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CDS AND STOCK MARKET: PANEL EVIDENCE UNDER CROSS-SECTION DEPENDENCY

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Abstract
In recent years, the spreads of CDS that are crucial aspects in detecting the financial risk level of countries have been taken more notice of by investors. In this paper, we investigate the relation between CDS spreads and countries' stock indices by using Basher and Westerlund (2009) panel cointegration and Dumitrescu-Hurlin (2012) panel causality tests. Causality from stock market to CDS figures has been detected by the Sequential Panel Selection Method (SPSM) of Chortareas and Kapetanios (2009) for 7 out of 13 G20 countries. Additionally, the study finds a negative correlation between variables with the usage of Common Correlated Effects (CCE) estimator. The positive increasing trend in stock markets causes a decrease in the financial risks that naturally allow low CDS spreads.

JEL Classification: C33, G15
Key words: CDS Spread, Stock Market, Panel Cointegration, Panel Causality, Cross-Section Dependency

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1. Introduction[i]

Financial market instruments distribute flows of funds to finance the investments of market players. Also, these instruments play a vital role in channeling funds from lenders to borrowers. Among them are the credit derivatives that transfer credit risks and yields from one party to another by making forward, future, option and swap contracts (Erdil, 2008: 3). The most commonly used one is credit default swaps (CDS) contracts which promise to promote payment of the credit and provide premium yield in exchange. That is, one party buys the protection with certain remuneration and the other takes the same risk in return for payment. The reasons why CDS have been used can be transferring of credit risk, enhancing the credit limit of a customer, gaining additional income by taking credit risk or portfolio diversification (Karabıyık and Anbar, 2006: 50). The increased importance of CDS contracts since the late 1990's led to efforts to describe the emergence of risk with clear statements. Therefore, the International Swaps and Derivatives Association (ISDA) defined the credit event as emergence of one or more conditions of bankruptcy, failure to pay, obligation acceleration, obligation default, repudiation/moratorium or restructuring (ISDA, 2003: 30). The risk taker recompenses the loss of the protection purchased by the other party. CDS can also be used as a commodity by investors. Any possible change in the risk of the credit debtor is able to alter the CDS prices, revealing new opportunities for investors to make profit. Thus CDS have become a risk indicator in the market. Moreover, CDS inform us regarding the quality of issued bonds of countries or companies and other debt instruments. In this respect, CDS prices use the credit risk information of the reference company, before revision of the bond price of the reference company. Hence the prices of CDS play an essential role for information in credit markets (Tözüm, 2009: 122). The provided knowledge of CDS contributes to detecting the country's risk. During recent years, CDS spreads have become a significant indicator with regard to risk perceptions of countries and companies. Country risk analysts consider that Eurobond yields are not susceptible to more analysis, and therefore they have taken fluctuations of CDS spreads (Ersan and Günay, 2009: 3).

Commodity prices, current deficit and rise in political risk can increase CDS premiums. Recent CDS literature highlights the relationship between CDS prices and the benchmark bond interest rate. While many studies consider that CDS premiums

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lead to high benchmark bond interest rates, there are limited papers regarding the impact of CDS premiums on the stock exchanges. In this context, the broadly accepted assumption is of a negative relationship between CDS premiums and stock indices. Under this assumption, high CDS premiums affect negatively confidence towards market and stock indices. On the other hand, positive trends on the stock exchange, with the usage of good economic indicators that imply lower country risk, confirm a negative relationship with CDS premiums.

The rest of our paper is organized as four parts. Initially, the study provides a brief overview of the literature. The next part focuses on the explanation of the econometric model. The following section addresses the empirical analysis and lastly the paper contains concluding remarks.

2. Literature Review

Studies of CDS and stock indices used various types to predict the relationship direction between datasets. Therefore, we describe previous studies regarding CDS and indices.

Alexander and Kaeck (2008) examine the effect of theoretical determinants of CDS spreads - interest rates, stock returns and implied volatility on daily changes in the iTraxx Europe indices in the period June 2004 and June 2007, using the Markov switching model. The study reveals that iTraxx Europe indices are sensitive to stock volatility during CDS market turbulence.

Fung *et al*. (2008) provide evidence for the relation between the U.S. stock market and the CDS market from 2001 to 2007. In terms of pricing and volatility, there is mutual feedback for the stock market and the high yield CDS market. They analyse market-wide relations, unlike other studies that use the firm level. Besides, the VAR model shows that the stock market leads both investment grade and high yield CDS markets.

