STOCK MARKETS LIBERALIZATION AFFECTS VOLATILITY?

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1. Introduction

Modern financial theory shows that the volatility of financial assets should be analyzed in order to build efficient portfolios. Volatility dedicated concern is the fact that investment decisions depend not only on the expected returns, but also the risks of various assets comprising the portfolio. In the emerging markets field, stock market volatility issues raise a lot of questions.

Stock market liberalization may lead to an improvement in information efficiency, but this is not satisfactory if it is accompanied by excessive market volatility, or even a financial crisis.Thus, although we can confirm that the existence of a weak form efficiency in most emerging markets in the long run, it is also important to analyze the financial impact of financial deregulation on stock market volatility. This argument is nonsense, because current studies of financial theory suggest no clear relationship between efficiency and volatility. Indeed, in an efficient market, volatility may increase or decrease due to the arrival of new information.

The current debate on market volatility, we focus on the aspects listed below:

- market volatility has two main features. It varies over time and seems to react strongly to political and economic turmoil. Then, it seems to have a long memory (persistent). In other words, a series of returns that has been volatile in the past should be the same today and tomorrow.
- the literature offers different interpretations of the level of market volatility. Some believe that market volatility is related to characteristics of firms, such as rate of return, dividend rate and financial performance [Schwert (1989)]. Other authors such as Stoll and Whaley (1990) attempt to obtain explanations by studying the microstructure of stock markets (exchange rate mechanism, pricing, information structure, etc.). In addition, based on models provided by behavioral finance, Shiller (1990) argues that volatility is caused by some psychological traits of investors, in particular, over-confidence and mimetism.

Bekaert and Harvey (1997) realize the time-series study of 17 markets using monthly time and they find that reduce volatility liberalization process. In their paper from 2000, they made a study found on 20 emerging markets that there is a small insignificant but mostly Increase in volatility following and liberalizations process. Kwan and Reyes (1997) find stock market liberalization in Taiwan that reduces volatility significantly. This result coincides with That Obtained by Cuñado et al. (2006) and Dhir (2007). De Santis and Imrohoroglu (1997) identified that there is no obvious relationship between liberalization and stock market volatility. The aame result obtains and Bellalah Nguyen (2008). Koot and Padmanabhan (1993), Levine and Zervos (1998), Miles

(2002) and Jayasuriya (2005) found significantly higher that is volatility in the period after liberalization.

2. Sample data and its statistical characteristics

To test various aspects of stock exchange indices, following the implementation of the liberalization process of capital markets, we use daily closing data of six indices related to European emerging capital markets: Hungary (BUX), Poland (WIG), Czech (PX), Slovenia (SBI), Slovakia (SAX) and Romania (BET) (Table 1).Analyzed time begins with the first day of publication of each indice and end on June 30, 2011 (except for stock index of Slovenia). All closing values of these indices are collected from Datastream database and are denominated in local currency.

We analyzed the stock market volatility, before and after liberalization process. Breaking point we considered the official date of liberalization of capital markets (Table no. 1).

Table no. 1. The sample analyzed indexes

Indices	Analyzed period	Official date of liberalization
BET	19 Sept. 1997 - 30 Jun. 2011	January 2006
BUX	2 Jan. 1991 - 30 Jun. 2011	July 2001
PX	7 Sept. 1993 - 30 Jun. 2011	January 2001
SAX	3 Jul. 1995 - 30 Jun. 2011	January 2001
SBI	3 Jan. 1994 - 14 Oct. 2010	January 2002
WIG	16 Apr. 1991 - 30 Jun. 2011	January 2001

Source: Author`s calculations

Based on these data we calculated the daily logarithmic returns using the closing prices of each trading day.

The main descriptive statistics of daily logarithmic return series corresponding to the six analyzed indices for the period from the first day of listing until 30 June 2011 are presented in Table 2.

