Macroeconomic factors' influence on 'new' European countries' stock returns: the case of four transition economies

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Abstract: This paper investigates whether current and future domestic and international macroeconomic variables can explain long and short run stock returns in four 'new' European countries (Poland, Czech Republic, Slovakia and Hungary). 'Old' western European countries (UK, France, Italy and Germany) are included in the empirical analysis, whilst USA is considered as a 'foreign global influence'. Using the present value model of stock prices and a complete range of cointegration and causality tests, it is found that 'new' European stock markets are not perfectly integrated with foreign financial markets, while domestic economic activity and the German factor are more influential on these stock markets than the American global factor.

Keywords: stock returns; macroeconomic factors; present value model; Central-Eastern ('new') stock markets; 'old' European stock markets; USA; cointegration and causality tests; long-run structural modelling; error-correction model.

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1 Introduction

The year 2004 was a historic date for Europe. EU-15 officially enlarged to EU-25, including several former Central Eastern (CE) countries that until little more than a decade ago seemed to be a world apart. During the process of enlargement these countries had to adapt their legislation to the Western standard, respecting the rules and introducing new economic ethos in their financial markets. Yet, economic differences can be a big problem to the construction of a real integrated European Union.

As stock markets have gained a dominant role in equity funding and portfolio allocation decisions, research examining possible stock market linkages and interdependences has enriched recent literature. Significant long-run relationships among different stock markets could be related to a range of reasons. The presence of strong economic ties and policy coordination in various markets can indirectly link stock price behaviour over time.

Long-run co-movements between stock markets have important regional and global implications, as a domestic economy cannot be insulated from external shocks and the scope for independent monetary policy then appears limited. The relationship between economic fundamentals and stock returns in developed markets such as the USA and Europe has been fairly extensively researched using cointegration and causality as a sound methodology for modelling both short- and long-run dynamics in a system of variables. However, the role of the economy in stock returns in 'New Europe' is not well documented.

In this paper, we attempt to fill this gap in the literature by examining relationships between local and foreign macroeconomic variables and share prices in eight European countries: UK, France, Italy, Germany, Poland, Czech Republic, Slovakia and Hungary. A study of a number of stock markets facilitates comparisons, thus allowing identification of similarities and differences. Emphasis will be placed on how macroeconomic variables affect share prices in less developed countries such as Poland, Czech Republic, Slovakia and Hungary as compared with more developed, efficient and organised markets, such as UK, France, Italy and Germany. Among the CE stock markets, Poland, the Czech Republic, Hungary and Slovakia are considered the most developed, in terms of capitalisation, turnover and number of traded securities (Hanousek and Filer, 2000).

An additional contribution by this paper is that it attempts to shed light on the informational efficiency of each market. The present value model of stock prices suggests that stock markets should be a leading indicator of economic activity. The use of an aggregate proxy for interest rates (IR) and industrial production (IP) permits the relationship inherent in the present value model to be tested. The suggestion is that if current IR and IP are found to be significant explanators of price behaviour, the present value model is violated.

The rest of the paper is organised as follows. Section 2 discusses the relevant literature and explains the contribution made by this study. Section 3 outlines the research procedure used to test the theoretical relationships and Section 4 describes the econometric methodology used. Section 5 reports the research data and augments and provides evidence about the robustness of the empirical results by testing alternative specifications of the models. Section 6 concludes the paper and discusses the possible implications for policy makers.

2 Literature review

The relationship between economic fundamentals and stock returns in developed markets such as the USA and Europe has been fairly extensively researched (e.g., Chen et al., 1986; Fama, 1990; Chen, 1991; Cheung and Ng, 1998; Choi et al., 1999; Dickinson, 2000; Nasseh and Strauss, 2000). In contrast to the evidence regarding the developed countries, the literature on this specific relationship focused on transition economies has recently started to emerge.

Many papers focus on European stock markets, such as Steely and Steely (1999), Gerrits and Yuce (1999), Yang et al. (2003) and Syriopoulos (2004) among others. A body of research examines the relationships among international stock markets across regions, such as Huang et al. (2000), Cheung et al. (1994), Kwon et al. (1997), Ratanapakorn and Sharma (2002), Chen et al. (2002), Swanson (2003), Chaudhuri and Wu (2003), Bessler and Yang (2003) among others. Only a few studies focus on the CE stock markets, such as Jochum et al. (1999), Dockery and Vergari (2001), MacDonald (2001), Gilmore and McManus (2002) and Voronkova (2003).

