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An Analysis of Spain's Sovereign Debt Risk Premium

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Abstract

This research hopes to answer a few questions. Do macroeconomic variables, specifically unemployment, government debt, and growth levels drive Spain's SDRP? Of what magnitude is that influence? What impact did the Great Recession have on the variables' magnitude of influence? This research will use time series analysis to answer these questions.

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I. Introduction

Since the Great Recession hit the United States, and the rest of the world, in 2008 and 2009, recovery has been slow. Spain in particular has had a hard time adjusting to the unstable economy, earning them a bailout of nearly €37 billion in November 2012. Four of its weakest banks are to be completely restructured, hoping to cut their balance sheets by over 60% by 2017. As the country stands now, unemployment is at 27% and it is said to be going through its second recession in three years (Thompson, 2012). Though it's too early to analyze the effects of the bailout, analyzing Spain's economy can still help answer important questions about the recession as well as Spain's future. It is important to analyze larger and influential countries in the European Union, like Spain, as they can often help explain the greater effects on the world economy as a whole.

Five years after the recession and following an EU bailout, one wonders if Spain's debt is a safe investment or one that carries more risk. One way to measure this is the Sovereign Debt Risk Premium, or SDRP. A Risk Premium is the expected return on an investment based on the level of risk that it carries, meaning that the Sovereign Debt Risk Premium is the expected return on investing in Spain's Sovereign Debt. The higher the risk, the higher the yield needs to be in order to attract investment. To find Spain's SDRP, Spain will be compared to an economically stable country, in this case, Germany. Germany is the third largest economy in the world and is often used as the "control" variable in economic tests of EU countries' well-being. An example is Iglesias et al. (2003) which, similar to this study, uses Germany as a control when testing Spain's economic indicators. Since October 2011 Germany's interest rate has not been higher than 2%, while Spain's has been as high as 6.8%. To put those numbers into perspective, the United States' interest rate has been about 1% since 2011. Germany's unemployment rate is currently at 7% (about the same as the United States), while Spain's is at a staggering 27%. Currently, Spain is still struggling with an interest rate of 4.5% (as of August 2013); while simultaneously Germany's interest rate is 1.7%. Because Germany and Spain are both part of the European Union and have such polar economic standings, juxtaposing the two will yield the best results. To find Spain's SDRP the yield of the German government debt is subtracted from the yield of the Spanish government debt.

This research hopes to answer a few questions. Do macroeconomic variables, specifically unemployment, government debt, and growth levels drive Spain's SDRP? Of what magnitude is that influence? What impact did the Great Recession have on the variables' magnitude of influence? This research will use time series analysis to answer these questions.

The rest of the paper is organized as follows: the next section is a literature review which discusses others' contributions to this study and how this study intends to build on them, followed by the description of the data and methods that are used, the last two sections are the results of the regression equation and the presentation of the conclusions. Tables and Figures can be found in the Appendix at the end of the paper.

II. Literature Review

This analysis will reveal whether or not the interest rate on Spanish debt is a function of unemployment, real GDP growth rates, and government debt and how much influence those variables have. Similarly Jimenez-Martin et al. (2010) show how risk premiums affect exchange rates. The study finds that returns on exchange rates are a function of volatility of economic indicators and the perception by state-uncertainty. Groba et al. (2013) find that both the risk premium and the default components of credit default swap spreads are partially explained by macroeconomic factors. Similarly, Schuknecht et al. (2009) analyze the bond spreads issued by 13 European countries. The sample period was from 1991 to early 2005. They find that yield spreads over bonds depends significantly on indicators of fiscal performance. These studies show how economic variables affect other kinds of risk premiums. This study focusses specifically on the sovereign debt risk premium which should be similarly affected by macroeconomic indicators. These studies show that risk premiums can generally be explained by global and local macroeconomic factors, this study builds on them by attempting to find how significant specific economic factors are to the SDRP.

The data used juxtaposes Germany and Spain before and after the financial crisis because of Germany's relative economic stability. Other literature on risk premiums finds that since the economic crisis at the end of the last decade Germany has become an economic "safe haven" Bernoth et al. (2012). It is reasonable that juxtaposing Spain's interest rate and other variables to Germany's will yield more informative results about Spain's stability. The research of Bernoth et al. (2012) finds that after the financial crisis, bond yield spreads can still be largely explained on the basis of economic principles. Similarly, this paper will show the magnitude of effect the aforementioned variables have on Spain's risk premium.

