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Globalization effects on contagion risks in financial markets

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Abstract

- **Research background:** Financial globalization has opened international capital markets to investors and companies worldwide. However, the global financial crisis has created big volatility in the stock prices that induces a restriction in the reflection of full information. We explore ten EU Member States (France, Germany, The United Kingdom, Belgium, Bulgaria, Romania, Greece, Portugal, Ireland, Spain), and the USA. The explored period is 03.03.2003 - 30.06.2016 as it includes the effects of the global financial crisis of 2008.
- **Purpose of the article:** To determine if there is a contagion effect between the Bulgarian stock market and the other examined stock markets during the crisis period and whether these markets are efficient.

Abstract

- **Methods:** Argument Dickey-Fuller Test, DCC-GARCH Model, Autoregressive (AR) Models, TGARCH Model, Descriptive Statistics. Capture Audience Attention
- **Findings & Value added:** Our results show that a contagion across the Bulgarian capital market and eight capital markets exist during the global financial crisis of 2008. We register the strongest contagion effects from US and German capital markets to the Bulgarian capital market. The Bulgarian capital market is relatively integrated with the stock markets of Germany and the United States. That is the explanation of why the Bulgarian capital market is exposed to financial contagion effects from the US capital market and the capital markets of EU member states during the crisis period. We register statistically significant AR (1) for UK, Greece, Ireland, Portugal, Romania, and Bulgaria, and we can define these global capital markets as inefficient.

Introduction

- Financial crises are a severe phenomenon in both developed and emerging countries.
- The financial crisis has created big volatility in the stock prices that induces a restriction in the reflection of full information. Therefore, this situation is a challenge for the Efficient Market Hypothesis.
- According to the Efficient Market Hypothesis (EMH), stock prices should always show a full reflection of all available and relevant information and follow a random walk process.

Introduction

- The global financial crisis of 2008 has affected the efficiency of the global capital markets and also financial activities and macroeconomic conditions.
- “Contagion” became the catchword for such phenomena and is now widely being used to describe the spread of financial disturbances from one country to another.
- After the crisis of 2008, the European and US stock markets underwent large depreciation and high stock market volatility.

Literature Review

- **Simeonov (2020)** makes a comprehensive stock profile for four of the most popular East Asian stock exchanges-Tokyo, Hong Kong, Taiwan, and Shanghai, for the period 2007 – 2019. It is concluded that the global financial crisis of 2008 has a significant and lasting negative impact only on the price component of the stock exchange profiles, while the stock exchange activity of the studied exchanges remains completely unaffected.
- **Pece et al. (2013)** analyse the existence of long memory in return series for nine indices from Central-Eastern European and Balkan emerging markets and they prove that all indices, except Czech index, have predictable behavior.
- **Pfeiferová and Kuchařová (2020)** state that in the financial market, risk management is associated with the process of identifying individual risks, their analyzes and making investment decisions by reducing the degree of uncertainty.
- **Ters and Urban (2018)** use a panel VAR methodology and they find rather comovement effects in the Visegrad group member countries (the Czech Republic, Hungary, Poland and Slovakia) as they have been only marginally affected by the turmoil in the peripheral countries during the sovereign debt crisis.

Literature Review

- **Harkmann (2014)** investigates the possible contagion from West European stock markets to stock markets in Central and Eastern Europe. The author concludes that the dynamic conditional correlation (DCCs) increased steadily between 2002 and 2012, which could be attributed to closer financial integration. During the crisis the dynamic correlations rose substantially, which suggests some contagion.
- **Alexakis and Pappas (2018)** investigate the existence of financial contagion in the European Union during the recent Global Financial Crisis (GFC) of 2007–2009 and the European Sovereign Debt Crisis (ESDC) that started in 2009. They find evidence of a non-synchronized transition of all countries to the crisis regime, in both crises.
- **Horváth et al. (2018)** use their approach with daily data from 1998 to 2014 and they find evidence of financial contagion for all of our examined emerging markets.
- **Apergis et al. (2019)** investigate whether contagion occurred during the recent global financial crisis across European and US financial markets. The findings indicate significant evidence of contagion, especially through the channels of higher order moments.