Norden and Weber (2009) claim a negative relationship between stock returns and CDS spreads by taking data that cover 2000-2002 from 58 European and US companies. Also, the study of Demirkan (2011) finds a negative relationship between stock returns of OECD countries and CDS spreads, as well.

Trutwein and Schiereck (2011) focus on the relation between equity and credit markets for major financial institutions. They confirm that there is a strong positive relation between changes in CDS spreads and implied volatility. That is, CDS markets and option implied volatility demonstrate simultaneously adjustment to changes under credit default risk.

The study of Trutwein *et al*. (2011) analyzes the impact of changes in default risk by using CDS spreads on equity returns. Findings of the study support the regime-dependent nature of link between CDS spreads and equity returns. Therefore, the market crisis condition reacts differently for abnormal returns and severe CDS spread movements.

Coronado *et al*. (2012) investigate the link between sovereign CDS and stock indexes for eight European countries (Spain, Portugal, Italy, France, Ireland, United Kingdom, Greece and Germany) during the period 2007-2010 by using VAR and panel data models. The study shows that stock index returns and sovereign CDS spreads changes have significantly negative correlation, and stock index return volatility is related to sovereign CDS spreads movements. Also, the stock market clearly leads the CDS market – which confirms previous results.

Fenech *et al*. (2013) observe correlation between CDS spreads and respective stock prices in Australia by splitting the data pre and post global financial crisis with Archimedean copulas. The study exhibits a negative co-movement for the post-global financial crisis period by including the 2006-2009 period.

Castellano and Scaccia (2013) use the Markov switching model in CDS and stock market index quotes. Daily closing quotes for five years from 2004 to 2010 are analyzed. The basic topic of the research is whether increases in volatility of CDS index changes can be an indicator of stock market turmoil. According to test results, volatility of the CDS market is a reliable instrument for predicting stock market crashes.

Narayan *et al*. (2014) study panel data and conclude that the stock market contributes to price discovery in nine sectors and CDS market contributes to price discovery in only six sectors from 07/02/2004 to 03/30/2012 by converting natural logarithmic forms of data series. Classified firms in terms of sectors and sizes are subjected to panel cointegration and panel VECM in order to estimate price discovery.

Eyssell *et al*. (2013) identify the determinants of levels and changes of sovereign CDS spreads in China. They find that both internal factors, such as the stock market index and interest rate, and global factors had vital impacts on CDS spreads between January 2001 and December 2010. Also, the study reveals that China sovereign CDS spread changes lead stock returns within the Vector Autoregressive model. Therefore, CDS is accepted as a leading economic indicator for cross-market trading and hedging.

Banerji *et al.* (2014) investigate the dynamic relations between external factors, domestic macroeconomic factors with sovereign spreads, debt to GDP ratio, etc. in Asian emerging countries. According to their study, variations in sovereign spreads are mainly driven by external shocks, with the term structure of U.S. interest rates and global risk aversion having the most important role.

Dergiades *et al.* (2013) examine the impact of the volume of activity in social media and web search queries on the sovereign spread between Greece, Ireland, Italy, Portugal, Spain and the German long-term government bond yield during the Greek debt crisis. They use daily time-series data related to the Greek crisis over the period from 20th May 2011 to 9th May 2013. The study suggests that unprocessed data, effortlessly traced in social media, contain valuable information content with respect to the short-run movements of financial markets.

The study analyses the relationship between CDS spreads and stock market prices of 13 out of G20 countries by doing Basher and Westerlund (2009) panel cointegration and Dumitrescu-Hurlin (2012) panel causality tests.

3. Econometric Methodology

Time series analysis investigates relationships separately. However, panel data analysis takes into consideration interaction among countries in order to obtain more advanced results. Thus the use of panel data analysis is more suitable instead of time series analysis for the study. The heterogeneous structure of the panel calls for application of the panel causality test of Dumitrescu and Hurlin (2012). The null hypothesis of the test indicates that there does not exist a Granger causality relationship in the panel, while an alternative hypothesis suggests that there is a causality relation, of at least one, in the cross section. Moreover, Granger causality tests using for time series and panel data analysis is assumed as linear (Alagidede *et al.*, 2011).

