

**Optimal Portfolio Analysis for the Czech Republic, Hungary and Poland  
During 2001– 2006 Period**

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**Abstract.**

This paper examines the strategy of investing in selected East European stock markets: The Czech Republic, Hungary, and Poland. These stocks markets are representative of the emerging stock markets of Eastern Europe and examined from the perspective of an investor who invests solely in the Eastern European markets. International Portfolio investment gradually increased during the late 2000's in this region. Four portfolio construction techniques were used including the Markowitz mean-variance analysis. The optimal portfolios are evaluated using standard selection criteria and it is shown that possessing a diversified international portfolio which includes some of the aforementioned stock markets is beneficial.

**Keywords:** Portfolio diversification; Markowitz Mean Variance Frontier; Eastern European Countries.

## 1. Introduction

International investment gradually increased during the late 1990s and the early 2000s with the emergence of markets the Czech Republic, Hungary, and Poland and this paper examines the strategy of investing in these three East Europe<sup>1</sup> stock markets: In our analysis we employed four methods of portfolio construction and instead of choosing a standard<sup>2</sup> period for portfolio evaluation, we use all the available data for different starting periods of portfolio evaluation, different historic periods to inference information for construction of the portfolio weights and different portfolio evaluation periods. Instead of obtaining an estimate of the portfolio weights and the total and mean portfolio returns, using an iterative technique with different starting periods of portfolio construction, different historic periods and different portfolio evaluation periods, we obtain distributions of the total and mean returns, the risk and all distributions of all the portfolio evaluation.

The **Czech Republic** is one of the most stable and prosperous of the post-Communist states of Central and Eastern Europe. Growth in 2000-05 was supported by exports to the EU, primarily to Germany, and a strong recovery of foreign and domestic investment. Intensified restructuring among large enterprises, improvements in the financial sector, and effective use of available EU funds should strengthen output growth.

**Poland** has steadfastly pursued a policy of economic liberalization throughout the 1990's and today stands out as a success story among transition economies. Even so, much remains to be done, especially in bringing down the unemployment rate - currently the highest in the EU. Poland joined the EU in May 2004, and surging exports to the EU contributed to Poland's strong growth in 2004, though its competitiveness could be threatened by the zloty's appreciation.

**Hungary** has made the transition from a centrally planned to a market economy, with a per capita income one-half that of the Big Four European nations. Hungary continues to demonstrate strong economic growth and acceded to the EU in May 2004.

Investors willing to assume the additional risk present in these markets have been well compensated. Yet, many market analysts have indicated that such markets are somewhat of an abnormality, in that they tend to be characterized as thin, narrow and driven by poorly informed individuals rather than by fundamentals. It cannot be assumed, however, that investing in emerging stock markets is more dangerous than investing in more progressive countries, given the expected returns. The average investor may increase his or her returns if they hold portfolios which include foreign stocks. Since stock markets are not highly correlated and consequently do not fluctuate in tandem, it is expected that diversification leads to a higher return for a given risk. This study is not the first to investigate the dynamic linkages<sup>4</sup> across the national stock indexes, but to our knowledge is one of only few that investigate these three country stock markets.

The remainder of the paper is organized as follows: Section 2 presents the Optimization algorithm and section 3 discusses the data used. Section 4 presents the results from the portfolio evaluation and discusses the findings. Finally, section 5 provides a summary and conclusions.

## 2. Portfolio Construction Techniques.

Four portfolio construction techniques were used in this paper:

### 2.1 The Mean-variance (E–V) efficient frontier.

If  $w$  is the vector of the holdings,  $\mu$  the vector of the expected returns of the assets and  $\Sigma$  the variance covariance matrix of the returns, then the portfolio variance is  $\sigma_p^2 = w' \Sigma w$  and the portfolio returns is  $\mu_p = w' \mu$ . The Markowitz model, assumes that portfolios can be completely characterized by their mean return and variance (or risk) and minimizes the variance of the portfolio:

$$\min_{w, \text{s.t. } w} w' \Sigma w \quad (1)$$

subject to:

$$w' i = 0 \quad (2)$$

where  $i$  is a vector of ones and  $\Sigma$  is a  $N \times N$  variance – covariance matrix of the expected returns of the  $j = 1, 2, \dots, N$  indexes.

**2.2 The equal weights portfolio.** According to this approach the weights of the three country indexes in the portfolio are defined as follows:

$$w_j = (1/ \text{Number of Indexes}) \text{ for } j = 1, 2, 3(\text{country indexes}) \quad (3).$$

**2.3 The random weights portfolio.** In this case the weights of the portfolio were obtained randomly using for each weight a uniform distribution. In order to achieve, that  $\sum_{j=1}^{N=3} w_j = 1$  an iterative correction technique using each time the previous weights, was used until to satisfied the above condition.

**2.4 The past returns weights portfolio.** Following this approach we estimated the portfolio weights with a two step procedure using the mean past returns:

In the first step we applied an iterative, with respect to the parameter  $0 \leq \lambda \leq 1$ , maximization approach:

$$\max_{\hat{\lambda}} \sum_{t=1}^T \sum_{j=1}^N (1 - \hat{\lambda}) \hat{\lambda}^j \bar{d}_{jt} \quad (4)$$

for  $0 \leq \lambda \leq 1$

with  $\bar{d}_{jt}$ : the mean past returns of the  $j = 1, 2, \dots, 3$  country indexes.

and in the second step we obtained the past returns weights using the relations :

$$\hat{w}_j = (1 - \hat{\lambda}) \hat{\lambda}^j \text{ with } \sum_{j=1}^n \hat{w}_j = 1 \quad (5)$$

Using the estimated weights evaluation techniques were applied to assess the optimal solutions derived by comparing them to other investment alternatives such as the MSCI EM (Emerging Markets) Europe, Middle East and Africa Index and the MSCI Europe.

