TITLE: THE RELATIONSHIP BETWEEN THE REAL ECONOMY AND EQUITY MARKETS IN CENTRAL EUROPE

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EXECUTIVE SUMMARY
The Relationship Between Economic Factors and Equity Markets in Central Europe
Jan Hanousek and Randall K. Filer

This paper investigates the extent to which broad equity markets in four Central European countries (The Czech Republic, Hungary, Poland and Slovakia) are related to conditions in the broader economy. Classical market efficiency requires that changes in economic conditions should be instantaneously reflected in changes in equity prices. As a corollary, efficiency requires that current period changes in economic variables should not be related to future changes in equity prices. Otherwise it would be possible to make a profit by trading based on current economic conditions, a violation of efficiency.

The results are quite striking. Only in the Czech Republic is there evidence of a general contemporaneous relationship between real variables and equity market prices. For the Czech Republic, the broad money supply, imports, exports, foreign capital inflow and industrial production are significantly related to stock market moves in the same period. The signs of these relationships are such that increases in the money supply and decreases in international integration (imports, exports and foreign capital inflow) and industrial production are associated with higher prices on the domestic equity market. Given that for most of the period under study there was little, if any, variation in the crown/dollar exchange rate, inflation rates were highly stable, and the government budget was very close to being in balance, there was little variation in these factors and no relationship between them and equity prices should be expected. With the exception of foreign capital inflow, no lagged values of economic variables predicted changes in equity prices enabled the prediction of future prices. Thus, the overall pattern for the Czech Republic is strongly consistent with conventional concepts of semi-strong market efficiency.

For the other three countries in the region no such claim can be made. For Hungary, changes in exchange rates appear to be instantaneously reflected in equity prices, a finding to be discussed below, while changes in the money supply, industrial production and government debt influence equity prices but only with one or more lags. In Poland and Slovakia lagged values of trade figures and industrial production seem to influence equity prices, while increases in prices appear to instantaneously result in lower equity prices in Slovakia.

The finding that only the Czech equity market appears to exhibit classical efficiency is surprising given the generally poor reputation of that market in the popular press. It must be recalled, however, that our results pertain only to the large firms that comprise the market index. These firms tend to follow international accounting and reporting standards and to be highly liquid and, therefore, not likely to suffer from transparency problems. The majority are also listed as foreign depository rights on one or more western exchanges (typically Frankfurt or Berlin, but
occasionally London or New York), thereby assuming all disclosure and other requirements of those exchanges.

Part of the reason why the Czech market appears more efficient than others in the region may have to do with the role of foreign capital in these four markets. Estimates are that approximately 70% of trading in Budapest and 30% in Warsaw involves foreign investors as compared with only a trivial fraction of trading in Prague. We find that the Czech and German markets show a strong, positive current-period interconnection, while the relationship between the Czech and U.S. markets is weaker and occurs only with a lag. The relationship in Hungary and Poland, on the other hand, is the reverse, with a strong instantaneous connection to changes in the U.S. market but only a lagged (or nonexistent) connection to the German market.

The overall pattern of the results suggests that the Czech markets responds quickly to changes in underlying fundamentals, (which are likely to be highly correlated with those in Germany, the largest external trading partner of all four countries under study), while movements in the Hungarian and Polish markets may be more heavily influenced by foreign capital, which responds to changes in local fundamentals only with a significant lag. The ironic conclusion may be that the poor reputation of the Czech equity market may have discouraged heavy participation by uninformed investors, resulting in a market that better reflects the underlying fundamentals of the local economy than is the case for the other, currently more highly-regarded, markets in the region.
THE RELATIONSHIP BETWEEN THE REAL ECONOMY AND EQUITY MARKETS IN EASTERN EUROPE

Jan Hanousek
and
Randall K. Filer

ABSTRACT

This paper investigates the possibility the newly emerging equity markets in Central Europe exhibit semi-strong form efficiency such that there is no relationship between lagged values of changes in the real economy and changes in equity prices. We find that such efficiency is characteristic of the Czech Republic where several economic factors create contemporaneous changes in equity prices but no lagged factors cause current-period changes in the stock market. In the other three countries in the region (Hungary, Poland, and Slovakia), however, markets do not appear to be efficient and lagged economic factors do affect equity prices. Finally, we show that the Czech market is closely integrated with that in Germany while Hungary and Poland more closely follow movements in the U.S. market. Overall, the results are consistent with the Czech market reflecting underlying fundamentals while the other markets exhibit speculative bubbles dominated by foreign capital.

