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The Relationship Between Economic Factors and Equity Markets in Central Europe

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Comments Welcome

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ABSTRACT

This paper investigates the possibility that newly emerging equity markets in Central Europe exhibit semi-strong form efficiency such that no relationship exists between lagged values of changes in economic variables 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 Central European countries, Hungary, Poland, and Slovakia, markets do not appear to be efficient and lagged economic factors do affect equity prices. Finally, we show that the Czech equity market is closely integrated with the German market while movements in prices in 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 three markets exhibit speculative bubbles dominated by foreign capital.

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Introduction

Following the collapse of communism, the countries of Central and Eastern Europe rapidly adopted institutions associated with market economies, but creating institutions that look similar to those found in conventional market economies does not ensure that they possess the same functional characteristics. Lack of experience combined with legal and regulatory uncertainty can result in these 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 former communist countries, the Visegrad group consisting of the Czech Republic, Hungary, Poland and Slovakia.[1]

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 these markets is very different, however. At the end of 1996, over 1,600 companies were traded on the Prague stock exchange[2] with a total market capitalization equal to 43% of the Czech GDP.[3] Despite the large number of listed firms, the market is dominated by a few firms with the 50 firms included in the PX-50 index, which we analyze below, amounting to about 85% of total market capitalization at the end of March, 1997. In Slovakia, by contrast, the firms traded on the

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[1]These countries are often called the Visegrad group after treaties of cooperation signed between them in Visegrad, Hungary in 1990 and 1991.

[2]In 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 several hundred more will be delisted by the end of the year, leaving perhaps 300 liquid firms on the formal market. The delisted firms are generally small, infrequently-traded companies and their exclusion from the market will not affect the overall relationship between the listed companies and the economy in general.

[3]This figure 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.

Bratislava Stock Exchange were valued at about 12% of GDP, a figure similar to the 11% of Hungary's GDP for the 43 firms traded on the Budapest Stock Exchange, 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 equity returns in these four countries typically follow a random walk, a finding consistent with weak-form market efficiency. In this paper, we turn our attention to testing for semi-strong market efficiency, which requires it to be impossible to earn excess returns based on public information. Empirical tests of semi-strong efficiency often ask whether lagged values of economic variables can be said to "Granger cause" equity market returns.[4] Previous work examining other markets has exhibited a mixed pattern, with 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.

Regardless of 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 substantial price movements since their inception. Figure 1 shows the time pattern of the most representative index[5] for each of these markets from the start of trading through the end of 1996. Moreover, unlike more stable markets in the West, substantial variation in these countries' macroeconomies has occurred in the few years since the

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[4]Early work of this type begins with Homa and Jaffee (1971), Rozeff (1974), Rogalski and Vinso (1977) and Huang and Kracaw (1984) for example. Some more recent studies include Darrat (1990), Kwok (1992), Lee (1992), Cornelius (1993), Gallinger (1994), Hiemstra and Jones (1994), Asai and Tsunemasa (1995), Fung, Lo and Leung (1995), Jensen, Mercer and Johnson (1996) and Kearney (1996).

[5]The 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.

fall of communism. This variability 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 changes of government have occurred, with resulting changes in expectations of policy priorities.[6]

For 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) lagged values of the real variable must not enable a potential investor to predict current 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 variable under examination being irrelevant in 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 four equations:

$$\Delta Y_t = \alpha + \sum_{i=1}^{r} \gamma_i \Delta Y_{t-i} \qquad (1)$$

$$\Delta Y_t = \alpha + \sum \gamma_i \Delta Y_{t-i} + \sum \beta_i \Delta X_{t-i} + \varepsilon_t, \qquad (2)$$

[6]Both Hungary and Poland replaced right-wing post-communist governments with coalitions headed by former communist parties. Slovakia saw two reversals of government as a nationalist government was replaced by a right-left coalition 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.

$$\Delta Y_t = \alpha + \sum \gamma_i \Delta Y_{t-i} + \mu \Delta X_t + \varepsilon_t, \quad (3)$$

and

$$\Delta Y_t = \alpha + \sum \gamma_i \Delta Y_{t-i} + \mu \Delta X_t + \sum \beta_j \Delta X_{t-j} + \varepsilon_t, \quad (4)$$

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 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 to investigate whether market movements can affect the real economy in these countries.

