Effects of Sovereign Credit Ratings on the Eurozone Stock Markets During the Recent Financial Crises

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Abstract
Investors have increased their investments in sovereign government bonds together with the globalization of economies. The increasing share of government bonds in total debt instruments raised the importance of sovereign credit ratings. Sovereign credit ratings do not affect only government bonds but also have potential to affect ratings of domestic banks or companies, so they may affect financial markets positively or negatively. This study examines the effects of sovereign credit ratings of the Eurozone countries, interest rate decisions of European Central Bank and US dollar/euro exchange rate on the stock markets of Eurozone countries during the recent financial crises from January 2008 to December 2012. Pedroni's cointegration analysis is used to test whether there is long term relationship among variables in the model, DOLS and FMOLS methods are used to estimate final unbiased coefficients of this relationship and test consistency of estimators and then Holtz-Eakin causality test is used to determine the direction of causality among the variables. We find that there was a long term relationship between stock index and sovereign credit ratings, foreign exchange rate and interest rate variables and the direction of causality was unidirectional from sovereign credit ratings andi nterest rate tostockindexandbidirectionalbetweenforeign exchange rate and stock index. On the other hand in the short term changes in sovereign credit ratings and foreign exchange rate had positive effects on stock market index; interest rate had negative effects on stock index.

Keywords: Sovereign Credit Ratings, European Economic and Monetary Union, Stock Markets.

JEL Codes: E44, F30, F34, G15, N14.

1. Introduction

Institutional and individual investors increased their investments in sovereign government bonds after financial liberalization and share of sovereign government bonds in total bonds has thus increased to 40% (S&P, 2012: 2). In this context investors need a benchmark which provides information about the riskiness of government bonds.

Sovereign credit ratings give an opinion about the risk level of government bonds to investors. On the other hand global financial crisis and Eurozone sovereign debt crisis caused investors to investigate the reliability of sovereign credit ratings. Major credit rating agencies Standard & Poor's (S&P), Moody's and Fitch made no assessments about countries in debt crisis before the crisis, but made successive unmeasured downgrades after outbreak of sovereign debt crisis. So they aggravated the crisis and were seen as a part of crisis due to the belated rating action and successive unmeasured downgrades.

Changes, especially negative changes in sovereign credit ratings of countries have potential effects on financial markets. This study firstly examines the sovereign credit rating methodologies of major credit rating agencies S&P, Moody's and Fitch. Next, studies that investigated the effects of sovereign credit ratings on the domestic stock and exchange markets of countries have been discussed. Finally, effects of three factors namely rating changes in sovereign credit ratings given by S&P, Moody's and Fitch, European Central Bank's (ECB) interest rate decisions and dollar/euro exchange rate on the domestic stock markets of Eurozone countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Greece, Slovenia, Cyprus, Malta, Slovakia, and Estonia) have been investigated between the period January 2008 and December 2012 by using panel cointegration and panel causality tests.

2. Sovereign Credit Rating Methodologies

Sovereign risk is the risk that a government may default on its debt obligations. Sovereign risk is generally mixed up with country risk. But they are distinct concepts. Country risk is related to doing business in a particular country, while sovereign credit ratings are more narrowly focused on the risk of a sovereign government defaulting on its debt obligations (Fitch, 2012: 2). Sovereign credit ratings are the most common benchmarks used for the evaluating sovereign risk and so investors generally take sovereign credit ratings as a reference for their investment decisions. Economic globalization and liberalization of financial markets increased the demand for sovereign credit ratings dramatically in recent years. Although there have been about 150 credit rating agencies in the world (Basel Committee on Banking Supervision, 2000: 14.), the share of S&P, Moody's and Fitch in credit rating market is about 95% (Alessi and Wolverson, 2013).

Table 1: Long Term Sovereign Credit Ratings used by Fitch, S&P and Moody's

Fitch	S&P	Moody's	Investment/Speculative Grade
AAA	AAA	Aaa	Investment
AA+	AA+	Aa1	
AA	AA	Aa2	
AA-	AA-	Aa3	
A+	A+	A1	
A	A	A2	
A-	A-	A3	
BBB+	BBB+	Baa1	
BBB	BBB	Baa2	
BBB-	BBB-	Baa3	
BB+	BB+	Ba1	Speculative
BB	BB	Ba2	
BB-	BB-	Ba3	
B+	B+	B1	
B	B	B2	
B-	B-	B3	
CCC+	CCC+	Caa1	
CCC	CCC	Caa2	
CCC-	CCC-	Caa3	
CC	CC	Ca	
C	C	C	
RD/D	SD/D		

Source: Fitch, S&P and Moody's.