Note that the mean return series are positive in all markets examined, to the extremes being placed Poland (0.084%) and Slovakia (0.007%).A first argument that returns do not follow a normal distribution law is given by the Kurtosis coefficient (have higher values of 3), which means that the distribution is leptokurtic, which is much less sharp than the normal distribution, and by the asymmetry coefficient (Skeweness) which is different from zero indicating a left asymmetry (except Czech Republic), ie the left tail is longer. The second argument that the distribution of daily stock market returns do not follow a normal distribution law is given by the value of Jarque-Bera test. The presence of elongated tails due to the fact that the arrived information on the market needs time to be incorporated under this generating the behavior of cluster returns which translate into a leptocurtic distribution of them.

Table no. 2. Descriptive statistics for the logarithmic return indices

Indices	BET	BUX	PX	SAX	SBI	WIG
No. observations	**3433**	**5139**	**4309**	**3900**	**4379**	**4609**
Media	**0.00050**	**0.00061**	**0.00030**	**0.00007**	**0.00022**	**0.00084**
Median	**0.00052**	**0.00051**	**0.00038**	**0.00000**	**0.00000**	**0.00070**
Maximum	**0.14577**	**0.13616**	**0.15391**	**0.11880**	**0.11018**	**0.14783**
Minimum	**-0.13117**	**-0.18033**	**-0.16186**	**-0.14810**	**-0.11344**	**-0.11344**
Standard deviation	**0.01894**	**0.01719**	**0.01536**	**0.01324**	**0.01192**	**0.02007**
Skewness	**-0.19135**	**-0.54959**	**0.34161**	**-0.85257**	**-0.42201**	**-0.04958**
Kurtosis	**9.55301**	**14.26331**	**17.48792**	**15.94815**	**15.72359**	**8.92586**
Jarque-Bera	**6161.64**	**27417.75**	**37760.81**	**27709.25**	**29661.35**	**6744.12**
Probability	**0.00000**	**0.00000**	**0.00000**	**0.00000**	**0.00000**	**0.00000**

Source: Author`s calculations in Eviews

Return indices remain positive both before liberalization (except Slovakia) and after completion of the process (except Romania), also returns have higher values recorded for the entire period. Kurtosis coefficients remain higher than the value of three, therefore the distributions are leptokurtic, and these do not follow the normal law (according to Jarque-Bera test). Before the implementation process, only distributions of BET and PX return indices have a right asymmetry, and for the other indices the distribution remains have a left elongated tail. After completing the process all indices have negative values of the asymmetry coefficients.

3. Empirical results on the impact of financial liberalization on volatility

In order to analyze the existence of dependencies in return series we used the model ARMA (p,q). Establishing ARMA model was based on three criteria: Akaike information criteria (AIC), Ljung-Box statistics and the analysis of correlogram of residuals. ARMA model with the smallest value of AIC for which the portemanteau test does not show significant results, is used to remove the linear structure of stock return series. These structures were removed in the case of three indices: BET, PX and SAX. McLeod-Li test statistics of squared residuals is significant to 1%, which indicates the presence of nonlinear dependencies in the return series of indices (Table no. 3).

Table no. 3. The ARMA (p,q) model

	BET	BUX	PX	SAX	SBI	WIG
Model	ARMA(1,0)	ARMA(1,0)	ARMA(4,0)	ARMA(0,0)	ARMA(2,0)	ARMA(8,0)
R^2	0.030449	0.006427	0.042745	0.00	0.059429	0.076353
AiC	-5.12511	-5.29375	-5.5493	-5.68216	-6.03135	-5.059306
$Q_s(5)$	6.091	16.065*	0.0922	5.8879	2.4976	0.1517
$Q_s(10)$	10.917	50.568*	10.484	13.438	19.064**	1.1612
$Q_{ss}(5)$	589.27*	1194*	2187.3*	139.55*	1287.1*	3105.8
$Q_{ss}(10)$	760.89*	1875.5*	3074.5*	168.85*	1414.6*	4209.6*

Source: Author`s calculations in Eviews

Note: R^2 is the determination coefficient, AIC is the Akaike information criteria, $Q_s(k)$ is the Ljung-Box test statistic, $Q_{SS}(k)$ is the McLeod-Li test statistics.

*, ** and *** represent significance level of 1%, 5% and 10%.

