CRISIS RISK MEASUREMENTS – TRADE WITH CREDIT DEFAULT SWAPS AGAINST MEASUREMENTS OF THE CAPITAL TRADE DYNAMICS

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Abstract

This study represents the increasing significance of credit default swaps for European capital markets, namely Germany, France, Belgium, Ireland, Italy, Portugal, Spain, Greece, Bulgaria and Romania. The period of analysis is between 2003- 2016 years. After developing a theoretical and empirical framework to model the relationship between credit default swap market and capital market, we apply an empirical research which uses logistic regression. Our dataset assesses the ability of CDS to predict financial crisis at stock markets. Regarding sovereign credit default swaps as reflection of credit risk, we find them to be a significant indicator explaining the periods proceeding financial crises, especially to developed capital markets.

Key words: *credit default swap, capital markets, financial crisis, correlation, Granger Causality Test, Logit model*

JEL: *C22;G01; G12*

Introduction:

The occurrence of the global financial crisis and its reflection on the European financial markets raises a lot of questions and discussions concerning its spreading and mechanism of operation. Why and what was the cause of the latest financial crisis which Alan Greenspan described as "a loan tsunami happening once every hundred years" are fundamental questions regarding capital markets, corporate finances, financial

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management and various economic sectors. With the coming of the Great Recession the topic of the Credit Default Swaps became more and more popular. Analysis topic were the issues related to how far they could assess the risk adequately, their ability to "foresee" the forthcoming crisis and the period of financial destabilization or the impact on the capital markets of developed countries. The development of the crisis provokes a significant increase in the values of credit default swaps, as a result of the aforementioned a great number of economists, investors and politicians try to disclose which market incorporates the information related to credit risk more quickly. For that purpose they examine: the relation between the market of sovereign credit default swaps (CDS) which represent measurers of bankruptcy risk of the respective country and capital markets which are a reflection of the prosperity of the respective country. *The aim of this paper is using econometric modeling of the CDS return to establish whether the degree of information efficiency, related to the ability of the CDS to foresee the coming of financial crisis at developed capital markets is more significant than in the countries with undeveloped capital market.* For the execution of this objective the following tasks are set:

1.Critical review of existing approaches for establishing interrelation between the two financial markets, presenting the consequences of its presence and reflecting the empirically established forms of interaction between them;

2.Presenting the category of return when reflecting and econometric modeling it.

3.Econometric analysis of financial timelines of data, reflecting the values of examined CDS and stock market indexes on the grounds of the following time period – 01.03.2003 – 01.07.2016 – encloses pre-crisis period 2003-2006; crisis period 2007-2012 – encloses the development of the financial crisis 2007-2009 and the subsequent debt crisis 2012-2012; post-crisis period 2013-2013.

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4.Systematizing empirical evidence for confirmation / rejection of the research hypothesis. Analysis of obtained data by applying correlation test, Granger Causality Test and Logit model regarding correlation degree and direction of cause and effect connection between the two types of the financial crisis at capital markets as well as clearing the degree of predictability of occurrence of the financial crisis at capital markets.

5.Summary and analysis of empirical results, synthesis of conclusions regarding the object and the subject of the study; applying logit models on the fluctuations of the studied variables based on a panel research of studied group of countries.

After execution of the assigned tasks the basic *research hypothesis* may be confirmed/ rejected. *It states that for countries with developed capital market the CDS are a more reliable measurer of risk and respectively more reliable "predictor" of incurring financial crisis than countries with undeveloped capital market.*

Theoretical and literary review

A good number of authors study the relation between capital markets and those of credit default swaps. Most researches analyzing the dynamics of default swaps observe dependencies in separate large corporations. The lower scientific interest towards the CDS dynamics may be due to the fact that some of the CDS markets have low liquidity.

The model of Merton *(Merton (1974))* discloses the interaction between the prices of shares and bonds by showing the presence of positive correlation between them. It also states that if the value of the assets of a specific company drops below the nominal value of its debt it falls into an insolvency. Later this model is further developed by Chan-Lau and Kim *(Chan- Lau, and Kim (2004))* as they accept that sovereign bonds are equivalent of the corporate debt. Based ot Merton's model (1974), *Norden and Weber (2004), Pena and Forte (2009)* research the relationship between sovereign CDS and stock market indexes where

they draw the conclusion that capital markets determine the behavior of CDS markets and have a key role during the incorporation of new information. The connection between the two variables is stronger with countries with high risk spread *(Coronado et al (2011)).* After them other authors think that the direction of interaction and the degree of correlation between the two financial markets depend on various factors such as: time; high or low degree of credit risk of a government or a corporation *(Fung et al. (2008), Coudert and Gex (2010)).*One of those authors proving the changing cooperation is Corzo *(Corzo et al (2012***)).** He reveals the change upon the dominating role of financial markets during different periods of time. He takes into consideration the fact that CDS are a determining factor at economics with high bankruptcy risk. The information impact and researching transmission mechanism of the credit risk at different markets and throughout separate periods of time is a factor that will help us understand the relative efficiency of markets – developed and developing as well as how changed can be their functioning upon changing market conditions *(Avino (2011)).* In support of Avino's statements, Baciu *(Baciu, O.A. (2014))* examines deviations of the efficiency in 20 European stock exchange markets for the period of 15 years. The results indicate that developed markets are closed to the efficiency than developing markets. One of the distinctive lines between the efficient and inefficient markets is the speed of incorporation of information in the market prices *(Tsenkov, V. (2015)).*

The relationship between credit default swap market and capital markets is observed and analyzed by several authors, but the forecasting ability of credit default swaps has gained importance since the Great Recession 2007- 2008. In historical perspective we shall mark that the formation and the mechanism of distribution of financial crisis is examined by Sachs, Tornel and Velasco *(Sachs, J., Tornel, A., Velasco, A.(1996)).* They examine the consequences of financial destabilizations of separate countries in 1995 and aim to clarify why only some specific developing markets are affected. An idea later Keminsky and Reinhart *(Kaminsky, G., Reinhart, (1996))* construct their methodology which

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contributes to a more precise prediction of specific time periods when a financial crisis will occur. Keminsky and Lisondo *(Keminsky, G., Lisondo (1996))* develop a methodology through which they foresee the occurrence of financial collapses with the assistance of main economic indicators: GDP growth, inflation, unemployment, return of stock market indexes, actual interest rate.

