Currency risk hedging in times of crisis: an analysis of European portfolios

Alexandra Horobet, Alina Draghici, Laura Gabriela Constantin
Bucharest Academy of Economic Studies
Faculty of International Business and Economics, Department of International Business and Economics
6 Piata Romana
Bucharest, 701631
Romania
e-mail: alexandra.horobet@gmail.com; alina.draghici@gmail.com; constantinlauragabriela@gmail.com

Abstract
Our paper investigates the changing diversification potential of European emerging capital markets for portfolios of developed European capital markets in times of crisis compared to normal times, taking into account the experience of the recent financial turmoil. More specifically, we examine the impact of currency risk on investments made by a Euro based investor in European countries, in a static and dynamic framework, by considering its evolution in normal versus turbulent times. Also, we use unhedged and hedged stock market returns to derive efficient frontiers that show whether the performance of well diversified portfolios made up of stocks from developed markets could be enhanced by including stocks from emerging markets and by hedging currency risk. We find that the contribution of currency risk to an investment made by a euro-based investor in other European countries was highly fluctuating over the three sub-periods under consideration, regardless of the country of investment. The currency risk contribution was positive indicating that currency risk adds to the local market risk, with a higher contribution of currency risk to the overall investment volatility in the case of emerging markets. At the same time, a definite conclusion in terms of whether hedging provides investors with better diversification opportunities cannot be reached, not even in crisis times: during our second sub-period, only portfolios made of EMU and developed markets, on one hand, and EMU, developed and emerging markets, on the other hand, provide investors with a better diversification potential in the unhedged returns case compared to hedged returns. Clearly, when only emerging markets are added to EMU, hedging currency risk is a better option compared to keeping investments unhedged.

Keywords: currency risk, hedging, portfolio investments, emerging markets
JEL codes: G11, G15

1. Introduction

In a framework of increasing international portfolio investments and of business opportunities diversification at the global level, but also of higher capital market integration, investors critically evaluate the exchange rate risk, particularly when investments are made in emerging markets. These markets are acknowledged of having higher levels of instability, compared to developed markets, and the crises that affected them in the 1990s, but also the current financial turmoil, have demonstrated that the impact of exchange rate fluctuations is seriously experienced by international investors. In this context, various studies raised the issue of a "legitimate" risk premium associated to investments in foreign markets that would compensate investors for taking on higher risks than at home.

Our paper investigates the changing diversification potential of European emerging capital markets for portfolios of developed European capital markets in times of crisis compared to normal times, taking into account the experience of the recent financial turmoil. More specifically, we examine the impact of currency risk on investments made by a Euro based investor in European countries, in a static and dynamic framework, by considering its evolution in normal versus turbulent times. Also, we use unhedged and hedged stock market returns to derive efficient frontiers that show whether the performance of well diversified portfolios made up of stocks from developed markets could be enhanced by including stocks from emerging markets and by hedging currency risk.

The contributions our paper makes to current research are threefold: (1) we show the role of hedging currency risk in determining the benefits from international diversification and explore whether hedging currency risk may improve the risk-return profile of investments at the European level; (2) we

consider the differences induced by macroeconomic evolutions and financial market volatility on the impact of currency risk for European portfolios; (3) we analyze whether emerging markets have preserved their diversification potential for portfolios composed of financial assets traded in developed markets in crisis times and address this research objective by taking into account the shape of efficient frontiers constructed from portfolios that include only developed markets, on one hand, and developed and emerging markets, on the other hand. This is directly approached by computing the curvature of the efficient frontier, based on the mathematics of the efficient frontier, as proposed by Roll (1977).

The structure of the paper is as follows. The research background is presented in section two; section three outlines sources and types of data together with the research methodology, while in sections four and five we have included the results and conclusions, respectively.

2. Research background

The impact of exchange rate fluctuations is felt at the level of risk and return for any investment made abroad, in a different currency than the reference currency of the investor. Jorion (1985), Levy and Lim (1994), Eun and Resnick (1994) and, more recently, Bugar and Maurer (2002) have shown that investors that do not control for the uncertainty associated to exchange rate movements are in the difficult position of obtaining gains from international investments that do not exceed the costs attached to holding assets abroad. The explanation resides in the correlations between exchange rates, which are not sufficiently small to provide investors with enough input for achieving good diversification in an international portfolio.

There are a few noteworthy points regarding the overall impact of currency risk on an international investment. First, currency fluctuations affect both the total return and the volatility of any foreign-currency denominated investment and, from time to time, the effects of currency fluctuations on the investment return may exceed the capital gain or income, especially over short periods of time. At the same time, empirical studies indicate that currency risk is generally smaller than the risk of the corresponding stock market. Second, the exchange risk of an investment may be hedged for major currencies by selling futures or forward currency contracts, buying put currency options, or even borrowing foreign currency to finance the investment, therefore currency risk can be easily eliminated in international investment strategies and does not represent a definite obstacle for international investments. Third, the contribution of currency risk should be measured for the total portfolio rather than for individual markets or securities, because part of that risk gets diversified away by the mix of currencies represented in the portfolio, as Biger (1979) and Giovannini and Jorion (1989) show. Fourth, the contribution of currency risk decreases with the length of the investment horizon, so an investor with a long time horizon should care less about currency risk than an investor who is concerned about monthly fluctuations in the portfolio's value.

Research on the links between stock market returns and exchange rate movements has developed since the beginning of the 1980s, with rather mixed evidences, depending on the methodology employed. One set of studies uses arbitrage pricing models to identify the exposure of national stock markets or various industries to exchange rate fluctuations. Aggarwal (1981) is among the first researchers that study stock prices and exchange rates and finds a significant relationship between the appreciating US dollar and US stock prices, but a few years later Soenen and Hennigan (1988) find an opposite relationship between the two. Jorion (1990) examines US multinational corporations exposure to exchange rate risk for a 17 years period and concludes that share prices of these companies are not systematically influenced by changes in nominal exchange rates. Bartov and Bodnar (1994) and Choi and Prasad (1995) confirm Jorion's findings, while Gao (2000) and Koutmos and Martin (2003) detect a more significant link between American companies share prices and changes in the nominal exchange rate of the dollar against various currencies. Besides US companies, Dutch companies have been researched by De Jong et al. (2002) that find more significant exposures in phases of the Dutch guilder depreciation, after investigating 117 companies over a 5-year period (1994-1998). British companies also display significant exposure, according to El-Masry (2003), but depending to a large extent on the nature of their businesses. Kyimaz (2003) investigates Turkish companies for the period 1991-1998 and finds significant exposures to exchange rate risk, but also variable in magnitude from one industry to another. Horobet and Lupu (2005) analyse the Romanian market over the 2000–2005 period and find weak significant exposures of stock returns to the euro-leu and US dollar-leu exchange rate. Their findings may be explained by the reduced importance of the euro or dollar denominated cash flows and/or assets and liabilities in the financial flows

