Study of the Correlation between the Romanian Stock Market and S&P500 Index during 2007-2009

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This article aims to study the evolution of the Bucharest Stock Exchange (BSE) and the particularities of its correlation with international stock markets during Jan 2007 - Dec 2009. The linear regression and correlation analysis on weekly and monthly data shows a good degree of synchronization between the main indices of BSE and S&P500, but also sometimes a specific behavior of the Romanian stock market that could be at least partly explained by its lack of maturity.

Key words: *contagion, correlation, crisis, emerging markets, stock markets, volatility*

JEL Classification: *G01, G14, G15*

1. Introduction

Although all the emerging and mature markets in the region have been adversely affected by the crisis, in the case of Romania the decline of stock market was in many ways more profound and more powerful than it should normally have been if we take into account the real economic situation, both from a macro and micro perspective, since it is empirically proved that the capital market is positively correlated with long-term economic growth.

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The market decline is most obvious if we analyze the evolution of the BSE's main indices during 2007-2010 but can also be put into light if we study other market variables such as average number of daily transactions, average number of shares traded daily, average daily market turnover, total market capitalization and the capitalization of the free float.

Even taking into account the three new listings that took place in 2010 (one being the Bucharest Stock Exchange and the others two closed end investment funds: IFond Financial Romania and IFond Gold), the Romanian stock market liquidity and capitalization is still very low comparing with levels from 2006 and early 2007.

The data shows that many foreign investors previously active in the Romanian stock market have chosen to liquidate positions and to repatriate capital. Also, most local private investors have become inactive due to market decline. The empirical observations of the behavior of local investors shows that most of them were fully invested into stocks on the 2007 market peak and as the crises manifested they refused to accept losses and to sell their stocks bellow the acquisition price. As a result they become "prisoners" of the market and were no longer making transactions. The local investors that remained active have gained a more speculative approach which is good for the market from the liquidity point of view but also led to an important increase in volatility.

Romanian brokerage community has been severely affected by the decline in stock market activity and turnover, but only very few financial services companies went out of business. Most of the brokerage companies have gone through a down-scaling process, staff reductions and closing down of branches.

Companies that originally intended to float on BSE have indefinitely delayed those intentions until market conditions will improve again. Managers became doubtful that the local stock market, under the new conditions brought by the 2007-2009 crisis, is still able to fulfill its

main role of providing financial resources for the companies that they are representing. Shareholders of those companies do also no longer believe that the stock market is able to form a fair and correct price for their holdings, and for that reason they are reluctant to support a decision to become public or to launch secondary public offerings.

2. Literature review

Over time, many investment managers and academics were interested to study the correlations between major and emerging stock market indices. Also, from obvious practical reason, the reactions of the stock markets on many types of previous financial and economic crisis were examined in detail by the research and academic community. More recently, starting with 2008, many authors showed interest to study the correlations between various stock markets during the 2007-2009 financial crisis.

King M.A. and Wadhwani S. (1990) investigated why, in October 1987, almost all stock markets fell together despite widely differing economic circumstances and argue that contagion between markets occurs as the result of attempts by rational agents to infer information from price changes over other markets. The two authors have the opinion that contagion provides a channel through which a "mistake" in one market can be transmitted to other markets. They find that hourly stock price data from New York, Tokyo and London during an eight month period around the crash offer support for the contagion model. In addition, the two authors find that the magnitude of the contagion coefficients is increasing with volatility.

Bekaert G. and Harvey C.R. (1997) analyze the reasons that volatility is different across emerging markets, particularly with respect to the timing of capital market reforms. They argue that capital market liberalizations often increase the correlation between local market returns and the world market, but do not drive up local marker volatility.

Choe H., Kho B.C., Stulz R.M. examined the impact of foreign investors on stock returns in Korea from November 30, 1996 to the end of 1997 using order and trade data and found strong evidence of positive feedback trading and herding by foreign investors before the period of Korea's economic crisis. The authors arque that during the crisis period, herding falls, and positive feedback trading by foreign investors mostly disappears. The conclusion of their research is that there is no evidence that trades by foreign investors had a destabilizing effect on Korea's stock market over the sample period. In particular, they found that the market adjusted quickly and efficiently to large sales by foreign investors, and these sales were not followed by negative abnormal returns.