To analyze the impact of liberalization on return volatility of the six indices, we use GARCH test where we introduced a dummy variable related to liberalization. Thus, the GARCH model shows:

$$\sigma_t^2 = \omega + \sum_{i-1}^{p} \alpha_i \cdot \varepsilon_{t-i}^2 + \sum_{j-1}^{q} \beta_j \cdot \sigma_{t-j}^2 + \gamma \cdot D_t$$

where D_t is the dummy variable that takes the value zero for the pre-liberalization period, respectively one for post-liberalization period.

The results of Table no. 4 shows that financial liberalization has a positive impact on stock market volatility in Hungary and Czech Republic stock markets, respectively a negative impact on the Poland capital market volatility.

Table no. 4. The GARCH (p,q) model

	BET	BUX	PX	SAX	SBI	WIG
MODEL	GARCH(3,1)	GARCH(2,1)	GARCH(1,1)	GARCH(2,1)	GARCH(4,1)	GARCH(2,1)
α_1	0.345582*	0.294876*	0.148982*	0.089856*	0.34496*	0.130253*
α_2	-0.14876*	-0.186334*	-	-0.040701*	-0.147693*	-0.036349***
α_3	-0.100925*	-	-	-	-0.160198*	-
α_4	-	-	-	-	0.030758*	-
β_1	0.899688*	0.877626*	0.83002*	0.939613*	0.934224*	0.891199*
$\Sigma\alpha_i + \Sigma\beta_j$	0.995585	0.986168	0.979002	0.988768	1.002051	0.985103
$Q_{ss}(5)$	2.8175	2.0932	3.3066	7.508	0.5815	6.4741
$Q_{ss}(10)$	5.0102	5.5029	5.9783	9.562	1.1242	9.8182
Dummy	-0.00000244	0.0000159*	0.0000239*	0.00000238	-0.00000111	-0.00000352*

Source: Author`s calculations in Eviews
Note: $Q_{ss}(k)$ is the McLeod-Li statistics.
*, ** And *** represent significance level of 1%, 5% and 10%.

As part of linear dependencies have been removed, it is necessary to consider whether the return series are present nonlinear dependencies, too. For this we applied the BDS test on standardized residuals of GARCH model.

Probabilities resulting from BDS test are above the threshold of acceptance of the null hypothesis, of 10%, only for the Poland stock market indice return series, which means that the standardized residuals of GARCH (2,1) model are independent and identically distributed. Nonlinear dependences D remain in the other return series.

The persistence of volatility shocks induced ($\Sigma\alpha_i+\Sigma\beta_j$) seems to be permanent, because the values are close to unity.Therefore we applied the Integrated GARCH test.IGARCH model mathematical expression looks as follows:

$$\sigma_t^2 = \sum_{i-1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j-1}^{q} \beta_j \sigma_{t-j}^2$$

This relationship is similar to a GARCH model. For this model to be an IGARCH model, it must fulfill the following condition:

$$\sum_{i-1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j-1}^{q} \beta_j \sigma_{t-j}^2 = 1$$

Since we introduced the dummy variable in the IGARCH model too, relationship model calculation will be:

$$\sigma_t^2 = \sum_{i-1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j-1}^{q} \beta_j \sigma_{t-j}^2 + D_t$$

According to Table no. 5, financial liberalization has a positive impact on return volatility for indices in Hungary, Czech Republic, Poland and Slovakia. For the other two stock markets the impact is insignificant.

Table no. 5. The IGARCH model

	BET	BUX	PX	SAX	SBI	WIG
Model	IGARCH(3,1)	IGARCH(2,1)	IGARCH(1,1)	IGARCH(2,1)	IGARCH(4,1)	IGARCH(2,1)
α_1	0.273486*	0.292305*	0.11894*	0.110187*	0.296574*	0.152116*
α_2	-0.114137*	-0.244847*		-0.070027*	-0.1276*	-0.079901*
α_3	-0.103651*				-0.138371*	
α_4					0.015749	
β_1	0.944303*	0.952541*	0.88106*	0.959839*	0.953647*	0.927786*
$\Sigma\alpha_i + \Sigma\beta_j$	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
$Q_{ss}(5)$	1.7854	4.2916	2.0645	31.857	0.8357	2.695
$Q_{ss}(10)$	7.3542	8.7496	4.5608	37.63	1.3167	4.937
Dummy	0.00000106	0.00000131*	0.00000233*	0.00000107*	0.000000326	0.0000011*

Source: Author`s calculations in Eviews
Note: $Q_{ss}(k)$ is the McLeod-Li statistics.
*, ** and *** represent significance level of 1%, 5% and 10%.