The conventional test of Granger causality is whether or not Equation (2) better explains movements in the dependent variable than Equation (1). As suggested above, to ensure that a failure to find that lagged values of economic factors have a significant effect on stock market returns results from the market efficiently processing information rather than from that information being irrelevant, we also examine whether Equation (3) better predicts returns than Equation (1). Finally, we ask whether, given that we know current information about economic factors (represented in Equation (3)), there is additional benefit from knowing past information (Equation (4)). A finding that past information improves our ability to predict current returns given that current information is also being used suggests that markets may not be processing information efficiently, but may not provide a trading strategy capable of producing excess returns, since the comparison of Equations (3) and (4) assumes knowledge of current period values. In summary, results support market efficiency if both of the following null hypotheses hold:

$$H_0: \mu \neq 0$$

$$H_0: \beta_j = 0, \forall j.$$

and

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. We examine each of the following macroeconomic variables: (1) money supply (M1 and M2); (2) industrial production[7] (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. Moreover, since the budget deficit in any quarter can be regarded as the change in outstanding government debt, 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 for each equation (r and s) were established by use of the Hannan-Quinn (1979) criteria, searching over a maximum of ten periods.[8] The second column of Table 2

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[7]Because a seasonality exists in measured industrial production in the countries under study, these figures are indexed to production in the same month of the previous year.

[8]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 these variables are cointegrated. Standard tests for serial correlation (Q or Durbin's H test) indicate no remaining

presents F tests of whether a contemporaneous relationship exists between economic factors and the equity market, while a test of Granger causality running from real factors to the stock market is presented in the third column. The fourth column presents an F-test of added explanatory power in moving from Equation (3) to Equation (4), while the final column tests reverse Granger causality running from the market to future economic variables.

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[9] 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

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serial correlation.

[9]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.

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,[10] 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 various economic factors lead to changes in equity prices in the same time period. Previous changes in the economy do not affect equity prices beyond the influence in the initial period. For the other Visegrad countries 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 is whether the observed relationships make economic sense in addition to their statistical significance. The second is what factors account for the divergent pattern across the countries in the region.

In addressing the first of these questions, we note that 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 between these two variables for the U.S.[11] while Darrat and Mukherjee (1986) find that in India increases in money supply cause increases in

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[10]Although for Poland, the pattern of signs on lagged trade figures exhibits contains one or more reversals making interpretation of these results difficult.

[11]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.

equity prices only with a lag. The explanation for our finding of a negative relationship between international flows and equity prices in several countries is less intuitively obvious. Trade deficits and increased imports may be taken as signals that government policy will become more restrictive, raising interest rates and cutting aggregate demand. This expectation does not explain, however, 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.[12] Finally, we have no intuitive explanation of 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 a surprising finding given the common perception that the Czech market is the least transparent of the four, a factor that is often assumed to lead to a lack of efficiency.[13] On the other hand, it must be recalled that our results pertain to only the large

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[12]This result may also be dominated by the fact that the Prague Stock Exchange's initial bubble broke in early 1994 at a time when reported exports were growing rapidly, in large part due to improved reporting of trade between the two 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.

[13]Thus, The Economist of April 13, 1996 reported: "In the Czech stock market [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

firms that comprise the market index. These firms tend to follow international accounting and reporting standards[14] 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.[15] 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. The underlying average price-earnings ratio of 15 for the stocks in the PX-50 at the end of 1996 seems in line with the economic performance and prospects of the firms comprising the index. Indeed, the overall pattern of slow but steady growth for Czech stocks seen in Figure 1 (at least after the initial bubble at the opening of trading in 1993) reflects the performance of the real economy. On the other hand, it is doubtful that changes in underlying fundamentals could explain the changes in the Warsaw and Budapest indices seen in Figure 1.

This analysis leads to an examination of 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.[16] We also note that

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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."

[14]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.

[15]This 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.

[16]Estimates of foreign involvement are from private conversations with analysts at Wood and Co., Budapest; Wood and Co., Prague; and Patria Finance, Prague.

only exchange rates appear to have an instantaneous effect on share prices on the Budapest stock exchange. 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.[17]

The striking result is 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.

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 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.