Financial crises are preceded by periods in which investors avoid risk. Coudert and Gex *(Coudert, V.,Gex, M.,(2006))* test the possibility whether the main indexes for risk measurement are able to predict the occurrence of a crisis. They think that the "risk appetite" decreases before crisis. They still mark that the reverse reaction is possible. Crisis may be preceded by a period of strong "risk appetite" during which investors are too optimistic and in this way they create "speculative balloons" at prices of risk assets. The recent mortgage crisis started with the collapse of Bear Stearns is an example of such reaction. The results of their research state that indicators related to risk avoidance foresee the coming of stock exchange crisis.

Based on the principle of the above-mentioned models, Neziri *(Neziri, H.(2009))* study the ability of CDS premiums to foresee the coming of the financial crisis of the capital markets having them as a source of information, reflecting the future expectations of investors at the stock market. To test whether sovereign credit default swaps are a leading indicator of financial crisis, Neziri (2009) follows Mishkin and White (2002) definition of stock market crisis as falls in price of an index below some threshold during a specified period of time. His dataset consists of a panel data with 21 emerging markets (Argentina, Brazil, Bulgaria, Chile, China,Colombia, Croatia, Hungary, India, Indonesia, Israel, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, South Korea, Thailand and Turkey) and reveals that the logistic regression results show that the one month change in a country CDS premium tends to increase one month ahead of a crisis in the stock

market. Neziri established that fluctuations in CDS premiums signal trouble in stock markets.

The conclusions Neziri *(Neziri, H.(2009))* arrived at support the study results of Coudert and Gex *(Coudert, V., Gex,M.,(2006***))** - namely the statement that CDS are reliable indicator of forthcoming crisis on the stock markets. Financial crises are a phenomenon which is determined by the behavior of investors *(Akerlof, G., Shiller, R. (2009))* by geographic and political characteristics. Accepting CDS as a measurer of investment expectations regarding the development of capital markets we review them as explanatory variable when defining the financial crisis.

Methodology:

The study aims to follow the degree of information efficiency related to the ability of the CDS to predict the occurrence of financial crisis at developed capital markets and it is clearer than in the countries with emerging and developing capital market and takes into consideration the significance and effect of specific factor – financial crisis of the year 2007.

Subject of the study are the following countries: *France (CAC 40), Germany (DAX), UK (FTSE 100), Belgium (BEL-20), Bulgaria (SOFIX), Romania (BET), Greece (ATHEX20), Portugal (PSI-20), Ireland (ISEQ-20), Italy (FTSEMIB) and Spain (IBEX35).* The selection of the aforementioned countries is based on the following criteria: countries with developed capital market which values of CDS during the crisis of 2007 do not undergo significant changes (Great Britain, Germany, France and Belgium); countries with relatively emerging markets which CDS spread values increase immediately after the beginning of the crisis but during debt crisis starts a process of constant decrease of their values (Bulgaria, Romania); countries with emerging markets which values of the CDS spread reach peak values – distressed countries (Greece, Portugal, Ireland, Italy and Spain) *(see table 1).* For the purpose of this research is used a database of the respective CDS values for the period 2003-2016 published respectively in the information bulletins of

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Deutschebank. Reviewed is the data of probability of default on the grounds of 5-year CDS spreads, due to the fact that 5-year-old CDS are the most liquid *(Goldman Sachs CDS 101 FICC, 2009)* with *Recovery Rate=40 %.*

Table 1: List of countries included in the three analyzed groups:

Countries with developed capital market:	Countries of relatively emerging capital markets	Countries of the Eurozone called distressedcountries
Great Britain	Bulgaria	Portugal
Germany	Romania	Ireland
France	-	Italy
Belgium	-	Greece
-	-	Spain

Conventionally this study may be divided into two sections:

Section1: The use of dynamic financial lines reflecting the daily values of the examined variables as well as dividing the observed period in three sub-periods is used as a first part of the empirical research with the purpose of disclosing main characteristics of the financial markets of the three groups of studied countries. The contribution of section 1 is to check the results from the theoretical and literary review, namely whether the interaction between the CDS and that the capital markets changes its determination and impact direction during three different time periods: pre- crisis period, crisis period and post- crisis period.

Data used during this research enclose: *day time values* of examined stock market indexes and CDS for the period 03.03.2003-30.06.2016 and return based on them according to the formula

$$r_t = \ln\left(\frac{P_t}{P_{t-1}}\right)$$

(1)

where r_t - return rate in the observation; $\ln\left(\dfrac{P_t}{P_{t-1}}\right)$ is measurement for return rate; **Pt** and **Pt-1** are respectively the values of the index for the periods **t** and **t-1**. The use of natural logarithm of price ratios is suitable from financial and mathematical aspect for they cannot be negative and therefore and log normally distributed. Calculating the return this way we examine the gradual change of values of indexes and values of CDS for two subsequent periods t and t-1 and not their specific values. The reviewed period is divided in to three sub-periods with the following duration: *Period 1 encloses 03.03.2003-29.12.2006*; *Period 2- 02.01.2007-28.12.2012* (covers the development of the financial crisis – 2007-2009 and the subsequent debt crisis 2010-2012); *Period 3 – 03.01.2013-30.06.2016.* The periods can be distributed as pre-crisis (period 1), crisis (period 2), post-crisis (period 3). Period 1 is characterized by clearly expressed ascending trend of growth in values of the two examined variables. Period 2 starts in 2007 due to the wish to cover the initial indications of emerging destabilization, the drop in the trust of investors as well as the complete collapse which followed. During this period of time a peak is reached in the increase of the CDS values which on its own is accompanied by a simultaneous collapse of capital markets. Revealing direct interactions between the values of return of researched stock market indexes and CDS may be reached through registration of correlation between them. Through correlation coefficient we check whether the value of the CDS with lag t reflects information which is already contained in the value of the stock exchange index with lag t-1.

The correlation between the two variables may be determined as a measurer of the degree of intensity of their mutual fluctuations. The presence of correlation may be accepted as interdependency between the CDS and stock market indexes. It is important to underline that the strong correlation connection is not equivalent to the cause-effect connection. In

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his study "Time Series Analysis" Hamilton (1994) states the following mathematical expression between the two variables X and Y:

$$Corr(X,Y) = \frac{Cov(X,Y)}{\sqrt{Var(X)Var(Y)}}$$

(2)

As we mentioned above the purpose of the correlation analysis is to establish whether CDS incorporate information which is no longer up-to-date for capital markets, i.e. we examine the dependency between the values of CDS with lag t in what interrelation are they with those of the stock market indexes with lag t-1. The strength of the correlation coefficients is tested at 62 and lag (3 months) and 124 lag (6 months).

