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THE INFLUENCE OF THE PORTUGUESE SOVEREIGN DEBT RATINGS ON TREASURY BOND YIELDS PERFORMANCE

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ABSTRACT

The rating agencies are often among those accused of taking part in the sovereign debt instability that followed the financial crisis of 2008. This work intends to empirically analyse the influence of changes in the Portuguese sovereign debt rating, as attributed by the three main international rating agencies (Moody's, S&P e Fitch), in the performance of mid to long-term treasury bond yields (2, 5 and 10 years) over the period between February 2003 and May 2012. Using simple and multiple linear regression models, estimated through the OLS method, and through the application of Chow's test, the statistical evidence shows that the changes in sovereign debt rating have a negative and significant impact on the performance of treasury bond yields for all maturities studied and this influence is higher for the period after the sovereign debt crisis. The evidence also show that the impact of changes in sovereign debt rating in treasury bond yields increases with the loss of investment grade.

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Introduction

The international rating agencies have often been accused of contributing to the instability in the sovereign debt markets that has prompted several European countries to request financial aid by the IMF, the European Central Bank and the European Commission. This paper intends to analyse the influence of changes in the sovereign debt ratings attributed by the three largest of those agencies (Moody's, S&P and Fitch) to the Portuguese government in the performance of Portuguese mid/long term treasury bonds, in the period between February 2003 and May 2012.

In this context, the following goals have been defined for this work: (i) to investigate whether the information content in sovereign debt ratings influences Treasury bond yields; (ii) to analyse whether there has been a change in the relationship between these two variables since the sovereign debt crisis began; and (iii) to test the impact of changes in sovereign debt rating in Treasury bond yields when the valuation is below to investment grade. The study focuses on the period between February 2003 and May 2012 and uses simple and multiple linear regression OLS models and Chow's test. The results indicate evidence of a negative and significant influence of ratings changes in Portuguese Treasury bond yields for all maturities, and that this influence is higher after the sovereign debt crisis than before.

This paper is organized as follows: In the next section is a summarized literature review of the influence of sovereign debt ratings in financial markets. In section 2 there is a description of the data base used and the methodology employed in the empirical analysis, the results of which are presented and discussed in section 3. Lastly, the conclusions, limitations and suggestions for future research are presented.

1. The Influence of Sovereign Debt Ratings in Financial Markets

Cantor and Packer (1995) and Kräussl (2005) state that governments seek a credit rating for their Treasury bond issues in order to facilitate access to international capital markets. The rating process is highly complex and analyses a variety of quantitative and qualitative factors (Cantor & Packer, 1996; Afonso, Gomes & Rother, 2007) and is highly subjective and opaque (Kräussl, 2000; Mora, 2006). Some authors have, therefore, tried

to identify the factors that influence the rating process for the international rating agencies (see Appendix I for a summary of some of these works).

Another area of empirical interest has been the investigation of the information content of debt ratings. Initially the researchers' attention was mainly focused on corporate assets (bonds, shares or both)[2]. However, the significant increase in government debt and the financial and economic crises that marked the 1990s have led to the increase in research about sovereign debt ratings (Kaminsky & Schmukler, 2002; Pukthuanthong-Le, Elayan & Rose, 2007). Bone (2002) claims that the economic and financial crises of the 1990s have caused severe doubts in international financial markets about the legitimacy and usefulness of sovereign debt ratings and the rating agencies themselves. On the one hand, they were unable to foresee the crises before they actually happened and, on the other hand, they have severely worsened the financing conditions of many companies and governments by successively downgrading debts after the crises were underway. Curiously, during the latest financial crisis the same behaviour has been observed[3] and the agencies have faced the same criticism of slow uptake and pro-cyclical behaviour[4] in the sovereign debt market (IMF, 2010). This is, according to Bone (2002), one of the reasons why many analysts believe that agencies attribute sovereign debt ratings based on a causal relationship and the downgrade announcements are lagged due to the presence of strong default risk in governments, that is, downgrades only happen when the market is already aware of the issuers' default risk increase.

The fact that the rating agencies' opinion translated into a debt rating is based on information supplied by the debt issuers, information which is, generally, publicly available, raises the question of whether that rating carries additional information to the market that could influence the performance of the issuers financial assets. Some authors claim that, if this is the case, a semi-strong efficient market should be able to analyse public information and incorporate its content into the financial asset prices

[2] For more information on *corporate rating* see Norden and Weber (2004, p. 2816).

[3] For example, Arezki, Candelon and Sy (2011), have identified 71 sovereign rating change announcements by the three rating agencies on European countries between 2006 and 2010, whereas before the global crisis (before 2008) there were very few sovereign rating changes on those countries, leading to the conclusion that the agencies have not anticipated the worsening macroeconomic conditions of those countries and, rather, reacted to the public information after the fact.

[4] This pro-cyclical nature of rating agencies' behaviour has been empirically tested and proved by Ferri, Liu and Stiglitz (1999), during the Asian crisis of 1997-1998. According to those authors, during that time the rating agencies, rather than anticipate the crisis, reacted to the economic cycle and that behaviour actually contributed to the deepening of the crisis.

prior to the announcement of a change in a debt rating. On the other hand, some authors consider rating agencies as specialists in obtaining and processing relevant information not publicly available. In that case, the announcements of changes in debt ratings carry important and new information which influences the performance of financial assets (Brooks, Faff, Hillier & Hillier, 2004; Kräussl, 2005; Kiff, Nowak & Schumacher, 2012).

This ambiguity has contributes to an increasing interest in the influence of sovereign debt ratings on the costs of government debt and the performance of other financial assets. Cantor and Packer (1996) were the first to investigate this issue. They analysed the information content of sovereign ratings attributed by the two largest international rating agencies (Moody's and Standard & Poor's) on the yield spreads of Treasury bonds of 49 countries (in developed and emerging economies) through *OLS* and concluded that the changes in sovereign debt rating negatively and significantly influence the yield spreads of Treasury bonds and that this impact is higher when the ratings are below investment grade. In the same research, using an event study methodology, the authors concluded that the market anticipates, by a few days the changes in sovereign debt rating.

