Emerging stock market integration and contagion in the context of global financial crisis

Ramona Birău, Jatin Trivedi

***Abstract* —** The aim of this paper is to examine emerging stock market integration and contagion in the context of global financial crisis. Moreover, trading decisions depend on the international financial architecture, especially in terms of high volatility spillovers, integration degree, propagation of financial shocks, global interdependence and migration of market disturbances. The main focus is to consider the financial econometrics framework based on ARCH/GARCH models and Granger causality test. This empirical research covers the period from January 2007 until February 2013 of daily returns of selected stock markets major indices.

***Keywords*—**international contagion, ARCH/GARCH models, volatility, portofolio diversification, Vector AutoRegression (VAR) models, Granger-Causality Tests

I. Introduction

The vulnerability of emerging stock markets to external shocks is currently a controversial and highly sensitive issue to both academics and practitioners. The global financial crisis that erupted in August 2007 is considered to be the most massive financial shock since the Great Depression of the 1930s. The root causes of this financial crisis that was generated by the US subprime mortgage collapse are mirrored in several fundamental factors, such as : excessive leverage, low liquidity, high-risk derivatives, permissive governance, credit rating agencies, taxes and subsidies, insignificant hedging funds, financial system solvency, conflicts of interest, systemic risks, financial regulatory practices or "too big to fail" complex. In addition, the turbulence in financial system has turned into heavy decreases on stock markets around the world. In the general context of globalization, the spread of crises from one market to another is assimilated to the concept of financial contagion. Thus, despite the fact that there is no generally accepted definition of contagion, it is perceived as an unpredictable propagation of shocks. However, in this turbulent financial habitat, stock markets become profoundly integrated. The international financial architecture is regarded as a continuous process of adjustment. Nevertheless, is strictly required to maintain a clear separation between common interdependencies, spillovers across financial assets and other random fundamentals. In financial literature, was revealed taxonomy of reasons why crises in developing countries might be contemporaneous in time (Masson, 1999). Contagion effects are the result of certain transmission channels of external financial shocks, such as the trade linkages. Contagion, by its very nature, can be a difficult concept to measure both in quantitative and qualitative approaches. The structure of this paper includes both an exhaustive theoretical approach and a section of original empirical research. The aim of this paper is to investigate the fragile boundary between the advantages of financial globalization and the dramatic effects of contagion in the context of the global financial crisis. The analysis is focused on the behavior of several European emerging stock markets (Hungary, Romania, Slovakia and Poland) from January 2007 to February 2013. The same methodology is applied for several mature stock markets (U.S, Japan, U.K and France). The empirical analyses of contagion based on emerging stock markets behavior is focused on the transmission of financial shocks originating from mature markets.

F. R. Birau is with the University of Craiova, Faculty of Economics and Business Administration, Department of Statistics and Economic Informatics, CO 200585, ROMANIA, e-mail birauramona@yahoo.com, mobile phone 40767.970.777

J. Trivedi is with Balaji Institute of International Business, Faculty of Finance and Business Management, Department of Finance & Economics, INDIA, e-mail contact.tjatin@gmail.com

II. Literature review

This paper aims to investigate the implications of international contagion in terms of emerging capital markets in the context of the global financial crisis. The interest of academics and financial practitioners to the subject has grown exponentially in the recent past, especially in terms of globalization. A good while, considerable empirical research has focused mainly on developed stock market contagion effects, but recent studies highlight the fact that emerging capital markets represent a fertile area of significance. Above all, the existence of international contagion between financial time series constitutes a dilemma of great interest. Thus, whether emerging capital markets are integrated and tightly connected or not remains an open question that has profound consequences for a wide range of issues, such as : financial economic theory, financial hedging, derivatives, risk management strategies, financial assets investments,

international portfolio diversification.

Generally, emerging capital markets are considered to be extremely attractive for both institutional and individual financial investors. Nevertheless, extreme financial events such as the current global financial crisis provide an intriguing perspective regarding emerging capital markets behavior. Empirical studies revealed a wide range of stylized facts, such as : volatility clustering, non-stationarity of financial asset price levels, leverage effect, heteroskedastic log returns, deviations from normal distribution, fat-tailed distributions, deterministic chaos. In recent past, financial integration and liberalization processes have generated higher volatility and lead to a more dramatic reaction to financial shocks. In this particular context, international contagion present a special resonance for international financial investors in order to use informations about one or more capital markets basically to forecast the performance of another. The debated issues raise the question of short-run and long-run equilibrium based on financial linkages among capital markets.

The empirical analysis of Grubel (1968) is the cornerstone regarding the benefits of international portofolio diversification strategies extrapolating the concept of modern portfolio extended by Markowitz (1952). Granger and Morgenstern (1970) discussed a topic of great interest, namely the predictability of stock market prices and its profound financial implications. Eun and Shim (1989) have provided interesting results regarding the international transmission of stock market movements among several mature markets, such as : Australia, Japan, Hong Kong, U.K, Switzerland, France, Germany, Canada and U.S.A., considering the fact that a series of multilateral interconnections were identified. Empirical analysis results highlighted that the correlations of U.S.A with Asian-Pacific and European stock markets, with the exception of U.K, are rather inconclusive and low, particularly because of the different trading hours of these particular stock markets. Forbes and Rigobon analyzed a sensitive issue, based on a relatively categorical premise, namely total exclusion of contagion and obvious preference for interdependence, conclusions generated strictly by the perception of stock market co-movements.