of Romanian companies, by the possible presence of internal hedging operations or by the low capital market efficiency. Furthermore, Horobet and Lupu (2006) analyze ten CEE countries (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovenia, Slovakia and Romania) by taking into consideration changes in these countries' real exchange rates against the U.S. dollar and the euro. The results indicate the lack of contemporaneous and lagged exposures, which may be interpreted as a failure of stock market investors to incorporate changes in the competitive positions of firms in these countries in the stock returns. More recently, Horobet and Dumitrescu (2008) investigated the exposure of national stock markets from four countries in Central and Eastern Europe – Czech Republic, Hungary, Poland and Romania – to nominal and real exchange rate risk, using monthly data over the 1999–2007 timeframe. They find that companies from the region show contemporaneous and lagged exposure to nominal and real exchange rate risk and that these exposures are of the same type in all countries, suggesting a similarity in the economic structure of these countries in terms of foreign operations activity – exporting versus importing.

While understanding the exposure of national capital markets and companies to currency risk is important, an analysis in the context of international portfolio investments is critical for the proper assessment of currency risk impact, given the diversification effects that national capital and currency markets provide to any international investor. Hauser et al. (1994) examine the role of exchange rate risk in determining the benefits from international diversification in developed and emerging stock markets. While a number of studies conclude that the benefits from diversification in developed markets are enhanced by hedging the exchange rate risk, they do not consider the unique effect of currency risk on the overall risk exposure in emerging markets. The above authors find that under certain conditions such hedging may not be beneficial. In fact, hedging the currency risk of high-risk emerging markets can decrease the gains from international diversification. Their findings indicate that only investors who tolerate high levels of risk can gain by diversifying into emerging markets. They further indicate that in such diversification, the hedging of currency risk is an inferior policy because of the negative correlations between the exchange rate and stock returns when measured in the local currencies of emerging markets. Middleton et al. (2007) study the potential benefits from diversifying into eight stock markets of CEE countries. Their results show that the optimal CEE portfolio significantly outperformed its developed market counterparts in the UK, US and the World over the time period analyzed (1998-2003), both in terms of risk and return. The degree of outperformance varies over time and was smallest during the Russian crisis. They also find that country factors are more important than industry factors in explaining the variation in CEE stock market returns, thus investors should concentrate on choosing the right countries and the time horizon of their investment should be less than one year. The CEE equity markets as valuable diversification opportunities to international investors is supported by Patev et al. (2006) who found that dollar-based investors can benefit from diversification in CEE, as they are not co-integrated.

Investigating the impact of exchange rate movement on risk-return outcome of foreign portfolio investments, Shetty and Manley (2006) find that hedging against currency risk does not help to improve the return outcome nor does it help to lower return correlations, except in few instances, but it does lower return volatilities for some investors. Although hedging currency risk is a common practice in developed financial markets, emerging markets have historically lacked derivatives markets as support for hedging decisions. As mentioned by Lien and Zhang (2008), financial derivatives markets sustained capital inflows into emerging economies, but they have also led to exacerbated volatility; therefore, the development of derivatives markets in emerging economies needs to be complemented by sound macroeconomic and financial policies.

The current financial crisis had a tremendous impact on global financial markets, regardless of the type of country, developed or emerging. Under these circumstances, it is critical to understand the national capital markets' exposure to various risk factors and, in the context of our research, to currency risk. Mainly, the question is whether during crisis periods one may detect a significant increase in the exposure to currency risk and if such exposure is global or country specific. Also, since it is common knowledge know that correlations among national markets increase in crisi times, it is relevant to enquire whether such phenomenon may lead to decreased diversification opportunities for international investors. In their study of a previous financial crisis - the 1997 Asian crisis - Chakrabarti and Roll (2002) found that covariances, correlations and volatilities increased from the pre-crisis to the crisis period in both European and East Asian countries. Before the crisis, diversification was more powerful in Asian region, due perhaps to closer ties among countries in European community, but during the crisis this situation reversed. Kenourgios et al.

(2011), investigate financial contagion, during the period 1995–2006, in two developed markets (United States and United Kingdom) and four emerging equity markets (Brazil, Russia, India, China). They find that there is a contagion effect from the crisis country to all others, for each of the examined financial crises and also that emerging BRIC markets are more prone to financial contagion. They conclude that these results have important implications for international investors, as the diversification sought by investing in multiple markets from different regional blocks is likely to be lower in turbulent times. Therefore, an investment strategy centred only on international diversification seems not to work in practice during turmoil periods. Brana and Prat (2010), using a process of risk ranking, show that the downside potential for market risk, achieved by an international portfolio diversification including emerging country assets denominated in local currencies, is higher than the downside potential for credit risk supported by an investor who includes exclusively in his portfolio emerging securities denominated in foreign currencies. The authors conclude that advantages gained from diversification due to low correlations between changes in return rates of emerging securities, but also with other asset classes, should induce investors to modify structurally their asset allocations in favour of securities denominated in local currency in order to improve their portfolio efficiency.

In the framework of optimal portfolio selection, Niklewski and Rodgers (2011) investigate if the current financial crisis has resulted in a long-term structural change in the conditional correlation relationship between returns in US equity markets and returns in international equity markets. The authors conclude that there isn't much confirmation of the hypothesis that economic structural adjustment has resulted in long-term changes in the correlation between US and developed markets. Nevertheless they find some that the conditional correlation relationship between US and emerging or frontier markets evidence was modified due to structural change.

3. Data and research methodology

We develop our research on three levels: (i) we investigate the relevance of currency risk hedging for the performance improvement of investments at the European level; (ii) we take into account the differences induced by the recent financial crisis in terms of currency risk impact on the performance of European portfolios; and (iii) we analyze whether European emerging markets have preserved their diversification potential for the European developed markets in crisis times compared to normal times, by observing the shape of efficient frontiers constructed from portfolios that include only developed markets, on one hand, and developed and emerging countries, on the other hand.