Other works have appeared since, mainly on emerging markets. Using event study methodology and Granger Causality, Reisen and Maltzan (1999) tested the connection between sovereign debt ratings and yield spreads of 26 countries in emerging markets between 1989 and 1997 and concluded that, even though the markets are capable of a strong anticipation of rating change announcements, the combination of the sovereign debt rating of the three main agencies (average sovereign rating) has a highly significant impact on sovereign debt yield spreads. The result of the Granger Causality test shows that sovereign debt ratings and yield spreads are influenced by the same macroeconomic fundamentals.

In the same line of research, Sy (2002) used data of 17 countries in *J.P. Morgan EMBI+*[5], to study the relationship between sovereign ratings and Treasury bond yield spreads, for the period between January 1994 and April 2001, using OLS. The empirical evidence confirms the existence of a negative and significant relationship between the

[5] Index of dollar-denominated foreign Treasury bonds issued by a group of countries from emerging markets.

two variables. Kaminsky and Schmukler (2002) used a data base of 16 countries also from emerging markets in three different regions (Asia, Eastern Europe and Latin America) from January 1990 and June 2000, to analyse whether the changes in sovereign rating and Outlook during the crisis periods have contributed to the financial instability in those countries. The authors have concluded that those changes had a direct impact not only on Treasury bond yields, but also on the stock returns of the companies in those countries. They also revealed the existence of contagion between emerging markets during crisis periods, between countries in similar macroeconomic situation. With a similar purpose, Gande and Parsley (2005) analysed the impact of changes in one country's sovereign debt rating on the yield spreads of Treasury bonds of other countries, for a sample of 34 countries of emerging and developed markets and concluded, as had Kaminsky and Schmukler (2002), that there is contagion between markets.

Recently, covering 35 emerging economies during the period between 1997 and 2010, Jaramillo and Tejada (2011) decided to test the link between sovereign debt ratings and spreads, by analyzing the impact that positive valuation in sovereign debt rating from a certain level may have in borrowing costs for governments and the evidences showed that the investment grade valuation significantly reduces the government funding costs. A similar result was presented by Bussière and Ristiniemi (2012). With a sample of monthly data for 40 countries from emerging and developing economies between 1977 and 2007, the authors investigated the effect of sovereign debt rating in yield spreads of Treasury bonds and concluded that the yield spreads react strongly to changes in rating, especially when there is a downgrade below investment grade.

Though much of the extant research in this area concerns emerging markets, the recent European sovereign debt crisis has prompted a new interest in these countries. Afonso, Furceri and Gomes (2012) have examined the effects of sovereign debt rating announcements by the three largest international agencies on the yield spreads of Treasury bonds and the spreads of Credit Default Swaps (CDS) of 24 countries of the European Union, with daily data from January 1995 until October 2010. The empirical evidence suggests there is a negative and significant impact on sovereign debt rating and outlook changes on Treasury bond yield spreads and CDS spreads, an impact which is higher when downgrades are announced. The study concludes also that: (i) there is evidence of causality between sovereign debt ratings and spreads; (ii) the reaction of

CDS spreads to negative rating announcements has increased after September 15, 2008, with the announcement of the bankruptcy of Lehman Brothers. The authors have also encountered evidence of contagion between markets, especially from countries with lower ratings to those with higher ratings. Unlike Cantor and Packer (1996) and Reisen and Maltzan (1999), these authors found no evidence that the markets anticipate the rating change announcements for an event window of one to two months.

For the Portuguese market, Pacheco (2011) applied the event study methodology to analyse the impact of Moody's sovereign and corporate rating changes on the performance of a set of seven listed Portuguese companies between September 2006 and July 2011. The results show that these companies' stock prices react significantly to rating changes and that this impact was significantly larger in 2010. The author considered this result to be justified by the increased sensitivity of financial markets to rating changes for that period.

2. Data Base and Methodology

This research uses monthly yields of Portuguese Treasury bonds with maturities of 2, 5 and 10 years, traded in the secondary market, as well as the historic rating for the Portuguese sovereign debt, over the period between February 2003 and May 2012. The data for the bond yields was obtained from Thomson Reuters Datastream, through the Agência de Gestão da Tesouraria e da Dívida Pública – IGCP (Portuguese Public Debt and Treasury Management Agency). Appendix II shows a graph illustrating the performance of yields for the different maturities during the period considered.

As for the debt rating information, it includes the Portuguese sovereign debt rating change announcements by the three main international rating agencies (Moody's, Standard & Poor's and Fitch) during the period considered. The announcement dates were collected directly from the rating agencies. During this period, 16 rating change announcements have been identified, all of them downgrades. These dates are in Appendix III.

The ratings of the three agencies is expressed in symbols, characterizing the quality of credit of debt issuers (Micu, Remolona & Wooldridge, 2006). There is a known equivalence between the ratings of the three agencies considered, which allows the

linear transformation of this ordinal scale into a numbered scale (between 1 for the lowest rating and 21 for the highest), as seen in Table 1. This has been the common method employed in this area of research (see, for example, Cantor & Packer, 1996; Gande & Parsley, 2005; Kräussl, 2005; Gärtner, Griesbach & Jung, 2011 e Afonso *et al*., 2012).

Table 1 – Linear Transformation of the Sovereign Debt Rating Scale

Grade	Moody's	S&P	Fitch	Linear Transformation
Investment	Aaa	AAA	AAA	21
	Aa1	AA+	AA+	20
	Aa2	AA	AA	19
	Aa3	AA-	AA-	18
	A1	A+	A+	17
	A2	A	A	16
	A3	A-	A-	15
	Baa1	BBB+	BBB+	14
	Baa2	BBB	BBB	13
	Baa3	BBB-	BBB-	12
Speculative	Ba1	BB+	BB+	11
	Ba2	BB	BB	10
	Ba3	BB-	BB-	9
	B1	B+	B+	8
	B2	B	B	7
	B3	B-	B-	6
	Caa1	CCC+	CCC+	5
	Caa2	CCC	CCC	4
	Caa3	CCC-	CCC-	3
	Ca	CC	CC	2
		C	C	
	C	SD	DDD	1
		D	DD	
			D	

Source: Own elaboration based on Micu *et al*. (2006); IMF (2010); Standard & Poor's (2011); Moody's (2011)