Strictly on the current global financial crisis, the issue of extreme financial events was explored in numerous studies by various researchers such as : Malliaris and Urrutia (1992), Arshanapali and Doukas (1993), Nagayasu (2001), Tan and Tse (2002), Lim and McAleer (2004). Flavin and Panopoulou (2006) performed empirical analysis based on the transmission mechanism of shocks in the presence of regime-switching volatility. On the other hand, Phylaktis and Ravazzolo (2005) highlighted the main aspects of stock market linkages in emerging markets and the practical implications for international portfolio diversification. According to Singh (2010) who investigated the Chinese and Indian stock market linkages with several developed stock markets, namely U.S., U.K., Japan and Hong Kong, both Chinese and Indian market are correlated with all the selected developed markets based on the analysis of Granger causality. Rodriguez (2007) highlighted in his article “Measuring financial contagion: A Copula approach” a particular approach of financial contagion based on models dependence with switching-parameter copulas. Technically, the empirical analysis is based on daily returns from five East Asian stock indices during the Asian crisis and from four Latin American stock indices during the Mexican crisis. The results demonstrated the existence of changing dependence during periods of financial turmoil.

III. Methodological approach

In order to examine impact on emerging stock market and developed markets to finding out unfathomable contagion impact within USUJFHPRS countries. (USA, UK, JAPAN, FRANCE, HUNGARY, POLAND, ROMANIA and SLOVAKIA) the paper represents data from year 07’ to 13’ under Bivariate GARCH model and compares the mean of correlations distributed entire research periods. Since recent development in estimation of standard errors, known as “Robust Standard Errors” (RSE) has also reduced the concern over Heteroskedasticity. If the sample size is large, then robust standard errors give quite a good estimate of standard errors even with Heteroskedasticity. Even if the sample is small, the need for a Heteroskedasticity correction that doesn’t affect the coefficients, but only narrows the standard errors somewhat, can be debated. Least Squares Model (LSM) is the great workhorse of applied econometrics. The basic version of the model assumes that, the expected value of all error terms, in absolute value, is the same at any given point. Thus, the expected value of any given error term, squared, is equal to the variance of all the error terms taken together. This assumption is known as Homoskedasticity. The primary etymology of the terms of Greek origin suggests their contradiction, so homo meaning the same or equal and hetero meaning different or unequal with the same common root skedasmos meaning spread or scatter. Conversely, data in which the expected value of the error terms is not equal, in which the error terms may reasonably be expected to be larger for some points or ranges of the data than for others, is said to suffer from Heteroskedasticity (Engle). ARCH and GARCH models, which stand for autoregressive conditional heteroskedasticity and generalized autoregressive conditional heteroskedasticity, have become widespread tools for dealing with time series heteroskedastic models such as ARCH and GARCH. The goal of such models is to provide a volatility measure - like a standard deviation - that can be used in financial decisions concerning risk analysis, portfolio selection and derivative pricing. Generally, financial time series data exhibit linear dependence in volatility, which implies the existence of heteroskedasticity. Consequently, detecting heteroskedasticity is an important issue that must be considered in the context of financial time series modeling and forecasting, especially considering the interests of potential international investors.

ARCH/GARCH Model

This paper will focus on financial applications, we will use financial notation. Let the dependent variable be labeled , which could be the return on an asset or portfolio. The mean value m and the variance h will be defined relative to past information set. Then, the return r in the present will be equal to the mean value of r (that is, the expected value of r based on past information) plus the standard deviation of r (that is, the square root of the variance) times the error term for the present period. Thus, a GARCH (1, 1) model for variance looks like this:

$$h_t = \omega + \alpha h_{t-1}\varepsilon_{t-1}^2 + \beta h_{t-1}$$

Above model forecasts the variance of date t return as a weighted average of a constant, yesterday's forecast, and yesterday's squared error. Of course, if the mean is zero, then from the surprise is simply . Nevertheless, the GARCH models are conditionally Heteroskedastic but have a constant unconditional variance. Possibly the most important aspect of the ARCH/GARCH model is the recognition that volatility can be estimated based on historical data and that an inappropriate model can be detected directly using conventional econometric techniques (Engle).

Vector AutoRegression (VAR) models

The basic definition of VAR model suggests a set of linear dynamic equations where each variable is specified as a function of an equal number of lags of itself and all other variables in the system. It can test if selected endogenous variables should not be treated as exogenous. The VAR in first differences can be expressed as :

$$\Delta X_t = \lambda_1 + \sum_{i=1}^{k} a_{1i}\Delta X_{t-i} + \sum_{j=1}^{k} b_{1j}\Delta Y_{t-j} + \mu_{1t}$$

$$\Delta Y_t = \lambda_2 + \sum_{i=1}^{p} a_{2i}\Delta X_{t-i} + \sum_{j=1}^{p} b_{2j}\Delta Y_{t-j} + \mu_{2t}$$

IV. Data and Results

In this paper we use stock price indices of USA, UK, JAPAN, FRANCE, HUNGARY, POLAND, ROMANIA and SLOVAKIA to compute the stock returns and find the impact of correlations between developed and emerging economy markets. The sample period is from 2nd Jan, 2007 to 20th Feb, 2013 for CAC 40, BUX INDEX, WIG20, BET-C, SAX INDEX, NIKKEY225, FTSE 100 and DJIA.

