CONNECTION OF EUROPEAN ECONOMIC GROWTH WITH THE DYNAMICS OF VOLATILITY OF STOCK MARKET RETURNS

Adrian Cantemir CĂLIN, PhD*

Abstract

The connections of macroeconomic growth and the financial markets are vastly studied in Europe mostly from the banking perspective. The impact of the capital markets on the economic development and the increased integration of all financial markets constitute an important element in the study of macroeconomic growth. The objective of this paper is to provide an analysis of the possible connections of the volatilities of stock market indexes computed with a GARCH model and the macroeconomic growth for a series of ten European countries. The problem of different frequencies – daily for the stock indexes and quarterly for the GDP growth – is solved by the use of the MIDAS methodology. We found connections of the dynamics of volatilities and main global events as well as the dependence of growth on these volatilities for some periods and some European countries.

Keywords: volatility, stock markets, MIDAS methodology

JEL Classification: G15, G17

1. Introduction

The macroeconomic growth and the financial development are largely interconnected and usually the links are two-way. The impact of the capital markets on the economic development and the increased integration of all financial markets constitute an important element in the study of macroeconomic growth, this subject being in the attention of researchers, practitioners, investors, and policymakers either. This subject is important for research by possible revealing of some macroeconomic determinants of systematic risks of the financial sector.

* *Institute for Economic Forecasting, Romanian Academy*

In asset pricing theories, macroeconomic indicators have an important role, determining many authors to empirically study the relation between macroeconomic variables and stock market volatility in different periods, with different frequencies, and for various regions.

While there are studies that highlighted the attention on international financial contagion, most papers (e.g. Levine 1997 and 2005; Wachtel, 2001) dealing with the relation economic growth – financial development are sustaining that financial depth is entrench economic growth by trade channel, by identifying proper investment opportunities, increasing liquidity, by promoting good corporate governance, and increasing diversification possibilities.

It was documented that there is no European economic growth pattern, as the recession induced by the recent global financial crisis was widespread with noticeable differences across countries, and also the economic recovery has taken place with different steps (Criste et al., 2011). The problems regarding the euro area governance were debated and marked out by Criste and Lupu(2012) that also highlighted the social and political implications of the crisis on European countries (Criste and Lupu, 2013).

Despite the efforts for economic convergence in the European Union, the financial architecture of its members is still diverse, the differences increasing more after the enlargement of 2004 and 2007. The unique feature of European financial system are observable in time and across the two main components (main group and new members) while comparing with other important financial markets in the world.

The stock market behavior is fluctuant and instable, while is connected with the relevant macroeconomic indicators (King et al, 1994; Corradi et al, 2010), international economic trends, political decisions (Siokis and Kapopoulos, 2007), consumption behavior (Campbell and Cochrane, 1999), and population demographic trend (Ciumara and Lupu, 2014).

The objective of this article is to provide an analysis of the possible connections of the volatilities of stock market indexes computed with a GARCH model and the macroeconomic growth for a series of ten European countries. The problem of different frequencies – daily for the stock indexes and quarterly for the GDP growth – is solved by the use of the MIDAS methodology.

The paper is structured in the following sections. Section 2 provides a short description of similar economic literature. Section 3

presents the data and the methodology used for the study, section 4 explains the obtained results while the last section round off the main conclusions.

2. Literature Review

As was previously shown in Albu (2014), the financial sector is compulsory for economic growth as was evidenced by many economists, but the financial crisis arisen in 2007 demonstrated that it can have a negative impact on the economy also.

The strong business cycle of stock market volatility, lower in expansion periods than in recessions, was evidenced by the papers of Errunza and Hogan (1998), Schwert (1989), , and Hamilton and Lin (1996), Brandt and Kang (2004), although it may depend on unobservable factor (Heston, 1993).

However, the distribution of price volatility during turbulent periods is still unknown and probably depend on the type of financial markets development, the distributions of jumps during financial crises being rather dependent on method used (Hanouseka et al, 2014).

The economic forces that influence the reaction of stock markets was previously documented by Chen et al (1986) that investigated if innovations in macroeconomic indicators (systematic economic news) affect the stock market returns, the authors concluding that these news are rewarded in correspondence with their exposure.

Karunanayake et al (2012) overlooked the interaction between GDP growth rates and stock market returns in US, UK, Canada, and Australia for a long period (1959-2010) using a multivariate GARCH model in order to introspect the cross-country transmission across analyzed countries. The results are demonstrating a country specific transmission from GDP growth to stock market only in US, while the spillovers from stock markets to GDP growth are transmitted in US and Australia and an influence from US to all the others.