Apart from rating, other macroeconomic variables have been included in the models in order to isolate the influence of ratings from that of the economic conditions of the country (Jaramillo & Tejada, 2011). The macroeconomic factors that have been indicated as important drivers of sovereign yields in previous literature include government debt (domestic and foreign) relative to GDP, budget deficit relative to GDP, international investment position, GDP growth rate and inflation rate (Barbosa & Costa, 2010; Maltritz, 2012; Bernoth & Erdogan, 2012). However, because most of these variables are only disclosed on an annual or quarterly basis, the ones considered here were inflation rate, based in the Consumer Price Index – CPI (annual change, calculated monthly, base 2012), the Industrial Production Index – IPI (base 2005), both obtained from the Portuguese National Statistics Institute (INE), as well as the monthly

return of the Portuguese Stock Index – PSI20, continuously compound. The monthly index prices were obtained from the data bank available on www.bolsapt.com.

The first goal defined for this work is to test the information content and relevance of sovereign debt ratings, that is, whether changes in these rating levels influence the Portuguese Treasury bond yields. Some authors mentioned in section one (such as Brooks *et al*., 2004; Kräussl, 2005; Kiff, *et al.*, 2012) claim that the information analysed by rating agencies is public and, therefore, efficient markets will anticipate the rating changes, fully incorporating these expectations into market prices prior to the rating change announcement. On the other hand, International Organization of Securities Commission – IOSCO (2008) claims that even though the information gathered by the rating agencies is public, the cost of access and time needed for analysis may be too high for most investors. This makes these ratings relevant and new information for the markets, which influences the performance of financial assets. In order to study this issue, the following hypothesis is tested:

H1 *– The changes in sovereign debt rating influence the yields of Portuguese Treasury bonds.*

In order to test this hypothesis, two OLS models were estimated. The first one includes only the rating as an independent variable to explain the behaviour of the Portuguese Treasury bond yields for the maturities considered (2, 5 and 10 years). The second includes three more independent variables: inflation rate, IPI and the return of the PSI20 index. Both models are presented in the following equations:

$$Yield_i = \beta_0 + \beta_1 Rating_i + \varepsilon_i \qquad [1]$$

$$Yield_i = \beta_0 + \beta_1 Rating_i + \beta_2 \mathrm{Inf}_i + \beta_3 \mathrm{PSI20}_i + \beta_4 \mathrm{IPI}_i + \varepsilon_i, \quad i = 1, 2, \cdots, n. \qquad [2]$$

Where,

- The dependent variable "$\boldsymbol{Yield_i}$" represents the yields of 2, 5 and 10 year Portuguese Treasury bonds at the end of each month i;
- The independent variable "$\boldsymbol{Rating_i}$" represents the average of the debt rating (transformed according to the scale in Table 1) from the three rating agencies considered (Moody's, S&P and Fitch) at the end of each month i;

- The independent variables "$\mathbf{Inf}_i$", "$\mathbf{PSI20}_i$" and "$\mathbf{IPI}_i$" represent the inflation rate, the return of the PSI20 index and the IPI as defined above, at the end of each month i;
- "$\boldsymbol{\varepsilon}_i$" is the error term and represents the portion of the variation in the dependent variable not explained by the independent variables considered in each model;
- The models' coefficients "$\boldsymbol{\beta}_j$" determine the degree of influence of each individual independent variable on the dependent variables for each model.

The model in Equation 2 will be also used as the reference model for the analysis in the second and third hypothesis tested, adjusted as necessary to fit its goals.

The second goal of this research is to investigate whether the influence of ratings on yields changes with the sovereign debt crisis. The volatility in sovereign debt markets has increased after this crisis, along with the successive downgrades of sovereign debts of the European countries most affected by it, namely Portugal. In order to test the existence of a structural break in the performance of Portuguese Treasury bond yields after March 2010[6], the period when the downgrades of the Portuguese sovereign debt rating have started, the following hypothesis is tested:

H2 *– The impact of the changes in the Portuguese sovereign debt rating on the yields of Portuguese Treasury bonds is higher after the sovereign debt crisis than before.*

In order to test this hypothesis, the test proposed by Chow (1960) will be used, as well as a second version of the model in Equation 2 including a dummy variable named *"DCrisis"* (which is one for the months since March 2010 and zero for those prior to that) instead of the "*Rating*". This substitution of variables was adopted after the estimation of the model in Equation 2 with both these variables and the verification that the Rating fully incorporates the effects of this dummy variable, therefore making it impossible to test this hypothesis. Then the model estimated is as following (Equation 3):

[6] This timing was proposed by Arghyrou and Kontonikas (2012) as the start of the sovereign debt crisis, defined as the beginning of the European authorities' intervention in Greece. With a monthly data base between January 1999 and August 2011, the authors have analysed the spreads between German and other European bond yields and detected two periods in their analysis: the period of the global financial crisis, between August 2007 and February 2010, and the sovereign debt crisis period, from March 2010.

$$Yield_i = \beta_0 + \beta_1 DCrisis_i + \beta_2 \text{Inf}_i + \beta_3 \text{PSI20}_i + \beta_4 IPI_i + \varepsilon_i \quad [3]$$

The third and last goal proposed for this work, refers to the impact or the influence of changes in sovereign debt rating (downgrade) to the levels below investment grade in the sovereign bond yields. This issue is related to the argument that the investors, especially the institutional ones (including Banks, Insurance Companies, Pension Funds, among other credit institutions) are prohibited by they own statutes and regulations to hold in their portfolios, debt securities classified below investment grade (Ferreira, 2010; Santis, 2012). As we know, on July 5, 2011 Portugal's rating was downgraded in four levels (from Baa1 to Ba2) by Moody's, thus loosing the investment grade classification. The other two rating agencies (S&P and Fitch) adopted the same posture of downgraded and early in the year 2012 the Portuguese government debt securities had the junk classification by all three rating agencies. For that reason, it was considered appropriate to examine this issue. Thus, the following hypothesis was tested:

H3 – *The downgrade of Portuguese sovereign debt rating to the levels below investment grade is associated with an increased of the impact of sovereign debt rating on the yields of Portuguese Treasury bonds*.