Methodology

- We explore the following capital market indexes for the following countries: France (CAC 40), Germany (DAX), The United Kingdom (FTSE 100), Belgium (BEL- 20), Bulgaria (SOFIX), Romania (BET), Greece (ATHEX20), Portugal (PSI-20), Ireland (ISEQ-20), Spain (IBEX35) and USA (DJIA).
- The explored period is 03.03.2003 - 30.06.2016 as it includes the effects of the financial crisis of 2008.
- We divide the explored period of sub-periods: pre-crisis period 03.03.2003-29.12.2006; crisis period (02.01.2007-28.12.2012) and post-crisis period 03.01.2013-30.06.2016).
- We apply the Argument Dickey-Fuller test to estimate stationarity. We prove that all variables are stationary in the form dlog (x) i.e. variables were integrated of order 1.

Methodology

- DCC-GARCH Model - $\mathbf{X_t = \mu_t + \epsilon_t}$

- Autoregressive (AR) Models –

$$Y_t = \rho_1 Y_{t-1} + \rho_2 Y_{t-2} + \ldots \rho_p Y_{t-p} + \varepsilon_t = \sum_{i=1}^{p} \rho_j Y_{t-j} + \varepsilon_t$$

- The Threshold GARCH (TGARCH) Model –

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{p} \quad \alpha_i \varepsilon_{t-i}^2 + \sum_{k=1}^{r} \gamma_k \varepsilon_{t-k}^2 I_{t-k}$$

Results

- During the full-time period, for mean, most of the data has a positive return except for BEL20 **(Table 1).**
- For Skewness, we found that all indices do not equal to zero, so this indicates asymmetry for all the series.
- The Kurtosis is greater than 3 for all of the explored countries, indicating that their distributions are leptokurtic.
- The normality hypothesis is rejected by the Jarque-Bera test.
- From the values of St. Dev., we prove that during the full explored period, the Romanian stock market is the riskiest one. The Greek and the Bulgarian capital markets are almost equal to the one of the Romanian stock markets. The standard deviation of the returns of the indices during the crisis period is higher than the stable periods. This reflects an increase in volatility during the crisis for all of the explored European capital markets.