The crucial point of the null hypothesis is the possible existing homogeneous relationship, whereas the alternative hypothesis searches for a heterogeneous relationship. The test statistic of basic hypothesis testing is the arithmetic mean of each individual Wald statistic. Additionally, the econometric test method provides reliable results in spite of low data numbers and unbalanced panel data models (Bozoklu and Yılancı, 2013).

According to this model, the null hypothesis is tested by the simple means of the Wald statistic individually. That is:

$$W_{N,T}^{Hnc} = \frac{1}{N} \sum_{i=1}^{N} W_{i,t} \quad \textbf{(1)}$$

where $W_{i,t}$ denotes the Wald test statistic for country i to test causality.

Dumitrescu and Hurlin (2012) offer an estimated standardized statistic for WHNC by using estimation values of mean and variance of the distribution due to no convergence to the same chi-square of each individual Wald statistics with a small sample for T. This statistical equation is below:

$$Z_{N,T}^{HNC} = \frac{\sqrt{N}\,[W_{N,T}^{Hnc} - \sum_{i=1}^{N} E(W_{i,t}]}{\sqrt{\sum_{i=1}^{N} Var(W_{i,t})}} \quad \textbf{(2)}$$

where i denotes total number of countries. W and T demonstrate Wald statistics and period numbers. The study of Dumitrescu and Hurlin (2012) explains the details of the model deeply.

4. Data and Empirical Results

In this paper, we analyze the CDS indexes and stock markets of 13 out of G20 countries[1] during the 52 weeks that cover the period 22 April 2013 to 15 April 2014. The countries and stock markets respectively are USA (S&P), Germany (DAX), Argentina (MERVAL), United Kingdom (UK), Brazil (IBOVESPA), France (CAC), South Africa (FTSE JSE), South Korea (KOSPI), Italy (FTSE MIB), Japan (NIKKEI), Mexico (BOLSA), Russia (RTSI) and Turkey (BIST). Descriptive statistics of the series are presented in appendix 1 and appendix 2 respectively for CDS and stock market indices.

Datasets of country stock exchanges and CDS indexes are provided by www.uk.finance.yahoo.com and www.dbresearch.com links. We take logarithms of the series in order to avoid heteroscedasticity problem and normalize series. Appendix 3 demonstrates the related graphics of CDS and stock markets for each countries.

Another significant point is that results of analyses are outcomes from Monte Carlo Simulation 10,000 replications. The structure of the datasets is crucial for the types of the tests in the panel data analysis. In this connection, the status of the variables should be detected as homogeneous or heterogeneous and convenient unit root, cointegration and causality tests should be used. Therefore, initially we detect the structure of the datasets thanks to the Pesaran and Yamagata (2008) slope homogeneity test in Table 1:

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[1] The reason why we selecting 13 out of 20 is the avaliability of data sets for our time period.

Table 1: Pesaran and Yamagata (2008) Slope Homogeneity Test Results

	Test Stat.	Prob.
Δ	9.25	0.00*
Δ_{adj}	27.76	0.00*

*indicates significance level in 1%.

According to results, variables are heterogenous at 1% level both Δ and Δ_{adj} statistically. Cross section dependency that is important in the panel data analysis requires us to view time and cross section dimensions. Cross section dependency can be studied by Breusch-Pagan (1980) LM or Pesaran (2004) CD tests.

Breusch Pagan (1980) CD_{LM1}, Pesaran (2004) CD_{LM2} and Pesaran (2004) CD_{LM} test the cross section dependency existence for panel data. When T > N CD_{LM1} and CD_{LM2} tests are considered in respect of cross section dependency. Meanwhile, under N > T condition, CD_{LM} test becomes the cross section dependency estimator.

Table 2 demonstrates the cross section dependency test results via CD_{LM1} and CD_{LM2} tests for CDS and stock markets. The results signify the existence of both CDS and stock market panel cross section dependency.

Table 2: Cross Section Dependency Test Results

	CDS	Stock Market
Cd LM1 (Breusch and Pagan 1980)	227.63 (0.00*)	281.30 (0.00*)
Cd LM2 (Pesaran 2004)	11.98 (0.00*)	16.27 (0.00*)

*indicates significance level in 1%.