Table – 1 contains the summary statistics of the stock index for specified period 07 – 13. The analyzed data represents entire sample of research area. MAX indicator for DJIA 14164.53 and MIN 6547.05, in case of FTSE 6732.40 as MAX indicator and MIN 3512.09. The bridging gap is covered in 150% from its MIN and MAX. It indicates the strong capitalization support to the market in view to compare the impact on developing economies which fluctuates variety of difference to absorb and exude volatility changes. CAC 40 shows MIN 2519.29 and 6168.15 MAX, considering with BUX, WIG, BET, and SAX, these all are highly impacted by small fluctuation in developed market is able to create large impact successfully on emerging capital markets.

Table 1: Summary of Statistics of stock market indices (data from January, 2001 to February, 2013)

Entire	FRANCE	HUNGARY	POLAND	ROMANIA
MIN	2519.29	9461.29	1327.64	1231.05
MAX	6168.15	28511.38	3917.87	7432.63
Skewness	0.95	-0.55	0.50	1.01
Kurtosis	-0.23	0.04	-0.18	-0.02
Vari	2.45	3.01	2.95	6.04
Obs.	1565	1504	1539	1569
Entire	SLOVAKIA	JAPAN	UK	USA
MIN	178.65	7054.98	3512.09	6547.05
MAX	467.08	18261.98	6732.40	14164.53
Skewness	0.43	1.10	-0.76	-0.69
Kurtosis	-1.45	-0.14	0.11	-0.44
Vari	2.61	2.59	1.92	2.16
Obs.	1523	1534	1544	1536

Source: Own computations based on selected financial data series

It represents the actual value plot of the market index series. It is observed that any force on developed economy market impacts large changes in bullish and bearish trends on emerging /underdeveloped capital markets. The level of volatility in stable market impacts entire group of underdeveloped market at a large. This kind of phenomenon is modeled in ARCH framework. The level of activity of changes at higher and lower level of underdeveloped and developed market are positively correlated with its level during the preceding periods (see fig.1 and fig.2) in relation with emerging markets (see fig. 4,5,6) The actual indicators of market index represented by GARCH model.

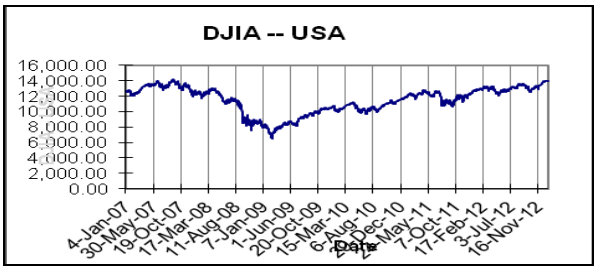

Fig. 1 : D.I.J.A index – USA

Source: Own computations based on selected financial data series

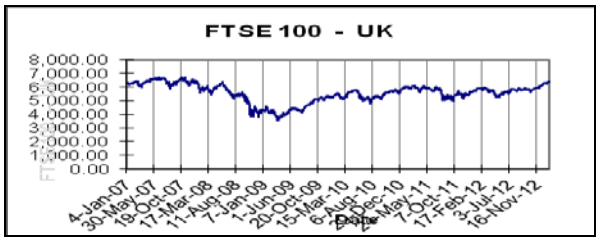

Fig. 2 : FTSE 100 index – U.K
Source: Own computations based on selected financial data series

The observation suggests that impact of volatility in market fluctuations represents stable and sound capital investment (in fig.1 and fig.2). It represetns the positive connectivity between developed capital markets where the over all reaction of market flows in similar directions with unwavering and constructive way. The contagion impact during the research period shows similar reactions of developed capital markets. The additional volatility impact is seen in mid of develop capital market (see fig. 3 and fig.4). Most of the estimated parameters are statistically significant at the 1% level of activity. It is found that certainity of change in variations from two different developed market is not exceding 2.25% in net total output changes. But it vary from emerging market changes for upper and lower level impact. On the other hand (fig.3 and fig.4) represent sensitivity of changes at upper level and lower level positively and formed by developed capital markets. This kind of fluctuations generate when economy development level is integrated towards developed economy and distanced from developing economy. Here the upper level changes shows light deep impact while lower level changes shows weighted impact as seen in observation. The volatility scenario is considered here at 1% of actual market position and impacted its market index. The position and impact on emerging capital markets is very curious and interesting as it represents the large changes at upper level of activity and at lower level of activity. The market volatility is here connected with economic sustainability. Therefore it takes time to absorb the changes generated by the developed capital markets (see fig. 4,5,6,7,8). It is observed that volatility impact on emerging market represents high degree of upper side and high degree of lower side. The certainty changes in variations and level of activity exceeds level of 1% at upper side and lower side.

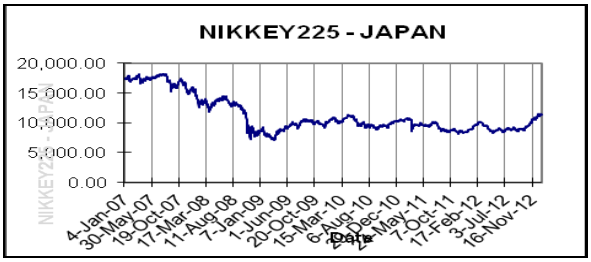

Fig. 3 : NIKKEY 225 index - JAPAN
Source: Own computations based on selected financial data series

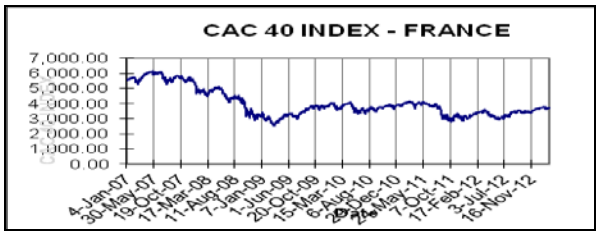

Fig. 4 : CAC 40 index - FRANCE
Source: Own computations based on selected financial data series

