Profitability and Risk Premiums in the Lisbon Stock Exchange

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Abstract

The capital market was deeply shaken by the financial crisis that erupted in 2008 in the U.S. with the housing market crash. In the financial economy due to the risk associated with the stock market the return should be greater than the return obtained by a risk-free investment. However instability arising from the financial crisis strongly affected the profitability of the market breaking the paradigm of the risk premium concept. This work will evaluate the effects of the financial and economic crisis on the profitability of the Portuguese equity market, on the real risk premium, on the systematic risk (beta) of several sectors and PSI 20 stocks and also demonstrate how diverged the interest rates of the Portuguese public debt are from the German public debt by focusing on two very specific sub-periods — "pre crisis" (2004-2007) and "post crisis" (2008-2014). From the results obtained it appears that during the period under analysis the Portuguese market is volatile and reacts strongly to periods of crisis. The risk premium is generally negative in the "post crisis" period for both PSI 20 TR and the PSI Geral. The financial sector stands out for being the most affected by the crisis. The same trend is observed in general for the majority of the sector indexes and stocks selected.

Keywords: Financial crisis, Pre crisis period, Post crises period, Profitability, Risk Premium, Yield, Interest Rate, Sovereign Debt

1. Introduction

In recent years, Economic Engineering has gained relevance in the Industrial Engineering context as a complement that ensures a decision process well defined and theoretically grounded. The growing concern of top and middle size companies with the investment process decision has lead to several models and theories to build up a relation between risk and return. In the literature models like the CAPM (Capital Asset Pricing Model) or the APT (Arbitrage Pricing Model) are the main models to explain this relationship. One of the main characteristics of these models is the concept of risk premium. The risk premium is defined as the required return for investing in a risky asset. However this concept depends on several factors such as the methodology adopted in its estimation, e.g. arithmetic or geometric mean, the time period and the instruments used as proxy of the market asset and the risk-free asset. There is not yet a consensus among the authors about which factors gives the best estimation power. (Damodaran, 2015). The present work intends to analyze the evolution of the profitability and the risk premiums of the Lisbon Exchange Stock between 2004 and 2014, highlighting what indexes, stocks and sectors were most affected by the 2008 crisis. At the same time it focuses also on the evolution of the Portuguese and German t-bonds and t-bills. To achieve a better understanding of the effect of the economic and financial crisis and the government austerity measures on the performance of the Portuguese stock market, the global period was divided into two sub-periods the “pre crisis” (2004-2007) and the “post crisis” (2008-2014).

2. Literature review

2.1 The 2008 crisis and its impact

A crisis can be defined as an instability situation triggered by several factors with a strongly impact on the financial markets. These factors can be based on a political, economic or financial situation. (Antunes, 2013) The financial crisis of 2008 was triggered by the collapse of the U.S. housing market due to the frenetically real estate consumption that started back in 2000. Furthermore the low level of income and the low employment rate led to the fast price inflation and the increase in indebtedness. The bankruptcy of several financial institutions such as Lehman Brothers bank institution further intensified the impact of the U.S. financial crisis affecting markets worldwide. (Ferraz, 2013)

The effects of the global crisis and its quantification in financial markets have been studied by several authors. The majority of the studies focus on the evaluation of the contagion effect. The literature suggests that the international repercussions of the financial crisis are mainly due to a high level of transmission and financial integration. This achievements were demonstrated by several authors such as Min & Hwang (2012), Hwang *et al.* (2013), Luchtenberg & Vu (2015) and Burzala (2016). Despite differences among the studies conducted by these authors it is evident that there is in general a positive correlation between the U.S. subprime crisis and the results of worldwide financial markets.

