STOCK MARKET COMOVEMENT IN THE EUROPEAN UNION AND TRANSITION COUNTRIES

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Rezumat

Această lucrare cercetează convergența pieței bursiere în țările Sunt folosite trei abordări pentru a obține estimări variabile în timp ale covarianței dintre beneficiile pieței bursiere din UE şi din Europa centrală şi de est: (1) analiza corelației; (2) teste de rădăcină unitate; (3) teste recursive de cointegrare. Rezultatele sugerează că există o corelație destul de slabă între piețele bursiere din UE şi cele din Europa centrală şi de est. Cu toate acestea, legătura dintre piețele bursiere din aceste regiuni s-a întărit după 2002. Această observație se bazează pe modificările observate pe piețele bursiere respective.

Abstract

This paper investigates stock market convergence of Central and Eastern European (CEE) countries to the rest of Europe. Three approaches are used to obtain time-varying estimates of the comovement between returns on CEE and EU stock exchanges: (1)

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realised correlation analysis; (2) rolling unit root tests, and; (3) recursive cointegration tests. The results suggest that there is a relatively weak correlation between stock markets in CEE countries and those in Europe. However, the link between the exchanges has strengthened since 2002. This finding is robust to changes in the reference stock exchange.

Keywords: Comovement; CEE countries; stock market

JEL Classification: G15; F36; P34

1. Introduction

Ever since Grubel (1968) it has been well known that diversifying a portfolio along international lines improves the portfolio's risk-return characteristics. One reason for the benefits of internationally diversifying a portfolio is that domestic portfolios might have a tendency to move together since they are affected by the same country specific factors such as the business cycle and economic policy. These factors, along with different legal and institutional regimes might act as a wedge to separate equity markets from full integration and induce large country specific variations in returns. In addition, as Roll (1992) argues, there might also be industry specific factors that create benefits from international diversification. For example, investing in Switzerland gives a relatively high weight to the banking sector and investing in Australia gives a relatively high weight to agriculture. Whatever, the reason, the benefits of international diversification can be impressive and Bodie et al (1999) have argued that the risk of an internationally diversified portfolio can be reduced to less than half the level of a diversified portfolio in the United States.

Since the 1980s, capital controls have been abandoned by many countries and stock markets have been increasingly deregulated so that investors are now able to create portfolios that include assets from a range of different countries. One consequence of this is that many emerging markets have proved attractive to investors since they offer the prospect of relatively high returns. Using data obtained from the International Monetary Fund's International Financial Statistics database, equity flows into CEE economies rose from just US$6 billion in 1996 to US$41.8 billion by 2005. However, international diversification of portfolios can only be justified if there are gains from it and this depends on the extent to which returns in

different countries are less correlated than returns in domestic markets. (See for example, Granger and Morgenstern 1970, and Speidell and Sappenfield 1992.). It is therefore important to understand the extent to which markets are integrated. If stock markets respond symmetrically to economic shocks, or if contagion induces a symmetric response to an economic shock, an internationally diversified portfolio might not necessarily achieve the benefits of diversification in optimal portfolio selection.

Most studies into co-movements in stock markets have focussed on developed economies (see for example, Koch and Koch, 1991; Campbell and Hamou, 1992; Longin and Solnik, 2001; Bessler and Yang, 2003). By comparison, there have been fewer studies into linkages between developed markets and emerging markets. Despite this, one area that has proved increasingly attractive to overseas investors is CEE. After the collapse of the Soviet Union, the former planned economies of CEE were at the forefront of transition and most now have functioning market economies. As part of the transition process, these economies removed restrictions on capital inflows, privatised their industries and established stock markets along the lines of those operating in the developed economies. In 2004, the Czech Republic, Estonia, Hungary, Poland, Latvia, Lithuania, Slovakia and Slovenia were formally admitted to the EU. Bulgaria and Romania were admitted to the EU on January 1 2007 while Croatia and the Republic of Macedonia have formally been granted candidate status for EU Membership in recognition of the extent to which they have met the Copenhagen Criteria. Since all of these countries meet the Copenhagen Criteria, they have, by definition, a functioning market economy.

There are reasons to believe that returns in the former transition economies of CEE might, at least to some extent, be correlated with each other. Following Poland in 1989, the economies of CEE liberalised their economies and began the process of transition simultaneously. The large monetary overhang inherited from Communist times and rapid growth of the money supply led to hyper inflation in all of the transition economies. All CEE economies have now reined back inflation. They have also adopted some form of fixed exchange rate and most of their currencies are tied to the euro. They have all created functioning stock markets with rules similar to those in developed economies. Furthermore, as transition has progressed, the economies of CEE have gradually integrated into the world

economy increasing their trade especially with the rest of Europe and reducing their trade with the former planned economies of the Soviet Union. Stock market linkages might also exist because the countries of CEE are geographically proximate to each other and so might be subject to the same economic shocks. Early studies into stock market integration among the transition economies of CEE with western stock markets found little or no supportive evidence (see for example, Linne, 1998; Gilmore and McManus 2003.) A slightly later study by Rockinger and Urga (2001) concluded that shocks in the United Kingdom were positively related to the Czech and Polish markets. However, since these early investigations, several CEE countries have now been admitted into the EU and techniques of investigation have improved. For both of these reasons it is now appropriate to re-examine the extent to which CEE stock markets are integrated with Germany and London. Of most relevance to our investigation, Chelley-Steeley (2005) finds evidence that stock markets of Hungary and Poland especially, and the Czech Republic to a lesser extent, are becoming more integrated with western (France, Germany, Japan, UK and US) markets. On the other hand, Gilmore et al (2008) find little evidence of increasing integration between the equity markets of the Czech Republic, Hungary and Poland with Germany and the UK.

