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Driving Factors of Efficiency of CEE Capital Markets

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Contents

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Abstract

In this paper I investigated the driving factors of integration of emerging capital markets into the global market. First, I analyzed the level of integration/segmentation of selected Central and Eastern European (CEE) countries using the methods of correlation analysis, cointegration, and CAPM. Second, I searched for the reason(s) of substantial variance of the level of integration/segmentation among the countries and throughout the time. I compared two different factors, which both might cause such differences, analyzing the problem from both static and dynamic point of views. I tried to answer the question, whether there is a causal relationship between the fluctuation of the level of integration/segmentation of a particular market within a pre-defined time frame and its economical (and political) performance. Or, alternatively, whether the decisive factor is more static than dynamic: the market size predetermines the level of integration that the country is able to achieve.

This paper was initiated by confronting results of three previous studies. Three students of Central European University have analyzed the subject of CEE capital market integration using different methodologies and timeframes and have arrived at different conclusions. Maria Haroutounian (1997) concludes her MA Thesis „Risk Exposure of Transition Equity Markets and their Integration into World Capital Markets" with the statement that all emerging markets (as represented by the Visegrad group) are becoming more and more integrated into world capital portfolio. On the other hand, Tigran Minasian (1998) widened his sample to several CEE countries and compared them on the market-size basis. The final result of his study was that large emerging countries are becoming more integrated into the global market, while small markets are becoming more segmented. The last research, conducted by Miriam Ratkovičová (1998) analyzed the time fluctuation of the level of integration of emerging capital markets and was concluded with the result that the level of a market's integration/segmentation is directly dependent on the country's economic performance. These papers analyzed other aspects of equity markets as well, which are not going to be dealt with here.

Conclusively, the aim of this paper was to analyze the results of the above mentioned papers, to update their models and reach a consensus in answering the question of where the equity markets of emerging Europe are going.

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1. Introduction

At the time of writing (December 1998), most stock markets were moving dramatically. Emerging stock markets around the world had been still reeling from October's 1997 Asian crisis when, from the biggest to the smallest, the countries of Central and Eastern Europe were unable to escape the Russian financial crisis. Some were exposed through the trade with Russia, some because of financial investments there. Others have been suffering through the indirect impact of crisis on international financial markets. Both the crisis on Russian stock markets and the recent East-Asian crisis were suggesting a re-run of the October 1987 stock market crash on emerging markets. Such erratic movements in financial markets call for a worldwide attention and deep analysis of the local markets and investors' behavior, as well as a re-examination of many of the traditional methodologies and their underlying assumptions used in equity market analysis.

The purpose of this paper was to examine the equity market of the representative group of six countries of emerging Europe (namely Czech Republic, Estonia, Hungary, Latvia, Poland, and Slovakia) and to provide evidence on the (in)efficiency on their capital markets. These countries have more or less successfully restructured their economies since 1989, reducing dependence on Russia and preparing for entry into the EU. There are big differences between the countries, which have undergone a successful transition (Czech Republic, Poland, Hungary) and those, which have experienced a botched or hesitant (e.g., Slovakia) transition. Still, all of them have experienced the influence of the financial crises on their economies. Equity prices tumbled, even in the most attractive economies, Hungary and Poland, where they fell in August 1998 by 40% and 30%, respectively. Slovak SAX fell below the psychologically important level of 100 points during the same period. It could be argued that Central Europe has been caught in the crisis less than Eastern Europe. However, geographical proximity to Moscow seems not to be overwhelmingly important (a good example is the case of Estonia, which has been weathering the storm much better than Latvia or Lithuania).

There have been two confronting views concerning the final effect of these crises. On the one side, some economists argue that the most perilous consequence of the crises might be a cut of economic growth and waned liquidity in these markets, as well as the erosion and eventual loss of confidence from foreign investors. The crises have stressed the differences between the emerging and developed markets, which were blurred while the international financial markets were booming and the investors were less discriminating. Now, many investors have pulled out of the CEE markets, often because

strong western economies have more liquid markets, making investments easier to sell. Even though the gap between these countries is not unbridgeable and there is an opportunity to improve the economic prospects if the right lessons are drawn from the Russian crisis and embarks on market-oriented reforms, the international investments environment has become more hostile than before, due to the turmoil in the East Asia as well as Russia. Central European markets have already staged some modest recoveries, but investors' sentiment towards all emerging markets could remain cautious for some time.

On the other hand, as the after-effect of the crises seems not to be very strong, foreign investors are returning to the region (mainly Poland and Hungary) they fled during the peak of the Asian crisis. That is partly because investors forget the country's 'emerging market' label and start to invest on the basis of company and economic performance. And partially because most big international funds are getting out of Russia, scared off by its continued political and economic instability, shifting some money into Central European region. Emerging markets of CEE are starting to come of age. Companies are still cheap to buy, but make plenty of money. Foreign direct investment is surging, which should have a knock-off effect on the new capital inflow.

The above discussion draws a lot of attention and requires an answer whether the differences between the emerging and developed markets are becoming sharper, scaring off the investors from CEE (the markets are becoming more segmented), or whether the investors are really starting to forget about the 'emerging-market' label, investing on the basis of economic performance only. (That is whether there is a trend of further integration of emerging markets into the world capital market). In this paper I tried to answer the above question by analyzing the pattern of integration/segmentation of six European emerging markets. The investigation itself was done in two dimensions (static and dynamic) using three different econometric methodologies (correlation, cointegration, and CAPM). From dynamic point of view, I analyzed the fluctuation of the level of integration/segmentation of each individual market throughout the time of its existence. I looked for the links of this fluctuation with the economic and political development of the particular country. I tried to answer the question whether there is any causal relationship between these factors. From the static point of view I split the selected markets into two sub-groups: small country portfolio (Slovakia, Estonia, Latvia) and large country portfolio (Hungary, Poland, and Czech Republic). The purpose was to test for the hypothesis of a country-size effect on the efficiency of the market. The hypothesis was that the level of integration of small countries into the world capital market is limited due to their size as the absence of sufficient market capitalization prevents them to run efficient stock exchanges.

I ensured that the countries form a representative sample of CEE region [1]. They have been exposed to different levels of influence of Russia [2], are of different sizes and have reached different levels of the transformation process. Nevertheless, numerous researchers have observed in their studies that emerging markets exhibit some common behavioral patterns. For instance, Fama and French (1997) specified four main features regarding emerging markets: (1) higher returns on average than in the developed countries during the same sample periods [3]; (2) greater volatility [4]; (3) weak links among the emerging market returns (very little, sometimes even negative correlation); and (4) size effect in emerging market returns [5]. In this paper I focused on the above mentioned characteristics of the emerging markets with a special focus on the Central and Eastern European region.

The remainder of the paper is organized following these characteristics. Subsequent to introduction is a short chapter analyzing the characteristics of the market return behavior testing for the first two features, high return and volatility. The following chapter focuses on the third characteristic, testing for the linkages among the selected group of emerging markets as well as their integration with the developed markets, as represented by the US and German markets. Except the correlation methodology found in the Fama and French (1997) I also used the test of cointegration (used also by Ratkovičová (1998)) and Capital Asset Pricing Model (found also in Haroutounian (1997) and Minasian (1998)). As opposed to correlation, which analyzes the capital market linkages from the short-term perspective, cointegration method is more forward-looking. Both of the methods have, however, a common disadvantageous fundamental assumption (even though usually not stated explicitly) that the risk is the same across the markets as well as constant or changing randomly over time. On the other hand, CAPM offers a differentapproach to

[1] Minasian (1998) also included Russia into the large-country portfolio. I felt that since the country has recently undergone a financial crisis, it is economically and politically unstable. It represents very a heterogeneous market, which is too large even in comparison with other CEE countries included in the large-market portfolio. I believe that this market requires a completely separate analysis and, consequently, I excluded it from the sample of selected countries.

[2] Share of trade with Russia (% 1997)

	Exports		**Exports**
Czech Republic	3.2	Latvia	21.0
Estonia	15.7	Poland	8.4
Hungary	5.0	Slovakia	3.7

Source: Nomura International; Daiwa

[3] See also Harvey (1995).

[4] Ten of the 16 countries' reported portfolios have annual return standard deviations above 50% what is in a sharp contrast with US market returns' standard deviation of 14.64%.

[5] Similar results have been found as well for the developed markets by, inter alia, Thaller (1992).

a different approach to testing for integration accounting for the proper adjustment to risk. The fourth chapter is divided into two sections. While the first one searches for the links between the fluctuation of the level of integration of each particular market and its economic perfomrance throught time, the second section compares the levels of integration of the markets achieved on the base of their size, testing for the hypothesis that only large countries are abble to run efficient capital markets, whereas small markets remain segmented and inefficient. The paper finishes with the summary of a research. The relevant literature references and an appendix with the empirical results and short data descriptions are attached at the end.