Table 1. Descriptive statistic of the explored indices

The Full Explored Period: March 2003 - June 2016											
	RATHEX	RBEL20	RBET	RCAC40	RDAX	RDJIA	RFTSE100	RIBEX35	RISEQ	RPSI20	RSOFIX
Mean	0.002962	-0.000446	0.008515	0.003028	0.008736	0.005082	0.003697	0.002074	0.002277	0.001653	0.004322
Median	-0.002969	0.000176	0.015797	0.010546	0.019494	0.007609	0.007970	0.008008	0.008432	-0.001335	0.002388
Maximum	0.663535	0.073016	0.257241	0.120462	0.191631	0.091161	0.083000	0.153789	0.178253	0.370302	0.251207
Minimum	-0.355481	-0.048918	-0.414192	-0.145225	-0.224954	-0.151526	-0.139536	-0.186727	-0.235823	-0.202173	-0.476323
Std. Dev.	0.087514	0.015765	0.088261	0.047970	0.055599	0.038350	0.037810	0.056205	0.058590	0.050531	0.086087
Skewness	2.134574	0.285622	-0.979921	-0.562221	-0.699231	-0.812321	-0.707958	-0.474524	-1.057397	1.669294	-1.272899
Kurtosis	24.17154	7.603920	7.211122	3.570364	5.462489	4.993187	4.128654	3.985350	5.611811	21.84667	10.17312
Jarque-Bera	3090.296	142.5859	142.9312	10.53165	53.12951	43.80622	21.72124	12.39939	74.82216	2427.024	383.8178
Probability	0.000000	0.000000	0.000000	0.005165	0.000000	0.000000	0.000019	0.002030	0.000000	0.000000	0.000000
Sum	0.471000	-0.070963	1.353929	0.481382	1.389014	0.808017	0.587842	0.329709	0.362012	0.262876	0.687172
Sum Sq. Dev.	1.210063	0.039267	1.230823	0.363574	0.488423	0.232371	0.225875	0.499130	0.542373	0.403430	1.170923
Obs.	159	159	159	159	159	159	159	159	159	159	159
Pre-crisis period: March 2003 – December 2006											
Mean	0.026740	-0.004652	0.034856	0.016661	0.020145	0.009874	0.012073	0.019545	0.019406	0.016031	0.037237
Std. Dev.	0.053725	0.016808	0.080896	0.031709	0.046241	0.024189	0.023576	0.033007	0.032882	0.033355	0.065413
Crisis period: January 2007 – December 2012											
Mean	-0.009499	0.000788	-0.007475	-0.006084	0.001632	0.000528	-0.000711	-0.008136	-0.014042	-0.006073	-0.019087
Std. Dev.	0.121883	0.018663	0.108912	0.057722	0.065997	0.048059	0.046987	0.068873	0.073404	0.069672	0.107261
Post-crisis Period: January 2013 – June 2016											
Mean	-0.003161	0.002066	0.004140	0.003094	0.006993	0.006279	0.000868	-0.000587	0.011327	-0.001351	0.003197
Std. Dev.	0.000120	0.005646	0.036673	0.042217	0.044124	0.031515	0.031038	0.049136	0.044697	0.051284	0.039469

Results

- The coefficients of lagged variances and shock-square terms are all significant at 1%, which means that the volatilities of these markets are time-varying **(Table 2).**
- The estimated parameters **θ1 and θ2** of DCC processes are all significant at 1%. The conditions that **θ1 + θ2 < 1** are all satisfied.
- The results for the significance of the conditional variances prove that the market volatility changes during the explored period and confirms the conditional heteroscedasticity in the returns of the indices.
- The highest values of **α coefficients** are registered in the crisis period. We may conclude that in crisis the volatility of the indices is more sensitive to market shocks and dynamic than during the post-crisis period.
- The autoregressive **coefficient of volatility β** is higher during the crisis period than during the stable periods, either.
- The obtained results support the dynamic conditional correlations model and allow us to reject the hypothesis of a constant correlation between the returns series.