Bernoth et al. (2012) also find that German government bond yields are still below other government bond yields with better debt positions. They inferred that that bond yields do not appropriately reflect fiscal performance, which is contrary to popular belief. Schuknecht et al. (2009) state that because risk premiums have always been positively related to debt and deficits, that government bond yields are "signals of the markets' assessment of the sustainability of fiscal policy". A different study by Akemann et al. (2005) show that interest rates are inversely related to debt sustainability which is more relevant to this paper considering Spanish debt's high risk premium of late. The study shows that an increasing interest rate will eventually lead to a decrease in the demand for government bonds which often leads to default. This shows the importance of interest rates and risk premiums as economic indicators despite the findings of Bernoth et al. (2012) regarding the ability of bond yields to appropriately reflect fiscal performance.

Iglesias et al. (2003) analyzes the evolution of the French, German, and Spanish risk premium using a multivariate GARCH-M model of the three countries. Using monthly data gathered from Datastream database and the bank of Spain, they found the excess holding yields on the 3-month short-term interest rate relative to the 1-month short-term interest rate in each country. They fit

a GARCH-M model to the series and using it the study finds that Spain's risk premium was time-varying and was dependent on the volatility of the German yield. So the evolution of the Spanish interest rate before entering the EMU has been more influenced by uncertainty in the German economy than in the Spanish economy. This paper will use more current data (from immediately after this study) to show how Spain's own economic indicators affect its interest rate and risk premium. It will show how Spain's economy has evolved to the point where its interest rates rely less on Germany's volatility and more on Spanish economic indicators.

II. Data and Methods

This section describes the data, methods, and transformations used to analyze the SDRP. Four data series were used: Risk Premium (the difference between Spain's and Germany's yield of government-issued bonds), Growth Gap (the difference between Spain's and Germany's GDP growth rates), Unemployment Differential (the difference between the growth rates of the unemployed population in Spain and Germany), Debt Differential (the difference between the growth rates of government debt in Spain and Germany). A dummy variable was also used to capture the change in market assessment of sovereign debt risk after the 2008 financial crisis. Called "Dummy_2008", it has a value of 0 before 2008 and 1 afterward. These data were gathered from the International Monetary Fund (IMF) database and the Eurostat database. The data sets are comprised of quarterly data from quarter 1 of 1999 to quarter 2 of 2013. Some data existed for all of 1999 and quarter 2 of 2013, but it was not complete across all variables. The IMF is an international organization made up of 188 countries whose goal is worldwide economic prosperity. Their online database is based on worldwide economic surveillance overseen by the member countries. Similarly Eurostat is a Directorate-General of the European Commission (the executive body of the European Union). Eurostat's database provides statistical information to the EU in an effort to promote the harmonization of statistical methods across its member countries. This analysis would have benefitted from more frequent data, but only quarterly data was consistently available across all of the variables.

From the IMF the following data for Spain and Germany was gathered: interest rates on government bonds in percents, unemployment and labor force in number of people, and real gross domestic product in euros (adjusted for 2005 euro prices and seasonally adjusted). From Eurostat the two governments' consolidated gross debt in euros based on current market prices were gathered. After gathering the data, it was transformed into the four datasets: Risk Premium, Growth Gap, Unemployment Differential, and Debt Differential.

To find the Risk Premium, German bond interest rates were subtracted from Spanish bond interest rates. To find the Growth Gap the GDP growth rates were first found by taking the first order differences of the logarithms of the countries' respective GDPs. The German GDP growth rates were then subtracted from the Spanish GDP growth rates to find the Growth Gap. The Unemployment Differential was found by first taking the first order differences of the logarithms of each counties' unemployed population and then subtracting Germany's from Spain's. Similarly the Debt Differential was found by first taking the first order differences of the logarithms of each counties' consolidated gross debt and then subtracting Germany's from Spain's.

The Sovereign Debt Risk Premium is the center of this analysis because it is an oft-used economic indicator. Akemann (2005), for example, finds that the SDRP

is inversely related to a country's ability to avoid default. SDRPs are often influenced by general macroeconomic factors like GDP growth, government debt, and unemployment. In fact, Groba (2013) finds that risk premiums are directly influenced by macroeconomic factors. Testing these specific variables against Spain's SDRP shows the magnitude of their influence. It is hypothesized that the Debt and Unemployment Differentials are positively related to the Risk Premium, as increases in all three variables tend to be associated with a worsening economic situation. It is also projected that the Risk Premium is positively related to the Growth Gap because a widening GDP growth gap implies general economic instability.