Moody's makes assessment of sovereign credit rating in three stages. Firstly it determines country economic resiliency by taking into the factors of economic strength and the institutional strength of the country. Then it determines government financial robustness by considering the factors of the financial strength of the government and the susceptibility to event risk. At the final stage it determines the rating by adjusting the degree of resiliency to the degree of financial robustness (Moody's, 2008: 2). On the other hand, Standard & Poor's firstly determines political score which reflects institutional effectiveness and political risks, economic score which reflects economic structure and growth prospects, external score which reflects external liquidity and international investment position, fiscal score which reflects fiscal performance, flexibility and debt burden and monetary score which reflects monetary flexibility and then it determines sovereign credit rating by combining there five scores (S&P, 2012: 3). Lastly, Fitch determines sovereign credit rating by considering the factors of macroeconomic performance and prospects, structural features, public finances and external finances (Fitch, 2012: 1).

Consequently, Moody's, Standard & Poor's and Fitch take into account similar factors in order to assess sovereign government bonds of countries, but their credit rating symbology differs. Long Term Sovereign Credit Ratings by Moody's, Standard & Poor's and Fitch are given in Table 1.

3. Literature Review

Changes in sovereign credit ratings and outlooks affect many financial instruments together with sovereign government bonds. Many studies have conducted to determine the effects of changes in sovereign credit ratings and outlooks on bonds, stock markets, currency markets, market risk and volatility, financial crises, bank funding, and also spillover effects of credit ratings in the literature. We will give methods and results of major studies in the literature aimed at determining the effects of changes in sovereign credit ratings on stock markets chronologically in this section.

Kaminsky and Schmukler (2002) examined whether changes in sovereign ratings and outlooks contribute to the instability of emerging financial markets for 16 emerging markets from January 1990 to June 2000 by using panel regression and performing event studies and they found that:

- Rating and outlook changes significantly affect bond and stock markets,
- Rating changes also contribute to contagion or spillover effects and
- Changes in credit ratings and outlooks have stronger effects on domestic as well as other countries financial markets during crisis times.

Brooks et al. (2004) examined the aggregate stock market impact of sovereign rating changes by using event study approach and cross-sectional regression. They found that rating downgrades had a negative wealth impact on market returns and a downgrade impacted negatively on both the domestic stock market and the dollar value of the country's currency and there was no evidence that emerging markets are particularly sensitive to rating changes or that markets react more severely to multiple rating changes.Martell (2005) examined the effects of changes in sovereign credit ratings at the aggregate level and firm level for 29 emerging countries from 1986 until 2003 by using event study methodology. He found that there was a significant negative stock price reaction to sovereign rating downgrades and no stock price reaction to sovereign rating upgrades and local stock markets react only to news of sovereign rating downgrades. On the other hand he found that sovereign credit rating changes affect larger firms more and firms in poorer emerging countries experience larger drops in the price of their shares.

Pukthuanthong-Le et al. (2007) examined the price impact of sovereign ratings on stock and bond markets for 34 countries from 1990 to 2000 by using a market model with a world stock index and U.S. Treasury bond returns as benchmarks for stock and bond markets, respectively. They found that stock and bond prices reacted only to downgrades, positive and negative rating reviews didn't seem to have an impact on a country's stock market, but exhibited anticipation and a price reaction in sovereign bond markets.

Hooper, Hume and Kim (2008) examined the effects of sovereign rating changes on international financial markets for 42 countries from 1995 to 2003 by using panel regression and they found that:

- Rating agencies provide financial markets with new tradable information,
- Rating upgrades (downgrades) significantly increased (decreased) USD denominated stock market returns and decreased (increased) volatility.

Li et al. (2008) examined the effects of changes in foreign currency sovereign credit ratings on domestic and cross-country stock market returns for 5 Asian countries from January 1990 to March 2003 by using panel regression and they found that changes in sovereign credit ratings affected stock returns in the Asian countries in their own and in other Asian countries and credit rating agencies didn't show strong evidence of pro-market-performance behavior during the 1997 Asian financial crisis, but rating changes in one country affected stock market returns of other crisis in crisis.

Wu and Treepongkaruna (2008) examined the effects of different types of sovereign rating announcements on realized stock and currency market volatility, skewness and correlations during financial crises for 5 countries (Australia, Hong Kong, Japan, Korea and Singapore) in the Asia-pacific region from 06 January 1997 to 31 August 2001 by using panel regression and they found that ratings events had significant and asymmetric impacts on higher moments of stock and currency market returns.