In this paper we extend the work of Gilmore et al. (2008) by including an increased number of countries in our sample and by testing for converging equity prices. We use three approaches to obtain time-varying estimates of the comovement between returns on CEE and EU stock exchanges. The first approach utilises the method of realised correlation analysis developed by several authors (Andersen et al., 2003), which draws on daily data to generate consistent estimates of the moments of the distribution of financial returns. We also use two other techniques, rolling unit root statistics and recursive cointegration tests, to obtain time-varying estimates of the comovement between the stock exchanges and we allow for non-linearity in daily returns. Both approaches allow the correlation to vary within the sample and so permit the authors to identify periods of strong correlation and to investigate whether EU membership has strengthened the correlation in stock exchange returns in the CEE countries relative to the rest of Europe.

Although daily returns may be subject to similar shocks, it is possible that equity prices on exchanges may drift apart. To evaluate whether equity prices between CEE and European exchanges are

converging, the authors employ the Hansen and Johansen (1992) recursive cointegration method with a rolling window. Unlike other studies in the area, the authors consider a wider cross section of CEE countries. These include Slovenia (SLEX), the Slovak Republic (SLVX), Estonia (ESX), Latvia (LATX), Lithuania (LITX), Bulgaria (BULX), the Czech Republic (CZEHX), Romania (ROMX), Hungary (HUNX) and Poland (POLX). In addition, the study presents evidence on convergence in both daily returns and equity prices.

The rest of the paper is organised as follows: Section 2 provides a brief review of the development of stock markets in CEE countries, while Section 3 outlines the econometric approach employed in the study. The empirical results are reported in Section 4 and some concluding remarks are given in Section 5.

2. Development of Stock Markets in Central and Eastern Europe

Securities exchanges in CEE were created as part of the process of transition which began with the collapse of the former Soviet Union in the early 1990s. During the early stages of transforming an economy from planned to market there is discontinuity in the structure of opportunities and incentives and there are major institutional, legal and political changes in the economic system. Among other developments, the economies of CEE embarked on large scale privatisation programmes and prior to this set in place one of the pillars of a market economy – the right to own and dispose of private property. As well as changes in the right to legal ownership, it was also necessary to establish some mechanism through which newly privatised assets could be transferred to private owners. In functioning market economies stock markets serve as a basic tool for ensuring efficiency of investments by providing investors with a mechanism for transferring ownership of companies and in the process revaluing them as new information on future prospects reaches the market. In this sense, legal protection of property rights in general and shareholder rights in particular, promote informed arbitrage in stocks and encourage the development of efficient stock markets.

Once privatisation was under way, the task of creating stock markets assumed pressing importance and, while these have been created in different ways, they have generally experienced similar problems during development (see Claessens et al. 2000). Initially,

liquidity of newly established stock markets was relatively low and trading was thin with the result that in the early days at least, markets tended to be open for only a few hours a day and only one or two days a week. Consequently stock prices were volatile compared with developed stock markets and it seems likely that this inhibited the growth of trade because of the increased risk.

Prior to the socialist regime, stock exchanges existed in many of the CEE economies. However, in the intervening years new generations, unaccustomed to the operation of capital markets, had grown up and viewed the newly created stock markets with suspicion and caution. One of the major challenges in the transition economies was therefore to educate investors and to explain the nature of risk capital. However, efforts to educate investors were somewhat confounded because, coupled with the absence of understanding about the operation of stock markets, there was an absence of reliable information about the companies traded on these markets. The information disclosed by companies was often inaccurate or incomplete and was frequently based on different accounting standards and practices. In other words, reliable corporate governance structures of the type common in developed market economies were not in place and companies were subject to few, if any, mandatory disclosure requirements. (See for example Kawalec and Kluza, 2000.)

3. Empirical Methodology and Data

3.1 Methodology

In this study, the authors employ three approaches to investigate convergence in daily stock market returns of CEE countries' to those in Europe: (1) realised correlation ratios, (2) rolling unit root tests and; (3) recursive cointegration tests. The realised correlation approach attempts to build a measure of the synchronisation of stock market returns using moments of the distribution of financial returns. Following Andersen, et al. (2003), the authors define daily returns as $r^i_{t,d} = ln(p^i_{t,d} / p^i_{t,d-1}) * 100$, where $p^i_{t,d}$ is the stock market index of *i-th* country, in year t on trading day d. One can then build consistent estimates of annual index volatility using the sum of the squared returns:

$$\sigma_{t,i}^2 = \sum_{d=1}^{D_t} (r_{t,d}^i)^2 \ .$$

(1)

One can also obtain a measure of realised covariance between the annual stock returns of country i and country j using:

$$\sigma_t^{ij} = \sum_{d=1}^{D_t} r_{t,d}^i \bullet r_{t,d}^j$$

(2)

By combining these two moments, one can then obtain a time-varying measure of the co-movement between the stock markets in CEE countries and the EU. Realised correlation ($\rho^{i,j}$) is calculated as:

$$\rho_t^{i,j} = \frac{\sigma_t^{i,j}}{\sigma_t^i \bullet \sigma_t^j}$$

(3)

Compared to standard coefficients of correlations, the realised correlation approach improves the accuracy of the measure of association between the two exchanges under consideration (Andersen et al., 1999). Pairwise realised correlations are estimated for each of the ten countries investigated relative to the DAX and the FTSE (All Shares). Note that the database forms an unbalanced panel since stock market indices are not available for each market over the entire sample period.[1]

Following Bernard and Durlauf (1996), convergence in the performance of two stock markets can be calculated by testing the differences in daily market indices for stationarity. In the case of convergence, the null hypothesis is that the difference between the daily stock market indices for country A (Y_i) and that for the comparative country, country (Y_j), is non-stationary, or:

[1] *The date of the first observation is provided in parentheses: Slovenia (1/11/1993), Slovak Republic (7/3/1995), Estonia (6/3/1996), Latvia (12/31/1999), Lithuania (12/31/1999), Bulgaria (10/20/2000), Czech Republic (9/7/1993), Romania (9/19/1997), Hungary (12/31/1990) and Poland (4/16/1991).*

$$H_0 : x_{it} \equiv (Y_{it} - Y_{jt}) = I(1) \quad \forall i = 1,..., N$$
$$H_1 : x_{it} \equiv (Y_{it} - Y_{jt}) \neq I(1) \quad \forall i = 1,..., N$$
(4)

where x_{it} is the difference in the stock market returns of country i relative to the benchmark country (Europe), and $I(1)$ denotes a unit root non-stationary process. Unit root tests can then be used to evaluate the null hypothesis given in Equation (4). Failure to accept the null hypothesis implies that the contrasts are stationary and the two series are converging. Unit root tests can be used to evaluate the null hypothesis given in Equation (4).