Subsequent stage of empirical research is to establish whether a time series may help us predict the changes in another time series, i.e. whether a specific action causes specific, measurable consequences *(Stock and Watson (2003))*. For that purpose we use the results of Granger Causality Test. With the help of Granger test we establish the direction of granger relation between the two variables, i.e. we will check whether CDS are in granger connection to stock market indexes and vice versa, i.e. after we have tested the power of correlation we will determine the cause-effect relation and direction of interaction. It is performed for every two variables with respective values with lag t of each of the examined countries for various periods of time.

Section 2: at this second section of the research, we use panel data. It includes monthly values of the growth rate of the examined stock market indexes and CDS for the period 03.03.2003-01.07.2016. The panel research contains three panels of countries distributed in respective groups of countries as is stated in table 1, namely- developed (panel 1), relatively emerging (panel 2) and distressed countries of the Eurozone (panel 3. This change is preconditioned by:

1. The necessity to check on monthly basis whether indications for incurring financial collapse could be more categorical and easily distinguishable than on daily basis.

2. Revealing of better predictability on swap market regarding emerging financial destabilizations of capital markets at three various groups of researched countries: developed (panel 1), relatively emerging (panel 2) and distressed countries of the Eurozone (panel 3).

In order to disclose the CDS' role when forecasting occurrence of capital markets' financial crisis we use logistic regression. We use logistic regression of the type:

$$F(x) = \frac{e^x}{1+e^x} \qquad\qquad (3)$$

For the purpose of logistic regression, the *law of large numbers* is compiled and it is not made a separation of the research time period of three sub- periods, namely to pre-crisis, crisis and post- crisis period. In order to inspect the presence of crisis for a respective period of time we shall determine maximal value threshold to which the price of a stock exchange index may drop for a certain period of time (*Mishkin and White (2002)*). The crisis probability is intentionally tested at the following three scenarios:

1. Relatively low changes in the price of the indexes (to 10%)

2. Decrease of the value of the index price with about one fourth of its value;

3. Extreme stock exchange collapse – with the decrease of the price index to 40%.

$$\text{Crisis}_{i,t} = 1, \text{ if}(P_{i,t}/ P_{i,t-6}) -1 <= -0,10 \qquad\qquad (4)$$

$$\text{Crisis}_{i,t} = 1, \text{ if } (P_{i,t}/ P_{i,t-6}) -1 <= -0,25 \qquad\qquad (5)$$

$$\text{Crisis}_{i,t} = 1, \text{ if } (P_{i,t}/ P_{i,t-6}) -1 <= -0,40 \qquad\qquad (6)$$

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Crisis i,t= 0 otherwise where $Crisis_{i,t}$ is the crisis indicator, $P_{i,t}$ is the value of the index in the moment t, $P_{i,t-6}$ is the value of the index during the previous six months. Thorough this equation we report the fact that the presence of crisis will cause decrease in the value of the index for the previous six months. We develop a model where the dependable variable is *Crisis_{i,t}*, and the explanatory such is the change in CDS**.** Examined is one-month change with explanatory variable with the aim to check its ability to predict the presence of financial crisis in the following month *(Neziri, H. (2009))*. In this econometric model we use equation expressing logistic regression which was used by Neziri in his research in order to assess the probability of incurring of financial crisis at stock exchange markets through regressive one-month change in CDS values.

$$\Pr(crisis_{i,t} = 1) = f(\alpha + \beta \Delta CDS_{i,t-1})$$
(7)

$$\Delta CDS_{i,t-1} = (CDS_{i,t-1} / CDS_{i,t-2}) - 1$$
(8)

where α and $\quad$ are coefficients.

Restrictive conditions of this research are determined in the following aspects:

1. *Time range*-this research is restricted in the time interval from 03.03.2003 – 30.06.2016

2. *Methodological restrictions* –they are set by the statistical properties of the researched data imposing the application of specific econometric tests and models giving opportunity for the irreflection. The proposed and used methodology does not claim to be the only possible and applicable when inspecting and proving the research thesis of this study.

3. *Place restrictions* – the analysis and the inspection of the research thesis are concentrated on specific capital and derivate markets.

Due to the aforementioned facts, conclusions drawn of this research do not engage processes and circumstances of other markets of the category of developed and emerging markets as well as those that were strongly affected by the financial crisis of the year 2007.

Results and discussions:

For the purpose of this research a stationarity test of the dynamic financial data lines is performed as well as the separate panels where:
1.The researched returns of stock market indexes and CDS indicate stationartity.The stationary is tested by test Dickey- Fuller *(ArgumentedDickey -Fuller (ADF) test, DickeyandFuller 19819);*
2.The researched growth temps of CDS and stock market indexes also indicate stationarity.

Results from the Correlation Analysis:

Based on values of correlation registered and presented in table 2 we can draw the following conclusions detemined towards every period of research.

Results from the Correlation Analysis for pre-crisis period-Period 1:

1.For all researched stock market indexes there are relatively high values of correlation with the respective CDS. Exception as reaction of the market trends of researched countries are the Belgian BEL 20, the Bulgarian SOFIX and the Irish ISEQ 20, demonstrating comparatively low values of correlation. The highest value of interdependence is reached by the Romanian BET which correlation ratio has value 0.823804 and the lowest the Belgian BEL 20 – 0.019156. This tendency of development of correlation coefficient of the countries mentioned above is confirmed at 62 lag and 124 lag. Relatively high values of correlation indicate good information efficiency between the two indicators respectively between the two type of financial markets – stock and CDS, i.e. the information contained in the stock market indexes leads to significant impact on the value of CDS as well as vice versa. On the other hand low values of correlation coefficients of CDS with BEL, SOFIX and ISEQ 20 disclose us relative independence which the two markets have.

2.During the pre-crisis period we can clearly report the distinction

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between countries with developed capital market, such with developing and emerging, i.e in the pre-crisis condition characterizing with stable development of financial markets the entire available risk information is acccumulated by both types of researched markets to an equal extent as the power of synchronization in this process cannot be categorically determined based on developed-developing market.