Figure 1 is a graph, in levels, showing Spain's SDRP over time. The data reveals three trends: the SDRP is stagnant from 2000Q1 to 2008Q1, generally increasing from 2008Q1 to 2012Q3, and decreasing from 2012Q3 to 2013Q1. This accurately portrays Spain's periods of economic stability (before the 2008 financial crisis), instability (during the crisis), and recovery (after the bailout in November 2012) over the last 13 years. Figure 1 indicates that the SDRP peaked in 2012Q3 immediately before the bailout and after the bailout it shows a sharp decline in the SDRP that mirrors the increase from years previous. From this it can be inferred that the bailout of nearly €37 billion in November 2012 has already started to positively affect the economic stability of Spain. Figure 2 shows all of the datasets. The Unemployment Gap shows a general downward trend until around 2006 when it begins to increase. It stays below 5%, but after a sharp increase in 2008, due to the recession, it goes past 10% and in the years following it continues to increase. The November 2012 bailout doesn't seem to show any effect on the unemployment gap as of yet, but employment is bound to remain stagnant for longer than financial indicators. The Growth Gap shows some seasonal trends, but stays around 0.005% until dropping to around 0% in 2006. It, too, spikes during the recession before finding a new normal at -0.01% in 2009. Spain and Germany had similar levels of growth until the recession where the numbers had an anomalous spike before showing the new normal where Spain's growth level is consistently lower than Germany's. The Debt Differential, similar to the Growth Gap, has seasonal trends that hover around 0% to -0.01% before the 2008 recession spike to almost .08%. The Debt Differential then dips down to -0.06% in 2011, spikes the next quarter and continues in this fashion. After the recession the data becomes highly irregular, with many spikes and dips, never reaching a new normal. It can be inferred from this that the German debt was immediately affected by the recession and the Spanish debt took a few years to feel the same effects. There is a direct correlation between the Unemployment Differential and the Risk Premium, while the Debt Differential and the Growth Gap share only a simultaneous spike with the Risk Premium during the 2008 recession.
Ordinary Least Squares Regression Estimation was used with Eviews software to fit a model to the data in the following form:

$$SDRP = \alpha + \beta 1\ \text{Debt Differential} + \beta 2\ \text{GDP Growth Gap} + \beta 3\ \text{Unemployment Differential} + \beta 4\ \text{Dummy\_2008} + e$$

III. Results

The first step to fitting a model to these series is finding their order of integration. The tables in the appendix show the Augmented Dickey-Fuller tests for unit roots and the Kwiatkowski-Phillips-Schmidt-Shin tests for stationarity. These datasets were tested for stationary motion, or "stationarity", in their mean and variance. Stationarity, or lack of stationarity, can strongly influence the behavior and properties of a series, and

without it, the estimated model cannot be accepted as an accurate portrayal of the data. If a series contains a unit root then it will be non-stationary and will then need to be adjusted, most economic and financial series contain a single unit root. For the Augmented Dickey Fuller test, the test statistic and the critical values are compared to accept or reject the null hypothesis that the sets have a unit root. If the t-stat is greater than the critical values at the 5% level, then it can be assumed with at least a 95% degree of confidence that there is a unit root.

Table 1 shows the ADF test for the Risk Premium series. The test statistic for levels is -0.1027, while the 5% critical value is -2.9135. The test-statistic is greater than the critical value at a 5% confidence interval, which means that the null hypothesis is not rejected with at least a 95% degree of confidence. The dataset has a unit root in levels, which means that the dataset must be differentiated (using the formula d(Risk_ Premium) in Eviews) to induce stationarity in the datasets. Table 1 also shows the ADF tests for the other datasets. The Unemployment Differential dataset also contains a unit root, while the other datasets do not.