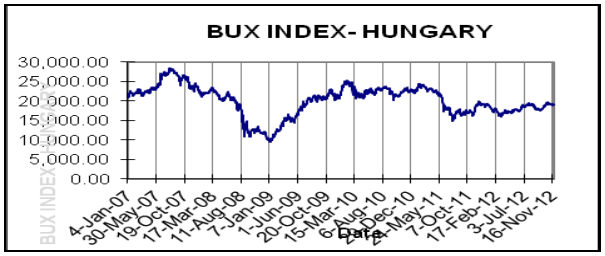

Fig. 5 : BUX INDEX - HUNGARY
Source: Own computations based on selected financial data series

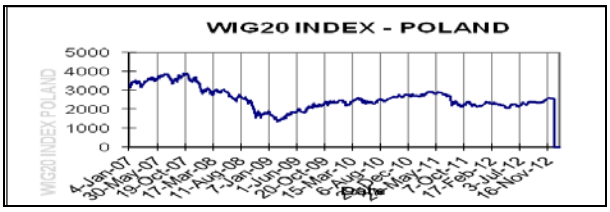

Fig. 6 : WIG20 INDEX - POLAND
Source: Own computations based on selected financial data series

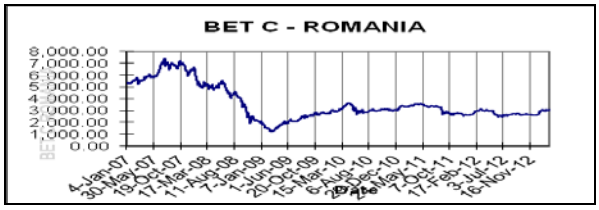

Fig. 7 : BET –C index - ROMANIA
Source: Own computations based on selected financial data series

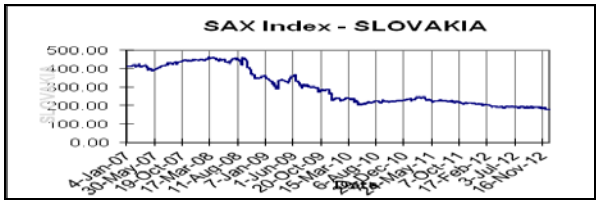

Fig. 8 : SAX index - SLOVAKIA
Source: Own computations based on selected financial data series

Figures above represent the emerging capital markets which

is mainly indicated in dependend market. We have considered all the fluctuation at upper level of activity and lower level of activity to represent the market index changes impacted from developed capital market. It is being noted that there is independent relationship between one developing market to another developing market but unable to generate direct relationships for market volatility. It is observed that during the resesrch study period changes at upper level of activity in develping market (see fig. 1 and fig.2) has generated large level of changes in emerging markets as seen in above figures. The lower side of activity has generated deep changes at independent level of capacitive economic changes in index.

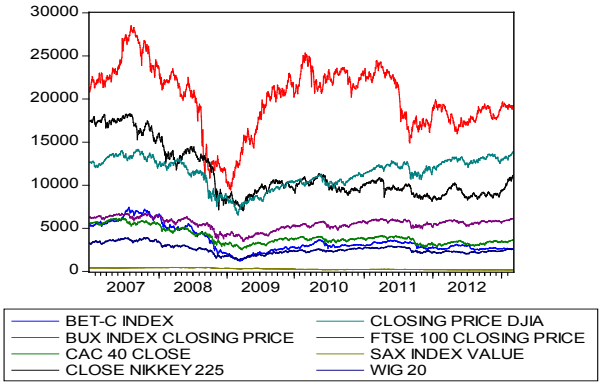

Fig. 9 : Common trend of selected indices
Source: Own computations based on selected financial data series

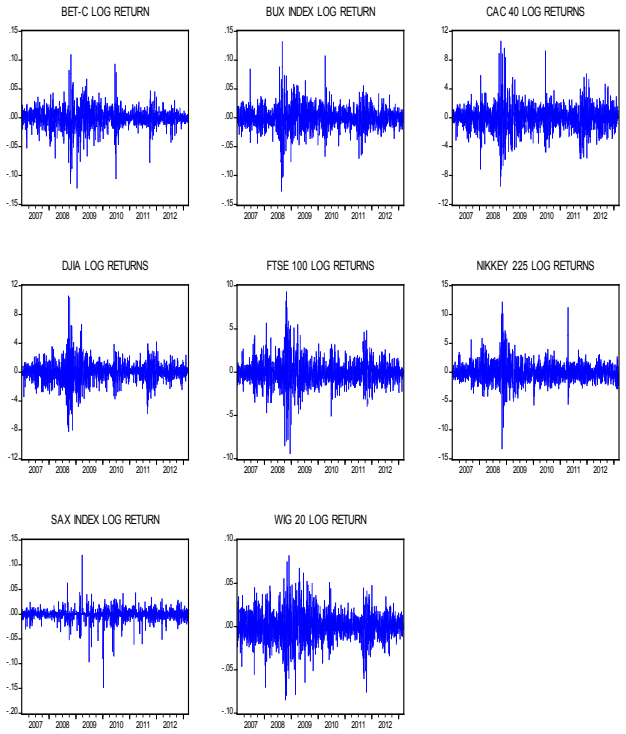

Fig. 10 : The log-returns of selected indices
Source: Own computations based on selected financial data series

