Sovereign Debt Markets in Euro-zone: Implications for Capital Markets Integration

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Abstract

This paper examines the impact of the financial crisis of 2007-2008 on the Euro-zone markets integration by analyzing their sovereign debt markets convergence/ divergence to see if the Euro-zone stock markets are moving towards integration. As economic integration of Euro-zone proceeds under the banner of the Single Market Europe, it is vital to observe the degree of economic harmonization that exist in these member countries at different economic cycles. Thus, the purpose of this research is to explore the yield spreads on government debt across the Euro-zone nations at different time periods to observe if the spreads display any divergent trend over time.
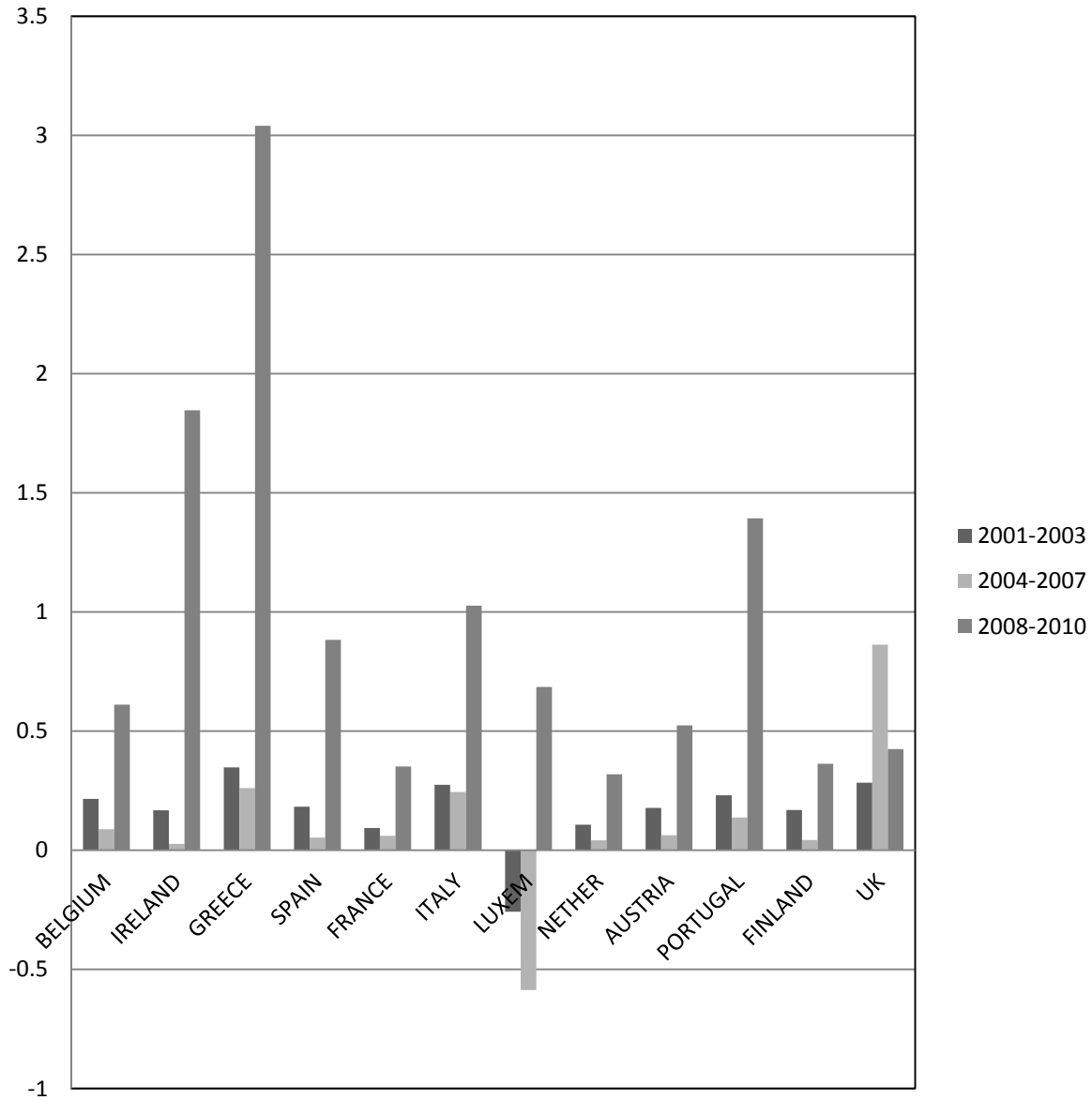
Analysis suggests that, time period 2008-2010 is a significant predictor for the government debt volatility of these countries financial stability and thus their economy's strength. This indicates that the country's yield spread and thus government debt is time dependent. Therefore, a country's financial stability and thus their economic status (or level) would depend on the economic cycle. However, results also indicate that financial crisis has impacted some of the countries more than the others. Thus, exhibiting differences in economic stability (or strength) among the countries and therefore, this has important implications for the economic policy makers in the Euro-zone countries.