Using of cointegration and causality tests that should consider cross section dependency and heterogeneous series are convenient based on test results in Table 1 and Table 2. On the other hand, stationary levels of the series are significant in order to make necessary cointegration and causality tests. Therefore, our study used second generation unit root test panel seemingly unrelated regressions augmented Dickey-Fuller (SURADF) Breuer *et al.* (2001, 2002) due to T > N. According to the SURADF panel unit root test, Table 3 and Table 4 indicate that all series have unit root at their levels. Statistical values are lower than critical values, however series are integrated at their first differences. Also, the SURADF test provides the statistics of each country separately though it analyses panel structures. Therefore, SURADF takes into account not only panel structure of the series but also differences among countries.

Table 3: SURADF Panel Unit Root Test Results for CDS

Countries	Level		First Difference	
	Statistic	**Critical Value (%5)**	**Statistic**	**Critical Value (%5)**
USA_{cds}	-2.781	-7.044	-8.110	-7.593
$Germany_{cds}$	-1.543	-6.874	-9.307	-7.789
$Argentina_{cds}$	-1.912	-7.126	-7.708	-7.643
UK_{cds}	-5.739	-5.802	-9.608	-7.048
$Brazil_{cds}$	-3.722	-5.682	-7.615	-7.098
$France_{cds}$	-7.007	-7.162	-11.45	-7.743
$South\ Africa_{cds}$	-1.995	-5.909	-7.739	-7.528
$South\ Korea_{cds}$	-2.742	-5.510	-7.833	-7.291
$Italy_{cds}$	-5.788	-6.048	-8.490	-7.582
$Japan_{cds}$	-3.761	-6.490	-7.994	-6.433
$Mexico_{cds}$	-3.334	-6.363	-9.570	-6.819
$Russia_{cds}$	-2.825	-5.916	-8.504	-7.216
$Turkey_{cds}$	-2.250	-5.734	-8.752	-6.935

Table 4: SURADF Panel Unit Root Test Results for Stock Markets

Countries	Level		First Difference	
	Statistic	**Critical Value (%5)**	**Statistic**	**Critical Value (%5)**
USA_{sm}	-2.781	-7.044	-8.110	-7.593
$Germany_{sm}$	-1.543	-6.874	-9.307	-7.789
$Argentina_{sm}$	-1.912	-7.126	-7.708	-7.643
UK_{sm}	-5.739	-5.802	-9.608	-7.048
$Brazil_{sm}$	-3.722	-5.682	-7.615	-7.098
$France_{sm}$	-7.007	-7.162	-11.45	-7.743
$South\ Africa_{sm}$	-1.995	-5.909	-7.739	-7.528
$South\ Korea_{sm}$	-2.742	-5.510	-7.833	-7.291
$Italy_{sm}$	-5.788	-6.048	-8.490	-7.582
$Japan_{sm}$	-3.761	-6.490	-7.994	-6.433
$Mexico_{sm}$	-3.334	-6.363	-9.570	-6.819
$Russia_{sm}$	-2.825	-5.916	-8.504	-7.216
$Turkey_{sm}$	-2.250	-5.734	-8.752	-6.935

Stationary levels [I(1)] of the series are available for testing the cointegration relation between panels. We intend to use the Basher and Westerlund (2009) panel cointegration test in respect of cross section dependency and structural breaks. Existence of cross section dependency validates the bootstrap critical value. If not, asymptotic probability is valid for detection of cointegration relations between variables. The test results are indicated in Table 5. Our analysis takes the critical bootstrap values owing to the existence of cross section dependency for both panels. Calculated test value accepts null hypothesis for existence of panel cointegration. That is, country CDS spreads and stock markets have an integrated structure. Besides, if there is no cross section dependency in the panel, the cointegration relation will be valid anyway according to asymptotic probability. Moreover, any structural break is detected for all countries under the model that allows 5 structural breaks. Weekly and short term data sets can be evaluated as the main reason for this result.

Table 5: Basher and Westerlund (2009) Panel Cointegration Test Results

T Statistic	1.263
Asymptotic Probability	0.103
Bootstrap Critical Value	0.748

*Constant and trend are included in model.