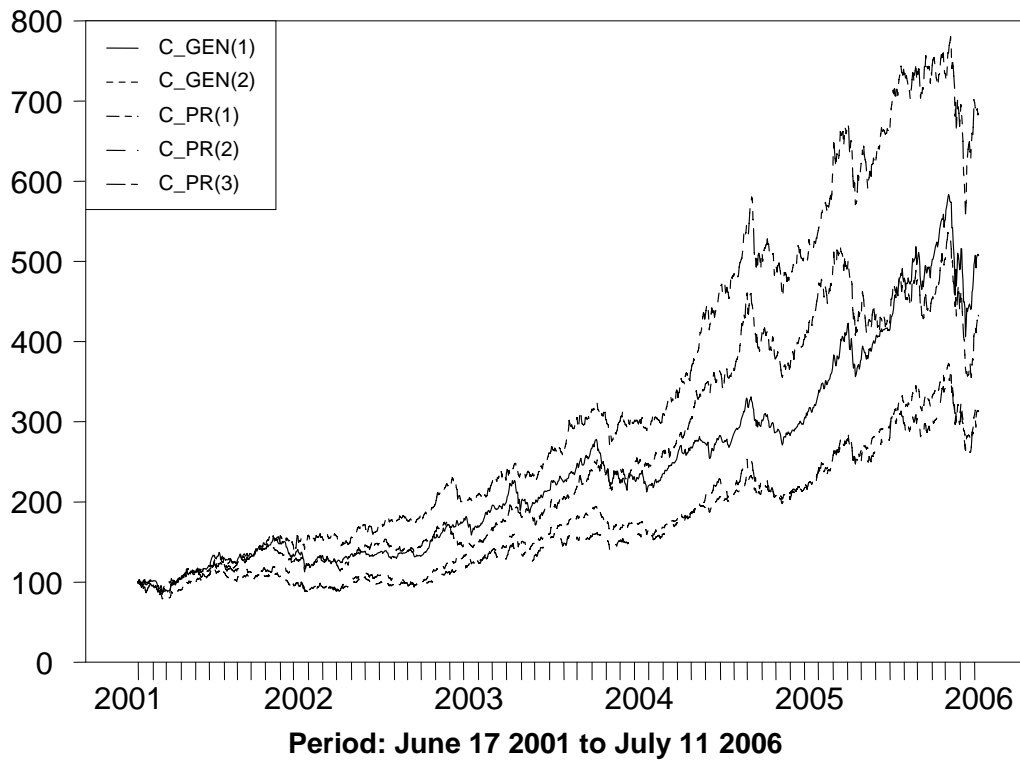
### **3.Data**

This study uses daily closing values for the stock indices of the East Europe: Czech Republic, Hungary, and Poland. The period under examination extends from July 12, 2001 through July 11, 2006, with a total of 1450 observations. Data are value weighted, expressed in United States Dollars (USD) and Local units, and not adjusted for dividends<sup>5</sup>. The performance of the Czech Republic, Hungary, and Poland exchanges are recorded and compared with two Morgan Stanley benchmarking Indexes<sup>6</sup>: the MSCI Emerging Markets Index and the MSCI Europe Index.

Table 1 and Figures 1 and 2 provides the reader a first, but informal, look of the basic characteristics of the trends of the levels and the variability of the returns of the under analysis indexes. Figure 1 presents a diachronic comparison between each country index and the benchmarking indexes in the whole 'estimation' period. Figure 2 presents an analogous comparison of the distribution of the four country returns and the two benchmarking indexes.

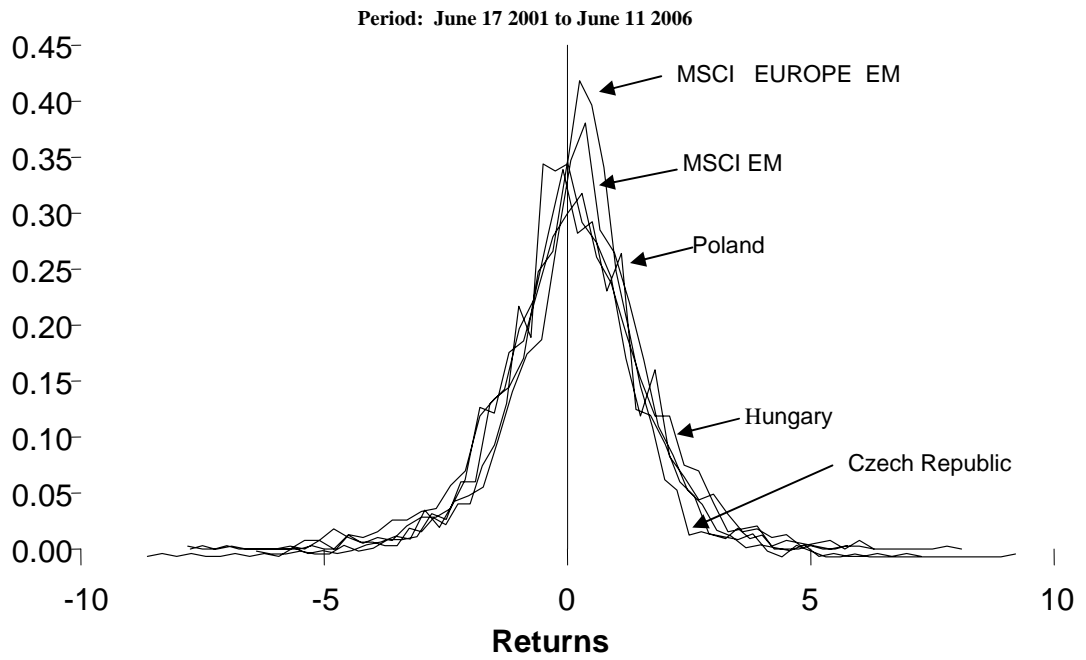
Table 1 provides some descriptive statistics. As expected in emerging markets, the standard deviation seems overall higher in the countries than in the benchmarking indexes, which suggests a higher level of risk. These risks are accompanied by higher mean returns, especially in local currency. The majority of the returns also display positive skewness and kurtosis, while the Jarque-Bera<sup>6</sup> test rejects the null hypothesis of normality at the 5% level.