The most popular unit root statistic in the applied econometric literature is the augmented Dickey-Fuller (ADF) test. The ADF framework uses a regression of the following form:

$$\Delta x_t = \alpha x_{t-1} + \sum_{s=1}^{S} \beta_s \Delta x_{t-s} + \varepsilon_t$$
(5)

where ε_t is a stationary error and the null hypothesis of a unit root process is rejected if the coefficient α is significantly less than zero. The lagged terms of the dependent variable are included to control for serial correlation in the residuals. The test allows for a constant and the Akaike Information Citerion is used to select the optimal lag length.

If the ADF test fails to accept the null hypothesis of non-convergence, this does not necessarily mean that stock markets in CEE countries are not converging to those in Europe. It is instead possible that the difference between the two series may be a non-linear mean-reverting process. To investigate this hypothesis one can employ the Kapetanios, Shin and Snell (2003), KSS, unit root test that investigates the null hypothesis of a unit root against the alternative of a non-linear stationary smooth transition autoregressive process. The test uses a regression of the form:

$$\Delta x_t = \delta x_{t-1}^3 + \sum_{s=1}^{S} \beta_s \Delta x_{t-s} + \varepsilon_t$$
(6)

The null hypothesis of a unit root, $\delta = 0$, is tested against the alternative of a non-linear stationary process using the t-ratio

obtained for the coefficient. Asymptotic critical values are obtained from Kapetanios, Shin and Snell (2003). Rejection of the null hypothesis would imply that there is non-linear adjustment towards the benchmark stock market.

To obtain time-varying measures of convergence, the authors employ rolling unit root tests based on different sub-sample periods. Setting the step size at $k = 30$ and rolling daily 5 year sub-samples, the number of observations employed to calculate each unit root statistic is therefore $5D + k = 5(262) + 30 = 1350$, where D is the number of trading days in a year. The t-statistics are scaled by the critical values at the 10 percent significance level and plotted in the next section.

Both the realised correlation coefficients and unit root tests are only able to evaluate co-movements in the returns of CEE countries and Europe. To evaluate the robustness of results, the authors employ the Hansen and Johansen (1992) recursive cointegration method with a rolling window. The recursive approach is adopted since traditional cointegration tests over the entire sample period would tend to reject the hypothesis that the series are cointegrated if equity prices are in the process of converging. The time-varying cointegration technique allows for changes in the relationship between the variables in a system. Similar to the rolling unit root procedure above, the time-varying cointegration procedure first calculates the trace statistic using rolling daily 5-year sub-samples. Pascual (2003) shows that this rolling window approach is statistically more powerful then when the length of the window increases as new observations are added. For expositional purposes the trace statistics are scaled using the 10 percent critical value: a value greater than one indicates cointegration or, in the context of this paper, convergence in equity prices.

3.2 Data

The daily stock market indices for ten of the CEE countries and the representative European exchanges (FTSE and DAX) are provided in Figure 1.[2] The figure shows that prior to 2002, the indices for most of the transition countries in our investigation simply fluctuated around some mean index value. As a result, with the exception of the Czech

[2] *The data were obtained from Datastream.*

Republic and Poland, the major correction that occurred in European markets between 2000 and 2002, reflected by the downward movements in both the DAX and the FTSE, are not apparent in the indices of the transition country stock exchanges.

However, after 2002, there was a sharp shift in the trend movement of the stock exchanges in transition countries. This shift in trend, for the most part, coincided with a pickup in European stock markets. The Lithuanian stock exchange had the largest jump during the second half of the sample period under consideration with the stock market index in this country rising by a cumulative 475 percent over the four year period. This represents an annual average change of 118.9 percent compared to 32 percent for the DAX and 14.5 percent for the FTSE. Slovenia, on the other hand, had the lowest rate of change during the period, but the change in the stock market index for this country was still above the European average.

The stock exchanges in these transition countries also became more susceptible to external economic conditions. While most exchanges in transition countries were sheltered from the correction that took place in Europe between 2000 and 2002, this was not the case in the first quarter of 2006 when eight of the ten CEE stock exchanges suffered major downturns similar to those obtained in the rest of Europe.

There was also a significant difference in the characteristics of the daily returns in the transition countries during the two sample periods (1990-2002 and 2003-2006). On average, daily returns on transition country stock exchanges were approximately 11.1 percent between 2003 and 2006, compared to just 5.9 percent between 1990 and 2002. These daily returns were also significantly higher than those obtained for either the DAX or FTSE during either period. Indeed, while the average daily returns for the DAX and FTSE were negative over the 1990-2002 period, most exchanges in transition countries managed to maintain positive average daily returns (with the exceptions of the Czech Republic and Slovenia).

The volatility of daily returns also fell significantly during the latter half of the sample period. On average, the coefficient of variation for transition countries between 1990 and 2002 was 30.4, almost twice the value for the DAX and FTSE. By the 2003-2006 period, the coefficient of variation for CEE countries had declined to just 10.9, compared to 29.6 for the DAX and 75.7 for the FTSE during the same

period. Slovenia, Poland and Hungary benefited from the largest declines in volatility.

Despite the tremendous decline in the volatility of daily returns experienced in most transition countries, the distribution of these returns remained highly non-normal. Figure 2 plots the normal curve that is implied by the mean and standard deviation of the returns of each stock exchange. These plots are consistent with the previous literature that documents fat tails in asset returns of transition countries (see for example, Harrison and Paton, 2005).

4. Results

4.1 Correlation

The starting point to evaluate convergence in stock market returns in transition countries relative to those in Europe is to calculate realised correlation ratios. Table 2 presents these ratios for each transition country, using the DAX as the basis of comparison between 1991 and 2006. As might be expected, the daily returns on most transition country exchanges are not highly correlated with the DAX the average correlation being only 0.14. However, the correlation between the exchanges has risen since the end of 2002. The average realised correlation ratio in transition countries up to 2002 was just 0.09. After 2002 it had risen, but still remained relatively low at 0.15.

