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Stock Market and Economic Growth: Evidence from three CEECs

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Abstract

This paper estimates a bivariate VAR-GARCH(1,1) model to examine linkages between stock market and economic growth in three CEEC countries (the Czech Republic, Hungary and Poland). The empirical findings suggest that there is unidirectional causality running from stock markets to growth in the levels, this linkage becoming stronger following the EU accession, which appears to be beneficial, presumably as a catalyst for institutional building and development. The same holds in most cases for volatility spillovers as well. In addition, Germany is confirmed to act as a locomotive for these countries, and a tight monetary policy is found to affect both economic and stock market growth adversely.

Keywords: Central and Eastern European countries (CEECs), GARCH model, Volatility spillovers

JEL Classification: C32, F36, G15.

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1 Introduction

The literature on the finance-growth nexus is extensive, most studies concluding that financial depth boosts growth (Levine, 1997, 2005; Wachtel, 2001) through several possible channels (e.g., by easing the exchange of goods and services through the provision of payment services, mobilising and pooling savings from a large number of investors, detecting investment opportunities, carrying out corporate governance, diversifying, increasing liquidity, reducing intertemporal risk etc. - see Levine, 2005).

A particularly interesting case is that of the Central and Eastern European countries (CEECs), where reforming the banking sector was the first crucial step towards financial development. From the 1990s foreign banks were allowed to enter the market, and within a decade they held a majority share in most CEEC banks and had turned a heavily regulated industry into a highly competitive one, stimulating economic growth to some extent. However, even after accession to the European Union, real GDP per capita in these countries remained considerably lower than the EU average, and the catch-up process was far from having been completed. Moreover, volatility in output growth has remained higher than in the other EU countries. Coricelli and Masten (2004) try to provide an explanation for the relatively low economic growth and its high volatility by examining the channels through which the credit markets could have affected them. They employ the GMM method to estimate Barro-type growth regressions including three indicators of financial development (i.e., credit to the non-government sector as a ratio to GDP, the spread of lending versus deposit rates and the EBRD index of institutional development) and argue that the underdevelopment of the banking sector and of the stock market, which was partially compensated by the growth of trade credit, could account for the low and volatile growth, the reason being that trade credit chains generate more volatility by trasmitting local shocks to the aggregate economy.

Only relatively few other empirical studies have examined the linkages between finance and growth in these countries. Hermes and Lensink (2000) focus on the role of stock markets in the process of financial intermediation and of deposit insurance to improve stability of the banking sector. Berglöf and Bolton (2002) do not find much evidence of a finance-growth nexus in the first decade of transition. Kenourgios and Samitas (2007) report that in Poland credit to the private sector was one of the main drivers of growth. Fink et al. (2005) find that financial depth affects growth positively only in the short run in a sample of 33 countries (11 transition economies and 22 market economies). Fink et al. (2008) conclude that financial market segments with links to the public sector (but not to stock markets) contributed to growth in nine EU-accession countries over the early transition years (1996–2000). Well-functioning financial intermediaries also appear to have had a significant impact on economic growth (Bonin and Watchel, 2003). Caporale et al. (2009) provide evidence for ten new EU members by estimating a dynamic panel model using GMM methods over the period 1994-2007. They report that stock and credit markets are still underdeveloped in these economies, and that their contribution to economic growth has been limited. By contrast, a more efficient banking sector is found to have accelerated growth. Furthermore, Granger causality test indicate that causality runs from financial development to economic growth, but not in the opposite direction. Kurach (2010) also takes a panel approach and finds that GDP growth, banking sector development, market liquidity, fiscal balance and EU membership have positive effects on stock market capitalisation in thirteen CEECs[1].

The present study provides more evidence on the linkages between stock market and economic growth, both in their levels and their volatilities, in three CEEC countries, namely the Czech Republic, Hungary and Poland (those with the highest market capitalisation in the region). The econometric framework is a bivariate VAR-GARCH (1,1) model including a dummy variable to evaluate the EU accession effect. This is important, since accession was expected to be a catalyst for further institutional change, institutional variables being increasingly used as a measure of financial development (see Beck et al., 2001).