This research is significant for the following interrelated reasons. First, this study empirically examines the interconnection of the level of integration of each selected market with its economic and political development. Second, it tests whether the level of the integration that the market is able to achieve is pre-determined by the size of the particular country. On the other hand, there are some limitations to this study as well. Whilst the three testing methods differ in detail from each other, operations of all are still just a simplification, which builds upon the Portfolio Theory whose assumptions are questionable, most notably the Efficient Market Hypothesis (EMH) [6]. The EMH evolved from a notion of a perfect market and, applied to stock markets, this means that the price of a share incorporates all information about that share. As such, security prices are fairly valued and will only change when new information will enter the marketplace. The EMH attributes significant movements in prices to the impact of important economic news. Prices will, therefore, follow a 'random walk' to the extent that new information will be independent of last piece of information, which has already been incorporated into share price.

Different types of efficiency can be distinguished in the context of the operation of financial markets. In this paper I dealt with the information processing efficiency, which has been propounded in three forms [7]:

– *Weak form efficiency (test for return predictability)*: The weak from states that knowledge of past share prices is fully absorbed into today's price. The next price change is random and totally independent of historic price movements.

– *Semi-strong efficiency (test for event studies)*: The semi-strong form postulates that randomness occurs because current prices reflect not simply past prices, but all publicly available information.

– *Strong efficiency (test for private information)*: The strong form declares that current prices fully reflect all information, including insider information.

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[6] Gordon and Rittenberg (1995) specified the five basic assumptions of the EMH.

[7] Fama (1970, 1991).

The evidence collected in the early literature on EMH suggested that stock market showed efficiency at least in its weak form [8]. In other words, current share prices should reflect all or most publicly available information about companies and their securities, weakening the speculative opportunities. Competition among well-informed market participants should drive financial asset prices to a level, which reflects the best possible forecast of their future payment scheme.

On the other hand, the EMH theory fails when it comes to an explanation of the financial market crashes, such as October 1987 Wall St. Crash, 1992 ERM debacle, erratic behavior of FT-SE 100 during 1994, 1997 East-Asian crisis, and 1998 Russian financial collapse. Following the EMH predictions, in order for the crash to have occurred, given the inter-relationship between corporate management, investors and the capital market, stock prices should have assimilated all the available information and issued warnings indicating their future drop. Since this did not happen, it suggests that the EMH, and hence the market, is at its most efficient when conditions are stable. This is usually in the middle of a bull or bear phase and, consequently, a significant portion of the market may be driven for a significant period of time by irrationality, conflicting uncertainties and speculation rather than fundamental values [9].

As a consequence, critics claim today that, after more than a decade of international financial scandals, the EMH, if it operates at all, does so only in the weakest of forms. The notion that stock prices follow a random walk is invalidated and the case for the EMH in any of its forms is seriously weakened. This raises further questions about linear models of asset pricing based on market efficiency, such as the CAPM.

Concerning the most recent development on asset pricing techniques, research has mainly focused on empirical studies and applications of existing models. Some new alternative models have been developed (such as Asset Pricing Theory, Coherent Market Hypothesis, Speculative Bubble Theory, Catastrophe Theory, etc.) which are able to handle non-linear relationships, but here too, standard econometrics using linear assumptions still tend to be used in order to simplify its implementations. Additionally, empirical evidence for its support is still sparse and its application is still limited to developed equity markets. Most of them also lack the possibility of predictions, therefore missing an alternative explanation of how financial markets operate.

Consequently, the original models based on EMH are still used for capital market efficiency analysis, even though the EMH is just an abstraction of the real world, a model with questionable assumptions as investors do not always behave rationally, capital markets are not perfectly competitive, and fiscal obstacles and barriers to trade do exist.

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[8] The hypothesis of strong form efficiency can never be tested fully, since true insider information is illegal and remains outside the public domain.

[9] See, e.g., Hill (1994).

2. Comparative Analysis of Return Behavior Characteristics

As already mentioned in the introduction, it has been observed in many studies that emerging market returns exhibit a very specific behavior. For instance, Fama and French (1997) compared the monthly equity returns in developed and emerging markets (CEECs not included in the sample base) during the period 1987–1995. First, the results of 12 industrialized and more than 30 developing markets show that average returns in emerging markets are higher than in developed markets. Second, specific characteristic of the emerging markets is a high volatility (the reported values of standard deviation of monthly returns for emerging markets are above 50%). Third, it has been shown that the links among the emerging markets measured by the correlation between the excess market returns of individual countries are weak. Forth, there seems to be a size effect in emerging market returns as big stocks tend to have lower average returns than small stocks [10].

In this part of the paper I focused on the first two characteristics of emerging markets. Table 1 (see Appendix) provides summary statistics for the daily equity returns (in local currencies) of the selected sample of CEECs for the entire period of their existence, starting since 1991 or the beginning of the operation of the local stock exchange (whichever was later) through 1998. For comparison, the results for Frankfurt and New York markets are also presented for the same time-period. In case of NYSE, the observations from the previous day were used due to the time difference of opening and closing of stock exchanges.

The mean daily returns during the sample period starting from the opening of local stock exchanges till the last quarter of this year in the six transitional markets range from 0.0264% in Slovakia to 0.2559% in Latvia. Comparing these results with the results of the two developed markets under study (0.055% for DAX and 0.0545% for NYSE index) I came to the conclusion that some of the developing markets support the hypothesis of relatively higher returns (Latvia, Poland, Hungary) while others do not (Czech Republic, Slovakia, and Estonia). **This could be, however, especially during the earlier stages of the transformation, influenced by a higher rate of inflation in Poland, Hungary and Latvia.**

The standard practice of market volatility determination is by the use of standard deviation measure. Following the theory, lower volatility indirectly reflects higher stock

[10] Investment managers classify firms that have high B/M (book-to-market equity), E/P (earnings-to-price), D/P (dividends-to-price), or C/P (cashflow-to-price) ratios as value/big stocks as opposed to growth/small stocks.

market development. Consequently, transition market returns are characterized by high volatility. This statement is fully supported by the results presented in Table 1 since all the V4 [11] and Baltic countries under study report a value of standard deviation of daily returns greater than 1% (Polish, Estonian and Latvian indices have s.d. even above 2%) while the s.d. measures of the two developed markets stay below or very close to 1%.

Figure 7 plots the mean rate of returns against the standard deviation. It can be observed that even though RICI, WIG, and BUX indices exceed the others in terms of average daily returns, the value of standard deviation is quite high (especially for Latvian and Polish indices). This means that there is a high trade-off between the rate of return and the volatility in these markets. On the other hand, even though SAX, PX-50, and TALSE provide lower average levels of returns than the developed market indices, they still have a substantially higher standard deviation.

The assumption of normality in returns is rejected for every stock index at 1% significance level according to the Bere-Jarque normality test. The pattern of significantly large kurtosis in all 8 markets indicates that returns are peaked higher than would be the case of normal distribution. Also, the kurtosis measure greater than 3 indicates fat tails. Since throughout the remainder of the paper I assumed normal distribution of the returns to be able to apply standard econometric models to the market data, possible problems with final results must be mention, which are dealt with in detail in Kominek and Majerowska paper (1999). On the other hand, although the returns are proved to be non–normal also in the case of industrialized markets their skewness and excess kurtosis levels tend to be much closer to zero what is considered to be a sign of a higher maturity of these markets.

The plots of the returns can bee seen in the Figures 16–21. They only confirm the great volatility with **the highest level in Polish WIG index**. Additionally, the presence of the heteroscedascisity can be observed from the graphs. When comparing the plots of the returns and the plots of indices themselves (see Figures 1–6), **it can bee seen that in the case of PX-50, SAX, and WIG the greatest volatility in returns resulted during the boom at the end of 1993 and the beginning of 1994. In case of the Hungarian index, there was an increase of standard deviation level during this period as well, but not so significant as the greatest volatility can be observed during the last several months of 1997.**

As the above mentioned observations from the graphs indicate, the summary statistics of emerging markets for the entire period are not very reliable, as the returns are very volatile. Additionally, the plots of the V4 and the Baltic indices show a trend

[11] Hungary, Poland, Czech Republic, and Slovakia are referred to as the Visegrad group or V4 after the treaties of cooperation signed between them in Visegrad, Hungary in 1990 and 1991.

pattern in the series. Consequently, a more detailed analysis is required measuring the mean, standard deviation, skewness, kurtosis, and normality for the different periods of market's development separately. Tables 2–9 report the results of descriptive statistics for the Visegrad markets for each year separately.

The presented results only confirm estimations from the graphs of the residuals. Both the skewness and excess kurtosis measures indicate non-normality and the test of $\sqrt{\chi^2}$ only confirms it statistically. Both Hungarian and Polish indices started their history during 1991 with the negative daily mean returns. During the boom in 1993, the average daily returns increased to the level of 0.1346% and 0.9542% respectively. Subsequently, during the period of 1994–95, they decreased again, in case of WIG even dropping below zero. However, the emerging markets had a difficult year in 1995 in general. International Finance Corporation reported a decrease in share prices of Investable Composite Index (incorporates 26 emerging markets – Czech Republic, Hungary, and Poland including) by 10.3% in USD terms at the end of 1995 [12]. That year began with some of the greatest monthly declines, following heavy losses in December 1994. One of the reasons could be the uncertainty due to the Mexico's currency crisis and subsequent massive sell-offs of shares. This trouble period in history of emerging markets is often compared to the famous October 1987 world stock market crash.