The majority of past empirical work investigating long-term stock market linkages has concentrated mainly on mature rather than emerging stock markets, and has provided a range of ambiguous and inconsistent conclusions, as statistical evidence supports the presence of cointegration relationships in a number of markets whereas it rejects it in others. Further insight then is useful, especially in emerging stock markets that appear to have low correlations with mature markets.

The conclusions have important implications for portfolio management decisions. If European stock markets, 'new' and 'old', share common trends, this would imply that there are no particular gains to be made from portfolio diversification, because the presence of common factors limits the amount of independent variation. Implicitly, shocks to the stock prices in integrated markets are temporary rather than permanent, leading to predictable long-run stock prices.

Bilson et al. (2001) suggest that developing markets may be partially segmented from global factors and as a consequence local factors are likely to be a major source of return variation. They note that the influence of foreign economies on Pacific Basin stock returns has received very little prior attention and conclude that the majority of past researchers must therefore believe these economies are either perfectly segmented or perfectly integrated with foreign economies. Bilson et al. (2001) address this issue using a multi-factor model set out below. This includes local factors and global factors in an attempt to explain realised returns in 20 emerging markets they studied.

$$R_{it} = \alpha_i + \sum_{m=1}^{G} \beta_{im} F_{imt}^{G} + \sum_{j=1}^{L} \gamma_{ij} F_{ijt}^{L} + \varepsilon_{it} \tag{1}$$

where $R_{it}, F_{imt}^{G}, F_{ijt}^{L}$ represent return, a set of global factors and a set of local factors.

As a result of the above findings, it is expected that a study of multiple countries in the European Union may produce additional insight into the differences and similarities between countries in Europe. Our paper attempts to extend the work of Bilson et al. (2001) to European countries.

- The countries studied are specifically chosen so as to perfectly represent 'Old Europe' (UK, France, Italy, Germany) and 'New Europe' (Poland, Czech Republic, Slovakia and Hungary).
- The variables chosen to explain stock returns are variables suggested by the present value model.

Furthermore, Bilson et al. (2001) use a global stock market index as the global factor. We make an attempt to make the analysis more relevant to domestic policy makers. Therefore, this paper uses the economic variables of a specific country based on historical trade patterns, with the obvious candidate country being the USA.

Cheung and Ng (1998), for Canada, Germany, Italy, Japan and the USA, and Nasseh and Strauss (2000), for France, Italy, Netherlands, Switzerland and the UK, find evidence that current cash flow proxies are a significant source of stock return variation. It has been suggested that the existence of cointegration and causality is a violation of the efficient market hypothesis (Groenwold, 1997).

Thus, if current industrial production is found to cause stock prices stock markets may be inefficient. To qualify this assumption further, cash flows must be bisected into an expected and an unexpected component. If the efficient market hypothesis holds, only the unexpected component should be able to explain stock returns, and this component must be random. This paper assumes that it is only the random unexpected component of current IR and IP that may influence stock returns and uses this assumption to comment on the 'informational' efficiency of the stock markets of 'new' European countries. Thus, a finding of significance of current IP and IR proxies does not necessarily indicate markets to be inefficient, rather that the markets may process information differently.

Much past research has been conducted into the impact of international globalisation and increased capital market integration. The majority of this work has concluded that the USA is the world's dominant economy and as a result research has generally found that US stock markets are exogenous and lead other world markets (Arshanapalli et al., 1995; Masih and Masih, 1999). Given these findings it is reasonable to expect that American domestic macroeconomic variables may influence European stock prices because of the information these variables are likely to contain about future economic activity.

3 Research procedure

Three models will be utilised to test the validity of the present value model and the relationship between economic variables and stock markets in the European Union. The first 'model' uses current industrial production to attempt to test for the relationship between a factor that represents current economic activity and stock prices:

$$SP_t = IP_t - IR_t, \tag{2}$$

where *SP* denotes domestic stock prices, *IP* is industrial production and *IR* is a domestic interest rate series. The present value model is also tested using the relationship below in an identity which is more consistent with market efficiency:

$$SP_t = IP_{t+1} - IR_t, \tag{3}$$

where IP_{t+1} denotes domestic industrial production leading one quarter. According to the present value model, current share prices should be caused by future industrial production. As a proxy for future industrial production, share prices will be led by industrial production by one quarter. Using American industrial production one quarter ahead and American interest rates as the external factors most likely to influence all European stock markets, the two factors below will be incorporated into a model to test the existence of a relationship and whether domestic or foreign factors have greater influence on domestic share prices.

$$SP_t = \mathrm{USIP}_{t+1} - \mathrm{USIR}_t + IP_{t+1} - IR_t, \tag{4}$$

where USIP_{t+1} is American industrial production leading one quarter ahead and USIR_t are American interest rates.