Results from the Correlation Analysis for crisis period- Period 2:

1.For all researched stock market researches of the group of countries with developed capital markets (Germany, France, Great Britain) with the exception of Belgium is observed a decrease in the value of correlation raiton. Identical behavior is disclosed by the countries with relatively emerging capital markets, namely Bulgaria and Romania as the sharpest drop we observe at the cooperation between CDS-BET, namely of the value of correlation ratio of 0.823804 to 0.399489. In the crsis conditions CDS and the researched indexes of the respective countries with emerging capital markets indicate greater extent of synrchronization in the dynamic with the developed markets.

2.We shall put a stress on the presentation in the crisis period of the Eurozone countries which unite under the notion "distressed countries". They indicate interrelation and dynamics which is contradictory to other two groups of researched financial markets. We find an increase in the values of correlation coefficients as the highest value is reached by Spain in the amount of 0.708947.

3.Based on correlation ratios for Period 2 decrease of the synchronization degree is observed, i.e. the two markets with different speed report the new crisis information. Reviewing the markets of CDS and stock markets as different risk measurers we report available different speed of incorporation of crisis information in the values of the measurers of the two markets, namely one of them reports the risk quicker than the other one

Results from the Correlation Analysis for post-crisis period-Period 3:

1.It is observed that from the three examined periods namely in the post-crisis Period 3 highest values of correlation are observed between CDS and the researched stock indexes of countries with developed capital markets (Germany, France, Great Britain and Belgium). At all examined correlation couples of this group of countries relatively high increase of correlation ratios is registered, i.e. we may claim that the dependencies established in the pre-crisis period are kept. The countries with relatively emerging capital markets, namely Bulgaria and Romania reveal identical behavior. The strongest is the dependency in Germany (0,851714), followed by Romania (0,806635), France (0,767933), Great Britain (0,698329), Belgium (0,616624) and Bulgaria (0,596545).

2.During the post-crisis recovery at the countries of the European Union that were mostly affected by the financial crisis of 2007 and the debt crisis after that we report significant decrease of correlation ratios. They have values between -0.007713 (Ireland) to 0.185312 (Portugal). Besides the registered decrease we shall mark the change in the sign of the correlation ratio in the following couples CDS-ISEQ20, CDS-IBEX35, CDS-FTSEMIB which indicates for extremely week, reversely proportionate dependency between the two variables.

3.Summarizing the results of period 3 based on correlation ratios we may draw the following conclusions – in the conditions of post-crisis recovery relatively emerging capital markets show behavior which discloses similarity with the countries with developed and effective markets *(Tsenkov, V (2012)).* "Distressed countries" of the Eurozone are in contrast with the aforementioned statement as they keep their behavior of period 2, namely disclose opposite market trend of those of developed economies and show strong decrease in the correlation degree.

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Table 2: Correlation coefficients between CDS and stock market indexes

Country	Corr	Pre-crisis period	Crisis period	Post-crisis period
Germany CDS-DAX	Corr (t) - (t-1) 62 lags 124 lags	-0,602326 -0,478513 -0,30853	-0,177283 -0,142871 -0,103143	0,851714 0,746513 0,718624
France CDS- CAC40	Corr (t) - (t-1) 62 lags 124 lags	-0,636152 -0,573461 -0,528642	-0,585869 -0,472053 -0,438052	0,767933 0,701682 0,681463
Great Britain CDS-FTSE100	Corr (t) – (t-1) 62 lags 124 lags	0,672877 0,618526 0,503671	0,131691 0,254831 0,186024	0,698329 0,657391 0,596041
Belgium CDS-BEL 20	Corr (t) – (t-1) 62 lags 124 lags	0,019156 0,010472 0,010781	0,047270 0,038251 0,026871	0,616624 0,584631 0,495683
Bulgaria CDS- Sofix	Corr (t) – (t-1) 62 lags 124 lags	0,279237 0,257301 0,198473	0,267501 0,204683 0,146071	0,596545 0,548206 0,493581
Romania CDS- BET	Corr (t) – (t-1) 62 lags 124 lags	0,823804 0,792146 0,738521	0,019156 0,010472 0,010781	0,019156 0,010472 0,010781
Greece CDS- ATHEX	Corr (t) - (t-1) 62 lags 124 lags	-0,510172 0,573261 0,497206	-0,644006 0,613025 0,586356	0,018125 0,824751 0,806327
Ireland CDS-ISEQ	Corr (t) - (t-1) 62 lags 124 lags	-0,303276 -0,375287 -0,357261	0,530209 0,430271 0,410362	-0,007713 -0,000461 -0,002835
Spain CDS-IBEX35	Corr (t) – (t-1) 62 lags 124 lags	-0,579916 -0,536824 -0,518357	-0,708947 -0,681953 -0,614527	-0,090093 0,072351 - 0,063582
Italy CDS- FTSEMIB	Corr (t) - (t-1) 62 lags 124 lags	-0,359015 -0,314825 -0,518357	-0,594383 -0,481952 -0,583681	-0,141165 -0,138751 -0,126835
Portugal CDS- PSI20	Corr (t) - (t-1) 62 lags 124 lags	0,347201 -0,001652 -0,002853	0,647503 0,038251 0,045831	-0,185312 -0,001037 -0,001529

Source: Author's calculations

Results from Granger Causality Test:

Based on the registered and presented in tables 3, 4, 5 results of the Granger Test we may draw the following conclusions determined according to every testing period:

Results from Granger Causality Test for pre-crisis period- Period 1

1.For most of the researched countries absence of Granger relation is observed between the respective CDS and stock market indexes. Exceptions are only the variables for Germany and Italy. There is observed synchronization in the trends of capital markets and the market of CDS 62 lags (approximately three-month period) as forming effect have the stock market indexes. We shall mark that this impact for a continuous period of time (124 lags – approximately equal to six-month time lag) keeps its constant effect only at developed and effective financial market such as the one in Germany.

2.In support of the conclusions of the correlaton analysis for the same period of research we again do not find any significant differences between countries with developed capital market, such with developing and emerging, i.e. in period of relatively stable financial condition at equal other conditions we can report clearly dominating impact of CDS on capital markets of developed countries or lack of such in those of other two groups of researched countries, exception of which the capital market in Germany is.