Similar results for this period can be observed for the other two V4 markets as well. After a tremendous start of both Czech and Slovak indices in 1993, they were hit by the global decreasing trend. Interestingly, SAX reacted with almost one-year delay (indicating segmentation of the market). In contrast to decreasing mean returns, the volatility level measured by standard deviation decreased for this period. In Hungary, Slovakia, and Czech Republic it went below 1% level in 1995. Even though s.d. of WIG returns stayed above 1%, when compared with the level of previous year (3.8118%) it was still a substantial decrease.

As far as the subsequent year of 1996, there was a complete turnaround in the development on equity markets. The Budapest Stock Exchange topped all the world's stock exchanges in terms of its average rise in share prices [13]. The average daily returns on BUX rose from 0.0151% to 0.3797%. A similar success has been observed in Polish market (a rise from 0.0058% to 0.2431%). This huge growth is most often attributed to the fact that the shares were previously undervalued. In addition, foreign investors showed increased interest in these markets as the local companies listed on the stock exchanges reported an excellent performance. The volatility measure increased in both markets by a small amount during this period, but it did not get to the extreme levels that

[12] World Economy in Transition, Finance and Development, March 1996.

[13] Brucker (1997).

WIG returns experienced during the boom of 1993–94. The blossoming of the Hungarian market continued also during 1997, while in Poland there was a substantial decline in the average daily returns. Last year, however, resulted in a decrease of BUX daily returns as well, most probably caused by the financial crisis on the Russian market.

Regarding the Slovak and Czech markets, neither one experienced the positive development in 1996 as measured by mean daily returns. In contrast, there has been a decreasing trend in both markets, which resulted in negative average returns of PX-50 during 1997, followed by SAX the following year. The reason could be a limited interest from the foreign investors' point of view due to the political instability in Slovakia and a high non–transparency and poor reputation of the Prague Stock Exchange in the case of Czech market.

Concerning the two Baltic indices, they started their existence in 1996 in very positive terms, reaching the highs of 0.7322% (RICI) and 0.3126% (TALSE) in average daily returns. Even though hit only marginally by the Asian crisis in 1997, they were caught completely in the web of falling Russian debacle last year.

The overall development on emerging markets described above in relation to the movements on the developed markets is graphically depicted in the Figures 8–15. In 1991 (Figure 8) both WIG and BUX lie on the negative side of the scale indicating negative mean returns. During the two subsequent years they are shifted far to the right, overrunning both the NYSE and German indices. The influence of Mexican currency crisis in 1994 is reflected by a gradual transition beyond the zero point during 1994–95 (Figures 9–10). The global boom during 1996 brought all the indices under the study to the first quadrant, while the East-Asian and Russian crisis had just the opposite influence. It can bee seen that the events on Russian financial markets had a much greater power in terms of influence on the CEECs, as only Czech market resulted in negative mean daily returns for 1997, but all except Polish WIG finished on the left-hand side of the graph (Baltic indices being positioned the most west-ward).

Another graphical representation is offered by Figures 22–27 showing the development on each market throughout the time separately as represented by the Sharpe Ratio (mean return over standard deviation), being the most commonly used indicator of the relative risk-return tradeoff.

3. Testing for the Integration/Segmentation of the CEE Markets

Numerous studies have investigated the interrelationship among the world financial markets involving a large number of markets. There are several ways to test for the degree of stock market integration, but basically two major approaches may be defined:

(1) One approach models the restrictions to integration explicitly and derives their effect on equilibrium returns [e.g. Cooper and Kaplains, (1986); Stultz (1993)]. The basic assumption of the approach lies on the definition of financially integrated markets, where capital flows freely across borders making the compensation of investors for bearing the risk, the 'price of risk', equal across markets. In the opposite case, if there are capital controls or other forces imposed preventing free movement of capital across borders, then it follows that different economies will demand different levels of compensation for risk, resulting in different prices of capital.

There are several difficulties arising from this approach when making an inter-country comparison, especially due to the large variety of different capital controls imposed upon the markets. In other words, different countries may have different mechanisms for restricting capital movements (ownership restrictions, taxes, or other barriers).

Another difficulty arises when the direct measure of the severity of capital control is not available. Specifically, it is possible that the market does not explicitly state any capital restrictions (or only very little), but there may be some informal barriers which lead to de facto market segmentation. An example could be the case of Slovakia when the political uncertainty could play a role of such an implicit barrier preventing foreign investors from entering the market. A similar example could be a bad reputation of the Prague Stock Exchange discouraging the foreign portfolio investment. By the same reasoning there could be problems arising in segmented markets, as there are always possibilities to circumvent the official restrictions.

In case of emerging markets, this problem is even magnified by a large number of barriers to consider and the difficulty to quantify them. As already mentioned, it is very hard to quantify and model political risk explicitly, which might be a very important factor for many emerging countries.

Given the difficulty of directly comparing the effects of wide array of official capital controls across countries, one of the methods used as a measure of deviation from capital market integration is cointegration, defining a common component in the short-run pattern of the stock prices. However, it has been shown on an example of several countries that the levels of national stock price indices are non-stationary what imposes a problem since the stationarity assumption is a requirement for the models examining

the efficiency of international stock markets. Specifically, the non-stationarity of international equity indices raises doubts about the consistency of estimated standard errors of such models.

In order to make the equity index series stationary, the normal econometric practice has been to take the first differences of the series. This method was used in section 3.1 on correlation. Unfortunately, first differencing imposes too many unit roots (as proven in section 3.2), and filters out potential important information regarding long-run common trends among non-stationary stock indices.

Cointegration test has become a new method of analyzing international market linkages. Cointegration is a property possessed by some non-stationary time series. In general terms, two variables are said to be cointegrated when a linear combination of the two is stationary, even though each variable is non-stationary. In contrast, lack of cointegration suggests that such variables have no long-run link; in principle, they can wander arbitrarily far from each other. In terms of cross border equity markets efficiency, cointegration implies that national stock market indices are linked (they do not drift far apart) even if the stock indices are non-stationary. In section 3.2 I used this methodology to test cross-border equity market efficiency of selected CEE equity markets as well as their linkages with the developed markets (Germany and USA).

Indeed, former studies testing the extent of integration of emerging markets using the first approach typically yield results that are consistent with the observed market regulations.

(2) The second approach initially assumes that markets are integrated and that a particular asset-pricing model holds [e.g. Campbell and Hamao, 1992]. The drawback of this approach is the lack of universally accepted international asset-pricing model.

In the international version of CAPM of Sharpe (1964) and Lintner (1965) investors are presumed to hold a diversified portfolio of equities from all national markets, that is, a world market portfolio. In this model, the portfolio is the variance of the world's well-diversified portfolio. The risk of individual countries or stocks is measured by their covariance with the world market portfolio. However, the world portfolio might be an inefficient benchmark. Roll and Ross (1994) point out that there may be little or no relation between risk and expected return in this case. As a result, although estimating risk exposure is possible, this risk exposure may not be that meaningful in distinguishing between high and low expected returns.

An alternative approximation of equilibrium is a multiple-factor world CAPM. In this case, the risk of an investment is measured by its contribution to the variance of a portfolio of the factors. These factors are often specified to present broad economic forces, such as world interest rates, dividend yields, inflation growth, etc.

As indicated by Harvey (1995), both single-factor and multiple-factor CAPM present measures of risk. These measures are contingent on the asset-pricing model's being well specified. Recent research on international equity markets, for instance, has uncovered considerable time variation in accepted access returns, but it is not clear what drives this predictability. Some studies show that common risk factor explains a large factor of the time and cross–market variation in returns [e.g. Harvey, 1991]. This suggests that markets in industrial economies are relatively well integrated. In the study on Latin American markets by Claessens, et al. (1995), the rejection of CAPM suggests segmentation of those emerging markets.

There are many possible sources of statistical rejection of these models. First, the fundamental assumptions that provide the building blocks for these models, such as utility specification, information environment, or distributional assumptions, could be violated. Second, the benchmark portfolio that is used to measure risk could be improperly specified. Third, there could be problems with the data caused by infrequent trading of the component stocks. Forth, capital markets may not be integrated.

Despite all the deficiencies of CAPM it has been found that returns in different industrial countries can be predicted by using a common set of instruments [Harvey, 1995]. This communality suggests that industrial countries are relatively well integrated [Claessens, 1995]. Thus, one way to measure integration is to test for any communality in the factors driving the predictability of returns across countries, using conditional (multiple-factor) CAPM.

3.1. Correlation

One way to measure integration with the world markets is to measure correlation between returns of individual countries. By definition, correlation is a measure of a common component in the variables under study. In this paper it is a measure of the common component in expected stock returns and hence, indirectly, of market integration. The low value means segmented markets while a high value means integrated markets. In general, if the markets are segmented (returns do not move together) they provide a possibility for reduction of risk by portfolio diversification, as lower returns in one market can be partially offset by relatively higher returns in the other markets.

Although it is unlikely that one global risk factor explains all of the cross-sectoral and time variation in stock returns, it is equally unlikely that returns in perfectly integrated markets would show low correlation. In fact, many authors found that stock returns in major industrial countries are highly correlated [Bekaert, 1995; Harvey, 1995]. However,

as Fama and French (1997) report, the third characteristic of emerging markets is a low correlation of their returns with the industrialized ones.