In order to test this hypothesis, we create a second dummy variable named *"DIG"* which is one for the period when the Portuguese sovereign debt was classified by the three international rating agencies as investment grade (February 2003 to June 2011) and zero for those after that. This variable will be tested in both multivariate models equated above (Equation 2 and 3). It will be further applied the Chow test in order to verify the structural change in the performance of Portuguese Treasury bond yields between the two periods. The two models estimated are, then:

$$Yield_i = \beta_0 + \beta_1 Rating_i + \beta_2 \text{Inf}_i + \beta_3 \text{PSI20}_i + \beta_4 IPI_i + \beta_4 DIG_i + \varepsilon_i \quad [4]$$

$$Yield_i = \beta_0 + \beta_1 DCrise_i + \beta_2 \text{Inf}_i + \beta_3 \text{PSI20}_i + \beta_4 IPI_i + \beta_4 DIG_i + \varepsilon_i \quad [5]$$

In Table 2 there is a summary of all the variables used, their brief description and the expected coefficient signs for the estimated models.

Table 2 – Explanatory Variables and Expected Coefficient Signs

Variable	Description	Expected Sign of Coefficients
Rating	Average of the rating attributed by the three largest international rating agencies, numeric scale	-
Inf	Inflation rate (Consumer Price Index – annual change, calculated monthly, base 2012)	+/-
IPI	Industrial Production index (base 2005)	-
PSI20	Return of the PSI20 Index, continuously compound	-
DCrisis	Dummy variable which is one for the months since March 2010 and zero for those prior to that.	+
DIG	Dummy variable which is one for the months before July 2011 and zero for those after that.	-

3. Empirical Results and discussion

In this section the results from the empirical study are presented and discussed. All the models estimated are analysed in order to verify whether the sovereign debt ratings influence Portuguese Treasury bond yields and whether this influence is higher since the sovereign debt crisis than it was before. For each model, the assumptions of the OLS model were tested and, where heteroskedasticity and/or autocorrelation were found the robust standard error estimator of Newey and West (1987) was used.

3.1. The Influence of Portuguese Sovereign Debt Ratings on Treasury Bond Yields

In this section, the first hypothesis is tested, in order to analyse the influence of changes in the Portuguese sovereign debt ratings on Portuguese Treasury bond yields. The models presented in Equations 1 and 2 of section 2 were estimated and these results are presented in Table 3 below. In the odd numbered columns are the results of the estimation of the model in Equation 1 for the yields of the 2, 5 and 10 year Treasury bonds. The even numbered columns present the results of the model in Equation 2, which include the macroeconomic variables defined in section 2.

Table 3 – Simple and Multivariate Regressions – Equations 1 and 2

Independent Variables	Expected Sign	Dependent Variable					
		2 Year TB Yields		*5 Year TB Yields*		*10 Year TB Yields*	
		(1)	(2)	(3)	(4)	(5)	(6)
Constant		29,6225 *** (3,57683)	25,5327 *** (3,07974)	30,5849 *** (2,24507)	28,4139 *** (2,17541)	23,4756 *** (1,25336)	22,5450 *** (1,25008)
Rating	(-)	-1,43338 *** (0,194093)	-1,35415 *** (0,192595)	-1,45169 *** (0,121893)	-1,41582 *** (0,119482)	-1,03375 *** (0,0684719)	-1,00941 *** (0,0687466)
Inf	(+/-)		0,582211 *** (0,0972061)		0,302329 *** (0,0676459)		0,141194 *** (0,0460709)
PSI20	(-)		-0,0251436 (0,0211809)		-0,00792942 (0,0148282)		-0,0105838 (0,00994327)
IPI	(-)		0,0139476 (0,0127317)		0,00867403 (0,00866817)		0,00183469 (0,00480063)
Adjusted R^2		0,825144	0,864206	0,913301	0,923723	0,936297	0,940149
F-Statistic		54,53843	27,55528	141,8381	43,07890	227,9309	61,92151
p-value (F)		<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
N		**112**	**112**	**112**	**112**	**112**	**112**

Obs.: 1) Standard errors estimated using the Newey and West (1987) methodology whenever heteroskedasticity and/or autocorrelation were detected; 2) ***Rating*** – average sovereign rating attributed by the international rating agencies; **Inf –** inflation rate; **PSI20** – PSI20 Index return rate; **IPI** – industrial production index; 3) Statistical significance at the 1%, 5% and 10% level is represented by ***, **, *, respectively. 4) The standard error is in parenthesis; 5) N = Number of observations.

Analysing the relationship between rating and yields, considering the model with only one variable (in columns 1, 3 and 5 of Table 3), the rating explains a considerable portion of the variability of the Portuguese Treasury bond yields: the adjusted R^2 is of 82% for the 2-year bonds and over 90% for the 5- and 10-year bonds. These results are in line with previous literature in this area. On the other hand, the coefficient of the independent variable is always negative and statistically significant at the one percent level.

In the multivariate model (columns 2, 4 and 6 of Table 3), the inclusion of the macroeconomic variables improves the adjusted R^2, but only marginally: for the 2-year bonds it increases to 86%, for the other two maturities there is only an increase of about 2 percentage points. The rating variable continues to be statistically significant at the one percent level for all maturities. This indicates that the driver for this high adjusted R^2 is the rating variable.

When analysing the other variables in the model, the only one with statistical significance (also at the one percent level) is the inflation rate. The other variables are

not statistically significant for any of the maturities considered. This indicates that the rating incorporates the impact that these variables might have on the bond yields, but also adds relevant information of its own. These results seem to strongly validate the first hypothesis tested, H1, confirming that changes in the Portuguese sovereign debt rating have a strong impact on the Portuguese Treasury bond yields.

3.2. Sovereign Rating, Debt Crisis and Yield Performance

After confirmed that there is evidence of strong influence of the Portuguese debt rating on Portuguese bond yields, now we intend to analyse whether this relationship has changed since the sovereign debt crisis. Specifically, Chow's test was applied in order to verify if there is a structural break in the impact of Portuguese sovereign credit rating on the Portuguese Treasury bond yields on March 2010, a date pointed as the start of the sovereign debt crisis in Europe by Arghyrou and Kontonikas (2012). A new model, which replaced the rating variable with a dummy as defined in section 2, Equation 3, was also estimated for this purpose. The results are presented in Tables 4 and 5.