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Table 3: Granger casuality test results for pre-crisis period (Period 1)

Null Hypothesis:	62 lags:		
	F-Statistic (probability)	Conclusion:	
DAX does not Granger Cause CDS	3.26321 (0.0388)	There is Granger	$dax \rightarrow cds$
BET does not Granger Cause CDS	4.29656 (0.0139)	There is Granger	$bet \rightarrow cds$
FTSEMIB does not Granger Cause CDS	4.61456 (0.0101)	There is Granger	$FTSEMIB \rightarrow cds$
	124 lags:		
DAX does not Granger Cause CDS	2.85761 (0.0228)	There is Granger	$DAX \rightarrow CDS$

Source: Author's calculations

Results from Granger Causality Test for crisis period- Period 2

1. For all examined stock market indexes of the group of countries with developed capital markets (Germany, France, Great Britain) with the exception of Belgium we may observe an information impact of stock exchange indexes on the CDS market with lags 62 which is in support of the researches of Coronado *(Coronado et al (2011)).,* Norden and Weber, Pena and Forte *(Norden and Weber (2004), Pena and Forte (2009)).* This Granger relation is unstable, i.e. it loses its operation at 124 lags for the following developed countries: France and Great Britain. The aforementioned is not valid for the German capital market where it is demonstrated permanency in its impact and in the period of financial crisis continues to be effective over the information contents of values of CDS with unchanged other conditions. Identical behavior at 124 lags for the Belgian BEL 20 is observed. Only during this period 2 of the results of Granger test we register market trend at Belgian financial markets showing synchronization with the dynamics of developed countries.

2.We shall put a stress on the presentation in the crisis period of countries

from the Eurozone which are united under the notion "distressed countries". They show interrelation and dynamic which suggest cooperation between the two types of examined markets different than the one with the effective and developed econmies. At 62 lags for Italy and Portugal characteristic is ineraction with the following direction CDS-FTSEMIB and CDS-PSI 20. In Greece and Ireland the interration between capital markets and CDS markets is bilateral, i.e. the relation of CDS support the determined movement of changes in stock market indexes as well as vice versa. The aforementioned impact is unstable with the increase of the time lags (at 124 lags) and loses its statistical significance. The only examined couple of variable IBEX 35-CDS keeps its Granger relation with 62 as well as with 124 lags.

3.During the financial destabilization and economic instability due to the crisis of 2007 the countries of the group of relatively emerging markets, namely Bulgaria and Romania do not disclose market trends similar to any of the other examined groups of countries. This may be due to the fact that accepting CDS as a measurer of investor's expectations regarding development of capital markets do not report the fluctuations of the stock market due to their low market capitalization as a measurer of the significance of the economy of a certain country as whole: capitalization of BSE is only 8% of GDP of the country while the one of Romania is 10% of the GDP.

Table 4: Granger casuality test results for crisis period (Period 2) :

Null Hypothesis:	62 lags:		
	F-Statistic (probability)	Conclusion:	
DAX does not Granger Cause CDS	3.56273 (0.0287)	There is Granger	$dax \rightarrow cds$
CAC40 does not Granger Cause CDS	3.72489 (0.0244)	There is Granger	$cac40 \rightarrow cds$
FTSE 100 does not Granger Cause CDS	3.79185 (0.0453)	There is Granger	$ftse \rightarrow cds$
ATHEX20 does not	2.68343	There is	$ATHEX20 \rightarrow CDS$

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Granger Cause FTSE	(9.E-0.5)	Granger	
CDS does not Granger Cause ATHEX20	2.43276 (0.0004)	There is Granger	$cds \rightarrow ATHEX20$
CDS does not Granger Cause ISEQ	4.97909 (0.0070)	There is Granger	$CDS \rightarrow ISEQ$
ISEQ does not Granger Cause CDS	2.08352 (0.0388)	There is Granger	$ISEQ \rightarrow cds$
IBEX35 does not Granger Cause CDS	3.82834 (0.0221)	There is Granger	$IBEX35 \rightarrow cds$
CDS does not Granger Cause FTSEMIB	3.22081 (0.0403)	There is Granger	$CDS \rightarrow FTSEMIB$
CDS does not Granger Cause PSI20	4.91524 (0.0042)	There is Granger	$CDS \rightarrow PSI20$
		124 lags:	
DAX does not Granger Cause CDS	2.86427 (0.0224)	There is Granger	$DAX \rightarrow dax$
BEL20 does not Granger Cause CDS	3.64673 (0.0159)	There is Granger	$BEL20 \rightarrow CDS$
IBEX35 does not Granger Cause CDS	2.10965 (0.0004)	There is Granger	$IBEX35 \rightarrow CDS$

Source: Author's calculations

Results from Granger Causality Test for post-crisis period- Period 3

1.It is noticeable that of the three examined periods namely in the post-crisis period 3 at 62 lags two-way Granger connection is observed between the CDS and stock market indexes for the following countries: *Germany* : $CDS \leftrightarrow DAX$; *France:* $CDS \leftrightarrow CAC\,40$; *Great Britain:* $CDS \leftrightarrow FTSE\,100$; *Bulgaria:* $CDS \leftrightarrow SOFIX$

2.In this period 3 at 62 lags for the first time we registrer synchronization in the behavior between the market trend in Bulgaria and the one of the developed capital countries. The Romanian BET and the Irish ISEQ have determining impact on the changes of information contained in their

respective CDS.

3.For the reviewed Period 3 at 124 lags the bilateral Granger connection at developed countries is interrupted and remains unilateral with a change of the information impact, namely in post-crisis period information impact on effective capital markets have the CDS (Germany, France and Great Britain), exception of which the Belgian derivative market is.

Table 5: Granger casuality test results for post-crisis period (Period 3) :

Null Hypothesis:	62 lags:		
	F-Statistic (probability)	Conclusion:	
CDS does not Granger Cause DAX	2.17041 (0.0145)	There is Granger	$cds \rightarrow dax$
DAX does not Granger Cause CDS	6.14285 (0.0022)	There is Granger	$dax \rightarrow cds$
CAC40 does not Granger Cause CDS	5.82120 (0.0401)	There is Granger	$cac40 \rightarrow cds$
CDS does not Granger Cause CAC40	4.56450 (0.0106)	There is Granger	$cds \rightarrow cac40$
FTSE does not Granger Cause CDS	3.78279 (0.0373)	There is Granger	$ftse \rightarrow cds$
CDS does not Granger Cause FTSE	4.96930 (0.0071)	There is Granger	$cds \rightarrow ftse\ 100$
CDS does not Granger Cause SOFIX	4.75686 (0.0087)	There is Granger	$cds \rightarrow sofix$
SOFIX does not Granger Cause CDS	4.42575 (0.0121)	There is Granger	$sofix \rightarrow cds$
BET does not Granger Cause CDS	3.23783 (0.0395)	There is Granger	$bet \rightarrow cds$
ISEQ does not Granger Cause CDS	4.41731 (0.0122)	There is Granger	$iseq \rightarrow cds$

