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Stock Prices and Exchange Rates in the EU and the USA: Evidence of their Mutual Interactions

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1. Introduction

Mutual relations between foreign exchange markets and stock markets have attracted much attention of researchers and academics since the beginning of 1990s. The last quarter of the century has witnessed significant changes in the international financial system such as the emergence of new capital markets, gradual abolishment of capital inflow barriers and foreign exchange restrictions, or the adoption of more flexible exchange rate arrangements in emerging and transition countries. All the mentioned features have broadened the variety of investment opportunities but, on the other hand, they have also increased the volatility of exchange rates and added a substantial portion of risk to the overall investment decision and portfolio diversification process. Studying the interaction between foreign exchange and stock markets has therefore become more complex and has received more research interest than before.

There is theoretical consensus neither on the existence of relationship between stock prices and exchange rates nor on the direction of the relationship. Considering "flow-oriented" models and "stock-oriented" models as two basic approaches to the exchange rate determination, a cardinal disagreement can be found. Flow models assume that the exchange rate is determined largely by a country's current account or trade balance performance. These models posit that changes in exchange rates affect international competitiveness and trade balance, thereby influencing real economic variables such as real income and output (Dornbusch – Fisher, 1980). Stock prices, usually defined as a present value of future cash flows of companies, should adjust to the economic perspectives. Thus, flow oriented models represent a positive relationship between stock prices and exchanges rates with direction of causation running from exchange rates to stock prices.[1] The conclusion of a positive relationship stems from the assumption of using direct exchange rate quotation.[2]

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On the other hand, stock oriented models put much stress on the role of the financial (formerly capital) account in the exchange rates determination. These models can be distinguished on portfolio balance models and monetary models. Portfolio balance models postulate a negative relationship between stock prices and exchange rates and come to the conclusion that stock prices have an impact on exchange rates.[3] Such models presume an internationally diversified portfolios and the role of exchange rates to balance the demand for and the supply of domestic as well as foreign assets. A rise in domestic stocks prices leads to the appreciation of domestic currency through direct and indirect channels. A rise in prices encourages investors to buy more domestic assets simultaneously selling foreign assets to obtain domestic currency indispensable for buying new domestic stocks. The described shifts in demand and supply of currencies cause domestic currency appreciation. The indirect channel grounds in the following causality chain. An increase in domestic assets prices results in growth of wealth, which leads investors to increase their demand for money, which in turn raises domestic interest rates. Higher interest rates attract foreign capital and initiate an increase in foreign demand for domestic currency and its subsequent appreciation. According to the monetary approach an exchange rate is the price of an asset (one unit of foreign currency) and therefore the actual exchange rate has to be determined by the expected future exchange rate similarly like prices of other assets.[4] The only factors influencing the actual exchange rate are those which affect the future value of the exchange rate. Since developments of stock prices and exchange rates may be driven by different factors the asset market approach emphasizes no linkage between stock prices and exchange rates.[5]

As theoretical economics as well as empirical researchers are far from any consensus related to the interactions between stock markets and foreign exchange markets it is advisable to carry out further tests and analysis of this kind of issue. However, this paper is mainly motivated by some other aspects. The vast majority of empirical research already performed has been focused on developed countries and on the USA above all. A wave of currency and financial crises in 1990s redirected an interest to the emerging economies which also suffered from the consequences of the crises. The European continent generally and region of Central and Eastern Europe prin-

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[1] Causation can be explained as follows: domestic currency depreciation makes the local firms more competitive, making their exports cheaper in international comparison. Higher exports lead to higher incomes and increase in firms' stock prices.

[2] Direct quotation defines exchange rate as the price of one unit of foreign currency in domestic currency terms. Thus domestic currency depreciation means raise (increase) in exchange rate.

[3] For more about portfolio balance approach see (Frankel, 1983) or (Branson – Henderson, 1985).

[4] More details about basic asset market models are given in (Frenkel, 1976), (Dornbusch, 1976), and (Frankel, 1979). For comprehensive review of asset market models see for instance (MacDonald – Taylor, 1992).

[5] If there are some common factors that affect both stock prices and exchange rates (such as interest rates) then we might expect an association between these two variables.

cipally have been neglected so far. The concentration of our study on four old and four new EU-member countries along with the USA may provide another insight into the issue. Moreover, our motivation is strengthened by the enlargement of the EU which took place on May 1, 2004. Ten countries joined the EU, which opened a space for comparison with the old member countries in many characteristics. The main purpose of this paper is to detect whether there have been any relationships between stock prices and exchange rates in the old and some new members of the EU and to realize what kind of causalities prevail in the case of its existence. The paper also tries to answer the question whether the linkages between analyzed economic variables are of a similar intensity and direction in the old and new part of the EU and in the USA. All studies use either nominal or real exchange rates but they do not employ both into analysis with the same data on stock prices. Since we perceive the differences between the development of nominal and real exchange rates, mainly in transition countries, as significant this paper is the first attempt to evaluate the causalities using two types of exchange rates simultaneously.

In order for our purposes to be accomplished, this study proceeds as follows. The next section presents a review of the relevant empirical literature. Section 2 explains methodological issues and describes the data employed. Section 3 contains the empirical results and the last section discusses the findings and summarizes the conclusions.

2. Review of Relevant Literature

Early studies estimating relationships between stock prices and exchange rates considered only simple regression and the correlation between the two variables. The first study was a paper by Franck and Young (1972). They pointed out no significant interaction. The first stage of the post-Brettonwood system, characteristic by more volatile exchange rates, was firstly taken into estimation in (Aggarwal, 1981). He found a positive correlation between the effective exchange rate of the US dollar and changes in indices of US stock prices for the period 1974–78. Giovannini and Jorion (1987) also detected empirical regularities between exchange rates and stock markets in the USA.

On the other hand, studies from the "pioneer" era came to different conclusions. For instance Solnik (1987) analyzed influence of several economic variables including exchange rates on stock prices in nine industrialized countries. Changes in exchange rates proved to be a non-significant factor in explaining the development of stock prices. Jorion (1990) found moderate relations between stock returns of US multinational companies and the effective US dollar exchange rate for the period 1971–87. On the contrary, Soenen and Hennigan (1988) reported strong negative interaction using monthly data of the US dollar effective exchange rate and US stock market index during 1980–86. Ma and Kao (1990) explained differences among countries by the nature of their economies, primarily by the export or import orientation.

Empirical work from the early stage was focused on the linkage between the returns in the stock and foreign exchange markets and did not use the levels of the series. Such a limitation was due to econometric assumptions about insufficient stationarity of financial data series. Stationarity is strictly required in regression analysis to avoid spurious inferences. By differencing the variables some information regarding a possible linear combination between the levels of the variables may be lost. The use of cointegration technique overcomes the problem of nonstationarity and allows an investigation of both the levels and differences of exchange rates and stock prices (Phylaktis – Ravazzolo, 2000).

Bahmani-Oskooee and Sohrabian (1992) were among the first to use cointegration and Granger causality to explain the direction of mutual relationships between the two variables. They employed monthly data on the S&P 500 index and US dollar effective exchange rate for the period 1973–88 and showed bidirectional causalities, at least in the short run. Since then many other papers investigating these aspects in various countries have applied these econometric procedures and have reported very mixed and diverse results. Ajayi and Mougoue (1996) observed significant interactions in eight industrial economies during 1985–91. More concretely, they revealed a negative short-run and positive long-run effect of increase in domestic stock prices on domestic currency value. However, currency depreciation influences the stock market in a negative way in the short--run.