Table 4 –Chow's Test for Structural Break on March 2010 (Equation 2)

Independent Variables	**Dependent Variable**		
	2-Year TB Yields	**5-Year TB Yields**	**10-Year TB Yields**
Constant	46,0488 ***	32,9428 ***	11,0887
	(16,7074)	(12,2388)	(7,92274)
Rating	-2,38331 **	-1,60082 **	-0,381494
	(0,916199)	(0,671147)	(0,434465)
Inf	0,633076 ***	0,270339 **	0,0264767
	(0,152795)	(0,111928)	(0,0724561)
PSI20	-0,0105167	-0,0165289	-0,0241088 *
	(0,0286095)	(0,0209574)	(0,0135667)
IPI	0,00169695	-0,000156234	0,00131052
	(0,0178967)	(0,0131099)	(0,00848667)
splitdum	-32,2906 *	-8,55334	8,78891
	(17,3061)	(12,6773)	(8,20662)
sd_Rating	1,05054	0,0728096	-0,549115
	(0,929224)	(0,680688)	(0,440642)
sd_Inf	0,918478 **	0,512395 *	0,520864 ***
	(0,410326)	(0,300578)	(0,194578)
sd_PSI20	-0,0997245	0,0248387	0,0284446
	(0,0643657)	(0,0471501)	(0,0305225)
sd_IPI	0,102584 **	0,0519721	0,00551695
	(0,0497005)	(0,0364073)	(0,0235682)
Adjusted R^2	0,883859	0,932820	0,943098
F Statistic	94,85948	172,2524	205,4118
***p-value* (F)**	<0,001	<0,001	<0,001
Chow's Test (March 2010)			
Chow's F Statistic	4,62127 ***	3,89788 ***	2,10886 *
***p-value* (F)**	(0,0008)	(0,0028)	(0,0703)
N	**112**	**112**	**112**

*** Statistically significant at the 1% level, ** Statistically significant at the 5% level and * Statistically significant at the 10% level

The results of Chow's test show that, for the 2- and 5-year Treasury bond yields, Chow's F statistic is statistically significant at the one percent level, indicating that with 99% confidence, the estimation coefficients are different before and after March 2010, indicating a structural change in the impact of sovereign ratings since the beginning of the sovereign debt crisis. For the 10-year Treasury bond yields it is only possible to admit this structural break at the 10% significance level.

To confirm these results, as mentioned previously, a model with a dummy is estimated (as represented by Equation 3). Table 5 presents the results for this model. The dummy variable is used to identify the period before and after the sovereign debt crisis.

Table 5 – Model with the Dummy Variable for the Crisis (Equation 3)

Independent Variables	**Expected Sign**	**Dependent Variables**		
		2-Year TB Yields	**5-Year TB Yields**	**10-Year TB Yields**
Constant		7,44072 *** (2,40538)	9,19732 *** (2,74740)	7,92304 *** (1,91637)
DCrisis	(+)	4,86067 *** (1,68877)	5,22383 *** (1,62202)	4,15884 *** (1,04104)
Inf	(+/-)	1,08981 *** (0,351482)	0,817869 ** (0,350847)	0,462243 * (0,235573)
PSI20	(-)	-0,0899132 ** (0,0390416)	-0,0746235 ** (0,0346971)	-0,0549925 ** (0,0225576)
IPI	(-)	-0,0673981 ** (0,0281368)	-0,0733088 ** (0,0319023)	-0,0472159 ** (0,0472159)
Adjusted R^2		0,593327	0,617178	0,685144
F Statistic		6,790390	8,708221	11,29245
p-*value* (F)		<0,01	<0,01	<0,01
N		**112**	**112**	**112**

Obs.: 1) Standard errors estimated using the Newey and West (1987) methodology whenever heteroskedasticity and/or autocorrelation were detected; 2) ***DCrisis*** – dummy variable which is 1 since March 2010 and 0 before; **Inf –** inflation rate; **PSI20** – PSI20 Index return rate; **IPI** – industrial production index; 3) Statistical significance at the 1%, 5% and 10% level is represented by ***, **, *, respectively. 4) The standard error is in parenthesis; 5) N = Number of observations.

This model confirms the existence of a difference in the reaction of Portuguese Treasury bond yields since March 2010. The dummy variable which was constructed to test Hypothesis H2 is always statistically significant at the one percent level and its sign is positive, as expected (indicating that the crisis has led to an increase in the Treasury bond yields). This confirms the results of Chow's test discussed above.

When comparing this model (Equation 3) with the one presented in Table 3 (Equations 1 and 2) it is evident that the rating has explanatory power beyond that of the other

macroeconomic variables studied. On the one hand, in the model presented in Table 5 these macroeconomic variables are almost all statistically significant at least at the five percent level (the only exception is the inflation rate, in the 10-year Treasury bond yield, where the significance level is only at 10%). This indicates that these variables have explanatory power, but it is captured by the rating variable in the previous models. On the other hand, the adjusted R^2 in the model in Table 5 is much lower than that of the model with the rating, even considering the model that only has the rating variable. This fact further validates the first hypothesis, H1. These findings are consistent with Cantor and Packer (1996) that the sovereign debt rating summarizes and complements the information contained in the macroeconomic variables, strengthening the theory that sovereign ratings have high explanatory power over Treasury bond yields.

3.3. The Loss of Investment Grade and Yield Performance

The proposed goal in this section is to test the impact of sovereign debt rating changes in sovereign debt yields when the investment grade valuation is lost. In ordered to test the third hypothesis, H3, was created a dummy variable (which assumes value 1 for the periods before July 2011, when the Portuguese sovereign debt was rated by the three international rating agencies as investment grade and 0 for the periods after that) and tested in two models, as specified in the section 2 in Equations 4 and 5. To analyse this issue, the Chow's test was also conducted in order to investigate if there is a structural change in the historical evolution of the Portuguese Treasury bond yields on July 2011. The empirical results are presented in table 6.