However these studies pay little attention to the post crisis period, namely the recovery period. The study led by Didier *et. al* (2012) focuses on this post crisis period and shows that emerging economies recover more strongly than more mature and developed economies. Later on, Ivanov *et al.* (2016) concluded that there is a significant degree of integration between the EU and U.S. equity market and therefore a considerable level of contagion. The results provide the necessary evidence to prove the existence of asymmetries in the absorption of positive and negative shocks that depends on the weakness of the fundamentals of the domestic market.

Other authors like Majapa & Gossel (2016) focused more concretely on studying the evolution of the market in periods of crisis instead of determining the contagion effect. By dividing the global period of analysis into three sub-periods, Majapa & Gossel (2016) evaluate the evolution of South African companies in the pre crisis period, post crisis period and also during the crisis.

Singh & Dhingra (2013) also conducted a similar study over several Indian companies. However the authors opted to evaluate only 2 periods, one before the 2008 crisis (2005-2007) and one immediately after (2008-2009). Despite some difference both studies resulted in the same conclusion. The market was indeed affected by the crisis, however the impact it had over each company performance was different. There is a negative relation between the market performance and evolution and the crisis.

2.2 CAPM and its variables

Determining the impact of the crisis over the stock market presupposes the existence of a model that could explain the relationship between return and risk. To streamline the process several authors developed some models. As referred before the most studied models in determining the cost of equity capital are the Capital Asset Pricing Model (CAPM) and the Arbitrage Price Theory (APT) model.

Since their development many authors have studied the applicability of these models, particularly the CAPM model. Black *et al.* (1972) and Fama & MacBeth (1973) show the existence of a relation between the return and the beta coefficient. On the other hand Banz (1981), Lakonishok & Shapiro (1986) and Fama & French (1992) found out some gaps in the CAPM model. Fama & French (1992) show that the relation between return and risk or week or inexistent.

In turn, Soares (1994) applied both models to the Portuguese market by studying Portuguese companies and the BVL and BTA indexes. The results of the CAPM model show that the coefficient of determination is weak and that the observed outcomes are poorly replicated by the model. Soares (1994) points out that the results are related to the poor adherence of the CAPM to the reality, the existence of more than one parameter explaining the systematic risk, and the beta instability. Regarding the APT model, Soares (1994) explains that despite the weak correlation between the selected stocks there are indeed common factors across stocks and that 2 factors have powerful results. Finally the author demonstrates the superiority of applicability of the APT model over the CAPM model due to the higher value of the coefficient of determination obtained.

The emergency of these models introduced for the first time the concept of beta and risk premium. However how these concepts are determined, especially the risk premium is still topic of discussion. In the estimation of the risk premium the risk-free asset must be defined. Black *et al.* (1971) adopted as a proxy the 1 and 3 month t-bills while Khajador & Valtchanov (2014) used 1 month t-bills. On the other hand Fernandes (2013) opted for 10 years t-bonds.

Furthermore few authors explain which type of risk premium is being analyzed. Fernández (2006) points out the existence of 4 types of risk premium: historical, expected, demanded and implicit. The value estimated will depend on which one it's chosen by the author.

In addition, the calculation method (arithmetic or geometric mean) utilized and the time period under scope will impact the final estimation. Ibbotson *et al.* (2010) estimated the risk premium between 1926 and 2000 in 5.90% according to the arithmetic mean and 3.97% according to the geometric mean, showing that there are in fact differences across the two calculation methods.

3. Methodology

3.1 Data Characterization

Before applying the methodology adopted some criteria must be defined, such as the time period. The period under scope encompasses the decade between 2004 and 2014 and can be aggregated in two main sub-periods: one between 2004 and 2007 called the "pre crisis period" and other between 2008 and 2014 called the "post crisis" period. The choice of such an extensive period is based on two key points: to ensure the significance of the statistical study and to ensure the real assessment of the market behavior against the implementation of the financial and economic assistance program by the Troika.

Several assets were selected to evaluate the impact of this program and the overall impact of the crisis over the Portuguese market, namely over the Lisbon Stock Exchange, the risk premiums and the beta coefficient.