Yu (1997) employed daily data on markets of Hong Kong, Tokyo, and Singapore for the period 1983–94 and detected bidirectional relationship in Tokyo, no causation for the Singapore market and causality running from changes in exchange rates to changes in stock prices. Abdalla and Murinde (1997) applied a cointegration approach to examine stock prices – exchange rate relationships in four Asian countries using data from 1985 to 1994. Their results reject an occurrence of causalities in Pakistan and Korea but support its existence in Indian and the Philippines. However, the direction is not similar. While the results for India show causalities from exchange rates to stock prices, the reverse causation was found for the Philippines. Bhattacharya and Mukherjee (2003) investigated the nature of the causal relationship between stock prices and macroeconomic aggregates in the foreign sector including exchange rate in India and found no significant linkage. Muhammad and Rasheed (2003) used monthly data on four South Asian countries for the period 1994–2000. They concluded that there is no relationship between exchange rates and stock prices in Pakistan and India either in the short-run or in the long-run. Markets in Bangladesh and Sri-Lanka appeared to be bidirectionaly linked.

Some studies have focused on particular industries rather than on the whole economy. Chamberlain *et al.* (1997) reported that US banking stock returns were very sensitive to exchange rates but those of Japanese banks were not. Griffin and Stulz (2001) noted that changes of weekly exchange rates had neglible impacts on industry stock indices in developed countries. Rim and Mohidin (2002) examined relations between industry indices and exchange rates using monthly data before and during the Asian financial crisis. Results show that industry indices had long-run positive effects on exchange rates, and exchange rates also had long-run positive effects on most indices. The short-run effects proved to be generally negative in both directions.

Ajayi *et al.* (1998) provided evidence to indicate unidirectional causalities from the stock to the foreign exchange markets for the advanced economies (USA, Korea) and no consistent causal relations in the emerging markets (Malaysia). Pan *et al.* (2000) noted that exchange rates had significant effects on stock prices in seven Asian countries during 1988–98. They reported much stronger interaction during and after the financial crisis in 1997, which corresponds with the conclusions of Granger *et al.* (2000). They investigated the relation during the Asian crisis period and detected in general some feedback reaction. Phylaktis and Ravazzolo (2000) analyzed a group of Pacific Basin countries over the period 1980–98 and their results suggest that stock and foreign exchange markets are positively related and that the US stock market acts as a conduit for these links. Ramasamy and Yeung (2001) considered causalities between the two markets in nine East Asian economies and realized that the direction of causalities can vary according to the period of study. For the period of the entire four years of the crisis (1997–2000) all countries, apart from Hong Kong, showed that stock prices cause movements in the exchange rates. Results on Hong Kong indicate bidirectional causality.

3. Methodology and Data

Thirty years ago, Granger and Newbold (1974) firstly pointed out that using non-stationary macroeconomic variables in time series analysis causes superiority problems in regression. The issue of unit root of such variables was empirically demonstrated in (Nelson – Plosser, 1982) and since then this important property of macroeconomic and financial data series has been generally accepted. Many studies[6] have lately shown that majority of time series variables are non-stationary or integrated of order 1.[7] Thus, a unit root test should precede any empirical study employing such variables. There have been a variety of proposed methods for implementing stationarity test and principally Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test have been widely used in econometric literature. Also this study, as a first step, executes both unit root tests to investigate whether the time series of exchange rates and stock prices are stationary or not.

If the series under consideration turn out to be integrated in the same order, it is possible to proceed testing for cointegration relationships between the integrated variables. In this paper, cointegration tests were carried by means of the method developed by Johansen (1988) and Johansen and Juselius (1990).

The Johansen method applies the maximum likelihood procedure to determine the presence of cointegrating vectors in non-stationary time series as a vector autoregressive (VAR):

[6] for instance (Engle – Granger, 1987)

[7] Time series variable is integrated of order 1 if its changes are stationary.

$$\Delta Z_t = C + \sum_{i=1}^{K} \Gamma_i \Delta Z_{t-1} + \Pi Z_{t-1} + \eta_t \tag{1}$$

where Z_t is a vector of non-stationary (in log levels) variables and C is the constant term. The information on the coefficient matrix between the levels of the Π is decomposed as $\Pi = \alpha\beta'$ where the relevant elements the α matrix are adjustment coefficients band the β matrix contains the cointegrating vectors. Johansen and Juselius (1990) specify two likelihood ratio test statistics to test for the number of cointegrating vectors. The first likelihood ratio statistics for the null hypothesis of exactly r cointegrating vectors against the alternative $r + 1$ vectors is the maximum *eigenvalue statistic*. The second statistic for the hypothesis of at most r cointegrating vectors against the alternative is the *trace statistic*. Critical values for both test statistics are tabulated in (Johansen – Juselius, 1990).

If the variables are non-stationary and are cointegrated, the adequate method to examine the issue of causation is the Vector Error Correction Model (VECM), which is a Vector Autoregressive Model (VAR) in first differences with the addition of a vector of cointegrating residuals. Thus, this VAR system does not lose long-run information. In the absence of any cointegrating relationship between the variables, the standard Granger causality test based on (Granger, 1988) would be applied. The Granger test involves the estimation of the following equations:

$$\Delta MSCI_t = \beta_0 + \sum_{i=1}^{q} \beta_{1i} \Delta MSCI_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta ER_{t-i} + \varepsilon_{1t} \tag{2}$$

$$\Delta ER_t = \varphi_0 + \sum_{i=1}^{r} \varphi_{1i} \Delta ER_{t-i} + \sum_{i=1}^{r} \varphi_{2i} \Delta MSCI_{t-i} + \varepsilon_{2t} \tag{3}$$

in which $MSCI_t$ and ER_t represent stock prices and exchange rates. ε_{1t} and ε_{2t} are uncorrelated stationary random processes, and t denotes the time period. Failing to reject the H_0: $\beta_{21} = \beta_{22} = ... = \beta_{2q} = 0$ implies that exchange rates do not Granger cause stock prices. Likewise, failing to reject H_0: $\varphi_{11} = \varphi_{12} = ... = \varphi_{1r} = 0$ suggest that stock prices do not Granger cause exchange rates.

If cointegration exists between *MSCI* and *ER*, the VECM is required in testing Granger causality as shown below:

$$\Delta MSCI_t = \beta_0 + \sum_{i=1}^{q} \beta_{1i} \Delta MSCI_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta ER_{t-i} + \alpha_1 Z_{t-1} + \varepsilon_{1t} \tag{4}$$

$$\Delta ER_t = \varphi_0 + \sum_{i=1}^{r} \varphi_{1i} \Delta ER_{t-i} + \sum_{i=1}^{r} \varphi_{2i} \Delta MSCI_{t-i} + \lambda_1 Z_{t-1} + \varepsilon_{2t} \tag{5}$$

where Z_{t-1} is the error correction term obtained from the cointegrating equation (1), so that changes in the variables $MSCI_t$ and ER_t are partly driven by the past values of Z_t. The first difference operator is marked by Δ. The error correction, α_1 and λ_1, are expected to capture the adjustments of $\Delta MSCI_t$ and ΔER_t towards long-run equilibrium, whereas the coefficients on $\Delta MSCI_{t-i}$ and ΔER_{t-i} are expected to capture the short-run dynamics of the model. Thus, in using equations (4) and (5) to test for the Granger-causal relationship between $MSCI_t$ and ER_t, we included the error-correction terms in order to introduce additional channels through which causality could emerge and equilibrium could be re-established. Failing to reject H_0: $\beta_{21} = \beta_{22} = ... = \beta_{2q} = 0$ and $\alpha_1 = 0$ implies that exchange rates do not Granger cause stock prices while failing to reject H_0: $\varphi_{11} = \varphi_{12} = ... = \varphi_{1r} = 0$ and $\lambda_1 = 0$ indicates stock prices do not Granger cause exchange rates.

