	**St Dev**	0.025	0.002	0.025
Czech				***EURGBP***			
Mean	-0.424	0.668	-1.092	**Mean**	0.086	0.181	-0.095
St Dev	0.067	0.011	0.073	**St Dev**	0.014	0.002	0.015
UK				***World***			
Mean	0.412	0.956	-0.543	**Mean**	0.298	1.238	-0.940
St Dev	0.150	0.025	0.152	**St Dev**			

Table 5. Descriptive statistics for total and decomposed risk premiums

A. 9 Results for the conditional ICAPM with constant prices of risk – Hungary

We used monthly returns denominated in Euro for the period January 1995 - December 2010. Data for the country indexes and for the world portfolio are from MSCI while Eurocurrency deposit rates are collected from DataStream. We used the following mean equation: $r_{it} = \delta_m cov_{t-1}(r_{it}, r_{mt}) + \sum_{c=1}^{4} \delta_c \, cov_{t-1}(r_{it}, r_{q+c,t}) + \varepsilon_{it}$, which expresses the asset excess return r_{it} as a f unction of its covariance risk $cov_{t-1}(r_{it}, r_{mt})$ and of its currency risk $cov_{t-1}(r_{it}, r_{q+c,t})$. $\delta_{m,}$ is the price of market risk and $\delta_{c,}$ is the world price of foreign exchange risk for currency c. The conditional covariance matrix H_t is:

$H_t = H_0 * (\iota\iota' - aa' - bb') + aa' * \varepsilon_{t-1} \varepsilon'_{t-1} + b'H_{t-1}b$, where H_0 is the unconditional variance covariance matrix of the residuals, ι is a 10×1 vector of ones, a and b are 10×1 vectors of unknown parameters and * denotes the Hadamard matrix product.

	European Monetary Union	Japan	USA	Hungary	United Kingdom	EURJPY	EURUSD	EURHUF	EURGBP	World Index
δ_m										0.0258
s.e.										0.0246
t-stat.										1.0470
p-val.										0.1475
δ_c						-0.0586	-0.0919	0.2403	0.0715	
s.e.						0.0292	0.0499	0.0671	0.0553	
t-stat.						-2.0090	-1.8390	3.5830	1.2920	
p-val.						0.0223	0.0329	0.0002	0.0983	

	European Monetary Union	Japan	USA	Hungary	United Kingdom	EURJPY	EURUSD	EURHUF	EURGBP	World Index
a_i	0.1701	0.0679	0.1219	0.2151	0.2371	-0.1294	0.0799	0.3342	-0.0138	0.1272
s.e.	0.0539	0.0557	0.0424	0.0897	0.0993	0.0954	0.0810	0.0609	0.1135	0.0365
p-val.	0.0008	0.1115	0.0020	0.0083	0.0085	0.0876	0.1621	0.0000	0.4515	0.0002
b_i	0.8008	0.4622	0.9103	0.8148	0.3218	0.7038	0.8676	0.8427	0.7867	0.8768
s.e.	0.0995	0.3575	0.0372	0.1578	0.3070	0.6887	0.1961	0.0546	0.9935	0.0439
p-val.	0.0000	0.0981	0.0000	0.0000	0.1473	0.1534	0.0000	0.0000	0.2142	0.0000

Table 1.Estimated coefficients for the conditional ICAPM model with constant prices of risk

Wald tests of joint parameter significance
Are the coefficients of all the conditioning variables of the price of market covariance risk jointly equal to zero? χ^2 Stat = 1.097 df = 1 p-level = 0.29490
Are the constant prices of currency risk jointly equal to zero? χ^2 Stat = 20.246 df = 4 p-level = 0.00045

Table 2. Wald test results

Summary statistics	EMU	Japan	USA	Hungary	U.K.	EUR JPY	EUR USD	EUR HUF	EUR GBP	World Index
Avg:	-0.056	-0.081	-0.004	-0.038	-0.052	-0.025	-0.026	-0.041	-0.031	-0.050
med:	0.109	-0.071	0.105	0.062	0.061	-0.114	-0.039	-0.090	-0.150	0.025
min:	-3.330	-2.250	-2.960	-4.910	-2.890	-2.900	-2.760	-4.220	-3.030	-3.200
max:	2.100	2.270	2.110	3.820	2.060	4.490	2.370	4.540	2.430	1.760
std:	0.980	1.000	0.990	1.020	0.990	1.000	1.000	1.010	1.000	0.990
skw:	-0.770	0.160	-0.560	-0.460	-0.520	1.030	-0.150	-0.040	-0.110	-0.720
Kurt[19]	1.170	-0.590	0.210	5.520	-0.160	3.250	-0.090	5.880	0.010	0.200
BJ[20]	16.810	2.330	6.130	137.640	5.250	65.740	0.500	151.610	0.230	9.840
pval	0.000	0.312	0.047	0.000	0.072	0.000	0.778	0.000	0.891	0.007
L-B[21]	17.210	12.330	15.270	11.360	16.070	4.880	18.220	20.940	13.620	15.020
pval[22]	0.142	0.420	0.227	0.498	0.188	0.962	0.109	0.051	0.326	0.240

Auto-corr. order	EMU	Japan	USA	Hungary	U.K.	EUR JPY	EUR USD	EUR HUF	EUR GBP	World Index
1	0.08	0.15	0.07	0.02	0.19	0.00	0.15	0.18	0.05	0.12
2	0.13	0.07	0.06	-0.19	0.07	0.13	0.02	-0.14	0.01	0.07
3	0.05	0.07	0.07	0.08	0.05	-0.04	0.06	-0.12	0.04	0.04
4	-0.02	-0.07	-0.06	0.01	0.10	0.01	-0.12	0.00	-0.04	-0.05
5	0.01	0.12	0.09	0.03	0.01	-0.02	0.06	0.12	0.06	0.07
6	0.13	-0.07	-0.01	-0.04	0.00	-0.01	0.05	0.05	-0.01	-0.02
7	-0.07	0.02	0.06	0.13	0.03	0.07	0.11	0.04	0.15	0.01
8	0.19	0.08	0.15	-0.08	0.19	0.02	0.16	-0.23	0.10	0.17
9	-0.04	0.17	0.15	0.02	0.12	0.05	0.11	-0.13	0.18	0.14
10	0.16	-0.04	0.19	0.09	0.09	0.06	0.16	0.09	-0.12	0.18
11	0.03	-0.08	-0.03	-0.02	0.00	0.02	0.12	0.06	-0.03	-0.03
12	0.15	0.02	0.10	0.12	0.11	0.08	0.09	0.04	-0.13	0.10

Table 3. Standardized residuals statistics

[19]The kurtosis is equal to zero for the normal distribution
[20]Bera-Jarque test statistics for normality
[21]Ljung-Box test statistic of order 12
[22]p-values for Ljung-Box test statistic of order 12