Exactly in the same way we used on behalf of 'Old Europe' German industrial production and interest rates as an external factor of influence for 'New Europe'. Germany is considered as the best representative of the 'Old Europe' countries due to closer economic ties and traditional neighbouring with 'New Europe'. In this case, the equation is

$$SP_t = \mathrm{GERIP}_{t+1} - \mathrm{GERIR}_t + IP_{t+1} - IR_t \tag{5}$$

where GERIP_{t+1} is German industrial production leading one quarter ahead and GERIR_t are the German interest rates. Information regarding the main trading partner for each of the four central eastern European countries examined in this study is given in Table 1.

Table 1 European external trade

Country	*Largest trading partner*				*Second largest trading partner*			
	2000	*2001*	*2002*	*2003*	*2000*	*2001*	*2002*	*2003*
Poland	Germany	Germany	Germany	Germany	EU(15)	EU(15)	EU(15)	EU(15)
Czech Republic	Germany	Germany	Germany	Germany	EU(15)	EU(15)	EU(15)	EU(15)
Slovakia	Germany	Germany	Germany	Germany	EU(15)	EU(15)	EU(15)	EU(15)
Hungary	Germany	Germany	Germany	Germany	EU(15)	EU(15)	EU(15)	EU(15)

The table outlines the main trading partner for each of the four 'new' European countries examined in this study; Poland, Czech Republic, Slovakia and Hungary. The largest and second largest trading partner for each country is given for the years 2000, 2001, 2002 and 2003. The largest trading partner is defined in terms of volume of export and imports of the external trade for the domestic economy.

Source: World trading organization

4 Methodological issues

The theory of cointegration became the most sufficient method for testing the co-dependence between stock markets' indices and macroeconomic factors. The cointegration examines the existence of a long-run common stochastic trend among stock prices' returns, interest rates and industrial production.

In order to test for cointegration, the Johansen's Maximum Likelihood approach (Johansen, 1988) is implemented. The Johansen cointegration procedure firstly specifies the following unrestricted *N*-variable VAR:

$$x_t = \mu + \sum_{i=1}^{k} \prod_i x_{t-i} + u_t \tag{6}$$

where $x'_t = [f'_t, s'_t]$, μ is a vector of intercepts terms and ε_t is a vector of error terms. Johansen (1988) and Johansen and Juselius (1990) reparameterised equation (6) in the form:

$$\Delta x_t = \mu + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \prod x_{t-k} + u_t. \tag{7}$$

Equation (7) is now a VAR reparameterised in error correction form, where $\Pi = -(\Pi - \Pi_1, \ldots, \Pi_k)$ represents the long response matrix. Writing this matrix as $\Pi = \alpha\beta'$, then the linear combinations $\beta'^{x_{t-k}}$ will be $I(0)$ in the existing cointegration, with α being the adjustment coefficients, and the matrix Π will be of reduced rank. The Johansen approach can be used to test for cointegration by assessing the rank (r) of the matrix Π. If $r = 0$, then all the variables are $I(1)$ and there are no cointegrating vectors. If $0 < r < N$, there will be r cointegrating vectors. Last, If $r = N$ then all of the variables are $I(0)$ and, given that any linear combinations of stationary variables will also be stationary, there are N cointegrating vectors.

Long-run structural modelling (LRSM) endeavours to achieve estimates of theoretically meaningful long-run relationships through testing both just-identifying and over-identified restrictions on the cointegrating vectors based on the relevant theories. In other words, LRSM provides a practical approach to discriminate between the vectors by incorporating long-run structural relationships suggested by theory in an otherwise unrestricted VAR model.