The result of low correlation between the developing countries suggests a possibility to decrease the higher volatility of the markets by combining them in portfolios. The foreign investors could use this result to fight against the uncertainty in these markets. However, as Fama and French (1997) show in their paper, the standard deviation of a diversified emerging market portfolio returns is still twice as large as the standard deviation of diversified developed market portfolio.

However imperfect, the correlation of expected returns is the measure of market integration, it is used in this study as it may shed a light on relative degree of integration of economy returns.

3.1.1. Methodology

Let us assume that an investor holds a portfolio of assets from n countries. The expected returns on the portfolio R_p, is simply the weighted average of expected returns for each country in the portfolio, the weights being the relative shares invested in each country,

$$R_p = \sum_{j=1}^{n} w_j R_j \qquad (1)$$

where w_j is the proportion of total funds invested assets from country $j, j=1,.....n$.

The total variance of the portfolio is then

$$\sigma_p = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j \sigma_{ij} = \sum_{i=1}^{n} w_i^2 \sigma_i^2 + 2\sum_{i=1}^{n}\sum_{j=i+1}^{n} w_i w_j \sigma_{ij} = \sum_{i=1}^{n} w_i^2 \sigma_i^2 + 2\sum_{i=1}^{n}\sum_{j=i+1}^{n} w_i w_j \rho_{ij} \sigma_i \sigma_j$$

where,

σ_i^2 is the variance of the return on the securities from country $i, i=1,...n$;

σ_i is the standard deviation of returns on stocks from country $i, i=1,...n$;

σ_{ij} is the covariance of returns on stocks from countries i and j; and

ρ_{ij} is the correlation between returns on stocks from countries i and j.

As a result, by holding portfolio of assets whose returns do not move together in perfect harmony, the lower returns on some of the assets can be partially offset by a relatively higher returns on the other assets, resulting in a reasonable overall portfolio return, yet a reduced total portfolio risk.

Thus, low correlation is indicative of greater degree of integration and significant benefits through portfolio diversification.

3.1.2. Empirical Results

The daily return correlations among the tested markets are very various. Concerning the entire period, most of the Visegrad markets exhibit remarkably small, and in many cases even negative, correlation with the industrialized markets (see Table 10). This is in a sharp contrast with 0.25 correlation between DAX and NYSE indices. The only exception among CEECs is Hungary, which shows a very strong correlation of 0.25 with DAX. On the other hand, other Visegrad and Baltic countries seem to be more integrated in between, since Slovak index has the highest correlation value with the Czech index, Polish WIG shows the greatest correlation with Hungarian BUX, and RICI has the highest value with TALSE.

Analyzing the level of integration among the markets separately for each period by splitting the data into eight-year sub-periods shows that all the Visegrad markets started their history with extremely low correlation of returns with the developed markets (Table 11 and 12). While the early stages of development (1991–92) on Budapest and Warsaw stock exchanges do not reveal any correlation neither with DAX and NYSE, nor among themselves, both SAX and PX-50 started in 1993 with quite a significant correlation value with the Polish index (Table 13).

Since 1994 BUX started to be oriented towards NYSE market even though its highest correlation was with PX-50 (Table 14). WIG followed the BUX's trend towards NYSE. The rest of the markets increased their integration during this year mainly with the other developing countries.

The subsequent year of 1995 could be characterized by a substantial segmentation trend on Visegrad markets (Table 15). There has been a drop in all reported values. Concerning the integration towards the world markets, both BUX and WIG reoriented towards the German market. Additionally, it must be mentioned that there also has been a decreasing trend of correlation among the two developed markets as well when the correlation dropped from 0.34 in 1991 to 0.16 in 1995.

The global trend has changes since 1996 (Table 16) as there has been a general pattern of acceleration in correlation what can be interpreted as the evidence of the gradual integration of emerging markets of CEE into the world capital market. Both WIG and BUX became notably correlated with DAX while the level of correlation with the NYSE index was not either too low. This has also resulted in a great increase of correlation of the two countries in between (0.35). In contrast, Slovak and Czech markets remained segmented from the world markets, but they increased their level of correlation with the V4. During this year the Baltics have also entered the game, being the mostly linked to the Polish and Hungarian markets.

The year of 1997 (Table 17) influenced by Asian events continued in a similar pattern. BUX and WIG reached enormous returns' correlation levels with DAX and among themselves of around 50%. Once again, SAX and PX-50 decreased their integration with the other markets when some of the reported levels dropped even to the negative values. Additionally, they also moved further apart from each other. Concerning the Baltic states, there have not been any radical changes since the previous year.

The year of 1998 could be characterized by a substantial increase in almost all levels of correlation values (Table 18). The Polish and Hungarian indices have segmented from the German DAX, but all the CEE stock prices increased their mutual correlation values, all being influenced by the Russian crisis (**It would be interesting to compare these results with the correlation of CEECs with the Moscow SE index**).

A conclusion could be made that as the performance on the capital markets worsened at the end of 1994 and remained so during the whole subsequent year, the share prices dropped, mean returns decreased, and at the same time the markets moved away from each other (became more segmented). This could be due to the global decreasing trend in capital markets. Additionally, there was an outside fear of possible over-heating of the Hungarian and Polish economies. Subsequently, as the development on the stock exchanges peaked its highs once again in 1996, the markets revealed much greater correlation and therefore became more integrated.

It is also possible to measure a correlation between the logarithmic forms of the indices themselves. However, since the time series are very strongly trended, results provide an insight into the similar pattern of the trends only. Still, it might be interesting to mention that the two western indices together with BUX exhibit a very strong correlation (close to 1) and thereby a very similar dynamics (see Table 19). In contrast, SAX and PX-50 are only very little correlated with the developed markets.

At the end I have to mention that in addition to defaults of the differencing methodology of the returns' correlation technique of integration testing, due to the substantial instability in emerging markets as well as a relatively short sample period, the presented return results for current period may not provide a representative picture of the expected future performance of these markets.

3.2. Cointegration

One of the main attempts of analysts – "chartists" studying stock indices is to prove that past prices are valuable indicators of future price movements. However, if the market is efficient in a sense that current price compounds all information, than such

'search' is clearly pointless. So the trading rules based on previous index series are simply a practical test of the weak-form of market efficiency.

The weak efficiency hypothesis concentrates on the econometric testing of the degree of integration (or cointegration) among stock markets. The hypothesis states that asset prices from two different markets cannot be cointegrated. If stock prices in two given markets are cointegrated, stock price changes in one market are predictable by changes in other market. On the other hand, if these stock prices are determined independently, then given the history of the stock prices in one market, no other information could be useful to explain changes in stock prices. Thus, cointegration implies inefficiency.

3.2.1. Methodology

Testing for cointegration involves three steps:

1. First, determine the presence of units (order of integration) in each of the indices involved. This basically involves the Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) unit root type of analysis. To test for the unit roots I used the regression model with the drift of the form:

$$x_t = \alpha_0 + \alpha x_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta x_{t-i} + e_t \qquad (1)$$

where x_t is any stock price series, α_0 is the drift, e_t are error terms, and the hypothesis is:

$$H_o : \alpha = 1$$
$$H_1 : \alpha \neq 1$$

Following the standard practice of the literature on unit root tests, I transformed the data into natural logarithms. Similarly as in the case of correlation test I used the lagged value of NYSE index. I also ran unit root test on the first difference of stock prices:

$$\Delta x_t = \beta_0 + \beta \Delta x_{t-1} + \sum_{j=1}^{n} \beta_j \Delta \Delta x_{t-j} + u_t \qquad (2)$$

with the hypothesis:

$$H_o : \beta = 1$$
$$H_1 : \beta \neq 1$$

If the null hypothesis of stock prices in a particular country have a unit root is not rejected, the consecutive changes in stock prices over the period are random. Hence, the stock market is weak-form efficient.

2. The second state involves estimating the following cointegrating regression by ordinary least squares:

$$x_t = \delta_0 + \delta_1 y_t + z_t \tag{3}$$

where x_t and y_t are the national equity index series being tested for cointegration. In fact, in this case, the estimate of δ_t is said to be super consistent, because it converges to the true value at a faster rate than would be so with conventional asymptotics. However, conventional inference procedures do not apply, and the super consistency result does require that y_t depends only on x_t; if other variables enter the relationship between y_t and x_t, the cointegration regression (3) must be modified accordingly [14].

3. Third, the stationarity of the cointegrating regression error z_t is tested for. That is, it is examined whether the estimated time series of the residuals from the cointegrating regression (3) has a unit root. In cointegration tests, the null hypothesis is non-cointegration (against the alternative of cointegration). Engle and Grander recommend the Dickey-Fuller test (DF) and the augmented Dickey-Fuller test (ADF) for cointegration, which is also going to be used in this analysis. This test is performed by estimating the following regression:

$$\Delta z_t = -\pi_0 z_{t-1} + \sum_{p=1}^{n} \pi_p \Delta z_{t-p} + \varepsilon_t \tag{4}$$

where z_t is the estimated residual recovered from eq. (3). This test involves the significance of the estimated π_0 coefficient: if π_0 is positive and significantly different from zero, the z_t residuals from the equilibrium equation are stationary so the hypothesis of cointegration is "accepted".