Summary statistics	EMU	Japan	USA	Hungary	U.K.	EUR JPY	EUR USD	EUR HUF	EUR GBP	World Index
Avg:	0.96	1.00	0.98	1.02	0.98	1.00	0.99	1.01	0.99	0.98
med:	0.37	0.67	0.39	0.25	0.47	0.31	0.43	0.21	0.46	0.47
min:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
max:	11.10	5.10	8.80	24.10	8.30	20.20	7.60	20.60	9.20	10.20
std:	1.74	1.16	1.45	2.78	1.36	2.23	1.37	2.79	1.40	1.49
skw:	3.54	1.88	2.66	6.29	2.56	6.16	2.20	5.46	3.03	3.31
Kurt[23]	14.94	3.35	8.68	45.89	8.34	48.60	5.52	32.68	12.15	14.48
BJ[24]	1229	116	468	10148	432	11260	226	5327	829	1139
pval	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L-B[25]	18.20	16.39	12.29	3.82	26.27	4.15	6.99	4.01	9.56	15.68
pval[26]	0.11	0.17	0.42	0.99	0.01	0.98	0.86	0.98	0.65	0.21

Auto-corr. order	EMU	Japan	USA	Hungary	U.K.	EUR JPY	EUR USD	EUR HUF	EUR GBP	World Index
1	0.15	-0.09	-0.02	-0.06	0.13	-0.06	-0.10	0.02	0.08	0.07
2	0.20	0.01	0.08	-0.07	0.04	0.05	-0.08	-0.03	0.02	0.10
3	0.14	-0.06	0.26	0.04	0.37	-0.01	-0.01	0.00	-0.01	0.24
4	-0.07	-0.10	-0.06	-0.06	0.12	-0.04	-0.01	-0.01	0.11	-0.10
5	0.05	0.10	0.03	-0.01	-0.02	0.08	0.12	0.10	-0.03	0.00
6	0.01	-0.16	0.07	0.06	0.08	-0.07	0.02	-0.07	0.19	0.02
7	0.07	0.17	-0.05	0.01	0.10	0.00	-0.06	0.00	0.04	0.00
8	-0.10	-0.04	0.05	0.02	0.03	-0.08	0.02	0.02	-0.05	-0.04
9	0.00	0.10	0.04	-0.04	0.00	0.07	-0.03	0.02	0.03	0.05
10	0.08	-0.01	0.05	-0.03	0.11	0.00	-0.13	-0.07	-0.07	0.13
11	-0.07	-0.12	-0.07	0.00	-0.10	-0.04	0.03	-0.07	-0.10	-0.08
12	0.18	0.14	0.03	0.10	-0.05	-0.02	-0.06	-0.07	-0.01	0.12

Table 4. Squared standardized residuals statistics

[23]The kurtosis is equal to zero for the normal distribution
[24]Bera-Jarque test statistics for normality
[25]Ljung-Box test statistic of order 12
[26]p-values for Ljung-Box test statistic of order 12