In a simple case where $r = 1$, typically the one restriction needed to identify the cointegrating relation can be viewed as a 'normalising' restriction, which could be applied to the coefficient of any of the integrated variables which enter the cointegrating relation (by fixing its coefficient to unity) without changing the likelihood function. However in the more general case where $r > 1$, the number of such 'normalising' restrictions must be at least equal to r linear independent restrictions on each of the cointegrating vectors, which need to be supplemented with further $r_2 - r$ a priori restrictions. The log-likelihood ratio statistic to test over-identifying restrictions is asymptotically distributed as a chi-squared (χ^2) variate with degrees of freedom equal to the number of over-identifying restrictions (v), namely $n - r_2 > 0$. A large value of χ^2 on (v) indicates that over-identifying restrictions are not consistent with data. Estimation of the model subject to all the (exact and over-identifying) restrictions thus enables a test of the validity of the over-identifying restrictions and hence of the economic theory to be carried out. The long-run structural modelling approach described in Pesaran and Shin (1998) and Pesaran and Smith (1999) was used in this study to test just- and over-identifying restrictions.[1]

A practical feature of cointegrated variables is that their time paths are influenced by the extent of any deviation from long-run equilibrium. After all, if the system is to return to equilibrium, the movement of at least some of the variables must respond to the magnitude of the disequilibrium. Thus, having identified the vector, either exactly identified or over-identified, a natural step is to examine the short-term dynamics influenced by temporary deviations from a long-run relationship. This is done by formulating the relationship in terms of vector error correction modelling (VECM). The VECM seeks to uncover the propagation mechanism underlying the behaviour of the dynamics under consideration or to indicate the direction of the Granger (temporal) causality. The VECM is also known as the Granger representation theorem.[2]

In sum, our paper includes a whole set of time series analysis techniques including LRSM of the cointegrating vectors, a VECM and a variance decomposition analysis. After normalising share prices as the dependent variable, LRSM will be used to determine the existence of a long-run causal relationship by placing a restriction of zero on the variable in the cointegrating vector. The rejection of such a restriction implies that the variable must enter the cointegrating vector significantly and a long-run causal relationship is said to exist.

The VECM is a VAR where the non-stationary variables have been transformed into a stationary series by first differencing. Such tests can allow the researcher to examine the relative exogeneity and endogeneity of each variable in the system over the short run as well as examining the significance of the long-run adjustment to the short-run dynamics of the system.

A Variance Decomposition (VDC) analysis can further enhance the above tests of causality by estimating the relative exogeneity and endogeneity of a system of variables in an out of sample test. Furthermore, a VDC can demonstrate the relative significance of each individual variable. This assists the comparison between domestic and international economic variables and their relative impact.

5 Data and empirical results

The mix of countries examined in our study was chosen specifically to allow for comparisons between economies of different sizes and cultures. The countries included are, on behalf of 'Old Europe', UK, France, Italy and Germany and for 'New Europe', Poland, Czech Republic, Slovakia and Hungary. USA is included as a foreign global economic influence as it is the worlds' largest economy and most likely to exert a significant foreign influence on all European countries. German macroeconomic indicators are also used as external factors of influence for 'New Europe' because of their close trading partnership.

The frequency of the data is quarterly. The sample periods for all countries are from 1990Q1 till 2004Q3. The variables data for the present value model of share prices are cash flows (aggregate industrial production), interest rates (Government bond rate) and share prices (total return indexes). The total return share market indexes used are: the British FTSE 100, the French CAC 40, the German DAX, the Italian MIB 30, the American S&P 500, the Polish WIG, the Czech PX50, the Slovakian SAX and the

Hungarian BUX. All indices were sourced from the Datastream International finance database.

Interest rates (IR) and industrial production (IP) indexes for each country were sourced from the International Financial Statistics publication compiled by the International Monetary Fund (IMF). The interest rate selected was a Government Bond rate in all cases. The data were deflated using each country's quarterly consumer price index; all data apart from interest rates were examined in natural log form.

5.1 Unit root tests

The first stage of the analysis was to determine if the time series are non-stationary in level form using both the Augmented Dickey-Fuller (ADF) (1981) and Phillips Perron (1998) tests.[3] The null hypothesis that each time series contains a unit root could not be rejected for all variables. To test that the variables are $I(1)$, the above unit root tests were then applied to the first difference of each variable. The unit root test applied to the first difference of each time series rejected the null of non-stationarity; hence the series can be described as $I(1)$. From the results given by the above unit root tests, it is concluded that all the time series under investigation follow an $I(1)$ process and cointegration tests can now be applied.

5.2 Tests for cointegration

The existence of cointegration in this paper provides strong preliminary evidence in favour of the present value model. If the present value model is to hold for the share prices of European countries, then a stationary long-run relationship must exist between share prices, interest rates and industrial production. The existence of cointegration implies that at least uni direction causality must exist. Unrestricted intercepts and restricted trends were included as exogenous variables in the cointegrating VAR. It is a strong prior that one cointegrating relationship exists in one of the four models outlined, based on the fact that domestic share prices must be caused by the variables that make up either the domestic or foreign present value models. In the case that more than one cointegrating vector is found, then a priori information is used to determine the present value model.