In three countries, namely the Czech Republic, Hungary and Poland, the correlation between daily returns and the DAX was particularly strong. Average correlation in this group of countries was twice as large as that for the other CEE countries. The association with the DAX for these exchanges also strengthened significantly after 2002. While the average correlation ratio for these countries prior to 2002 was just 0.22, between 2002 and 2006 the realised correlation with the DAX had risen on average to 0.35. Poland had the largest jump in correlation between the two periods rising from 0.19 between 1990 and 2002 to 0.37 between 2002 and 2006. Only two countries experienced a decline in realised correlation after 2002: the Slovak Republic and Bulgaria.

Rather than using the DAX, Table 3 uses the FTSE as a proxy for European stock exchanges. Table 3 shows that the daily returns on transition country exchanges are more highly correlated with the FTSE than the DAX. The average ratio with the FTSE was 0.17 compared to 0.14 for the DAX. The results provided in Table 2 also indicate that the realised correlation after 2002 expanded in most

CEE countries. However, the rate of change in the correlation ratio was not as large as that when the DAX was employed.

Similar to Table 2, the Czech Republic, Hungary and Poland had the highest average correlation ratios; 0.38 compared to just 0.17 for all CEE countries. However, unlike Table 2, the realised correlation ratios in these countries only increased significantly between the 1990-2002 period and the 2003-2006 period in the Czech Republic and Poland. Estonia and Poland were the only two countries to report declining rates of correlation. Care should be taken, however, when employing correlation coefficients. Forbes and Rigobon (2002) show that correlation coefficients tend to be biased upwards during periods of significant market volatility. This could therefore lead to incorrect inferences regarding comovements in stock market returns. This is particularly likely to be the case before and after April 2003 as a result of the Second Persian Gulf conflict. The plots of the stock market indices provided in Figure 1 show that Germany and the UK were significantly affected by this shock, while CEE markets typically were not. This shock could probably therefore have influenced the realised correlation coefficients during this period.

4.2 Convergence in Stock Market Returns

To test the hypothesis that the daily returns of the stock exchanges are converging to those in CEE countries, rolling unit root tests for each country are calculated. Figure 3 reports the ADF test statistics scaled by the asymptotic critical value at the 10 percent level so that values above 1 indicate that the test statistic rejects the hypothesis of a unit root or no convergence. The test statistic is reported for each month of the rolling five-year sample so that a value greater than 1 indicates that the series are converging for the five-year period up to that month.

Figure 3 shows that in most countries, up to 2004, the test statistic scaled by the 10 percent critical value was less than one for all the CEE countries, indicating no convergence of daily returns in these countries to that obtained on the DAX. However, there is evidence of a strengthening in convergence in most of the countries in our sample. By the end of the sample period, therefore, the rolling unit root statistics for the Czech Republic, Estonia, Romania, the Slovak Republic, Slovenia, Lithuania and Bulgaria were converging with the rest of Europe. In Hungary, Poland and Latvia, however, there was little or no convergence.

Figure 4, allows for non-linearity in the mean-reverting process when testing for convergence. The inferences from this figure are quite similar to that obtained earlier: there was little or no evidence of convergence in the CEE countries. By the end of the sample period, however, there was some evidence of convergence. The significance of convergence in Latvia, Hungary and Poland, suggests that while there is no evidence of linear convergence in these markets there is non-linear convergence.

Figures 5 and 6 also present the rolling unit root tests for convergence, but instead employ the FTSE as the measure of European returns rather than the DAX. Similar to Figure 3, the rolling unit root test statistics in Figure 5 suggest that there was little or no convergence in stock exchanges in Europe for most of the sample period. However, most exchanges were trending towards convergence except Latvia, Hungary and Poland, which were non-linearly related to exchanges in Europe.

4.3 Convergence in Stock Market Prices

To evaluate the robustness of the results reported earlier, the scaled rolling trace statistics are plotted in Figures 7 and 8. Values greater than 1 indicate cointegration or that equity prices between CEE and European exchanges are converging. Figure 7 shows the evolution of the trace statistic for each country and the DAX. The figure shows that while there is some evidence of convergence for CEE countries, there are periods when the null hypothesis of no cointegration could not be rejected (standardised trace statistic less than 1). Similar to Gilmore et al. (2008), convergence seems to be periodic for all the countries surveyed. Looking at the individual country results, there is a pronounced upward shift in the standardised trace statistic for the Czech Republic, Hungary, the Slovak Republic and Latvia, after 2002. Prior to this period, the standardised trace statistic for these countries generally fluctuated around 1. For the remainder of countries that had data prior to 2002, Estonia, Romania and Slovenia, there is no significant shift in the trace statistic. Although the sample span for Bulgaria, Latvia and Lithuania are fairly small, the results suggest that equity prices on these exchanges seem to be converging to the DAX.

Given that the DAX consists of the 30 major German companies trading on the Frankfurt Stock Exchange, it might not be representative of the rest of Europe. To evaluate the robustness of

the results obtained earlier, the authors consider the convergence of equity prices in CEE countries to those obtained on the FTSE. The results are presented in Figure 8 and it is clear that they are similar to those obtained earlier. There is episodic evidence of convergence for all the countries in the sample. Only in the Czech Republic, Hungary, and the Slovak Republic was there a prolonged period during which the standardised trace statistic exceeded 1. Similar to the results obtained earlier, equity prices in Bulgaria, Latvia and Lithuania seem to be converging to those on the FTSE, particularly between 2003 and 2004.

5. Conclusions

In this paper, the authors have attempted to investigate the degree of comovement between stock exchanges in CEE countries investigated and those in developed European markets. Three measures are employed: realised correlations, time-varying unit root tests and recursive cointegration statistics. These approaches allow us to investigate the degree of association between the exchanges as well as changes in the degree of association.