Introduction

Following the collapse of communism, the countries of Central and Eastern Europe rapidly adopted the institutions of market economies. Creation of an institution with an outward appearance similar to that in conventional market economies, however, does not mean that this institution possess the same functional characteristics. Lack of experience as well as legal and regulatory uncertainties can result in newly-created institutions failing to perform with the same degree of efficiency as their more established counterparts in the west.

This paper examines the workings of capital markets in the four most advanced of the former communist countries, the Visegrad group consisting of The Czech Republic, Hungary, Poland and Slovakia. Formal stock markets have been active in Hungary and Poland since the beginning of 1993 and in the two parts of the former Czechoslovakia since the middle of that year. The extent of

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3These countries are often called the Visegrad countries after a series of treaties of cooperation signed between them in Visegrad, Hungary in 1990 and 1991.
these markets is very different, however. At the end of 1996, there were over 1,600 companies traded on the Prague stock exchange with a total market capitalization equal to 43% of the Czech GDP. In Slovakia, by way of contrast, the firms traded on the Bratislava Stock Exchange were valued at about 12% of GDP, a figure that was similar to the 11% of Hungary's, GDP at which the 43 firms traded on the Budapest Stock Exchange were valued and somewhat more that the 66 traded firms in Poland which were worth only 7% of GDP.

In previous work (Filer and Hanousek, 1997), we have established that returns in equity markets as a whole in these four countries typically follow a random walk, a finding consistent with weak-form market efficiency. We now turn our attention to a test of semi-strong market efficiency. Efficiency of this type requires that it not be possible to earn excess returns based on any public information. Empirical tests of semi-strong efficiency often ask whether lagged values variables in the real economy can be said to “Granger cause” equity market returns. Previous work has exhibited a mixed pattern, with some studies for some countries finding results inconsistent with market efficiency for at least some macroeconomic factors, while other studies find no relationship between past values of macroeconomic variables and current market returns. No matter what the relationship in more established markets, there is reason to question whether information is instantaneously processed in the emerging markets of Central and Eastern Europe. These markets have exhibited a substantial price movements since their inception. Figure 1 shows the time pattern of the most representative index for each of these markets from the start of trading through the end of 1996. In addition, unlike more stable markets in the West, there has been substantial variation in the real economies in these countries in a short period of time. This can be seen in Table 1 which presents the degree of variation in several real economic variables. Finally, in three of the four countries under study there have been significant changes of government, with resulting changes in expectations of policy priorities.

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4In the spring of 1997, approximately 400 of these were delisted from the exchange for failure to disclose required information or because they were highly illiquid. It is anticipated that another 400 will be delisted by the end of the year. These are generally small, infrequently-traded companies and their exclusion from the market does not affect the overall relationship between the listed companies and the economy in general.

5This compares with primary market capitalization equal to 17% of GDP in Austria, 21% in Italy, 28% in Germany, 37% in Spain, and 39% in France. In the U.S., the U.K. and the Netherlands, on the other hand, market capitalization exceeds GDP.


7The PX-50 for the Czech Republic, BUX for Hungary, WIG for Poland and SAX for Slovakia. In each case we have normalized the index to equal 100 at the start of our analysis sample.

8Both Hungary and Poland replaced right-wing reform governments with coalitions headed by reformed communist parties. Slovakia saw two reversals of government as a nationalist government was replaced by a right-left coalition (continued...
For a research to support a conclusion that a market is semi-strong efficient two results must hold:

1) There must be a contemporaneous relationship between a real variable and the returns market, and

2) Adding lagged values of the real variable must not result in a significant improvement in our ability to forecast returns in the market.

Both of these relationships are important. If the first fails to hold, then the fact that the second does is not proof of efficiency. It may simply be due to the fact that the variable being examined is irrelevant for determining prices in the equity market. Thus, a finding that lagged values of football scores does not enable the prediction of current market returns is consistent with either markets instantaneously incorporating all effects of football results in prices or with there being no relevant information about market prices in football results.