The cointegrating vector tested for current economic activity includes only domestic economic variables and takes the form $\{SP_t, IP_t, IR_t\}$, while the tests for future economic activity include industrial production leading domestic share prices by one quarter; the cointegrating vector takes the form $\{SP_t, IP_{t+1}, IR_t\}$. The cointegration test for external factors includes domestic industrial production leading domestic share prices by one quarter; the external factors used in this test are economic variables from the USA and Germany including industrial production one quarter ahead. The external factor cointegrating vector is given as $\{SP_t, IP_{t+1}, IR_t, \text{USIP}_{t+1}, \text{USIR}\}$ and $\{SP_t, IP_{t+1}, IR_t, \text{GERIP}_{t+1}, \text{GERIR}\}$, respectively. A finding of cointegration provides preliminary evidence in support of the present value model of share prices, which defines a long-run relationship between cash flows (aggregate industrial production), interest rates (Government bond rate) and share prices (total return indexes).

The results of the Johansen ML test for cointegration are presented in Table 2. It can be seen from the results that a finding of cointegration is rejected in most cases, however, our prior assumption that cointegration must be present in at least one model is rejected only twice. The finding of no cointegration in the case of Slovakia and Hungary is not surprising. However, due to the strength of the prior economic theory it is assumed that at least one cointegrating relationship does exist for Slovakia and Hungary thus allowing the tests of causality to proceed.

Table 2 Johansen cointegration tests results

	Current economic activity		*Future economic activity*		*External factors USA*		*External factors Germany*	
Countries	*ME*	*Trace*	*ME*	*Trace*	*ME*	*Trace*	*ME*	*Trace*
UK	$r = 1$	$r = 1$	$r = 0$	$r = 2$	$r = 1$	$r = 1$	$r = 1$	$r = 1$
France	$r = 0$	$r = 1$	$r = 2$	$r = 0$	$r = 1$	$r = 2$	$r = 1$	$r = 2$
Italy	$r = 1$	$r = 1$	$r = 0$	$r = 2$	$r = 0$	$r = 1$	$r = 0$	$r = 0$
Germany	$r = 1$	$r = 0$	$r = 1$	$r = 0$	$r = 0$	$r = 0$	$r = 0$	$r = 0$
Poland	$r = 2$	$r = 1$	$r = 1$	$r = 1$	$r = 0$	$r = 0$	$r = 2$	$r = 1$
Czech republic	$r = 0$	$r = 2$	$r = 0$	$r = 1$	$r = 0$	$r = 1$	$r = 2$	$r = 1$
Slovakia	$r = 1$	$r = 1$	$r = 0$	$r = 0$	$r = 0$	$r = 0$	$r = 1$	$r = 1$
Hungary	$r = 0$	$r = 0$	$r = 0$	$r = 0$	$r = 1$	$r = 1$	$r = 1$	$r = 1$

r: indicates the number of cointegrating relationships found in the Johansen ML cointegration tests. To ascertain the existence of cointegration both the maximal eigenvalue (ME) statistic and the trace statistic were considered and are reported in the table.

5.3 Causality tests

5.3.1 Long- run structural modelling

Table 3 summarises the results obtained from the LRSM analysis, which is specifically used in this paper to determine the existence of long-run causal relationships from economic variables to the domestic share market that is under examination. Each cointegrating equation was normalised on share prices so that the estimated equations can be identified as $\{SP_t = IP_t - IR_t\}$ for the current economic activity model; $\{SP_t = IP_{t+1} - IR_t\}$ for the future economic activity model that is treated as the proxy for the present value model and $\{SP_t = IP_{t+1} - IR_t + \text{USIP}_{t+1} - \text{USIR}\}$ and $\{SP_t = IP_{t+1} - IR_t + \text{GERIP}_{t+1} - \text{GERIR}_t\}$ for the external factor model, which uses USA and Germany as foreign influence.

Unidirectional causality could then be examined by placing a restriction of zero on each variable in question. If that restriction could not be rejected, then the restriction remained in the long-run cointegrating vector; therefore, the variables that appear as zero in the table below are insignificant in causing share prices in the long run. Panels in Table 3 show the results of the LRSM test, which are used in this paper to examine the presence of long-run causality.