Four old, four new EU-member countries, and the USA were selected for the empirical analysis. Since all countries under estimation are open economies with foreign trade and investment relations with many different countries and currency areas we consider effective exchange rates as more appropriate than bilateral exchange rates for such kinds of analysis. As mentioned above, one of the aims of this paper is to show differences in results using nominal exchange rates (*NEER*) and real exchange rates (*REER*). Therefore, monthly data on both types of exchange rate for all countries were employed and derived from the IMF International Financial Statistics.[8] The development of prices on local stock markets is embodied by monthly data on stock indices. As we foresaw problems stemming from the non-consistent construction of the local stock indices and differences in the techniques of their definition and calculation, we decided to use national stock indices based on a uniform methodology. Thus, we used the *MSCI* Standard National Indices expressed in local currencies provided by Morgan Stanley.[9]

The sample period varies for each country depending on the availability of data. Regarding *NEER*, for Austria, France, Germany, UK, and the USA the sample period is 1969:12–2003:12; for Poland 1993:12–2003:12; for the Czech Republic 1994:12–2003:12; for Hungary 1995:01–2003:12; and for Slovakia 1995:06–2003:12. Considering *REER* the sample period for the first group of the countries is smaller, particularly 1978:01–2003:12. The sample period for the new-member countries is of the absolutely same length as in the *NEER* case. To check for possible changes in intensity or direction of mutual relationships during the time and to overcome disproportion in the length of data on old and new EU-member countries, we divided the whole analyzed period into two sub-intervals. The first period covers the time 1969:12(1978:01)–1992:12 and data strictly in developed economies. The second period includes data on all analyzed countries taken from the time interval 1993:01–2003:12.

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[8] NEER represents the ratio (expressed on base 1995 = 100) of an index of the period average exchange rate of the currency in question to a weighted geometric average of exchange rates for the currencies of selected countries and the Euro area. REER is defined as a nominal effective exchange rate index adjusted for relative movements in national price or cost indicators of the home country, selected countries, and the Euro area. In both cases an increase in the index reflects an appreciation.

[9] MSCI Index for Slovakia was substituted by the SAX – official index of the Bratislava Stock Exchange.

4. Empirical Results

4.1 Test for Stationarity and Cointegration Analysis

As a first step in analysis we transformed all time series into natural logarithm values. Thus, first differences correspond to growth rates. Consequently we tested for unit roots in all stock market indices and the *NEER* and *REER* for both periods. We used the ADF test with and without trend as recommended by Engle and Granger (1987) and backed up their results by the PP test again with and without trend.[10] The lag length and bandwith in the unit root test were allowed to vary across individual countries so as to mop up any residual serial correlation. The optimal number of lags was chosen according to Schwartz Info Criterion (SIC) and the bandwith was based on Newey-West using Barlett kernel spectral estimation method. To conserve the space the results are not reported here but may be obtained from the author upon request.

Considering stock market indices we found that the null hypothesis of a unit root in levels must be accepted in all cases. However, it can be rejected for all series considering the first differences. *NEER* turned out to be integrated of order 0 in two countries (Hungary and Poland).[11] The rest of *NEER* time series are integrated of order 1. ADF and PP tests led to acceptation of the null hypothesis of a unit root in *REER* levels in all countries which means that all *REER* time series are stationary at first differences. Summarizing all above, more than one I(0) time series appeared in no country.

On the basis of the above unit root tests, we performed the Johansen's cointegration test to see whether any combinations of the variables are cointegrated. According to Johansen (1997) the selection of variables to be included in cointegration test should be based on economic reasoning, i.e. stationary variables should be included only if reasonable. However, at least two variables need to be non-stationary to perform a cointegration test. Since we employ two variables only in tests, the results of test including Polish and Hungarian *NEER* must show two cointegrating equations to be relevant and significant.[12] The lag length is chosen by applying the SIC and Akaike Info Criterion (AIC) on the undifferenced VAR. Relevant results are presented in *Table 1*.

Evidence suggests that for the first period the null hypothesis of no cointegration can be rejected in none of the countries. Analyzed financial markets in all developed countries do not share the same stochastic trend and

[10] Identical results of all four alternative tests were needed to conclude about stationarity of any time series. If even one test showed non-stationarity, the time series was treated as non-stationary.

[11] Stationarity of the NEER time series in Poland and Hungary stems from specific exchange rate arrangements valid during the economic transformation process. Crawling peg and crawling band are quasi-fixed exchange rate regimes that provide very stable development resulting from gradual devaluation made by small steps defined and announced in advance.

[12] As the cointegration rank increases by the number of stationary variables, the correct number of cointegration equations is equal to the number of equations found by the Johansen's test minus the number of stationary variables.

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TABLE 1 Bivariate Cointegration Test

	1969:12(1978:1)–1992:12		1993:1–2003:12	
	$r = 0$	$r \leq 1$	$r = 0$	$r \leq 1$
	Austria			
MSCI/NEER	3.283185	0.326759	10.56136	0.007898
MSCI/REER	4.876845	0.755855	16.91531 **	3.366820
equation			$MSCI_t = 0.075631\ REER_t - 6.360597$ (0.21364)	
	Czech Republic			
MSCI/NEER	n.a.	n.a.	10.30382	0.134413
MSCI/REER	n.a.	n.a.	9.181978	0.991493
	France			
MSCI/NEER	12.19328	0.917407	10.63396	2.722841
MSCI/REER	10.74320	0.635402	13.87845	1.860813
	Germany			
MSCI/NEER	7.732358	0.376639	13.44555	4.495134
MSCI/REER	12.74433	1.891833	22.65806 *	6.318900 **
equation			$MSCI_t = 4.028763\ REER_t - 24.29950$ (3.95389)	
	Hungary			
MSCI/NEER	n.a.	n.a.	25.20498 *	3.502783
MSCI/REER	n.a.	n.a.	7.391830	0.000063
	Poland			
MSCI/NEER	n.a.	n.a.	26.19535 *	3.707052
MSCI/REER	n.a.	n.a.	14.26361	3.163351
	Slovakia			
MSCI/NEER	n.a.	n.a.	6.751800	0.890310
MSCI/REER	n.a.	n.a.	10.02985	1.153015
	United Kingdom			
MSCI/NEER	5.182784	0.097877	11.77710	4.037124
MSCI/REER	12.86464	0.868828	16.10427 **	4.409677 **
equation			$MSCI_t = -2.073399\ REER_t + 2.754970$ (–7.25874)	
	United States			
MSCI/NEER	6.456333	0.006646	20.76988 **	4.076211 **
MSCI/REER	5.960585	0.474434	26.55986 *	4.220836 **
equation			$MSCI_t = -7.801531\ NEER_t + 30.28578$ (–4.54484)	
equation			$MSCI_t = -8.088357\ REER_t + 31.72408$ (–3.82915)	

Note: * and ** denote significance at 1% and 5% levels. The critical values of trace statistics for the null hypothesis of no cointegration (H_0: $r = 0$) are 20.04 (1% level) and 15.41 (5% level), respectively. The critical values for the null hypothesis of at most one cointegrating relationship (H_0: $r \leq 0$) are 6.65 (1% level) and 3.76 (5% level), respectively. The numbers in parentheses beneath the estimated coefficients are *t*-statistics.

consequently no stable long-run linkages between stock prices and exchange rates exist. Our expectation about *REER* as a considerably distinct expression of exchange rate development then the *NEER* is not justified because the results are rather mixed. Whereas Austria, Germany and the UK demonstrate stronger relationship between stock market indices and the *REER*, France and the USA show evidence of higher trace statistics using the *NEER*. Similarly, while there are no noticeable differences in the long-run linkages in Austria, France, and the USA, results in Germany and the UK vary significantly involving *NEER* and *REER* into analysis.