Table 2. Results from the applied Bivariate DCC-GARCH model

Par.	SOFIX-ATHEX	SOFIX-BEL20	SOFIX-BET	SOFIX-CAC40	SOFIX-DAX	SOFIX-DJIA	SOFIX-FTSE100	SOFIX-IBEX35	SOFIX-ISEQ	SOFIX-PSI20
Pre-crisis period: March 2003 – December 2006										
α(1)	0.088**	0.088**	0.088**	0.088**	0.088**	0.088**	0.088**	0.088**	0.088**	0.088**
α(2)	0.097**	0.106**	0.102**	0.094**	0.112**	0.124*	0.096**	0.121*	0.099***	0.095**
β(1)	0.931*	0.931*	0.931*	0.931*	0.931*	0.931*	0.931*	0.931*	0.931*	0.931*
β(2)	0.832	0.994*	0.896*	0.902*	0.835*	0.918**	0.915*	0.891*	0.901*	0.825*
Θ(1)	0.011*	0.023*	0.015*	0.035*	0.011*	0.028*	0.020*	0.025*	0.018*	0.037*
Θ(2)	0.824*	0.925*	0.857*	0.927*	0.967*	0.805*	0.971*	0.834*	0.915*	0.795*
Crisis period: January 2007 – December 2012										
α(1)	0.102*	0.102*	0.102*	0.102*	0.102*	0.102*	0.102*	0.102*	0.102*	0.102*
α(2)	0.118*	0.154*	0.124*	0.094	0.174*	0.152**	0.096*	0.116*	0.109**	0.118*
β(1)	0.995*	0.995*	0.995*	0.995*	0.995*	0.995*	0.995*	0.995*	0.995*	0.995*
β(2)	0.874*	0.825*	0.915*	0.942*	0.926*	0.915**	0.894**	0.948**	0.879**	0.918*
Θ(1)	0.018*	0.034*	0.028*	0.039*	0.152*	0.028*	0.034*	0.011*	0.013*	0.039*
Θ(2)	0.902*	0.892*	0.912*	0.915*	0.834*	0.905*	0.911*	0.907*	0.832*	0.902*
Post-crisis Period: January 2013 – June 2016										
α(1)	0.086*	0.086*	0.086*	0.086*	0.086*	0.086*	0.086*	0.086*	0.086*	0.086*
α(2)	0.079*	0.082*	0.091**	0.101**	0.086**	0.093**	0.105	0.084	0.094*	0.090*
β(1)	0.898*	0.898*	0.898*	0.898*	0.898*	0.898*	0.898*	0.898*	0.898*	0.898*
β(2)	0.912*	0.864*	0.906*	0.894	0.975	0.932*	0.906**	0.861*	0.946	0.857**
Θ(1)	0.015*	0.021*	0.018*	0.032*	0.019*	0.012*	0.025*	0.019*	0.038*	0.028*
Θ(2)	0.805*	0.912*	0.947*	0.835*	0.875*	0.912*	0.908*	0.846*	0.835*	0.812*

Results

- The dynamic correlation between SOFIX-ATHEX reaches its peak in 2009 when it is the peak of the Greek financial crisis and maintain high values during the sovereign debt crisis.
- The most significant is the dynamic correlation between SOFIX- DJIA with the highest peak between 2008-2009.
- The results show increased (stronger) correlation dynamics between the Bulgarian stock market and developed European countries and the United States during the crisis period, with overtaking information impact between the SOFIX-DAX.