Table 6 – Models with the Dummy Variable for the Investment Grade Loss (Equation 4 and 5) and Chow's Test

Independent Variables	Exp. Sign	Dependent Variables: 2-Year TB Yields (1)	(2)	5-Year TB Yields (3)	(4)	10-Year TB Yields (5)	(6)
Constant		23,6168 *** (2,73932)	11,2644 *** (1,93481)	26,9019 *** (1,70472)	13,0361 *** (1,89039)	22,3999 *** (0,880744)	10,3028 *** (1,34315)
Rating	(-)	-1,09169 *** (0,196291)		-1,20868 *** (0,109091)		-0,989525 *** (0,0481322)	
DCrise	(+)		2,42490 ** (1,09240)		2,77844 *** (1,05310)		2,64286 *** (0,719133)
Inf	(+/-)	0,588852 *** (0,0922558)	0,715953 *** (0,193363)	0,307570 *** (0,0648813)	0,442534 ** (0,183903)	0,141697 *** (0,0464602)	0,229560 * (0,131075)
PSI20	(-)	-0,0208109 (0,0209235)	-0,0294373 (0,0215858)	-0,00451000 (0,0144288)	-0,0139089 (0,0168609)	-0,0102556 (0,0100173)	-0,0173534 (0,0123414)
IPI	(-)	0,00941863 (0,0106711)	-0,0159074 (0,0161294)	0,00509970 (0,00834234)	-0,0216148 (0,0145278)	0,00149159 (0,00502868)	-0,0151690 (0,0106527)
DIG	(-)	-2,50070 (2,03034)	-8,24032 *** (1,89572)	-1,97358 (1,20081)	-8,27285 *** (1,58865)	-0,189442 (0,693619)	-5,12863 *** (1,11263)
Adjusted R^2		0,870781	0,816355	0,928278	0,860051	0,939683	0,873643
F Statistic		29,73847	18,54031	59,97820	35,17154	148,2210	38,46897
p-*value* (F)		<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Chow's Test for Structural Break (July 2011)							
Chow's F Statistic		28,2238***		9,86543***		6,44797***	
p-*value* (F)		(0,0000)		(0,0000)		(0,0000)	
N		**112**	**112**	**112**	**112**	**112**	**112**

Obs.: 1) Standard errors estimated using the Newey and West (1987) methodology whenever heteroskedasticity and/or autocorrelation were detected; 2) ***Rating*** – average sovereign rating attributed by the international rating agencies; 3) ***DCrisis*** – dummy variable which is 1 since March 2010 and 0 before; **Inf –** inflation rate; **PSI20** – PSI20 Index return rate; **IPI** – industrial production index; **DIG –** dummy variable which is 1 before July 2011 and 0 after that; 4) Statistical significance at the 1%, 5% and 10% level is represented by ***, **, *, respectively. 5) The standard error is in parenthesis; 6) N = Number of observations.

The statistical evidence of the two estimated models presented in table 6 shows that the dummy variable *DIG*, when tested in the same model with variable *Rating* (Equation 4), although the coefficient sign is as expected, there are no statistical significance (the effect of the dummy variable is fully captured by the variable *Rating*, as happened in the previous question), while that, in the second model (Equation 5) estimated without the variable *Rating* (replaced by dummy variable *DCrise*), the same dummy variable *DIG* shows to be statistically significant at the one percent level and negative sign as expected, indicating that the loss of investment grade increase the impact of sovereign debt rating on the *yields of Portuguese Treasury bonds*, thus allowing, the validation of Hypothesis H3.

The results of Chow´s test for structural break in July 2011, support the evidence of the estimation of the model 5 that there is difference in market reaction in both periods. As we can see in table 6, the p-value associated with the Chow's F statistic is less than one percent significance level in all specifications of the models, pointing to the existence of structural change in the Treasury bond yields performance from the break point defined.

Conclusion

Even though the issue of the relationship between credit ratings and the performance of financial assets is not new, its study has gained in interest in the past years. The global financial crisis and the European sovereign debt crisis that followed have brought further criticism to rating agencies and an increased need to further investigate the relationship between sovereign ratings and Treasury bond yields. This paper presents some empirical evidence to this effect, studying the influence of the Portuguese sovereign debt rating attributed by the three main international rating agencies on the performance of Portuguese Treasury bond yields (with maturities of 2, 5 and 10 years) between February 2003 and May 2012.

The results validate previous findings in extant literature that the changes in sovereign debt ratings negatively and significantly influence the yields of Treasury bonds and indicate that ratings do, indeed, possess relevant information that the market cannot acquire from public information alone. There is also evidence that there was a structural break in the influence of these ratings over the yields since March 2010, when the European sovereign debt crisis has initiated. The results also indicate that the loss of investment grade valuation changes the markets behaviour, specifically, the evidences shows that Portuguese sovereign debt rating change to the level below investment grade in July 2011 caused an increase in Portuguese Treasury bonds yields. These findings are valid for all the models tested and all the maturities analysed of the Portuguese Treasury bonds.

These results show that, even though they are widely criticised, the rating agencies still carry tremendous influence in financial markets and investors do consider their opinions as fundamental in their decision-making processes. There is also evidence that these agencies have a strong impact in the costs of financing of countries, here clearly demonstrated for the Portuguese case, which confirms their power in these matters.

This research is, in a way, bounded by certain limitations encountered by the authors, namely the fact that much of the information considered relevant in these studies is only disclosed on a quarterly or annual basis, such as the GDP growth, budget deficits and government debt, therefore precluding their use in this work. Some models were tested with these quarterly variables, but the results found were unreliable due to the small sample size. Therefore, a possible suggestion for future research would be to broaden the time period or alter the methodology in order to include these variables.

Another possible work stemming from this research would be to investigate whether the possibility of contagion between other countries, namely Greece and Ireland, and Portugal. This would also be an interesting study that might be performed in future.

References

Afonso, A. (2003). Understanding the determinants of sovereign debt ratings: Evidence for the two leading agencies. *Journal of Economics and Finance*, 27 (1), 56 – 74.

Afonso, A., Gomes, P. & Rother P. (2007). What "hides" behind sovereign debt ratings? *European Central Bank*. Working Paper Series, No. 711.