It is found in the Table 1 that exchange rates and stock market indices proved to be cointegrated in six out of nine analyzed countries during the second period. However, we should recall that *NEER* time series in Hungary and Poland were identified to be of I(0). This fact may affect the significance of cointegration test results negatively. Thus, we consider such results as invalid and we do not involve them into further analysis. Anyway, one could conclude in three interesting ways.

First, we found substantial differences in the power of cointegration between two geographical areas. While the data series do indeed possess a long-run equilibrium relationship between themselves in the traditional part of the EU and in the USA, stock prices and exchange rates seem to be really cointegrated in none of the new EU-member countries. One exception is the relationship between Polish *MSCI* index and *REER* that shows trace statistics very close to the 5% level critical value and may be therefore treated as cointegrated at 10% level.

Secondly, concerning the time point of view, there is clear evidence of markedly stronger long-run linkages between analyzed economic variables in all developed countries during the second period. Elimination of barriers and obstacles of free capital flows in the international scale along with relaxing currency restrictions and shifts towards more flexible exchange rate arrangements have created a more favorable environment for relationships between stock and foreign exchange markets to appear.

Thirdly, results report obvious predominance of *REER* in detecting cointegration in a majority of the economies. *REER* is more complex indicator of exchange rate development than *NEER* since it reflects, besides nominal exchange rate, relative price level in the home economy and abroad. For that reason *NEER* and *REER* not need to follow the same way and direction as it is apparent from *Figure 1* and *2*. Higher inflation in a home country than abroad may contribute to real appreciation of domestic currency even in the case of nominal depreciation. Real appreciation forces domestic companies and exporters to increase international competitiveness by cost reduction, improvement of productivity or increase in efficiency. Level of such abilities would be subsequently mirrored in the stock prices and stock market development. Accepting such type of the "flow-oriented" models' assumptions one can state that *REER* is expected to have more powerful long-run relationship with the stock market development than only the *NEER*. Considering "stock-oriented" models, stock prices development should determine exchange rates. Growth of stock prices attracts foreign investors and causes domestic currency nominal appreciation, which in circumstances of stable and common rate of inflation automatically means concurrent real appreciation. An increase of stock prices based on economic fundamentals and growth is usually accompanied by some rate of inflation that multiplies and strengthens mutual relationship between stock prices and exchange rates expressed by *REER*. Moreover, stock prices are derived from expected future dividends whose level depends on profit and profitability. In inflationary environment, profits rise equally with inflation and

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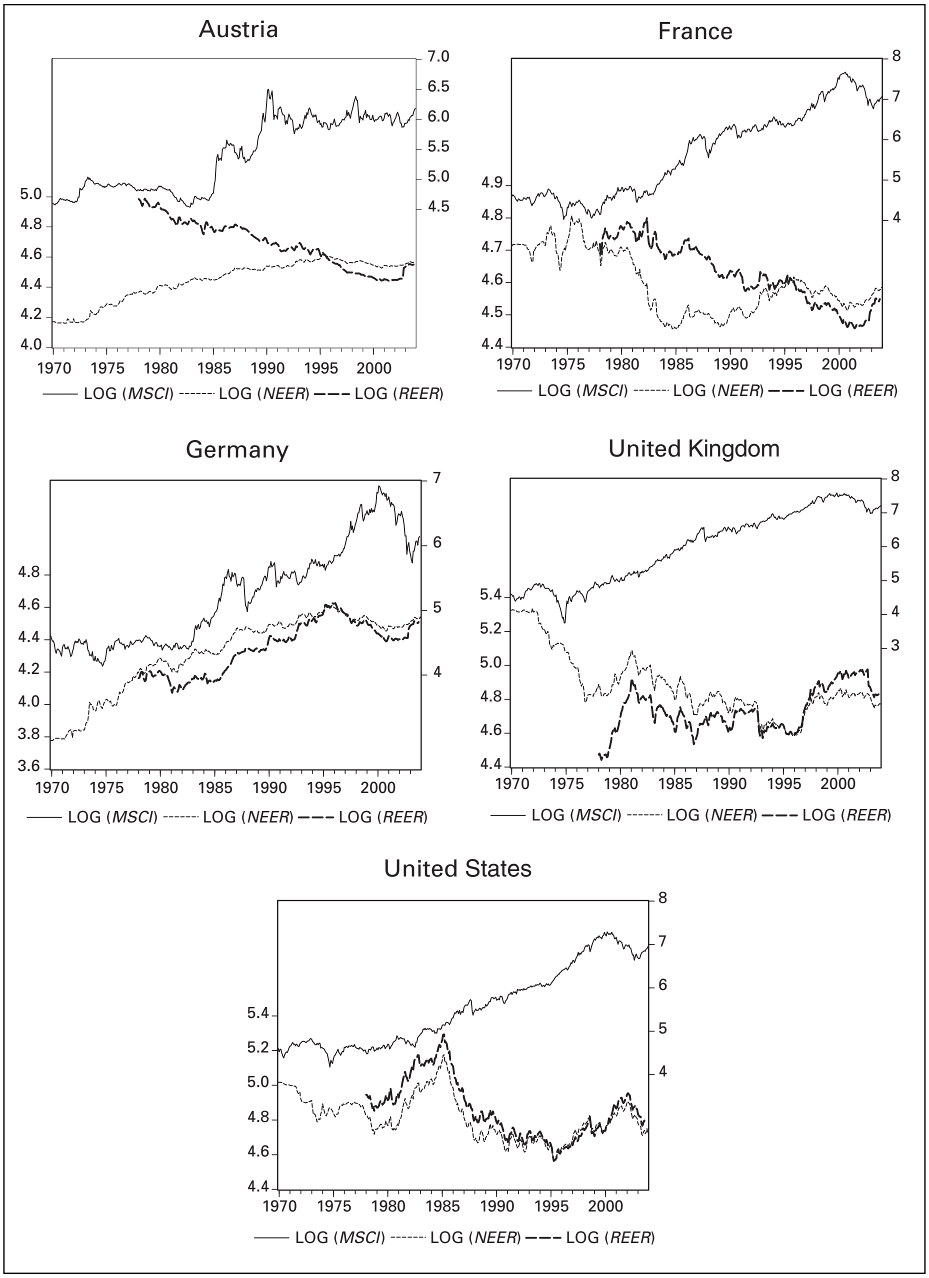
FIGURE 1



therefore stock prices should also increase. Knowing the impact of inflation on the real exchange rate, it may be pointed out that stock market development is linked with *REER* more tightly than with *NEER*.