As a proxy of the Portuguese market it was chosen the PSI 20 TR index and the PSI Geral index. Furthermore in order to highlight which sectors and companies were most impacted during the recession period (2008-2014) we also evaluated the following sector indexes: Base Materials (PTBM), Industrial (PTIN), Consumer Goods (PTCG), Services (PTCS), Telecommunications (PTTEL), Utilities (PTUT), Financial Sector (PTFIN) and Technology (PTTEC). The following stocks were also selected and analyzed: ALTR, BCP, BPI, BANIF, CTT, EDP, EDPR, GALP, IPR, JMT, EGL, NOS, PHR, PTI, RENE, SEM, SON and TDSA.

Finally, as a proxy of the risk-free asset we selected Portuguese and German Government t-bonds and t-bills with different maturities, taking into account the controversial classification of the Portuguese public debt as risk-free in the post-crisis context. In contrast the impact of the crisis on the German market was much lower and thus their yields were also used as a benchmark to determine the risk premium and guarantee reliable results.

All data were taken from the Bloomberg platform for the period between 2004 and 2014. For the analysis purposes daily observations of the stock and market closing prices were used. All stock and market prices are already adjusted to the dividend distribution. The inflation rate data was extracted by the National Statistics Institute.

The data extracted correspond to nominal values. In the estimation of the risk premiums these values were adjusted to the inflation rate to fully give an understanding of the risk premiums performance and to highlight if this performance was below the inflation rate.

Finally the data extracted needed some adjustments in order to serve as input to the statistical model chosen. The data processing was carried out with the help of MS Excel and SPSS software.

3.2 Statistical Hypothesis tests

Hypothesis tests allow inferring a set of general characteristics of a population from a sample. These are decision-tests that test the results of a sample (parameters or variables) by formulating hypotheses. The test results indicates whether the formulated hypothesis is feasible and therefore whether or not should be accepted. (Kohler, 1994)

3.3 Hypothesis formulation

Under the light of the recent economic events and the literature review the following questions were drawn in order to understand the impact of the crisis on the Portuguese stock market:

- Were the average Portuguese yield equal in the pre crisis period (2004-2007) and the post crisis period (2008-2014) (H_0: $\mu_1 = \mu_2$ e H_a: $\mu_1 \neq \mu_2$)? Was this difference statistically significant?
- What was the impact of the crisis on the Lisbon stock market? Were the two most representative indexes – PSI 20 and PSI Geral – impacted in the same way? And which companies and sectors were most affected?
- Was the average return of the pre crisis period different from the post crisis (H_0: $\mu_1 = \mu_2$ e H_a: $\mu_1 \neq \mu_2$)? Was this difference statistically significant?

3.4 t-Tests

In order to test the above hypothesis the t-test for independent samples was applied. The t-test for independent samples is useful in these cases since the two main subgroups have different sizes (the pre crisis period encompasses 4 years and the post crisis period encompasses 6 years of analysis) and also since the two sub-periods are distinct and independent. The return of the asset is not dependent on the historic return but the dependency is on its current price which in turn is dependent on its past price and on the market environment.

$$t_{var\ equal} = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\left(\frac{{S_1}^2}{n_1} + \frac{{S_2}^2}{n_2}\right)}} \qquad (1)$$

$$t_{var\ different} = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{{S_P}^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \qquad (2)$$

$${S_P}^2 = \frac{(n_1 - 1){S_1}^2 + (n_2 - 1){S_2}^2}{n_1 + n_2 - 2} \qquad (3)$$

Different Where $\bar{X}_1 - \bar{X}_2$ is the difference between the mean of the two samples, ${S_i}^2$ is the variance of the sample i and n_i is the size of the sample i.