Klimavičienė (2011) examined the price impact of sovereign credit rating announcements on the stock markets of Estonia, Latvia, and Lithuania from January 2000 to June 2009 by using event study approach. He found that the price impact of downgrades was much higher than that of upgrades.

Cristopher, Kim and Wu (2012) examined the effects of sovereign credit ratings on time varying stock and bond market correlations for 19 emerging countries between January 1994 and January 2007 by using an error correction model and they found that:

- Stock and bond market co-movements within a region respond heterogeneously to sovereign ratings information.
- Sovereign ratings and outlooks tend to be positively related to regional stock market co-movements
- Sovereign rating and outlooks tend to be negatively related to regional bond market co-movements and
- The negative influence is concentrated in the countries that have higher foreign currency debt ratings than the regional average.

Michaelides et al. (2012) examined the effect of sovereign debt rating changes on daily stock market returns for 65 countries between February 1989 to August 2011 by using event-study methodology and they found that the stock market moved before the public announcement of a sovereign rating downgrade, weak reaction at the event and a mild correction after the event and the results are much weaker for upgrades.

Brooks et al. (2012) examined the effects of sovereign credit rating announcements on realized stock market return distributions during normal and financial crisis periods in order to determine whether sovereign credit ratings destabilize stock markets during financial crisis for 75 countries from January 1996 to May 2010 by using panel regression and they found that sovereign credit ratings did not destabilize stock markets during financial crises.

4. Data, Methodology and Empirical Results

4.1. Data

We examine changes in sovereign credit ratings of 17 Eurozone countries which consist of Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Greece, Slovenia, Cyprus, Malta, Slovakia, and Estonia from January 2008 to December 2012. The share of S&P, Moody's and Fitch in credit rating market is about 95%, therefore we get sovereign credit ratings from these three credit rating agencies. Although they use different scales, their long-term debt ratings are broadly comparable across rating agencies. The similarity in rating scales allows a simple linear transformation of the ratings on a scale of 1–21 for Fitch, S&P and Moody's. If there is an upgrade or a downgrade by one notch, then the rating is changed by +1 or −1. If there is an outlook change from positive to stable or from stable to negative, then the rating is changed by −1/3. If an outlook changes from positive to negative, the rating is changed by −2/3. We get the data of exchange rates and interest rate from the European Central Bank's (ECB) Database and data of daily stock market index from Bloomberg and Matriks.

Fitch, Moody's and S&P made a total of 201 changes in long term foreign currency debt ratings/ outlooks of Eurozone member countries. Changes in long term foreign currency debt ratings consist of 10 rating upgrades, 116 rating downgrades, 17 positive variations and 58 negative variations outlook.

Rating downgrades andnegative variations in outlooks constitute about 86,57% of changes in sovereign credit ratings of Eurozone countries because selected study period mostly cover crisis times.

Table 2: Number of Upgrades and Downgrades by Credit Rating Agency

Agency	Total Changes	Ratings		Outlooks	
		Upgrades	Downgrades	Upgrades	Downgrades
Fitch					
Long term foreign currency rating	54	4	33	4	13
Moody's					
Long term foreign currency rating	68	0	40	5	23
Standard&Poor's					
Long term foreign currency rating	79	6	43	8	22
Total (Foreign currency rating)	**201**	**10**	**116**	**17**	**58**

Table 3: Number of Upgrades and Downgrades by Country

Country	Total Changes	Ratings		Outlooks	
		Upgrades	Downgrades	Upgrades	Downgrades
Austria	3	0	1	0	2
Belgium	7	0	3	0	4
Cyprus	23	1	18	0	4
Estonia	15	4	3	5	3
Finland	1	0	0	0	1
France	5	0	2	0	3
Germany	1	0	0	0	1
Greece	36	3	23	3	7
Ireland	26	0	15	4	7
Italy	10	0	7	0	3
Luxembourg	2	0	0	0	2
Malta	5	0	3	0	2
Netherlands	2	0	0	0	2
Portugal	19	0	14	1	4
Slovakia	12	2	2	3	5
Slovenia	16	0	10	1	5
Spain	18	0	15	0	3

Definitions and symbols of the variables used in econometric analysis are presented in Table 4.