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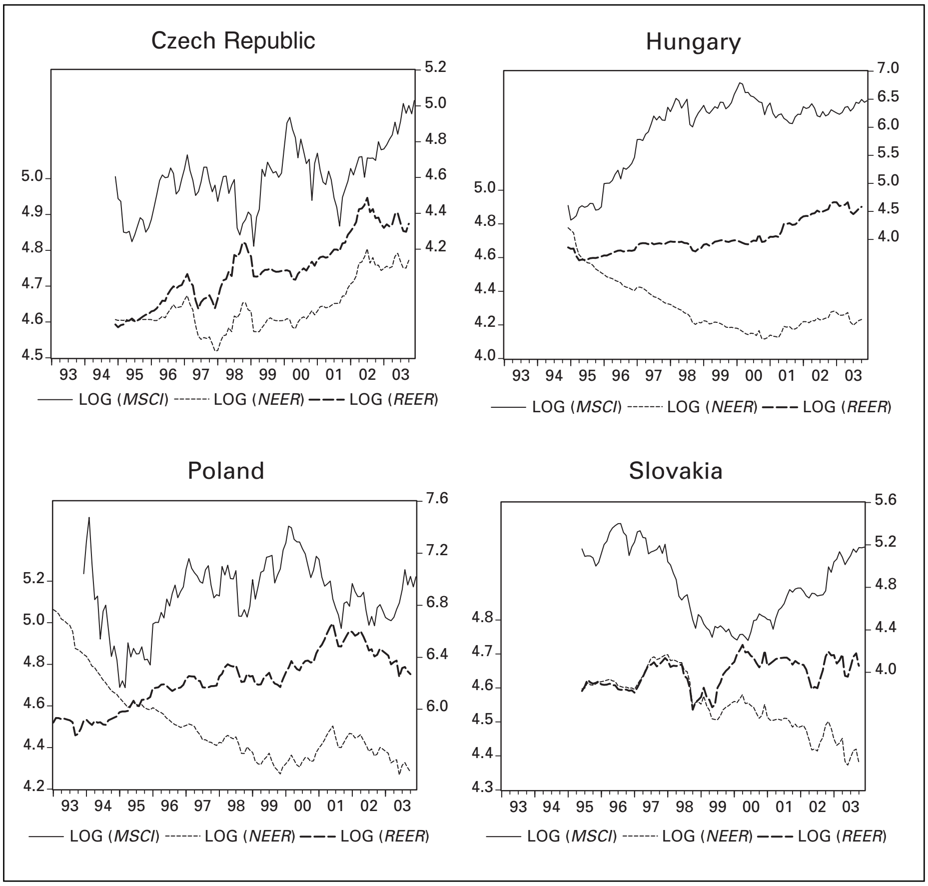
FIGURE 2



4.2 Vector Error Correction Modeling and Granger Causality Test

Given the VEC mechanism that is embedded in the Johansen's procedure, the deviation from long-run equilibrium is corrected through a series of partial short-run adjustments. The VECM specification restricts the long-run behavior of the variables in the system to converge to their long-run relationship while allowing a wide range of short-run dynamics. The VECM is therefore a suitable framework to examine the short-term adjustments needed by two variables to reach a long-run equilibrium. A number of lags differ among estimated models and is between two and four. Similarly with prior estimations, the optimal number was set according to SIC and AIC. *Table 2* shows the estimates of the VECM for each country where cointegration appeared.

Estimation of the VECM leads to miscellaneous results. As mentioned above, estimated coefficients α_1 and λ_1 are supposed to capture the long-run equilibrium of the system. Only for the USA the parameters are sta-

TABLE 2 VECM Estimates

	AUT ***MSCI***	**AUT** ***REER***	**GER** ***MSCI***	**GER** ***REER***	**UK** ***MSCI***	**UK** ***REER***
Z_{t-1}	–0.1779 (–3.501)*	0.0011 (0.126)	–0.0229 (–0.939)	–0.1131 (–3.785)*	0.0168 (0.572)	0.0340 (3.319)*
$MSCI_{t-1}$	0.1048 (1.158)	–0.0076 (–0.504)	–0.0167 (–0.178)	0.0062 (0.539)	–0.0024 (–0.024)	–0.0585 (–1.709)***
$MSCI_{t-2}$	0.1934 (2.125)**	–0.0105 (–0.693)	0.1195 (1.267)	–0.0233 (–2.017)**	–0.0356 (–0.363)	0.0886 (2.597)**
$MSCI_{t-3}$	–0.0195 (–0.216)	0.0079 (0.527)	0.0003 (0.003)	0.0082 (0.699)	–0.0809 (–0.807)	–0.0514 (–1.469)
$MSCI_{t-4}$						
ER_{t-1}	0.5566 (1.005)	0.2117 (2.296)**	–0.9292 (–1.282)	0.4209 (4.745)*	0.3907 (1.568)	0.1726 (1.985)**
ER_{t-2}	0.0351 (0.062)	0.0259 (0.275)	0.3252 (0.427)	–0.2305 (–2.471)**	0.2465 (1.034)	–0.0468 (–0.563)
ER_{t-3}	0.0051 (0.009)	–0.0508 (–0.557)	–0.8059 (–1.127)	–0.1226 (–1.400)	–0.0352 (–0.154)	0.0764 (0.958)
ER_{t-4}						
constant	0.0025 (0.529)	–0.0008 (–1.007)	0.0045 (0.704)	0.0001 (0.001)	0.0025 (0.661)	0.0014 (1.039)
R^2	0.1296	0.0602	0.0359	0.3289	0.0409	0.2250
$Adj.R^2$	0.0709	0.0045	–0.0212	0.2892	–0.0159	0.1790
F–statistics	2.3633	1.0805	0.6288	8.2645	0.7197	4.8946

	USA ***MSCI***	**USA** ***NEER***	**USA** ***MSCI***	**USA** ***REER***
Z_{t-1}	0.0329 (3.188)*	0.0081 (2.279)**	0.0336 (4.099)*	0.0048 (1.665)***
$MSCI_{t-1}$	–0.1201 (–1.278)	0.0002 (0.006)	–0.1587 (–1.655)	0.0019 (0.057)
$MSCI_{t-2}$	–0.133 (–1.436)	0.0299 (0.935)	–0.2173 (–2.255)**	0.0386 (0.368)
$MSCI_{t-3}$			–0.0561 (–0.585)	–0.0307 (1.130)
$MSCI_{t-4}$			–0.2025 (–2.135)**	0.0080 (0.238)
ER_{t-1}	0.2276 (0.891)	0.3155 (3.583)*	0.1817 (0.707)	0.3820 (4.074)*
ER_{t-2}	–0.1543 (–0.596)	–0.1190 (–1.333)	–0.1454 (–0.515)	–0.1418 (–1.417)
ER_{t-3}			0.0003 (0.001)	–0.0031 (–0.032)
ER_{t-4}			–0.3000 (–1.158)	0.0338 (0.369)
constant	0.0087 (2.193)**	–0.0008 (–0.064)	0.0106 (2.543)**	0.0004 (0.262)
R_2	0.0864	0.1606	0.1597	0.1854
$Adj.R_2$	0.0492	0.1265	0.0935	0.1211
F–statistics	2.3273	4.7084	2.4088	2.8824

Note: * , ** and *** denote significance at 1, 5 and 10% levels. *ER* represents particular exchange rate expression, *t*-statistics in parentheses.

tistically significant in all models using both expressions of exchange rates. Since both $\alpha_1 \neq 0$ and $\lambda_1 \neq 0$, changes in the effective exchange rates are transferred to the stock market and vice versa in the USA. For Germany and the UK, λ_1 is statistically significant while α_1 is not. This result implies that while exchange rates and stock prices are bound together in one long--run equilibrium relation, the *REER* follows and adjusts to innovations in the stock market. Austria possesses a different estimation outcome while only α_1 proved to be significant. Finally, two of three α_1 significant coefficients are positive, declaring that an increase in effective exchange rates (appreciation of domestic currency) has a positive effect on the domestic stock market in the long-run. The negative α_1 parameter appeared in Austria indicating a negative impact of appreciation on stock prices. Analogically, three of four significant λ_1 coefficients are positive (the UK and twice in the USA), suggesting that a booming domestic stock market contributes noticeably to the domestic currency's appreciation. Only Germany demonstrates the reverse long-run relationship, i.e. increasing stock prices cause the domestic currency to depreciate.

