CENTRAL AND EASTERN EUROPEAN STOCK MARKETS IN TIMES OF CRISIS

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Abstract

The recent collapse of international capital markets, after a period of accelerated development, led inevitably to refresh interests on the subject emerging market volatility. In this regard, the purpose of this study is to analyse the impact of macroeconomic factors on the evolution of volatility of one emerging stock market from Central and Eastern Europe in the period January 2010 - November 2013. Using ARCH family models and a set of variables: the volume of trading BET, the interest rate on short-term exchange rates EUR/ROL and USD/EUR and the American stock index S&P500, we tested the impact of the determinants of national versus international on the variation of an index from Emerging Europe after the crisis.

I. Introduction

The development of stock markets has not been and is still not a linear process, but on the contrary, is strewn with periods of crisis and stagnation, phenomena that in a globalised world is propagating differently from one region to another, displaying striking differences between the markets. In the context of permanent mutations, the international size and importance of emerging stock markets has increased considerably, having as result the increasing role in the economy of these segment and, thus, enhancing their participation in the global context. Moreover, when the global crisis is addressed, two main features of the evolution of stock markets in Central and Eastern Europe are highlighted in the literature: strong correlation with the trend of international stock exchanges, i.e. a relatively high degree of contagion and decoupling from the development of national economy.

Given these and the fact that the economic crisis of 2008 has not lost its pulse in the European perimeter it inevitably led to reviving interests regarding the volatility of these markets. Although the variations of financial asset prices are a normal part of the process of allocation of funds in a competitive environment, the extreme values

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are damaging: they negatively affect the proper functioning of the financial system and, thus, the economic performance. Moreover, indirect negative implications of large stock prices fluctuations are reflected on consumer spending and business environment. In addition, is well documented the fact that emergent markets are more likely to generate higher degree of volatility than the developed ones (Wang, 2007).

In these circumstances, the aim of this study is to analyse the impact of domestic and international macroeconomic indicators on the evolution of volatility of the Romanian stock market.

Using the GARCH family models, we find that the increase in the volatility of Romanian stock exchange can be attributed especially to international spillovers, while the domestic factors explains in a lesser extent the volatility of the market.

We consider ourselves entitled to believe that this study represents an increasingly interesting challenge for the policymakers and for the researchers in the field. Beyond the interest that characterizes the pure scientific knowledge, the pragmatic utility of this study lies in the real force of prediction that a responsible policy maker is not allowed to disregard. Thus, the governments can adopt policies in order to prevent or better manage the negative consequences that the volatility of stock market could have over the economic growth on the long run.

II. Literature review

There is a wide literature written on the topic “volatility of stock markets”, but there is still room for research in the field given the fact that the empirical results are controversial. From this encyclopaedia of factors that have an impact on emerging capital market volatility we were interested only on macroeconomic indicators and capital flow liberalization.

First, we remember the impact of the changes in macroeconomic factors on the volatility of financial asset prices. In this regard, the economic theory postulates the idea that " fundamentals matter, but in a non-routine manner" in explaining and understanding the oscillations of capital markets (Frydman and Goldberg, 2011, p. 214). The authors add that the empirical puzzles are not anomalies but are artefacts of the discontinuity between predetermined mathematical models and market reality. In the empirical register, Officer's work (1973) is pioneering in confirming the impact of macroeconomic factors on the volatility of capital markets. Moreover, in the perimeter of emerging stock markets, the articles developed by Pierdzioch et al. (2008) and Zhao (2010) and Bartram and Bodnar (2012) validate also the influence the macroeconomic indicators such as interest rates, money supply and exchange rates over stock market volatility.

However, we notice, that there are results in the literature that are not precisely consonant with economic theory. Here the differences of opinion are not translated into an absolute negation of the nexus between the economic factors and stock market volatility (an absurd fact!), but into a weak linkage, almost non-existent, between them. The reference work that supports this idea is that of Schwert (1989) that shows that macroeconomic volatility does not help in predicting stock market volatility, with the exception of some sub-periods. This puzzle was also confirmed in

the empirical research among emerging markets (Ibrahim, 2002; Abugri, 2008; Wang, 2010).