Thus, we estimate the following three equations:

\[ \Delta Y_t = \alpha + \sum_{i=1}^{r} \gamma_i \Delta Y_{t-i} \quad (1) \]

\[ \Delta Y_t = \alpha + \sum_{i=2}^{r} \gamma_i \Delta Y_{t-i} + \mu \Delta X_t + \epsilon_t \quad (2) \]

\[ \Delta Y_t = \alpha + \sum_{i=1}^{r} \gamma_i \Delta Y_{t-i} + \mu \Delta X_t + \sum_{j=1}^{s} \beta_j \Delta X_{t-j} + \epsilon_t, \quad (3) \]

where \( Y \) represents the stock market index, \( X \) is one of a set of macroeconomic variables and \( r \) and \( s \) are the appropriate lag lengths. All variables are expressed in first differences in order to account for the high degree of serial correlation in each variable. In addition we run the set of reverse regressions with the \( X \) variables on the left-hand side and the \( Y \) variables on the right-hand side in order to investigate whether market movements can affect the real economy in these countries.

\[ \ldots \text{continued} \]

that was, in turn, replaced by the ousted nationalists after new elections a few months later. Only the Czech Republic has had a stable, center-right coalition government for the entire period under study.
Results are supportive of market efficiency if both of the following null hypotheses hold:

\[ H_0: \mu = 0 \]

\[ H_0: \beta_j = 0, \forall j. \]

The first of these can be evaluated by an F-test of added explanatory power in moving from equation (1) to equation (2), while the second is an F-test in moving from equation (2) to equation (3).

**Data and Empirical Results**

The analysis is conducted on monthly data for the main stock market index in each country from the beginning of 1993 (or the beginning of trading, whichever is later) through the end of 1996. Thus, for Hungary and Poland we have 48 monthly observations while for the Czech Republic and Slovakia we have 40 months of data. We examine each of the following macroeconomic variables: (1) money supply (M1 and M2), (2) industrial production\(^9\) (as a proxy for GDP which is not available monthly), (3) government budget deficit, (4) inflation rate, (5) exchange rate versus the U.S. dollar, and (6) imports, exports and the trade deficit. In addition, since the periodic budget deficit can be regarded as the change in government debt outstanding while the trade deficit can be regarded as the change in foreign capital in the domestic market, we estimate these relationships in levels as well as differences.

Lag lengths (r and s) were established by use of the Hannan-Quinn (1979) criteria, searching over a maximum of ten periods.\(^{10}\) Table 2 presents the results of the F tests of a contemporaneous relationship between factors in the real economy and the equity market, Granger causality running from real factors to the stock market, and reverse causality running from the market to future real values.

The results are quite striking. In only the Czech Republic is there evidence of any contemporaneous relationship between real variables and equity market prices. For the Czech Republic, the broad money supply, imports, exports, foreign capital inflow and industrial production are significantly related to stock market moves in the same period. The signs of these relationships

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\(^9\)Because there is profound seasonality in measured industrial production in the countries under study, these figures are indexed to production in the same month of the previous year.

\(^{10}\)The Hannan-Quinn Criterion appears to be more accurate in determining the true order of an autoregression in moderate sample sizes than the alternative Akaike Information (1969) and Schwarz Minimum Bias (1978) Criteria. We checked the order of our estimated equations using these alternatives. The Schwarz and Hannan-Quinn criteria never differed by more than a single period although Akaike sometimes suggested three or four additional lags. Dickey-Fuller tests on the residuals from equation (3) establish that there was no remaining serial correlation.
are such that increases in the money supply and decreases in international integration (imports, exports and foreign capital inflow) and industrial production\textsuperscript{11} are associated with higher prices on the domestic equity market. Given that for most of the period under study there was little, if any, variation in the crown/dollar exchange rate and the government budget was very close to being in balance for almost every period, there was little variation in these factors and no relationship between them and equity prices should be expected. Thus, the total pattern for the Czech Republic is strongly consistent with conventional concepts of semi-strong market efficiency.