Table 4: Definitions of Variables

Symbols of Variables	Variables
SE	Stock-Exchange
FFCR	Fitch-Foreign Currency Rating
MFCR	Moody's-Foreign Currency Rating
SPFCR	Standart&Poor's-Foreign Currency Rating
ER	Euro/ECU Exchange Rates
IR	Interest Rate of ECB

Pedroni, Kao and Johansen Fisher cointegration tests were used to determine the long term relationship among variables and then Holtz-Eakin causality test was applied for the analysis of existence and direction of causality. Eviews 7.1, Stata 11.0 and Rats 8.1 statistical packages were used in the analyses.

4.2. Methodology

Three types of data time series, cross-sectional data and pooled-panel data which is a combination of time series and cross-sectional data are used in econometric analyses (Gujarati, 2004: 25).

Panel data is the pooling of observations on a cross-section of economic units such as households, countries,firms, etc. over several time periods. Values belonging to any year form cross-sectional dimension of panel, values of variable over time form time dimension of panel (Baltagi, 2005: 11). Panel data analysis is able to analyze multiple behavioral relations better than cross section method does (Saygılı et al., 2006: 98).

Cointegration analysis examines the relationship of long term equilibrium among series. The most common method used in cointegration analysis of panel data series is method developed by Pedroni. This method is a test which allows heterogeneity in cointegration vector. It also allows cointegrated vector to be different among cross sections under alternative hypothesis as well as it allows dynamic and fixed effects to be different among cross sections of panel. Pedroni created seven tests in order to test cointegration. Rejecting null hypothesis in case of absence of cointegration means that panel data are cointegrated (Güvenek and Alptekin, 2010: 180–181).

The stationarity of residual e_{it} shows whether there is a long term cointegration relationship between y and x variables.

$$y_{it} = \alpha_i + \delta_i t + \beta_{1i} X_{2it} + \beta_{2i} X_{2it} + \ldots + \beta_{Mi} X_{Mit} + e_{it}$$

If the series are cointegrated, generalized Granger causality should be calculated for the casuality relationship among data in short and long term. Generalized Granger causality is formed by adding error correction models to standard Granger casuality model. Generalized Granger causality model is as follows:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{L} \beta_1 \Delta y_{t-i} + \sum_{j=1}^{I} \beta_2 \Delta x_{t-j} + \beta_3 \lambda_{t-1} + \varepsilon_t$$

$$\Delta x_t = \gamma_0 + \sum_{i=1}^{M} \gamma_1 \Delta y_{t-i} + \sum_{j=1}^{N} \gamma_2 \Delta x_{t-j} + \gamma_3 \delta_{t-1} + \omega_t$$

I, L, M, N represents optimal lag length, $\varepsilon_t$and ω_t represents error terms which don't have serial correlations, λ and δ represents first lagged values of error terms which is derived from long term cointegration relationship and shows the dimension of past nonequilibrium. It is possible to reach short and long term causalities between x and y variables. While β_1, β_2, γ_1 and γ_2 coefficients show short term causality relationship among variables in the model, β_3, y_3 coefficients show long term causality relationship. β_3 and γ_3 coefficient should be negative for stability of model (Şimşek and Kadılar, 2010: 133).

4.3. Empirical Results

4.3.1. Stationarity Tests

The panel data analysis which conducts both time and cross sectional analyses requires that variables should be stationary in order to show the real relationships among the variables.

Table 5:Panel Unit Root Test Results.

Variables	Levin, Lin & Chu Test Results		Im, Pesaran& Shin Test Results		ADF-Fisher Chi-square	
	Level	First Difference	Level	First Difference	Level	First Difference
	Trend and Constant	Constant	Trend and Constant	Constant	Trend and Constant	Constant
FFCR	0.0742	0.0001*	0.0625	0.0211*	0.0823	0.0001*
MFCR	0.0707	0.0000*	0.0922	0.0022*	0.1103	0.0000*
SPFCR	0.6554	0.0000*	0.6402	0.0000*	0.0976	0.0000*
ER	0.1202	0.0038*	0.2103	0.0030*	0.1289	0.0000*
IR	0.3114	0.0014*	0.0933	0.0000*	0.1366	0.0139*
SE	0.2704	0.0000*	0.1031	0.0023*	0.1590	0.0000*

Series were seasonally adjusted for the stationarity analyses of variables, periods of crisis and policy changes were taken into account in according to their statistical significances and trend and fixed components were included in the model as long as they are significant in model selection.
* Significant at the 0.05 and 0.01 level, lags for ADF Test are selected automatically by based on Schwarz information criterion, Bandwith for Phillips-Perron Test are selected automatically by based on Newey-West Bandwith.
Cusum path lies within the confidence interval bounds at %5, It is not observed structural breakpoint.