We examine the benefits derived from hedging exchange rate risk in European diversified portfolios, by constructing six efficient frontiers: an unhedged frontier of developed markets; a hedged frontier of developed markets; an unhedged frontier of emerging markets; a hedged frontier of emerging markets; an unhedged frontier combining developed and emerging markets; and a hedged frontier combining developed and emerging markets. In all cases, we allow for short selling.

The dynamics of currency risk impact on European investments will be studied by decomposing the overall period in three sub-periods, different from the perspective of global macroeconomic developments and financial markets evolutions: (i) January 2005 – September 2007, a period of economic growth and booming financial markets; (ii) October 2007 – May 2009, a period of financial turmoil which marked the entry into the second largest economic recessions ever; (iii) June 2009 – March 2011, a period of slow recovery, particularly in emerging markets.

To analyze the benefits derived from hedging exchange rate risk in European diversified portfolios, we compute 1-month synthetic forward rates using Interest Rate Parity between local currencies and Euro. Using unhedged and hedged stock market returns we derive efficient frontiers that show whether the performance of well diversified portfolios made up of stocks from European developed markets could be enhanced by including stocks from emerging markets and by hedging currency risk. The diversification potential of European emerging markets is considered by taking into account the shape of the efficient frontiers constructed from developed and emerging markets and for different periods. More specifically, we use the mathematics of the efficient frontier, as proposed by Roll (1977), which shows that the frontier can be described by the equation

$$\sigma_p^2 = \frac{a - 2br_p + cr_p^2}{ac - b^2} \qquad (1)$$

where σ_p^2 is the variance of the efficient portfolio p and r_p is the return of the efficient portfolio. The efficient set constraints are given by $a = E'V^{-1}E$, $b = E'V^{-1}\iota$ and $c = \iota'V^{-1}\iota$, where E is the mean return vector of n assets, V is the variance-covariance matrix, and ι is the unit vector. Rearranging, we have

$$\frac{\sigma_p^2 - 1}{c} = \left(\frac{c}{ac - b^2}\right)\left(\frac{r_p - b}{c}\right)^2 \quad (2)$$

Equation (2) is the equation for a parabola that has a curvature C as follows:

$$\frac{\delta^2(\sigma_p^2)}{\delta(r_p)^2} \equiv C = \frac{2c}{ac - b^2} \quad (3)$$

We use the average value of C for each efficient frontier, derived from the C values for 20 portfolios along the frontier, and for the three sub-periods to provide a direct measure for the diversification potential of emerging markets.

We use monthly data on stock indices and exchange rates between January 2005 and February 2011. For eleven markets in the EMU area we use the MSCI EMU Index (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain) denominated in Euros. For three other developed countries in Europe (Norway, Switzerland and United Kingdom) and five European emerging markets the domestic market indices are collected from the Morgan Stanley Capital International (MSCI) Database in local currencies and Euro. Three of the emerging markets are EU members (Czech Republic, Hungary and Poland) and the remaining two are Turkey and Russia. The exchange rates against the Euro are collected from the Pacific Exchange Rate Service. The risk-free interest rates are collected from the CEIC Database and they are T-bill rates, Central Banks' rates or EURIBOR with 1-month maturity, depending on the country.

4. Results and discussion of findings

4.1. Descriptive statistics and general discussion

Table 1 presents the values of mean monthly returns, standard deviations, skewness and excess kurtosis, for stock market returns in euro and for spot exchange rates of countries' currencies against the euro. Overall, investments made in all markets would have provided the euro-based investor with positive and better mean returns except for United Kingdom compared with the mean return that would have been obtained in the EMU. This happened although the average changes in foreign currencies against the euro over the period do not necessarily indicate appreciations of the currencies against the euro – it is worthwhile to note that CEE currencies except for Polish zloty incurred appreciations against the euro, as well as the British pound, while other currencies depreciated on average against the euro over the period. At the same time, all these markets except for Switzerland and United Kingdom would have exposed the euro-based investor to higher risks, indicated by higher standard deviations of returns compared to EMU. It is interesting to note that skewness is negative for all markets, including EMU, which denotes asymmetric return distributions, with a higher chance of returns lower than the mean return. The kurtosis values, as skewness values, indicate non-normality of returns and leptokurtic distributions of returns, thus confirming previous research on capital markets return attributes. The mean changes in exchange rates were low for all currency pairs, and currency volatility was smaller compared to the local markets' returns volatility denominated in euro, suggesting that currency risk might not have been a significant contributor to the overall risk of an investment outside EMU.

Besides the values of standard deviations for local returns compared to EMU we were interested in investigating the effective contribution that the volatility of local currencies exchange rates has on the euro-denominated European market returns. Table 2 presents the difference between foreign returns denominated in local currencies, unhedged and hedged returns in euro from investments outside the EMU area, as well as their variances over the entire period and the three sub-periods considered in our research.

Table 1. Descriptive statistics of returns and spot rates changes, February 2005 - February 2011