Table 3 Summary of long-run structural modelling results

Country share returns	*Variables in the cointegrating vector*				
Panel A: current economic activity					
	IP	*IR*	*Trend*		
UK	3.28	0.046	0.00		
France	1.77	0.00	0.00		
Italy	2.89	0.00	–0.35		
Germany	4.94	0.00	0.00		
Poland	0.69	0.43	–0.24		
Czech Republic	0.00	0.16	0.079		
Slovakia	0.00	0.35	–0.028		
Hungary	0.00	0.42	–0.013		
Panel B: future economic activity					
	IP_{t+1}	*IR*	*Trend*		
UK	2.47	0.00	0.00		
France	1.78	0.00	0.00		
Italy	1.71	0.00	–0.134		
Germany	6.45	0.00	0.00		
Poland	0.00	0.12	–0.042		
Czech Republic	0.33	0.54	0.00		
Slovakia	0.00	0.76	–0.042		
Hungary	0.00	0.22	–0.042		
Panel C: external factors		*(USA)*			
	IP_{t+1}	*IR*	$USIP_{t+1}$	*USIR*	*Trend*
UK	0.00	0.00	0.18	0.88	0.00
France	2.71	0.00	0.00	0.97	0.00
Italy	0.05	0.00	0.00	–0.14	–0.144
Germany	2.98	0.00	0.00	0.83	0.00
Poland	0.83	0.24	0.00	–0.79	–0.002
Czech Republic	0.00	0.31	3.15	–0.77	0.00
Slovakia	0.00	0.13	1.05	–0.54	0.00
Hungary	0.00	0.11	0.75	–0.65	0.00
Panel D: external factors		*(Germany)*			
	IP_{t+1}	*IR*	$GERIP_{t+1}$	*GERIR*	*Trend*
Poland	0.00	0.00	2.87	0.11	0.00
Czech Republic	0.00	0.01	1.05	0.32	0.00
Slovakia	0.00	0.42	4.05	0.49	0.00
Hungary	0.00	0.77	1.87	0.93	0.00

IP refers to current industrial production while IP_{t+1} refers to industrial production leading share prices by a quarter; IR refers to the domestic interest rates used; while $USIP_{t+1}$ and USIR refer to the future US industrial production and US interest rates respectively. $GERIP_{t+1}$ and GERIR refer to the future German industrial production and German interest rates respectively.

In panel A, it can be seen that current industrial production is a significant cause of share prices in UK, France, Italy, Germany and Poland, while interest rates significantly cause share prices in Poland, Hungary, Slovakia and Czech Republic. The significance of current industrial production violates the theory of the present value model and indicates that there is an unexpected portion of industrial production that influences share prices; this influence does not exist in 'new' European Union countries. Panel B indicates that future industrial production significantly causes share prices in 'Old Europe'.

Panel C of Table 3 illustrates share price causality stemming from domestic and American (external) economic factors. The inclusion of US economic factors does not alter the composition of the French and German model, indicating that the domestic economy has greater importance for share prices than the US economy. The opposite is true in the case of UK and Italy where the inclusion of US variables eliminates the significance of domestic future industrial production in favour of the US government bond rate; similarly 'new' European countries domestic interest rates lose significance with the inclusion and subsequent significance of US interest rates.

Domestic industrial production remains significant for French and German share prices, as do US interest rates for all 'Old Europe' countries. Polish share prices appear to look past domestic industrial production to US industrial production, which has a significant positive influence, and US interest rates, which have a significant negative influence. Domestic interest rates were found to have a significant positive influence, which may be consistent with the findings of Fama (1990) that short-term interest rates may track economic activity. Thus, an increase in economic activity is likely to result in an increase in share prices.

Finally, panel D shows share prices causality stemming from domestic and German macroeconomic factors, only in 'New Europe'. In this case, there is a clear German influence on the main indicators in Poland, Slovakia, Czech Republic and Hungary.

5.3.2 Vector error correction model

In Table 4, panel A summarises the results for the error correction model including current economic activity; panel B meanwhile includes the results for the error correction model including future economic activity. Panel C summarises the error correction models that include US influences in all European countries and panel D summarises the error correction models that include German influences in 'New Europe'.