All series are stationary at their first differences and thus the Dumitrescu-Hurlin (2012) panel causality test takes into account the cross section dependency of series. When we look to the results of the Dumitrescu-Hurlin panel causality test in Table 6, there is no causality relation from CDS spreads to stock markets by accepting the null hypothesis. Meanwhile, the causality relation from stock market to CDS spreads is not the same. Initially, the alternative hypothesis which signifies at least one causality relation in the panel is accepted. Sequential Panel Selection Method (SPSM) of Chortareas and Kapetanios (2009) helps to determine which countries have causality relation from CDS spreads to stock market. According to SPSM, the lowest Wald statistic belongs to Russia and we analyze again the same data without Russia. This process lasts till the acceptance of the alternative hypothesis, which is that at least one series in the panel is stationary. Table 6 demonstrates the consequences of the just 1 lag structure in order to not cover more areas.

Table 6: Dumitrescu Hurlin Panel Causality Test Results

Causality from Stock Market to CDS		
Countries	**Wald Statistic**	**Prob.**
Russia	-34.53	0.00*
Italy	-18.14	0.00*
France	-21.49	0.00*
UK	-16.46	0.00*
Argentina	-7.64	0.00*
South Korea	-9.11	0.00*
Germany	-6.12	0.01*
Japan	-3.03	0.11
USA	-1.86	0.17
Turkey	-1.75	0.18
Brazil	-1.00	0.31
South Africa	-0.61	0.43
Mexico	-0.49	0.48
Causality from CDS to Stock Market		
Countries	**Wald Statistic**	**Prob.**
Panel	-0.0082	0.9935

* indicates significance level in 1%.

As a result of the analysis, while the stock exchanges of Russia, Italy, France, UK, Argentina, South Korea and Germany are the causality of the changes of CDS spreads, Japan, USA, Turkey, Brazil, South Africa and Mexico do not have such a relation. Additionally, the results do not alter with 1, 2 and 3 lag structures.

Integration among countries has become more intensive thanks to globalized economic structure and an economic shock in one country can easily spread to other countries. Therefore, Pesaran (2007) designed the Common Correlated Effects (CCE) estimator to provide accurate estimation for long term regression coefficients under cross section dependency (Eratas *et al.*, 2013). We take the stock markets as an independent variable due to causality direction from stock exchange to CDS spreads Table 6. Pesaran's (2007) CCE Mean Group Estimates reveals the results at Table 7 that denote a 0.03459 % decrease in CDS spreads when the stock market increases 1%. The main underlying reason is the decreasing possibility of CDS premiums which are affected by the positive impact of economic indicators and the favorable perception of increasing trend in stock exchange markets by reducing risk.

Table 7: CCE Estimation Results

Dependent Variable	Independent Variable	Coefficient	Standard Dev.	T_{stat}
CDS	Stock Market	-0.03459	0.019450	-1.77870

5. Conclusion and Discussion

In recent years, frequently CDS spreads have been accepted as a critical indicator to measure country risk by market investors. The relation between invested stock exchanges and CDS has attracted numerous academic studies. In this context, we have found that the stock exchanges of 7 out of 13 G20 countries – Russia, Italy, France, UK, Argentina, South Korea and Germany – have direct country-CDS spreads, with the usage of the Dumitrescu-Hurlin (2012) panel causality test. Besides, the Basher and Westerlund (2009) panel cointegration test confirms the co-integrated structure between variables and the CCE estimator verifies that variables affect each other negatively. The facts show that positive trends in stock exchanges enhance the confidence of investors and lead to lower CDS premiums. When CDS premiums are considered as indicators for financial crises, stock exchanges can be accepted as precursor indicator for financial crises.

In the literature, the studies of Fung *et al*. (2008) and Coronado *et al*. (2012) support our results that reveal causality from stock exchange to CDS spreads. Also, papers of Weber (2009), Demirkan (2011), Coronado *et al*. (2012) and Fenech *et al*. (2013) observed a negative cointegration relation between variables as our findings.