Using a bivariate VAR-GARCH(1,1), Caporale and Spagnolo (2011) analyzed the relations between economic growth and stock market in Czech Republic, Hungary and Poland, their results pointing out a one way causal relation from stock market to the economic growth, this relation being more solid after the accession into EU of these countries. For a larger sample of East European countries (11 EU new members, in the period 2000-2013) Albu et al (2014)

explored the long term correlation between stock market capitalization and GDP per inhabitant; after using a nonlinear model, the results disclosed that the dynamics was bigger in countries with a GDP per inhabitant under the average GDP in all 11 countries.For a set of seven East European Countries, Lupu and Calin (2014) investigated the possible bonding between economic growth and stock market dynamic in the period 1998-2014, concluding that there is slight dependence between analyzed indicators, Slovenia been the only exemption.

3. Data and Methodology

Our data for the dynamics of the European capital market consists of daily data for the stock market indexes from January 2000 until October 2014 for a set of European countries: Austria, Belgium, Czech Republic, France, Germany, Hungary, Italy, Netherlands and Portugal, totaling 4773 observations for each series, in a synchronous framework. Table 1 below shows the descriptive statistics of these series for the whole interval. We can notice that the main statistical properties identified by the literature hold for this sample. The second part of Table 1 exhibits the first four principal moments for the quarterly growth of the same countries for the same time frame.

Table 1

Statistical properties of logarithmic changes in stock prices and GDP per capita

	Stock Indexes				GDP per capita			
	Mean	**St. Devs**	**Skewness**	**Kurtosis**	**Mean**	**St. Devs**	**Skewness**	**Kurtosis**
AUSTRIA	0.00	0.01	-0.38	14.53	0.01	0.05	-0.92	2.48
BELGIUM	0.00	0.01	0.06	12.78	0.01	0.06	0.07	1.42
CZECH REP.	0.00	0.01	-0.96	25.35	0.02	0.08	-0.80	3.07
DENMARK	0.00	0.01	-0.24	10.39	0.01	0.04	-0.23	2.03
FRANCE	0.00	0.01	-0.11	9.99	0.01	0.03	0.44	1.97
GERMANY	0.00	0.01	-0.14	10.27	0.01	0.02	-0.53	2.90
HUNGARY	0.00	0.01	0.20	18.83	0.01	0.10	-1.00	3.16
ITALY	0.00	0.01	-0.25	9.96	0.00	0.08	-0.17	1.68
NETHERLANDS	0.00	0.01	-0.13	12.78	0.01	0.04	0.27	1.67
PORTUGAL	0.00	0.01	-0.40	13.57	0.01	0.05	-0.23	1.99

Source: Datastream, author's calculations

We notice that the stock indexes exhibit the well-known stylized facts for the daily log-returns, as mentioned in state-of-the-art articles, with zero mean, low volatilities and mostly negative unconditional skewness and large unconditional kurtosis. We also can observe the same unconditional moments for the GDP per capita series.

As far as the methodology is concerned, we are using two main tools, a volatility model and the mixed frequency model. According to the development of Bollerslev (1986), the seminal GARCH model extends the work of Engle (1982) to allow for the employment of past conditional volatilities in the detection of the current volatilities. We reproduce here the shape of this model:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{m} \alpha_i a_{t-i}^2 + \sum_{j=1}^{s} \beta_j \sigma_{t-j}^2$$

where:

$$\alpha_0 > 0, \alpha_i \geq 0, \beta_j \geq 0$$

The connection between the daily log-returns for the stock market indexes and the quarterly changes of the GDP per capita is realized by means of the ADL-MIDAS (p_Y^Q, q_X^D) model in keeping with the developments of Andreou, Ghysels, and Kourtellos (2010). Their work consists in the generalization of an aggregation algorithm for the high frequency data according to the following specification:

$$Y_{T+1}^Q = \mu + \sum_{j=0}^{p_Y^Q - 1} \alpha_{j+1} Y_{t-j}^Q + \beta \sum_{j=0}^{q_X^D - 1} \sum_{i=0}^{N_D - 1} w_{i+j*N_D}(\theta^D) X_{N_D - i, t-j} + u_{t+1}$$