Afonso, A., Gomes, P. & Rother P. (2011). Short-and long-run determinants of sovereign debt credit ratings. *International Journal of Finance and Economics*, 16, 1 – 15.

Afonso, A., Furceri, D. & Gomes, P. (2012). Sovereign credit ratings and financial markets linkages: Application to European data. *Journal of International Money and Finance*, 31, 606 – 638.

Arezki, R., Candelon, B. & Sy, A. (2011). Sovereign rating news and financial markets spillovers: Evidence from the European debt crisis. *International Monetary Fund*. Working Paper, Vol. 11, No. 68.

Arghyrou, M. & Kontonikas, A. (2012). The EMU sovereign-debt crisis: Fundamentals, expectations and contagion. *Journal of International Financial Markets, Institutions & Money*, 22, 658 – 677.

Avendano, R., Gaillard, N. & Nieto-Parra, S. (2011). Are working remittances relevant for credit rating agencies? *Review of Development Finance*, 1, 57 – 78.

Barbosa, L. & Costa, S. (2010). Determinants of sovereign bond yield spreads in the euro area in the context of the economic and financial crisis. *Banco de Portugal*, Working Paper, No. 22.

Bernoth, K. & Erdogan, B. (2012). Sovereign bond yield spreads: A time-varying coefficient approach. *Journal of International Money and Finance*, 31, 639 – 656.

Bissoondoyal-Bheenick, E. (2005). An analysis of the determinants of sovereign ratings. *Global Finance Journal*, 15, 251 – 280.

Bone, R. (2002). Análise crítica dos fundamentos dos ratings soberanos: O caso da Argentina. *Indicadores Económicos, Revista FEE*, Porto Alegre, Vol. 30, No.1, 74 – 100.

Brooks, R., Faff, R.W., Hillier, D. & Hillier, J. (2004). The national market impact of sovereign *rating* changes. *Journal of Banking & Finance*, 28, 233 – 250.

Bussière, M. & Ristiniemi, A. (2012). Credit ratings and debt crises. *Banque de France*. Document de Travail, No. 396.

Cantor, R. & Packer, F. (1995). Sovereign credit *rating*. *Federal Reserve Bank of New York*, Working Paper, Vol. 1, No. 3.

Cantor, R. & Packer, F. (1996). Determinants and impact of sovereign credit ratings. *Economic Policy Review*, Working Paper, Vol. 2, No. 2.

Chow, G. (1960). Tests of equality between sets of coefficients in two linear regressions. *Econometrica*, vol. 28, No. 3, 591 – 605.

Ferri, G., Liu, L. & Stiglitz, J. (1999). The procyclical role of rating agencies: Evidence from the East Asian Crisis. *Economic Notes by Banca Monte dei Paschi di Siena SpA*, Vol. 28, No. 3, 335 – 355.

Gande, A. & Parsley, D. (2005). News spillovers in the sovereign debt market. *Journal of Financial Economics*, 75 (3), 691 – 734.

Gärtner, M., Griesbach, B. & Jung, F. (2011). PIGS or Lambs? The European sovereign debt crisis and the role of rating agencies. *International Advances in Economic Research*, 17 (3), 288 – 299.

Hill, P., Brooks, R. & Faff, R. (2010). Variations in sovereign credit quality assessments across rating agencies. *Journal of Banking and Finance*, 34, 1327 – 1343.

International Monetary Fund – IMF (2010). The uses and abuses of sovereign credit ratings. In Global Financial Stability Report: Sovereigns, funding and systemic liquidity. *World Economic and Financial Surveys*, pp. 85–122 (available in www.imf.org/external/pubs/ft/gfsr/2010/02/pdf/chap3.pdf).

International Organization of Securities Commissions - IOSCO (2008). Consultation report: The role of credit rating agencies in structured finance markets (available in http://www.iosco.org/library/pubdocs/pdf/IOSCOPD263.pdf).

Jaramillo, L. & Tejada, C. (2011). Sovereign credit ratings and spreads in emerging markets - Does investment grade matter. *International Monetary Fund*. Working Paper, Vol. 11, No. 44.

Kaminsky, G. & Schmukler, S. (2002). Emerging markets instability: Do sovereign *rating*s affect country risk and stock returns? *The World Bank Economic Review*, Vol. 16, No. 2, 171 – 195.

Kiff, J., Nowak, F. & Schumacher, L. (2012). Are rating agencies powerful? An investigation into the impact and accuracy of sovereign ratings. *International Monetary Fund*, Working Paper, Vol. 12, No. 23.

Kräussl, R. (2000). Sovereign credit ratings and their impact on recent financial crises. *Center for Financial Studies*, Working Paper, No. 04.

Kräussl, R. (2005). Do credit rating agencies add to the dynamics of emerging market crises? *Journal of Financial Stability*, 1, 355 – 385.

Maltritz, D. (2012). Determinants of sovereign yield spreads in the Eurozone: A Bayesian approach. *Journal of International Money and Finance*, 31, 657 – 672.

Mellios, C. & Paget-Blanc, E. (2006). Which factors determine sovereign credit ratings? *The European Journal of Finance*, Vol. 12, No. 4, 361 – 377.

Micu, M., Remolona, E. & Wooldridge, F. (2006). The price impact of rating announcements: which announcements matter? *Bank for International Settlements*, Working Paper, No. 207.

Moody's Investors Service (2011). Rating symbols and definitions (available in http://www.moodysanalytics.com/~/media/Brochures/Credit-Research-Risk-Measurement/Quantative-Insight/RDS/Moodys-Rating-Symbols-and-Definitions.ashx).

Mora, N. (2006). Sovereign credit ratings: Guilty beyond reasonable doubt? *Journal of Banking & Finance,* 30, 2041 – 2062.

Newey, W. & West, K. (1987). A Simple, Positive, Semi-Definite Heteroscedasticity and Autocorrelation Consistent Covariance Matrix. *Econometrica*, Vol. 55, No. 3, 703 – 708.

Norden, L. & Weber, M. (2004). Informational efficiency of credit default swap and stock markets: The impact of credit rating announcements. *Journal of Banking & Finance,* 28, 2813 – 2843.