This study investigates common unit root processes with panel unit root tests according to Levin, Lin and Chu (2002) and the unit root process for each unit (firm) individually in parallel with Im, Pesaran and Shin (2003). The stationarity in individual invariant series is analyzed through the Augmented Dickey Fuller (ADF) (1979) test. The results of the stationarity analyses of the data used in the panel regression are given in Table 5.

Unit root test results which were applied to levels of variables show that series are not stationary at level [I(0)]. It was seen that series included unit root problem. Therefore it was taken first differencing of series and then it was seen that the series are stationary [I(1)]. So we will use first differenced series in our analyses (Table 5).

4.3.2. Panel Cointegration Test Results and Evaluation of the Results

Three different types of cointegration analysis method called as Pedroni, Kao and Johansen Fishercointegration analysis were used to determine whether there is an interaction among the variables in long term. Pedroni proposed a few tests which allowed heterogeneity in the cointegration analyses in 1999, 2000 and 2004. This test allows heterogeneity in cointegration vector. This test doesn't allow only dynamic and fixed effects to be different among cross sections of panel, but also allows cointegrated vector to be different among cross sections under alternative hypothesis. Pedroni's approach becomes different from McCoskey's and Kao's approaches in terms of assumption of cross sectional trend and null hypotheses which have nonexistence of cointegration. Allowing multiple regressors, varying of cointegration vector in different parts of panel and allowing heterogeneity of errors through cross sectional units constitute good sides of Pedroni's tests. Seven cointegration tests were presented to cover "within" and "between" effects in the panel and these tests were separated as two different categories. The first category includes 4 tests which are pooled at "within" dimension, The second category includes the remaining 3 tests at "between" dimension. The first three of four tests in the first category are non-parametric tests. The first test is a statistic that is a kind of variance ratio. The second is similar to Phillips-Peron (PP) (rho) statistic and the third is similar to PP (t) statistic. The fourth statistic is a parametric statistic which is similar to Augmented Dickey Fuller (ADF) (t) statistic. The first one of three test in the second category is similar to PP (rho) statistic, the other two tests are similar to PP (t) and ADF (t) statistics.

Different criteria were evaluated to determine appropriate lag length before the panel cointegration analysis and the results were presented in Table 6.

Table 6: Lag Length Criteria

VAR Lag Order Selection Criteria						
Endogenous variables: FFFCR FMFCR FSPFCR FER FIR						
Exogenous variables: C						
Sample: [2008M01-2012M12]						
Included observations: 952						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-2159.119	NA	2.24e+17	56.97682	57.16082	57.05035
1	-2008.803	272.9417	1.11e+16	53.96851	55.25654	54.48327
2	-1934.361	123.4179	4.10e+15	**52.95686***	**55.34893***	**53.91285***
3	-1899.254	52.65986	4.39e+15	52.98037	56.47647	54.37758
4	-1841.959	**76.89618***	**2.74e+15***	52.41997	57.02010	54.25841

* indicates lag order selected by the criterion.
LR: Sequential Modified LR test Statistic (each test at 5% level)
FPE: Final Prediction Error
AIC: Akaike Information Criterion
SC: Schwarz Information Criterion
HQ: Hannan-Quinn Information Criterion

It was seen that different lag lengths were obtained when criteria were examined. Since error correction model forthe AIC, HQ and SC criteria were found conformable in diagnostic tests and also most of the studies in the literature have based on these criteria, analyses were conducted for 2 lags.

Table 7: Cointegration Test Results

Pedroni Panel Cointegration Test Result				
(Within-Dimension)				
	t-Statistic	**Prob.**	**Weighted t-Statistic**	**Prob.**
Panel v-Statistic	3.33201	0.0298*	3.92311	0.0023*
Panel rho-Statistic	-2.80976	0.0154*	-1.66547	0.0016*
Panel PP-Statistic	-2.00254	0.0000*	-2.664002	0.0000*
Panel ADF-Statistic	-3.98773	0.0000*	-2.604338	0.0000*
(Between-Dimension)				
	t Statistic		**Prob.**	
Group rho-Statistic	-0.00853		0.1321	
Group PP-Statistic	-2.83431		0.0000*	
Group ADF-Statistic	-0.24856		0.0973	
Kao Panel Cointegration Test Result				
	t- Statistic			**Prob.**
ADF	-2.63454			0.0209*
Residualvariance	30542.43			
HAC variance	56091.09			
Johansen Fisher Panel Cointegration Test Result				
Hypothesized No. Of CE(s)	**Fisher Stat. (from trace test)**	**Prob.**	**Fisher Stat. (from max-eigen test)**	**Prob.**
None	239.5	0.0000	164.9	0.0000*
At most 1	88.18	0.0000	52.06	0.0001*