Aggarwal R., Inclan C. and Leal R. (1999) examined the kinds of events that cause large shifts in the volatility of emerging stock markets during the period 1985 - 1995. They found that most events tend to be local and include the Mexican peso crisis, periods of hyperinflation in Latin America, the Marcos-Aquino conflict in the Philippines, and the stock market scandal in India. According to the authors, the October 1987 crash is the only global event during the period 1985-1995 that caused a significant jump in the volatility of several emerging stock markets.

Gelos R.G. and Sahay R. (2001) examined financial market co-movements across European transition economies and compared their experience to that of other regions. They found that correlations in monthly indices of exchange market pressures can partly be explained by direct trade linkages, but not by measures of other fundamentals.

Forbes K.J. and Rigobon R. (2002) argue that there is a high level of market co-movement during all periods, which he calls "interdependence". Previous research suggested that contagion (defined as a significant increase in market co-movement after a shock to one country) it is often occurring during crises. Forbes and Rigobon's paper is in opposition with that belief and shows that there was virtually no increase in unconditional correlation coeficients (i.e.,

no contagion) during the 1997 Asia crisis, 1994 Mexican devaluation and 1987 U.S. market crash.

Maroney N., Naka A. and Wansi T. explored risk and return relations in six Asian equity markets affected by the 1997 Asian financial crisis and found that after the start of the crisis, national equity betas increased (due to leverage linked to exchange rates) and average returns fell substantially. Subsequently, the authors propose a new probability-based asset pricing model that captures leverage effects using valuation ratios. Their results show the role of leverage in explaining the likelihood of the financial crises.

Hartmann P., Straetmans S. and de Vries C.G. (2004) characterize asset return linkages during periods of stress by an extremal dependence measure. Their estimates for the G-5 countries suggest that simultaneous crashes between stock markets are much more likely than between bond markets. Also, their data show that stock-bond contagion is approximately as frequent as flight to quality from stocks into bonds. Also, they found that extreme cross-border linkages are surprisingly similar to national linkages, illustrating a potential downside to international financial integration.

Latter, Bekaert G., Harvey C.R. and Ng A. (2005) study contagion and propose a two-factor model with time-varying betas that accommodates various degrees of market integration. The authors apply this model to stock returns in three different regions: Europe, Southeast Asia, and Latin America. In addition to examining contagion during crisis periods, they document time variation in world and regional market integration and measure the proportion of volatility driven by global, regional, and local factors.

Markwat T., Kole E. and van Dijk D. (2009) show that stock market contagion occurs as a domino effect, where confined local crashes evolve into more widespread crashes. Using a novel framework based on ordered logit regressions the authors model the occurrence of local, regional and global crashes as a function of their past occurrences and

financial variables. They find significant evidence that global crashes do not occur abruptly but are preceded by local and regional crashes.

Over time, Romanian authors were also interested to study the specific behavior of Romanian exchange traded stocks in relation with other markets but also at different stages of the economic cycle. Lupu R., Tudor C. (2008) investigated the possibility to provide a forecast for the sign of asset returns at Bucharest Stock Exchange taking into account eight stocks part of BET index and using an EGARCH model. They find that some of the coefficients of model were statistically significant meaning that there is some power that the second and the third moments of the distribution have some power to forecast the sign of the future returns.

Pop C., Curutiu C. and Dumbrava P. (2009) present the Bucharest Stock Exchange evolution before the 2007-2009 crisis started to manifest and try to identify the main factors which influenced its explosive growth. The paper investigates the current financial crisis influences on Bucharest Stock Exchange – with an emphasis over the factors which might have deepen the descendent trend for the Romanian stock exchange market. The authors also present the effects of the current financial crisis on the future development of Bucharest Stock Exchange, taking into consideration the position of the Romanian capital market in Eastern Europe.