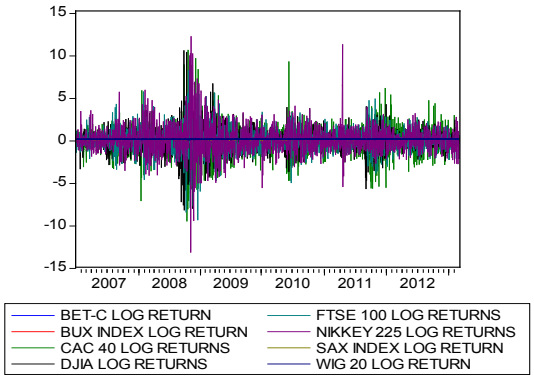

Fig.11 : Common graphs of selected stock indices returns
Source: Own computations based on selected financial data series

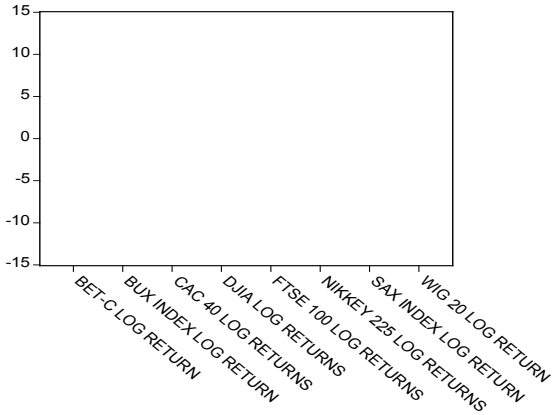

Fig.12 : Descriptive Stats Box Plots
Source: Own computations based on selected financial data series

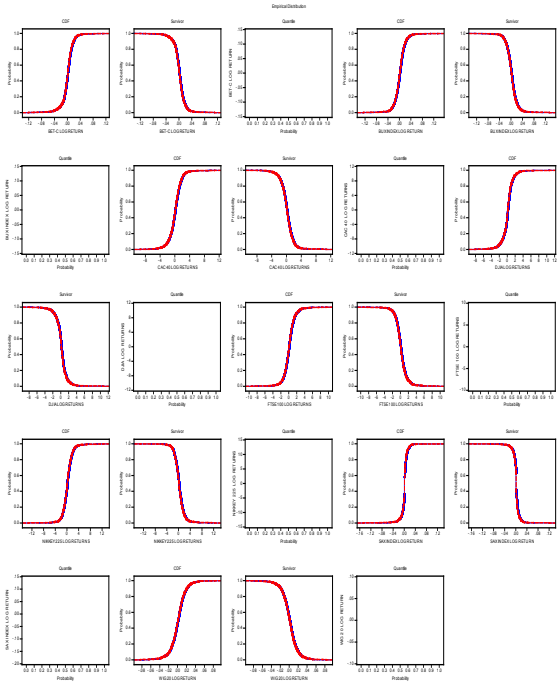

Fig.13 : Distribution Graphs CDF – SURVIVOR-QUANTILE
Source: Own computations based on selected financial data series

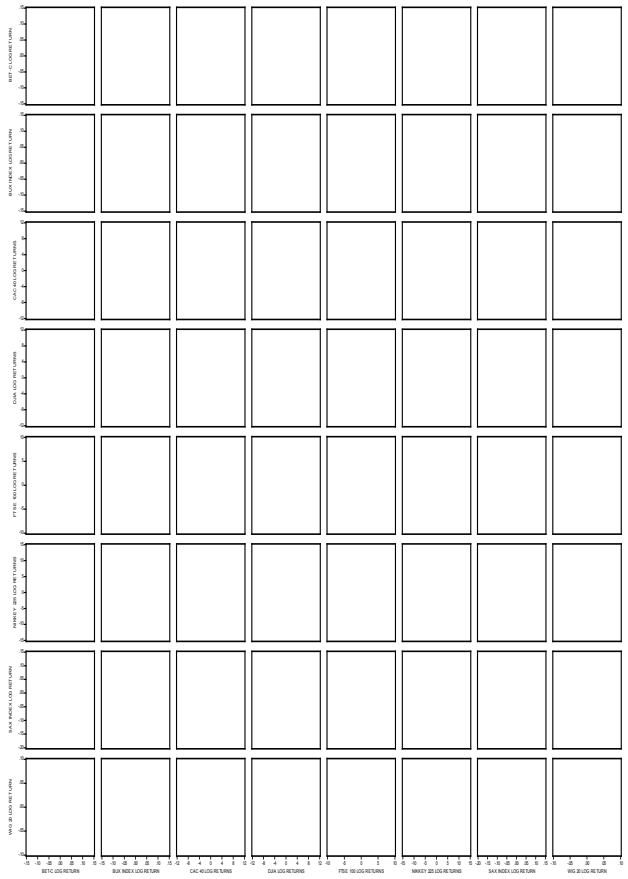

Fig. 14 : Matrix of all pairs of selected stock market indices
Source: Own computations based on selected financial data series