**Total Returns of the East Europe Stock Markets  
&  
Benchmarking Indexes.  
(U.S. Dollars)**



**Figure 1:** Diachronic comparisons of the three East Europe Stocks Markets Indexes with the two benchmarking MSCI Indexes.

### Mean Returns Of Density Distributions



**Figure 2:** Diachronic comparisons of the density distributions of the returns of the three East Europe stocks Markets and the two benchmarking MSCI Indexes.

**Table 1.** Summary statistics of daily stock markets returns and the selected benchmarking indexes over the sample period July 12, 2001 through July 11, 2006. (in Dollars and Local Currency)

**Panel 1: in Dollars.**

Stock Markets Indexes	Total Returns(%)	Mean Returns(%)	Standard Deviations	Kurtosis	Symmetry	Jarque Bera
Czech Republic	160,3585	0,124599	1,598061	-0,25541	1,900268	207,6335
Hungary	125,8972	0,097822	1,606608	0,047359	1,019306	56,19666
Poland	207,5146	0,161239	1,508749	-0,1153	2,383308	307,4499
MSCI Europe Index	48,66886	0,037816	1,145687	-0,14456	2,811228	428,281
MSCI Emerging Markets Index	175,6244	0,13646	1,531289	-0,55387	3,031733	558,6914

**Panel 2: in local currency.**

Czech Republic	130,1017	0,101168	1,450509	-0,10902	1,464671	117,4979
Hungary	92,1925	0,071689	1,438909	0,223277	1,313	103,061
Poland	149,3498	0,116135	1,406322	-0,18319	2,768756	417,963
MSCI Europe Index	15,00546	0,011668	1,198191	-0,0695	3,748693	754,0256
MSCI Emerging Markets Index	160,7377	0,12499	1,496787	-0,50985	3,141838	584,6436

**Source:** Our Estimates.



#### 4. The Empirical Results

Using daily data from July 12, 2001 through July 11, 2006 and the aforementioned portfolio construction techniques, we generated for each portfolio category several random portfolios, using an iterative approach. Instead of choosing a standard<sup>7</sup> period for portfolio evaluation, which is the typical methodology in the relevant literature, we used subsamples of our data in the time estimation period, to obtain different (random) starting periods for portfolio construction, different (random) historic periods in order to construct the portfolio weights and different (random) portfolio evaluation periods. Taking the standpoint of institutional investors, we also make the assumption that an investor cannot partake in short selling. Table 2 presents the ‘average’ portfolio weights<sup>8</sup> of the three country indexes for the four portfolio construction techniques using the data in USA dollars and local currencies.

**Table 2.** Average Portfolio Weights.

**Panel 1: in Dollars**

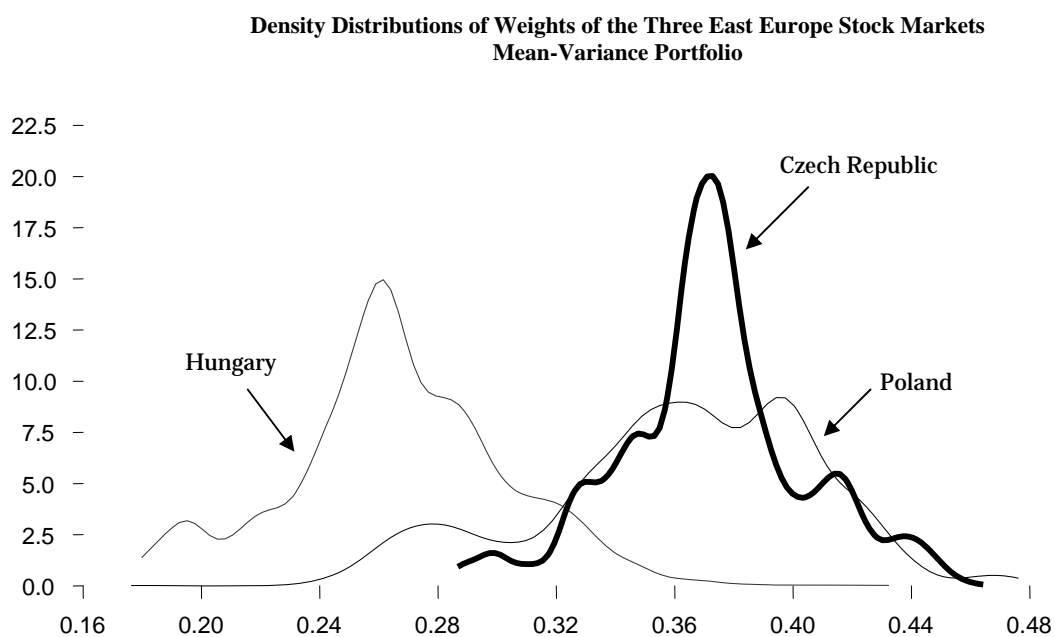
	Czech Republic	Hungary	Poland
Portfolio( Markowitz )	0.3598	0.2661	0.3741
Portfolio(Equal Weights)	0.3333	0.3333	0.3333
Portfolio(Random Weights)	0.3359	0.3350	0.3291
Portfolio(Past Returns)	0.0925	0.0408	0.8666

**Panel 2: in Local Currencies**

Portfolio( Markowitz)	0.4026	0.2344	0.3630
Portfolio(Equal Weights)	0.3333	0.3333	0.3333
Portfolio(Random Weights)	0.3325	0.3358	0.3317
Portfolio(Past Returns)	0.1439	0.0468	0.8093

**Source:** Our Estimates.

According to the estimates of Table 2 there are not serious differences in the average portfolio weights using USA dollars and local currencies. There are differences between the four portfolio construction techniques. The Markowitz and the three naïve portfolio techniques have similar average weights. Exception is the case of past returns portfolio which allocates a weight of 80.9 % to the stocks market of Poland. The application of the Markowitz mean variance approach, on the average allocates 35.9 percent of the funds to Czech Republic, 26.6 percent in the Market of Hungary, and final 37.4 percent of the total funds to Poland. Analogous are the weights using the two naïve portfolio construction techniques. Figure 3 presents graphically the density distributions of the weights of the three East Europe country indexes using the Markowitz Mean Variance Algorithm.