The layout of the paper is the following. Section 2 outlines the econometric modelling approach. Section 3 describes the data and presents the empirical findings. Section 4 offers some concluding remarks.

2 The model

We model the joint process governing the stock market returns index and economic growth in Central Europe using a bivariate VAR-GARCH(1,1) specification[2]. In order to test for possible effects of the EU accession (May 2004), we include a dummy variable (denoted by *) in the first and second moment. The model has the following specification:

$$\mathbf{x}_t = \boldsymbol{\alpha} + \boldsymbol{\beta}\mathbf{x}_{t-1} + \boldsymbol{\gamma}\mathbf{f}_{t-1} + \boldsymbol{\delta}\mathbf{z}_{t-1} + \mathbf{u}_t \tag{1}$$

where $\mathbf{x}_t = (Stock_t \ \mathrm{Re}\,turns, G\,\mathrm{row}\,th_t)$. We control for monetary policy shocks including in the mean equation the domestic 90-days Treasury Bill rate ($\mathbf{f}_{t-1}$). Furthermore, exogenous shocks measured by German stock market returns and economic growth are also included ($\mathbf{z}_{t-1}$). The residual vector $\mathbf{u}_t = (e_{1,t}, e_{2,t})$ is bivariate and normally distributed $\mathbf{u}_t \mid I_{t-1} \sim (\mathbf{0}, H_t)$ with its corresponding conditional variance covariance matrix given by:

$$H_t = \begin{bmatrix} h_{11t} & h_{12t} \\ h_{12t} & h_{22t} \end{bmatrix} \tag{2}$$

The parameter vector of the mean return equation (1) is given by the constant $\boldsymbol{\alpha} = (\alpha_1, \alpha_2)$ and the autoregressive term, $\boldsymbol{\beta} = (\beta_{11}, \beta_{12} + \beta_{12}^{*} \mid \beta_{21} + \beta_{21}^{*}, \beta_{22})$. Furthermore, $\boldsymbol{\gamma} = (\gamma_{11} \mid \gamma_{22})$ and $\boldsymbol{\delta} = (\delta_{11} \mid \delta_{22})$ are respectively the monetary policy shocks and the exogenous parameters[3]. The parameter matrices for the variance Equation (2) are defined as C_0, which is restricted to be upper triangular, and two unrestricted matrices A_{11} and G_{11}. Therefore, the second moment will take the following form:

[1] Caporale and Spagnolo (2011) estimate a trivariate VAR-GARCH(1,1)-in-mean model to examine linkages between the same three CEECs as well as the UK and Russia. Their empirical findings suggest that there is significant co-movement (interdependence) of these markets with both the Russian and the UK ones. Furthermore, whilst the introduction of the euro has had mixed effects, EU accession has resulted in an increase in volatility spillovers between the three CEECs considered and the UK (contagion).

[2] The model is based on the GARCH(1,1)-BEKK representation proposed by Engle and Kroner (1995).

[3] Note that δ_{11} measures the effect of German stock market returns and is included in the returns equation whereas δ_{22} measures the effect of the German economic growth and is included in the growth equation.

$$
\begin{aligned}
H_t &= C_0^{'}C_0 + \begin{bmatrix} g_{11} & g_{12}+g_{12}^* \\ g_{21}+g_{21}^* & g_{22} \end{bmatrix}^{'} H_{t-1} \begin{bmatrix} g_{11} & g_{12}+g_{12}^* \\ g_{21}+g_{21}^* & g_{22} \end{bmatrix} \\
&+ \begin{bmatrix} a_{11} & a_{12}+a_{12}^* \\ a_{21}+a_{21}^* & a_{22} \end{bmatrix}^{'} \begin{bmatrix} e_{1,t-1}^2 & e_{2,t-1}e_{1,t-1} \\ e_{1,t-1}e_{2,t-1} & e_{2,t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11} & a_{12}+a_{12}^* \\ a_{21}+a_{21}^* & a_{22} \end{bmatrix} \quad (3)
\end{aligned}
$$