I. Introduction and Background

It is widely accepted that European market integration is dependent on the successful common monetary policy as well as the fiscal discipline exercised by the member nations. The common monetary policy administered by the European Central Bank is expected to harmonize the short-term interest rates in the Euro-zone. However, fiscal policies of member nations administered by individual governments have not been in harmony. Growth and Stability Pact placed limits on debt loads and budget deficits as percent of GDP. Violation of these fiscal norms occurred even before the financial crisis of 2007-2008. Fiscal divergences only grew bigger and much more widespread among the Euro-zone members after the financial crisis. The present study seeks to analyze the economic convergence/ divergence of Euro-zone countries in order to discover whether or not the Euro-zone will stabilize from the fiscal point of view. In order to gain an understanding of Euro-zone's fiscal conditions, it is important for us take a short walk along the memory lane.

Maastricht treaty was expected to foster fiscal and economic convergence among the Euro-zone countries. With this expectation Euro-zone's sovereign debt markets showed remarkable convergence of interest rates (risk-free rates) at the outset. The stock markets also showed an early but feeble trend towards integration (Naidu and Choudhury, 2008 & 2010). The financial crisis of 2008 struck a devastating blow to the fiscal health of several Euro-zone countries (see Graph-1). Their sovereign debt markets began to diverge. German bond yields stayed low and steady. However, the bond yields in other Euro-zone countries began to rise.

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Graph-1: Graph of average yield spread by countries
(2001-2003, 2004-2007, 2008-2010)

The purpose of this research is to explore the yield spreads on government debt across all the Euro-zone nations over time period 2001 to 2010 to observe if the spreads display widening divergent trends. The main questions we aim at answering are: Which are the countries that contributed in the divergence of yield spreads? What is the magnitude of observed variability of yield spread before and after financial crisis? This paper aims to provide evidence on the significance of sovereign debt markets convergence as a necessary condition for Euro-zone capital market integration.

TABLE-1: Summary statistics of yield spreads in the Euro-zone (2001-2003)

Variable	N	Mean	Std Dev	Minimum	Maximum
BELGIUM	36	0.2158333	0.0992652	0.0800000	0.4100000
IRELAND	36	0.1677778	0.0832933	0.0200000	0.2800000
GREECE	36	0.3475000	0.1369958	0.1500000	0.6100000
SPAIN	36	0.1830556	0.1136616	0.0400000	0.3700000
FRANCE	36	0.0927778	0.0395410	0.0300000	0.1700000
ITALY	36	0.2741667	0.0946686	0.1400000	0.4600000
LUXEM	36	-0.2577778	0.4227536	-1.1200000	0.3000000
NETHER	36	0.1069444	0.0513152	0.0100000	0.1900000
AUSTRIA	36	0.1777778	0.0941158	0.0100000	0.3400000
PORTUGAL	36	0.2308333	0.1117746	0.0300000	0.4400000
FINLAND	36	0.1691667	0.0826136	0.0300000	0.2700000
UK	36	0.2838889	0.1946466	0.0700000	0.7500000