We applied the BDS test on the standardized residuals of IGARCH model, too. Existence of nonlinear dependence problems do not disappear.Compared with obtained results by applying the BDS test on standardized residuals of GARCH model indicates that fewer nonlinear dependencies were removed.

The financial crisis that began in the United States, on the prime mortgage market in 2007 quickly spread across Europe into a global crisis affecting the world financial systems and economic activity in almost all countries. Global financial turmoil has caused a deep crisis in several emerging European markets. The graphics of rolling windows methodology show an increase in volatility due to the occurrence of financial crisis in emerging markets. Therefore we applied the GARCH and IGARCH models on the time that disregard the corresponding period of the crisis. Thus, analyzed periods are: 1 July 2001 - July 23, 2007 (Hungary), 1 January 2001 - June 7, 2007 (Poland), January 1, 2001 - 15 October 2007 (Czech Republic), January 1, 2002 - 31 August 2007 (Slovenia), 1 January 2001 - March 26, 2008 (Slovakia) and 1 January 2006 - August 25, 2008 (Romania).

Applying ARMA model we obtain lower values for AIC. However, linear structures are removed only for two stock markets (Romania, Slovakia), and nonlinear dependencies remain at 1% significance level for all indices (Table no. 6).

Table no. 6. The ARMA (p,q) model

AR	BET	BUX	PX	SAX	SBI	WIG
model	ARMA(1,0)	ARMA(1,0)	ARMA(2,0)	ARMA(0,0)	ARMA(2,0)	ARMA(11,0)
R^2	0.062265	0.009706	0.079626	0.00	0.061628	0.087215
AiC	-5.32019	-5.34979	-5.81777	-5.73818	-6.11706	-5.004659
$Q_s(5)$	3.3347	14.948*	20.276*	3.865	3.2974	0.079
$Q_s(10)$	14.129	44.843*	25.911*	15.81	27.295*	0.197
$Q_{ss}(5)$	274.9*	1183.8*	1471.5*	151.23*	836.65*	2641.9*
$Q_{ss}(10)$	297.16*	1710.6*	1630*	195.85*	905.76*	3527.2*

Source: Author`s calculations in Eviews
Note: R^2 is the determination coefficient, AIC is the Akaike information criteria, $Q_s(k)$ is the Ljung-Box test statistic, $Q_{ss}(k)$ is the McLeod-Li test statistics.
*, ** and *** represent significance level of 1%, 5% and 10%.

GARCH model results show that financial liberalization leads to lower volatility in stock markets in Hungary, Czech Republic and Poland (Table no. 7). By applying the BDS test on standardized residuals of GARCH model, there were removed a larger number of nonlinear structures.Null hypothesis is rejected by stock indice WIG, in almost all cases, it is rejected by BET and BUX indices, and in half of the cases for PX and SAX indices.

Table no. 7. The GARCH (p,q) model

	BET	BUX	PX	SAX	SBI	WIG
MODEL	GARCH(3,1)	GARCH(2,1)	GARCH(1,1)	GARCH(4,1)	GARCH(4,1)	GARCH(2,1)
α_1	0.335822*	0.320384*	0.141082*	0.131668*	0.343557*	0.160062*
α_2	-0.132165*	-0.200307*	-	-0.016615	-0.154039*	-0.058354*
α_3	-0.108216*	0.120077*	-	-0.017751	-0.15103*	-
α_4	-	-	-	-0.047227*	0.038352*	-
β_1	0.893965*	0.865266*	0.830202*	0.939767*	0.927267*	0.876254*
$\Sigma\alpha_i + \Sigma\beta_j$	0.989406	0.985343	0.971284	0.989842	1.004107	0.977962
$Q_{ss}(5)$	1.2942	1.2811	5.0369	4.2723	0.5607	4.9736
$Q_{ss}(10)$	5.5465	4.435	9.6144	12.917	1.0808	8.6971
Dummy	-0.0000092	-0.000013***	-0.0000274*	-0.00000342	0.00000015	-0.000039*