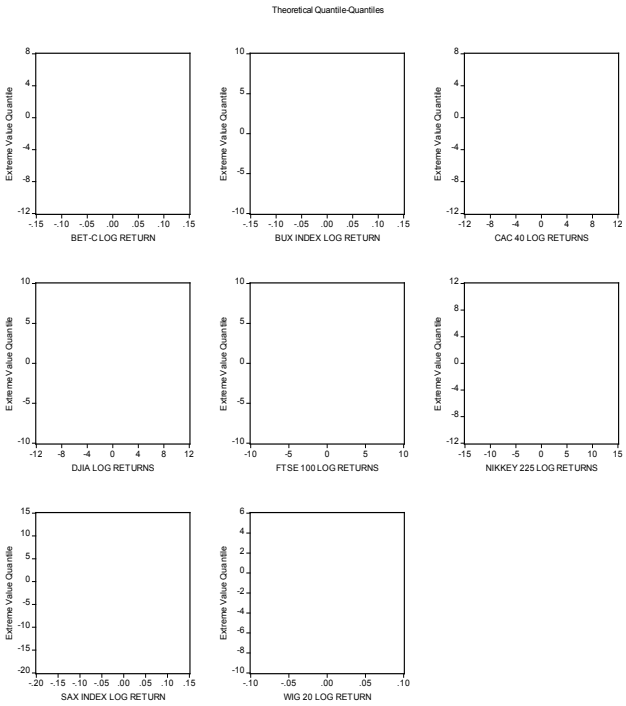

Fig.15 : Theoretical Quantile – Quantiles (Extreme values)
Source: Own computations based on selected financial data series

Pairwise Correlation Matrix

	BET_C_LO...	BUX_INDE...	CAC_40_L...	DJIA_LOG...	FTSE_100...	NIKKEY_2...	SAX_INDE...	WIG_20_L...
BET_C_LOG_RETURN	1.000000	0.017642	0.100016	-0.021991	-0.008406	-0.038227	0.051747	-0.012446
BUX_INDEX_LOG_RETURN	0.017642	1.000000	0.023325	0.044823	-0.022643	0.031310	0.022452	0.013047
CAC_40_LOG_RETURNS	0.100016	0.023325	1.000000	0.012618	-0.037080	0.037820	0.084232	0.121722
DJIA_LOG_RETURNS	-0.021991	0.044823	0.012618	1.000000	-0.036871	0.003581	0.049674	0.057126
FTSE_100_LOG_RETURNS	-0.008406	-0.022643	-0.037080	-0.036871	1.000000	0.063538	-0.031681	-0.032115
NIKKEY_225_LOG_RETU...	-0.038227	0.031310	0.037820	0.003581	0.063538	1.000000	-0.033234	-0.018712
SAX_INDEX_LOG_RETURN	0.051747	0.022452	0.084232	0.049674	-0.031681	-0.033234	1.000000	0.010161
WIG_20_LOG_RETURN	-0.012446	0.013047	0.121722	0.057126	-0.032115	-0.018712	0.010161	1.000000

Fig. 16 : Pairwise Correlation Matrix
Source: Own computations based on selected financial data series

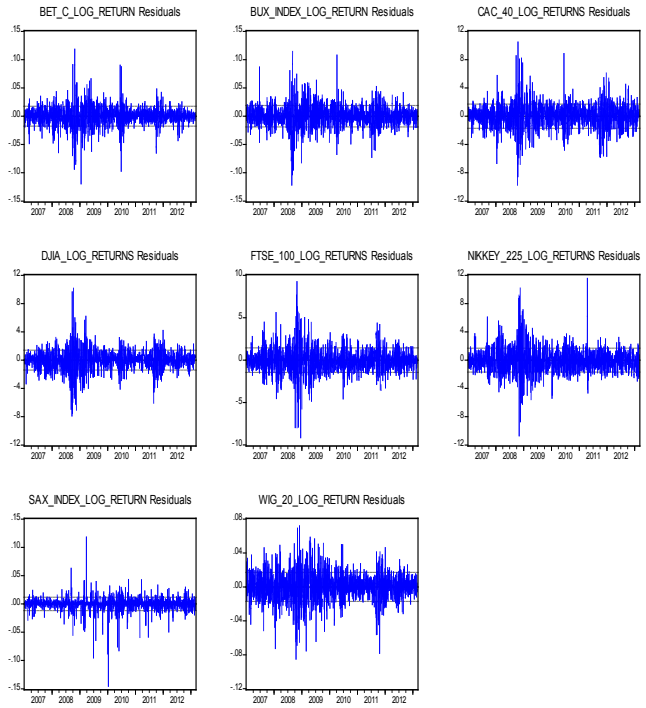

Fig. 17 : The log-returns residuals of selected indices
Source: Own computations based on selected financial data series

The results of VAR Granger Causality tests/Block Exogeneity Wald Tests indicate that all variables in the model can be treated as endogenous considering that remaining variables have significant impact on them jointly, but not always individually). Chi-square statistics and probability values of pairwise Granger causality/block exogeneity Wald test results between the endogenous variables.

Table 2 : VAR Granger Causality tests/Block Exogeneity Wald Tests

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 04/07/13 Time: 22:27
Sample: 2/01/2007 28/02/2013
Included observations: 1517

Dependent variable: BET_C_LOG_RETURN

Excluded	Chi-sq	df	Prob.
BUX_INDE...	1.235004	2	0.5393
CAC_40_L...	11.08422	2	0.0039
DJIA_LOG...	0.813127	2	0.6659
FTSE_100...	0.773542	2	0.6792
NIKKEY_2...	1.563782	2	0.4575
SAX_INDE...	2.007980	2	0.3664
WIG_20_L...	28.76681	2	0.0000
All	43.17811	14	0.0001

Dependent variable: BUX_INDEX_LOG_RETURN

Excluded	Chi-sq	df	Prob.
BET_C_LO...	2.018859	2	0.3644
CAC_40_L...	0.078065	2	0.9617
DJIA_LOG...	0.594962	2	0.7427
FTSE_100...	3.064611	2	0.2160
NIKKEY_2...	0.806481	2	0.6682
SAX_INDE...	0.115496	2	0.9439
WIG_20_L...	1.664189	2	0.4351
All	7.996004	14	0.8895