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	124 lags:		
CDS does not Granger Cause DAX	3.23014 (0.0168)	There is Granger	$cds \rightarrow dax$
CDS does not Granger Cause CAC40	2.56495 (0.0367)	There is Granger	$cds \rightarrow cac40$
CDS does not Granger Cause FTSE	3.12625 (0.0142)	There is Granger	$cds \rightarrow ftse\ 100$

Source: Author's calculations

4.Summarizing the results of period 3 on the grounds of the result of the Granger Test performed we may draw the following conclusions – in the conditions of post-crisis recovery of CDS they increase their information impact on capital markets, i.e. the crisis turns the CDS into an important financial tool especially for developed economies upon unchanged other conditions. The financial crisis turns the changes in values of CDS in a "primary" indicator for the stock market that present is upcoming risk. If the swaps "sense" risk in the contemporary conditions, it will be obligatory reflected by the stock market. We may say that swaps play their role but keeping in mind the lack of significant Granger connections in pre-crisis period we may say that this position is mostly a reaction of caution at developed capital markets or we witness "more nervous" reflection of newly-come negative information signals.
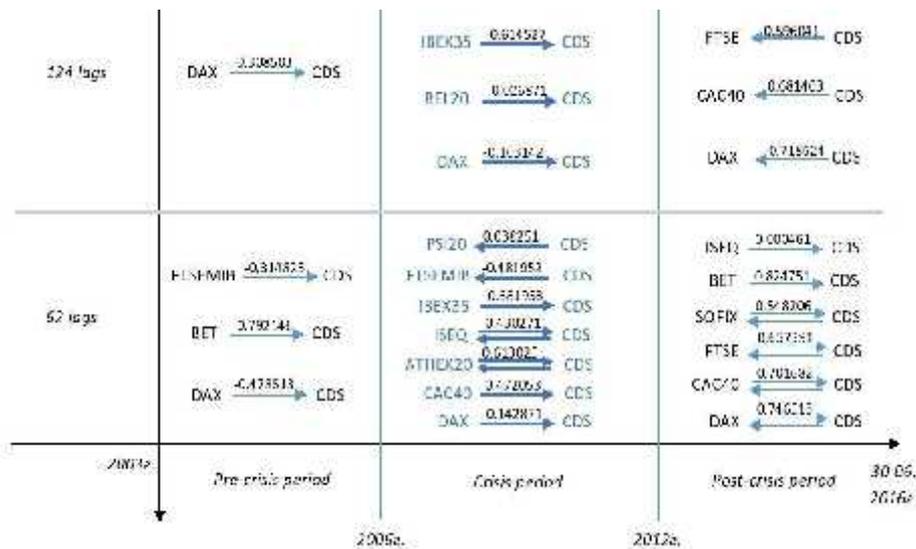
Summarizing the conclusions of the correlation analysis and the one of Granger the test of Period 1, 2 and 3 *(figure 1)* we draw the conclusion that the interaction between the CDS and stock market indexes of reviewed countries is strongly variable and unstable for different periods of time. The aforementioned conclusions support this thesis of Coronado *(Coronado et al (2012))* who claims that after 2010 capital markets lose their leading position regarding to determined changes on CDS during the same year start to put a stress on the crisis and the state debt which additionally contributes to the increase of the significance of CDS. Based on the aforementioned conclusions we may make the following summaries:

1.Regardless of the enhanced degree of synchronization between the two financial markets in the pre-crisis period there are no significant Granger connections through which to disclose information impact of one market on the other. Exceptions are Germany and Italy where Granger connection is observed with direction of operation of capital markets to these of CDS.

2.After upcoming of the financial crisis in the stage of its development forming and exceeding incorporation of the information is observed which predicts future financial risk, of capital markets of developed countries. Contrary impact we find with countries having reached highest risk spread during the crisis namely exceeding synchronization in reflecting the negative new information signals and proactive ifnormation efficiency at he market of CDS and capital such.

3.Not accidentally after coming of the financial crisis and the subsequent debt one more and more talking is about CDS and their significance. After analysis of the results of correlation ratios and examined Granger connections we may state that the crisis transforms CDS in financial tool which reacts sensitively towards negative information flows. In such a "nervous" way react the financial markets of developed countries (Germany, France and Great Britain for trimester as well as six-month time period). This is why fluctuations in their value may be accepted as "forerunner" of subsequent risk.

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Figure 1: Summary graphical representation of the results of correlation and

Granger test

Source: author's systematization

Results from Logistic regression model (Logit):

1.For the purpose of the Logit test we have compiled three panels of countries (see table 1) – *Panel 1 (635 obs.)* – Countries with developed capital markets, *Panel 2 (54 obs.)*- countries with emerging capital markets and low degree of capitalization and *Panel 3 (134 obs.)* - includes countries of the Euro zone which are determined as "distressed countries" and have reached peak values of their CDS during the financial crisis of 2007 and the subsequent debt crisis left the most negative consequences on their economy. The period of research is 03.2003-06.2016 and contains monthly database of examined variables. The time period, the database of panel research are changed for the necessity to inspect on monthly basis whether there will be indications for a crisis that could be more categorical and more easily distinguishable than daily one for separate countries and their markets. For the purposes

of the logistic regression, time- period dividing is not made, in order to investigate a larger number of observations for a longer period of time, i.e to increase the statistical significance of the results.

2.On the grounds of data in table 6 we may state that for the countries of panel 1 there is lowest percentage of foreseen financial crisis for researched period *(1,92%)*. For countries which are included in panel 2 (Bulgaria and Romania), this indicator is equal to 31.7% but it characterizes with lack of statistical significance .At panel 3 (Italy, Ireland, Spain, Portugal and Greece) we report *34%* of foreseen crisis.

Table 6: Results from the logistic regression

Country:	Number of predicted Crisis	Tranquil	% Crisis
Developed markets **Panel 1**	12	624	1,92%
Emerging markets **Panel 2**	13	41	31,7%
Distressed countries **Panel 3**	34	100	34%
Total	59	765	7,71%

Source: Author's calculations

3.Table 7 reveals ratios and marginal effects of factors that are supposed to affect on the probability of incurrence of financial crisis at capital markets. One-month changes of CDS values for Panel 1 (Developed countries) and Panel 3 (Italy, Ireland, Spain, Portugal and Greece) are statistically significant at 5% level of significance. It supposes that one-month CDS fluctuations are able to foresee incurrence of upcoming financial crisis at capital markets. Based on the results of logit test for Bulgaria and Romania (Panel2), the role of one-month CDS changes is not determinative in foreseeing upcoming financial collapse. This is due

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to the reason that one-month CDS fluctuations and their marginal effects do not have statistical significance.