Second, among the determinants of volatility in emerging stock markets we find the major global events, particularly economic and financial crises. Thus, numerous studies have analysed the emerging market volatility consistent with the events that took place globally and also the contagion effect on these markets. In this regard, the authors Wang and Moore (2009) investigated sudden changes in the volatility of capital markets in Central Europe and found that these sudden changes occurred due to the evolution of emerging markets and the integration process of the New Member States, changes in exchange rate policy and financial crises. Michelfelder and Pandya (2005) demonstrated that shocks on the US financial market are rapidly transmitted at the global level, but the innovations in other financial markets do not have a large impact on the US capital markets. However, in an increasingly globalised world, the answer to the question which is the sign between financial liberalisation and stock market volatility is tricky. On one hand, there are studies that points out that an increased liberalisation reduces the volatility of financial assets (Umutlu et al., 2010; Jaleel and Samarakoon, 2009). On the other hand, Stiglitz (2004) and Gabaix et al. (2006) argues that foreign portfolio investments can cause instability or excessive volatility in the group of emerging capital markets.

On the background of the aforementioned empirical evidences, a parallel between the two determinants has been sketched in the literature. This highlights the fact that major influences on the volatility of emerging markets come from major global events, while the impact of national variables loses its intensity. Concerned by these problems, Michelfelder and Pandya (2005), Wang and Moore (2009) and Ulku and Demirci (2012) proved that the main causes of sudden changes in Emerging Europe are major global events rather than local factors.

The literature reviewed on the topic offers a generous unexploited niche. First we mention the divergence of opinions on the impact of macroeconomic domestic variables versus external ones on the volatility of emerging markets. Second, although the literature in the field is vast, the mainly targeted markets are those from Asia, and to a lesser extent those from Eastern Europe. In our research we try to cover this gap.

Conclusive, it appears that the factors that influence the volatility of emerging markets have changed or, in other words, involve a different hierarchy. Therefore, we want to find out which is the new hierarchy for the determinants of Romanian stock market volatility. Is this more international or more domestic?

III. Data

To depict movements between stock market volatility and domestic and international macroeconomic factors, we perform our empirical research using a GARCH model on the experience of Romanian stock market. Therefore, we will analyse the BET index. We have chosen this index because it represents the reference index for the Romanian capital markets. The importance of this derives from the fact that, in general, emerging markets face a lower number of transactions compared to

developed markets, and selecting this aggregate index dilute the effects of this unfavourable conjuncture.

The independent variables that we will use in testing our hypothesis are the following: short-term interest rates for loans granted in national currency in the interbank market – overnight (IRS), overnight US dollar LIBOR interest rate (LIBOR), the exchange rates measured as local currency per EUR (EUR/ROL) and USD per EUR (EUR/USD), the Industrial Production Index (IPI), the unemployment rate (UR) and the gross average salary earnings (WAGES). The industrial production index is seasonally adjusted. Taking into consideration that original series dispersion is not constant, the variables will be logarithmic transformed, in order to stabilize the variance, except for the interest rates.

We have considered the short-term interest rates as proxy for the benchmark interest rate of the National Bank of Romania. The theoretical register indicates that the changes of interest rate determine the fluctuation of stock prices in the opposite direction, thereby increasing their related volatility. The other domestic variables, i.e. industrial production index, unemployment rate and the wages are included in the analysis in order to control the influence of national factors. The preference for the two exchange rates is justified it by intention to capture the nominal external influences. The empirical evidence links the exchange rate fluctuations to an increased volatility of stock markets.

Monthly time series data ranging from 2005M01 to 2015M02 have been used. The data is collected from Datastream Thomson Reuters.

IV. Methodology

The working hypothesis is that international factors have a higher impact than the domestic ones on the volatility of the capital market in Romania.

In order to investigate the volatility of stock index returns we will perform the GARCH methodology (Generalized Autoregressive Conditional Heteroskedasticity Model) proposed by Bollerslev in 1986. The specifications of GARCH model, illustrated below, are generally used and accepted in the literature (e.g. Taylor, 2005; Poon, 2005; Asteriou and Hall, 2007) and the notations belong to Asteriou and Hall (2007). The general form of GARCH (p, q) is defined as:

Mean equation: $$Y_t = \alpha + \beta' X_t + u_t \qquad (1)$$

$$u_t \sim i.i.d.N(0, \sigma_t^2)$$

Where, Y_t is the rentability of the index, X_t is a k×1 vector of explanatory variables, β is a k×1 vector of coefficients, α is the constant. Normally, we assume that the error term, u_t is independently distributed with a zero mean and a constant variance σ2.

Variance equation: $$\sigma_t^2 = \omega + \sum_{i=1}^{p} \delta_i \sigma_{t-i}^2 + \sum_{j=1}^{q} \gamma_j u_{t-j}^2 \qquad (2)$$

Where, ω is the constant term, δ_i are the GARCH parameters that have to be estimated and γ_j are the ARCH terms.