The weighting structure is denoted by $w(\theta^D)$ and the mentioned paper is using the Almon lag polynomial

$$w_j(\theta^D) = w_j(\theta_1, \theta_2) = \frac{exp\theta_1 j + \theta_2 j^2)}{\sum_{j=1}^{m} exp(\theta_1 j + \theta_2 j^2)}$$

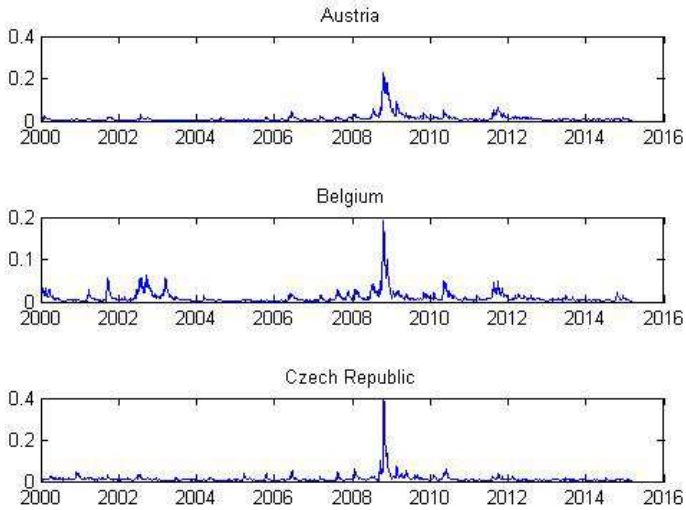
Under these notations, our quarterly changes in the GDP per capita is represented by Y_t^Q and the log-returns of the indexes used as explanatory variables are denoted by X_t^D.

4. Results

This section provides the results obtained as consequence of performing the above mentioned methodology for the data described previously.

The first three charts are exhibiting the results of the GARCH model fitting on the series of log-returns for the stock market indexes.

Figure 1: Volatility dynamics for stock market indexes of Austria, Belgium and Czech Republic



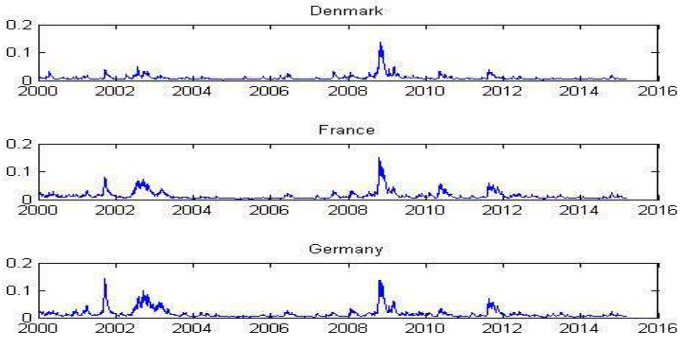
Source: Datastream, author's calculations

The most important element that can be observed is the fact that all indexes show large volatility spikes in the same moment, i.e. the September 2008. In figure 1 we notice that Austria and Belgium seem to have the same level of volatility outlier for this spike, with larger values for the Austrian stock market (the Belgium is presented at a different scale). The Czech Republic seems to show a large level of volatility in the case of September 2008 and relatively less connected levels of volatilities for the rest of the sample, which proves its emerging market status.

If we are to consider the simultaneity of the volatility spikes as proof of contagion, then we can notice that Austria and Belgium seem to be more connected that each of them with the volatility dynamics of the Czech Republic stock index.

Figure 2 shows the volatility dynamics for Denmark, France and Germany, which visually look very connected if we observe the simultaneity of the spikes. As in the previous case for Austria and Belgium we notice that these three countries show low levels of volatility after a spike that took place at the beginning of 2012, a moment that marks the shift in the monetary policy decisions generating insurance that the state will do "whatever necessary" to save the markets. This denotes a moment that announced the soon to be announce Quantitative Easing set of monetary policy decisions.

Figure 2: Volatility dynamics for stock market indexes of Denmark, France and Germany



Source: Datastream, author's calculations

Figure 3 shows the dynamics of volatilities for the rest of the countries in our sample. We notice that Portugal shows a different set of dynamics from this perspective in the pre-crisis period. However, the after-crisis period seems similar for all the four countries in the figure.