**Figure 3.** Density Distributions of the weights of the three East Europe country MSCI Indexes using the Markowitz Mean Variance Approach.

**Table 3:** Statistics for the Average Returns<sup>9</sup> of the Three East European stock markets, the four portfolios and the two benchmarking indices during the periods of portfolio implementation.

**Panel 1: in Dollars**

<b>Stock Markets</b>	<b>Mean Returns (%)</b>	<b>Maximum (%)</b>	<b>Minimum (%)</b>	<b>Standard Deviation</b>	<b>Kurtosis</b>	<b>Skewness</b>	<b>Sharp</b>	<b>LPM</b>
Portfolio(Mean Variance)	0,138554	0,830457	-0,97795	0,00149	-0,55709	4,046395	0,135437	0,007756
Portfolio(Equal Weights)	0,132885	0,842343	-0,95382	0,001595	-0,52239	3,693436	0,130791	0,007762
Portfolio(Random Weights)	0,132776	0,98821	-0,90971	0,001528	-0,5025	3,426792	0,125011	0,008039
Portfolio(Past Returns)	0,169173	0,960093	-1,20212	0,001577	-0,55329	5,334983	0,132567	0,009175
Czech Republic	0,132031	1,145421	-1,06678	0,001832	-0,68613	4,259565	0,099697	0,00992
Hungary	0,095772	1,101456	-0,93403	0,001825	-0,53608	3,307829	0,073415	0,009782
Poland	0,170853	0,975263	-1,21564	0,001581	-0,52151	5,752378	0,130287	0,009329
MSCI Europe Index	0,037376	0,848256	-0,93678	0,001328	-0,80523	4,458093	0,064785	0,007021
MSCI Emerging Markets Index	0,126467	1,304692	-0,86124	0,001687	-0,45677	4,021237	0,107386	0,009451

**Panel 2: in Local Currencies.**

Stock Markets	Mean Returns (%)	Maximum (%)	Minimum (%)	Standard Deviation	Kurtosis	Skewness	Sharp	LPM
Portfolio(Mean Variance)	0,115407	-1,08926	0,128643	0,00136	-0,54187	4,79659	0,921238	0,007008
Portfolio(Equal Weights)	0,110118	-1,10987	0,123783	0,00137	-0,59431	4,958513	0,92408	0,007069
Portfolio(Random Weights)	0,109506	-1,08516	0,117447	0,00141	-0,58441	4,741332	0,926612	0,007233
Portfolio(Past Returns)	0,132562	-0,98759	0,117531	0,00144	-0,40309	5,12527	0,957229	0,008607
Czech Republic	0,114204	-0,97907	0,094094	0,00161	-0,21195	3,443023	1,153371	0,008859
Hungary	0,077488	-1,09206	0,066929	0,00160	-0,48926	4,13776	1,073249	0,008487
Poland	0,138663	-1,26437	0,120203	0,00147	-0,79698	7,674133	0,965314	0,008797
MSCI Europe Index	0,018511	-1,03681	0,057561	0,00133	-1,42041	5,087403	0,657409	0,007108
MSCI Emerging Markets Index	0,11874	-1,47656	0,105563	0,00166	-0,57521	4,531538	0,990089	0,009189

**Source:** Our Estimates.

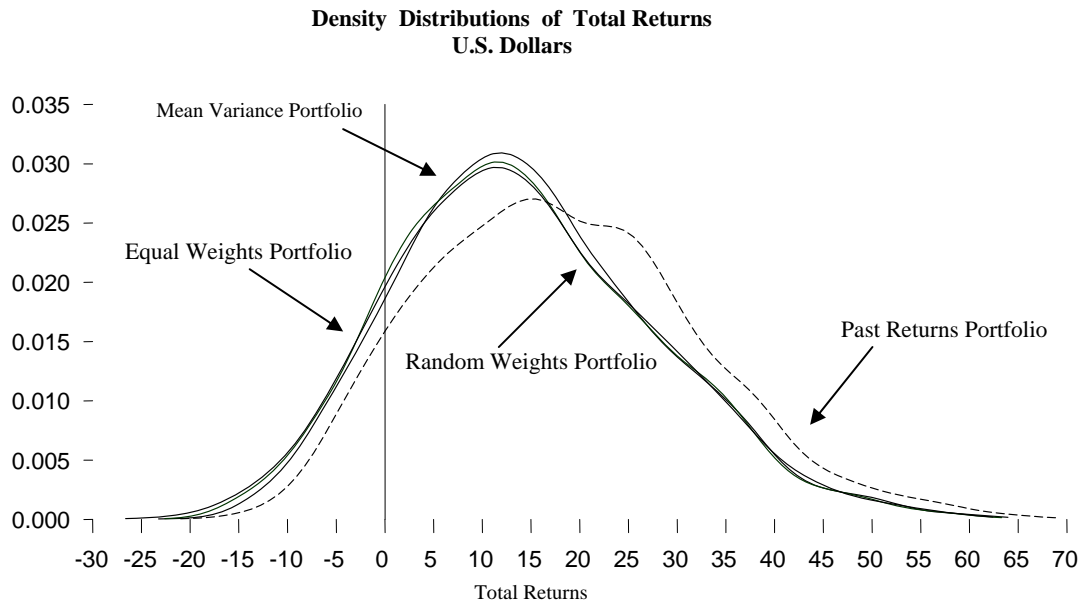
According the results on Table 3 we may conclude that the average returns of the portfolios are positive independently if we use data in dollars or in local currencies. In addition the returns of the the naïve portfolio with the past returns over performs the analogous mean returns of the other portfolios. Similar results can be obtained from the comparison of the average returns of the four portfolios with the average returns of the three countries. Exception is the case of Poland in witch the average returns over performs the four portfolios and the benchmarking indexes mean returns. Figure 4 and 5 presents a graphical comparison of the total and mean returns of the four portfolios in U.S. Dollars respectively, confirming the previous results based on the estimates of Table 3.