The specific hypothesis is:

$$H_o : \pi_0 = 0$$
$$H_1 : \pi_0 \neq 0$$

The DF and ADF statistics are the "t-statistics" associated with estimated coefficients π_0. Based on simulation, Engle and Yoo (1987) provide critical values for cointegration tests.

[14] Stewart (1991).

3.2.2. Empirical Results

3.2.2.1. Unit Roots

Before testing for cointegration, the order of integration of the national indices must be determined. Tests for unit roots are performed using the Dickey-Fuller (DF) and the augmented Dickey-Fuller (ADF) tests. The null hypothesis is that the national stock indices have a unit root, against the alternative that they do not. The results of the unit root tests based on log index units are presented in the Table 20 (see Appendix). Panel A reports the DF and ADF tests of stationarity for the entire period in levels and first differences of the emerging stock indices about a non–zero mean, while Panel B reports the results for the developed market indices. Tables 21–28 list the results obtained after splitting the sample if data into eight years. The critical values of statistics are tabulated in Engle and Yoo (1987).

The reported results indicate the presence of a unit root in the levels of all indices (i.e., the null hypothesis can not be rejected at 1% significance level), with the only exception of PX-50 (Czech index) for the year of 1995 and RICI for 1997. However, with regards to the dynamics of the two indices, it can be observed from the Figures 3 & 5 (see Appendix) **that PX-50 & RICI exhibited a relatively stationary pattern during this period**. Still, there is no evidence to support the presence of a unit root in first differences of the stock price indices. The null hypothesis of a unit root in first differences is rejected for all nine stock price index series at 1% significance level. These results are broadly consistent with the hypothesis that national stock index series are individually integrated of order one, I(1), implying that the stock price level of the i^{th} market at t is solely dependent on the stock price at (t–1), plus an error term. The markets are individually weak-from efficient. This satisfies the first condition of cointegration.

3.2.2.2. Univariate Cointegration

Next I examined whether the six CEE national stock market index series are cointegrated. The general procedure is as follows. Each of the indices is taken as a base index and the OLS estimations of the cointegration regressions with each of the rest of the CEE stock prices under study are performed to examine the stationarity of the residuals. The Granger's representation theorem suggests that for the pair which exhibits cointegration, the symmetry of cointegration applies:

If X has at least one cointegration vector, which reduces the order of unit roots in the system of a linear combination of X and Y, there always exists an invertible finite-dimensional vector for Y which assures cointegration between Y and X. (Ma (1993), pp.290–291).

In practice, however, testing the null hypothesis of cointegration is not the same as testing the null hypothesis of no cointegration. In the second case the null hypothesis of no cointegration, which is also used in this study, cannot be accepted symmetrically. The reason behind it is that the empirical testing procedure described under methodology used here is designed to find a linear OLS vector that would stabilize the system of otherwise non–stationary index series. The failure to find such a factor does not imply that there is no other cointegration vector. In other words, empirically rejecting the hypothesis that X and Y are not cointegrated does not automatically imply the acceptance that Y and X (test in the opposite direction) are cointegrated. Subsequently, it is necessary to test the null hypothesis of no cointegration in both ways due to the described asymmetry.

The Tables 29–34 contain the results from the test of cointegration throughout the whole period under study, each taking different CEE stock price series as a base index. For obvious reasons it was not investigated whether CEE markets could explain for the changes in developed markets' indices (the same reasoning can be used for exclusion of Baltic indices in Tables 29–32). The reported results show that the stock markets of Hungary, Czech Republic, Slovakia, Poland, Estonia, and Latvia appear not to be cointegrated either with the German and New York markets, or within the CEE group since the null hypothesis of no cointegration cannot be rejected in either case. At the 5% level the critical value of the DF statistic is –3.37 and ADF statistic is –3.25. Both are tabulated in Engle and Yoo (1987). This outcome suggests that the links of the stock prices in the six CEE stock exchanges have been very weak over the period 1991–1998. While both BUX and PX-50 seem to be mostly related with the developed markets (even though still not satisfying the limits of cointegration), WIG looks like a completely segmented market. On the contrary, SAX, the index of Slovak Republic, which is assumed to be the most isolated market out of the V4, imposing the greatest barriers, shows the highest level of relation with all the markets under study for the entire period of its existence [15]. Surprisingly, SAX is the only index under study in case of which the cointegration with DAX cannot be rejected at 5% significance level. As far as the two Baltic indices, they seem to have developed much stronger links towards the V4 than towards the developed markets. These results seem to be in a sharp contrast with the studies of the cointegration of major world stock exchanges (France, Germany, Japan, UK, US), which usually result in substantial amount of interdependence among these markets [16].

[15] It must be mentioned that in recently there have been numerous steps taken in attempt to lessen the barriers imposed on the flow of capital in Slovakia, the latest being an amendment to the economic acts fostering the development of the capital market by canceling the taxation of yields from securities.

[16] See, e.g., Ma (1993); Arshanapali and Doukas (1993); Kam and Pikki (1993); etc.

Since, as mentioned earlier, the period under study is relatively large and numerous significant changes have occurred in transition countries during this period, the results over the entire sample period are not very reliable. Consequently, the dataset was divided into seven subsamples.

Concerning the first three years under study (1991–1993), the reported results are consistent with the results from the correlation testing (see Tables 35–37). It could have been expected that since the markets indicated only very low level of correlation in their return behavior during these years, they probably would not result in a high cointegration either.

A paradox of the subsequent year of 1994 (Table 38) is a result of cointegration of Hungarian BUX with the Frankfurt index at 5% significance level (DF=–3.408* and ADF=–3.738*). It is a surprising finding since BUX return series for this year resulted in a much higher correlation with the NYSE index (15.61%) than with DAX (10%). SAX became another index resulting in significant ADF level (–3.268*) reported for the residuals of the OLS of SAX on PX-50. This result, however, is consistent with the highest level of correlation between the two markets for 1994 (21.75%). In contrast to a relatively high level of correlation between BUX and PX-50 (21.67%) and BUX and SAX (17.20%), in both of the two cases a hypothesis of no correlation could not be rejected.

Similar as in the case of correlation testing, the year of 1995 (Table 39) can be characterized by an overall deceleration of the mutual integration of the markets as represented by the drop in all the DF and ADF statistics to zero or low unit values. With portfolio investors being threatened by a Mexican currency crisis and a subsequent global drop in both share prices and returns, the emerging markets became more segmented. It would be interesting to compare these results with the development on industrialized markets during this period.

The results from the year 1996 reveal many surprising observations (Table 40). First, it has to be repeated that both BUX and WIG recorded a great increase in terms of return growth while the other two Visegrad indices SAX and PX-50 have undergone a generally decreasing trend. This resulted in a high correlation of both BUX and WIG with the DAX index (17.35% and 17.52% respectively) as well as an increase of the correlation between the two markets (35.26%). On the other hand, both Czech and Slovak indices show only a very low level of correlation with the developed markets. Subsequently, it has been a great surprise that Hungarian index reported extremely low levels of DF and ADF statistics resulting in no cointegration with the rest of the markets under study. On the other hand, the null hypothesis of no cointegration in the case of PX-50 is rejected in the case of DAX and the DF and ADF statistics got close to the critical values in case of both NYSE and BUX. Concerning SAX and WIG, their reported DF and

ADF values are consistent with the correlation results. The generally low correlation of Slovak market resulted on very low DF and ADF statistics accepting no cointegration hypothesis. WIG's extremely high value of correlation with BUX resulted in a level of DF and ADF being close to the critical value. The last surprise for this year was that RICI's relatively high correlation with WIG (11.38%) and low correlation with PX-50 (–3.72%) resulted in almost a rejection of no cointegration with PX-50 (DF=3.1036) while the reported DF and ADF values for cointegration with WIG are relatively very low.

The results for both 1997 and 1998 indicate a collective segmentation trend in all CEECs markets as all DF and ADF statistics dropped significantly (see Tables 41 & 42). This is in a sharp contrast with a huge increase in correlation values, especially in the case of BUX and WIG with regards to the developed markets. In general, these results indicate that the magnitude of interdepence between the Visegrad countries has decreased over the last two sub-periods. Therefore, the linkages among these markets during this period are consistent with the notion of cross-border efficiency efficiency in the sense that these markets probably do drift apart. On the other hand, as these markets seem to decrease their external linkages in terms of weak-form efficiency (the hypothesis of no cointegration cannot be rejected in any of the markets under 5 % significance level), it is implied that the performance of one market has no impression on the others. The most important implication of the results of cointegration tests suggesting a small degree of interdependence in the stock prices of CEE stock markets is that they offer an appealing choice for international portfolio diversification policy by random diversification schemes in these markets.

The final conclusion can be made that there has been quite a substantial fluctuation of integration and segmentation of Central and Eastern European markets throughout the period under study, starting with no cointegration, increasing the international links during 1994, separating during 1995 just to increase the cointegration linkages during 1996, and a subsequent continuous drop since 1997. It can be deducted that the timing of the cointegration fluctuation has been more or less consistent with the correlation fluctuation. However, the specific results (and not just the general trend) have been often in a sharp contrast between the two testing procedures, as already discussed above.