Dependent variable: CAC_40_LOG_RETURNS

Excluded	Chi-sq	df	Prob.
BET_C_LO...	13.77750	2	0.0010
BUX_INDE...	1.558742	2	0.4587
DJIA_LOG...	4.921280	2	0.0854
FTSE_100...	0.588105	2	0.7452
NIKKEY_2...	5.246390	2	0.0726
SAX_INDE...	0.602134	2	0.7400
WIG_20_L...	4.787203	2	0.0913
All	33.16030	14	0.0027

Dependent variable: DJIA_LOG_RETURNS

Excluded	Chi-sq	df	Prob.
BET_C_LO...	0.392648	2	0.8217
BUX_INDE...	6.741824	2	0.0344
CAC_40_L...	1.612853	2	0.4465
FTSE_100...	1.420238	2	0.4916
NIKKEY_2...	5.473406	2	0.0648
SAX_INDE...	0.995079	2	0.6080
WIG_20_L...	4.368181	2	0.1126
All	20.96149	14	0.1026

Dependent variable: FTSE_100_LOG_RETURNS

Excluded	Chi-sq	df	Prob.
BET_C_LO...	0.342045	2	0.8428
BUX_INDE...	0.590354	2	0.7444
CAC_40_L...	0.860051	2	0.6505
DJIA_LOG...	8.890766	2	0.0117
NIKKEY_2...	1.888732	2	0.3889
SAX_INDE...	6.078729	2	0.0479
WIG_20_L...	16.15893	2	0.0003
All	33.21175	14	0.0027

Dependent variable: NIKKEY_225_LOG_RETURNS

Excluded	Chi-sq	df	Prob.
BET_C_LO...	1.327152	2	0.5150
BUX_INDE...	1.909883	2	0.3848
CAC_40_L...	2.894449	2	0.2352
DJIA_LOG...	4.372349	2	0.1123
FTSE_100...	57.11738	2	0.0000
SAX_INDE...	0.226725	2	0.8928
WIG_20_L...	5.016258	2	0.0814
All	76.94441	14	0.0000

Dependent variable: SAX_INDEX_LOG_RETURN

Excluded	Chi-sq	df	Prob.
BET_C_LO...	8.812753	2	0.0122
BUX_INDE...	6.667376	2	0.0357
CAC_40_L...	1.831632	2	0.4002
DJIA_LOG...	0.143381	2	0.9308
FTSE_100...	1.864303	2	0.3937
NIKKEY_2...	1.187652	2	0.5522
WIG_20_L...	0.672703	2	0.7144
All	20.45822	14	0.1163

Dependent variable: WIG_20_LOG_RETURN

Excluded	Chi-sq	df	Prob.
BET_C_LO...	10.71340	2	0.0047
BUX_INDE...	3.275401	2	0.1944
CAC_40_L...	1.545406	2	0.4618
DJIA_LOG...	1.722212	2	0.4227
FTSE_100...	1.459018	2	0.4821
NIKKEY_2...	4.508259	2	0.1050
SAX_INDE...	1.638431	2	0.4408
All	25.57509	14	0.0293

V. Conclusions

In this paper we have examined the relationship of developed capital markets and emerging capital markets and its volatility impact on the actual output of index. The study results in various interesting findings to understand the development and dependency of under developed, developing, and developed capital markets. We found that there is direct relationship and positive impact on any two developed capital markets (see fig. 1 and 2). Capital markets which is not fully developed and sound but moving towards development generates parallel positive impact. The upper side of activity and lower side of activity represents the capability to absorb by these kind of market. The present evidence of the study reveals the independent relationships between developing capital markets but not able to generate the capability to absorb and exude. Empirical analysis suggested that emerging capital markets are highly dependend on movement index of developed capital markets and fluctuates at high degree at upper side of activity and lower side of activity. It is also considered and found that when any high level of fluctuations noted in developed market it impacts dramatically on emerging capital markets. As per the "decoupling theory" it putforth that even in advanced countries with strong and highly developed capital markets went into heavy downturn, it had impacted emerging economies worst but original markets were affected marginally, and can largely steam ahead with their own strenth. The decoupling theory has almost completely lost credibility (Subbarao, 2008). The empirical analysis is based on daily stock price indices of USA, UK, Japan, France, Hungary, Poland, Romania and Slovakia in order to compute the stock returns and find the impact of correlations between developed and emerging economy markets. The empirical evidence is based on ARCH/GARCH models, which stand for autoregressive conditional heteroskedasticity and generalized autoregressive conditional heteroskedasticity. Empirical analysis suggested that emerging capital markets are highly dependend on movement index of developed capital markets and fluctuates at high degree at upper side of activity and lower side of activity. The results have significant implications for financial investment process and risk management, especially in terms of globalization and financial liberalization. The further extention of this paper can be waiting on a study of econometrix analysis of developed and emerging capital market which may impact on real sector actual development variables.