Pacheco, L. (2011). Moody's credit ratings and the stock market performance of Portuguese rated firms. *Universidade Portucalense – Infante D. Henrique,* Working Paper, No. 22.

Pukthuanthong-Le, K., Elayan, F. & Rose, L. (2007), Equity and debt market responses to sovereign credit ratings announcement. *Global Finance Journal*, 18, 47 – 83.

Reisen, H. & Maltzan, J. (1999). Boom and bust and sovereign ratings. *Organisation for Economic Co-operation and Development Centre*. Working Paper, No. 148.

Standard & Poor's (2011). Guide to credit *rating* essentials: What are credit *rating*s and how do they work? Version 1.4 (available in http://img.en25.com/Web/StandardandPoors/SP_CreditRatingsGuide.pdf).

Sy, A. (2002). Emerging market bond spreads and sovereign credit ratings: reconciling market views with economic fundamentals. *Emerging Markets Review,* 3, 380 – 408.

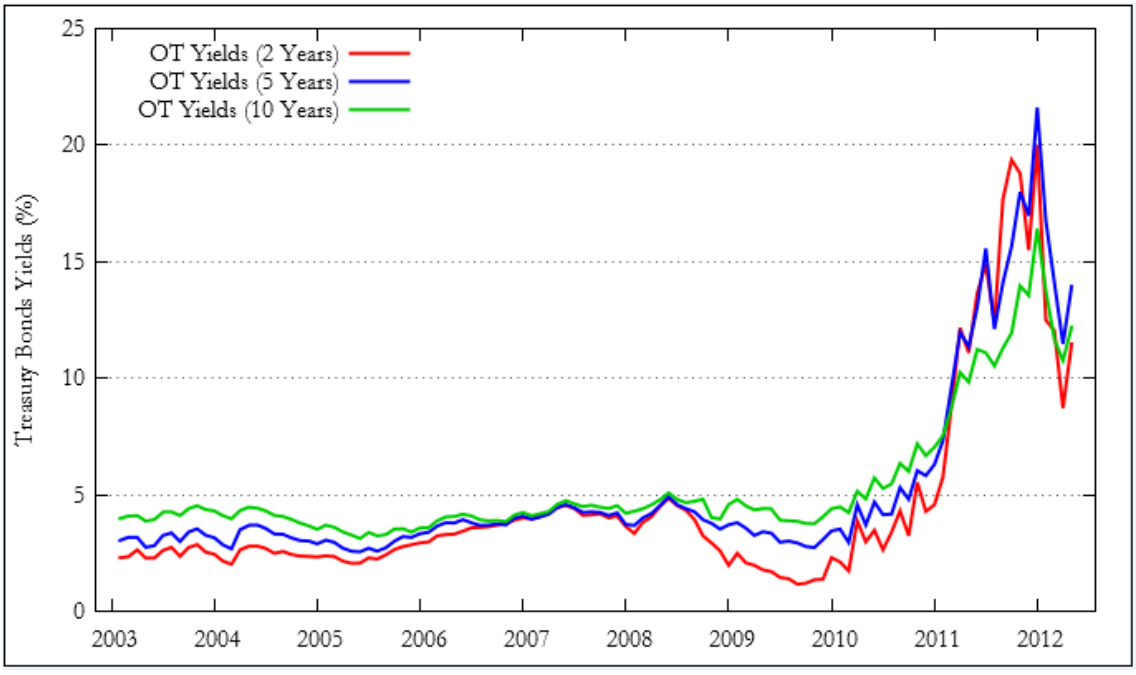
APPENDIX

Appendix I: Determinants of Sovereign Rating: Literature Review Summary

	Period	Sample (number of countries)	Relevant Statistical Variables													
			GBP per capita	GDP Growth Rate	Inflation	External Public Debt	Level of Economic Development	History of Failure	Real Exchange Rate	Balance of Current Account	Efficacy of Governments	External Reserves	Government Revenue	Volatility of the stock market	Volatility on Foreign Flows	Corruption Index
Cantor &Packer (1996)	1995	49	X	X	X	X	X	X								
Afonso (2003)	2001	81	X	X	X	X	X	X								
Bissoondoyal-Bheenick (2005)	2002	95	X		X											
Mellios & Paget-Blanc (2006)	2002	86	X		X			X	X				X			X
Hill, Brooks & Faff (2010)	1990-2010	129	X	X	X	X		X						X		
Afonso *et al.* (2011)	1995-2005	130	X	X		X		X			X	X				
Avendano, Gaillard & Nieto-Parra (2011)	1993-2006	55	X		X					X					X	

Source: Own elaboration based on the empirical results of the research referenced.

Appendix II - Evolution of Portuguese Treasury Bonds Yields of in the medium/long term (February 2003 to May 2012)



Source: *Thomson Reuters Datastream, 2012*

Appendix III - Announcements dates of change in the levels of sovereign rating and outlook of Portuguese sovereign debt, February 2003 to May 2012.

Announcements dates	Standard & Poor's	Moody's	Fitch
29-10-2004	AA (Negative)		
27-06-2005	AA- (Stable)		
29-06-2005			AA (Negative)
01-05-2007			AA (Stable)
13-01-2009	AA- (Negative Watch)		
21-01-2009	A+ (Stable)		
03-09-2009			AA (Negative)
29-10-2009		Aa2 (Negative)	
07-12-2009	A+ (Negative)		
24-03-2010			AA- (Negative)
27-04-2010	A- (Negative)		
05-05-2010		Aa2 (Negative Watch)	
13-07-2010		A1 (Stable)	
30-11-2010	A- (Negative Watch)		
21-12-2010		A1 (Negative Watch)	
23-12-2010			A+ (Negative)
15-03-2011		A3 (Negative)	
24-03-2011	BBB (Negative Watch)		
24-03-2011			A- (Negative Watch)
29-03-2011	BBB- (Negative)		
01-04-2011			BBB- (Negative Watch)
05-04-2011		Baa1 (Negative Watch)	
05-07-2011		Ba2 (Negative)	
24-11-2011			BB+ (Negative Watch)
13-01-2012	BB (Negative)		
14-02-2012		Ba3 (Negative)	

Source: Own Elaboration (available data from Standard and Poor's, Moody's and Fitch)