According to the kurtosis of the average returns, the Mean Variance Portfolio has the lowest kurtosis of the other portfolios and all the portfolios reveal positive skewness with the portfolio of the past returns to reveal the highest, in U.S Dollars and local currencies.

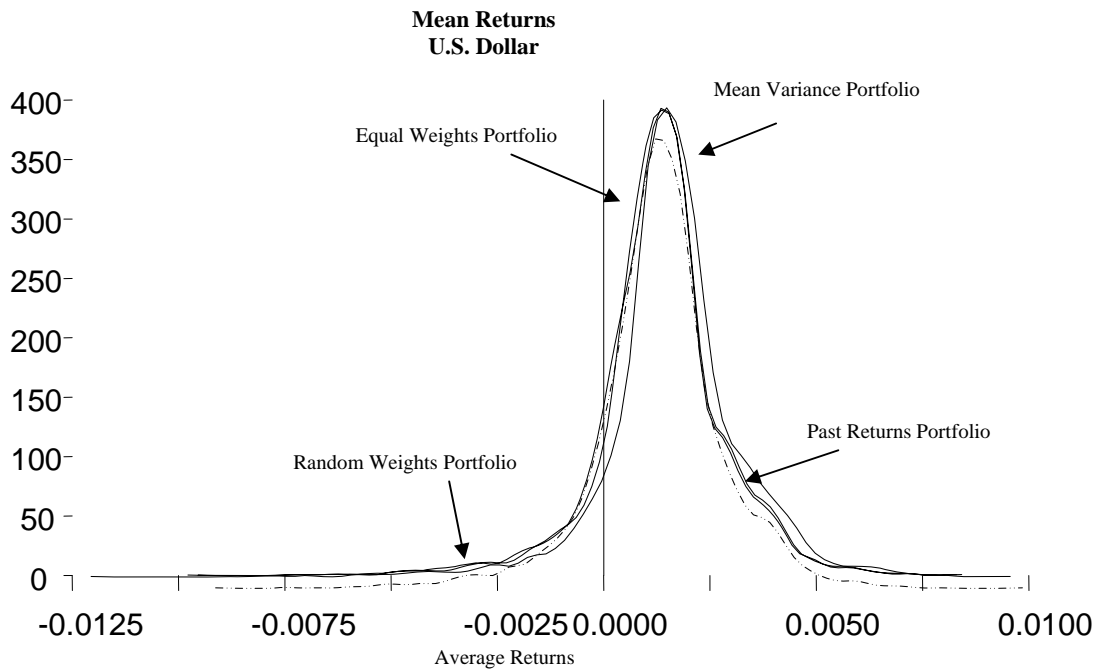
Regarding the risk of the four portfolios it is obvious that the Markowitz portfolio has the lowest risk independently how we approach the risk using the standard deviation or the Sharp<sup>10</sup> and Lower Partial Moment<sup>11</sup> criteria.

The standard deviations of the four portfolios are lower compared with the analogous risks of the country and benchmarking indexes. In addition the Mean Variance Portfolio has the lowest possible standard deviation compared with the other three portfolios. Figure 6 in which we compare the densities of the risks of the four portfolios verify that the Mean Variance Portfolio has the lowest possible standard deviation. The superiority of the Mean Variance Portfolio is obvious.

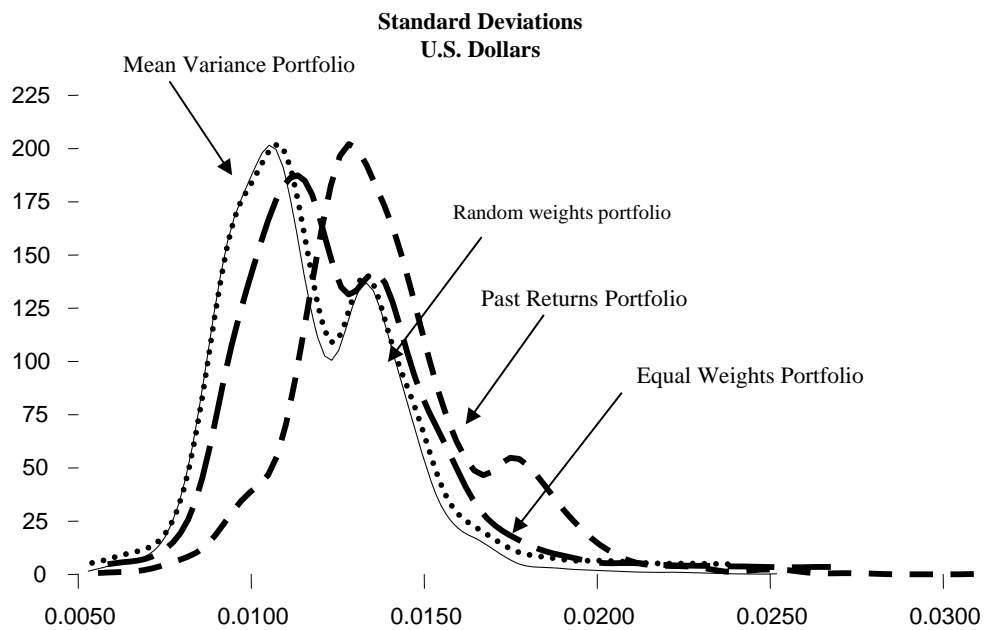
Analogous conclusions can be driven about the portfolios risks, using the Lower Partial Moment and Sharp criteria. As can be seen in Table 3 the Mean Variance Portfolio has the lower LPM compared with the analogous country and benchmarking indexes with exception the case of the benchmarking MSCI Europe in U.S Dollars. Additional evidence are available on Figure 7 where we compare the Lower Partial Moment of the four portfolios. Analogous results can be obtained using the Sharp criterion. The comparisons in the eighth column of Table 3 and in Figure 8 confirms another time the potential of the Markowitz Mean Variance portfolio to reveal the lowest risk compared with the other three portfolio alternatives.