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[17]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

	Czech Republic 9/93 - 12/96	Hungary 1/93 - 12/96	Poland 1/93 - 12/96	Slovakia 9/93 - 12/96
Monthly Inflation	mean = 0.7% s.d. = 0.5% min = 0.0% max = 2.3%	mean = 1.6% s.d. = 1.1% min = -0.9% max = 4.4%	mean = 2.0% s.d. = 1.2% min = -0.9% max = 5.6%	mean = 0.8% s.d. = 0.6% min = 0.0% max = 2.4%
Monthly Change in Industrial Production	mean = 0.4% s.d. = 6.1% min = -12.2% max = 20.9%	mean = 0.3% s.d. = 6.1% min = -12.0% max = 13.8%	mean = 0.2% s.d. = 5.5% min = -12.0% max = 11.6%	mean = 0.7% s.d. = 5.2% min = -12.3% max = 11.7%
Unemployment Rate	mean = 3.1% s.d. = 0.3% min = 2.8% max = 3.8%	mean = 11.6% s.d. = 1.1% min = 10.0% max = 13.6%	mean = 15.2% s.d. = 0.9% min = 13.5% max = 16.9%	mean = 13.6% s.d. = 1.0% min = 11.9% max = 15.2%

TABLE 2

F-Tests of Significant Relationships between Real Variables and Market Indices

	Czech Republic				Hungary			
	Contem-poraneous	Lags Only	Lags Added	Reverse	Contem-poraneous	Lags Added	Lags	Reverse
M1	3.10 (1,25)	0.00 (1,25)	0.01 (1,24)	0.46 (1,35)	1.68 (1,41)	1.60 (1,42)	0.06 (1,40)	1.25 (1,41)
M2	10.46*** (1,25)	0.07 (1,25)	1.17 (1,24)	0.73 (3,30)	1.72 (1,42)	5.55* (1,43)	4.20* (1,41)	0.34 (1,38)
Exports	12.18*** (1,25)	0.26 (1,25)	2.56 (1,24)	1.91 (1,35)	2.17 (1,41)	1.59 (1,42)	1.19 (1,40)	3.69 (1,39)
Imports	7.08*** (1,25)	0.33 (1,25)	0.01 (1,24)	2.11 (4,29)	2.03 (1,41)	1.65 (1,42)	0.01 (1,40)	0.76 (1,39)
Trade Balance	0.02 (1,25)	1.73 (1,25)	2.77 (1,24)	3.78** (4,29)	1.23 (1,41)	2.73 (1,42)	1.85 (1,40)	0.02 (1,39)
Foreign Capital Inflow	4.86* (1,25)	5.54* (1,45)	1.45 (1,24)	0.68 (1,35)	1.01 (1,41)	2.97 (1,42)	2.52 (1,40)	0.03 (1,36)
Budget Deficit	1.49 (1,25)	0.30 (1,25)	0.11 (1,24)	0.31 (1,35)	1.38 (1,42)	0.21 (1,43)	0.67 (1,41)	2.35 (1,36)
Government Debt	1.70 (1,25)	0.06 (1,25)	0.49 (1,24)	0.49 (4,29)	3.59[a] (1,42)	3.64[a] (1,43)	2.90[a] (1,41)	0.01 (1,37)
Price Level	1.00 (1,25)	0.25 (1,25)	0.15 (1,24)	1.00 (4,26)	2.62 (1,42)	0.01 (1,43)	0.40 (1,41)	0.09 (1,40)
Exchange Rate versus US Dollar	0.96 (1,25)	0.20 (1,25)	0.32 (1,24)	0.96 (1,35)	4.29* (1,43)	0.12 (1,43)	0.80 (1,42)	0.62 (1,35)
Industrial Production	4.33* (1,25)	0.19 (1,25)	1.32 (1,24)	1.18 (1,31)	1.39 (1,42)	2.46 (1,43)	4.43* (1,41)	0.00 (1,40)