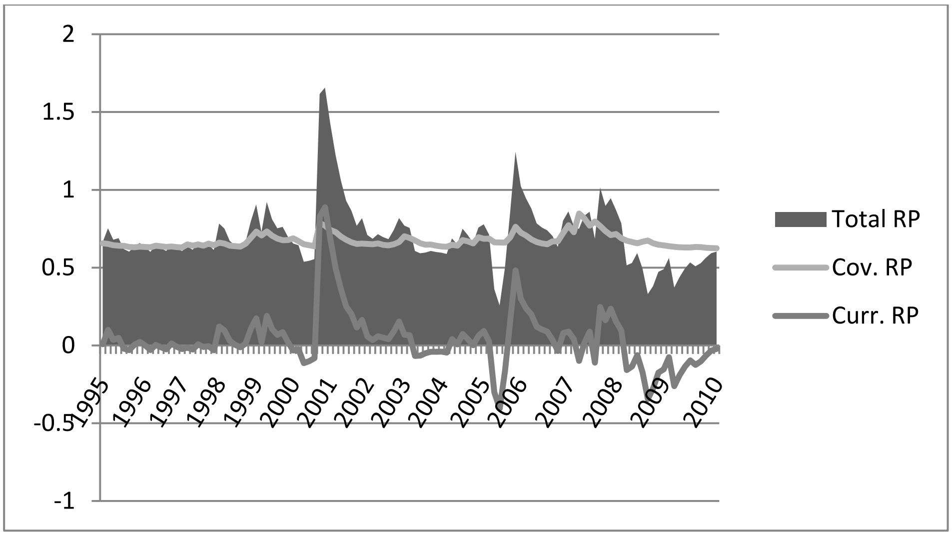

Figure 1. Risk premium decomposition - EMU equity market

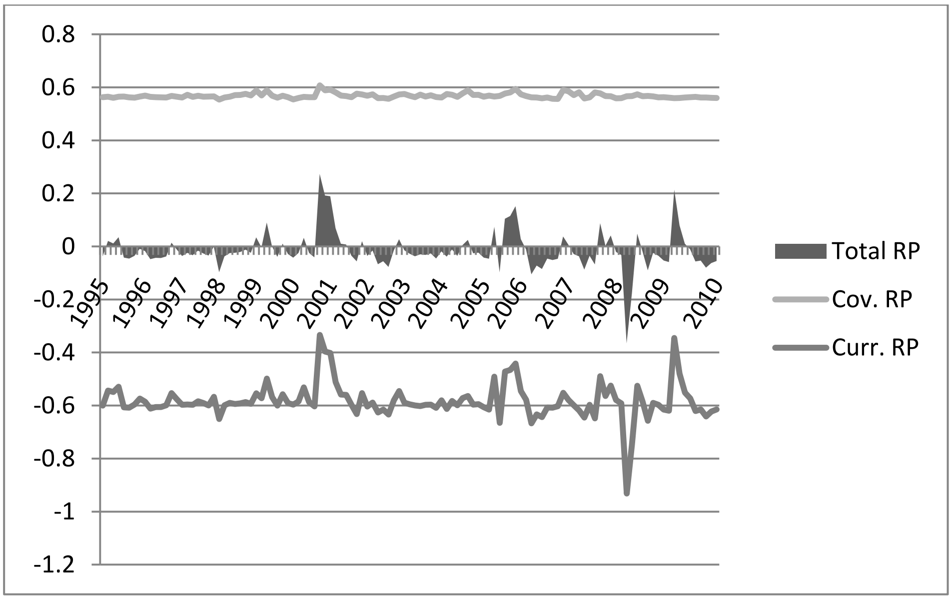

Figure 2. Risk premium decomposition - Japan equity market

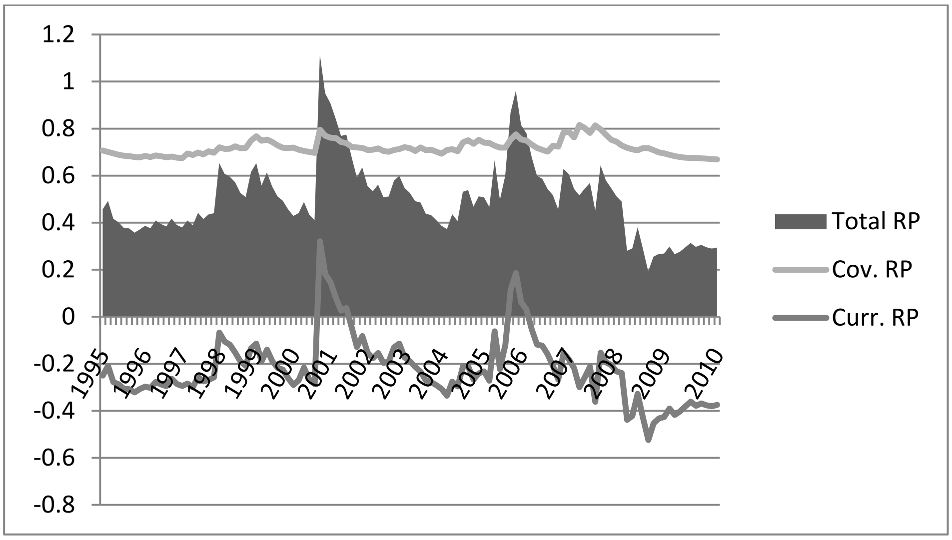

Figure 3. Risk premium decomposition - USA equity market

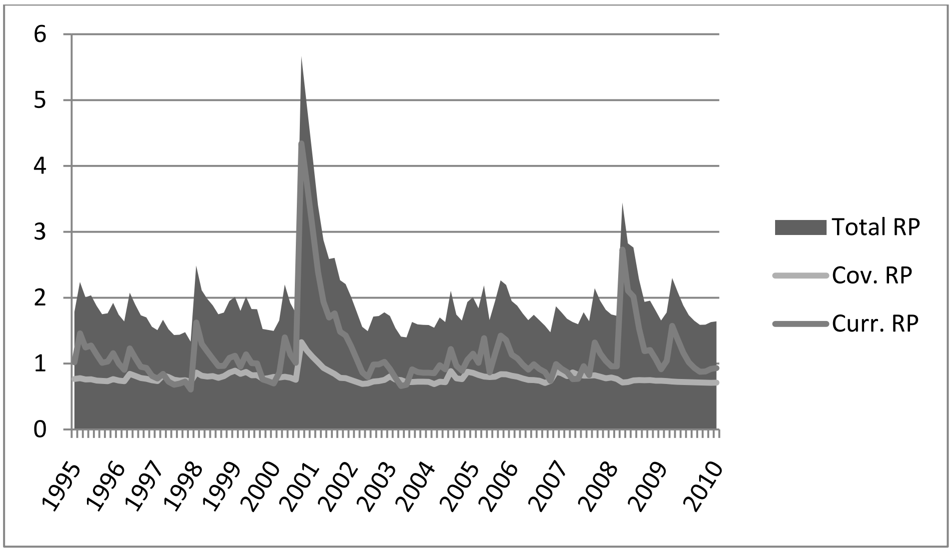

Figure 4. Risk premium decomposition - Hungary equity market

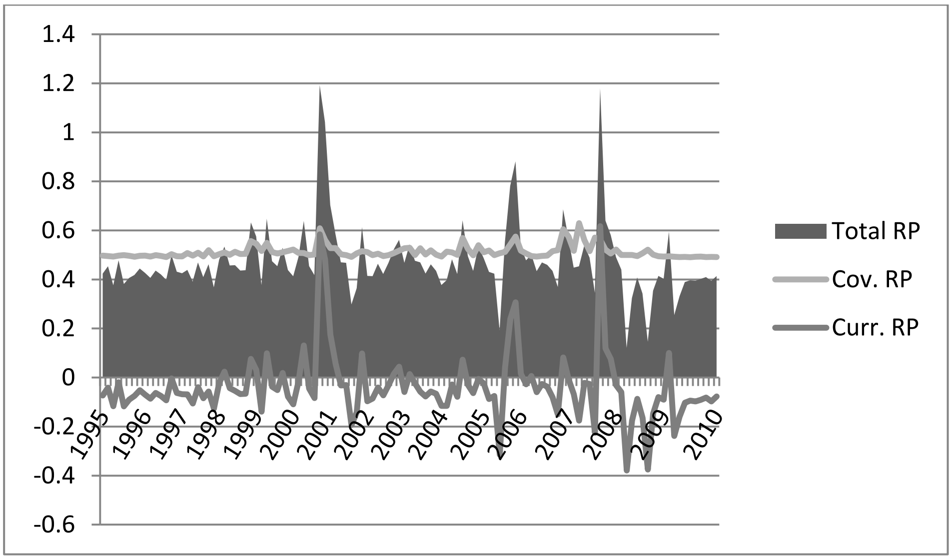

Figure 5. Risk premium decomposition - UK equity market

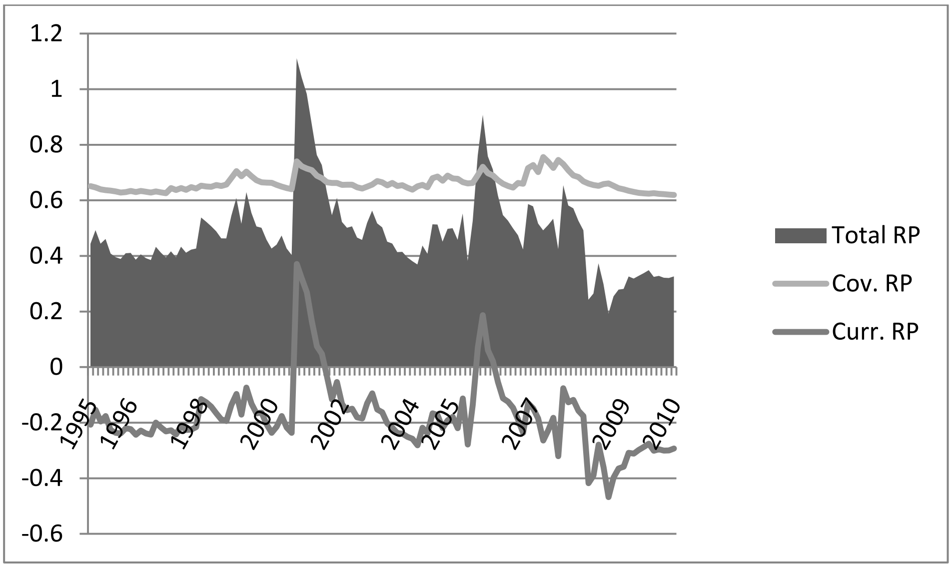

Figure 6. Risk premium decomposition - World market portfolio

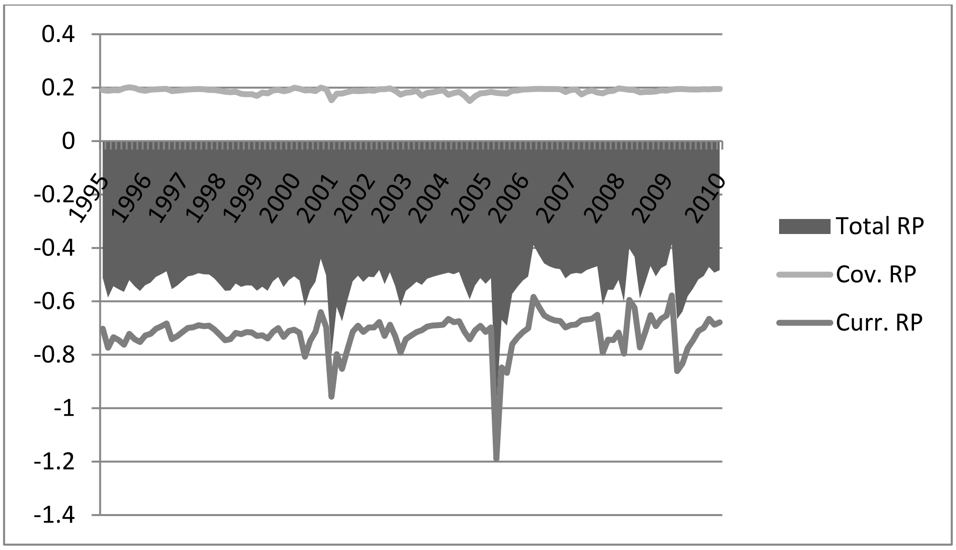

Figure 7. Risk premium decomposition – JPN Eurodeposit

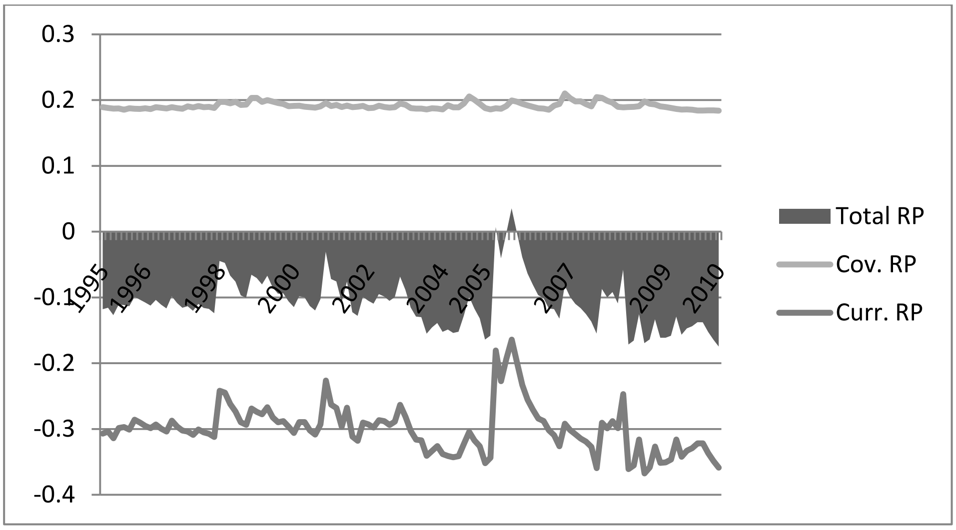

Figure 8. Risk premium decomposition – USD Eurodeposit

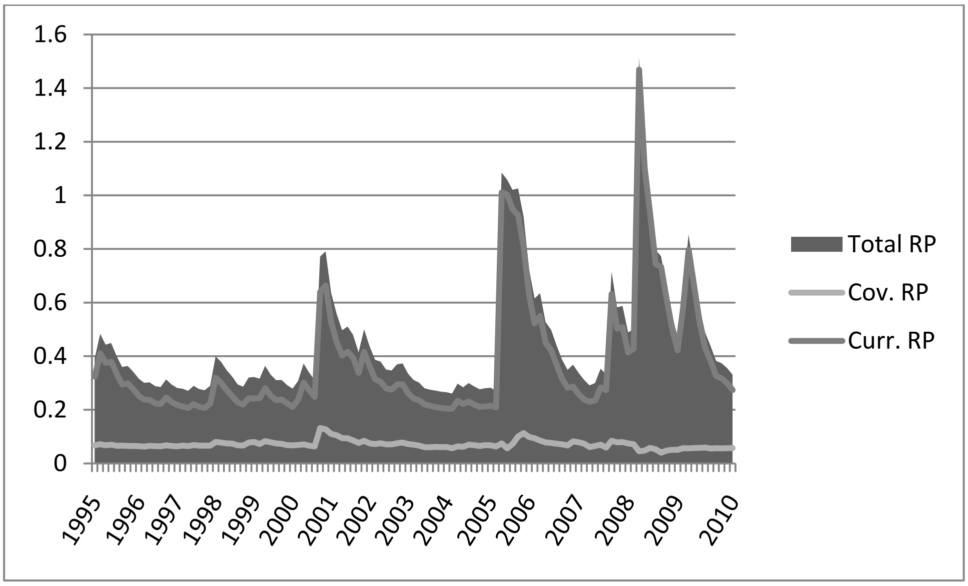

Figure 9. Risk premium decomposition – HUF Eurodeposit

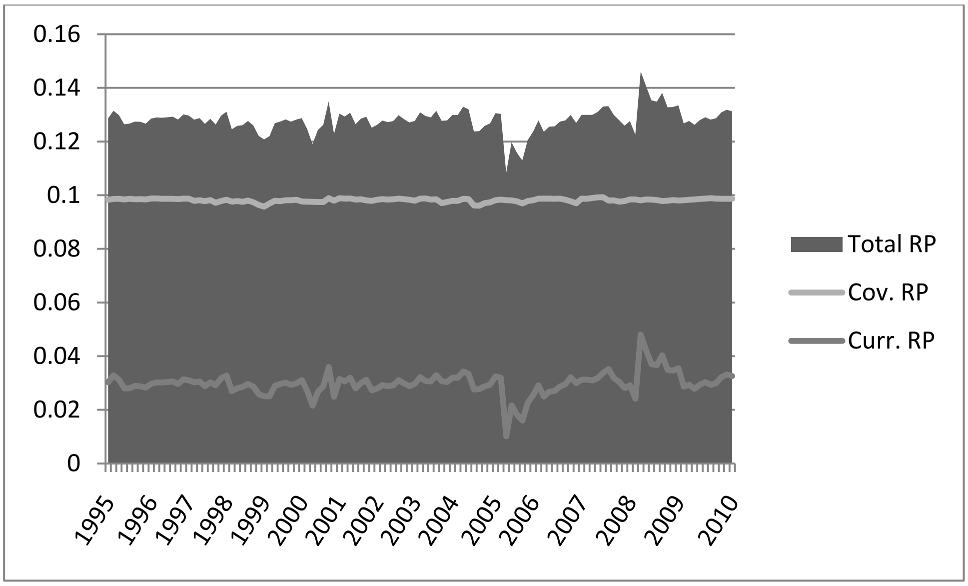

Figure 10. Risk premium decomposition – GBP Eurodeposit

	TP	MP	CP		TP	MP	CP
EMU				***EURYEN***			
Mean	0.711	0.672	0.039	**Mean**	-0.533	0.187	-0.720
St Dev	0.213	0.044	0.187	**St Dev**	0.073	0.009	0.070
Japan				***EURUSD***			
Mean	-0.014	0.568	-0.582	**Mean**	-0.108	0.191	-0.300
St Dev	0.072	0.009	0.067	**St Dev**	0.038	0.005	0.036
US				***EURHUF***			
Mean	0.500	0.719	-0.219	**Mean**	0.450	0.071	0.380
St Dev	0.162	0.033	0.142	**St Dev**	0.228	0.015	0.227
Hungary				***EURGBP***			
Mean	1.939	0.789	1.150	**Mean**	0.128	0.098	0.030
St Dev	0.612	0.090	0.543	**St Dev**	0.005	0.001	0.004
UK				***World***			
Mean	0.475	0.513	-0.038	**Mean**	0.485	0.662	-0.177