The most long-run interactions were discovered in the USA where the bidirectional causalities exist in both estimated models. Uniformly, the results imply that USD appreciation (depreciation) tends to bring about a rise (decline) in American stock prices. This finding is theoretical underpinning. For the USA as an economy with a significant import sector, the favorable effects of currency appreciation on import prices may produce a bullish stock market in the long-run.[13]

In addition, a test for the USA and the UK implicitly supports principles of the "stock-oriented" models, too. Significance of the cointegration factor's coefficient documents that innovation of the stock markets indices are transmitted to the exchange rate in a positive way. An increase in stock prices has positive effects on effective exchange rates (currency appreciation). Such results are absolutely in accordance with the unique position of the UK and the USA in the world economy and among financial centers. Stock markets in the UK and the USA belong to the prestigious group of the most efficient and developed markets with the largest turnover and market capitalization and they play a leading role and attract domestic as well as foreign investors. Consequently, development on the stock markets drives demand for and supply of national currency and affects the exchange rate significantly. Solidity of this long-run linkage in the USA is intensified by the evidence of same causality found between market indices and both expressions of exchange rate.

On the contrary, Austria tends to causality running from changes in *REER* to changes in stock prices and justifies in this ways assumptions of the "flow--oriented" models that real depreciation initiates increase in stock prices. The Austrian stock market plays a somewhat regional role and does not considerably influence the behavior of global investors. The annual turnover of Austrian Stock Exchange was EUR 19.31 billion in 2003. Development of stock prices rather reflects international competitiveness, economic si-

[13] See (Ma – Kao, 1990) for a detailed clarification.

tuation and perspectives of Austrian companies that are, due to degree of Austrian economy openness[14], substantially determined by *REER*.

The most statistically significant VECM includes German *MSCI* and *REER* time series and reveals a long-run effect of shifts in domestic stock prices on domestic currency value. The causation is however negative, which means that an increase in stock prices results in real depreciation of the currency. One may conclude that such estimation clearly confirms outcomes of monetary models that stock prices and exchange rates are independent variables affected by different factors. Detected long-run equilibrium relation and its direction should be therefore considered as econometric-based instead of fundamentally-based. An explanation may be as follows. While the German stock market was copying the general and long-lasting boom of the world capital markets in the 1990s, the real economy experienced, after the unification blossom, a significant slowdown. Post-unification Germany had an overvalued real exchange rate and needed a substantial real depreciation.[15]

The short-run dynamics of the system may be examined by performing bivariate Granger causality tests. We applyed the tests with the aim of seeking a presence of short-run relationships where no long-run causalities appeared, and to confirm the VECM results where the cointegration between stock prices and exchange rates exists. The Granger causality test requires that all data series involved are stationary. Otherwise the inference from the *F*-statistics might be spurious because the test statistics will have nonstandard distributions. Accordingly, we employed the first differences of all log-level series. The test results of Granger causality are given in *Table 3* for traditional part of the EU and the USA and in *Table 4* for new EU-members. Number of lags was chosen again applying AIC, whilst one and two lags were identified as an optimal lag length in majority of cases.

Considering the first analyzed period, we detected no short-run relation, which corresponds with the prior finding of no long-run linkage in the first time period. During the second period stock and foreign exchange markets turned out to be short-run linked in much more cases. Restricting our focus on developed countries, we found unidirectional causalities running from stock market indices to exchange rates. More concretely, we may see the strongest relations in the UK where the stock market has a positive effect on *REER* and, to a lesser degree, also on *NEER*. Relations with the same direction but lower intensity were also detected in France, Germany and the USA. In the case of France, a relation indicating that MSCI does Granger cause *NEER* was revealed with three months lag at 10 percent level. In Germany *MSCI* seems to Granger cause *REER* with one month lag at 5%

[14] Total amount of goods and services export equaled to almost 60 % of the Austrian GDP in 2003.

[15] That has been accomplished, maybe temporarily, by the post-1995 weakness of the German Mark and then the Euro. Within a monetary union, real depreciation may occur through relatively low inflation (or, more precisely, relatively low increases in unit labor costs in the common currency). According to US Bureau of Labor Statistics the Germany's hourly compensation costs in manufacturing were the highest in the world in 2001. As they are not offset by higher productivity, and as the euro has been appreciating against external currencies, the real depreciation could be achieved only through an extended period of low inflation or even deflation.

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TABLE 3 Granger Causality Tests

	1969:12(1978:1)–1992:12		1993:1–2003:12	
	_t_–statistics	**probability**	**_t_–statistics**	**probability**
	Austria			
$NEER \nrightarrow MSCI$	0.65333	0.52113	0.59202	0.55477
$MSCI \nrightarrow NEER$	0.36121	0.69717	0.10226	0.90287
$REER \nrightarrow MSCI$	0.02719	0.97318	0.63350	0.53247
$MSCI \nrightarrow REER$	0.52240	0.59404	0.47260	0.62452
	France			
$NEER \nrightarrow MSCI$	0.59306	0.55335	0.44112	0.64432
$MSCI \nrightarrow NEER$	0.24533	0.78262	2.91304 ***	0.05804
$REER \nrightarrow MSCI$	0.51226	0.60005	1.09337	0.33835
$MSCI \nrightarrow REER$	1.66643	0.19196	1.94398	0.14754
	Germany			
$NEER \nrightarrow MSCI$	0.20614	0.81385	0.11090	0.89512
$MSCI \nrightarrow NEER$	1.76184	0.17370	0.55011	0.57829
$REER \nrightarrow MSCI$	1.42859	0.24248	0.53861	0.58494
$MSCI \nrightarrow REER$	0.45825	0.63316	3.49142 **	0.03354
	United Kingdom			
$NEER \nrightarrow MSCI$	0.81451	0.44395	0.65224	0.52265
$MSCI \nrightarrow NEER$	0.63057	0.53307	3.33769 **	0.03874
$REER \nrightarrow MSCI$	1.29574	0.27635	2.14978	0.12090
$MSCI \nrightarrow REER$	0.84720	0.43040	8.38378 *	0.00039
	United States			
$NEER \nrightarrow MSCI$	1.28555	0.27819	0.65259	0.52247
$MSCI \nrightarrow NEER$	1.18341	0.30782	2.11223	0.12530
$REER \nrightarrow MSCI$	1.33850	0.26496	0.85492	0.42787
$MSCI \nrightarrow REER$	0.98374	0.37600	2.34992 ***	0.09068

Note: * , ** and *** denote significance at 1 , 5 and 10% levels.