	Poland				Slovakia			
	Contem-poraneous	Lags Only	Lags Added	Reverse	Contem-poraneous	Lags Only	Lags Added	Reverse
M1	0.004 (1,43)	0.15 (2,41)	0.15 (2,40)	0.99 (2.40)	0.01 (1,24)	3.26 (1,25)	3.54 (1,24)	1.07 (3,31)
M2	0.04 (1,42)	0.00 (1,43)	0.00 (1,41)	3.05* (3,32)	0.59 (1,25)	1.77 (1,25)	2.91 (1,24)	0.55 (1.35)
Exports	1.15 (1.36)	8,70*** (3,35)	17.50*** (3,33)	3.01 (1,40)	0.96 (1,26)	3.39** (6,22)	3.36** (6,20)	0.77 (1,34)
Imports	1.06 (1,36)	9.03*** (3,35)	12.85*** (3,33)	1.53 (1,40)	4.05[a] (1,24)	5.72* (1,25)	3.42[a] (1.23)	1.36 (3,29)
Trade Balance	0.55 (1,40)	2.20 (2,39)	2.91 (1,40)	4.09** (4,27)	1.49 (1,26)	5.56*** (6,22)	4.78** (6,20)	1.87 (3,29)
Foreign Capital Inflow	0.59 (1,40)	2.88 (2,40)	4.44** (2,38)	0.52 (1,39)	3.84 (1,26)	3.05 (1,27)	0.04 (1,25)	0.46 (1,33)
Budget Deficit	0.16 (1,43)	2.38 (1,43)	2.17 (1,42)	0.03 (1,43)	0.09 (1,24)	0.20 (1,25)	0.12 (1,24)	0.95 (4,29)
Government Debt	0.01 (1,43)	1.30 (2,42)	1.28 (2,41)	0.14 (6,33)	0.90 (1,27)	0.91 (1,27)	0.29 (1,26)	0.34 (1,34)
Price Level	0.21 (1,42)	1.28 (1,43)	1.61 (1,41)	0.10 (1,38)	7.72** (1,27)	1.42 (1,27)	1.28 (1,26)	2.11 (1,32)
Exchange Rate versus US Dollar	1.61 (1,42)	0.08 (1,43)	0.21 (1,41)	0.01 (1,40)	2.16 (1,26)	2.16 (3,25)	1.27 (3,23)	7.46** (1,34)
Industrial Production	0.02 (1,43)	0.02 (1,43)	0.01 (1,42)	0.16 (1,43)	0.11 (1,25)	8.00** (1,25)	8.55*** (1,24)	1.91 (3,28)

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

[a] Although neither is significant individually , the combination of contemporaneous and lagged variables is jointly significant at 10% level.

Table 3

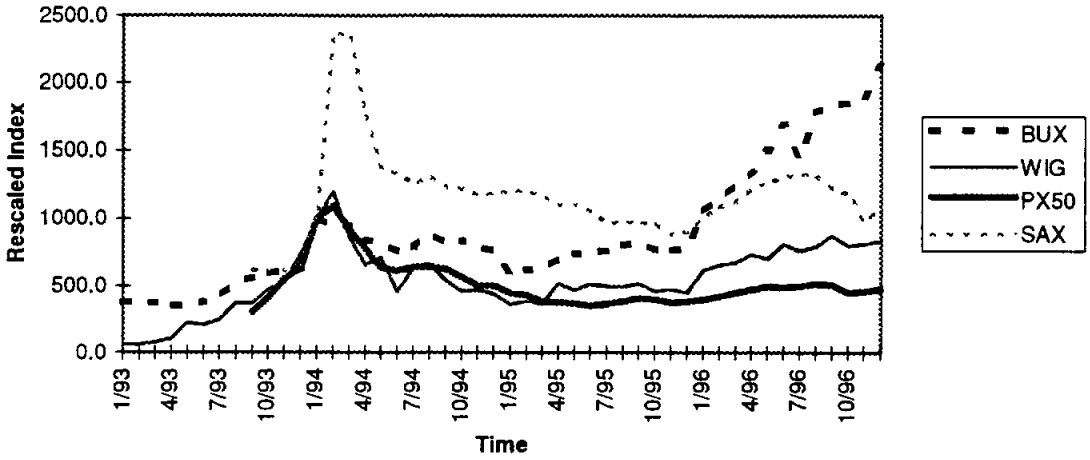
F-Tests of Significant Relationships between Western and Visegrad Market Indices

	Czech Republic			Hungary		
	Contem-poraneous	Lags Only	Lags Added	Contem-poraneous	Lags Only	Lags Added
DAX	6.47** (1,25)	0.44 (1,25)	0.04 (1,24)	2.16 (1,43)	2.72 (1,43)	4.11* (1,42)
Dow-Jones Industrial Average	1.76 (1,25)	5.00** (2,24)	3.79* (2,23)	5.14** (1,43)	1.76 (3,39)	1.41 (3,38)
	Poland			Slovakia		
	Contem-poraneous	Lags Only	Lags Added	Contem-poraneous	Lags Only	Lags Added
DAX	1.80 (1,43)	0.26 (1,43)	0.60 (1,42)	0.04 (1,25)	1.27 (1,25)	1.36 (1,24)
Dow-Jones Industrial Average	7.47** (1,43)	0.23 (1,43)	0.16 (1,42)	3.32 (1,25)	2.47 (1,25)	2.15 (1,24)

** Significant at 5% level
* Significant at 10% level

Figure 1

Visegrad Stock Indices, 1993-1996



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