* Significant at the 0.01 and 0.05 level

We found that there was cointegration in other words a long term relationship among variables as a result of all applied tests except group rho and group ADF test. It was seen that there was a long term relationship and co-movement among variables with regard to most of test results except two tests. FMOLS (Full Modified Ordinary Least Square) and DOLS (Dynamic Ordinary Least Square) were applied to determine coefficients of long term relationships in other words degrees and direction of relationship after finding the existence of relationship.

4.3.3. Cointegration Coefficient Results with FMOLS and DOLS

DOLS and FMOLS methods developed by Pedroni (2000) were used to estimate final unbiased coefficients of this relationship and test consistency of estimators with expectations after cointegration tests were applied. FMOLS method corrects the biases of estimators with standard fixed effects which arise from problems such as autocorrelation, heteroscedasticity etc. On the other hand DOLS is a method which can correct biases of static regression which arise from endogeneity problems by including dynamic considerations to the model. FMOLS method, which allows considerable heterogeneity among individual cross sections, considers possible correlation between the differences of constant term, error term and independent variables.

Panel FMOLS analysis results present effects of independent variables both for every country in the analysis and overall panel. The main finding of this analysis is that a 1% increase in independent variables led a 0.52% increase in stock index (Table 8).The study proposes that long term cointegration coefficients for each country in the analysis are positive and statistically significant. This is general and overall effect of independent variables. Germany, France, Netherlands, Belgium and Spain are the first five countries which have been affected considerably. In other words these countries are those whose stock markets have been affected considerably by the changes in independent variables and changes in sovereign credit ratings, interest and foreign exchange rate increased stock markets of these countries. When we conducted our analysis only with sovereign credit ratings by excluding foreign exchange rate and interest rate variables, figures are changing but orders of affected countries by size of effect are not changing. We find that Germany, France, Netherlands, Belgium and Spain are the first five countries affected mostly, on the other hand Slovenia Greece, Slovakia, Ireland and Luxembourg are the countries affected at the least.

Table 8: FMOLS Estimation Results

Countries	Coefficient	t-Statistic
Austria (ATX)	0.56	22.45*
Belgium (BEL 20)	0.61	31.09*
Cyprus (FTSE 20)	0.52	34.87*
Estonia (TSE General)	0 40	12.42*
Finland (CAC 40)	0.39	18.46*
France (CAC 40)	0.65	23.04*
Germany (DAX)	0.68	15.87*
Greece (ATG)	0.24	16.03*
Ireland (ISEQ Overall)	0.34	32.66*
Italy (FTSE-MIB)	0.45	28.51*
Luxembourg (LuxX)	0.38	30.68*
Malta (MSE)	0.50	25.21*
Netherlands (AEX)	0.62	14.05*
Portugal (PSI 20)	0.51	22.88*
Slovakia (SAX)	0.29	13.22*
Slovenia (SBI TOP)	0.22	12.90*
Spain (IBEX 35)	0.57	28.73*
Overall Panel	**0.52**	**41.77***

* Significant at the 0.01 and 0.05 level

The effects of changes in sovereign credit ratings on stock markets of Eurozone countries varied. Because analysis was conducted during debt crisis period and effects of sovereign debt crisis on Eurozone countries differ. The effects of changes in sovereign credit ratings on stock markets of countries such as Greece, Ireland in crisis remained limited. But the effects of changes in sovereign credit ratings on stock markets of developed Eurozone countries such as Germany, France and Netherland are much stronger than the countries in crisis are.