Harrison B., Lupu R., and Lupu I. (2010) studied the statistical properties of the CEE stock market dynamics using a panel data analysis and found that there is evidence of stationarity for the returns provided by the Romanian stock indices. They have also identified some particular characteristics of returns in these markets such as a great amount of non-linearity and cross corelation.

3. Data and methodology

In order to investigate the correlation between Romanian stock market and other relevant major and emerging exchanges, I have collected weekly and monthly data for three Romanian stock indices (BET, BET-XT and BET-FI computed by Bucharest Stock Exchange) and three foreign indices (S&P500 for the New York Stock Exchange, DAX for the Frankfurt Stock Exchange and WIG20 for Warsaw Stock Exchange). The date for the Romanian indices was collected from Bucharest Stock Exchange web site (www.bvb.ro) and the date for the foreign indices was collected from Yahoo Finance (finance.yahoo.com). For the period January 1st 2007 – December 31st 2009 the result was 6 sets of 154 observations containing the weekly closing prices for those 6 indices and another 6 sets of 35 observations containing the monthly closing prices for the same 6 indices. All the data was then transformed into weekly and monthly returns by applying the first difference. Subsequently, I studied the correlations between the 6 indices and the linear regression relation between S&P500 returns and each of the remaining 5 indices' return (using least squares method).

Quarterly GDP data for Romania was collected from Eurostat (www.ec.europa.eu/eurostat) for the period 2006-2009 and the evolution was studied in comparison with that of BET index during the same period.

Also, monthly data regarding the activity of foreign investors on Bucharest Stock Exchange was collected exchange (www.bvb.ro) and from the Romanian National Securities Commission (www.cnvmr.ro) and was compared with the evolution of the Romanian indices.

Daily market turnover was collected from www.ktd.ro for all companies traded at Bucharest Stock Exchange during the period 2007-2009 in order to investigate the market structure and the most relevant market sectors.

4. Results and interpretations

4.1. Characteristics of the evolution of Bucharest Stock Exchange during the period July 2007 – August 2009

From the empirical observations of the behavior of the local stock exchange, day by day, in real time, since the early beginning of the current crisis, I was able to distinguish a few particularities from the general evolution of more established exchanges in Europe. It is my belief that in Romania, the Bucharest Stock Exchange (BSE) was in fact the first institution, and the Romanian brokers were the first community, that felt the effects and consequences of the sub prime collapse in United States of America. This happened because the local stock market was already in the process of getting correlated with the major stock markets around the world. At the moment when the stocks' decline started in USA and Western Europe, the main indexes of Bucharest Stock Exchange started their long and abrupt downtrend.

This is in fact the first important characteristic of the way our local exchange behaved during the crisis: it had a high degree of correlation with the global markets. Lupu R. and Lupu I. (2009) study the evolution of many European and international stock indices and argue "that the conditional correlations become more statistically significant with the global market as we go from the early stages (2005) to spring 2009".

We can have a visual demonstration of the correlation between Bucharest Stock Exchange's main index BET and the New York Stock Exchange's SP500 in the chart presented in Figure 1.

The analysis of the weekly observation for the three Romanian stock indices and three international indices (BET, BET-XT, BET-FI, WIG20, DAX and S&P500) shows that we can not assume a normal distribution of weekly returns for any of the 6 samples (see Table 1). We can immediately observe that the volatility and the maximum negative amplitude of weekly variations are much higher for the