	RET_EMU	RET_NOR	RET_SWI	RET_UK	RET_CZK	RET_HUN	RET_POL	RET_RUS	RET_TUR
Mean	0.0006	0.0058	0.0045	-0.0003	0.0070	0.0011	0.0047	0.0074	0.0054
Median	0.0108	0.0263	0.0029	0.0079	0.0089	0.0157	0.0155	0.0309	0.0185
Maximum	0.1397	0.1337	0.0915	0.1227	0.1703	0.2194	0.2427	0.2142	0.2574
Minimum	-0.1719	-0.3236	-0.1146	-0.1214	-0.2454	-0.4824	-0.3300	-0.3683	-0.3539
Std. Dev.	0.0543	0.0900	0.0383	0.0451	0.0717	0.1090	0.0982	0.1082	0.1212
Skewness	-0.8476	-1.4995	-0.6900	-0.5956	-0.5289	-1.1980	-0.5495	-0.9626	-0.6114
Kurtosis	4.2627	5.9970	3.9167	3.9493	4.4139	6.8757	4.1547	4.3317	3.8418
Jarque-Bera	13.5898	54.6766	8.3479	7.0574	9.4843	63.1514	7.7296	16.6669	6.7037
Probability	0.0011	0.0000	0.0154	0.0293	0.0087	0.0000	0.0210	0.0002	0.0350
		SPOT_NOREUR	SPOT_CHFEUR	SPOT_GBPEUR	SPOT_CZKEUR	SPOT_HUFEUR	SPOT_PLZEUR	SPOT_RBLEUR	SPOT_TKLEUR
Mean		0.0009	0.0026	-0.0029	0.0029	-0.0013	0.0004	-0.0012	-0.0033
Median		0.0027	-0.0004	0.0015	0.0038	0.0006	0.0055	0.0005	-0.0018
Maximum		0.0926	0.0715	0.0591	0.0488	0.0617	0.0681	0.0531	0.0738
Minimum		-0.0890	-0.0510	-0.1378	-0.0640	-0.1146	-0.0956	-0.1510	-0.1883
Std. Dev.		0.0231	0.0202	0.0263	0.0193	0.0286	0.0294	0.0282	0.0423
Skewness		-0.1542	1.1020	-1.7606	-0.7249	-1.0584	-0.6458	-2.6364	-1.3963
Kurtosis		7.7705	5.8990	11.1183	4.7186	5.9350	3.9394	14.4536	7.3797
Jarque-Bera		69.5107	40.3364	238.1789	15.3761	39.8315	7.7575	483.5899	82.0639
Probability		0.0000	0.0000	0.0000	0.0005	0.0000	0.0207	0.0000	0.0000

Note: RET_ denotes unhedged returns and SPOT_ denotes the changes in the spot exchange rates against the EUR; NOR – Norway, SWI – Switzerland, UK – United Kingdom, CZK – Czech Rep., HUN – Hungary, POL – Poland, RUS – Russia, TUR – Turkey.

Table 2. Unhedged and hedged returns and volatilities

	NOR	SWI	UK	CZK	HUN	POL	RUS	TUR
January 2005 - February 2011								
Ret local	0.00489	0.00193	0.00262	0.00411	0.00245	0.00429	0.00865	0.00868
Var(ret local)	0.00635	0.00168	0.00200	0.00451	0.00842	0.00601	0.01086	0.00862
Ret EUR unhedged	0.00584	0.00449	-0.00026	0.00703	0.00111	0.00472	0.00744	0.00541
Var(ret EUR unhedged)	0.00810	0.00147	0.00204	0.00514	0.01187	0.00964	0.01171	0.01468
Var(s)	0.00053	0.00041	0.00069	0.00037	0.00082	0.00087	0.00080	0.00179
Ret EUR hedged	0.00746	0.00497	-0.00383	-0.04466	-0.00098	0.00318	0.00647	-0.00671
Var (ret EUR hedged)	0.00693	0.00190	0.00264	0.19232	0.00723	0.00683	0.02069	0.01212
January 2005 - September 2007								
Ret local	0.02064	0.01376	0.00863	0.02113	0.01650	0.01832	0.02985	0.01909
Var(ret local)	0.00243	0.00080	0.00052	0.00252	0.00464	0.00393	0.00526	0.00580
Ret EUR unhedged	0.02276	0.01156	0.00837	0.02396	0.01585	0.02077	0.03088	0.01956
Var(ret EUR unhedged)	0.00272	0.00066	0.00046	0.00277	0.00631	0.00605	0.00512	0.01223
Var(s)	0.00018	0.00004	0.00013	0.00014	0.00058	0.00051	0.00012	0.00194
Ret EUR hedged	0.02478	0.01024	0.00607	-0.09801	0.00493	0.00958	0.02972	0.00752
Var (ret EUR hedged)	0.00276	0.00088	0.00053	0.43216	0.00455	0.00381	0.00679	0.01407
October 2007 - May 2009								
Ret local	-0.02997	-0.02578	-0.01939	-0.02169	-0.03962	-0.03663	-0.03549	-0.02348
Var(ret local)	0.01475	0.00285	0.00385	0.00968	0.01602	0.01095	0.02569	0.01588
Ret EUR unhedged	-0.03697	-0.02113	-0.03066	-0.02039	-0.04559	-0.04518	-0.04581	-0.03531
Var(ret EUR unhedged)	0.01886	0.00218	0.00462	0.01077	0.02327	0.01755	0.02765	0.02426
Var(s)	0.00129	0.00067	0.00165	0.00079	0.00158	0.00173	0.00193	0.00247
Ret EUR hedged	-0.03401	-0.01664	-0.03945	-0.01042	-0.02233	-0.03106	-0.00530	-0.05095
Var (ret EUR hedged)	0.01566	0.00299	0.00463	0.01179	0.01377	0.01414	0.05807	0.01428
June 2009 - February 2011								
Ret local	0.01409	0.01030	0.01443	0.00276	0.02110	0.02191	0.01838	0.02346
Var(ret local)	0.00338	0.00104	0.00204	0.00199	0.00544	0.00282	0.00378	0.00551
Ret EUR unhedged	0.02081	0.01811	0.01554	0.00736	0.02313	0.02780	0.02243	0.02263
Var(ret EUR unhedged)	0.00450	0.00126	0.00092	0.00277	0.00783	0.00519	0.00398	0.00856
Var(s)	0.00032	0.00071	0.00062	0.00037	0.00051	0.00057	0.00072	0.00097
Ret EUR hedged	0.02058	0.01751	0.01500	0.00404	0.01036	0.02603	-0.01775	0.01372
Var (ret EUR hedged)	0.00339	0.00196	0.00249	0.00308	0.00524	0.00346	0.00715	0.00554