Table 7: Logit regressions on stock market crisis prediction:

Dependent variable: Crisis Indicator	Panel (1)		Panel(2)		Panel(3)	
Independent variables(t-1):	Coefficients	MarginalEffects	Coefficients	MarginalEffects	Coefficients	MarginalEffects
Constant	-4.588460** [0.443978]		-3.066077 [1.894515]		--3,594900** [0.677182]	
Credit Defalut Swaps	0.304706** [0.126520]	0.0014492** [0.00195]	0.497185 [0.477539]	0.002495 [0.00006]	0.783986** [0.194786]	0.0043821** [0.00036]
McFadden R-squared	0.037024 (636)		0.018220 (54)		0.125134 (134)	
LogLikelihood	-57.32554		-29.26130		-66.39994	
LR statistic	4.408072		1.086078		18.99463	
P-Value	0.03576		0.2973		0.0013	

Notes: The value in brackets shows the standard deviation

*** significance at 5%; Marginal effects coefficients represent the full value of slope coefficient, calculated on the basis of the results from Logit regression*

On the grounds of the results stated in table 7 related to the values of CDS we establish that everywhere one-month changes in the CDS value has positive sign which on its hand corresponds to the fact that at equal other conditions the increase of the value of CDS alarms about increasing probability of incurrence of financial crisis at capital markets. For panel 1 we observe the following dynamics: if the value of CDS increases with 1% at equal other conditions the probability of incurrence of capital market crisis increases with 1,36%. At panel 3: if the value of CDS increases with 1% at equal other conditions the probability of incurrence of crisis at capital markets is increased with 2,19%, i.e. at financial markets of the Euro zone reaching peak values of CDS during

the financial crisis of 2007, the changes in the one-month values of CDS have better perspective when predicting the occurrence of financial risk.

4.Through table 8 we express the probabilities for occurrence of financial crisis where the dependant variable is crisis$_{i,t}$ and explanatory one is the one-month changes in the values of CDS: *Panel 1* - characterizes with share of accurately predicted crisis in the amount of 3.84% . The change of the six-month value of stock market indexes in interval to 40%, i.e. at financial collapse at capital markets, we have 100% predictability of the incurred financial crisis. For the entire researched period 2003-2016 the methodology encloses 12 peaks with significant incurrrence of crisis out of total 635 observations. In the remaining 623 cases the econometric does not enclose such significant peaks of change. The high percentage of False Alarms 96.55% can be explained by the fact that the crisis is not a natural condition of capital markets and regardless of indexes' fluctuations they manage to keep their stability. Actually, false alarms are the crisis situations which do not have sufficient power to fall into some of the three levels of significance, i.e. these are mostly protocrisis conditions of market than actual crisis. As a whole the used logistic regression when calculating the probability of incurring of financial crisis suggests 92.04% accurately classified observations which includes as a rule foreseen crisis as well as the conditions of financial stabilization.

Panel 3 - The percentage ratio being accurately predicted crisis is significantly higher than the one at panel 1, namely *37,17%.* At stock market collapse, i.e. at *(P$_{i,t}$/ P$_{i,t-6}$) -1 <= -0,40,* five numbers of crisis are foreseen ,of which 38% present accurate foreseen crisis which is the prediction of the subsequent two financial crisis through one-month change in CDS values. For panel 3 the amount of the False Alarms is significantly lower than the one in panel 1- 62.83%, i.e. in many of the cases when there were preconditions for crisis they actually happened. The significantly large number of foreseen crisis for this panel for the period 2003-2016 is determined by the behavior of the included countries characterizing them as distressed. We shall mark that the share of

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accurately classified observations is 68.12 which is significantly lower than the value of panel 1, i.e. as a whole the used logistic regression gives higher assessment of the model for panel 1 which includes developed markets compared with the results of panel 3.

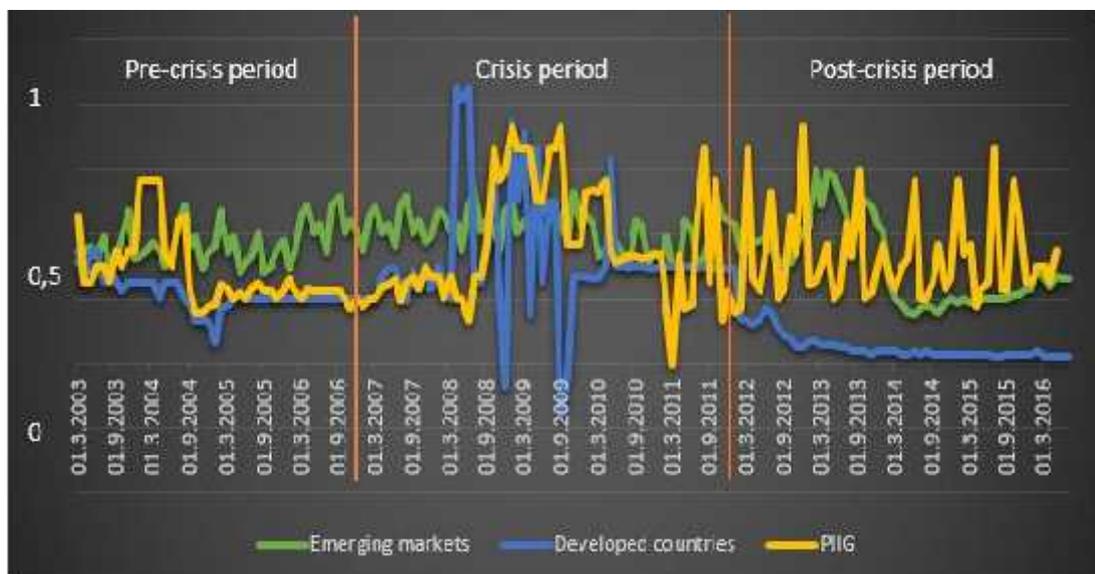**Table 8: Forecasts of crisis probabilities in stock markets:**