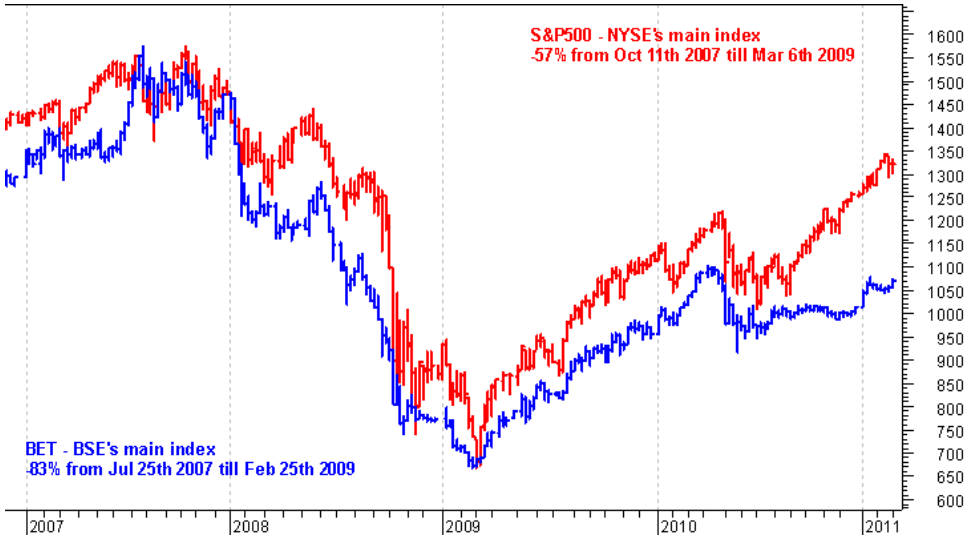
Romanian indices in comparison with the international mature and emerging stock indices.

Studying the matrix of cross correlations inside the sample, we see a high correlation between the Romanian indices and mature market indices (DAX and S&P500) but not higher than the correlations between WIG20 and the same two mature market indices (Table 2).

The study of the linear dependence between every two indices shows that we have a high degree of confidence when saying that the Romanian stock indices are moving in sync with the international indices because the statistical tests show that the linear regression coefficient is in every case significantly different from zero. Still, in every case we obtain a relatively low R squared which tells us that there are also other important factors that contribute to the evolution of the weekly returns of the Romanian stock indices during the period 2007-2009 (see Table 3).

Figure 1

Correlation between BET and S&P500



Source of data: Bucharest Stock Exchange and Yahoo Finance; calculations by the author

Table 1

Weekly data statistics

	SP500	DAX	WIG20	BET	BET_FI	BET_XT
Mean	-0.000880	0.000214	-0.000973	-0.002453	-0.002771	-0.003525
Maximum	0.120258	0.161162	0.173660	0.111259	0.314202	0.177678
Minimum	-0.181955	-0.216633	-0.153280	**-0.270358**	**-0.447528**	**-0.323046**
Std. Dev.	0.035595	0.041371	0.043201	**0.053419**	**0.085180**	**0.059921**
Skewness	-0.538936	-0.666416	0.134678	-1.130363	-0.763744	-1.184733
Kurtosis	7.853783	8.948158	4.881544	7.344367	9.645363	8.897908
Jarque-Bera	158.6266	238.4242	23.18187	153.8999	298.3369	259.2313
Probability	0.000000	0.000000	0.000009	0.000000	0.000000	0.000000

Source of data: Bucharest Stock Exchange and Yahoo Finance; calculations by the author

Table 2

Correlations (weekly sample)

	SP500	DAX	WIG20	BET	BET_FI	BET_XT
SP500	1.000000	0.883168	0.620686	0.553518	0.472909	0.539404
DAX	0.883168	1.000000	0.682172	0.601034	0.529279	0.590116
WIG20	**0.620686**	**0.682172**	1.000000	0.542459	0.516965	0.556000
BET	**0.553518**	**0.601034**	0.542459	1.000000	0.853581	0.959594
BET_FI	**0.472909**	**0.529279**	0.516965	0.853581	1.000000	0.937898
BET_XT	**0.539404**	**0.590116**	0.556000	0.959594	0.937898	1.000000

Source of data: Bucharest Stock Exchange and Yahoo Finance; calculations by the author

Table 3

Linear regression output (weekly sample)