When the overall period is considered, unhedged returns in euro were more volatile than returns denominated in local currencies in all countries except for Switzerland, which suggests that currency risk was an additional contributor to the risk of these markets for a euro-based investor. Interestingly, though, hedged returns in euro were higher than unhedged returns only for Norway and Switzerland, but the same thing is not observed for their variance: in four countries the variance of hedged returns in euro was higher than the variance of unhedged returns (Switzerland, United Kingdom, Czech Republic and Russia), while in the remaining countries (Norway, Hungary, Poland and Turkey) the situation was reversed. When one observes the impact of currency risk over the three sub-periods interesting findings emerge. In the first sub-period, which may be called the "normal" period, currency risk has actually diminished the overall volatility of the investment in three countries (Switzerland, United Kingdom and Russia). Interestingly, albeit unhedged returns in euro were higher than hedged returns for all countries, the variance of hedged

returns was higher than the variance of unhedged returns in all countries except for Hungary and Poland, which is a finding that contradicts somehow the general belief that hedging should reduce risk. The second sub-period brought bad news in terms of returns, as all mean local and euro returns were negative, except for Switzerland, and the variance of euro returns was higher compared to local returns. No pattern in terms of the difference between the volatility of unhedged versus hedged returns in euro may be detected across our sample of countries: in four of them – Norway, Hungary, Poland and Turkey – unhedged returns were more volatile than hedged returns, and in the remaining four – Switzerland, United Kingdom, Czech Republic and Russia – unhedged returns proved to be less volatile. This confirms that full hedging against currency risk in times of crisis was profitable in terms of returns, but not necessarily in terms of risk, and that the effectiveness of a hedging policy is very much country-specific. The third sub-period considered, which we named the "slow recovery" period, has features that resemble to some extent the previous two sub-periods. As such, hedged returns were on average smaller than unhedged returns in all countries, and the variance of returns denominated in euro was higher than the variance of local returns, with the exception of United Kingdom. One more time, no pattern regarding the variance of hedged versus unhedged returns may be identified: the variance of hedged returns is higher for five countries (Switzerland, United Kingdom, Czech Republic, Russia and Turkey) and lower for the remaining three countries (Norway, Hungary and Poland).

Wrapping-up our analysis over the three sub-periods, a few noteworthy points emerge: (1) the contribution of currency risk to an investment made by a euro-based investor in other European countries was highly fluctuating over the three sub-periods under consideration, regardless of the country of investment; (2) in general, the currency risk contribution was positive – the exceptions are Switzerland for the overall period and the first and second sub-periods, United Kingdom for the first and third sub-period and Russia for the second sub-period -, indicating that currency risk adds to the local market risk; (3) in the case of emerging markets we find a higher contribution of currency risk to the overall investment volatility, which generally adds to higher local market risk to make them more volatile for a euro-based investor.

In order to examine the potential benefits derived from adding emerging markets and hedging exchange rate risk in European diversified portfolios, during the overall period and the three sub-periods, we considered portfolios made of investments in EMU countries and investments in the other European markets, as follows: a portfolio that includes EMU and the three developed countries (Norway, Switzerland and United Kingdom), a portfolio that includes EMU and the five emerging markets (Czech Republic, Hungary, Poland, Russia and Turkey), and another portfolio that includes EMU and all eight European countries. We thus study the impact of hedging currency risk in diversified portfolios over the entire period and the three sub-periods. Therefore, we generated twenty-four efficient portfolio frontiers using unhedged and hedged euro returns while allowing for short-selling: unhedged frontiers of EMU and developed markets; hedged frontiers of EMU and developed markets; unhedged frontiers of EMU and emerging markets; hedged frontiers of EMU and emerging markets; unhedged frontiers combining EMU, developed and emerging markets; and hedged frontiers combining EMU, developed and emerging markets. In the case of short-selling case, the maximum amount allowed was set to -1 (100%) for each asset. The analysis of our findings, illustrated in Figures 1 to 4, follows.

4.2. Analysis of diversification potential: efficient frontiers

For the overall period (January 2005 – February 2011), when allowing for short-selling, the performance of portfolios formed of developed, emerging and by combining developed and emerging markets could be enhanced by hedging currency risk, especially for higher levels of risk (see Figure 1). As far as the portfolios made up of stocks from developed and emerging markets are concerned, investors that tolerate low and high levels of risk would have been better off by not hedging currency risk, while for the middle levels of risk there seems to be a situation of indifference, since the unhedged and hedged efficient frontiers are superimposed.

When analyzing the first sub-period (January 2005 – September 2007), which we considered the "normal" period (see Figure 2), we find an expected pattern for all the three pairs of efficient frontiers: the portfolios' performance is enhanced by hedging currency risk, regardless of whether they were formed by stocks from only developed, only emerging or developed and emerging markets. For portfolios formed of EMU and emerging countries and of developed and emerging countries, respectively, not hedging currency

risk would have been the proper choice. Interestingly, during the normal period, as for the overall period, for intermediate levels of risk, the unhedged frontier overlays the hedged frontier.

Figure 1. Efficient frontiers, overall period

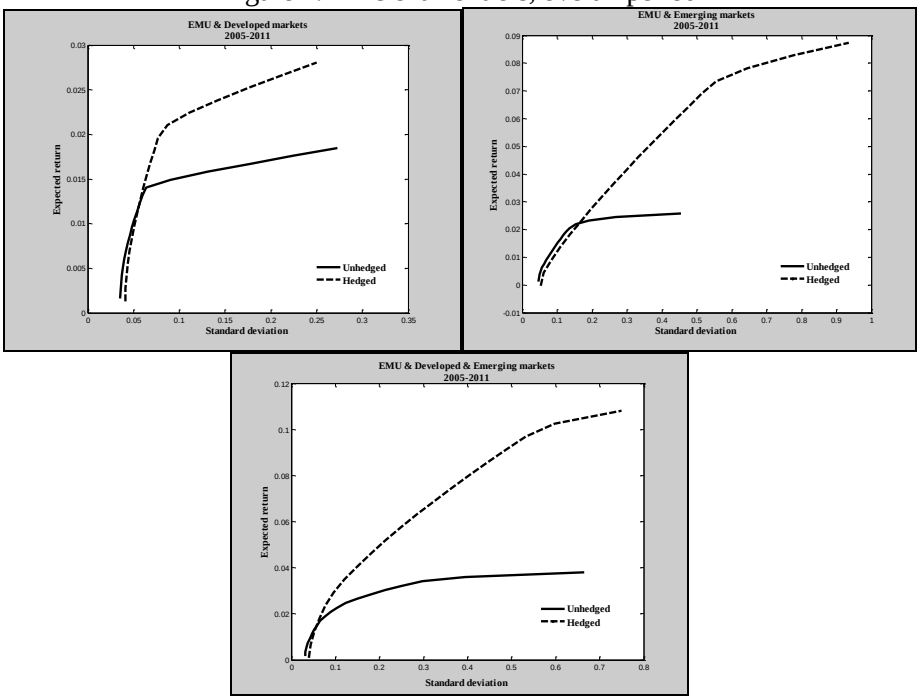
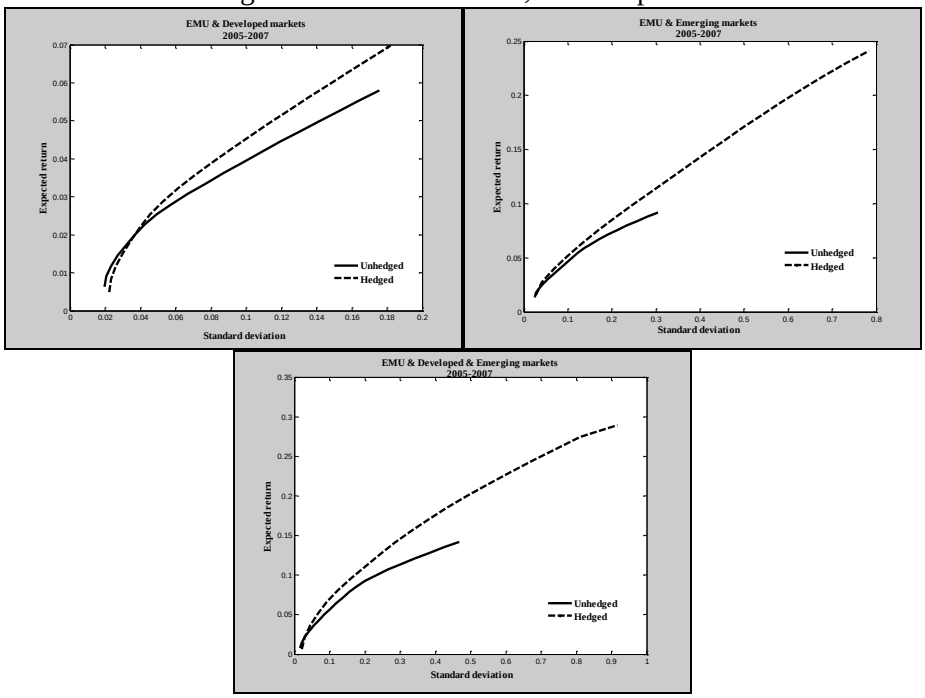