St Dev	0.151	0.026	0.137	**St Dev**	0.151	0.030	0.132

Table 5. Descriptive statistics for total and decomposed risk premiums

A. 10 Results for the conditional ICAPM with time – varying prices of market risk and constant prices of currency risk – Hungary

We used monthly returns denominated in Euro for the period January 1995-December 2010. Data for the country indexes and for the world portfolio are from MSCI while Eurocurrency deposit rates are from DataStream. We used the following mean equation which expresses the asset excess return r_{it} as a function of its covariance risk $cov_{t-1}(r_{it}, r_{mt})$and of its currency risk $cov_{t-1}(r_{it}, r_{q+c,t})$:

$r_{it} = \delta_{m,t-1} cov_{t-1}(r_{it}, r_{mt}) + \sum_{c=1}^{4} \delta_c \, cov_{t-1}(r_{it}, r_{q+c,t}) + \varepsilon_{it}$, where $\delta_{m,}$ is the price of market risk ($\delta_{m,t-1} = \exp(\kappa'_m z_{t-1})$) and $\delta_{c,}$ is the world price of foreign exchange risk for currency c. The price of market risk is function of a number of instruments including the world index dividend yield in excess of the one-month EuroEuro rate (XDPR), the change in the US term premium (ΔUSTP), the change in the one-month EuroEuro rate (ΔEuroEuro) and the US default premium (USDP)

The conditional covariance matrix H_t is: $H_t = H_0 * (\iota\iota' - aa' - bb') + aa' * \varepsilon_{t-1}\, \varepsilon_{t-1}' + b'H_{t-1}b$, where H_0 is the unconditional variance covariance matrix of the residuals, ι is a 10×1 vector of ones, a and b are 10×1 vectors of unknown parameters and * denotes the Hadamard matrix product.