The respective structure of the VECM for the current economic activity model, the future economic activity model (the proxy for the present value model) and external factors model is estimated as:

$$
\begin{aligned}
\Delta SP_t &= a_1 Z_{t-1} + \beta_{SPi}\Delta SP_{t-1} + \beta_{IPi}\Delta IP_{t-1} + \beta_{IRi} IR_{t-1} + \varepsilon_t \\
\Delta SP_t &= a_1 Z_{t-1} + \beta_{SPi}\Delta SP_{t-1} + \beta_{IPi}\Delta IP_{t+1_{T-1}} + \beta_{IRi} IR_{t-1} + \varepsilon_t \\
\Delta SP_t &= a_1 Z_{t-1} + \beta_{SPi}\Delta SP_{t-1} + \beta_{IPi}\Delta IP_{t-1} + \beta_{IRi}\Delta IR_{t-1} + \beta_{\mathrm{USIP}_{t+1}i}\Delta \mathrm{USIP}_{t+1_{T-1}} \\
&\quad + \beta_{\mathrm{USIR}_i}\Delta \mathrm{USIR}_{t-1} + \varepsilon_t \\
\Delta SP_t &= a_1 Z_{t-1} + \beta_{SPi}\Delta SP_{t-1} + \beta_{IPi}\Delta IP_{t-1} + \beta_{IRi}\Delta IR_{t-1} + \beta_{\mathrm{GERIP}_{t+1}i}\Delta \mathrm{GERIP}_{t+1_{T-1}} \\
&\quad + \beta_{\mathrm{GERIR}_i}\Delta \mathrm{GERIR}_{t-1} + \varepsilon_t .
\end{aligned}
\tag{8}
$$

Table 4 Summary of error correction models

Explanatory variable	*Error correction coefficients* *UK*	*France*	*Italy*	*Germany*	*Poland*	*Czech Republic*	*Slovakia*	*Hungary*
Panel A: current economic								
Intercept	0.213	0.034	0.996	0.996	–0.615	0.185	0.287	0.556
dSP1	0.519*	0.329*	0.143*	–0.108*	0.069*	0.173	0.227	–0.015
dIP1	0.356*	0.917*	0.021*	–0.203*	0.664*	–0.806	–0.260	0.500
dIR1	0.728	0.222	0.131*	–0.015*	–0.010*	–0.042*	–0.034*	–0.040*
ECT(1)	0.221	0.518	0.056*	0.018	–0.041*	–0.029*	–0.029*	–0.141*
Panel B: future economic activity								
Intercept	0.338	0.578	0.029*	–0.380	–1.53*	0.156	0.329*	–0.031
$dSP1_{t+1}$	0.518	0.723	0.065*	–0.099	0.041	0.114	0.192	–0.009
dIP1	0.912	0.438	0.046	1.547*	0.26	0.512	0.412	0.796
dIR1	0.883	0.102	0.001	–0.028*	–0.013	–0.039	–0.006	–0.032*
ECT(1)	0.983*	1.115*	1.060*	–0.037*	0.104*	–0.032	–0.034*	–0.145*
Panel C: external factors (USA)								
Intercept	0.983	0.319	0.025*	–0.008	–1.61*	–0.120	0.198*	–0.383*
dSP1	0.078*	0.328	0.051*	–0.125	0.048	0.140	0.083	–0.063
dIP1	0.121	0.031	0.085	1.542*	0.35	0.548	0.098	0.818
dIR1	0.022	0.381	0.002	–0.026	–0.013	–0.038	–0.001	–0.043*
dUSIP1	0.218*	0.031	0.361*	0.004	–1.97	–0.322	0.460	0.968
dUSIR1	0.311*	0.889	–0.003	–0.001	0.005	–0.022*	–0.001	–0.011
ECT(1)	0.131*	1.101*	1.091*	0.005	–0.095*	0.002	–0.020*	–0.049*
Panel D: external factors (Germany)								
Intercept					–1.61*	–0.120	0.198*	–0.383*
dSP1					0.048	0.140	0.083	–0.063
$dIP1_{t+1}$					0.35	0.548	0.098	0.818
$dIR1_{t+1}$					–0.013	–0.038	–0.001	–0.043*
dGERIP1					–1.97	–0.322	0.460	0.968
dGERIR1					0.005	–0.022*	–0.001	–0.011
ECT(1)					–0.095*	0.002	–0.020*	–0.049*

*denotes significance at the 5% level. *T*-statistics are tests of the null hypothesis that the coefficient is equal to zero.

dSP1, dIR1, dIP1, dUSIR1, dUSIP1, dGERIR1, and dGERIP1 denote domestic share prices, domestic interest rates, domestic industrial production, US and German government bond rate and industrial production respectively.