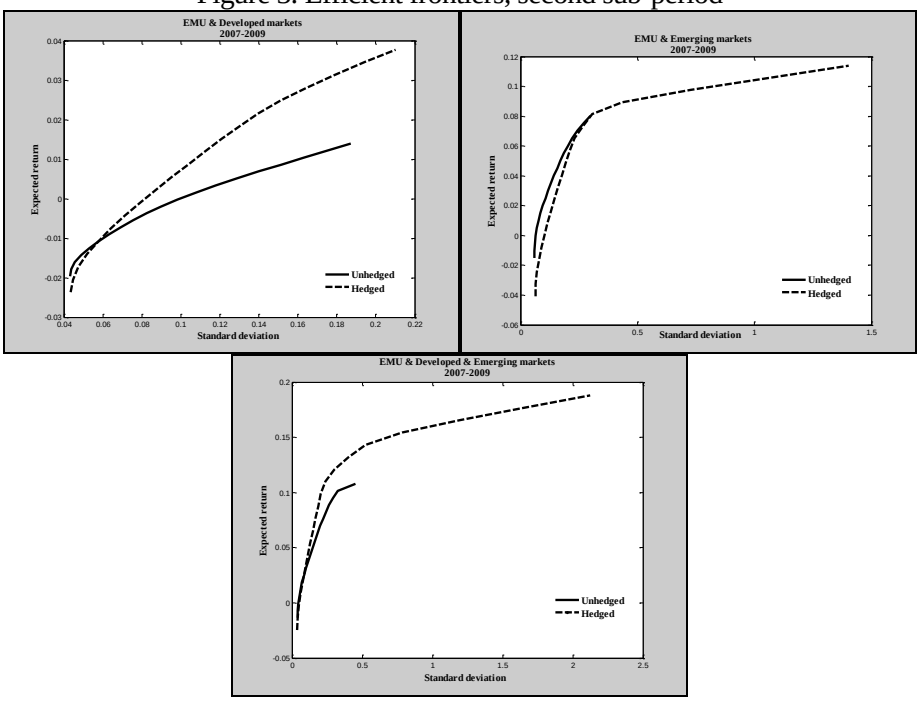
Figure 2. Efficient frontiers, first sub-period



The analysis performed for the second sub-period (October 2007 – May 2009), the "turbulent" period reveals that for the portfolios formed with stocks from developed markets and for those formed with stocks from developed and emerging markets, currency hedging enhances the risk-return performance (see Figure 3). The case of portfolios formed by stocks from emerging markets is different in that hedging seems to be a good idea only for high levels of risk. Therefore, it is inconclusive whether it was better to hedge currency risk or not during this period. For the other two situations, regarding the portfolios made up

by stocks from EMU and emerging markets and by stocks from emerging and developed markets, hedging currency risk appears to have enhanced the performance over the sub-period.

Figure 3. Efficient frontiers, second sub-period



When investigating the recovery period (June 2009 – February 2011), the portfolios' performance is improved when hedging currency risk, except for investors tolerating low levels of risk that would choose to invest in portfolios formed by stocks from developed markets (see Figure 4). Therefore, it seems that, overall, when allowing for short-selling, hedging currency risk seems to be a good choice whether investing in stocks from developed, emerging or developed and emerging markets.

For the overall period as well as for the normal and recovery ones, it appears that an EMU-based investor that decides to diversify by adding emerging markets to an EMU portfolio should not hedge currency risk, while, during turbulent times, as expected, it is worth hedging his position. An analysis of efficient frontiers derived from stocks of developed and emerging markets reveals that overall, for the entire period and for the first and third sub-period, an investor is better off if not hedging currency risk, with minor exceptions when considering a certain degree of risk tolerance. However, as predicted, during crisis periods, it is advisable that an investor choose to hedge currency risk.

4.3. Analysis of diversification potential: the curvature of efficient frontiers

In order to examine more thoroughly the diversification potential of portfolios composed of financial assets traded in developed and emerging markets we explore the shape of the previously derived efficient frontiers by employing a measure of the curvature of the efficient frontier as explained in Section 3. The higher the average curvature value (C), the lower the effectiveness of diversification.