	DAX	WIG20	BET	BET_FI	BET_XT
S&P500 coefficient	1.026496	0.753326	0.830688	1.131690	0.908044
Std. Error	0.044220	0.077186	0.101378	0.171024	0.114976
t-Statistic	23.21342	9.759880	8.193963	6.617119	7.897677
Prob.	0.0000	0.0000	0.0000	0.0000	0.0000
R-Squared	0.779985	0.385251	0.306383	0.223643	0.290956

Source of data: Bucharest Stock Exchange and Yahoo Finance; calculations by the author

The study of the monthly observations for the three Romanian stock indices and three international indices (BET, BET-XT, BET-FI, WIG20, DAX and S&P500) gives us a better view because it shows that we can assume a normal distribution of monthly returns for five of the 6 indices. The exception is BET_FI (see Table 4). Again, as we have noticed when we studied the weekly sample, we observe that the volatility and the maximum positive and negative amplitudes of monthly variations are much higher for the Romanian indices in comparison with the international mature and emerging stock indices.

Studying the matrix of cross correlations inside the monthly sample, we see a high correlation between the Romanian indices and mature market indices (DAX and S&P500) but not higher than the correlations between WIG20 and the same two mature market indices. Still, the indices of correlation calculated from the monthly data are higher in value, for all Romanian indices, in comparison with the ones computed from the weekly data sample. This tells us that on longer term, the co-movement of the Romanian stock market in relation with international stock markets is even more evident (see Table 5).

When using the monthly sample, the study of the linear dependence between every two indices again shows that we have a high degree of confidence when saying that the Romanian stock indices are moving in sync with the international indices because the statistical tests show

that the linear regression coefficient is in every case significantly different from zero. The confidence is even higher in comparison with the similar study on the weekly sample because this time, in every case, we have obtained higher value for R squared (see Table 6).

Table 4

Monthly data statistics

	SP500	DAX	WIG20	BET	BET_FI	BET_XT
Mean	-0.005538	-0.001322	-0.007233	-0.008947	-0.004674	-0.011769
Maximum	0.093925	0.167621	0.189609	**0.287839**	**0.717774**	**0.406523**
Minimum	-0.168269	-0.150678	-0.234198	**-0.326838**	**-0.564468**	**-0.400220**
Std. Dev.	0.058198	0.069705	0.083260	**0.130490**	**0.215753**	**0.152416**
Skewness	-0.679152	-0.247772	-0.280816	-0.231239	0.703270	0.080628
Kurtosis	3.309862	3.089327	3.778157	3.297182	5.755290	4.096734
Jarque-Bera	2.830633	0.369752	1.343064	0.440711	13.95622	1.792042
Probability	0.242849	0.831207	0.510925	0.802233	**0.000932**	0.408191

Source of data: Bucharest Stock Exchange and Yahoo Finance; calculations by the author

Table 5

Correlations (monthly sample)

	SP500	DAX	WIG20	BET	BET_FI	BET_XT
SP500	1.000000	0.915689	0.838400	0.805138	0.655730	0.773346
DAX	0.915689	1.000000	0.843079	0.805445	0.704458	0.798309
WIG20	**0.838400**	**0.843079**	1.000000	0.818552	0.696183	0.795695
BET	**0.805138**	**0.805445**	0.818552	1.000000	0.855172	0.972397
BET_FI	**0.655730**	**0.704458**	0.696183	0.855172	1.000000	0.941620
BET_XT	**0.773346**	**0.798309**	0.795695	0.972397	0.941620	1.000000

Source of data: Bucharest Stock Exchange and Yahoo Finance; calculations by the author

Table 6

Linear regression output (monthly sample)