Looking at the first order differences (FOD) of the Risk Premium dataset in Table 2, the t-stat is -5.5532 while the critical value at 5% is -2.9145. In this case the t-stat is less than the critical value and thus the null hypothesis is rejected. The FOD of the SDRP dataset does not have a unit root. The FOD of the other variables was taken and then tested for unit roots as well. The ADF test was used again on the other three datasets and finds in Table 2 that the t-stats are less than the 5% critical values. The datasets do not have unit roots after taking their first order differences. These tests suggest that the datasets are now stationary. Another test to ensure this assumption is correct is the Kwiatkowski-Phillips-Schmidt-Shin test for stationarity.

For this test the critical values are compared to the test statistic. If the t-stat is greater than the critical value at the 5% level, then the null hypothesis is rejected. The null hypothesis in this case is that the datasets exhibit stationarity. Table 3 shows the KPSS tests for stationarity in the FOD of the four datasets. In all four cases the t-stats fall outside of the 10% confidence interval. The t-stats are very small, which means that that, with absolute certainty, the null hypothesis is not rejected. The datasets exhibit stationarity in first order differences.

To summarize, both the ADF test for unit roots and the KPSS test for stationarity suggest that the datasets are not stationary in levels, but are stationary in first order differences.

Using Eviews to estimate a regression resulted in the coefficients in Figure 3.0. After looking at multiple lags for the Debt Differential, a two-quarter lag showed the greatest explanatory power. The hypothesis that the Debt and Unemployment Differentials and the Growth Gap would be positively related to the Risk Premium was correct. This reinforces the idea that increases in debt and unemployment will increase Spain's SDRP and that a widening GDP growth gap will do the same. The sign, magnitude, and statistical significance of each variable, is then analyzed individually. The Debt Differential has a lag of 2 quarters, whereas the others have none. This lag is used to better capture the dynamics of the dataset. After trying out several other lags, a lag of two quarters explained the most about the dependent variable. Its coefficient is 4.1445 indicating that a 1% increase in the Debt Differential will result in a 4.1445% increase in the SDRP after two quarters. The p-stat shows the probability that the coefficient is statistically equal to 0. For this variable it is 0.00980 which means that it is 99% certain that the coefficient is not equal to zero. The Growth Gap's coefficient is 7.6101

indicating that a 1% widening of the Growth Gap will result in a 7.6101% increase in the SDRP. For this variable the p-stat is 0.0980 which means that it is only about 90% certain that the coefficient is not equal to zero. The Unemployment Differential's coefficient is 0.2843 indicating that a 1% increase in the Unemployment Differential will result in a 0.28% increase in the SDRP. For this variable the p-stat is 0.3875 which means that with no certainty is the coefficient not equal to zero. The Dummy Variable's coefficient is 0.1653 indicating that the recession caused a 16% increase in the SDRP. For this variable the p-stat is 0.0605 which means that, with almost 95% certainty, the coefficient is not equal to zero. The f-test tests the hypothesis that all of the coefficients are equal to 0. The f-statistics can be seen at the bottom of Figure 3.0. The f-stat is 3.7216 which is greater than 2 and the null hypothesis that the all of the coefficients are statistically equal to 0 is thus rejected. This is accomplished with at least 95% certainty because the p-value of the f-stat is 0.0108. The adjusted R-squared value is 0.1849 which means that the regression can explain 18.49% of the data.

This model was subjected to diagnostic checking, to ensure the regression is valid. For the purposes of this paper, three different diagnostic checks were used: White's test for homoscedasticity, the Breusch-Godfrey test for autocorrelation, and the Jarque-Bera test for normality of distribution. The desired results for these tests would be to have regression residuals that are homoscedastic, not autocorrelated, and normally distributed. Diagnostic checking tests the reliability of the estimated parameters.

Table 4.0 shows a condensed version of the results of the tests. For all of the tests, if their p-values are greater than .05 then it is certain to at least a degree of 95% confidence that the null hypothesis is not rejected. For White's test for homoscedacity the p-value is 0.5065, which is greater than .05, so the null hypothesis that the residuals are homoscedastic fails to be rejected. For Breush-Godfrey's test for autocorrelation the p-value is .5237, which is greater than .05, so the null hypothesis that there is no autocorrelation fails to be rejected. For the Jarque-Bera test for normality of distribution the p-value is .000000, which is much less than .05. This means that the null hypothesis that the residuals are normally distributed is rejected. All but one of the tests had the desired results for reliable parameters except for the Jarque-Bera test for normality of distribution. The Jarque-Bera test in Figure 3.3 shows that the distribution is relatively normal and that it is nearly certain that the estimated parameters were reliable and gave an acceptable R-Squared value despite the Jarque-Bera test results.