The results of the analysis are displayed in Table 3. We interpret the results from two perspectives: first, we observe the diversification potential of each category of markets (developed, emerging, developed and emerging) for EMU assets in an unhedged and hedged framework; second, we compare the diversification potential of each portfolio, using unhedged and hedged returns, across the three sub-periods. More specifically, we observe the change of the average curvature value from the normal to the crisis period and the crisis to the slow recovery period.

As far as the portfolios formed by EMU and European developed markets are concerned, unhedged returns provide investors with better diversification opportunities in the second and third period, while hedged returns are better for the overall period, as well as for the third sub-period. In the case of portfolios composed of EMU and emerging markets, investors would be better off in terms of

diversification potential by maintaining their returns unhedged in the first and third period, and better off by hedging in the second period and overall. When developed and emerging European markets are added to a portfolio consisting of EMU assets, hedging provides better diversification opportunities in the first sub-period and over the entire period, while keeping their portfolios unhedged would have benefited investors in the second and third sub-period.

Figure 4. Efficient frontiers, third sub-period

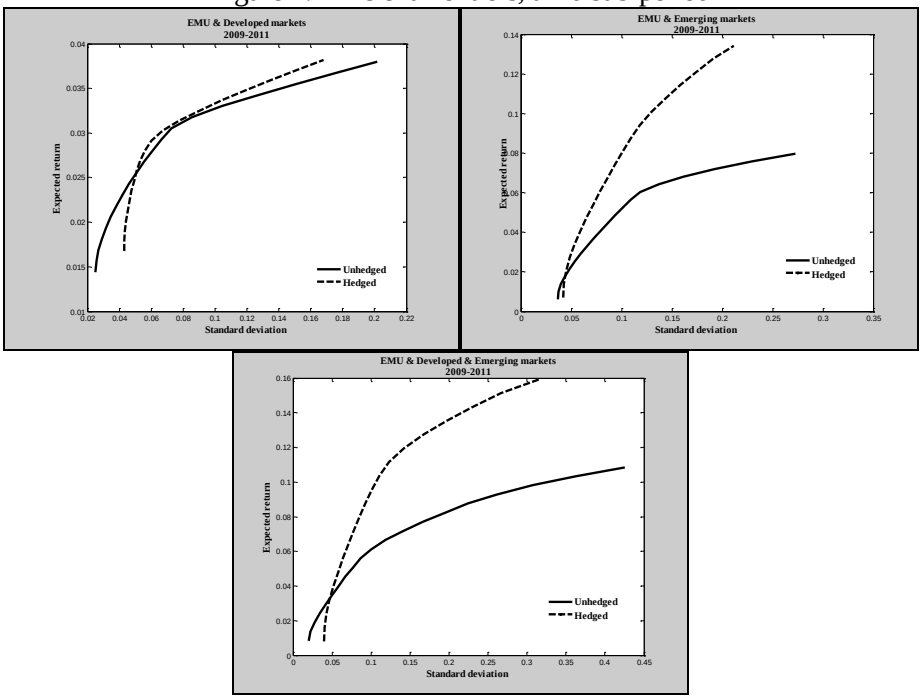


Table 3. Average curvature values

Portfolio / Period	EMU-Developed		EMU-Emerging		EMU-Developed-Emerging	
	Unhedged	*Hedged*	*Unhedged*	*Hedged*	*Unhedged*	*Hedged*
Overall period	10.71	14.85	5.29	9.38	30.75	55.37
First sub-period	13.82	16.70	9.74	8.90	22.02	24.13
Second sub-period	23.07	15.87	8.63	11.02	64.75	38.04
Third sub-period	11.34	10.91	5.60	4.89	23.09	21.77

When we contrast the diversification potential of our portfolios across the three sub-periods and during the overall period, it is obvious that a portfolio consisting of EMU and developed and emerging provides investors with the highest diversification potential, but the second diversification potential comes not from portfolios made from EMU and emerging markets, but from the ones that include EMU and developed markets. This result, as can be seen in Table 3, is present for all sub-periods and the overall period. Moreover, a definite conclusion in terms of whether hedging provides investors with better diversification opportunities cannot be reached, not even in crisis times: during our second sub-period, only portfolios made of EMU and developed markets, on one hand, and EMU, developed and emerging markets, on the other hand, provide investors with a better diversification potential in the unhedged returns case compared to hedged returns. Clearly, when only emerging markets are added to EMU, hedging currency risk is a better option compared to keeping investments unhedged.

5. Conclusions

Our research examines the impact of currency risk on investments made by a euro-based investor in European countries, in a static and dynamic framework, by considering its relevance in normal versus turbulent times. We also investigate whether the performance of well diversified portfolios made up of stocks from European developed markets could be enhanced by including stocks from emerging markets

and by hedging currency risk. We develop our research on three levels: first, we examine the benefits derived from hedging exchange rate risk in European diversified portfolios; second, we study the dynamics of currency risk impact on European investments by decomposing the overall period in three sub-periods, different from the perspective of global macroeconomic developments and financial markets evolutions: (i) January 2005 – September 2007, a period of economic growth and booming financial markets; (ii) October 2007 – May 2009, a period of financial turmoil which marked the entry into the second largest economic recessions ever; (iii) June 2009 – March 2011, a period of slow recovery, particularly in emerging markets; third, we analyze the diversification potential of European emerging markets by taking into account the shape of the efficient frontiers constructed from developed and emerging markets and for different periods.

A few noteworthy conclusions emerge out of our work: (1) the contribution of currency risk to an investment made by a euro-based investor in other European countries was highly fluctuating over the entire period and the three sub-periods under consideration, regardless of the country of investment; (2) in general, the currency risk contribution was positive indicating that currency risk adds to the local market risk; (3) in the case of emerging markets we find a higher contribution of currency risk to the overall investment volatility, which generally adds to higher local market risk to make them more volatile for a euro-based investor.

When short-selling is allowed, hedging currency risk seems to be a good choice whether investing in stocks from developed, emerging or developed and emerging markets. For the overall period as well as for the normal and recovery ones, an EMU-based investor that decides to diversify by adding emerging markets to an EMU portfolio should not hedge currency risk, while, during turbulent times, as expected, it is worth hedging his position. An overview of the efficient frontiers derived from stocks of developed and emerging markets reveals that overall, for the entire period and for the first and third sub-period, an investor is better off if not hedging currency risk, with minor exceptions when considering a certain degree of risk tolerance. However, as predicted, during crisis periods, it is advisable that an investor should choose to hedge currency risk.