TABLE 4 Granger Causality Tests

	_t_–statistics	**probability**	**_t_–statistics**	**probability**
	Czech Republic		**Hungary**	
$NEER \nrightarrow MSCI$	0.99946	0.37176	2.05984	0.13290
$MSCI \nrightarrow NEER$	0.16185	0.85079	1.11220	0.33291
$REER \nrightarrow MSCI$	1.25320	0.29008	1.49582	0.22909
$MSCI \nrightarrow REER$	0.71269	0.49282	1.94962	0.14775
	Poland		**Slovakia**	
$NEER \nrightarrow MSCI$	1.73750	0.18071	0.33243	0.71803
$MSCI \nrightarrow NEER$	1.54774	0.21728	0.36859	0.69272
$REER \nrightarrow MSCI$	1.60307	0.20590	0.02595	0.97439
$MSCI \nrightarrow REER$	0.87383	0.42020	0.52291	0.59453

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TABLE 5 Summary of Mutual Relations between Stock Prices and Exchange Rates

	1969:12(1978:1)–1992:12							
	long-run				**short-run**			
	NEER → *MSCI*	*MSCI* → *NEER*	*REER* → *MSCI*	*MSCI* → *REER*	*NEER* → *MSCI*	*MSCI* → *NEER*	*REER* → *MSCI*	*MSCI* → *REER*
Austria	NO	NO	NO	NO	NO	NO	NO	NO
Czech Republic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
France	NO	NO	NO	NO	NO	NO	NO	NO
Germany	NO	NO	NO	NO	NO	NO	NO	NO
Hungary	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Poland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
U.K.	NO	NO	NO	NO	NO	NO	NO	NO
USA	NO	NO	NO	NO	NO	NO	NO	NO
	1993:1–2003:12							
	long-run				**short-run**			
	NEER → *MSCI*	*MSCI* → *NEER*	*REER* → *MSCI*	*MSCI* → *REER*	*NEER* → *MSCI*	*MSCI* → *NEER*	*REER* → *MSCI*	*MSCI* → *REER*
Austria	NO	NO	**YES**	NO	NO	NO	NO	NO
Czech Republic	NO	NO	NO	NO	NO	NO	NO	NO
France	NO	NO	NO	NO	NO	**YES**	NO	NO
Germany	NO	NO	NO	**YES**	NO	NO	NO	**YES**
Hungary	NO	NO	NO	NO	NO	NO	NO	NO
Poland	NO	NO	NO	NO	NO	NO	NO	NO
Slovakia	NO	NO	NO	NO	NO	NO	NO	NO
U.K.	NO	NO	NO	**YES**	NO	**YES**	NO	**YES**
USA	**YES**	**YES**	**YES**	**YES**	NO	NO	NO	**YES**

level. Such results may be generally treated as confirmation of the long-run causality in the short-run horizon.

Analysis of short-run mutual interactions in four new EU-member countries led to similar results as the cointegration tests. Causal relations between stock prices and exchange rates were found in none of the four countries and, moreover, the value of the t-statistics suggests that not a trace of short-run dynamics can be observed. Thus, stock prices and effective exchange rates prove to be independent variables with separate and independent development. Such findings are in conflict with the results of Stavárek (2004) or Murinde and Poshakwale (2004) confirming the existence of Granger causalities in Hungary and partly in the Czech Republic and Poland. The divergent results may stem from the different frequency of data since cited studies employed a daily data in which the short-run dynamics is more evident. All causalities revealed in the analysis are transparently summarized in *Table 5*.

5. Conclusion

After performing analysis and tests of long-run and short-run dynamics between stock prices and exchange rates in a group of nine countries we have come to the following conclusions.

Firstly, evidence suggests that long-run relationships between considered variables did not appear during the first analyzed period covering the years 1970–1992. One of the possible explanations may be exchange rate arrangements prevailing in the developed countries under estimation in the 1970s, 1980s, and first years of 1990s. The Brettonwood system, currency snake, and European Exchange Rate Mechanism provided limited space for exchange rate volatility because nominal exchange rates were allowed to fluctuate only within a very tightly defined band. Thus, mutual relations between stock prices and exchange rates could not emerge completely. The period from 1993 to 2003 shows much stronger long-run causalities preferably in the developed countries. Cointegration between stock prices and exchange rates appeared in four of nine economies. The direction of the relations is unfortunately not uniform and differs among countries. Nevertheless, the UK and the USA may be highlighted because their stock markets evidently give impulses to the exchange rate development. Long-run equilibrium in the new EU-member countries was not confirmed. Reasons should be sought in relative underdeveloped stock markets and in quasi-fixed exchange rate regimes in Poland and Hungary. Although tests for short-run relations resulted to mixed conclusions concerning intensity and type of exchange rate, all cases of the Granger causalities were likely to be unidirectional with relation running from stock prices to exchange rates.

Secondly, *REER* proved to be a better expression of exchange rate that *NEER*. While cointegration using *REER* was found in four countries, we registered long-run causalities employing *NEER* only in the USA. Therefore, we see *REER* as a more appropriate variable to fulfill preconditions of both "flow-oriented" as "stock-oriented" models.

Thirdly, as it indicated above, neither the intensity nor direction of causal relations are the same in the developed economies and the new EU-member countries. Stock markets in post-communist countries are not so tightly linked with real economy and do not efficiently reflect a companies' actual and expected performance. Similarly, stock markets in the new EU-member countries play regional and rather marginal roles. In addition, they are flat and not sufficiently attractive for international investors. Therefore, it was impossible to register any long-run or short-run relation between stock prices and exchange rates.

Consequently, the development of the domestic stock market cannot be efficiently be implemented into exchange rate forecasting in the economic environment of new Central European EU-member countries and vice versa. In terms of policy relevance, monetary authorities of these countries are not forced to take into account stock market development in realization of their exchange-rate policy. Such findings are essential with respect to the necessity to stabilize the development of the domestic currency's exchange rates in the ERM II system before joining the European Monetary Union. How-

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ever, the expected deepening of European financial markets integration and gradual diffusion of the Euro as a legal tender to more countries might cause the causal relations to appear in the new EU-members as well.

REFERENCES

ABDALLA, I. S. A. – MURINDE, V. (1997): Exchange Rate and Stock Price Interactions in Emerging Financial Markets: Evidence on India, Korea, Pakistan, and Philippines. *Applied Financial Economics*, vol. 7, 1997, pp. 25–35.

AGGARWAL, R. (1981): Exchange Rates and Stock Prices: A Study of U. S. Capital Market under Floating Exchange Rates. *Akron Business and Economic Review*, vol. 12, 1981, pp. 7–12.

AJAYI, R. A. – FRIEDMAN, J. – MEHDIAN, S. M. (1998): On the Relationship between Stock Returns and Exchange Rates: Tests of Granger Causality. *Global Finance Journal*, vol. 9, 1998, pp. 241–251.

AJAYI, R. A. – MOUGOUE, M. (1996): On the Dynamic Relation between Stock Prices and Exchange Rates. *Journal of Financial Research*, vol. 19, 1996, pp. 193–207.

BAHMANI-OSKOOEE, M. – SOHRABIAN, A. (1992): Stock Prices and the Effective Exchange Rate of the Dollar. *Applied Economics*, vol. 24, 1992, pp. 459–464.