For the other three countries in the region no such claim can be made. For Hungary, changes in exchange rates appear to be instantaneously reflected in equity prices while changes in money supply, industrial production and government debt influence equity prices with a lag. In Poland and Slovakia trade figures and industrial production seem to influence equity prices with a lag,\textsuperscript{12} while increases in prices appear to instantaneously result in lower equity prices in Slovakia.

Summary and Conclusions

The results presented above strongly suggest that the Czech equity market exhibits semi-strong form efficiency. Changes in the real economy lead to changes in equity prices in the same time period. Previous changes in the real economy do not affect the real economy beyond the influence in the initial period. For the other Visegrad countries real economic changes seem to affect equity prices primarily with a lag if at all. Thus, these markets do not appear to exhibit semi-strong form efficiency and opportunities for profitable trading strategies may exist.

There are two key questions yet to be answered. The first of these is whether or not the observed relationships make economic sense in addition to their statistical significance. The second is what accounts for the divergent pattern across the countries in the region.

Turning to the first of these questions, the positive relationship between money supply and equity prices in the Czech Republic is exactly what would be expected and what has been found in previous studies for other countries. Rozeff (1974) and Hancock (1989), for example, find a contemporaneous relationship for the U.S.\textsuperscript{13} while Darrat and Mukherjee (1986) find that increases in money supply cause increases in equity prices only with a lag in India. The explanation for the negative relationship between international flows and equity prices, seen in several countries, is less intuitively obvious. Trade deficits and increased imports may be taken as signals that government

\textsuperscript{11}This sign is especially problematic. Because industrial production exhibits strong seasonal variation, we also tried using industrial production relative to the previous year. Relationships here were not statistically significant but the sign remained unchanged.

\textsuperscript{12}Although for Poland, the pattern of signs on lagged trade figures exhibits contains one or more reversals making interpretation of these results difficult.

\textsuperscript{13}Abdullah and Hayworth (1993) and Lee (1994) on the other hand find that lagged changes in money supply also influence equity prices in the U.S.
policy will become more restrictive, raising interest rates and cutting aggregate demand. This does not, however, explain why increased exports are related to lower stock prices. Perhaps greater international integration in general is seen as a weakening of potential monopoly profits for local firms. On the other hand, the simple correlation between imports and equity prices is much stronger (more negative) than that between exports and the stock market while the correlation between imports and exports is quite high. Thus, the apparent negative relationship between exports and equity prices may simply be a statistical artifact with exports serving as a proxy for imports. Finally, we have no intuitive explanation for why increases in industrial production should result in lower stock prices. A similar result has been reported for the U.S. and Japan by Kaneko and Lee (1995), who found that decreases in the growth rate of industrial production were associated with increases in stock market returns.

We turn now to the question of why the Czech market appears to be more efficient than other markets in the region. This is at least in part a surprising finding given that the common perception is that the Czech market is the least transparent of the four, a factor that is often assumed to lead to a lack of efficiency. On the other hand, it must be recalled that our results pertain to only the large firms that comprise the market index. These firms tend to follow international accounting and reporting standards and to be highly liquid and, therefore, not likely to suffer from transparency problems. Nemeček (1997) reports that among the 170 most liquid stocks on the Prague Stock Exchange, less than 0.2% of volume is apparently due to “informed trades” where parties on one side or the other of the transaction operated with private information. On the other hand, the poor reputation of the Prague Stock Exchange in general may have limited its attractiveness to foreign portfolio investment and discouraged speculative bubbles caused by overly optimistic uninformed investors. Indeed, it is doubtful that changes in underlying fundamentals could explain the changes in the Warsaw and Budapest indices seen in Figure 1. Estimates are that approximately 70% of trading in Budapest and 30% in Warsaw involves foreign investors as compared with only a

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14In addition, this result may be dominated by the breaking of the initial bubble on the Prague Stock Exchange in early 1994 at a time when reported exports were growing rapidly in part due to improved trade reported between the halves of the former Czechoslovak Federal State. Indeed, if we restrict observations to those after the middle of 1994, adding exports to an equation containing imports adds no significant explanatory power.