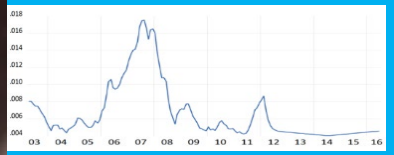

Fig. 1: Dynamic conditional correlations SOFIX-CAC40

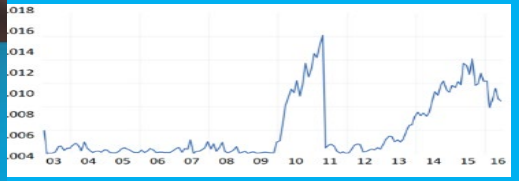

Fig. 2: Dynamic conditional correlations SOFIX- ATHEX

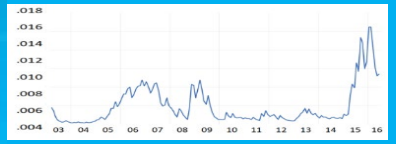

Fig. 3: Dynamic conditional correlations SOFIX-ISEQ

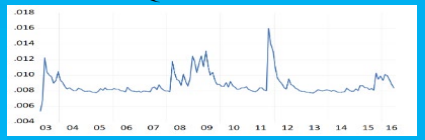

Fig. 4: Dynamic conditional correlations SOFIX-IBEX35

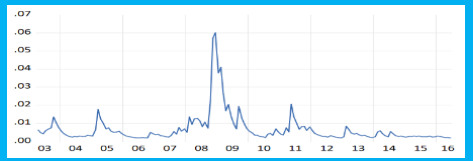

Fig. 5: Dynamic conditional correlations SOFIX-PSI20

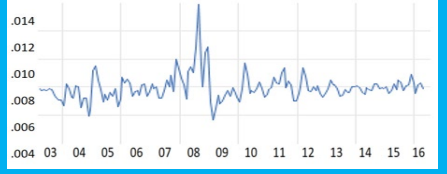

Fig. 6: Dynamic conditional correlations SOFIX- BEL20

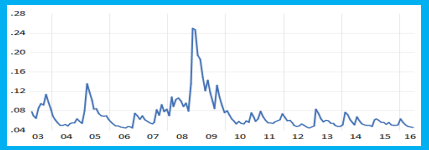

Fig. 7: Dynamic conditional correlations SOFIX- DJIA

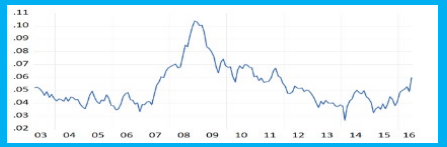

Fig. 8: Dynamic conditional correlations SOFIX- DAX

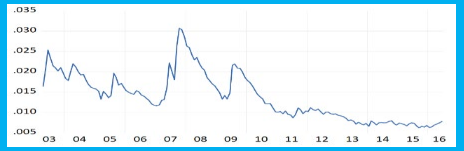

Fig. 9: Dynamic conditional correlations SOFIX- BET

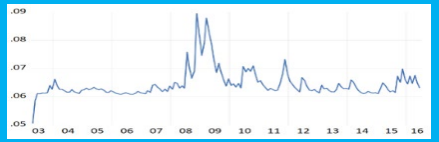

Fig. 10: Dynamic conditional correlations SOFIX-FTSE10

Results

- **Table 3 presents** the results of the contagion test.
- We prove that the dynamic condition correlations between examined indices increase from the periods with low volatility (pre-crisis period) to the period with high volatility (crisis period).
- We register the strongest negative information flow for Bulgarian and the US capital markets.
- The German DAX index also has a significant impact on the SOFIX return.
- Our results show that the financial contagion exists between Bulgarian and Romanian capital markets.
- The PIIGS block, which was most affected by the global financial crisis, has transferred negative shocks to the SOFIX.

Table 3. The Results from the Contagion Test

Unadjusted Conditional Correlation					
Relation	Pre-crisis ρ_{ij}^{t}	Crisis period ρ_{ij}^{c}	t-student	Change of correlation coefficients	Contagion
SOFIX-ATHEX	0.492	0.715	11.14*	45.33%	YES
SOFIX-BEL20	0.435	0.402	0.266	-7.59%	NO
SOFIX-BET	0.401	0.618	6.282*	54.11%	YES
SOFIX-CAC40	0.358	0.418	0.083	16.76%	NO
SOFIX-DAX	0.374	0.608	9.084*	62.56	YES
SOFIX-DJIA	0.318	0.524	5.159*	64.77%	YES
SOFIX-FTSE100	0.349	0.504	6.188*	44.41%	YES
SOFIX-IBEX35	0.385	0.648	4.190*	44.41%	YES
SOFIX-ISEQ	0.486	0.682	8.154*	40.33%	YES
SOFIX-PSI20	0.418	0.591	9.182*	41.39%	YES
Adjusted Conditional Correlation					
SOFIX-ATHEX	0.232	0.352	7.315*	51.72%	YES
SOFIX-BEL20	0.218	0.204	0.158	-6.42%	NO
SOFIX-BET	0.195	0.350	3.085*	79.48%	YES
SOFIX-CAC40	0.182	0.218	0.018	19.78%	NO
SOFIX-DAX	0.186	0.358	6.084*	92.47%	YES
SOFIX-DJIA	0.192	0.376	3.794*	95.83%	YES
SOFIX-FTSE100	0.159	0.284	3.042*	78.61%	YES
SOFIX-IBEX35	0.197	0.326	2.381*	65.48%	YES
SOFIX-ISEQ	0.231	0.354	3.908*	53.24%	YES