Source: Author`s calculations in Eviews
Note: $Q_{ss}(k)$ is the McLeod-Li statistics.
*, ** And *** represent significance level of 1%, 5% and 10%.

The results of the IGARCH model show that the liberalization process has a positive and significant impact on two stock markets (Slovakia and Slovenia). For the other four stock markets, financial liberalization leads to a decrease volatility (Table no. 8). BDS test does not eliminate the nonlinear dependencies (except for WIG index).

Table no. 8. The IGARCH model

	BET	BUX	PX	SAX	SBI	WIG
MODEL	IGARCH(3,1)	IGARCH(2,1)	IGARCH(1,1)	IGARCH(4,1)	IGARCH(4,1)	IGARCH(2,1)
α_1	0.259532*	0.30023*	0.106389*	0.140252*	0.282327*	0.179679*
α_2	-0.093068*	-0.253765*	-	-0.024107	-0.12829*	-0.10853*
α_3	-0.121494*	-	-	-0.015519	-0.128751*	-
α_4	-	-	-	-0.071989*	0.020625**	-
β_1	0.95503*	0.953535*	0.893611*	0.971363*	0.954089*	0.928851*
$\Sigma\alpha_i + \Sigma\beta_j$	1.000000	1.000000	1.0000000	1.0000000	1.0000000	1.0000000
$Q_{ss}(5)$	1.3529	3.683	2.5911	6.0798	0.8081	3.635
$Q_{ss}(10)$	7.7933	7.5755	5.6863	9.245	1.2612	6.8362
Dummy	-0.0000062*	-0.00000128*	-0.0000203**	0.00000593*	0.0000034**	-0.00000136*

Source: Author`s calculations in Eviews
Note: $Q_{ss}(k)$ is the McLeod-Li statistics.
*, ** and *** represent significance level of 1%, 5% and 10%.

The results from econometric models correspond to those shown in the graphs obtained by applying the rolling window methodology. The results are consistent with those of Bekaert and Harvey (1997), Cuñado et al. (2006) and Nguyen and Bellalah (2008).

4. Conclusions

A priori, it would be better for developing countries to liberalize their stock markets to allow domestic investors to benefit from financial integration, such as diversification of risk and capital cost reduction, namely to make capital markets more efficient, more liquid and competitive. However, it is appropriate to emphasize certain additional measures in a preventive perspective, against the risks of financial instability, identified by some authors that would increase stock market volatility following liberalization:

- we know that when a market is liberalized, it is exposed to sudden inputs and outputs of capital flows.A lack of consistency in liberalization policies, will result in capital flows to become more volatile, and investors will try to protect the transfer of capital to safer places. The volatility in capital flows will affect the movement of market volatility. Therefore, to reduce volatility, the first step and certainly the most important is to ensure consistency of reform programs.

- regulatory measures to avoid failures in the local market should be considered.This is necessary to strengthen the preconditions for the proper functioning of the market. These conditions relate mainly to financial infrastructure, quality and quantity of flow of disseminated information, respectively investor education on the nature of financial securities and portfolio management.
- the extent that political and institutional systems in developing countries do not have the maturity of the developed countries, they should master the pace of deregulation, as the rapid liberalization could cause that local financial markets are highly vulnerable to shocks external.

However, increased volatility following financial liberalization is not always a negative element. This may reflect a consolidation of information efficiency of markets, which increases the asset price fluctuations at the arrival of new information, due to feedback received from investors. Therefore, creating a transparent investment environment is essential to reduce the negative effects of herding behavior and lack of investor confidence.

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