In the financial empirical research, the most popular specification of this model is GARCH (1,1). The fame of this model is justified by: the model has only four parameters easy to estimate, the volatility forecasts using this model have similar accuracy to the specifications of more complicated models (Taylor, 2005; Lunde and Hansen, 2004). In these circumstances, the conditional variance equation is given by the formula:

$$\sigma_t^2 = \omega + \delta\sigma_{t-1}^2 + \gamma u_{t-1}^2 \quad (3)$$

Moreover, we will try to capture asymmetries in terms of negative and positive shocks by using the threshold GARCH (TGARCH) with the following formula (for a TGARCH(1,1)):

$$\sigma_t^2 = \omega + \delta\sigma_{t-1}^2 + \gamma u_{t-1}^2 + \theta u_{t-1}^2 d_{t-1} \quad (4)$$

Where d_t takes the value of 1 for $u_t < 0$, and 0 otherwise. Therefore 'good news' and 'bad news' have different impacts.

In the following, we will focus our attention on steps needed to be implemented and carried out in the analysis of GARCH.

The first step is testing the stationarity of variables through Augmented Dickey-Fuller (ADF), Kwiatkowski-Philips-Schmidt-Shin (KPSS) and Philips-Perron (PP) tests in order to determine the order of integration. The ADF and PP tests indicate the presence of a unit root in the case of each variable. The results of these tests are not reported here to save space, but are available by the authors upon request. We, then, estimate the autoregressive process (AR) in order to specify the appropriate model of conditional average.

After estimating the models GARCH(1,1) and TGARCH(1,1) we verify if the models are correctly specified, through checking if the standardized residuals have no serial correlation, the conditional heteroscedasticity or any other nonlinear dependence by performing the functions ACF and PACF of the standardized residuals and via the Q-test (Ljung-Box statistics). The diagnosis of GARCH models was also performed through the ARCH-LM test (Lagrange Multiplier) which implies that if the variance equation is correctly specified there are no ARCH effects in the residuals. The results for the diagnosis tests are reported in Appendix.

V. Empirical results

In the table below are briefly displayed the results for GARCH(1,1) and TGARCH(1,1) models for Bucharest Stock Exchange, in the period January 2005 – February 2015.

Table 1

Estimated parameters for GARCH(1,1) and TGARCH(1,1) models for BET index, January 2005-February 2015

Model	Equation	Variable	Coefficient	Std. error
GARCH(1,1)	Mean eq.	IRS(-1)	-0.005724*	0.002152
		LIBOR	0.076391**	0.032958
		EUR/ROL(-1)	-1.164742*	0.287586
		EUR/USD	-0.497128*	0.156409
		UR(-1)	-0.049384*	0.016323
		WAGES(-1)	0.439583*	0.092371
	Conditional variance eq.	ω	0.000605***	0.000359
		γ	0.181261***	0.171446
		δ	0.776212*	0.150516
		IPI(-3)	-0.058943***	0.048442
TGARCH(1,1)	Mean eq.	IRS(-1)	-0.005458**	0.374208
		LIBOR	0.076232**	0.195867
		EUR/ROL(-1)	-1.155713*	0.002448
		EUR/USD	-0.645169*	0.034249
		UR(-1)	-0.069334*	0.018309
		WAGES(-1)	0.237578**	0.111917
	Conditional variance eq.	ω	0.003344*	0.000868
		γ	0.162014***	0.042821
		θ	0.151012***	0.163614
		δ	0.620361***	0.171992
		IPI(-3)	-0.084162*	0.031369

Notes: *,**,*** means the significance level at 1%, 5% and respectively 10%.

First, the figures in the table points out that the sum between ARCH and GARCH coefficients is less than 1 in all analysed series, a necessary condition for the process to be mean reverting. However, although the amount is less than 1, this value is very close to 1, which means a slow mean reversion.

Secondly, analysing the determinants of BET volatility, we notice that all the coefficients are statistically significant. In other words, all the national and international variables have an impact on the domestic aggregate variable. However, in both models, the greatest impact it provided by the exchange rate EUR/ROL, followed

closely by the exchange rate EUR/USD. The negative sign of the relationship is consistent with economic theory which postulates that an exchange rate appreciation would be expected to cause a drop in the stock prices. The works of Zhao (2009) and Diamandis and Drakos (2011) are supporting our conclusion. These studies bring to the fore the influence of exchange rate on emerging stock markets, a relation that is even more significant and powerful in times of economic recession.

Thirdly, we note that, the asymmetry coefficient is positive and statistically significant. Specifically, this means that bad news has larger effects on the volatility of the series than good news.