II. Data and Research Methodologies

For this study, we collected yields on 10-year government bonds from European Central Bank's data source. Yield spreads are calculated using German Bund yield as the benchmark reference rate. The data was divided into three time periods (2001-2003, 2004-2007, and 2008-2010) for each country in order to facilitate the comparisons. These time periods can be thought of as different stage of economic integration, such as, initial stage (2001-2003), intermediate stage (2004-2007), and tertiary stage (2008-2010).

TABLE-2: Summary statistics of yield spreads in the Euro-zone (2004-2007)

Variable	N	Mean	Std Dev	Minimum	Maximum
BELGIUM	48	0.0887500	0.0455522	0.0300000	0.2000000
IRELAND	48	0.0268750	0.0577285	-0.0500000	0.2400000
GREECE	48	0.2604167	0.0521029	0.1300000	0.3500000
SPAIN	48	0.0535417	0.0365239	0	0.1600000
FRANCE	48	0.0600000	0.0307357	0.0200000	0.1400000
ITALY	48	0.2447917	0.0535541	0.1400000	0.3600000
LUXEM	48	-0.5866667	0.5953698	-1.3300000	0.4700000
NETHER	48	0.0418750	0.0376239	-0.0200000	0.1300000
AUSTRIA	48	0.0633333	0.0393205	0	0.1400000
PORTUGAL	48	0.1379167	0.0670649	0	0.2800000
FINLAND	48	0.0422917	0.0566903	-0.0500000	0.1700000
UK	48	0.8622917	0.2068738	0.4800000	1.1900000

We hypothesize that the yield spread should be more or less similar for all Euro-zone countries and converge over time for them to have economic harmonization. Tables1-3 presents summary statistics of yield spread for Euro-zone countries at three different time periods. We observe (see, Tables 1-3) that the average yield spread is lower for the periods 2001-2003 and 2004-2007 compared to the period 2008-2010. Standard deviations of yield spread also follow the similar pattern; indicating that the yield spread is more erratic lately, specifically after the

financial crisis and thus the economic harmonization of these countries are in jeopardy. Greece is being in the worst place with an average yield spread of 3.0394 and standard deviation of yield spread of 2.8065 immediately followed by Ireland and Portugal with average yield spread of 1.8466 and 1.3922, and standard deviation of yield spread 1.3571 and 1.1454 respectively. Therefore, we analyze the distribution of yield spread for all countries to observe any deviations from the central location and also the volatility of yield spread. Graph 1 also depicts the same information of average yield spread for three different time periods. Regression analysis is employed as a statistical methodology to test the hypothesis of equality of average yield spreads for three different time periods to identify the degree of differences between the time periods. Thus, indentifying the time period at which the economic divergence of the union is exceedingly significant. Subsequent regression models included different sets of countries to identify the country effect on the yield spreads.

TABLE-3: Summary statistics of yield spreads in the Euro-zone (2008-2010)

Variable	N	Mean	Std Dev	Minimum	Maximum
BELGIUM	36	0.6105556	0.2451232	0.2200000	1.1100000
IRELAND	36	1.8466667	1.3570830	0.2200000	5.6900000
GREECE	36	3.0394444	2.8065087	0.3700000	9.1000000
SPAIN	36	0.8822222	0.6058011	0.1500000	2.4700000
FRANCE	36	0.3508333	0.1215701	0.1200000	0.6300000
ITALY	36	1.0269444	0.3888284	0.3700000	1.6900000
LUXEM	36	0.6847222	0.3179711	0.3000000	1.4100000
NETHER	36	0.3183333	0.1616964	0.1000000	0.6900000
AUSTRIA	36	0.5236111	0.2360527	0.1900000	1.1400000
PORTUGAL	36	1.3922222	1.1453611	0.2800000	4.3800000
FINLAND	36	0.3630556	0.1856697	0.1100000	0.8000000
UK	36	0.4247222	0.2644616	-0.0200000	0.9000000