Equation (3) models the dynamic process of H_t as a linear function of its own past values H_{t-1} and past values of the squared innovations $\left(e_{1,t-1}^2, e_{2,t-1}^2\right)$. The BEKK model guarantees by construction that the covariance matrix in the system is positive definite. Given a sample of T observations, a vector of unknown parameters θ and a 2×1 vector of variables $\mathbf{x}_t$, the conditional density function for the model (1) is:

$$
f\left(r_t|I_{t-1};\theta\right) = (2\pi)^{-1}\left|H_t\right|^{-1/2}\exp\left(-\frac{\mathbf{u}_t^{'}\left(H_t^{-1}\right)\mathbf{u}_t}{2}\right)
$$

The log likelihood function is:

$$
L = \sum_{t=1}^{T} \log f\left(r_t|I_{t-1};\theta\right)
$$

where θ is the vector of unknown parameters. Standard errors are calculated using the quasi-maximum likelihood method of Bollerslev and Wooldridge (1992), which is robust to the distribution of the underlying residuals.

3 Empirical results

We use monthly data (from Datastream) for three CEEC countries, namely the Czech Republic, Hungary and Poland. Furthermore we control for monetary policy by including 90 days Treasury Bills over the period 1/1996 - 4/2011, for a total of 182 observations. The CEEC area countries under investigation are the three biggest financial markets in the region by market capitalisation. We define monthly stock returns and economic growth as logarithmic differences of stock indices and industrial production (as a proxy for Gross Domestic Product) respectively. In order to test the adequacy of the models, Ljung– Box portmanteau tests were performed on standardized residuals and squared residuals. Overall the results indicate that the VAR-GARCH(1,1) specification captures satisfactorily the persistence in the first and second moment of all the series considered. Cross-market dependence in the conditional mean and variance vary in magnitude and sign across countries. Note that the sign in cross-market volatilities are not relevant.

Please Insert Tables 1-3 about here

The estimated VAR-GARCH(1,1) models with the associated robust standard errors and likelihood function values are presented in Tables 1-3. We select the optimal lag length of the mean equation using the Schwarz information criterion. The parameter estimates for the conditional means suggest statistically significant bidirectional spillovers-in-mean at the standard 5% significance level. In particular, spillovers originating from financial markets are bigger than those from the real economy ($\beta_{12} < \beta_{21}$) for all countries considered. This finding seems to be reinforced by the EU accession. Concerning the conditional variance equations, the estimated "own-market" coefficients are statistically significant and the estimates of g_{11} suggest a high degree of persistence in the volatility of stock returns. By means of Wald tests we test several other hypotheses, specifically (i) the presence of spillovers from stock market volatility ($a_{21} = g_{21} = 0$) to economic growth volatility; (ii) the presence of spillovers from economic growth volatility ($a_{12} = g_{12} = 0$) to stock market volatility; (iii) the effect of stock market volatility ($a^*_{21} = g^*_{21} = 0$) on economic growth volatility after the EU accession, and (iv) the effect of economic growth volatility ($a^*_{12} = g^*_{12} = 0$) on stock market volatility after the EU accession. The results reported in Tables 1 to 3 suggest the following.

First, when considering the effect of stock market returns on economic growth (mean equation) we observe significant spillover effects for all countries considered. The coefficient is largest in the case of Hungary, being equal to 0.2723. The spillover effects increase after the EU accession ($\beta_{21} + \beta^*_{21}$), in the case of Hungary the corresponding coefficient increasing to 0.4371. On the contrary, the effect of economic growth on stock market returns is not statistically significant either before ($\beta_{12} = 0$) or after the EU accession ($\beta^*_{12} = 0$) for all countries considered.

Concerning the effect of stock market return volatility on economic growth volatility, we also find evidence of significant spillovers. In particular, in the case of Czech Republic these are stronger ($a_{12} = 0.2879$) compared to those for Hungary (0.1850) and Poland (-0.2182). The effects of the EU accession on spillovers all go in the same direction with an increase in the EU accession coefficient ($a_{12} + a^*_{12}$).The increase[4] is particularly marked in the case of Poland (-0.4613). On the contrary, we find evidence of spillovers running from economic growth volatility to stock market volatility only in the case of Poland ($a_{21} = 0.3859$) before the EU accession. The positive sign of the dummy coefficient in both the mean and the variance equation can be interpreted as a reputational effect by arguing that EU membership decreases a country's investment risk and therefore leads to higher investment and growth.