The results suggest that, with the exception of the Czech Republic, Hungary and Poland, there is a relatively weak correlation between daily returns in CEE countries and those in Europe. However, the link between the exchanges has strengthened since 2002. This finding is robust to changes in the reference stock exchange. The rolling trace and unit root statistics presented in this study, however, suggests that there is only evidence of episodic convergence in equity prices. These results suggest that although the exchanges may be experiencing similar shocks, and therefore have similar fluctuations in daily returns, equity prices are not consistently drifting towards those in the major European exchanges. These results are similar to Gilmore et al. (2008), but expand on these results by considering a broader cross-section of CEE countries. Only in the cases of the Czech Republic Hungary, Latvia and Slovak Republic (after 2002) was there a prolonged period during which the standardised trace statistic exceeded the 10 percent critical value. Although the sample span for Bulgaria, Latvia and Lithuania are fairly small, the results suggest that equity prices on these exchanges seem to be converging to those on the DAX and FTSE, but there was little or no

evidence of equity price convergence for Estonia, Romania and Slovenia.

The CEE countries therefore continue to offer investors scope for diversifying their portfolios internationally, but the benefits from doing so are, in general, sporadic. In addition, the speed at which the stock exchanges in the CEE countries are converging with European exchanges differs and some CEE countries offer better scope for portfolio diversification than others.

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Table 1

Descriptive Statistics for Daily Stock Market Returns in Transition Countries

	Mean	Max	Min	Std. Dev.	Skewness	Kurtosis	Observations
Full Sample							
RSLVX	0.038	9.574	-11.484	1.342	-0.385	9.609	2700
RSLEX	0.067	18.933	-11.613	1.269	-0.433	29.261	3415
RROMX	0.076	10.113	-11.902	1.726	-0.164	9.061	2283
RPOLX	0.041	9.406	-11.344	1.847	-0.421	8.820	3100
RLITX	0.099	8.686	-10.216	0.936	-0.216	18.046	1696
RLATX	0.104	9.461	-14.705	1.569	-1.231	23.968	1796
RHUNX	0.076	13.616	-18.033	1.639	-0.844	17.362	3846
RFTSE	0.016	5.904	-5.589	1.123	-0.143	5.559	2606
RESX	0.082	12.867	-21.577	1.774	-1.276	26.446	2643
RDAX	0.036	7.553	-9.871	1.377	-0.209	6.991	4199
RCZEHX	0.008	7.048	-7.566	1.213	-0.326	5.975	3011
RBULX	0.169	21.073	-20.899	1.897	-0.422	37.623	1523
1990-2002							
RSLVX	-0.007	9.574	-11.484	1.450	-0.372	9.686	1760
RSLEX	0.067	18.933	-11.613	1.464	0.392	23.210	2424
RROMX	0.027	10.113	-9.734	1.957	0.059	7.600	1300
RPOLX	0.009	9.406	-11.344	2.110	-0.366	7.442	2109
RLITX	-0.016	4.580	-10.216	0.876	-1.900	29.312	730
RLATX	0.086	9.461	-14.705	2.135	-1.120	15.620	782
RHUNX	0.062	13.616	-18.033	1.742	-0.913	17.843	2862
RFTSE	-0.002	4.930	-5.589	1.281	-0.144	4.508	1563
RESX	0.051	12.867	-21.577	2.157	-1.139	19.265	1639
RDAX	0.022	7.553	-9.871	1.416	-0.247	6.892	3156
RCZEHX	-0.041	5.820	-7.566	1.275	-0.208	5.328	2022
RBULX	0.130	21.073	-20.899	2.893	-0.334	19.953	525
2003-2006							
RSLVX	0.123	4.074	-5.027	1.105	-0.238	5.920	940
RSLEX	0.067	3.550	-2.801	0.554	0.230	7.281	991
RROMX	0.141	5.317	-11.902	1.362	-0.859	11.725	983
RPOLX	0.109	4.055	-5.474	1.093	-0.249	4.553	991
RLITX	0.185	8.686	-4.445	0.969	0.670	11.886	966
RLATX	0.118	4.967	-6.763	0.920	0.162	9.362	1014

Full Sample							
RHUNX	0.114	4.866	-5.380	1.292	-0.148	3.869	984
RFTSE	0.044	5.904	-4.918	0.830	0.046	8.066	1043
RESX	0.134	7.178	-4.029	0.828	0.925	13.470	1004
RDAX	0.079	7.086	-6.336	1.250	-0.012	7.027	1043
RCZEHX	0.108	7.048	-6.125	1.070	-0.610	8.143	989
RBULX	0.190	6.130	-4.515	1.045	0.268	7.622	998

Table 2

Realised Correlation Ratios with DAX

	slex	slvx	esx	latx	litx	bulx	czehx	romx	hunx	polx
1991	n.a.	n.a.	n.a.	n.a.	n.a.	n.a	n.a.	n.a.	0.048	0.006
1992	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-0.018	0.025
1993	0.179	n.a.	n.a.	n.a.	n.a.	n.a.	0.015	n.a.	0.091	0.052
1994	0.083	n.a.	n.a.	n.a.	n.a.	n.a.	-0.093	n.a.	0.100	-0.040
1995	-0.075	-0.022	n.a.	n.a	n.a.	n.a.	0.056	n.a.	0.074	0.105
1996	0.008	0.028	0.033	n.a.	n.a.	n.a.	0.059	n.a.	0.203	0.183
1997	0.003	-0.135	0.127	n.a.	n.a.	n.a.	-0.022	0.126	0.398	0.294
1998	0.137	-0.040	0.075	n.a.	n.a.	n.a.	0.604	0.056	0.537	0.449
1999	0.092	0.084	0.125	n.a.	n.a.	n.a.	0.331	-0.062	0.399	0.212
2000	-0.027	-0.068	0.026	-0.011	0.046	0.065	0.436	0.047	0.484	0.273
2001	0.034	0.052	0.126	0.001	0.063	0.110	0.369	0.009	0.446	0.345
2002	0.020	0.038	0.202	0.045	-0.035	0.073	0.346	-0.021	0.460	0.358
2003	0.151	0.073	0.131	-0.026	0.045	-0.080	0.249	0.077	0.231	0.333
2004	0.058	0.012	0.161	0.023	0.077	0.070	0.379	-0.046	0.361	0.388
2005	0.041	0.007	0.122	-0.034	0.084	-0.013	0.300	0.057	0.221	0.331
2006	0.040	0.100	0.106	0.084	-0.002	-0.061	0.533	0.076	0.481	0.430