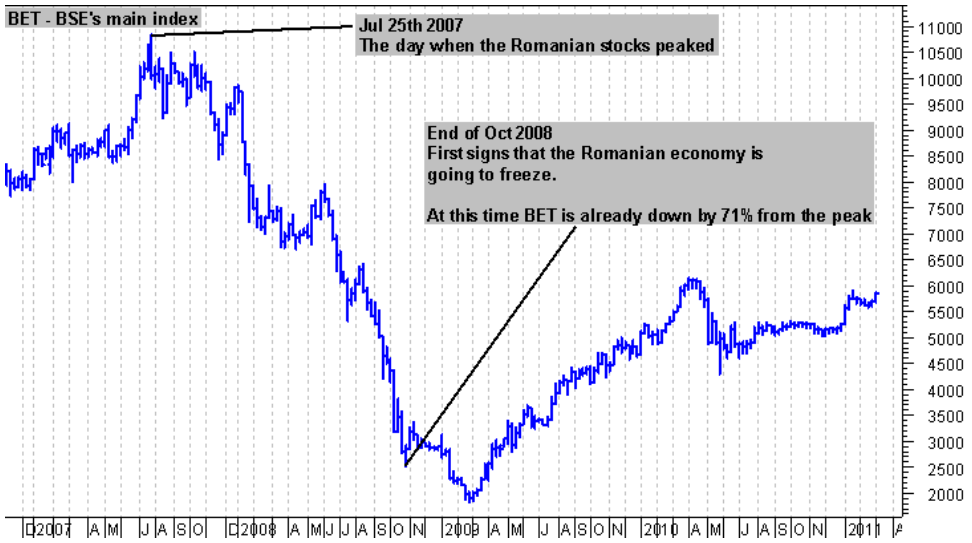
	DAX	WIG20	BET	BET_FI	BET_XT
S&P500 coefficient	1.096751	1.199445	1.805273	2.430955	2.025345
Std. Error	0.083793	0.135742	0.231491	0.487236	0.289032
t-Statistic	13.08880	8.836226	7.798458	4.989273	7.007334
Prob.	0.0000	0.0000	0.0000	0.0000	0.0000
R-Squared	0.838486	0.702914	0.648247	0.429981	0.598065

Source of data: Bucharest Stock Exchange and Yahoo Finance; calculations by the author

The second important characteristic of our stock exchange during the crisis was that for a long period of time it was decoupled from the local economy. BSE reached its peak at the end of July 2007. Still, for the local economy 2007 was a great year. Also for the most part of 2008 Romania registered a very good economic growth both in terms of GDP and in terms of companies' profits. In the late autumn 2008, the economic problems started to show signs (or in some cases become evident) for the first time in Romania. By that time the BSE's main indices had already lost more than 70% (see Figure 2).

Figure 2

BET evolution between Jan 2007 – Mar 2011



Source of data: Bucharest Stock Exchange; calculations by the author

Data from Eurostat is showing that Romania's GDP continued to expand until the third quarter of 2008 and only after that the economic activity began its decline. Thereafter, we can say that the stock market anticipated the downturn in the real economy with four quarters in advance. The early decline of the BET and other local stock indices are the result of the sell orders issued by the foreign institutional investors who made their exits from the emerging economies as they anticipated that the crisis will also spread towards them. They acted before the actual economic data could confirm their supposition, which is absolutely normal behavior in the stock market. The only surprising element is that this time, in Romania's case, the period of time between the anticipation and the confirmation was extremely long.

Table 7

GDP and BET performance (quarterly data)

	GDP (mio EUR)	%QoQ GDP growth	BET value (points)	%QoQ growth
2006q01	22276.7		7499	
2006q02	23616.1	6.01%	7056	-5.91%
2006q03	24391.1	3.28%	7952	12.71%
2006q04	26413.7	8.29%	8050	1.22%
2007q01	27861.1	5.48%	8547	6.18%
2007q02	30255.1	8.59%	9665	13.08%
2007q03	32152.6	6.27%	9635	-0.31%
2007q04	31868.3	**-0.88%**	**9825**	1.97%
2008q01	32161.9	0.92%	6920	**-29.57%**
2008q02	33692.3	4.76%	6502	**-6.03%**
2008q03	35607.9	5.69%	4258	**-34.52%**
2008q04	33797.1	**-5.09%**	2901	**-31.87%**
2009q01	30159.8	**-10.76%**	2367	**-18.39%**
2009q02	28699.9	**-4.84%**	3434	45.07%

Source of data: Bucharest Stock Exchange and Eurostat; calculations by the author

4.2. Particularities of the correlation between BSE and the global markets

While being correlated with the global markets is something normal for an emerging stock exchange, the exact way that our local market behaved during the first part of the crisis presented some particularities that worth being mentioned and studied.