	κ'_m			
	coeff.	**s.e.**	**t-stat.**	**p-val**
XDPR	-0.113	0.1653	-0.673	0.2503
ΔUSTP	0.1604	0.0574	2.794	0.0026
ΔEuroEuro	0.8072	1.2192	0.662	0.2540
USDP	-0.0139	0.0287	-0.483	0.3145

	European Monetary Union	Japan	USA	Hungary	United Kingdom	EURJPY	EURUSD	EURHUF	EURGBP	World Index
δ_c						-0.0489	-0.0723	0.2722	0.0704	
s.e.						0.0284	0.0531	0.0674	0.0568	
t-stat.						-1.722	-1.362	4.036	1.239	
p-val						0.0425	0.0866	0.0000	0.1077	
a_i	0.1549	0.0653	0.1552	0.1553	-0.0954	-0.1572	0.0489	0.3077	-0.0211	0.1360
s.e.	0.0455	0.0459	0.0356	0.1210	0.0544	0.0847	0.0719	0.0611	0.0331	0.0289
p-val	0.0003	0.0771	0.0000	0.0996	0.0397	0.0316	0.2484	0.0000	0.2617	0.0000
b_i	0.7915	0.4939	0.9090	0.9708	-0.5551	0.4961	0.8461	0.8713	1.0170	0.8911
s.e.	0.1021	0.4476	0.0448	0.0237	0.3668	0.4194	0.2047	0.0446	0.0148	0.0486
p-val.	0.0000	0.1349	0.0000	0.0000	0.0651	0.1184	0.0000	0.0000	0.0000	0.0000

Table 1.Estimated coefficients for the conditional ICAPM model with time – varying prices of market risk and constant prices of currency risk

Wald tests of joint parameter significance
Are the coefficients of all the conditioning variables of the price of market covariance risk jointly equal to zero? Note: in this specification, the price of cov risk is only function of time varying info variables!! χ^2 Stat = 8.018 df = 4 p-level =0.09092
Are the constant prices of currency risk jointly equal to zero? χ^2 Stat =20.044 df = 4 p-level =0.00049

Table 2. Wald test results

Summary statistics	EMU	Japan	USA	Hungary	U.K.	EUR JPY	EUR USD	EUR HUF	EUR GBP	World Index
Avg:	0.01	-0.06	0.04	-0.01	0.00	-0.04	-0.04	-0.07	-0.04	0.00
med:	0.19	-0.03	0.10	0.06	0.10	-0.19	-0.11	-0.08	-0.18	0.14
min:	-3.01	-2.28	-2.68	-4.51	-2.44	-2.96	-2.88	-4.33	-3.09	-2.92
max:	2.20	2.34	2.55	3.89	2.50	4.22	2.38	4.31	2.38	2.29
std:	0.99	1.00	0.99	0.99	1.00	1.00	1.00	1.00	1.01	1.00
skw:	-0.57	0.17	-0.29	-0.27	-0.33	0.92	-0.07	-0.16	-0.08	-0.51
Kurt[27]	0.82	-0.62	0.10	4.95	-0.20	2.58	-0.13	5.45	-0.02	-0.04
BJ[28]	8.86	2.60	1.64	108.78	2.35	44.66	0.23	130.83	0.15	4.89
pval	0.01	0.27	0.44	0.00	0.31	0.00	0.89	0.00	0.93	0.09
L-B[29]	25.18	11.98	18.76	10.56	19.66	4.97	15.85	20.47	13.52	19.77
pval[30]	0.01	0.45	0.10	0.57	0.07	0.96	0.20	0.06	0.33	0.07

Table 3. Standardized residuals statistics

Summary statistics	EMU	Japan	USA	Hungary	U.K.	EUR JPY	EUR USD	EUR HUF	EUR GBP	World Index
Avg:	0.98	1.00	0.98	0.97	0.99	1.00	0.99	1.01	1.01	0.98
med:	0.33	0.63	0.40	0.26	0.43	0.32	0.50	0.24	0.53	0.48
min:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
max:	9.00	5.50	7.20	20.30	6.30	17.80	8.30	18.80	9.60	8.50
std:	1.62	1.15	1.39	2.52	1.32	2.08	1.35	2.71	1.41	1.37
skw:	2.89	1.95	2.20	5.81	2.10	5.42	2.51	5.40	3.11	2.62
Kurt	9.11	3.95	5.25	38.37	4.60	38.46	8.13	31.62	13.21	8.84
BJ	525	140	213	7208	177	7157	412	5009	958	475
pval	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L-B	13.21	19.71	8.89	5.40	21.00	5.77	6.43	5.14	8.93	10.28
pval	0.35	0.07	0.71	0.94	0.05	0.93	0.89	0.95	0.71	0.59

Table 4. Squared standardized residuals statistics

[27] The kurtosis is equal to zero for the normal distribution
[28] Bera-Jarque test statistics for normality
[29] Ljung-Box test statistic of order 12
[30] p-values for Ljung-Box test statistic of order 12

BI Norwegian School of Management

Preliminary Thesis Report

The relationship between stock prices and exchange rates on CEE markets

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Students: Andreea Oana Moldoveanu

Iulia Tintea

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BI Oslo

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Master of Science in Financial Economics

The relationship between stock prices and exchange rates on CEE markets

I. Introduction

The increased opportunities of high returns and the distinct attributes of emerging markets did not escape for long the attention of both investors and researchers. The liberalization process of these markets together with the removal of control barriers over capital inflows led to a significant increase in foreign portfolio investments. In addition, the relationship between macroeconomic variables and stock prices has been of high interest for researchers in order to determine whether the financial markets are integrated or to evaluate what drives the returns on developed or emerging markets.

Foreign exchange risk is one of the most important dimensions of foreign investments and international asset pricing. The existence of currency risk is one of the major issues facing international investors because exchange rate volatility may reduce the benefits of international diversification. The question we want to address in our study is whether there is a long run relationship between the stock prices and exchange rates. This fact raises the issue of pricing currency risk and the importance of the size of the risk premium. In fact, an investment in a foreign asset is a combination of an investment in the performance of the foreign asset and an investment in the performance of the domestic currency relative to the foreign currency. Therefore, it is important to determine whether the currency risk is priced in international capital markets and the size of this risk premium.