Table 3

Realised Correlation Ratios with FTSE

	slex	slvx	esx	latx	litx	bulx	czehx	romx	hunx	polx
1997	0.086	-0.116	0.050	n.a.	n.a.	n.a.	0.115	0.130	0.383	0.303
1998	0.120	-0.015	0.106	n.a.	n.a.	n.a.	0.594	-0.042	0.524	0.470
1999	0.012	0.044	0.081	n.a.	n.a.	n.a.	0.353	-0.045	0.404	0.244
2000	-0.059	0.026	0.154	0.033	0.004	-0.008	0.414	-0.021	0.494	0.308
2001	0.036	0.110	0.152	0.024	0.074	0.051	0.362	0.061	0.458	0.345
2002	0.017	0.010	0.217	0.076	0.033	0.056	0.424	0.033	0.406	0.368
2003	0.187	0.122	0.141	0.046	0.007	-0.070	0.305	0.053	0.292	0.283
2004	0.041	0.040	0.123	0.074	0.109	0.036	0.272	-0.037	0.297	0.271
2005	-0.018	0.006	0.146	-0.004	0.240	0.002	0.400	0.086	0.342	0.454
2006	0.031	0.094	0.087	0.072	0.023	-0.059	0.581	0.078	0.513	0.495

Figure 1

Stock Market Indices for Europe and Selected Transition Countries

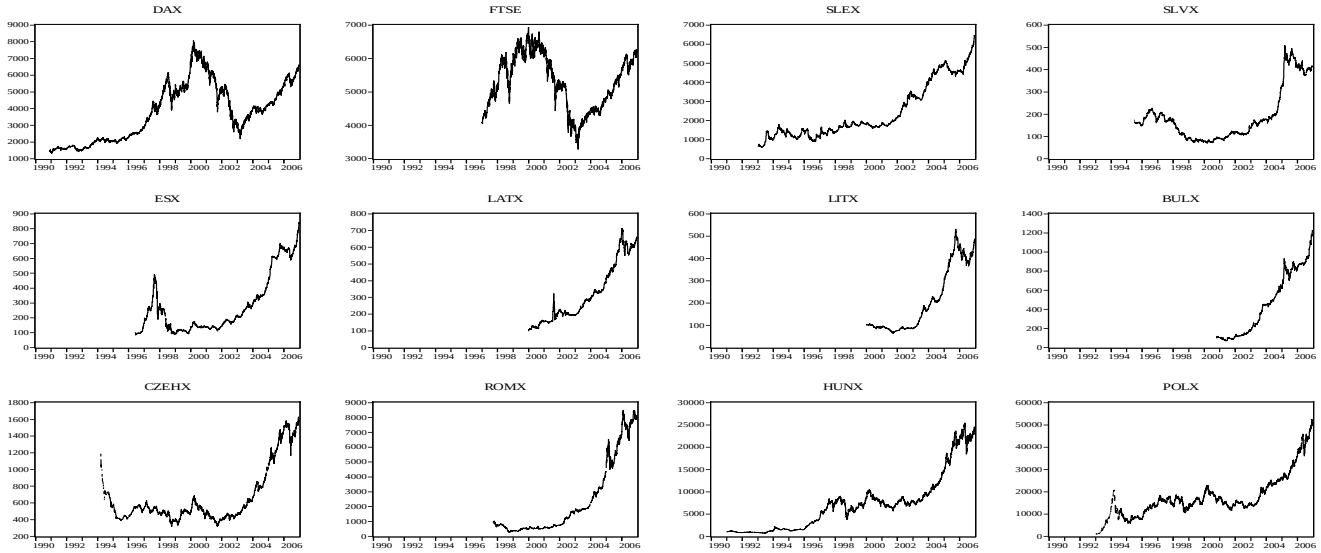

Figure 2

Density and Histogram of Daily Stock Market Returns

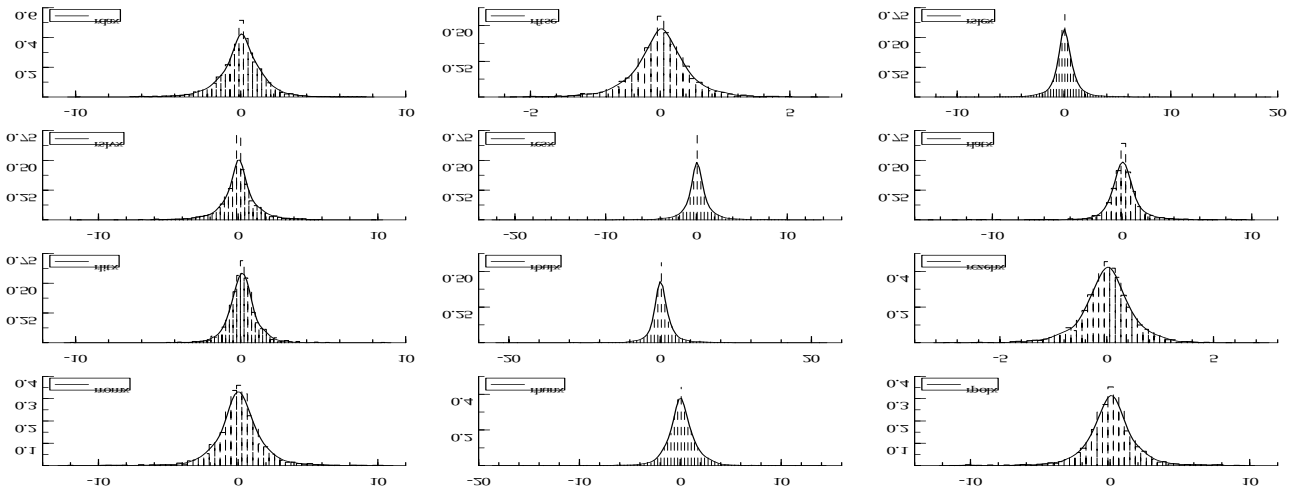

Figure 3

Convergence with DAX (Rolling ADF – Statistic)