15Thus, The Economist of April 13, 1996 reported: “In the Czech stockmarket [in contrast with Poland and Hungary], the prices at which shares are traded are often a mystery. Investors can trade on the Prague Stock Exchange or through a chain of share shops called the RM-System. Most deals, however, are struck in private by the voucher funds. They are also given a privileged view of companies’ inner workings through seats on their boards.” The Wall Street Journal (May 8, 1996) characterized the Prague stock market as “anarchy to the outsider, sweet profit to those in the know.”

16This is in marked contrast with the results reported by Easley, et. al. (1996) for the U.S. who found using a similar methodology that among the most liquid stocks on the New York Stock Exchange approximately 16% of traded volume may have been information-based.
trivial fraction of trading in Prague. To further investigate possible foreign influence on the Visegrad equity markets, we examined the relationship between these markets and leading western markets as represented by the DAX (Germany) and Dow-Jones Industrial (U.S.) indices. Tests of Granger causality between these indices and those in Central Europe are reported in Table 3.

The striking result is that the Czech market and the German one show a positive current-period correlation, while the relationship between the Czech market and the U.S. is weaker and occurs only with a lag. The relationship in Hungary and Poland, on the other hand, is the reverse, with a strong instantaneous connection to changes in the U.S. market but only a lagged (or nonexistent) connection to the German market.

This pattern is consistent with our earlier results suggesting that the Czech equity market is semi-strong form efficient while those in the other Visegrad countries are not. It appears that the Czech markets responds quickly to changes in underlying fundamentals, (which are likely to be highly correlated with those in Germany, the largest external trading partner of all of the countries under study), while movements in the Hungarian and Polish markets may be more heavily influenced by foreign capital which responds to changes in local fundamentals only with a significant lag.

\[\text{Estimates of foreign involvement are from private conversations with analysts at Wood and Co., Budapest, Wood and Co., Prague and Patria Finance, Prague.}\]

\[\text{For obvious reasons, we do not investigate whether Visegrad markets Granger cause changes in the much larger Western markets.}\]
TABLE 1
Extent of Variation in Economic Indicators, Visegrad Economies