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Appendix 1: Descriptive Statistics for CDS

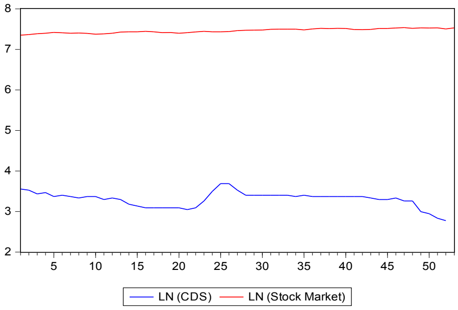
	USA	Germany	Argentina	UK	Brazil	France	S. Africa	S. Korea	Italy	Japan	Mexico	Russia	Turkey
Mean	27.63	26.28	2382	33.32	175.11	61.82	203.19	70.8	206.55	58.38	104.73	179.34	203.44
Median	29	25.00	2371	29.50	180.5	63	203	69	212.5	56	102.5	170.5	208
Maximum	40	35.00	3873	51	214.	81	267	114	286	87	158	270	276
Minimum	16	20.00	1649	23	105	48	148	54	113	39	76	131	117
Std. Dev.	4.90	4.05	580	8.80	26.5	10.05	23.98	10.98	49.69	11.09	18.21	31.07	40.35
Skewness	-0.04	0.69	0.50	0.59	-0.83	0.23	0.02	1.36	-0.18	0.54	0.7	1.07	-0.67
Kurtosis	3.56	2.63	2.38	1.88	3.36	1.72	3.15	6.02	1.66	2.62	3.09	4.12	2.94
Jarque-Bera	0.70	4.45	2.98	5.73	6.34	4.02	0.05	35.98	4.13	2.83	4.3	12.83	3.97
Probability	0.70	0.10	0.22	0.05	0.04	0.13	0.97	0.00	0.12	0.24	0.11	0.00	0.13

Appendix 2: Descriptive Statistics for Stock Market

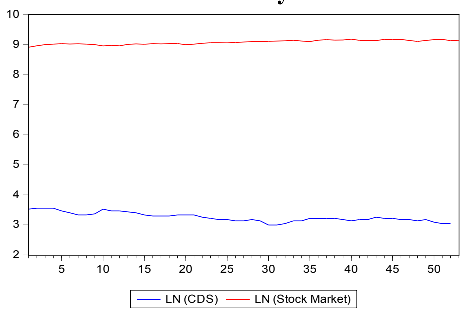
	USA	Germany	Argentina	UK	Brazil	France	S. Africa	S. Korea	Italy	Japan	Mexico	Russia	Turkey
Mean	1737	8809	4766	6577	50901	4127	43651	1954	18325	14494	40845	1347	73667
Median	1744	8865	5241	6583	51186	4165	44017	1957	18304	14462	40863	1348	74258
Maximum	1878	9742	6468	6838	56406	4484	48213	2052	22175	16178	42958	1516	90546
Minimum	1555	7459	2976	6116	44966	3651	37852	1822	15239	12686	37517	1062	61189
Std. Dev.	91.83	614	1095	148	3002	210	2842	53.45	1780	799	1127	96.33	7346
Skewness	-0.11	-0.17	-0.17	-0.81	-0.18	-0.51	-0.31	-0.44	0.16	0.04	-0.41	-0.76	0.50
Kurtosis	1.69	1.84	1.54	3.90	1.99	2.39	2.05	2.73	2.21	2.58	3.35	3.40	2.98
Jarque-Bera	3.85	3.20	4.92	7.69	2.52	3.13	2.87	1.89	1.60	0.40	1.80	5.57	2.27
Probability	0.14	0.20	0.08	0.02	0.28	0.20	0.23	0.38	0.44	0.81	0.40	0.06	0.32

Appendix 3: Graphics of Series (Logarithmic Forms)