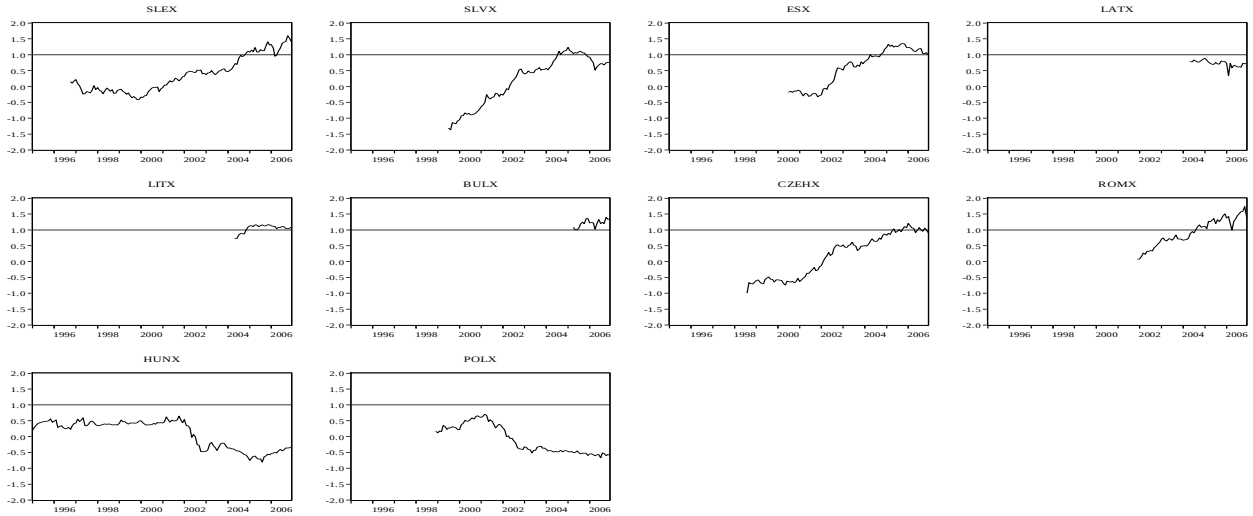

Figure 4

Convergence with DAX (Rolling KSS – Statistic)

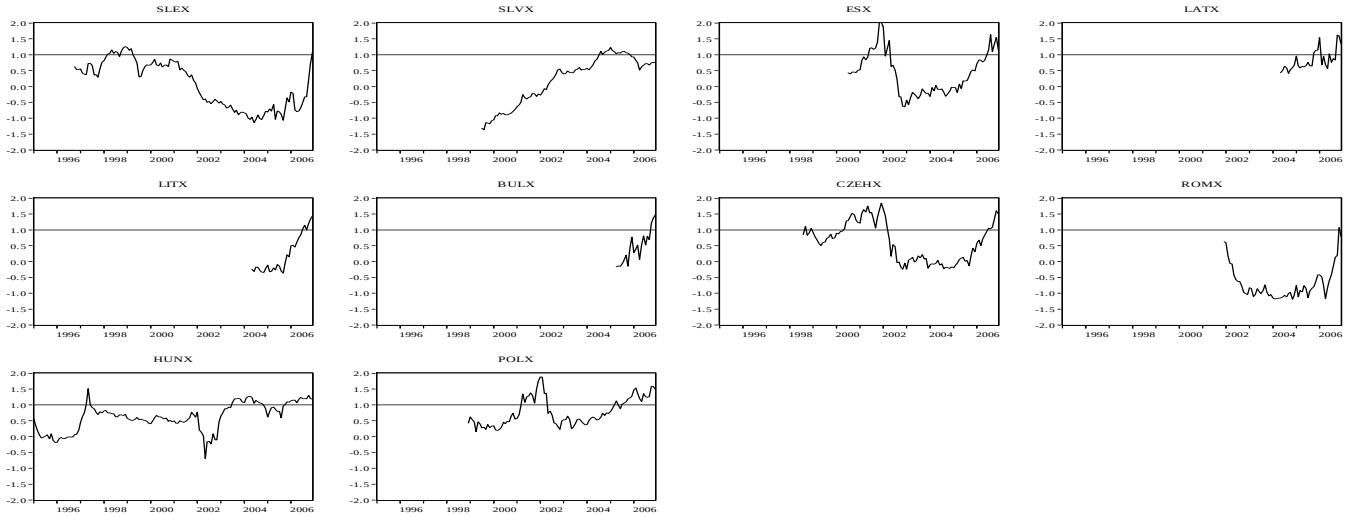

Figure 5

Convergence with FTSE (Rolling ADF – Statistic)