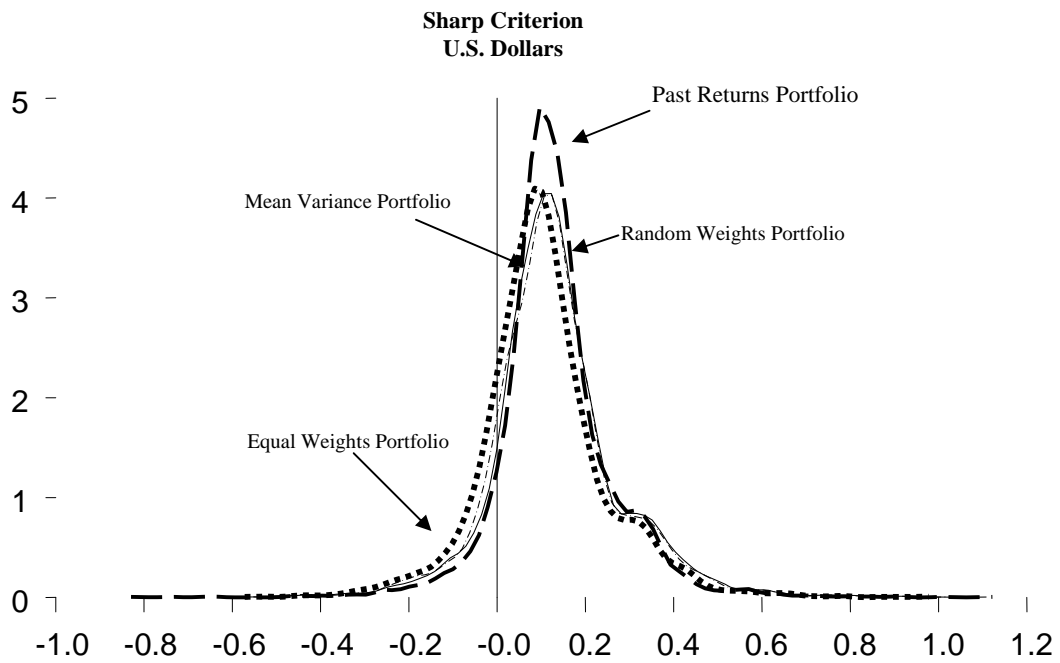
**Figure 4.** Comparisons of the density distributions of the total Returns of the four portfolio's.



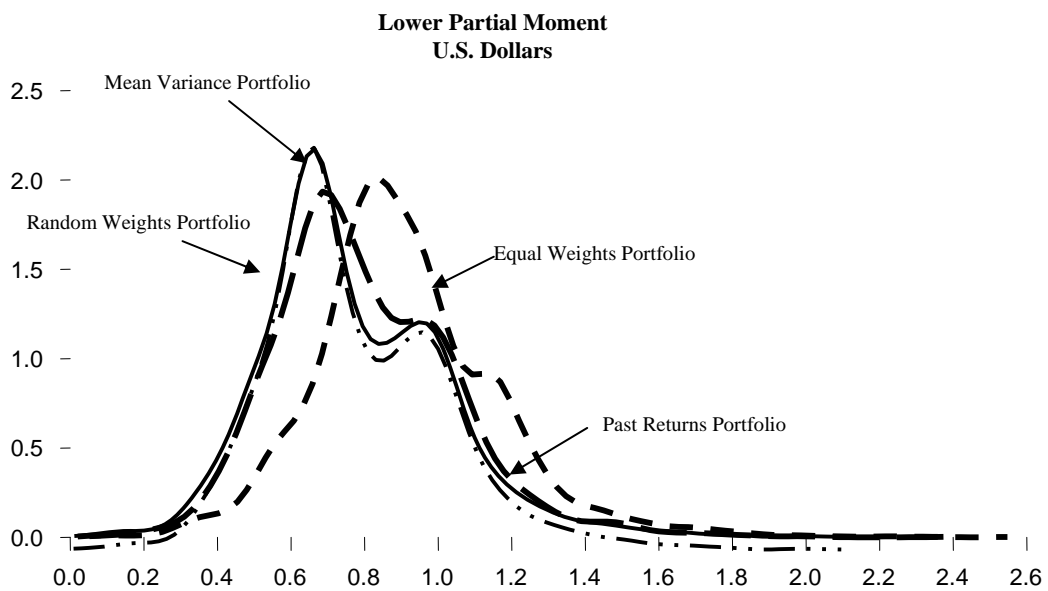
**Figure 5.** Comparisons of the density distributions of the average returns of the four portfolios.



**Figure 6:** Comparisons of the density distributions of the Standard Deviations of the returns of the four portfolios.

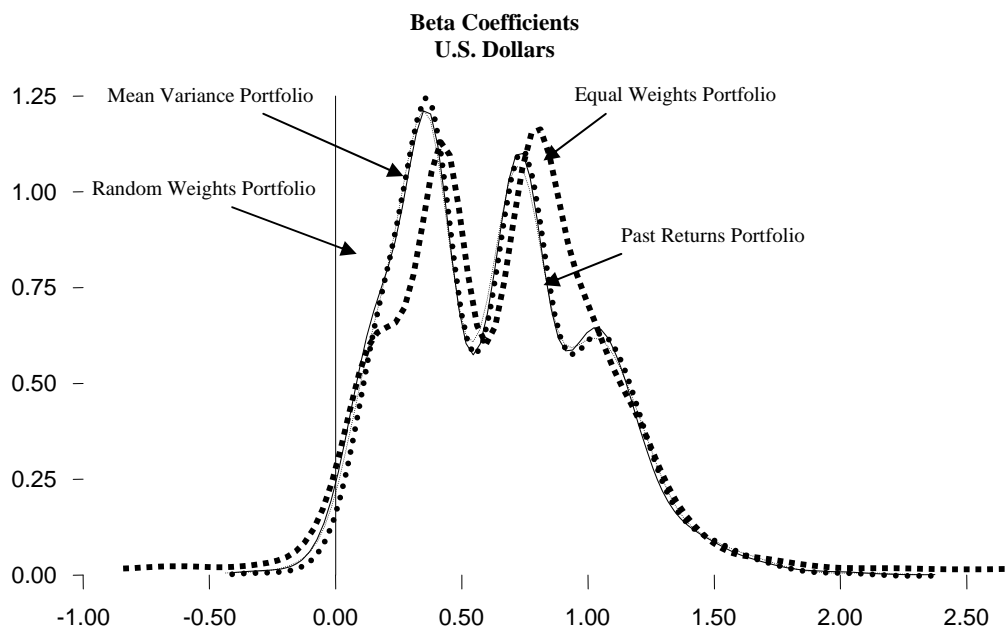


**Figure 7.** Comparisons of the density distributions of the Sharp Ratio of the four portfolio techniques.



**Figure 8.** Comparisons of the density distributions of the Lower Partial Moment coefficient of the four portfolio techniques.