Moreover, the results presented in the table above highlight that both the domestic interest rate and exchange are lagged. This means that investors react faster to the international news rather than the national ones. This hypothesis supports previous studies developed by Anatolyev (2008), Ozdemir (2009) and Pirovano (2012). The authors demonstrated that in emerging markets the importance of international factors in determining volatility increased, while domestic factors play an increasingly less significant role. In the case of Romanian stock market we highlight two reasons for this situation. One, the analysed period incorporates also the global economic recession, and it is well known that the contagion is very powerful in times of turbulences. The other one is related to the fact that almost one third of the total investors are foreign investors that react faster to the international news than the domestic ones.

Also, the other domestic variables ale lagged, but this assumption is already validated in the economic theory, the reasoning being based on how the rational consumer would react to economic events. The potential explanations would be that an increased industrial production and level of wages and a decreased unemployment rate, in other words, an economic growth, leads to an increase in the economic activity, resulting in higher earnings for the companies.

VI. Conclusions

The financial market liberalization and the EU accession have had various considerable successes and failures. Thus, even if some issues were solved by the free movement of capital, also a number of new challenges have emerged, such as the presence of contagion and systemic risks that inevitably lead to greater fluctuations among prices of financial assets. Moreover, in this regard is well documented that the degree of volatility that characterizes these markets is higher than the one recorded in more mature and developed markets.

To investigate the presence and determinants of an emerging stock market, namely the Romanian stock exchange, we used GARCH and TGARCH models. The main results highlight: the aggregate variable volatility is largely determined exchange rates EUR/ROL and EUR/USD, the analysed index responds faster to the international variables fluctuations than to the domestic ones. Therefore, we place ourselves among the authors that support the superiority of international stock markets interdependencies, as Ozdemir, Pirovano or Anatolyev.

Emerging stock market volatility is very important to be known by the investors in order to decide on the formation and diversification of the potential portfolio of financial assets. The necessity for such a study demonstrates, by its very nature, also a real predictive power. A responsible decision maker is not allowed to neglect positioning arising from analyses of this kind.

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Appendix: Diagnosis tests

Table1

ACF, PACF and Q-test for GARCH(1,1) model

Sample: 2005M05 2015M02
Included observations: 118

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|. |	.|. |	1	-0.030	-0.030	0.1084	0.742
*|. |	*|. |	2	-0.076	-0.077	0.8165	0.665
.|* |	.|* |	3	0.127	0.123	2.8069	0.422
.|. |	.|. |	4	-0.055	-0.055	3.1840	0.528
.|* |	.|* |	5	0.144	0.165	5.7997	0.326
.|. |	*|. |	6	-0.044	-0.068	6.0398	0.419
*|. |	.|. |	7	-0.093	-0.055	7.1358	0.415
.|* |	.|. |	8	0.090	0.038	8.1795	0.416
.|. |	.|. |	9	-0.057	-0.041	8.5999	0.475
.|. |	.|. |	10	0.035	0.040	8.7578	0.555
.|. |	.|. |	11	0.068	0.053	9.3624	0.588
.|. |	.|. |	12	0.021	0.071	9.4238	0.666

Source: own computation using Eviews software

Table 2

ACF, PACF and Q-test for TGARCH(1,1) model

Sample: 2005M05 2015M02
Included observations: 118

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|. |	.|. |	1	-0.018	-0.018	0.0396	0.842
.|. |	.|. |	2	-0.017	-0.017	0.0743	0.964
.|* |	.|* |	3	0.150	0.150	2.8515	0.415
*|. |	*|. |	4	-0.130	-0.129	4.9644	0.291
.|* |	.|** |	5	0.202	0.213	10.076	0.073
.|. |	*|. |	6	-0.045	-0.086	10.336	0.111
*|. |	.|. |	7	-0.095	-0.041	11.488	0.119
.|* |	.|. |	8	0.096	0.016	12.667	0.124
.|. |	.|. |	9	-0.020	0.047	12.718	0.176
.|. |	.|. |	10	0.040	0.007	12.932	0.227
.|. |	.|. |	11	0.048	0.043	13.239	0.278
.|. |	.|. |	12	0.012	0.051	13.260	0.350

Source: own computation using Eviews software

Table 3

ARCH-LM tests for GARCH(1,1)

F-statistic	2.640739	Prob. F(1,115)	0.1069
Obs*R-squared	2.626356	Prob. Chi-Square(1)	0.1051

Source: own computation using Eviews software

Table 4

ARCH-LM tests for TGARCH(1,1)

F-statistic	0.634940	Prob. F(1,115)	0.4272
Obs*R-squared	0.642435	Prob. Chi-Square(1)	0.4228

Source: own computation using Eviews software