Results

- We register statistically significant AR (1) for the following countries: The United Kingdom, Greece, Ireland, Portugal, Romania, and Bulgaria. We can define these capital markets as inefficient .
- The highest value of the AR (1) is registered for the Greek index ATHEX and this financial market can be determined as the most inefficient.
- The US capital market can be defined as efficient due to the non-statistically significant values of AR (1).
- Based on the positive values of AR (1) of the Greek, Irish, Portuguese, Romanian, and Bulgarian indices, we can conclude that AR (1) gives a greater weight of the return of the previous period and therefore strengthens the established market trend.
- The positive values of AR (1) lead to the accumulation and acceleration of the positive market trend.

Table 4. The values of AR (1) in the TGARCH model for the whole period under examination

Index	AR (1) for the whole examined period
BEL 20	-0.007471
CAC	0.107091
DAX	0.125258
IBEX 35	0.012454
DJIA	0.281503
ATHEX	0.948586*
ISEQ	0.154979***
FTSE 100	-0.110156***
PSI 20	0.078225**
SOFIX	0.300833*
BET	0.086118*

Results

Table 5. The indices with relatively high market efficiency and their coefficients of persistence below 0,94 and leverage coefficients

Index	Coefficient of persistence < 0,94	Leverage coefficient
DAX	0.666247	0.293095**
FTSE 100	0.756942	0.335537*
IBEX	0.795043	0.268119*
CAC	0.828806	0.769672**
SOFIX	0.849258	-0.017604
PSI 20	0.863198	-0.108970
BET	0.895839	0.169299**
DJIA	0.901308	0.381560*

- **Table 5** presents the values of the coefficient of persistence and leverage coefficient for the capital markets with relatively high market efficiency.
- The most efficient financial market in the group is the German one with the lowest value of the coefficient of persistence for the DAX index.
- We can clearly distinguish developed countries like Germany and the UK and relatively new European stock markets - Bulgaria and Romania.
- The values of the leverage coefficient present how market volatility reacts depending on whether market impulses lead to positive or negative returns. Besides, the lowest positive value of the leverage coefficient is resisted for the Romanian BET index. This can be attributed to the fact that the market dynamics of Romanian stock exchange follow short-term trends rather than stable, longer-term market trends.

Results

Table 6. The indices with relatively low market efficiency and their coefficients of persistence higher than 0,94 and leverage coefficients

Index	Coefficient of persistence > 0,94	Leverage coefficient
ATHEX	1.838203	-0.692084***
BEL 20	1.015379	-0.064635*
ISEQ	0.942459	0.078306*

- **Table 6** presents the values of the coefficient of persistence and leverage coefficient for the capital markets with relatively low market efficiency.
- We can conclude that Greek, Belgian, and Irish capital markets are relatively informationally inefficient markets compared to the other examined markets.

Conclusion

- Our results show that a contagion across the Bulgarian capital market and eight capital markets exist during the financial crisis of 2008.
- We register the strongest contagion effects from US and German capital markets to the Bulgarian capital market.
- The obtained results indicate that the Bulgarian capital market is relatively integrated with the stock markets of Germany and the United States. That is the explanation of why the Bulgarian capital market is exposed to financial contagion effects from the US capital market and the capital markets of EU member states during the crisis period.
- Correlation trends between bull and bear phases, indicating their dynamic nature and conditions.

Conclusion

- Our results suggest that financial contagion from the US stock market and the capital markets of the developed European countries to the Bulgarian capital market occurs just before the financial crisis, but we find that the contagion is stronger during the crisis.
- Negative shocks from the PIIGS block have a strong impact on financial contagion during the sovereign debt crisis as well.
- The capital markets of the following countries: The United Kingdom, Greece, Ireland, Portugal, Romania, and Bulgaria can be defined as inefficient.
- The most efficient financial market in the group is the German one with the lowest value of the coefficient of persistence for the DAX index (0.666247).

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THANK YOU FOR YOUR ATTENTION!

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