As for the control variables, the German economy appears to have a leading role for all the three countries considered, with positive and statistically significant coefficients (measured by δ_{22}) being equal to 0.0428, 0.0255, and 0.0338 for the Czech Republic, Hungary, and Poland, respectively. Furthermore, the German stock market also has a positive impact (measured by δ_{11}) on the domestic stock markets with the estimated coefficients being equal to $0.3213, 0.2510$, and 0.3633 for the Czech Republic, Hungary, and Poland, respectively. Finally, the monetary policy variable considered, in accordance with our prior, is statistically significant for all the three countries and indicates a negative interest rate impact on both economic growth ($\gamma_{22} < 0$) and stock markets ($\gamma_{11} < 0$).

4 Conclusions

This paper has analysed level and volatility spillovers between stock market returns and economic growth for three CEEC countries (the Czech Republic, Hungary and Poland) using a VAR-GARCH(1,1) framework. The empirical findings suggest that there is unidirectional

[4] Note that in the conditional variance equation the sign of parameters is not relevant and should be considered in absolute value.

causality running from stock markets to growth in the levels, this linkage becoming stronger following the EU accession. The same holds in most cases for volatility spillovers as well. In addition, Germany is confirmed to act as a locomotive for these countries, and a tight monetary policy is found to affect both economic and stock market growth adversely.

Following the early transition phase, elements of market-oriented intermediation had already become the rule rather than the exception in these countries, despite the fact that financial depth was still limited (Bonin and Wachtel, 2003). The implementation of additional reforms, the entry of foreign banks and the privatisation of state-owned banks have reduced transaction costs and increased credit availability (see Caporale et al., 2009). Our results suggest that EU accession has provided a strong impetus, strengthening the effects of stock market growth on economic growth, presumably through institutional building and development. Other possible benefits are risk diversification and wider access to smoothing instruments. However, whilst accession has improved the efficiency of the banking sector, it has also increased contagion risks within the region and with other major economies outside it (see Caporale and Spagnolo, 2011). Regarding the effects on output growth volatility, a decrease after accession can be rationalised in terms of the higher efficiency of financial markets in the EU as a whole, which could reduce the transmission of shocks to output (see Coricelli and Masten, 2004). The adoption of the euro could further stimulate financial development and growth, although it has also been argued that it could lead to an excessive credit expansion by reducing nominal interest rates, with resulting lower real rates and higher credit (see Schadler et al., 2003); this, however, might not represent a problem in the context of the Eurozone as a whole, with the elimination of currency risks and improved efficiency of the financial sector (see Coricelli and Masten, 2004).

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TABLE 1: Estimated VAR-GARCH(1,1) model

Czech Republic

	Coeff.	S.E.		Coeff.	S.E.
			Conditional Mean Equation		
α_1	0.0058	(0.0026)	β_{11}	0.2738	(0.0691)
α_2	0.0048	(0.0015)	β_{22}	-0.1955	(0.0908)
γ_{11}	-0.0017	(0.0007)	β_{12}		
γ_{22}	-0.0010	(0.0001)	β^*_{12}		
δ_{11}	0.3213	(0.0639)	β_{21}	0.0662	(0.0222)
δ_{22}	0.0428	(0.0201)	β^*_{21}	0.0317	(0.0122)
			Conditional Variance Equation		
c_{11}	0.0486	(0.0103)			
c_{12}	0.0027	(0.0009)			
c_{22}	0.0001	(0.0001)			
g_{11}	-0.4302	(0.1859)	a_{11}	0.2048	(0.0992)
g_{21}			a_{21}		
g^*_{21}			a^*_{21}		
g_{12}	0.2064	(0.0648)	a_{12}	0.2879	(0.0371)
g^*_{12}	-1.0991	(0.4456)	a^*_{12}	0.2284	(0.0494)
g_{22}	-0.3383	(0.1642)	a_{22}	-0.7058	(0.0832)
LogLik	1022.14				
$LB_{Growth,(5)}$	8.4858		$LB_{Stock,(5)}$	7.0493	
$LB^2_{Growth,(5)}$	3.7098		$LB^2_{Stock,(5)}$	5.3075	