**Figure 9.** Comparisons of the density Distributions of the ‘Beta’ coefficients of the four portfolio techniques with respect the MSCI Europe Emerging Markets Index.

Finally Figure 9 presents a comparisons of the distributions of the ‘Beta’ coefficients of the four portfolios with respect to MSCI Emerging Markets benchmarking index. The (average) portfolio's betas<sup>12</sup> is 0.621132(2.12), 0.627318(2.14), 0.629645(2.19) and 0.59733(2.65) for MSCI Europe Emerging Markets benchmarking index, well below the corresponding market beta of one. Hence, they are less volatile than the market, as represented by the MSCI Europe Emerging Markets benchmarking index.

#### **4. Conclusion.**

This paper studies the daily stock market returns of three Eastern Europe countries, and the prospect of investment for the purposes of diversification. The period from July 12, 2001 through July 11, 2006, is used as the basis of the analysis. Using an iterative technique with randomly selected historical and portfolio implementation periods we applied four portfolio techniques to construct the optimal portfolio of these countries. The weights of the optimal portfolio is the average of the 5000 different iterations with respect the date of the portfolio starting evaluation period, for the four portfolio construction techniques. The optimal portfolio, acquired through the application of the Markowitz Mean Variance approach, on the average allocates 35.9 percent of the funds to Czech Republic, 26.6 percent in the Market of Hungary, and final 37.4 percent of the total funds to Poland.

The (average) portfolio's betas<sup>13</sup> is 0.621132(2.12), 0.627318(2.14), 0.629645(2.19) and 0.59733(2.65) for MSCI Europe Emerging Markets benchmarking index, well below the corresponding market beta of one. Hence, they are less volatile than the market, as represented by the MSCI Europe Emerging Markets benchmarking index<sup>14</sup>.

While the total returns of the portfolio might be quite appealing, additional risk factors need to be both examined and accounted for. There are intrinsic dangers in foreign investment. The optimal portfolio derived above incorporates both of these risks, since it is based on the allocation of funds into foreign securities. Therefore, investors are rewarded for the additional risk they are bearing by higher premiums.

Nevertheless, it is beneficial for the contemporary investor to possess a well diversified portfolio, rather than to limit his investments to a single market. The low correlation among stock markets implies that their movements are not perfectly synchronized. Consequently, investing in a portfolio consisting of allocations in several foreign exchanges permits an investor to negate the risk that an adverse fluctuation in any given market will have a considerable effect on the return of his or her portfolio.

## Notes

1. We have chosen these three countries mainly for data availability reasons, since the MSIC collects only data for these three countries.
2. Usually the last period of the whole sample size.
3. The dynamic linkages among the world's major markets have been studied since the late 1960s (e.g., Grubel (1968) Granger and Morgenstern (1970) Levy and Sarnat (1970) Grubel and Fadner (1971) Agmon, (1972) Bertoneche (1979) Hilliard (1979), with increased scrutiny emerging in the last decade (e.g., Schollhammer and Sands (1985), Eun and Shim (1989) Meric and Meric (1989) Von Furstenberg and Jeon, (1991,1989),Birati and Shachmurove (1992) Chan et al.(1992), Malliaris and Urrutia (1992) Roll (1992) Friedman and Shachmurove (1996) ,Shachmurove (1996). While some have studied the Latin American economies (e.g., Bhagwati (1993), Alonso (1994), Niarchos, and Alexakis (2000), Markellos and Siriopoulos, (2007) Kalra, et al. (2004), Moosa and Al-Deehani (2005).
4. On the basis of the evidence provided by French et al. (1987), and Poon and Taylor (1992), it is expected that adjustment for dividends would not affect the results.
5. The MSCI Emerging Markets Index is a free float-adjusted market capitalization index that is designed to measure equity market performance in the global emerging markets. As of May 2005 the MSCI Emerging Markets Index consisted of the following 26 emerging market country indices: Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Israel, Jordan, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Russia, South Africa, Taiwan, Thailand, Turkey and Venezuela. The **MSCI Europe Index** is a free float-adjusted market capitalization index that is designed to measure developed market equity performance in Europe. As of May 2005, the **MSCI Europe Index** consisted of the following 16 developed market country indices: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

6. Jarque-Bera (1980) , Bera- Jarque (1981)
7. Usually using the last period of the whole sample size.
8. The average portfolio weight is defined as:  $\bar{w}_j = \frac{1}{(N_{iters} - 1)} \sum_{k=1}^{N_{iters}} w_{kj}$  with  $w_{kj}$  the estimated weight of the j country at the k iteration and  $N_{iter}$  : the number of iterations.
9. The average returns are defined as follows:  