		Number of predicted crisis	Crisis predicted correctly Pr(D|+)	False Alarm Pr(~D|+)	Sensitivity Pr(+|D)	Specificity Pr(-|~D)	Share of correctly classified obs.
Panel1	**total**	**12**	**3,45%**	**96,55%**	**3,84%**	**98,14%**	**92,04%**
	- 0,10	8	21.05%	78.95%	10.81%	98.99%	96.84%
	- 0,25	3	16.67%	83.33%	2.70%	99.66%	97.3%
	- 0,40	1	100.00%	0.00%	2.70%	100.00%	97.63%
Panel2	**total**	**13**	**25.58%**	**74.42%**	**19.14%**	**76.4%**	**64.17%**
	- 0,10	3	18.27%	82.73%	11.56%	73.52%	63.58%
	- 0,25	7	30.33%	69.67%	7.86%	96.51%	93.23%
	- 0,40	3	28.33%	71.67%	5.41%	94.83%	95.02%
Panel3	**total**	**34**	**37.17%**	**62.83%**	**17.32%**	**78.64%**	**68.12%**
	- 0,10	12	33.33%	66.67%	8.21%	99.64%	97.24%
	- 0,25	17	18.25%	81.75%	9.41%	92.37%	94.46%
	- 0,40	5	38.00%	62.00%	6.41%	93.8%	95.32%

Notes: *Crisis predicted correctly- number of matches between financial crisis prediction and actually realized one; False Alarms- includes predicted but not realized crisis; Sensitivity- the percentage of probability of one crisis to be predicted, when realized; Specifity- the probability of one financial crisis not to be predicted and not to be realized; share of correctly classified obj. - Includes the percentage of all correctly predicted situations, on the basis of the data used. D – realized crisis; ~D - unrealized crisis; „+-„ Predicted crisis; " – „ –unpredicted financial crisis.*

Based on the graphical modeling of the probability of occurrence of the financial crisis' dynamic in the capital markets *(Graph 1),* we can conclude that in the pre-crisis period, we report the lowest levels of probability of occurrence of financial instability of the developed capital markets (Panel 1). Similar dynamics is observed for the euro area countries, namely Portugal, Italy, Ireland, Spain and Greece (PIIIG). During the crisis period the values of probability for Panel 1 reach their highest levels ((01.03.2008. See. Table 8-100% predicted and realized financial crisis in the developed capital markets in the case of a decline in the value of stock index by 40%).In the early of 2009, the probability of financial destabilization for the "distessed countries" reaches its highest levels, either. After this period, we observe a downward trend in its dynamic. The post- crisis period is characterized by economic stabilization for the developed capital markets (lower and prolonged retention of stable low values of probability). A mirror opposite development of probabilistic values is reported for the countries of the panel 3. We observe cyclic increase and decrease in probability levels, which marks a long and unsuccessful post-crisis recovery and economic instability of their capital markets. The calculated and plotted levels of probabilities of Panel 2 (emerging markets) maintain permanent levels of volatility during the pre-crisis and crisis period and subsequent decline in their values in the post-crisis period, do not have statistical significance .

Graph 1: Graphical modeling of the estimated probability of a financial crisis in the capital markets through Logit model

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On the grounds of the aforementioned establishments, based on the results of the logistic regression, aiming through one-month change of the value of CDS to predict the occurrence of financial crisis at capital markets, we may make the following conclusions: for countries with developed capital markets of other two panels the applied methodology reports 100% crisis which characterizes with extreme capital market collapse as we registered in 2007 and the models registers 92.04 accurately predicted periods - financial destabilizations as well as periods with ascending market trend. For panel 2 being countries Bulgaria and Romania CDS do not have significant predictive ability which is condition on the low capitalization of stock exchanges. The behavior of CDS is established not be a significant indicator for countries with undeveloped and ineffective markets, i.e. they perform their function as risk measurers only for countries with developed capital markets. For the countries of panel 3 (Italy, Ireland, Spain, Portugal and Greece) every change in the risk exposition of CDS is incorporated in stock market indexes, i.e. they report the presence of larger number of crisis which conditions the reaching of peak values of CDS. As a whole the applied method estimates the debt of accurately classified observations in the amount of 68.12% which is almost 30% lower than those of countries with developed capital markets.

Of the aforementioned we may draw the conclusion that the crisis as economic event increased the significance of CDS as made them into a "reliable" measurer of risk for countries with developed capital markets and economies. For them they are indicator whose fluctuations are not only signals of incurring financial collapse but also for periods with ascending market trend. Those results support the conclusions that *Naziri, Coudert and Gex* draw, namely that the fluctuations of CDS predict shocks at capital markets and have significant information value.

Conclusion:

The idea to study the degree of correlation of the capital markets and swap debt default and verify the ability of the one-month changes in the

values of CDS to predict the financial crisis in the capital markets was triggered by the growing importance of CDS, and the fact that they were determined as source for the occurrence of the financial meltdown in 2007 *(Oren, B., (2013)).* In order to confirm / reject the research hypothesis through using econometric modelling of the CDS return to establish whether the degree of information efficiency, related to the ability of the CDS to foresee the coming of financial crisis at developed capital markets is more significant than in the countries with undeveloped capital market. Based on empirical results the following conclusions may be drawn:

1. Through the results of logistic regression, CDS effect and CDS predictability are proven as well as their impact on the capital markets is strongly expressed in the pre-crisis and post-crisis period for countries with developed economies (see table 2, graph 1). For time period enclosing the development of financial collapse the values of CDS does not accumulate the subsequent risk which reflects on the decrease of synchronization between the two markets.

2. Contrary behavior is registered to the countries with the highest risk spread during the crisis as well as Bulgaria and Romania. Regardless of the increasing synchronicity between the two researched markets, concerned to reflecting the newcomers data signals for subsequent financial collapse, credit default swaps do not have "effective" predictive ability. For the emerging markets their role does not have statistic significance, this supports the thesis that credit default swaps do not entirely carry out their functions in the countries with undeveloped capital markets.

3. The crisis transforms CDS into a financial tool which reacts sensitively regarding negative information flows. In such a "prognostic" way the financial markets of developed countries react (Germany, France and Great Britain in three-month as well as six-month time period). This strongly predictive character of CDS for developed capital market is expressed by the significantly higher number of "proto-crisis" (False

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Alarms) (96.55%) compared to the one of countries with emerging capital markets (where fluctuations of CDS have no statistical significance) and those of distressed countries of the Eurozone (62.83%).

For the future research first and main place shall be for the testing of those dependencies when grouping of larger number of countries of Central and Eastern Europe in order to establish whether in the entire region characterizing the developed capital markets CDS have also no statistical significance.

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