Table 9: Panel DOLS Results

Countries	Coefficient	t-Statistic
Austria (ATX)	0.31	12.09*
Belgium (BEL 20)	0.59	9.43*
Cyprus (FTSE 20)	0.28	11.05*
Estonia (TSE General)	0.30	13.67*
Finland (CAC 40)	0.63	8.22*
France (CAC 40)	0.71	9.82*
Germany (DAX)	0.68	12.70*
Greece (ATG)	0.22	11.99*
Ireland (ISEQ Overall)	0.45	20.03*
Italy (FTSE-MIB)	0.39	16.41*
Luxembourg (LuxX)	0.57	13.66*
Malta (MSE)	0.52	9.92*
Netherlands (AEX)	0.65	14.50*
Portugal (PSI 20)	0.69	17.06*
Slovakia (SAX)	0.25	10.55*
Slovenia (SBI TOP)	0.20	9.63*
Spain (IBEX 35)	0.59	12.88*
Overall Panel	**0.48**	**21.09***

* Significant at the 0.01 and 0.05 level

Panel DOLS test demonstrate that increase in independent variables in the long term affects stock index positively in panel and 1% increase in independent variables led a 0.48% increase in stock index in panel.

We find that long term cointegration coefficients are positive and statistically significant for each country. This is general and overall effect of independent variables. Overall panel value of panel DOLS test results and overall value of Panel FMOLS test results and order of stock markets of Eurozone countries which were affected from changes in independent variables by size were found close to each other. Panel DOLS test results demonstrated that stock markets of France, Portugal, Germany, Netherlands, Finland, Belgium and Spain are the countries affected mostly by changes in independent variables. In other words, these countries are those whose stock markets were affected considerably by the changes in independent variables and changes in sovereign credit ratings, interest and foreign exchange rate increased stock markets of these countries. When the analysis is conducted only sovereign credit ratings figures excluding foreign exchange rate and interest rate variables, change but orders of affected countries by size of effect do not change. The findings demonstrate that France, Portugal, Germany, Netherlands, Finland, Belgium and Spain are the top countries affected mostly, on the other hand Slovenia, Greece, Slovakia, Cyprus and Estonia are the countries affected at the least. The existence of long term relationship shows that there is at least one-sided causality. So we will conduct causal hypothesis after examining long term relationships among variables.

4.3.4. Evaluation of Panel Causality Test Results

Pedroni's heterogenous panel cointegration test shows whether there is long term relationship among variables, but gives no information about direction of causality. Causality is tested traditionally by using two stages Engle-Granger causality procedure. But the study did not use traditional causality procedure because of problems in parameter estimation which arise from measurement errors and problem of variables not included in the model. So Holtz-Eakin(1988) causality test was used in the study.

Table 10: Holtz-EakinCasuality Test Results

Causality	**Wald χ^2**	**Causality**	**Wald χ^2**	**Causality**	**Wald χ^2**
SE→FFCR	45.309(0.09)	**SE→FFCR$_{t-1}$**	56.62(0.12)	**SE→FFCR$_{t-2}$**	54.23(0.19)
FFCR→SE	12.64(0.00)	**FFCR$_{t-1}$→SE**	15.82(0.03)	**FFCR$_{t-2}$→SE**	19.02(0.02)
SE→MFCR	56.80 (0.12)	**SE→MFCR$_{t-1}$**	48.09(0.15)	**SE→MFCR$_{t-2}$**	48.52(0.23)
MFCR→SE	17.33(0.01)	**MFCR$_{t-1}$→SE**	13.21(0.02)	**MFCR$_{t-2}$→SE**	26.33(0.00)
SE→SPFCR	36.72(0.13)	**SE→SPFCR$_{t-1}$**	42.04(0.23)	**SE→SPFCR$_{t-2}$**	41.74(0.11)
SPFCR→SE	19.02(0.00)	**SPFCR$_{t-1}$→SE**	20.04(0.00)	**SPFCR$_{t-2}$→SE**	14.08(0.01)
SE→ER	14.56(0.00)	**SE→ER$_{t-1}$**	17.92(0.00)	**SE→ER$_{t-2}$**	18.22(0.01)
ER→SE	18.09(0.00)	**ER$_{t-1}$→SE**	20.31(0.01)	**ER$_{t-2}$→SE**	22.91(0.02)
SE→IR	34.78(0.09)	**SE→IR$_{t-1}$**	44.59(0.16)	**SE→IR$_{t-2}$**	42.85(0.13)
IR→SE	10.87(0.00)	**IR$_{t-1}$→SE**	13.67(0.02)	**IR$_{t-2}$→SE**	14.61(0.00)
Arellano-Bond AR(1) Statistic	-3.335(0.16)	-5.667(0.00)		-4.306(0.01)	
Arellano-Bond AR(2) Statistic	0.997 (0.12)	-1.022(0.23)		-1.231(0.18)	
Sargan Statistics	17.45 (0.14)	12.82(0.12)		24.44(0.20)	
Wald Causality Test Null Hypothesis	There is no causality from independent variables to stock indexes. 23.556(0.02)	There is no causality from one period lag values of independent variables to stock indexes. 18.974(0.00)		There is no causality from two period lag values of independent variables to stock indexes. 21.450(0.00)	