IV. Conclusion

Since the 2008 recession, Spain's economy has been struggling; so much so, that the EU agreed to give the country a €37 billion bailout in November 2012. The risk premium on Spanish debt is an economic indicator of that struggle. As Spain approaches economic collapse the risk premium increases portraying the risk of the investment in its debt. Spain's interest rate was compared to that of Germany's to find the risk premium because Germany has a more stable economy. To see which variables affect the SDRP a time series analysis was applied to certain economic indicators' effect on the SDRP. The following data for Spain and Germany was gathered from the IMF and Eurostat databases: interest rates on government bonds, the unemployment level, labor forces, real GDPs, and government debts. That data was transformed into the Risk Premium, Growth Gap, Unemployment Differential, and Debt Differential of the two countries. With the data properly transformed the process of estimating a model began. Using ADF and KPSS tests, the datasets were tested for stationarity, with the result that the data is

stationary in FOD. With the stationary data, a model was estimated and diagnostic checking found that the model was homoscedastic, not autocorrelated, and normally distributed.

The Unemployment Differential had a large p-stat indicating the coefficient's lack of significance. This implies that the Spanish labor market does not have a strong relationship to its financial market. The Growth Gap had a p-value too high to consider its coefficient significant, but low enough that assumptions about the Growth Gap's effect on the SDRP would be inconclusive. The Dummy Variable showed the positive effect the 2008 recession had on Spain's SDRP, increasing it by 16%. The Debt Differential's coefficient was statistically significant and showed that as the differential increases, the SDRP increases by 4.1445 times more (after a two quarter lag).

These findings imply that the Debt Differential drives the SDRP and that the Unemployment Differential does not. The 2008 recession increased Spain's SDRP, thereby showing the economic indicating power of the SDRP. The findings in this paper build on the findings of Schkneckt et al. (2009) and Groba et al. (2013) and Bernoth et al. (2012) that macroeconomic indicators have an effect on interest rates by showing the magnitude of influence the Debt Differential has on SDRP. Possible flaws in this study include the lack of frequency in the data used and the few variables that were tested. More frequent data would increase the significance of these findings and more variables would have been more informative as to the effects of macroeconomic indicators on SDRP.

Possible implications of this study include the Spanish government's ability to better focus recovery efforts on its debt, knowing now that the Debt Differential has a great effect on its SDRP. The European Central Bank, now knowing about the lag in the Debt Differential, can anticipate that lag when giving out bailouts to countries like Spain. Should Spanish government face another recession or other economic difficulties, decreasing its debt can help to lower its SDRP. The negative effects a recession can have on a country's economy are evident in this analysis. The Spanish government now knows that once they enter a recession, their SDRP will increase and they should account for that increase. This study could be extended further with the inclusion of more macroeconomic indicators to find their magnitudes, doing a similar analysis without Germany to see if those results have a higher r-squared, and doing the same analysis in a few years to see the effect of the November 2012 bailout on Spain's SDRP.

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Appendix

ADF Tests

Table 1

H_0: Series has unit root	
Variables in levels	Constant
Risk Premium	-0.1027
Debt Differential	-4.1589
Growth Gap	-5.0391
Unemployment Differential	-2.1509
1% Critical Value	-3.5504
5% Critical Value	-2.9135
10% Critical Value	-2.5845

Table 2

H_0: Series has unit root	
Variables in FOD of levels	Constant
Risk Premium	-5.5532
Debt Differential	-11.8101
Growth Gap	-9.5355
Unemployment Differential	-10.4788
1% Critical Value	-3.5504
5% Critical Value	-2.9135
10% Critical Value	-2.5845

Table 3

H_0: Series is stationary	
Variables in FOD of levels	Constant
Risk Premium	0.2212
Debt Differential	0.1777
Growth Gap	0.0573
Unemployment Differential	0.1480
1% Critical Value	0.7390
5% Critical Value	0.4630
10% Critical Value	0.3470

Table 4

Variable	Coefficient
Constant	-0.0004 (-0.0077)
Debt Differential (t_{-2})	4.1445** (2.7211)
Growth Gap	7.6101 (1.6903)
Unemployment Differential	0.2844 (0.8727)
Dummy Variable	0.1653* (1.9265)
Adjusted R-Squared	0.1849
F-Statistic	3.7216
Sample Size	49