A multiple regression analysis was applied to assess the significance and magnitude of time-period effect on yield spread of these Euro-zone countries to observe the effect of financial crisis. In the multiple regression model for this study, independent variables were primarily indicators of three time periods to observe the convergence/divergence of the economic integration over time. In addition to the primary independent variable, time-periods; the analysis also included country indicator variables to control for country differences on the yield spread. However, subsequent regression analysis were employed that are only country specific for the last three years of time period due to the significance of this specific time period

Thus, a multiple regression model was run using SAS software (see, SAS/STAT User's Guide, 1993) on two different types of factors; namely time-periods and countries. Time-period is to measure the effect of one of the three time periods on the yield spread for these countries. This factor is designed as indicator variables ("1" or "0") to test the hypothesis of yield spread widening in recent years (time-period) as a measure for economic performance in attaining the economic harmony of the union. The specification of the regression model takes the following form:

$$Yield\_Spread = \beta_{1,1}Period_1 + \beta_{1,2}Period_2 + \beta_{1,3}Period_3 +$$

$$\beta_{2,1}Country_1 + ... + \beta_{2,11}Country_{11} + \varepsilon \quad .... \quad (2)$$

Where:

Yield_Spread: Difference between German Bund yield and a country bond yield.
   Period: Time-periods: 2001-2003, 2004-2007, 2008-2010 (indicator variable: 1 or 0),
   Country: A specific country=1, else=0.

TABLE 4: Regression results of three different periods on yield spread.

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	412.83998	137.61333	257.98	<.0001
Error	1437	766.53232	0.53343		
Corrected Total	1440	1179.37230			
R-Square	0.3501		Adj R-Sq	0.3487	

Parameter Estimates					
Variable	DF	Parameter Estimates	Standard Error	t Value	Pr > |t|
PERIOD1	1	0.16600	0.03514	4.72	<.0001
PERIOD2	1	0.10795	0.03043	3.55	0.0004
PERIOD3	1	0.95528	0.03514	27.19	<.0001

Note: Periods (three different time periods):
Period1=2001-2003, Period2=2004-2007, Period3=2008-2010

III. DISCUSSION OF EMPIRICAL RESULTS

Monthly data for Euro-zone countries were obtained. Summary statistics of yield spread appear in Table 1 for the period 2001-2003, in Table 2 for the period 2004-2007, and in Table 3 for the period 2008-2010. As discussed above, average yield spread is highest during the period of 2008-2010 and also the variability of yield spread is highest during that period. This can also be observed through Graph 1. Greece displays the highest average yield spread and also the volatility of yield spread during 2008-2010. This leads us to examine the phenomenon of capital market integration of the union in two phases. In the first phase, we run regression analysis with all Euro-Zone countries (except for UK to avoid perfect collinearity) on the yield spread using all ten years of data. Regression result indicates the significant effect of third time-period (2008-2010) on the yield spread (see Table-4). Similar result is also observed in Table-5 even after controlling for country effects. This leads us to the second phase of regression analysis that uses the data only from the last three years (2008-2010) to observe the differences of country effects on the yield spread to avoid any confounding effect.

TABLE 5: Regression results of third period and countries on yield spread.