To begin with, we state the economic problem and its implications. Moreover, Section III presents the theoretical background while the next part describes the necessary data for the study. Section V outlines the research methodology we will use in our paper and Section VI concludes this paper.

II. Economic problem and research question

Emerging markets have drawn the attention of both investors and researchers given their increased opportunities of high returns and distinct characteristics. If investors' interest is mainly fuelled by the benefits that may be obtained from portfolio diversification in emerging markets, researchers have particularly studied their characteristics and the process of financial markets development in these countries. Although the emerging capital markets in Central and Eastern Europe (CEE) are more recent in the field of international investments, compared to Latin American or Asian countries, their accession to the European Union has spurred the researchers' interest in investigating the diversification potential offered by these markets, the risk factors that affect the returns and also the degree of financial integration of CEE markets with the developed markets and other emerging markets. In terms of financial integration, exchange rates also play an important role, as their unpredictability and high volatility may be a sign of rather high market segmentation (Fratzescher, 2001). Also the high volatility translates into significant costs of hedging and implicitly higher risk premiums. For investors that place their money in developed markets, situations when they confront themselves with high losses due to exchange rates are rather seldom. In contrast, gains obtained by investors on emerging markets can be easily transformed into important losses when these markets face dramatic drops of exchange rates. The worst situations arise when both asset prices and exchange rates depreciate concomitantly. To cover currency risk investors may demand a premium, yet the existence and the size of this premium, is still subject of research.

In our paper we aim to study the dynamic relationship between stock prices and foreign exchange rates on the Central and Eastern European countries, namely The Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, The Slovak Republic and Slovenia. We have chosen to analyze this group of countries due to the fact that we found many studies focusing on developed countries but much less evidence on emerging markets. Moreover emerging countries have recently gone through a process of financial liberalization, especially in what concerns the foreign exchange market. We use a sample period of 21 years (1990-2010) divided into two sub periods, before and after entering the European Union.

These two sub periods offer an interesting test for conditional international asset pricing models due to the development of the stock market from a relatively closed one to an open one, after the restrictions on private ownership were abolished. Moreover, these countries are interesting because their currencies (the Czech crown, the Estonian crown which has been replaced by the Euro on 01 January 2011, the Latvian lat, the Lithuanian litas, the Hungarian forint, the Polish zloty, the Slovak crown and the Slovenian tolar which were replaced by the euro on 01 January 2009 and respectively 01 January 2007) are more volatile especially compared to the currencies of developed countries. Therefore, the currency risk is relatively higher than in the case of developed countries and as a result investors should demand a higher risk premium.

Our primary goal is to determine whether the global market risk is priced in these emergent markets and its role in pricing. Secondly, we intend to explore whether currency risk is priced in the local stock markets. Finally, we determine whether the global market and currency risks are time varying and to what degree these sources of risk influence the risk premium.

III. Literature review

Generally, an investment can be defined as a current commitment of money and other resources in the expectation of reaping future benefits (Bodie, Kane, Markus, 2003). From a financial point of view, an investment is the commitment of funds by buying securities or other monetary or paper (financial) assets in the money markets or capital markets, or in fairly liquid real assets, such as gold or collectibles. Types of financial investments include shares, other equity investment and bonds (including bonds denominated in foreign currencies). These financial assets are then expected to provide income or positive future cash flows, and may increase or decrease in value yielding the investor capital gains or losses. These types of investments can be made in local or foreign assets, in this last case the total risk being compounded of the risk of the investment and the risk of the foreign currency. The risk of the investment represents the potential that the chosen action or activity (including the choice of inaction) will lead to a loss (an undesirable outcome). Therefore, the total risk in an international investment includes credit risk, liquidity risk, operational risk and market risk. The credit risk is also called default risk and occurs if the firm goes into default. The liquidity risk refers to the fact that the asset cannot be sold due to lack of liquidity in the market, leading to losses for the investor. An operational risk is, as the name suggests, a risk arising from execution of a company's business functions. It is a very broad concept which focuses on the risks arising from the people, systems and processes through which a company operates. It also includes other categories such as fraud risks, legal risks, physical or environmental risks.

Market risk is the risk that the value of a portfolio, either an investment portfolio or a trading portfolio, will decrease due to the change in value of the market risk factors. The four standard market risk factors are stock prices, interest rates, foreign exchange rates, and commodity prices and the associated market risk are:

- Equity risk, which is the risk that one's investment will depreciate because of stock market dynamics (the stock prices or the implied volatility will change)
- Interest rate risk, which is the risk that the interest rates or the implied volatility will change.
- Currency risk, which is the risk that foreign exchange rates or the implied volatility will change.
- Commodity risk, which is the risk that commodity prices or the implied volatility will change.

Generally, currency risk can be defined as the risk that arises from the change in price of one currency against another and it is considered a key element in foreign investments. This risk flows from differential monetary policy and growth in real productivity, which results in differential inflation rates. For example if an U.S. investor owns stocks in Hungary, the return he will realize is affected by both the change in the price of the stocks and the change of the Hungarian forint against the U.S. dollar. If he realized a return in the stocks of 10% but the Hungarian forint depreciated 10.5% against the U.S. dollar, he would make a small loss. Therefore, in order to compensate for this additional risk, the investor requires a risk premium which is the return in excess of the risk-free rate of return that an investment is expected to yield. This foreign exchange risk premium has been investigated by researchers in a wide variety of frameworks. The difficulty in modelling this premium arises from a characteristic of international currency markets: the fact that the domestic currency tends to appreciate when domestic interest rates tend to exceed foreign rates (Hodrick, 1987). The mentioned deviations from the uncovered interest parity relationship are often interpreted as a risk premium from investing in a foreign currency by a rational and risk-averse investor. Apart from the negative correlation with the subsequent depreciation of the foreign currency, another well-documented property of these deviations includes extremely high volatility (Fama, 1984). Another study that uses a GARCH in mean framework in order to determine time series properties of foreign exchange risk premium is conducted by Engle (1996). His studies succeeded better in capturing empirical regularities observed in the excess return series but it is was difficult to interpret the predictable components of the excess return as a measure of the risk premium. Poghosyan and Kocenda (2007) investigate macroeconomic sources of foreign exchange risk in new E.U. members, namely the Czech Republic, Hungary, Poland and Slovakia by using the stochastic discount factor approach and a multivariate GARCH- in mean model. Their findings suggest that in these economies, real factors play a small role in determining foreign exchange risk, which contradicts the evidence coming from more developed countries, while nominal and monetary factors have a higher impact. Thus, the monetary policy adopted by these countries has an important effect on the evolution of the exchange rates and investors use this information in pricing.

A model used in pricing risky securities is the capital asset pricing model which describes the relationship between risk and expected return. This model is based on Harry Markovitz's (1952) portfolio theory and was developed by Sharpe (1964), Lintner (1965) and Mossin (1966). The assumptions behind the CAPM model are: the investors are price-takers, all investors plan for one identical holding period, they may borrow or lend any amount at a fixed risk-free rate, they trade without transaction or taxation costs, they are rational mean-variance optimizers, have homogenous expectations or beliefs. The model shows that the risk premium can be determined, taking into account the risk free rate, the systematic risk and the market premium:

$E(r_i) - r_f = \beta_i \ * [E(r_{m)} - r_f]$,

where $E(r_i)$ is the expected return on the capital asset,

r_f is the risk free interest rate

β_i is the systematic risk of the capital asset, which shows the sensitivity of the expected excess asset returns to the expected excess market return

$\beta_i = \frac{cov(R_i, R_m)}{var(R_m)}$,

and $E(r_{m)} - r_f)$ is the market premium, the difference between the expected market rate of return and the risk-free rate of return (Bodie, Kane, Marcus, 2003). In our study, we will use a conditional international capital asset pricing model, originally developed by Adler and Dumas (1983) to investigate the existence and the size of the risk premium in emerging markets.