Table 5

Test	Value	P-Value
White Statistic	0.9603	0.5065
Breusch-Godfrey Statistic	0.6569	0.5237
Jarque-Bera Statistic	39.7081	0.0000

Figure 1

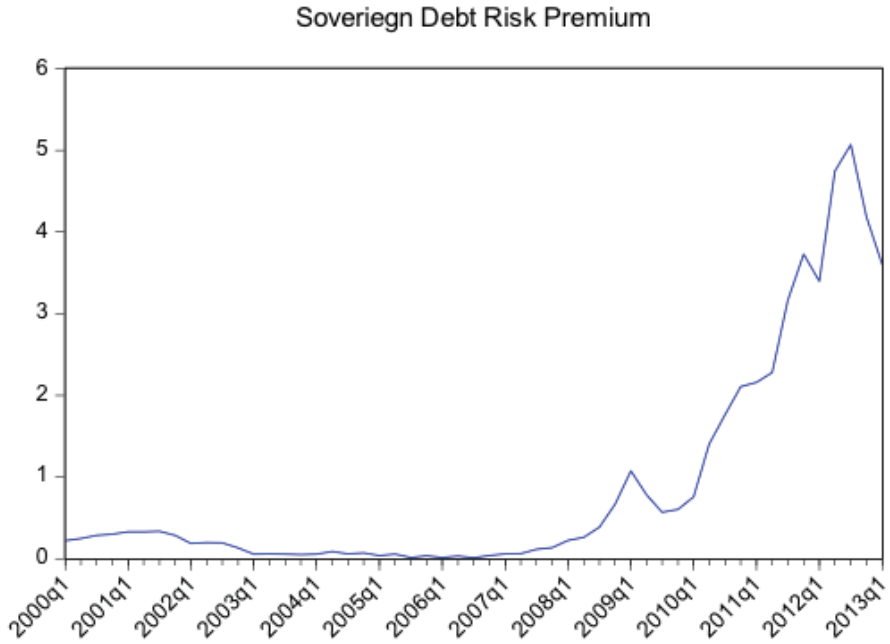

Figure 2

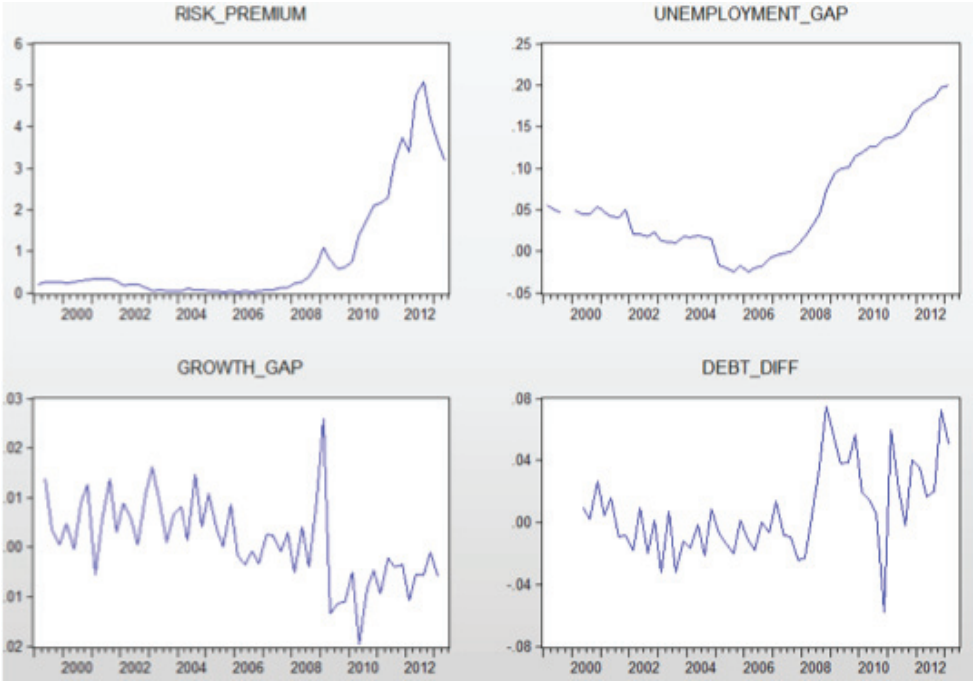

Figure 3