The dependent variable in each model is change in domestic share prices, ΔSP_{t-1}, while $\Delta IR_{t-1}, \Delta IP_{t-1}, \Delta \mathrm{USIP}_{t-1}, \Delta \mathrm{USIP}_{t+1_{r-1}}, \Delta \mathrm{USIR}_{t-1}, \Delta \mathrm{GERIP}_{t+1_{r-1}}$ and $\Delta \mathrm{GERIR}_{t-1}$ are the differenced temporary lagged explanatory variables for domestic interest rates, domestic industrial production, US and German government bond rate and industrial production, respectively.

The significance of these variables describes a short-term causal relationship with share price return. The error correction term is taken from the cointegrating VAR and highlights a_1Z_{t-1} influence of the speed and significance of the long-run adjustment on domestic share returns; it is denoted by ECT(1) in the table.

A VECM provides evidence of short-term causality as well as indicating the significance and speed of the long-run error adjustment via the error correction term. The results of the VECM are presented in Table 4. In the current economic activity model, share prices and current industrial production were found to have significant short-term causes on 'old' Europe and Polish share prices while interest rates were a significant short-term cause of all countries' share prices. The fact that past share prices are a significant cause of future share prices in 'new' European countries and Italy is a violation of weak from market efficiency. It was expected that the error correction terms (ECT 1) in the current activity model would not be significant as this model does not represent the present value model; it is expected that in the future economic activity model the error correction terms will be significant representing the correction to the long-run relationship that is the present value model.

Evidence of significant short-term causality in the model for future economic activity is also rare; future industrial production is only significant for Germany, while interest rates are significant for Germany and Hungary. Past share prices are surprisingly a significant short-term cause of future share prices in Italy. As expected the majority of error correction terms are significant in the future economic activity models, with Slovakia having the fastest error correction adjustment and France the slowest.

As displayed in panel C, US future industrial production and interest rate in the VECM have a short-term causal relationship with UK, Italy and Poland, respectively, while there is little change to the significance or size of the error correction terms. Finally, panel D shows the close economic ties and causal relationship between Germany and for all 'new' European countries with few exceptions.

6 Conclusions

This paper has attempted to model eight European Union countries' share markets in two groups ('old' and 'new' Europe) on a domestic or external present value model for share prices. A current economic activity multifactor model, a future economic activity model and two alternative external factor models were estimated. These models proposed incorporated both global and local factors by a set of macroeconomic variables such as industrial production and interest rates in different time lags. Using cointegration and causality techniques for UK, France, Italy, Germany, Poland Czech Republic, Slovakia, Hungary and USA, we selected evidence for their economic integration.

The US automatically selected as an external factor of global influence for all European Union countries and Germany was also selected as an economic influence only for 'new' European countries, based on trading partnership data.

The prior condition that all share markets should adhere to either a domestic or external present value model (as tested via the presence of cointegration) was upheld in all cases. As expected economic variables were generally a significant cause of share prices as shown via LRSM. Generally domestic industrial production was more prominent than domestic interest rates, while US interest rates are more prominent than US industrial production. Furthermore, a number of short-run causal relationships were also found giving different implications for policy makers interested in long-run and short-run contagion. The main findings strongly suggest that the emerging CE European capital markets are macro economically cointegrated with the German economic influence, but less or none influenced by the American global factor.

Our results also support portfolio management decisions. Foreign investors (US) can benefit from diversifying into equity markets of 'new' European countries, since these markets are not cointegrated with the American global economic influence. The relatively low correlations of returns between the US and CE European markets are not dependent and do indicate diversification benefits for both short- and long-term investors.

On the other hand, 'new' Europe seems to become increasingly integrated with 'old' Europe. Such a situation was expected, especially with Germany, due to their very close trading, cultural and historical partnership.

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Notes

[1]This test of over-identifying restrictions on the cointegrating relations pre-assumes that the variables, $X_t = (y_t, x_t)$, are $I(1)$, and the number of cointegrating relations, r, is correctly chosen.

[2]The Granger Representation theorem states that, for any set of $I(1)$ variables, error correction and cointegration are equivalent representations. In a cointegrated system, $\{z_t\}$ does not Granger cause $\{y_t\}$ if lagged values Δz_{t-1} does not enter the Δy_t equation and if y_t does not respond to deviations from the long-run equilibrium.

[3]For the sake of brevity, the results of the ADF and PP tests are not presented but are available upon request.