References

[1] Agarwal, R.N, "Capital Market Development", Corporate Financing Pattern and Economic Growth in India, Institute of Economic Growth Discussion Paper No.20, 2000

[2] Bai, J., Perron, P., "Estimating and Testing Linear Models with Multiple Structural Changes", Econometrica, Vol. 66, No.1, pp. 47-78, 1998

[3] Bai, J. and Perron, P., "Computation and Analysis of Multiple Structural Change Models," Journal of Applied Econometrics, Vol. 18, No. 1, pp. 1-22, 2003

[4] Birău, R., Ehsanifar, M., Mohammadi, H., "Forecasting the Bucharest Stock Exchange BET-C Index based on Artificial Neural Network and Multiple Linear Regressions", the 1st WSEAS International Conference on Mathematics, Statistics & Computer Engineering, Dubrovnik, Croatia, June 25-27, 2013

[5] Birău, R., "Cointegration and international linkage between Greek and Romanian stock markets", 2nd WSEAS International Conference on Finance, Accounting and Auditing, Brasov, Romania, June 1-3, 2013, ISBN: 978-1-61804-192-0, pp.114-119

[6] Bollerslev, T., "Modelling the coherence in short-run nominal exchange rates: A multi variategeneralized ARCH model", Review of Economics and Statistics, 72, pp.498-505, 1990

[7] Bollerslev, T., Chou, R. Y., & Kroner, K. F., "ARCH modeling in finance: A review of the theory and empirical evidence", Journal of Econometrics, 52, pp.5-59, 1992

[8] Cappiello, L., R.F. Engle and K. Sheppard, "Asymmetric Dynamics in the Correlations of Global Equity and Bond Returns", ECB Working Paper No. 204, 2003

[9] Engle, R., "Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models", Journal of Business and Economic Statistics, 20(3), 339-350, 2002

[10] Engle, R. F. and Sheppard, K., "Theoretical and empirical properties of dynamic conditional correlation MV GARCH", Working Paper No. 15, University of California, San Diego, 2001

[11] Engle, R.F., K. Sheppard, "Theoretical and Empirical Properties of Dynamic Conditional Correlation Multivariate GARCH", NBER Working Paper, 8554, 2001

[12] Eun, C.S., Shim, S., "International Transmission of Stock Market Movements", Journal of Financial and Quantitative Analysis, 24, 2, pp. 241-256, 1989

[13] Forbes, K., Rigobon, R., "No contagion, only interdependence: Measuring stock market comovements", The Journal of Finance, 5, pp. 2223-2261, 2002

[14] Granger, C, Morgenstern, O., "The Predictability of Stock Market Prices", Heath Lexington Books, Heath & Co, Lexington, 1970

[15] Grubel, H.G., "Internationally Diversified Portfolios: Welfare Gains And Capital Flows", American Economic Review, 58(5), 1299-1314, 1968

[16] Johansen, S., Juselius, K., "Maximum likelihood estimation and inferences on co integration – with applications to the demand for money", Oxford Bulletin of economics and Statistics, vol 52, no 2, pp 169–210, 1990

[17] Kasa, K., "Common stochastic trends in international stock markets", Journal of Monetary Economics, vol 29, pp 95–124, 1992

[18] Mohan, R., "Global Financial Crisis and Key Risks: Impact on India and Asia", Remarks prepared for IMF-FSF High-Level Meeting on the Recent Financial Turmoil and Policy Responses at Washington D.C. October 9, 2008

[19] Nagayasu, J., "Currency crisis and contagion: Evidence from exchange rates and sectoral stock indices of the Philippines and Thailand", Journal of Asian Economics, 12(4), pp. 529-546, 2001

[20] [18] Nath, G.C., Verma, S., Study of Common Stochastic Trend and Cointegration in the Emerging Markets - A Case Study of India, Singapore and Taiwan, NSE Working Paper No. 25, 2003

[21] Panton, D., Lessig VP., Joy, O., "Co-movement of international equity markets: A taxonomic approach", Journal of Financial and Quantitative Analysis, 11(3), pp.415-432, 1976

[22] Phylaktis, K., Ravazzolo, F., "Stock market linkages in emerging markets: implications for international portfolio diversification", Journal of International Financial Markets, Institutions and Money, vol 15, pp 91–106, 2005

[23] Rodriguez, J., "Measuring financial contagion: A copula approach", Journal of Empirical Finance 14, pp. 401–423, 2007

[24] Serban, M., Brockwell, A., Lehoczky, J., Srivastava, S., "Modelling the dynamic dependence structure in multivariate financial time series", Journal of Time Series Analysis 28, 763–782, 2007

[25] Singh, G.S.P., "Chinese and Indian Stock Market Linkages with Developed Stock Markets", Asian Journal of Finance & Accounting, Vol. 2, No. 2: E2, 2010

[26] Solnik, B., "Why do not diversify internationally rather than domestically", Financial Analyst Journal 30, 48–54, 1974

[27] Taylor, M.P, Tonks, I., "The internationalization of stock markets and abolition of UK exchange control", Review of Economics and Statistics, vol 71, pp 332–6, 1989

[28] Trivedi, J., Birău, R., "Analysis of international contagion in emerging stock markets in terms of global financial crisis", 2nd WSEAS International Conference on Finance, Accounting and Auditing, Brasov, Romania, June 1-3, 2013, ISBN: 978-1-61804-192-0, pp.120-125

[29] Trivedi, J., Birău, R., "Investigating international transmission patterns of stock price volatility", 2nd WSEAS International Conference on Finance, Accounting and Auditing, Brasov, Romania, June 1-3, 2013, ISBN: 978-1-61804-192-0, pp.126-131

[30] Trivedi, J., Birău, R., "Co-movements between emerging and developed stock markets in terms of global financial crisis", the 1st WSEAS International Conference on Mathematics, Statistics & Computer Engineering, Dubrovnik, Croatia, June 25-27, 2013