<table>
<thead>
<tr>
<th></th>
<th>Czech Republic 9/93 - 12/96</th>
<th>Hungary 1/93 - 12/96</th>
<th>Poland 1/93 - 12/96</th>
<th>Slovakia 9/93 - 12/96</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Inflation</td>
<td>mean = 0.7% s.d. = 0.5% min = 0.0% max = 2.3%</td>
<td>mean = 1.6% s.d. = 1.1% min = -0.9% max = 4.4%</td>
<td>mean = 2.0% s.d. = 1.2% min = -0.9% max = 5.6%</td>
<td>mean = 0.8% s.d. = 0.6% min = 0.0% max = 2.4%</td>
</tr>
<tr>
<td>Monthly Change in</td>
<td>mean = 0.4% s.d. = 6.1% min = -12.2% max = 20.9%</td>
<td>mean = 0.3% s.d. = 6.1% min = -12.0% max = 13.8%</td>
<td>mean = 0.2% s.d. = 5.5% min = -12.0% max = 11.6%</td>
<td>mean = 0.7% s.d. = 5.2% min = -12.3% max = 11.7%</td>
</tr>
<tr>
<td>Industrial Production</td>
<td>mean = 3.1% s.d. = 0.3% min = 2.8% max = 3.8%</td>
<td>mean = 11.6% s.d. = 1.1% min = 10.0% max = 13.6%</td>
<td>mean = 15.2% s.d. = 0.9% min = 13.5% max = 16.9%</td>
<td>mean = 13.6% s.d. = 1.0% min = 11.9% max = 15.2%</td>
</tr>
<tr>
<td></td>
<td>Czech Republic</td>
<td>Hungary</td>
<td>Poland</td>
<td>Slovakia</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------</td>
<td>---------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td>Contemporaneous</td>
<td>Lags</td>
<td>Reverse</td>
<td>Contemporaneous</td>
</tr>
<tr>
<td><strong>M1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M1</td>
<td>3.10</td>
<td>0.01</td>
<td>0.46</td>
<td>1.68</td>
</tr>
<tr>
<td></td>
<td>(1,25)</td>
<td>(1,24)</td>
<td>(1,35)</td>
<td>(1,41)</td>
</tr>
<tr>
<td><strong>M2</strong></td>
<td>10.46***</td>
<td>1.17</td>
<td>0.73</td>
<td>1.72</td>
</tr>
<tr>
<td></td>
<td>(1,25)</td>
<td>(1,24)</td>
<td>(3,30)</td>
<td>(1,42)</td>
</tr>
<tr>
<td>Exports</td>
<td>12.18***</td>
<td>2.56</td>
<td>1.91</td>
<td>2.17</td>
</tr>
<tr>
<td></td>
<td>(1,25)</td>
<td>(1,24)</td>
<td>(1,35)</td>
<td>(1,41)</td>
</tr>
<tr>
<td>Imports</td>
<td>7.08***</td>
<td>0.01</td>
<td>2.11</td>
<td>2.03</td>
</tr>
<tr>
<td></td>
<td>(1,25)</td>
<td>(1,24)</td>
<td>(4,29)</td>
<td>(1,41)</td>
</tr>
<tr>
<td>Trade Balance</td>
<td>0.02</td>
<td>2.77</td>
<td>3.78**</td>
<td>1.23</td>
</tr>
<tr>
<td></td>
<td>(1,25)</td>
<td>(1,24)</td>
<td>(4,29)</td>
<td>(1,41)</td>
</tr>
<tr>
<td>Foreign Capital Inflow</td>
<td>4.86*</td>
<td>1.45</td>
<td>0.68</td>
<td>1.01</td>
</tr>
<tr>
<td></td>
<td>(1,25)</td>
<td>(1,24)</td>
<td>(1,35)</td>
<td>(1,41)</td>
</tr>
<tr>
<td>Budget Deficit</td>
<td>1.49</td>
<td>0.11</td>
<td>0.31</td>
<td>1.38</td>
</tr>
<tr>
<td></td>
<td>(1,25)</td>
<td>(1,24)</td>
<td>(1,35)</td>
<td>(1,42)</td>
</tr>
<tr>
<td>Government Debt</td>
<td>1.70</td>
<td>0.49</td>
<td>0.49</td>
<td>3.59*</td>
</tr>
<tr>
<td></td>
<td>(1,25)</td>
<td>(1,24)</td>
<td>(4,29)</td>
<td>(1,42)</td>
</tr>
<tr>
<td>Price Level</td>
<td>1.00</td>
<td>0.15</td>
<td>1.00</td>
<td>2.62</td>
</tr>
<tr>
<td></td>
<td>(1,25)</td>
<td>(1,24)</td>
<td>(4,26)</td>
<td>(1,42)</td>
</tr>
<tr>
<td>Exchange Rate versus US Dollar</td>
<td>0.96</td>
<td>0.32</td>
<td>0.96</td>
<td>4.29*</td>
</tr>
<tr>
<td></td>
<td>(1,25)</td>
<td>(1,24)</td>
<td>(1,35)</td>
<td>(1,43)</td>
</tr>
</tbody>
</table>
Although neither is significant individually, the combination of contemporaneous and lagged variables is jointly significant at 10% level.

Table 3

F-Tests of Significant Relationships between Western and Visegrad Market Indices

<table>
<thead>
<tr>
<th></th>
<th>Czech Republic</th>
<th>Hungary</th>
<th>Poland</th>
<th>Slovakia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contemporaneous</td>
<td>Lagged</td>
<td>Contemporaneous</td>
<td>Lagged</td>
</tr>
<tr>
<td>DAX</td>
<td>6.47**</td>
<td>0.04</td>
<td>2.16</td>
<td>4.11*</td>
</tr>
<tr>
<td></td>
<td>(1.25)</td>
<td>(1,24)</td>
<td>(1,43)</td>
<td>(1,42)</td>
</tr>
<tr>
<td>Dow-Jones Industrial Average</td>
<td>1.76</td>
<td>3.79*</td>
<td>5.14**</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td>(1,25)</td>
<td>(2,23)</td>
<td>(1,43)</td>
<td>(3,38)</td>
</tr>
</tbody>
</table>

** Significant at 5% level
* Significant at 10% level
Figure 1

Visegrad Stock Indices, 1993-1996

Rescaled Indices, Jan 94=1000
References