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	335.08165	27.92347	62.57	<.0001
Error	1427	636.83317	0.44627		
Corrected Total	1439	971.91482			
R-Square	0.3448		Adj R-Sq	0.3393	

Parameter Estimates					
Variable	DF	Parameter Estimates	Standard Error	t Value	Pr > |t|
Intercept	1	0.31076	0.06206	5.01	<.0001
PERIOD3	1	0.82245	0.03842	21.41	<.0001
BELGIUM	1	-0.27408	0.08624	-3.18	0.0015
IRELAND	1	0.05758	0.08624	0.67	0.5044
GREECE	1	0.56275	0.08624	6.53	<.0001
SPAIN	1	-0.21650	0.08624	-2.51	0.0122
FRANCE	1	-0.40042	0.08624	-4.64	<.0001
ITALY	1	-0.06925	0.08624	-0.80	0.4221
LUXEM	1	-0.66408	0.08624	-7.70	<.0001
NETHER	1	-0.41317	0.08624	-4.79	<.0001
AUSTRIA	1	-0.32175	0.08624	-3.73	0.0002
PORTUGAL	1	-0.01542	0.08624	-0.18	0.8582
FINLAND	1	-0.38092	0.08624	-4.42	<.0001

The following results address research question of similarities/dissimilarities of average yield spreads between time periods for the Euro-zone countries. This is to infer whether the union will converge or diverge in the long run. Comparing the three different time periods using regression (without 'intercept' to avoid perfect collinearity), the analysis (three indicator categories for three time periods) shows a significant difference in the mean yield spread (F=257.98, $p < 0.0001$, see Table-4). Period 2008-2010 shows the highest levels of yield spread (μ=.9553), the next highest level is period 2001-2003 (μ=0.1660). The lowest average yield spread period is 2004-2007 (μ=.1080). This show that the economic integration started sound at the initial stage (2001-2003), and then improved further at the intermediate stage (2004-2007); only to collapse later during 2008-2010 time periods. Moreover, results also indicate that period 2008-2010 differs significantly from the other two periods. While the results of these analyses show a significant difference in yield spread over time, further study would help to identify which time period is contributing the most for these yield spread differences and thus contributory to the economic divergence.

The multiple-regression model (with all three periods included) accounts for 35.01% variation (see, Table-4) in the yield spread (R^2=.3501), among these, period 2008-2010 is the strongest (t=27.19, $p < 0.0001$) indicator variable to account for yield spread divergence. However, to control for country specific differences on the yield spread we have run a regression

model that also include countries as a categorical variable (eleven indicator variables for twelve countries to avoid perfect collinearity). This regression model accounts for 34.48% variation (see, Table-5) in the yield spread (R^2=.3448) and period 2008-2010 (Period-3) is still highly significant (t=21.41, p < 0.0001) indicator variable to account for yield spread divergence. In addition, interaction between time-periods and countries indicate that yield spread of a country is dependent on economic cycle. Thus, suggesting that some of these countries are not economically strong enough to withstand different economic cycle (specifically, economic downturn) and thus economic integration of these countries may not be viable to be in the union.

TABLE 6: Regression results on yield spread after controlling for countries in third period.

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	256.36882	23.30626	23.48	<.0001
Error	420	416.86575	0.99254		
Corrected Total	431	673.23457			
R-Square	0.3808		Adj R-Sq	0.3646	

Parameter Estimates					
Variable	DF	Parameter Estimates	Standard Error	t Value	Pr > |t|
Intercept	1	0.42472	0.16604	2.56	0.0109
BELGIUM	1	0.18583	0.23482	0.79	0.4292
IRELAND	1	1.42194	0.23482	6.06	<.0001
GREECE	1	2.61472	0.23482	11.13	<.0001
SPAIN	1	0.45750	0.23482	1.95	0.0520
FRANCE	1	-0.07389	0.23482	-0.31	0.7532
ITALY	1	0.60222	0.23482	2.56	0.0107
LUXEM	1	0.26000	0.23482	1.11	0.2688
NETHER	1	-0.10639	0.23482	-0.45	0.6507
AUSTRIA	1	0.09889	0.23482	0.42	0.6739
PORTUGAL	1	0.96750	0.23482	4.12	<.0001
FINLAND	1	-0.06167	0.23482	-0.26	0.7930