When currency risk is not hedged, we observe a decrease of the diversification potential from the normal to the crisis period and a reverse evolution from the turbulent period to the slow recovery one. When considering the case of hedging currency risk, we notice an increase in the diversification potential both from the normal to the crisis period and from the turmoil period to the slow recovery one. Considering the EMU and European emerging markets portfolios we have an increasing diversification potential over the three periods analyzed, when taking into consideration the unhedged returns. Allowing for currency risk hedging we have a decreasing diversification potential from the first to the second analyzed period. Including in the portfolios all the markets considered in our investigation, for the unhedged returns the results show a decrease of the diversification potential from the first to the second period, followed by an increase from the crisis to the slow recovery period. The same evolution characterizes the portfolios when hedging currency risk.

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References

AGGARWAL, R. (1981). Exchange rates and stock prices: a study of the US capital markets under floating exchange rates. *Akron Business and Economic Review*, vol.12, pp. 7-12.

BARTOV, E., BODNAR, G. (1994). Firm valuation, earnings expectations, and the exchange-rate exposure effect. *Journal of Finance*, vol. 49, no. 5, pp. 1755-1788.

BIGER, N. (1979). Exchange Risk Implications of International Portfolio Diversification. *Journal of International Business Studies*, vol. 10, no. 2, pp. 63-74.

BRANA S., PRAT S. (2010). The introduction of emerging currencies into a portfolio: Towards a more complete diversification model. *International Economics*, vol. 121, pp. 5-24

BUGAR, G. MAURER, R. (2002). International Equity Portfolios and Currency Hedging: The View Point of German and Hungarian Investors. *Asian Bulletin*, vol.32, no.1, pp. 171-197

CHAKRABARTI, R., ROLL, R. (2002). East Asia and Europe during the 1997 Asian collapse: a clinical study of a financial crisis. *Journal of Financial Markets*, vol. 5, no.1, pp. 1-30.
CHOI, J., PRASAD, A. (1995). Exchange rate sensitivity and its determinants: A firm and industry analysis of U.S. Multinationals. *Financial Management*, vol. 24, no. 3, pp. 77-88.
DE JONG, A., LIGTERINK, J., MACRAE, V. (2002). *A Firm-Specific Analysis of Exchange-Rate Exposure of Dutch Firm*. Erasmus Research Institute of Management Working Paper
EL-MASRY, A. (2003). *The Exchange Rate Exposure of UK Nonfinancial Companies: Industry-Level Analysis*. Manchester Business School Working Paper
EUN, C.S., RESNICK, B.G. (1994). International diversification of investment portfolios, US and Japanese perspective. *Management Science*, vol. 40, no. 1, pp.140-60.
GAO, T. (2000). Exchange rate movements and the profitability of U.S. multinationals. *Journal of International Money and Finance*, vol. 19, no. 1, pp. 117-134.
GIOVANNINI, A., JORION, P. (1989). The Time-Variation of Risk and Return in the Foreign Exchange and Stock Markets. *Journal of Finance*, vol.44, no.2, pp. 307-325.
HAUSER, S., MARCUS, M., YAARI, U. (1994). Investing in emerging stock markets: is it worth while hedging foreign exchange risk?. *Journal of Portfolio Management*, vol. 20, no. 3, pp. 76-81.
HOROBET, A., DUMITRESCU, S. (2008). Insights into Central and Eastern European countries competitiveness: on the exposure of capital markets to exchange rate risk. *Review of Economic and Business Studies*, no.2, pp.107-126.
HOROBET, A., LUPU, R. (2005). Expunerea la riscul valutar a firmelor româneşti : o analiză sectorială, *Oeconomica*, year XIV, no. 4, pp. 107-136.
HOROBET, A., LUPU, R. (2006). Real exchange rates and corporate performance: a comparative analysis for CEE countries. In *Proceedings of the 2006 International Conference on Commerce, Academy of Economic Studies Bucharest, Romania*, pp. 272-281.
JORION, P. (1985). International Portfolio Diversification with Estimation Risk. *Journal of Business*, vol.58, no.3, pp. 259-278.
JORION, P. (1990). The exchange rate exposure of U.S. multinationals. *Journal of Business*, vol. 63, no. 3, pp. 331-345.
KENOURGIOS D., SAMITAS A., PALTALIDIS N. (2011). Financial crises and stock market contagion in a multivariate time-varying asymmetric framework. *Journal of International Financial Markets, Institutions and Money*, vol. 21, issue 1, pp. 92-106.
KOUTMOS, G., MARTIN, A. (2003). First- and Second-Moment Exchange Rate Exposure: Evidence from U.S. Stock Returns. *The Financial Review*, vol. 38, no. 3, pp. 455-471.
KYIMAZ, H. (2003). Estimation of foreign exchange exposure: an emerging market application. *Journal of Multinational Financial Management*, vol.13, no. 1, pp. 71-84.
LEVY, H., LIM, K.C. (1994). Forward Exchange Bias, Hedging and the Gains from International Diversification of Investment Portfolios. *Journal of International Money and Finance*, vol.13, no. 2, pp. 159-170.
LIEN, D., ZHANG, M. (2008). A Survey of Emerging Derivatives Markets. *Emerging Markets Finance and Trade*, vol.44, no.2, pp. 39-69.
MIDDLETON, C.A.J., FIFIELD, S.G.M., POWER, D.M. (2008). An investigation of the benefits of portfolio investment in Central and Eastern European stock markets. *Research in International Business and Finance*, vol. 22, no. 22, pp. 162-174.
NIKLEWSKI J., RODGERS T. (2011). *International portfolio diversification and the 2007 financial crisis: will structural change in equity market correlations have a lasting impact on optimal portfolio selection?*, Coventry University, Economics, Finance and Accounting Applied Research Working Paper Series
PATEV, P., KANAYRAN, N., LYROUDI, K. (2006). Stock market crises and portfolio diversification in Central and Eastern Europe. *Managerial Finance*, vol. 32, no. 5, pp. 415-432.
SHETTY, A., MANLEY, J. (2006). Analysis of currency impact on international investment. *Managerial Finance*, vol. 32, no. 1, pp. 5-13.
SOENEN, L.A., HENNINGAN, E.S. (1988). An Analysis of Exchange Rates and Stock Prices: the U.S. Experience between 1980 and 1986. *Akron Business and Economic Review*, Vol.19, pp.7-16.