BHATTACHARYA, B. – MUKHERJEE, J. (2003): *Causal Relationship between Stock Market and Exchange Rate. Foreign Exchange Reserves and Value of Trade Balance: A Case Study for India.* Paper presented at the Fifth Annual Conference on Money and Finance in the Indian Economy, January 2003.

BRANSON, W. H. – HENDERSON, D. W. (1985): The Specification and Influence of Assets Markets. In: Jones, R. W. – Kenen, P. B. (eds.): *Handbook of International Economics*. Vol. 2. Amsterdam, Elsevier, 1985, pp. 179–201.

CHAMBERLAIN, S. – HOWE, J. S. – POPPER, H. (1997): The Exchange Rate Exposure of U. S. and Japanese Banking Institutions. *Banking and Finance*, vol. 21, 1997, pp. 871–892.

DORNBUSCH, R. (1976): Expectations and Exchange Rate Dynamics. *Journal of Political Economy*, vol. 84, pp. 1161–1176.

DORNBUSCH, R. – FISHER, S. (1980), Exchange Rates and the Current Account. *American Economic Review*, vol. 70, 1980, pp. 960–971.

EICHENBAUM, M. – SINGLETON, K. J. (1986): Do Equilibrium Real Business Cycle Theories Explain Postwar US Business Cycles? In: *NBER Macroeconomics Annual.* Cambridge, MIT Press, 1986, pp. 91–135.

ENGLE, R. F. – GRANGER, C. W. (1987): Co-integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, vol. 55, 1987, pp. 251–276.

FRANCK, P. – YOUNG, A. (1972): Stock Price Reaction of Multinational Firms to Exchange Realignments. *Financial Management*, vol. 1, 1972, pp. 66–73.

FRANKEL, J. (1979): On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials. *American Economic Review*, vol. 69, 1979, pp. 610–622.

FRANKEL, J. (1983): Monetary and Portfolio Balance Models of Exchange Rate Determination. In: Bhandari, J. – Putnam, B. (eds.): *Economic Interdependence and Flexible Exchange Rates*. Cambridge (MA), MIT Press, pp. 84–114.

FRENKEL, J. (1976): A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence. *Scandinavian Journal of Economics*, vol. 78, 1976, pp. 200–224.

GIOVANNINI, A. – JORION, P. (1987): Interest Rates and Risk Premia in the Stock Market and in the Foreign Exchange Market. *Journal of International Money and Finance*, vol. 6, 1987, pp. 107–124.

GRIFFIN, J. M. – STULZ, R. M. (2001): International Competition and Exchange Rate Shocks: A Cross-country Industry Analysis of Stock Returns. The *Review of Financial Studies*, vol. 14, 2001, pp. 215–241.

GRANGER, C. W. – HUANG, B. – YANG, C. (2000): A Bivariate Causality between Stock Prices and Exchange Rates: Evidence from Recent Asian Flu. The *Quarterly Review of Economics and Finance*, vol. 40, 2000, pp. 337–354.

JOHANSEN, S. (1997): *Likelihood-Based Interference in Cointegrated Vector Autoregressive Models*. Oxford, Oxford University Press, 1997.

JOHANSEN, S. (1988): Statistical Analysis of Cointegrating Vectors. *Journal of Economic Dynamics and Control*, vol. 12, 1988, pp. 231–254.

JOHANSEN, S. – JUSELIUS, K. (1990): Maximum Likelihood Estimation and Inference on Cointegration, with Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, vol. 52, 1990, pp. 169–210.

JORION, P. (1990): The Exchange Rate Exposure of US Multinationals. *Journal of Business*, vol. 63, 1990, pp. 331–345.

MA, C. K. – KAO, G. W. (1990): On Exchange Rate Changes and Stock Price Reactions. *Journal of Business Finance and Accounting*, vol. 17, 1990, pp. 441–449.

MacDONALD, R. – TAYLOR, M. (1992): Exchange Rate Economics. A Survey. *IMF Staff Papers*, 1992, no. 39, pp. 1–57.

MUHAMMAD, N. – RASHEED, A. (2003): *Stock Prices and Exchange Rates: Are they Related? Evidence from South Asian Countries.* Paper presented at the 18th Annual General Meeting and Conference of the Pakistan Society of Development Economists, January 2003.

MURINDE, V. – POSHAKWALE, S. (2004): *Exchange Rate and Stock Price Interactions in European Emerging Markets Before and After the Euro.* Paper presented at the EFMA 2004 Annual Meeting in Basel, July 2004.

PAN, M. S. – FOK, R. C. W. – LIU, Y. A. (2001): *Dynamic Linkages between Exchange Rates and Stock Prices: Evidence from Pacific Rim Countries*. Working Paper at College of Business Shippensburg University.

PHYLAKTIS, K. – RAVAZZOLO, F. (2000): *Stock Prices and Exchange Rate Dynamics*. Paper presented at the EFMA 2000 Meeting in Athens, May 2000.

RAMASAMY, B. – YEUNG, M. (2001): The Causality between Stock Returns and Exchange Rates: Revisited. The *University of Nottingham in Malaysia-Division of Business and Management Research Paper Series*, no. 2001-11.

RIM, H. K. – MOHIDIN, R. (2002): Study on the Effects of Exchange Rate on Industry Indices in Malaysia. The *H. R. Frehn Center for Management Working Paper*, no. 2002-01.

SIMS, C. A. (1972): Money, Income and Causality. *American Economic Review*, vol. 4, 1972, pp. 540–542.

SOENEN, L. A. – HENNIGAR, E. S. (1988): An Analysis of Exchange Rates and Stock Prices: the U.S. Experience between 1980 and 1986. *Akron Business and Economic Review*, vol. 19, 1988, pp. 7–16.

SOLNIK, B. (1987): Using Financial Prices to Test Exchange Rate Models: A Note. *Journal of Finance*, vol. 42, 1987, pp. 141–149.

STAVÁREK, D. (2004): Causalities between Stock and Foreign Exchange Markets: Evidence from Selected EU-Member Countries. In: Hanisz, R. N. – Znaniecka, K. (eds.): *Finance in Enlarged European Union.* Katowice, Wydawnictwo Akademii Ekonomicznej, 2004, pp. 233–243.

YU, Q. (1997): Stock Prices and Exchange Rates: Experience in Leading East Asian Financial Centres: Tokyo, Hong Kong and Singapore. *Singapore Economic Review*, vol. 41, 1997, pp. 47–56.

SUMMARY

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Stock Prices and Exchange Rates in the EU and the United States:
Evidence on their Mutual Interactions

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This paper investigates the nature of the causal relationships among stock prices and effective exchange rates in four old EU member countries (Austria, France, Germany, and the UK), four new EU member countries (Czech Republic, Hungary, Poland, and Slovakia), and in the United States. Both the long- and short-term causalities between these variables are explored using monthly data. The paper also endeavors to answer the question of whether the linkages between the analyzed economic variables are of similar intensity and direction in old and new EU member countries, and whether or how relationships have changed. The results show much stronger causality in countries with developed capital and foreign-exchange markets (i.e., old EU member countries and the United States). Evidence also suggests more powerful long- and short-term causal relations during the 1993–2003 period than during 1970–92. Causalities seem to be predominantly unidirectional, with the direction running from stock prices to exchange rates. Finally, we detected strong relations when applying the real effective exchange rate than the nominal effective exchange rate.