The rapid growth of emerging capital markets has lead to a ser ies of questions arising both from global investors as well as from the developing countries themselves. If investors are mainly preoccupied by di versification benefits, developing countries closely study the effects that international capital flows might have on local markets and economic growth. In this context, researchers have analyzed the characteristics of emerging markets for a better understanding of the role that financial markets have in promoting economic growth (Barry, Peavy, Rodriguez, 1998).

Among the first authors to notice the rather different evolution of these markets as compared to developed markets we mention: Divecha, Drach and Stefek (1992), Harvey (1995), Barry, Peavy and Rodriguez (1998) as well as Bekaert (1998). These studies have shown that emerging markets have higher volatility, low correlations with both developed markets but also with the other emerging markets and at the same time higher long term returns. However these markets are more likely to be exposed to political shocks or exchange rates devaluations. Analyzing emerging markets, researchers have noticed that models implying full market integration, which are commonly used for developed markets, are no longer suitable due to the distinct characteristics of these markets (Harvey, 1995).

Starting with the 90's, developing countries gained access to foreign capital, which lead to a rapid increase of foreign investments, especially portfolio investments, towards emerging financial markets. As a consequence, especially in Europe, the new direction of research in the field refers to the process of economic integration and the implications it has on financial market integration in the region. A number of initiatives aimed at promoting financial market integration and removing barriers from free capital movements started in the early 80s.

Financial market integration is a very important factor for the development of the European financial system, as it results in economic growth and efficiency improvement, it leads to a more dynamic business environment, it increases the liquidity and profitability of trade systems and it allows a better capital allocation (McAndrews and Stefanadis, 2002).

Baele et al. (2004) review the reasons for an expected increase of financial integration in Europe. First, the introduction of the common currency, the euro, has as effects the removal of exchange rates fluctuation within the euro zone, which significantly reduces the costs of currency hedging that were a barrier for international investments. Second, the home biasness is expected to decline, along with the elimination of barriers for international diversification, which induces a more active investing behaviour of institutional and individual investors, towards holding more European diversified portfolios. Third, once the exchange rate risk is eliminated, investors will most likely pay attention to other risks, such as the liquidity or political risk, thus pressuring authorities to adopt policies that would reduce these risks as well.

Moreover the relationship between foreign exchange markets and asset pricing as well as the size of the exchange rate premium has drawn the attention of many researchers. However, most early studies on portfolio diversification have focused on the benefits of low return correlations (Solnik 1974) rather than on the role of foreign exchange risk. As for the studies that take into account the foreign exchange risk, the results are quite different from one research to another. For example, in order to determine an asset pricing model where foreign exchange risk is priced, Solnik (1974) assumes that there is a different consumption good in each country and as a result trade takes place in intermediate goods, that there is no inflation so that the price of the good is fixed and the exchange rate is simply the price of the domestic good in terms of the foreign good. He also assumes that the capital markets are perfect with no transaction costs, taxes or capital controls and always in equilibrium. In his paper, Solnik shows that the risk premium of a security over its national risk free rate is proportional to its international systematic risk and this coefficient of proportionality is the risk premium of the world bond market over a world bond rate. Moreover, Stulz (1981) criticizes the assumption made by his predecessors that the relative prices of the imports are perfectly correlated with the exchange rates. He develops an international asset pricing model based on the assumption that financial markets are fully integrated and on the existence of differences in consumption opportunity sets. Furthermore, Dumas and Solnik (1995) show that there is only little evidence that global equity and foreign exchange markets deviate from full integration. They also find that there exists a risk premium significantly different from zero and therefore, models of international asset pricing should include the currency risk in addition to the market risk.

De Santis and Gerard (1998) estimate a conditional version of the International Capital Asset Pricing Model to test whether exchange risk premium has a significant impact on international returns. The study analyses a number of developed international equity markets (Germany, Japan, United Kingdom and the United States) together with Eurocurrency deposits, allowing the variables to be time varying. By this mean the magnitude and the dynamics of the market and currency risk premium are assessed. The results show that the components of the risk premium vary significantly over time and across markets. The premium for the currency risk is found to represent in average only a small fraction of the total premium, when taking into account the total sample.

Kim (2003) investigates the existence of long-run equilibrium relationships among the stock price and macroeconomic variables, including real exchange rate in the United States using Johansen's cointegration analysis. The article finds evidence of a negative relationship of the S&P500 with the real exchange rate for the period 1974 – 1998. Another study, conducted by Murinde and Poshakwale (2004) investigates price interactions between the foreign exchange market and stock market on three European emerging countries, by applying a bivariate vector autoregressive model and the Granger methodology, using daily observations. They find evidence that stock prices unidirectionally Granger cause exchange rates only for one of the analyzed markets, while for the other two countries the authors find that there are mutually reinforcing interactions between the variables. In what concerns pricing of the currency risk, Carrieri et. al. (2006) conduct empirical tests in a conditional setting both for developed and emerging markets to assess whether emerging market currency risk is priced and its impact on the developed financial markets. The results showed that emerging market currency risk is priced separately from other local risk factors and it has a high contribution in driving the returns for both developed and emerging markets. Antell and Vaihekoski (2007) use the model of De Santis and Gerard (1998) to study the pricing of global, local market risk and currency risk on the Finnish stock market. Their study is made from the perspective of an US investor and it aims to determine whether global market risk and currency risk are priced on the Finnish stock market, whether these risks are time-varying and the size of the required risk premium. Their findings show that the price of world risk is time-varying, that the price of currency risk is significantly different from zero and that the currency risk is not time-varying in the case of the Finnish financial market.

De Santis, Gerard and Hillion (2003) analyze how the removal of exchange risk on European markets may affect international financial markets. For an international investor, the introduction of the single currency reduces the number of sources of risk affecting financial assets but not necessarily the risk exposure of the assets. As the study emphasis, when introducing the single currency, the exchange rate risk for investors in Euro area no longer exists, but this does not mean that currency risk is removed as the investors might still be affected by the devaluation of the Euro.

IV. Data

In our paper we aim to study the dynamic relationship between stock prices and foreign exchange rates on the Central and Eastern European countries, namely The Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, The Slovak Republic and Slovenia, as we have already mentioned. We collect data for a twenty years period, namely January 1990 to December 2010 and we intend to split the sample in two sub periods: before and after entering the European Union. The first sub period is between 1990 and 2003, while the second is 2004-2010. We use monthly returns on stock indexes for the eight countries plus a value-weighted world index, the primary sources for this data being DataStream and national stock exchanges. As we take the view of an US investor, all the returns are measured in US dollars. For the conditionally risk free asset for an US investor, measured in US dollars for month t, we use an one-month holding period return on the one-month Eurodollar interbank money market rate on the last trading day of month t-1. We utilize continuously compounded returns (in percentages, not decimals) due to the fact that these describe price changes during volatile periods more accurately.