We can conclude that the large movements in volatility dynamics are rather simultaneous for all the countries in the sample. We can mention the spikes at the beginning of 2002, the one in September 2008, a smaller one in 2010 and a larger one in 2012. This observation is consistent with the phenomenon of contagion, i.e. large correlations when returns are negative (and consequently exhibit large volatilities due to the Black's leverage effect) and not so

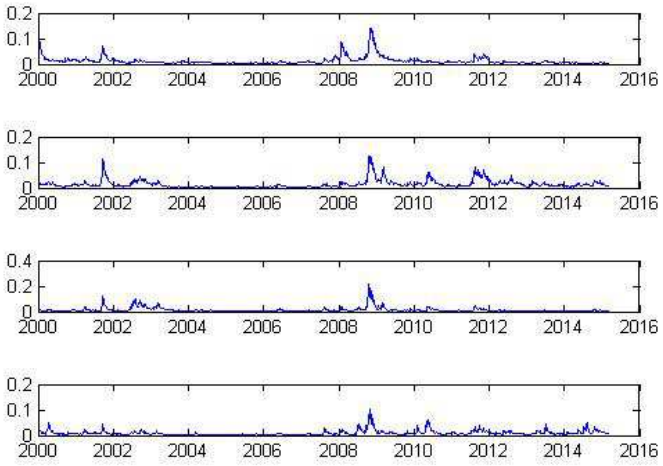
large connections when the returns are positive and markets may present small volatility movements.

In all the cases, the low volatility levels present after the last spike in 2012 represent a period of increased confidence in the new vision of the monetary policies and they can be corroborated with the positive trends in the markets. Portugal and Italy have the largest values of volatilities in this period, which is consistent with their macroeconomic status in a large part of this time sample, related to their credit difficulties.

The results of the MIDAS dependence analysis are presented in tables 2 for the whole sample under analysis and in tables 3 and 4 for the two periods marking the before-the-crisis and during-the-crisis time spans.

With very few exceptions, we can notice that these connections are not statistically significant in general. We appreciate this result as a proof of the fact that the GDP data is not determined by the dynamics of the stock market volatilities, which represent a measure of risk. The result is true for the whole sample and for each of the two sub-samples in our analysis.

Figure 3: Volatility dynamics for stock market indexes of Hungary, Italy, Netherlands and Portugal, respectively



Source: Datastream, author's calculations

The most notable exception for the whole sample analysis is represented by Germany, in which case we have a large T-statistic. Taking into account the fact that the volatility dynamics for Germany are quite similar to those of France (mainly) and to a lesser extend those of Belgium, Denmark and Netherlands, this result shows that the risk in the investments in Europe is mainly driven by the German macroeconomic dynamics via its stock markets.

Table 2

MIDAS regression results for each country for the whole sample period covering January 2001 until October 2014

	Coeff	St. Errors	T-Stats	R2	Log-Like	Akaike	Schwartz
AUSTRIA	1.07	0.94	1.13	0.16	99.28	-350.33	-340.11
BELGIUM	-0.36	0.27	-1.33	0.83	133.83	-419.42	-409.20
CZECH REP.	2.01	1.74	1.16	0.16	70.85	-293.47	-283.25
DENMARK	-0.22	NaN	NaN	0.57	125.51	-402.79	-392.57
FRANCE	-0.38	0.61	-0.62	0.51	140.40	-432.55	-422.33
GERMANY	1.46	0.44	3.30	0.17	136.66	-425.08	-414.86
HUNGARY	1.49	1.82	0.82	0.21	54.07	-259.89	-249.68
ITALY	-0.31	0.37	-0.86	0.72	100.82	-353.40	-343.18
NETHERLAND	-0.34	0.24	-1.42	0.57	130.86	-413.48	-403.27
PORTUGAL	-0.06	NaN	NaN	0.55	113.25	-378.25	-368.04

Source: Datastream, author's calculations

The low connections of the macroeconomic dynamics in the European economies is not transmitted to the markets – the markets would probably suffer the most if the German economy is showing a weakness.