Subsequent multiple regression analysis is used to further explore the study using only the last time-period (Period-3) data to observe the differential effect of Euro-zone countries (without UK to avoid perfect collinearity) on the yield spread during this 2008-2010 time period. This multiple-regression model (with all eleven countries) accounts for 38.08% variation (see, Table-6) in the yield spread (R^2=0.3808), among these, only five PIIGS countries (namely Portugal, Ireland, Italy, Greece, and Spain) are highly statistically significant with positive parameter estimates indicating that these countries together contributes most to the higher yield spread and thus account for yield spread divergence. However, to avoid any confounding effect that may be due to country specific differences on the yield spread we have run another regression model that only include PIIGS countries as a categorical variable (five indicator variables for five countries). This second regression model accounts for 37.44% variation (see,

Table-7) in the yield spread (R^2=0.3744), among these, Greece is still the strongest (t=14.51, p < 0.0001) country to account for yield spread divergence with respect to core Euro-zone countries. These findings combined suggest that period 2008-2010 is the most significant predictor of yield spread divergence economic cycle. This indicate that European Union countries are moving further apart in recent years, specifically after the financial crisis, with respect to economic integration and thus may result in union disintegration. However, necessary fiscal policy reforms by the PIIGS countries assisted by the ECB and stronger members of Euro-zone countries may be able to reverse this economic divergence in the future and keep the union intact.

TABLE 7: Regression results of PIIGS countries on yield spread in third period.

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	252.07050	50.41410	50.99	<.0001
Error	426	421.16407	0.98865		
Corrected Total	431	673.23457			
R-Square	0.3744		Adj R-Sq	0.3671	

Parameter Estimates					
Variable	DF	Parameter Estimates	Standard Error	t Value	Pr > |t|
Intercept	1	0.46798	0.06264	7.47	<.0001
PORTUGAL	1	0.92425	0.17716	5.22	<.0001
IRELAND	1	1.37869	0.17716	7.78	<.0001
ITALY	1	0.55897	0.17716	3.16	0.0017
GREECE	1	2.57147	0.17716	14.51	<.0001
SPAIN	1	0.41425	0.17716	2.34	0.0198

IV. CONCLUSION

In this study we have examined the impact of financial crisis on the economic integration of Euro-zone countries for three different time periods. Preliminary analysis through mean comparisons from summary statistics tables (Tables 1-3) provided the fact that the time-periods and country effect are significant factors on the yield spread. We also observed that the country's yield spread and thus government debt is time dependent. Thus, a country's financial stability and therefore their economic status (or level) would depend on the economic cycle. The economic cycle 2008-2010 found to be the most statistically significant predictor for the government debt volatility. Results indicate that primarily PIIGS countries (Portugal, Ireland, Italy, Greece, and Spain) were deeply impacted by this recent financial crisis. Regression analysis also provided similar conclusions of the effect of financial crisis. Regression models without controlling for country effects and also after controlling for country effect displayed the same results that financial crisis has impacted some of the countries more than the others. Thus, exhibiting difference in economic stability (or strength) among these Euro-zone countries and thus questioning the economic integration of the union.

Findings from this study have important implications for capital markets integration and the future of the Euro-zone itself. Despite the differences among individual countries, their performance on the yield spread was impacted by the recent financial crisis. Therefore, the relationship of yield spread difference with respect to economic cycle for different countries does appear significant in this research study. This predictive power of country's economic/financial cycle (time-period) dependent performance on the government debt does not depend on whether and how long they have been with the union. Rather, it may depend on the social and political environment of these countries. These findings are consistent with the hypothesis that an efficient economic development process is very much interrelated with the country's economic stability. Therefore, the results of this study indicate that the financial crisis influence on the country's economic progression is dependent on the country and may be its fiscal and other socio-economic policies. Thus, the countries with wider yield spreads may be a hindrance to the process of full market integration in the Euro-zone.

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