To represent economic risk, we use two types of risk in our international asset pricing model: global market risk and exchange rate risk. The global market risk is measured by the global market portfolios returns proxied by the total return on the Morgan Stanley Capital International (MSCI) world equity market index, which is available with or without dividends reinvested, so we can compute returns that include both capital gains and dividend yields. In order to quantify exchange rate risk, we use single bilateral currency exchange rates in order to detect if the exchange rates (USD/CZK, USD/EEK, USD/LVL, USD/LTL, USD/HUF, USD/PLN, USD/SKK and respectively USD/SIT) are relevant for the pricing of each country's stocks. As in the case o f returns, we also use continuously compounded changes in exchange rates.

In order to test our model we employ other test assets in addition to the global market portfolio, namely the US market portfolio and the market portfolios of the above mentioned countries, which are calculated using the local indexes.

We utilize global and local variables in order to determine predictable time-variation in assets returns, risk exposure and the premium for risk. These variables are chosen to match those used by De Santis and Gerard (1998) and on the basis of previous studies (Antell and Vaihekoski 2007). Therefore, the global information set contains a constant, the dividend yield on the world market index in excess of the one-month Eurodollar rate, the change in the US term premium, the change in the one-month Eurodollar rate (the same as for the risk free asset) and the US default premium. The change of the US term premium is measured by the yield on the ten-year constant maturity bond in excess of the one-month Eurodollar rate while the US default premium represents the yield difference between Moody's Baa and Aaa-rated bonds. The dividend yield on the world market index in excess of the one-month Eurodollar rate and the change in the US term premium are taken from the Federal Reserve Economic Database.

In order to model the risk premium for the studied countries, we add local variables in the global information set, respectively the difference between US and the local annual inflation rates which shows the depreciation or appreciation of the currency and a European Monetary Union indicator which is set to one after the country joined the monetary union. This is only the case of Slovenia, which joined the monetary union in 2007 and Slovakia in 2009.

Furthermore, we employ two variables in order to model the price of local risk: a liberalization dummy variable (it has a value of one after all restrictions of private ownership in the local stock market were removed) and an annualized difference between the US and local short-term interest rates.

V. Methodology

The model we use in our research is based on the conditional international capital asset pricing model, originally developed by A dler and Dumas (1983). This model starts from the assumption that investors form expectations taking into consideration the risk and return as computed in the home currency. In an international framework however, the global portfolio cannot be considered the only source of risk, being necessary to include additional risk factors, the currency risk being one of the most important. A risk premium is added to these models, in order to reflect the covariance between the assets and different exchange rates.

Based on the importance given to the time variation of the variables, there are two approaches developed by researchers: conditional and unconditional. The unconditional models assume that expected risk and returns are constant in time, while conditional approaches describe the evolution of the risk – return assuming the two variables change in time. Conditional models are usually ARCH and GARCH models, where the investors' expectations regarding asset prices, interest rates or exchange rates are known.

In order to study the impact of global, local and currency risk on the analyzed emerging markets we use the framework of De Santis and Gerard (1998). Thus we also assume that PPP is violated so that investors across countries have different expectations regarding the real returns on assets, which must include a market premium along with a currency premium. The conditional version of the model as specified by De Santis and Gerard (1998) is the following:

$$E_{t-1}(r_{it}) = \delta_{m,t-1} cov_{t-1}(r_{it}, r_{mt}) + \sum_{c=1}^{L} \delta_{c,t-1}\, cov_{t-1}(r_{it}, \pi_{ct}), \qquad i = 1, \dots, M,$$

and $\delta_{c,t-1} = \theta_{t-1} \left(\frac{1}{\theta_c} - 1\right) \frac{W_{c,t-1}}{W_{t-1}}$

and $\delta_{m,t-1} = \theta_{t-1} = \frac{1}{\sum_{c=1}^{L+1} \frac{W_{c,t-1}}{W_{t-1}} * \frac{1}{\theta_c}}$,

where $E_{t-1}(r_{it})$ and $cov_{t-1}(r_{it}, r_{mt})$ represent moments, conditional on t he information available to investors at the end of time t-1. θ_c is the coefficient of the relative risk aversion for investors from country c, while θ_{t-1} is an average of the risk aversion coefficients for each country weighted by wealth denoted with $\frac{W_{c,t-1}}{W_{t-1}}$. π_{ct} represents the inflation of country c, measured in the reference currency, while r_{mt} stands for the excess return on the world portfolio. The article assumes that domestic inflation is non s tochastic, therefore $cov_{t-1}(r_{it}, \pi_{ct})$ measures the exposure of the asset to the currency risk of the analyzed country, c, and the coefficient $\delta_{c,t-1}$ measures the risk premium demanded by investors for bearing currency risk.

It has been empirically proved in many studies that foreign exchange risk is priced in developed markets and the premium demanded by investors to compensate this risk is an important component of expected return. However, although emerging markets have drawn the attention of many researchers, in this area we found much less evidence. Studies that employ an unconditional approach, except for Carrieri et. al. (2006), have found an exchange risk premium that is not statistically different from zero. Carrieri et.al. (2006) showed that exchange risk is globally priced but the significance of the currency risk factor might be affected by the model specification. Our intention is to employ a conditional model to study whether the world and currency risk factors are time-varying and to what extent these sources of risk account for the risk premium. Also we will take into consideration local risk factors since we deal with emerging markets that are known to be less integrated with the global financial markets. In the study conducted on Finland, Antell and Vaihekoski (2007) suggest using a conditional version of the world CAPM for partially segmented markets that implies a ser ies of restrictions for the expected returns, as i n the following model:

$$E_{t-1}(r_{it}) = \delta_{m,t-1} cov_{t-1}(r_{it}, r_{mt}) + \sum_{c=1}^{L} \delta_{c,t-1}\, cov_{t-1}(r_{it}, f_{ct}) + \delta^1_{m,t-1} cov_{t-1}(r_{it}, r^1_{m,t}),$$

$i = 1, \dots, M$,

where $\delta_{m,t-1}$, $\delta^{1}_{m,t-1}$ and $\delta_{c,t-1}$ are the conditional prices of world and local market risk and exchange rate risk for currency c.

The next step is to analyze the implication of the conditional asset pricing model and to model the investors' conditional expectations. In order to accomplish that we will use the methodology employed by De Santis and Gerard (1998), a multivariate GARCH-M approach.

As we take the perspective of a US investor, we assume he invests both in the domestic market and in each of the analyzed markets. Thus we estimate the model by employing a system of equations in which the first equation will price each of the analyzed countries in turn, the second equation is used to price the world market index, the third equation in the system accounts for the conditional price of risk of the domestic US market and the last equation is used to determine the price of the currency risk for each country.

We expect the currency risk to have a significant impact on the performances of investments in emerging markets, leading to an increase of the overall volatility associated to the investment. Simultaneously we expect an increase in the expected rates of return, namely a risk premium that compensates the volatility of the exchange rates.

VI. Conclusion

The question we aim to address has important implications for investor decisions in terms of asset allocation and managing international portfolio risk, especially taking into account the changes that have occurred in the exchange rate regimes on emerging markets.

Exchange rates also play an important role in what concerns the financial integration process in Europe. Unpredictable exchange rates that are characterized by high volatility are translated into higher costs of hedging and implicitly higher risk premiums. Given that volatile exchange rates usually characterize less integrated markets we expect to see higher currency risk premium demanded by investors during the first analyzed period as compared to the second period when the CEE markets have joined the European Union and therefore the degree of financial integration has increased.

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