Table 3

MIDAS regression results for each country for the first period of our analysis, covering January 2001 until October 2014

	Coeff	St. Errors	T-Stats	R2	Log-Like	Akaike	Schwartz
AUSTRIA	0.56	1.02	0.55	0.15	70.53	-244.57	-236.13
BELGIUM	-0.63	NaN	NaN	0.81	93.31	-290.14	-281.70
CZECH REP.	2.85	1.94	1.47	0.18	50.81	-205.13	-196.68
DENMARK	0.60	0.94	0.63	0.54	84.23	-271.97	-263.53
FRANCE	-0.38	0.81	-0.48	0.44	94.72	-292.95	-284.51
GERMANY	1.25	0.73	1.72	0.10	91.21	-285.93	-277.48
HUNGARY	0.93	1.32	0.70	0.19	40.31	-184.14	-175.69
ITALY	-3.02	3.63	-0.83	0.73	69.23	-241.98	-233.54
NETHERLAND	-0.38	0.30	-1.29	0.54	91.76	-287.04	-278.59
PORTUGAL	1.09	1.08	1.01	0.71	84.37	-272.26	-263.82

Source: Datastream, author's calculations

However, looking at the two sub-samples, the dynamics of the volatilities cannot significantly explain the macroeconomic movements in the case of Germany. We notice a higher level for the T-statistic in the pre-crisis period, but not significant.

If no significance could be detected in the pre-crisis period for any of the countries in our sample, we notice the exception of Portugal in the second sub-sample.

Table 4

MIDAS regression results for each country for the second period of our analysis, covering January 2010 until December 2009

	Coeff	St. Errors	T-Stats	R2	Log-Like	Akaike	Schwartz
AUSTRIA	3.33	1.94	1.72	0.27	30.42	-96.24	-92.38
BELGIUM	-0.56	0.38	-1.48	0.89	39.66	-114.72	-110.86
CZECH REP.	3.09	2.70	1.14	0.29	22.27	-79.94	-76.08
DENMARK	-1.02	0.82	-1.24	0.77	43.81	-123.02	-119.16
FRANCE	-0.89	0.57	-1.54	0.78	47.45	-130.31	-126.44
GERMANY	-0.30	0.29	-1.03	0.08	42.02	-119.45	-115.58
HUNGARY	5.96	3.92	1.52	0.34	15.68	-66.77	-62.91
ITALY	-0.23	0.40	-0.58	0.69	30.93	-97.27	-93.40
NETHERLAND	-0.29	0.39	-0.75	0.69	38.18	-111.77	-107.90
PORTUGAL	-15.70	2.78	-5.64	0.76	42.50	-120.41	-116.55

Source: Datastream, author's calculations

We take notice of the fact that in general neither of the two samples generated enough evidence to consider that there exists a relation between the macroeconomic developments and the stock market volatilities.

5. Concluding Remarks

This paper provides an analysis of the volatility of stock market indexes for a set of ten countries for the period between January 2001 and October 2014. Taking into account the stylized facts noted in the literature for the daily stock market log-returns we observed that the volatility dynamics exhibit the phenomenon of contagion, i.e. low levels during the period of increases (especially before September 2008) and large levels during the crisis. These observations are consistent also with the fact that large spikes in the volatilities are mostly simultaneous across all the ten countries in our sample, irrespective of their level of development – so both for the developed and emerging markets.

The next step of our analysis consisted in the analysis or the connections between volatilities on one hand, which are usually

interpreted as measures for the investment risk in an economy in general (for those economies in which the stock market represents a large portion of the economic activity) and changes in the GDP per capita, on the other hand. The study dealt with the division of the sample in two sub-samples, one for the pre-crisis period and the second for the after-crisis period. In general no significant connection was found between the two series, using a MIDAS methodology that solves the problem of different frequencies. For the whole sample Germany showed a significant connection, which means that, if we consider the risk to be similar (at least across developed European countries) then the German economy has the largest probability to generate clientele for the European stock markets.

Acknowledgement

This work was supported by the project "Excellence academic routes in doctoral and postdoctoral research - READ" co-funded from the European Social Fund through the Development of Human Resources Operational Programme 2007-2013, contract no. POSDRU/159/1.5/S/137926.

References

1. Albu, C. (2014), "Considerations on the role of financial markets in economic growth", Hyperion Economic Journal Year II, no.2(2), pp. 37-43.
2. Albu, L. L., Lupu, R., Calin, A. C. (2014), "A Nonlinear Model to Estimate the Long Term Correlation between Market Capitalization and GDP per capita in Eastern EU Countries", Journal of Economic Computation and Economic Cybernetics Studies and Research, Issue
3. Andreou, E., Ghysels, E., Kourtellos, A. (2013), "Should Macroeconomic Forecasters Use Daily Financial Data and How?", Journal of Business & Economic Statistics, 31, pp. 240–251.
4. Brandt, M. W., Kang, Q. (2004), "On the Relationship between the Conditional Mean and Volatility of Stock Returns: a Latent VAR Approach", Journal of Financial Economics 72, pp. 217-257.
5. Bollerslev, T. (1986),"Generalized autoregressive conditional heteroskedasticity", J. Econom, 31, 307–327.
6. Campbell, J. Y., Cochrane, J. H. (1999), "By Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior",.Journal of Political Economy 107, pp. 205-251.
7. Caporale, G. M., Spaguolo, N. (2011), Stock market and Economic growth:Evidence from Tree CEECs", Economics and Finance WP Series 11-16, Brunnel University, London.