3.2.2.3. Multivariate Cointegration

The methodology of testing for univariate cointegration as described above assumes that the economic variable is determined by only one underlying variable. Specifically, I tested whether, for instance, SAX is cointegrated with each of the rest of CEE indices separately. The underlying assumption of such study was that there is only one cointegration vector in each stock index and that the equilibrium level of one stock index

can be modeled by only one other stock index. However, when dealing with the international time series, it is conceivable that economic variables are simultaneously driven by several underlying fundamentals. That means that the univariate cointegration tests dealing with the non-stationary time series such as stock indices fail to account for the possible presence of more than only one stochastic system in the modeled economic variables. This model-misspecification biases the cointegration-test results [17].

The multivariate cointegration model pre-supposes a certain level of interrelationship among the markets under study. Due to the geographic proximity and especially economic and political similarity and interconnection, I decided to test for the multivariate cointegration among the Visegrad group only. The logic behind the multivariate cointegration test is that if BUX, WIG, SAX, and PX-50 stock indices are integrated, then following the economic theory, an equilibrium relationship should exist among all V4 markets simultaneously. The implication is that the stock index of an integrated market should be modeled by the other three stock indices. Consequently, a more proper form of cointegration tests should be conducted on the system of the relationship among the Visegrad stock markets as folows:

$$BUX_t = \alpha_0 + \alpha_1 WIG_t + \alpha_2 PX\text{-}50_t + \alpha_3 SAX_t + e_t \quad (5)$$

$$WIG_t = \beta_0 + \beta_1 BUX_t + \beta_2 PX\text{-}50_t + \beta_3 SAX_t + u_t \quad (6)$$

$$PX\text{-}50_t = \gamma_0 + \gamma_1 BUX_t + \gamma_2 WIG_t + \gamma_3 SAX_t + z_t \quad (7)$$

$$SAX_t = \delta_0 + \delta_1 BUX_t + \delta_2 WIG_t + \delta_3 PX\text{-}50_t + y_t \quad (8)$$

Subsequently, the stationarity tests are then performed on any of the estimated residuals e_t, u_t, z_t, y_t. Coming back to cointegration testing asymmetry, it is necessary to conduct cointegration tests on all four equations since if any of the tests for cointegration fails to reject the null hypothesis of no cointegration, it does not imply any cointegration in the rest of the models.

The testing procedure is similar to the one applied in the univariate cointegration tests and the following equation specification is used:

$$x_{1t} = \alpha_0 + \beta_2 x_{2t} + \beta_3 x_{3t} + \beta_4 x_{4t} + z_t \quad (9)$$

Where x_{it} represents stock indices from different V4 markets. The residuals z_t are recovered and tested for the presence of the unit roots.

[17] Ma (1993).

The Table 43 reports the results obtained from OLS regression specified in the equations (5) to (8). The critical value for ADF statistic tabulated in Engle and Yoo (1987) for 10% significance level is –4.06. Two of the residuals (from the OLS with BUX and WIG as base indices) reject the presence of unit roots and thus fail to reject the null hypothesis of no cointegration. Therefore, it can be said that I manage to find two cointegration vectors, which stabilize the system of V4 stock indices which is given by equations (5) & (6). The residuals from the equation (7) also reported the ADF value extremely close to the critical level, leaving SAX as the only base-index reporting low cointegration statistics.

Subsequently, it has been a big surprise to see the results of multivariate cointegration test for the sub-samples of six year-periods (see Table 44). High, even significant values of ADF statistic for the entire period under study resulted in extremely low values for the subsample periods. On of the possible explanations could be that there is a certain cyclical pattern of interconnection among the V4 markets which reflects in significant DF and ADF values for the entire period under study. In case that these cycles do not correspond with the year-end periods, these relationships would be broken by the process of splitting the data into yearly sub-periods, resulting in cointegration.

The conclusion is that even though in the case of univariate cointegration testing no cointegration has been found among the V4 for the whole period, and almost all of the stationary residuals for the individual subsamples were from the industrialized market indices, the multivariate cointegration testing revealed much stronger links among the V4 countries. All of the reported DF and ADF statistics are much higher than in the case of univariate cointegration. This implies that any one stock market index should be modeled by the other three indices to avoid the underspecification of the integration models. Additionally, only large samples of data over longer periods of time should be tested to avoid an unintentional break in the natural periods of development. One should be able to come to similar conclusion in case of multivariate cointegration testing of a group of three Baltic states.

Due to the shifts of dependence of Visegrad indices on the developed markets (as revealed by correlation and univariate cointegration techniques), I used the multivariate cointegration method to model each of the indices based on both DAX & NYSE indices. Unfortunately, no cointegration vector was found.

3.3. CAPM

To test the sensitivity of small countries returns to measure of global economic risk I use the single and multiple-factor Capital Asset Pricing Model (CAPM).

Single Factor CAPM

The basic assumption of the model is that the investors divide their wealth into riskless and risky investments in proportion that depends on individual risk aversion. In choosing a portfolio of risky assets, investors seek a high expected returns-to-variance ratio. In international version of the CAPM, the country risk is defined as sensitivity (covariance) of the country returns to a world stock return. The reward per unit of sensitivity is the world price of covariance risk. The difference in the countries' covariances should explain the differences in national performance if there is only one source of risk.

However, as was mentioned earlier, the international CAPM may have many sources of statistical rejection, such as, the existence of more than one source of risk, incomplete market integration, or some other misspecification. The notion that risk can be defined as the sensitivity of market returns to the changes in the world returns is contingent on the assumption of complete market integration. As the amount of segmentation increases, the risk can take on new definitions as a security's sensitivity to local market factors. The intuition is as follows. In integrated markets the sensitivity to local events can be hedged by a diversified portfolio (negative event in one country may be offset by positive news in another). However, if markets are segmented, the sensitivity to local events can have dramatic effects on required returns for the securities that trade in the local market. Thus, in single factor CAPM the assumption of complete market integration is crucial. Based on correlation analysis in section 3.1 it is reasonable to suspect that small emerging markets of Eastern Europe are not perfectly integrated into world markets. Thus, it is clear that a single factor model is not enough to provide a meaningful definition of risk in emerging models.

Despite all deficiencies of CAPM, many authors [Harvey, 1991; Buckberg, 1995] found that the empirical results indicate that the covariances are able to capture some, but not all, of the dynamic behavior of country returns. The idea here is to explore the emerging markets' sensitivities to world returns. This is a logical place to start, and the study may have important insights that can be persuade for future studies on small market integration. If the local returns are dependent on world portfolio returns, then betas may capture some degree of integration into world markets.

Multiple Factor CAPM

International asset pricing models that include multiple factors are described in Bansal et. al. (1993). In this case, the risk of the country investment is measured by its contribution to the variance of a portfolio of the factors (assuming the factors are traded asset returns). The global factors are often specified to represent broad economic forces

such as world interest rates, world inflation growth, dividend yields, business cycle movements. The local risk factors may include interest rates, exchange rates growth, dividend yields. The risk of each country can be characterized by a number of betas that represent the sensitivity to changes in these factors. The dependence on global factors, as well as lack of dependence on local factors, may be indicative of some degree of integration.

Another important issue in CAPM specification concerns how information is incorporated into the analysis. The traditional analyses of returns employ static models. For example, risk exposures and therefore expected returns are often assumed to be constant. In the context of mature, industrial economies, this might be an innocuous assumption. In context of emerging markets, however, it is unlikely that risk exposure remains constant over time. Emerging countries are often characterized by shifting industrial structure that will induce changes in risk sensitivities. In this study, however, the short period of time for which returns data is currently available prohibits estimation of time-varying betas.

3.3.1. Methodology

Single Factor CAPM

According to the model, if emerging markets are a part of global market, then each market's expected returns should be proportional to the covariance with a world portfolio in excess of the safe rate:

$$E(R_{jt})\text{-}R_{ft} = \alpha + \beta_j [E(R_{wt})\text{-}R_{ft}]$$

where,

R_{jt} is the total return on some asset/country j;

R_{ft} is the rate of return on the risk-free asset (US T-bills rate);

β_j is the proportionality factor

R_{wt} is the total return on the world portfolio.

Under the model, optimizing behavior leads investors to care only about covariance risk with the world portfolio and about no other sources of risk. If the single factor CAPM describes the world expected returns, the proportionality factor β_j may be interpreted as the measure of integration of the country j into world markets and positive significant intercept, α, would imply that returns in that country exceed expected level of performance (i.e., investors in that country are expected to earn positive rates of return even if the world as a whole were expected to earn nothing).

Multiple Factor CAPM

Whereas the single-factor CAPM focuses upon the linear relationship between beta factors and returns, the multiple-factor CAPM is more general model, which subdivides the systematic risk into smaller components. Any factor which impacts upon investor returns may be incorporated into the model. For example, an unexpected change in the rate of inflation (purchasing power risk) might affect the price of securities generally. In other words, the multiple factor CAPM conditions the expected returns on some economic factors Z_{t-1}. The returns now depend on a number of global and local risk factors. In a k-factor model, the expected value of an excess return for country j satisfies:

$$E(R_{jt})\text{-}R_{ft} = E(\sum_{i=1}^{k}\beta_{jk} Z_{jt}/Z_{jt-1})$$

where,

Z_j is a set of conditioning information for country *j*;

β_{jk} is the sensitivity of the excess returns in country *j* to the k^{th} factor in Z_j.