First of all, we witnessed higher average intraday volatility at BSE's indexes compared with S&P500, DJI, DAX, FTSE100 or WIG20. During the 2 years of turbulence in the markets there were quite many days when local indexes fluctuated more than 5% (either positive or negative) while mature markets rarely exceeded 3%. Also, BSE had a few panic days (not consecutive though) when blue chips raised or declined 15% (maximum permitted by the electronic trading system)

and there were no more buyers/sellers willing to put orders into the market.

Also, during the 2007-2008, most of the times, the negative days for S&P500 were followed by extreme declines on BSE, while positive days for S&P500 were followed by only minor recoveries. We could say that BSE copied and exaggeratedly amplified all the negative events from the international markets but had only small reactions to the positive events. This behavior is partially explained by the contagion effect.

Very often, BSE opened the day with large gaps that reflect the overnight exchange activity in USA and Asia. Usually these gaps range between 1% to 3%, positive or negative, comparing with the closing price of the preceding trading day.

And last but not least, during the whole period, BSE had very limited or almost no reaction at all when local macro indicators were announced, but fluctuated wildly at 8:30 EST when important US macroeconomic indicators were made public.

5. Conclusions

During the financial crisis our local stock exchange was directly and very strongly impacted. The declines were very much correlated with those of the more established exchanges. One particularity was that the volatility and the amplitude of those declines were much larger compared with the ones from the leading stock exchanges in Europe and USA.

Both on weekly and monthly data the Romanian indices showed a similar degree of correlation with S&P500 index in comparison with the Polish emerging market stock index WIG20. Still, the Romanian indices showed higher volatility and higher amplitude of extreme (both positive and negative) variations.

The linear regression coefficients have values above 1 on the monthly date sample for all the Romanian indices. Also the values of those coefficients are higher than the one computed for WI20 and DAX which shows that the fluctuations of the S&P500 index were not only accurately mirrored by the Romanian stock market during 2007-2009 period but that they were also significantly amplified.

Although this is in some extent normal for a emerging or frontier market, in my opinion, it also shows a vulnerability of BSE which is the result of its lack of maturity. In order to improve its stability during times of financial turbulence, we need to further develop the exchange and stimulate the development of the local investors so that their participation in the market will increase.

Among the things that can be done by the exchange officials and stock market professionals, I consider that the most important is to encourage new large private owned company to float on the market. By bringing more issuers to the exchange, the market depth will increase (in terms of total capitalization, free float, daily market turnover and total number of daily stock transactions).

One particular way of development may be to promote companies that are currently traded/listed on the Rasdaq OTC market to the second tear of BSE. These are small but dynamic companies, mostly private owned, with a much diversified field of activities and with potential for the current investors.

Of course, the fastest way to improve the market depth would be to float on the stock exchange the companies where the state is currently the major shareholder. This could be done as part of faster and more transparent privatization process. The flotation of the Ownership Fund that took place in Feb 2011 is a very good example in this sense, since it provided a powerful boost for BSE. While many promises were made during the last years from the government officials, these large state-owned companies are extremely slow to implement the steps towards an eventual IPO. This is why although they will

represent the most important breakthrough in the sustainable development of the BSE, the exchange officials and the local brokerage community must rely mainly on their own efforts directed towards convincing private owned companies of the advantages of being traded on our local stock market.

Regarding the local investors, the participation of both private persons and institutional investors is deficient and has a lot of room for improvement. If the local capital will grow and will begin to represent a larger share of the average daily market turnover, the BSE's vulnerability at the movements of foreign speculative capital will be significantly reduced (as the Poland's experience clearly shows). The easier way would be to attract more private persons to invest on the local exchange, but the most efficient way remains to convince the institutional investors (mainly the Level II and Level III private managed pension funds) of the long term profitability of investing in companies traded on BSE.

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