8. Chen, N.-F., Roll, R., Ross, S.A. (1986), "Economic Forces and the Stock Market", Journal of Business 59, pp. 383-403.
9. Ciumara, T., Lupu, I. (2014), „Îmbătrânirea populaţiei şi pieţele financiare", in Ed. Emilian M. Dobrescu și Dumitru Batâr, Îmbătrânirea activă. Studii și cercetări, Oscar Print, Bucharest, pp. 37-49.
10. Corradi,V., Distaso, W., Male, A. (2010), "Macroeconomic Determinants of stock market volatility and volatility risk premium", London School of Economics.
11. Criste A., Lupu I. (2012), "A Critical Analysis Regarding the Euro Area Governance", Ovidius University Annals, Economic Sciences Series, Vol. XII, issue 1, pp. 170-174.
12. Criste A., Lupu I. (2013), "The European Project beyond the Financial Crisis", Ovidius University Annals, Economic Sciences Series, Volume XIII, Issue 1, Ovidius University Press, pp. 179-183.
13. Criste A., Lupu I., Milea C., Ailincă A. (2011), The Reflection of the Current Crisis on the Economic Growth in the European Union New Member States, ActaUniversitatisDanubius. ŒconomicaVol. 7, No. 2 (2011), pp. 58-68.
14. Engle, R. (1982),"Autorregressive Conditional Heteroskedasticity withEstimates of United Kingdom Inflation", Econometrica, vol. 50, issue 4, pp. 987-1008.
15. Errunza, V., Hogan, K. (1998), "Macroeconomic Determinants of European Stock Market Volatility", European Financial Management 4, pp. 361-377.
16. Hamilton, J. D., Lin, G. (1996), "Stock Market Volatility and the Business Cycle", Journal of Applied Econometrics 11, pp. 573-593.
17. Hanouseka , J., Kočenda, E., Novotnýa , J. (2014), "Price jumps on European stock markets", Borsa Istanbul Review, Volume 14, Issue 1, pp. 10–22.
18. Heston, S. L. (1993), "A Closed-Form Solution for Options with Stochastic Volatility with Applications to Bond and Currency Options", Review of Financial Studies 6, pp. 327-343.
19. Karunanayake, I., Valadkhani, A., O'Brien, M. (2012). "Stock market and GDP growth volatility spillovers", Proceedings of the 41st Australian Conference of Economists (pp. 1-23). Melbourne: Victoria University.
20. King, M., Sentana, E., Wadhwani, S. (1994), "Volatility and Links between National Stock Markets", Econometrica 62, pp. 901-933.
Levine R. (1997), "Financial development and economic growth: Views and agenda", Journal of Economic Literature, 35(2), pp. 688-726.

21. Levine R. (2005), "Finance and Growth: Theory and Evidence," Handbook of Economic Growth, in: Aghion P. and S. Durlauf (ed.), vol 1, pp. 865-934.
22. Lupu R., Calin A.C**.** (2014), "A mixed frequency analysis of connections between macroeconomic variables and stock markets in Central and Eastern Europe", Financial Studies, Volume 18, issue 2, pag. 69-79.
23. Lupu, I. (2012), "The Theory of International Financial Contagion", Financial Studies, vol. 16, no. 4, "Victor Slăvescu" Centre for Financial and Monetary Research, pp. 35-42.
24. Schwert, G. W. (1989), "Why Does Stock Market Volatility Change over Time?", Journal of Finance 44, pp. 1115-1153.
25. Siokis, F. Kapopoulos, P. (2007), "Parties, Elections and Stock Market Volatility: Evidence from a Small Open Economy", Economics & Politics, Vol. 19, No. 1, pp. 123-134.
26. Wachtel P. (2001), "Growth and Finance: What do we know and how do we know it?", International Finance, 4(3), pp. 335-362.