The consistency of system GMM estimation should be checked before evaluating results of panel causality analysis. In this context, three basic tests have been applied in the study. These are Wald test which shows that whether all variables in the model are as a whole significant or not, Arellano-Bond (AB) test which estimates whether there is autocorrelation problem in the model or not and Sargan test which shows whether instrumental variables are valid or not. Wald χ^2 test showed that each model is significant as a whole. Sargan test was applied for the analysis of the validity of instrumental variables used in system GMM estimation in other words whether there are over-identifying restrictions in panel estimation.

Validity of instrumental variables was tested with null hypothesis which shows the relationship between instrumental variables and error terms. The study puts forward that instrumental variables were valid. AR(1) test developed by Arellano and Bond (1991) tests null hypothesis which says that there is no first-order autocorrelation, AR(2) tests null hypothesis which says that there is no second-order autocorrelation.

AB test shows that there is no autocorrelation problem in AR (2) process. Causality tests showed that there was a unidirectional causality from sovereign credit rating and interest rate variables to stock index variable and bidirectional causality between foreign exchange rate and stock index.Consequently, there was a long term relationship between stock index and sovereign credit ratings, foreign exchange rate and interest rate variables and the direction of causality was unidirectional from sovereign credit rating and interest rate to stock index and bidirectional between foreign exchange rate and stock index. The study also found that changes in sovereign credit ratings and foreign exchange rate had positive effects on stock index and only interest rate had negative effects on stock index in the short term as a result of GMM estimation coefficients. In this context upgrades in sovereign credit ratings and increases in foreign exchange rate will increase the stock market, but the increase in interest rate will decrease the stock index in the short term.

5. Conclusion

Globalization of financial markets allows companies and countries to borrow from financial markets especially after 1980s. This increased the importance of sovereign credit ratings assigned to countries which is also a ceiling for ratings of their domestic companies. So changes in sovereign credit ratings and outlooks have potential effects on stock markets as well as currency markets, bank funding etc. In this study the effects of changes in sovereign credit ratings of Eurozone member countries together with interest rate decisions European Central Bank and US dollar/euro exchange rate on stock markets of Eurozone countries during Eurozone sovereign debt crisis from January 2008 to December 2012 have been examined.

The study found that there was a long term relationship between stock index and sovereign credit ratings, foreign exchange rate and interest rate variables and there was a unidirectional causality from sovereign credit rating and interest rate variables to stock index variable and bidirectional causality between foreign exchange rate and stock index. On the other hand, in the short term increases in sovereign credit ratings and foreign exchange rate had positive effects on stock index and, increases in interest rate had negative effects on stock index. Studies aimed at determining effects of changes in sovereign credit ratings on stock markets reached mixed results. Some studies such as Brooks et al. (2004), Martell (2005), Pukthuanthong-Le et al. (2007) found that while rating downgrades affect stock markets negatively, rating upgrades don't have significant effects on stock markets. On the other hand some studies such as Hooper, Hume and Kim (2008) found that rating upgrades also affect stock markets positively.

Similarly studies aimed at determining relationship between interest rate, exchange rate and stock market index have reached different findings. According to the traditional economic theory, higher interest rates lead lower investment and consumption expenditures, so profitability of firms will decrease and people invest their money in fixed income securities instead of stocks. So our finding on negative relationship between interest rate and stock index in the short term is meaningful in terms of economic theory. On the other hand while some studies such as Ajayi and Mougoue (1996), Dimitrova (2005), Liu and Shrestha (2008) found a negative relationship between exchange rate and stock market, some studies such as Aggarwal (1981), Giovannini and Jorion (1987) and Roll (1992) found a significant positive relationship between two variables. On the other hand some studies such as Bahmani-Oskooee and Sohrabian (1992) found no significant relationship between these variables.

Consequently changes in sovereign credit ratings don't affect only government sector, but also financial sector through stock markets depending on rating upgrades or downgrades. So credit rating agencies have become important players in globalized world and the accurateness of credit ratings is very important for the efficiently functioning of global financial markets. The accurateness of the information provided by rated governments, companies is also very important for the right credit rating, because credit rating a bilateral process. On the other hand there is no global regulation for the credit rating agencies, although their rating agencies are globally effective. In this context a global regulation which controls both credit rating agencies and rated countries, companies.

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