Ideally, the information set, Z_{t-1}, should replicate information investors use to predict prices. For each period the actual rates set during the previous period serve as a conditioning information. Initial tests of the model established that a four factor linear version of the multiple-factor CAPM is a more accurate predictor of security returns. Specifically, **Ross (1976)** stated that the expected return on a stock is directly proportional to its sensitivity to:

– investor attitude toward risk;

– interest rate;

– inflation;

– industrial productivity.

I felt that an exchange rate is yet another crucial factor, which needs to be incorporated into the model. Additionally, as the intention of my research was to test for the integration/segmentation of the markets, I needed to use two types of factors: global and local. Consequently, I used the following five local and five global instruments:

$$Z_{jt-1} = (R_{jt-1}\text{-}R_{ft-1}; e_{jt-1}; i_{jt-1}; \pi_{jt-1}; Y_{jt-1}; R_{wt-1}\text{-}R_{ft-1}; e_{wt-1}; i_{wt-1}; \pi_{wt-1}; Y_{wt-1})$$

where,

R_{t-1}-R_{ft-1} is the lagged local excess returns;

e_{jt-1} is the lagged local exchange rate;

i_{jt-1} is the lagged local interest rate;

π_{jt-1} is the lagged local inflation;
Y_{jt-1} is the lagged local GDP growth;
R_{wt-1}-R_{fi-1} is the lagged return on world portfolio;
e_{wt-1} is the lagged rate of change of foreign exchange rate;
i_{wt-1} is the lagged US interest rate;
π_{wt-1} is the lagged US inflation;
Y_{wt-1} is the lagged US GDP growth.

The predictive power of global factors may be interpreted as indicative of some integration. Similarly, the lack of predictive power by local factors may be interpreted as some degree of integration.

3.3.2. Empirical Results

3.3.2.1. Single-Factor CAPM

The regression results are reported in Table 45 and are quite surprising and contradictory to the results obtained by Minasian (1998). All the world return betas are positive and significant at 1% or 5% level and thereby accepting the CAPM. In case of Visegrad countries betas are considerably higher than for Baltic states indicating stronger links with the world market returns and consequent higher degree of integration as well as dependence on global risk factors. This finding, however, could have been expected from the results of other tests (e.g., Visegrad group, especially Hungary and Poland, revealed much higher correlation and cointegration with the developed markets).

Another interesting, but prospective finding was in case of Czech and Slovak markets, where negative intercepts document poor performance of the two indices (Slovak SAX has been blocked below the psychologically important level of 100 points for already several months).

It is interesting to compare these results to the findings reported in the study of Minasian (1998). In his thesis he finds that in contrast to the 'large markets' (which he defines to be Hungary, Poland, Czech Republic, and Russia) for which the CAPM can be expected, all 'small countries' (Slovakia, Latvia, Estonia, and Lithuania) rejected the single-factor model due to the world return betas being small and insignificant. The reason for such different results could be due to the different time-range tested. Consequently, I split the period under study into seven years and test for the single factor CAPM for each year separately. The results are presented in Table 46.

Since 1992 through 1995, all V4 indices report high and significant world return betas (except for PX-50 in 1993). It is interesting to observe that while during 1992–1993 the intercepts are positive and in two cases even significant (indicating positive average daily

excess returns), in 1994–95 the constants dropped below zero (on average, investors incurred losses on their stocks that year). Making analogy with summary statistics (Tables 3–6) these findings are fully consistent with the hypothesis of strong influence of Mexican crisis on the markets performances.

During the global capital market boom in 1996, all V4 intercepts increased significantly (as well as mean daily returns in Table 7). The two Baltic states started their existence with positive significant intercepts as well. All the markets under study seem to be integrated into the world capital market during that year as represented by large significant betas.

The East Asian crisis in 1997 caused jump-down in all the intercepts, and thereby average returns, but most of them stayed positive. The single-factor CAPM model can be accepted for the Visegrad group only as betas for world returns are very small and insignificant in the case of Estonia and Latvia. This means much higher integration of V4 markets into the global capital market. Making analogy with the findings obtained by Minasian, whose testing sample concentrated mainly on this period, the results seem much more alike. In case of Hungarian market, the beta value increased above the unity meaning that the market became more volatile, unstable and vulnerable to global risk.

In 1998 all the intercepts dropped below zero revealing much greater influence of the Russian crisis than the Asian one. This is in line with and only confirms the results of the previous testing methods of correlation and cointegration.

3.3.2.2. Multi-Factor CAPM

The results of multiple-factor CAPM are summarized in Table 47. For all countries the test rejects the null hypothesis of no predictability at 5% significance level. It is interesting to observe that for all markets under the study, the local excess returns seem to be the driving factor, as betas are significant for all the markets, whereas the world excess return beta is significant only in the case of Polish WIG. As far as the other factors under the study, they do not seem to be very important as local exchange rate beta is significant in the case of Hungary and Estonia, and local GDP growth beta in case of Hungary and Czech Republic only. The Polish market seems to be the only integrated one, as global factors' betas are not significant in any of the other cases.

At the end I used Wald test to test for the collective significance of both global and local factors. While local factors are collectively significant in case of all markets under study, the global factors seem to be influential in case of Poland, Czech Republic and Estonia only. The inability of the multiple-factor model to characterize the examined emerging market returns might be the result specified economic factors being inefficient and/or miss-specified with regards to the dynamics of these markets.

4. Integration vs. Segmentation Analysis

It is not clear what is driving efficiency (i.e. highest returns for lowest variance) of capital markets. The existing literature assumes that stock market in a given country depends on either global risk (integrated market), or local risk (segmented market). Additionally, the benefits/disadvantages of integration/segmentation of the market are also vague. The problem can be approached in two levels.

From the market point of view, the argument for beneficiary of integration is conditioned upon the initial assumption. Integration leaves countries vulnerable to global economic risk factors. Since all of the emerging markets under study are characterized by frequent changes in macroeconomic policies and/or political instability, then, assuming that world (or leading world economies) are economically more stable, it seems plausible that for local markets dependence on the world risk factors will be preferred to domestic ones. Consequently, the final benefits of integration are efficient pricing and efficient capital allocation and therefore reduced cost of capital, as well as insensitivity of local stock exchanges to local risk factors. Then the only factors that influence stock returns will be global factors. This, however, is contingent on the assumption that integration mitigates local risk factors' effect. Alternatively, in case that the country is politically unstable and this local risk represents an intrinsic characteristic of the market, then the integration will add up global risk factor to local ones. In this case both local and global variance will contribute to higher risk premium and higher cost of capital, if the markets are integrated.

From the investors' point of view, there are differing views on consequences of integration as well. On the one side, there are critiques of the integration among researchers that argue that integration may lead to lower potential diversification benefits and thus reduces appetite of the international investment community for stocks in emerging markets. Contradictory, the opponents argue that these concerns are ill-founded for two reasons [Bekaert, 1995]:

(1) Studies do not detect any relation between the risk-return trade-off of individual markets (as measured by Sharpe ratio) and market integration or the openness measures.

(2) Capital markets integration might help secure long-lasting portfolio flows from institutional investors. The trend toward international diversification has caused an increasing number of money managers and institutional investors to practice global-asset-allocation strategies based on neutral benchmark that is close to world market portfolio (e.g. world portfolio defined by Morgan Stanley Capital International).

Summarizing the above arguments, it can be concluded that integration is beneficial

to both markets and investors. Integration may be viewed as a consequence of large amount of investment in a particular country, and is therefore an indication of realized diversification benefits. The process of integration itself takes place only when large number of global investors try to reap excess profits on high-yield markets, thus bringing the return levels to one world level. Thus, it can be argued that faster integration of a country with the world markets means higher attractiveness of that country's stocks. Therefore, the concern that integration reduces potential diversification benefits and hence is not beneficial for local markets is inappropriate. Segmentation of a market means not only potential, but also unrealized diversification benefits.

In this section of the paper I wanted to test for the two factors that may cause either permanent of temporary segmentation/integration of the market. Is there any evidence for a presence of a permanent 'ceiling' on the level of integration that the country is able to achieve, which is predetermined by its size? Additionally, taking into account this 'ceiling', is there any connection between the fluctuation of the level of integration/segmentation achieved by the market and its economic/political performance?

4.1. Dynamic Aspect: Time Factor

The tested hypothesis was whether the integration/segmentation of the particular market depends on its economical and/or political performance throughout the time. The basis of the method is a sensitivity analysis, which has already been undertaken for each of the methodologies throughout the paper. Making analogy with these results the following conclusions can be stated for each of the methodologies:

Correlation

An examination of the return behavior for each year separately showed that the integration/segmentation of the markets is dynamically consistent with the positive/negative development on the markets. The possible reason could be that during the period when the capital markets are booming, lots of international portfolio investors are entering the market and the stocks of the domestic companies get listed on the western stock exchanges. Consequently, the markets become more correlated and thus also more integrated. On the other hand, poor performance of the equity market may limit its attractiveness to foreign portfolio investment and make the market more segmented. Another justification for this explanation could be that the two "most highly-regarded" and better performing markets of the region, Hungary and Poland, show much higher correlation with the developed markets. Additionally, they also absorb much

higher portion of foreign capital inflows into CEECs (see Tables 48–53).