$$\frac{1}{N_{iter} - 1} \sum_{iter=1}^{N_{iter}} \left[ \frac{1}{T_{iter} - 1} \sum_{t=1}^{T_{iter}} \left( \sum_{j=1}^N w_{j,iter} d_{j,t,iter} \right) \right]$$
 with  $N_{iter}$  : the number of iterations,  $T_{iter}$  : number of observations used in the portfolio evaluation,  $w_{j,iter}$  : portfolio weights of the j country index at the  $iter$  iteration and  $d_{j,t,iter}$  : the returns of the j country index at the  $t = 1, 2, \dots, T_{iter}$  period at the  $iter = 1, \dots, N_{iter}$  iteration.
10. The Sharp Ratio (1966) is a traditional total performance measure used to measure the expected return of the two portfolios per unit of risk: Sharp Ratio =  $\frac{\sum_{s=1}^T d_{js} - r^f}{\sigma_j}$  for  $j = 1, 2, \dots, 4$  with  $d_j$  = Returns of the j index in the portfolio evaluation period and  $r_r^f$  = is the risk free return. In ur analysis we assumed a risk free return equal to 3.5%.
11. We calculate the LPM as:  $LPM(a, t) = \frac{1}{K} \sum_{t=1}^K Max[0, t - r_t]^a$ . Where a is the investor's risk tolerance value and degree of the lower partial moment, t is the target return, K is the number of observations  $r_t$  is the portfolio's return during period t. Following Gilmore et al. (2005), we therefore take the standpoint of the risk-averse investor by letting a = 2 and a target return equal to zero.
12. All the betas estimates are statistical significant (t-statistics in parentheses).
13. All the betas estimates are statistical significant.
14. The analogous beta estimates for the equal weights portfolio with respect to the three indexes are: 0.55, 0.46, 0.27 and 0.6003 respectively (All these beta estimates are statistically significant at the 5% level).

## References

1. Agmon, T. (1972), "The relations among equity markets: A study of share price co-movements in the United States, United Kingdom, Germany, and Japan", *Journal of Finance*, September, 839-855.
2. Alonso, I.T. ,(1994), "Trade, industrialization, and integration in twentieth century Central America", (ed)Praeger Publishers, Westport, Connecticut).
3. Aubin,C., Berdot,J.P. Goyeau,D.and Leonard,D.(2005), "Quelles convergences financières pour les PECO's? Une analyse économétrique de l'évolution des marches d'actions" *Revue Economique*, 56(1), pp. 149-169
4. Bertoneche, M.L.(1979), "Spectral analysis of stock market prices", *Journal of Banking and Finance* 3, 201-208.
5. Bhagwati, J.N.(1993), "Beyond NAFTA: Clinton's trading choices", *Foreign Policy* 91, 155-162.
6. Birati, A. and Shachmurove,Y.(1992), "International stock price movements before and during the Gulf Crisis", in: *Atlantic Economic Society: Best Papers Proceedings*, Vol. 2(2) 42-47.
7. Chan, C.K., Gup B.E. and Pan, M.S.(1992), "An empirical analysis of stock prices in major Asian markets and the United States", *The Financial Review* 27(2), 289-307.
8. Eun, C.S. and Shim, S.(1989), "International transmission of stock market movements", *Journal of Financial and Quantitative Analysis* 24(2), 241-256.
9. French, K. R., Schwert, G.W. and Stambaugh, R.F.(1987), "Expected stock returns and volatility", *Journal of Financial Economics*, 19, September, 3-29.
10. Friedman, J. and Shachmurove, Y.(1996), "International transmission of innovations among EC stock markets" in: J. Doukas, and L. Lang, (eds) *Research in international business and Finance* (JAI Press Inc., Greenwich, Connecticut), 35-64.

11. Granger, C. W. and Morgenstern, O. (1970), "Predictability of stock market prices" Heath-Lexington Books, Lexington, KY
12. Grubel, H. and Fadner, K. (1971), "The interdependence of international equity markets" *Journal of Finance* 26, 89-94.
13. Grubel, H. G. (1968), "Internationally diversified portfolios", *The American Economic Review* 58, 1299-1314.
14. Jarque, C. M. and Bera, A. K. (1980), "An efficient tests for normality Homoskedasticity and serial independence of regression residuals", *Economic Letters* 6 255-259
15. Kalra, R., Stoichev, M. and Sundaran, S. (2004), "Diminishing gains from international diversification", *Financial Services Review*, 13, pp. 199-213
- Levy, H. and Sarnat, M. (1984), "Portfolio and investment selection: Theory and practice" (ed) Prentice Hall, Englewood Clies, NJ).
16. Malliaris, A. G. and Urrutia, J. (1992), "The international crash of October 1987: Causality tests", *Journal of Financial and Quantitative Analysis* 27(3), 353-364.
17. Markellos R. N. and Siriopoulos, C. (2007) "Diversification benefits in the smaller European stock markets", *International Advances in Economic Research*, 3(2), pp. 142-153,
18. Markowitz, H. M., and Todd, P. (2000), "Mean-Variance Analysis in Portfolio Choice and Capital Markets", Frank J. Fabozzi Associates (ed), New Hope, Pennsylvania.
19. Meric, I. and Meric, G. (1989), "Potential gains from international portfolio diversification and inter-temporal stability and seasonality in international stock market relationships", *Journal of Banking and Finance* 13 (4-5), 627-640.
20. Moosa, I. A., and Al-Deehani T. M. (2005), "The myth of International Diversification", Working Paper, No. 8/05, 31p. Department of Economics, Macquarie University, Australia.

21. Niarchos, N. and Alexakis, C.(2000). “The long term dynamics of the European stock exchanges: Leaders and followers”, *European Research Studies Journal*, Vol. III (1-2), pp. 57-67 or
22. Roll, R.(1992),”Industrial structure and the comparative behaviour of international stock market indices” , *Journal of Finance* 1(4), 3-41.
23. Schollhammer, H. and Sand, O. (1985), “The interdependence among the stock markets of major European countries and the United States: An empirical investigation of interrelationships among national stock price movements”, *Management International Review* 25(1), 17-26.
24. Shachmurove, Y.(1996), “Dynamic linkages among Latin American and other major world stock markets” , in: J. Doukas and L. Lang, (eds) *Research in international business and finance* (JAI Press Inc., Greenwich, Connecticut), 3-34.
25. Sharpe, W.F.(1966), “Mutual fund performance” ,*Journal of Business* 39(1), Part II, 119-138.
26. Siriopoulos, C. and Asteriou D. (2001) “Emerging financial systems in central and eastern European countries” ,*East-West Journal of Economics and Business*, IV(2), pp. 85-97 etc
27. Von Furstenberg, G.M. and Jeon B.N.(1989),“International stock price movements: Links and messages” ,*Brookings Papers on Economic Activity* 1, 125-179.