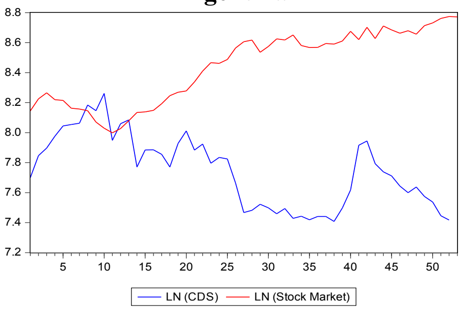
USA



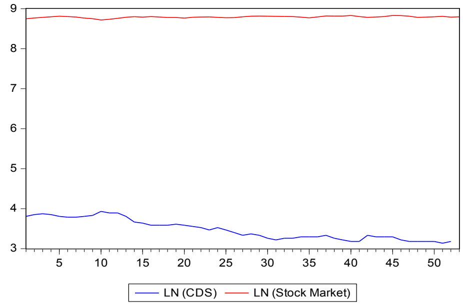
Germany



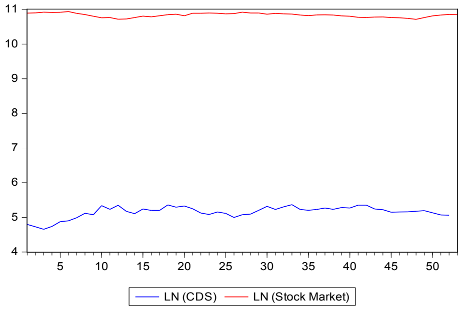
Argentina



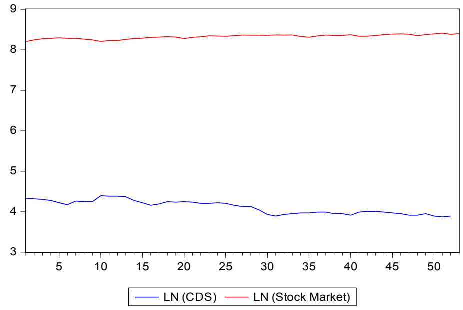
UK



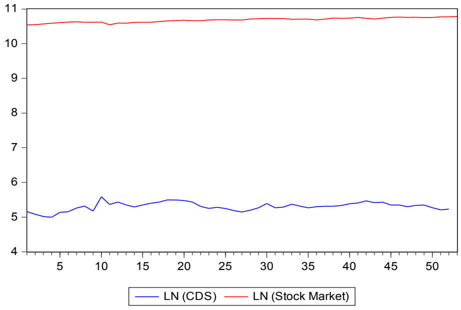
Brasil



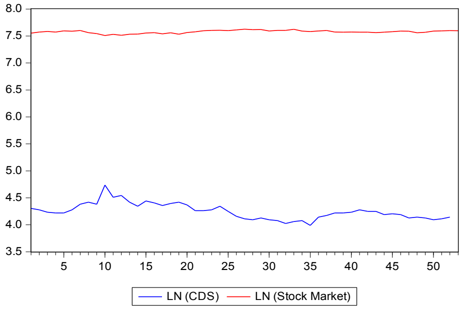
France



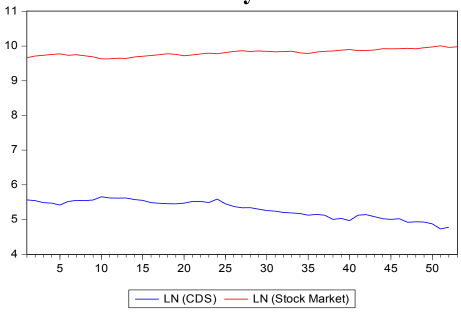
South Africa



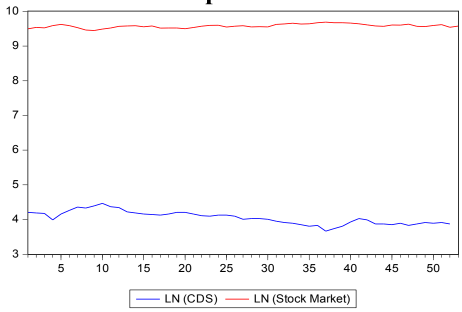
South Korea



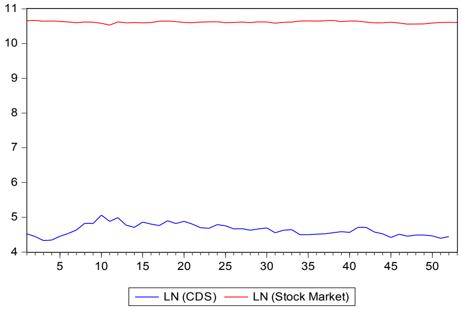
Italy



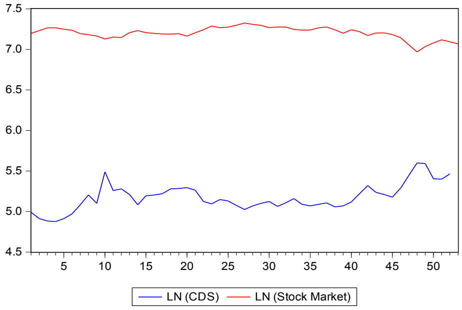
Japan



Mexico



Russia



Turkey