Cointegration

The examination of the cointegration after splitting data into eight subsequent years showed a fluctuation in the amount of relationship between the markets which was again consistent with the fluctuation in the performance of the markets. However, **the specific pattern of the dual relationship between each pair of the markets has been substantially different from the outcome of the correlation testing.**

CAPM

As far as the performance of each particular market throughout the time period under study, the single-factor CAPM only confirmed the results obtained by the two previous methods. During the times of high correlation and cointegration values, the CAPM reported positive and significant intercepts, and vice versa. However, concerning the level of integration/segmentation as measured by the size and significance of world return betas, single-factor CAPM appears to be an inappropriate approach for testing the hypothesis.

Conclusively, it can be stated that different development on the developed/world market has different influence on the emerging markets of CEE. On the one hand, overall positive development is more or less immediately reflected into the indices of CEECs, raising the mean returns and Sharpe Ratio (e.g., 1993, 1996). On the other hand, external negative development can cause various results on V4 and Baltic group. First, concerning the crisis on the other emerging markets (outside of the European region) as represented by the Mexican currency crisis, there was a strong, but delayed (almost by 1 year) response from the post-communist markets under study. On the other hand, the shake of the developed part of the world (Asia market in 1997) had only a limited impact on the region. The last financial crisis came out of the region itself (Russia is still considered as one of the most influential markets of the region) last year and none of the markets was able to escape it. This would suggest a strong integration within the region, partial integration with the rest of the emerging countries (with a delayed reaction), and unstable relationship with the developed markets (trend towards integration during positive times and vice versa).

4.2. Static Aspect: Size Factor

As was already stated earlier, compared to developed markets, transitional stock markets are characterized by weak regulations, operational inefficiency, and small market capitalization. Among these factors, size appears to be an intrinsic characteristic of some economies. Stock exchanges in countries like Baltic states, Slovakia, and Slovenia will always have small market capitalization.

Main characteristics of small countries stock exchanges are small market capitalization value, which in turn may affect liquidity and the extend of market capitalization.

(1) Small number of listed companies with one or two leading corporations (e.g. Slovakia, Croatia, Slovenia).

(2) A number of small, for investors 'unattractive' companies with low capitalization.

The purpose of this section was to address the following question: Is it efficient for small emerging economies to establish equity markets or will the small countries benefit more if the local shares are traded on foreign exchanges? Does the size of the market predetermine the level of integration that the market is able achieved, or there is no interconnection at all?

The null hypothesis of this research was that stock markets in small economies are segmented and consequently exposed to local risk factors, therefore being inefficient and thus increasing the cost of capital. The intuition behind this hypothesis is that the companies in small countries are unattractive, and that higher return does not justify information and transaction costs to global investors. Alternatively, if this hypothesis is rejected, it means that smaller size implies lower level of required investment, which might lead to faster integration with the world markets, mitigating the effect of local risk.

In his thesis, Minasian (1998) reported that small countries appear to have higher degree of predictability and segmentation. To compare performance of small versus large economies he constructed hypothetical portfolios with equal investments in each country. His main finding was that small market portfolios yield higher return and lower volatility. CAPM model's main results indicate higher degree of predictability, market segmentation and dependence on local risk factors for smaller countries.

The size-effect is one of the many anomalies that have been observed at stock markets in resent years. After numerous researches on the small caps yielding, on average higher returns [e.g., Banz, 1981; Klein and Ledemen, 1993], there has been only little research on country size effect. Keppler and Traub (1993) investigated the small country effect on 18 industrial countries, including the MSCI world index and document higher returns and lower volatility for portfolios consisting of small countries. They

concluded that, the size is a useful selection criterion for enhancing the returns and reducing the risk of global equity portfolios.

The relation between size and mean return has been typically analyzed by grouping individual stocks into portfolios on the basis of market capitalization, with periodic regrouping to account for changes in size over time. Statistically significant differences in mean returns between large and small firms have been documented. Consequently, to compare performance of small and large emerging markets I defined the following two portfolios in this study:

(1) Small Size Portfolio (Slovakia, Estonia, and Latvia)

(2) Large Size Portfolio (Poland, Hungary, and Czech Republic)

After grouping the countries according to their size I constructed the hypothetical portfolios with equal investment in each country. The returns, therefore, are the arithmetic averages of daily returns on individual markets.

There are two possibilities for market comparison on the size basis. The performance and integration of the indices can be compared either on the individual-basis (findings for all the previous tests have been reported in the tables in appendix such that large markets and small markets were grouped together). Alternatively, comparisons may be done on the group-basis by re-running all the tests on the hypothetical portfolios.

The summary statistics (see Table 54) do not support the size-effect anomaly, since the small-market portfolio has lower average daily returns (0.0592%) then the large market portfolio (0.0806%), but still higher variance as measured by standard deviation. Consequently, even though the small markets are segmented as evidenced by extremely low levels of correlation and cointegration (see Tables 55 and 57), and thus offering large potential diversification possibilities, these would not be justified by the highly volatile returns, which are even below the average world level (0.0633%). These results are in line with the previous findings done on individual-basis, which also documented larger segmentation, lower returns, and higher variance for small emerging countries under study than the large ones.

Thus, the evidence suggests that smaller countries are segmented. However, accounting for the fact that two out of three small countries in my sample are in the initial stage of stock exchange operating, it could be argued that the segmentation is a consequence of operational inefficiency and lack of experience. It is quite possible that Baltic States are gradually integrating with the world markets, just like in case of Visegrad countries during the first years of the existence of their stock exchanges. Especially, since the sensitivity analysis conducted on the individual basis and reported in Tables 16–18 did not support the null hypothesis.

These results are fully consistent with the findings of Claessens, et al. (1995) who in their study on return behavior examined emerging markets of Latin America, and suggested that small size effect, found in many industrial countries does not prevail as systematically in the emerging markets. They use the CAPM and find that the CAPM is typically rejected in most emerging countries.

5. Conclusion

The purpose of this paper was to determine whether the capital markets of Central and Eastern Emerging Europe are gradually becoming integrated into the world capital markets. Additionally, the driving/preventing factors of this integration, as represented by economical and political performance and the size of the market, were investigated. In other words, I tried to find out whether there is any causal relationship between the market integration and its performance. Namely, whether a good performance can be observed as a driving factor of market's integration into the world capital market. Without contradicting the result of this analysis I also tested whether the size of the market can proof as being a preventing factor of integration, given that the country is relatively small.

Summarizing the main results it can be stated that a positive relationship has been found between the market performance and its integration. However, the presence of the size effect could not been supported by the test results (what is in line with Claessens, et al (1995) findings on Latin America emerging markets).

At the end, a judgement on whether the CEE markets under study are efficient should be passed. However, the final notion of efficiency depends on its initial definition. For instance, according to Harvey (1995) the markets are efficient if they are globally integrated since segmentation implies inefficient allocation and pricing (high cost) of capital due to the exposure to local risk factors. On the other hand, as cointegration literature states [18] the markets are efficient if they are not cointegrated since the opposite would mean that they follow the development of each other (they are predictable), and the risk-diversification portfolio investment is therefore not possible. Consequently, since the notion of efficiency as defined in capital market environment is disputable, once saying that the markets are efficient when they are integrated (global efficiency), other time when they are not (individual efficiency), I tried to limit the use of the word efficiency throughout the paper, referring rather integration/segmentation (unless the type of efficiency was clearly defined).

[18] see, e.g., Eagle and Granger (1987); Chan and Pikki (1993); Ma (1993); etc.

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Appendix

Data Description

This study concentrates on Central and Eastern European countries stock exchanges: Czech Republic, Estonia, Hungary, Latvia, Poland, and Slovakia. PX-50, TALSE, BUX, RICI, WIG and SAX indices are the official indices of the Prague, Tallinn, Budapest, Riga, Warsaw and Bratislava stock exchanges, respectively. They were created according to the International Finance Corporation (IFC) Index methodology as capital-weighted indices – they compare market capitalization of a selected set of shares with the market capitalization of the same set of shares as of the reference day. The indices belong to so-called performance indices that reflect an overall change of wealth resulting from investment in the shares that are included in the index. This means that performance indices reflect, in addition to changes in prices, also the dividend payments and income resulting from changes in the amount of the share capital, that is a difference between the current market price and issue price of the new shares.

The index formulas are flexible and allow to alter representation of particular companies in the index and their number, depending on how their tradability changes or in the case of a new company entering the capital market. In the case of a change in the index structure, the correction factors are set up in such a way that the index with the new structure continuously follows development of the index with the previous structure.

Daily closing data for all four indices have been collected from the respective stock exchanges over the period beginning 1993 and ending 1998. When national stock exchanges were closed due to national holidays, bank holidays, or other reasons, the index level was assumed to remain the same as the one on the previous trading day. Since national stock markets are operating in the same time zone with the same opening and closing times, no attention is needed to the problem of the trading overlap common in analysis of the world stock exchanges.

For comparison purposes I used the indices of developed markets, specifically German and US markets. Throughout the entire analysis I used the lagged value of NYSE index to adjust for the time differences. For the purpose of CAPM I approximated the risk free asset by the use of GT-30 (30-year maturity British government bonds).