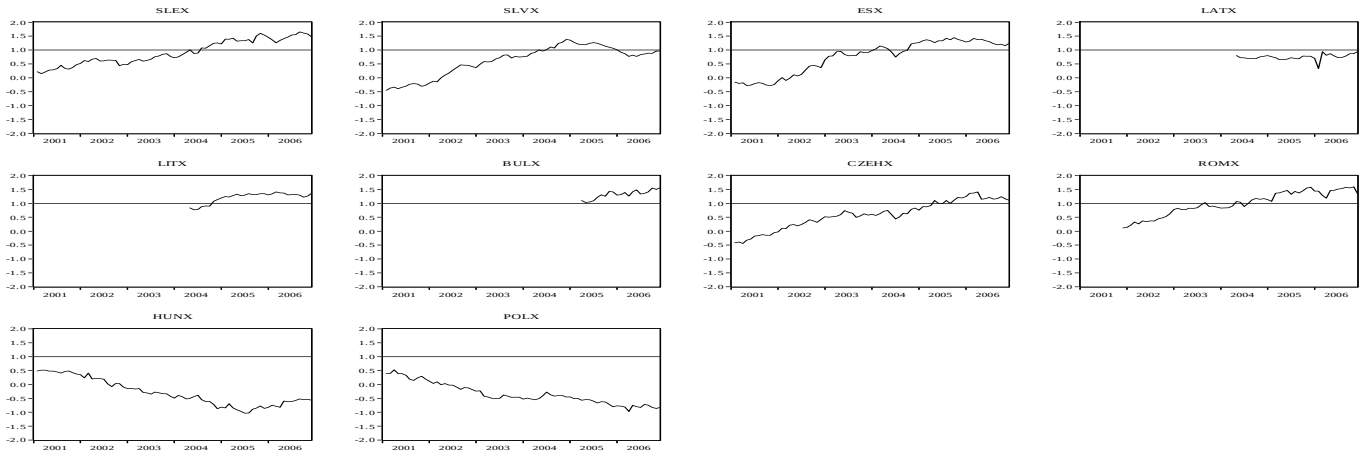

Figure 6

Convergence with FTSE (Rolling KSS – Statistic)

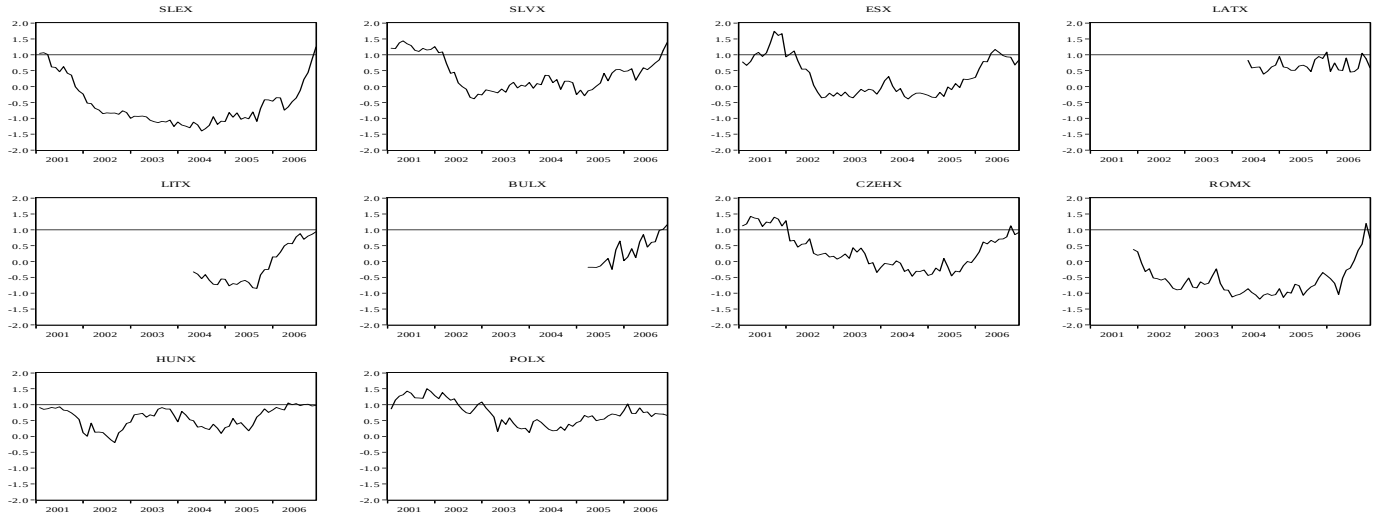

Figure 7

Convergence with DAX (Rolling Trace Statistic)

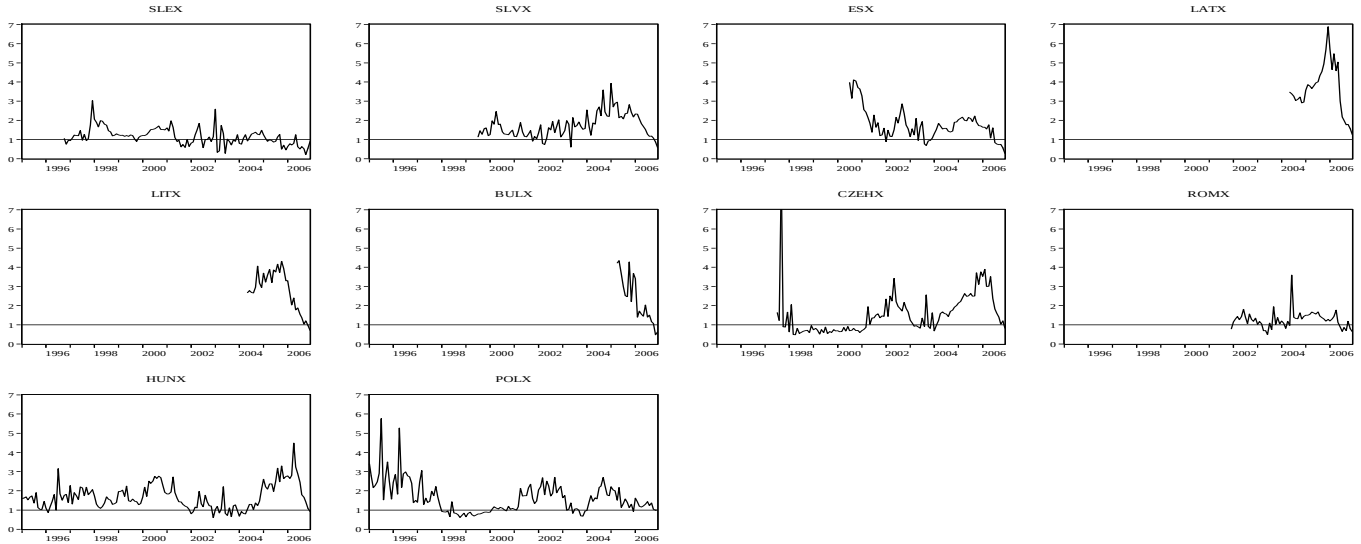

Figure 8

Convergence with FTSE (Rolling Trace Statistic)