Note: Standard errors (S.E.) are calculated using the quasi-maximum likelihood method of Bollerslev and Wooldridge (1992), which is robust to the distribution of the underlying residuals. All parameters reported are statistically significant at 5%. $\text{LB}_{Growth(5)}$ and $\text{LB}^2_{Stock(5)}$ are respectively the Ljung-Box test (1978) of significance of autocorrelations of five lags in the standardized and standardized squared residuals for economic growth and stock market returns. Parameters β_{21}, a_{12} and g_{12} measure the causality effect running from economic growth to stock market returns whereas parameters β_{12}, a_{21} and g_{21} measure the causality effect running from stock market returns to economic growth. Parameters indicated with a * refer to the EU accession dummy variable. The covariance stationary condition is satisfied by all the estimated models, all the eigenvalues of $A_{11}\otimes A_{11}+G_{11}\otimes G_{11}$ being less than one in modulus. Note that in the conditional variance equation the sign of parameters is not relevant. Parameters not statistically significative at 5% are not reported.

TABLE 2: Estimated VAR-GARCH(1,1) model
Hungary

	Coeff.	S.E.		Coeff.	S.E.
		Conditional Mean Equation			
α_1	0.0064	(0.0028)	β_{11}	0.2521	(0.0592)
α_2	0.0096	(0.0021)	β_{22}	-0.3775	(0.0661)
γ_{11}	-0.0007	(0.0001)	β_{12}		
γ_{22}	-0.0039	(0.0017)	β_{12}^*		
δ_{11}	0.2510	(0.0722)	β_{21}	0.2723	(0.0602)
δ_{22}	0.0255	(0.0101)	β_{21}^*	0.1648	(0.0602)
		Conditional Variance Equation			
c_{11}	0.0114	(0.0162)			
c_{12}	0.0054	(0.0025)			
c_{22}	0.0001	(0.0001)			
g_{11}	0.2352	(0.0985)	a_{11}	0.1621	(0.0713)
g_{21}			a_{21}		
g_{21}^*			a_{21}^*		
g_{12}	0.3946	(0.0652)	a_{12}	0.1850	(0.0869)
g_{12}^*	-0.9266	(0.4453)	a_{12}^*	0.2016	(0.2185)
g_{22}	0.3314	(0.1023)	a_{22}	-0.0937	(0.0408)
LogLik	996.16				
$LB_{Growth,(5)}$	7.5941		$LB_{Stock,(5)}$	6.7969	
$LB^2_{Growth,(5)}$	5.1716		$LB^2_{Stock,(5)}$	9.5946	

Note: See notes Table 1.

TABLE 3: Estimated VAR-GARCH(1,1) model
Poland

	Coeff.	S.E.		Coeff.	S.E.
		Conditional Mean Equation			
α_1	0.0087	(0.0043)	β_{11}	0.2328	(0.0735)
α_2	0.0120	(0.0056)	β_{22}	-0.2179	(0.0512)
γ_{11}	-0.0005	(0.0001)	β_{12}		
γ_{22}	-0.0058	(0.0016)	β^*_{12}		
δ_{11}	0.3633	(0.0840)	β_{21}	0.1178	(0.0260)
δ_{22}	0.0338	(0.0147)	β^*_{21}	0.0161	(0.1261)
		Conditional Variance Equation			
c_{11}	0.0138	(0.0064)			
c_{12}	-0.0069	(0.0014)			
c_{22}	0.0001	(0.0001)			
g_{11}	0.4675	(0.1992)	a_{11}	0.1245	(0.0505)
g_{21}	-0.9009	(0.1147)	a_{21}	0.3859	(0.0926)
g^*_{21}			a^*_{21}		
g_{12}	0.5768	(0.1159)	a_{12}	-0.2182	(0.1019)
g^*_{12}	-1.6972	(0.3727)	a^*_{12}	-0.2431	(0.0926)
g_{22}	-0.2325	(0.0797)	a_{22}	-0.1698	(0.0759)
LogLik	838.25				
$LB_{Growth,(5)}$	1.8812		$LB_{Stock,(5)}$	4.7535	
$LB^2_{Growth,(5)}$	2.2524		$LB^2_{Stock,(5)}$	5.8999	

Note: See notes Table 1.