4. Empirical Results

4.1 Public debt instruments evolution

The figure 1 shows the difference in the annual yield evolution of the Portuguese and the Germany market. Interest rates of Portuguese t-bonds show themselves on average higher than the German rates for the whole period (2004-2014), which is complacent with its higher risk associated. The global average rate of the Portuguese 5 and 10 years t-bond is circa 5.00% while the German rate is less than 3.00%. Still, there are some years, such as in 2007, where these differences are small. However, those discrepancies suffered a boost after 2008 due to a period of insolvency of several large financial institutions in the U.S. and euro zone, such the fall of Lehman Brothers, the revision of the Portuguese sovereign debt rating (which went from AA- to A+ in 2009) and the uncertainty of the evolution of the economy.

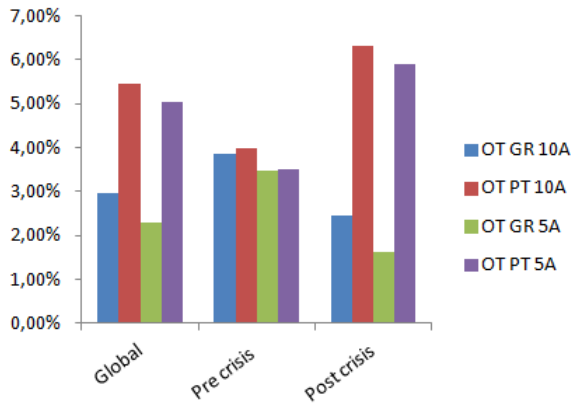

Figure 1: Government t-bonds return evolution using the arithmetic mean (AM)

The results obtained for the 6 and 9 months t-bills follow the same pattern with just slight differences. The evolution of the t-bonds and t-bills was also tested with the geometric mean to outline differences between the two calculation methods. Yet these differences are tenuous for the majority of the maturities, circa 0.02%. The biggest difference is observed in the post crisis period given the disparity in the interest rate at the beginning of the period compared to the rate at the end of the period.

Comparing the period between 2004 and 2007 (pre crisis) with the period between 2008 and 2014 (post crisis) there is a decrease in the German interest rate that contrasts with the increase of the Portuguese interest rate, due to the constant risk of default of Portugal. In fact, the Portuguese t-bonds yield exceeded the

value of 6.00% in the post crisis period considering the arithmetic mean.

The hypothesis "the average return of the Portuguese t-bonds and t-bills is equal for the two sub-periods and this difference is statistically significant" was tested. The result of the Leven test rejected the hypothesis that the variance is equal for the two sub-periods. The result was transversal for all bond maturities. As for the t-test, the p-value obtained was the same for all maturities examined with a value of 0.00 which is lower than the significance level (0.05). Therefore it is possible to infer that the difference between averages is statistically significant for any adopted level of significance. The null hypothesis can be rejected since there are proofs that the average return is different in the pre crisis and post crisis period.

4.2 PSI 20 TR and PSI Geral evolution

Between 2004 and 2014 the PSI 20 TR showed an annual return varying between 4.04% and 6.19% according to the geometric and arithmetic mean respectively. The PSI Geral underperformed the PSI 20 TR showing a lower average return of 6.01% for the arithmetic mean and 3.79% for the geometric mean. It was interesting to observe that while the average return decreased, the volatility more than doubled between the two periods, being a reflection of the market risk.

Regarding the statistical model, the results of the Levene's test indicates that the variance of the two sub-periods is different and thus the null hypothesis is rejected for the 0.05 significance level. Moreover, according to the t-test the null hypothesis "the average return of the pre crisis period is equal to the average return of the post crisis period" is rejected for both PSI 20 TR and PSI Geral, since the p-value obtained is 0.007 and 0.006 respectively.

	PSI 20 TR		
	Return (AM)	Return (GM)	HV
Global average	6.19%	4.04%	18.23%
Pre crisis average	22.47%	21.75%	10.45%
Post crisis average	-3.11%	-6.08%	22.67%

	PSI Geral		
	Return (AM)	Return (GM)	HV
Global average	6.01%	3.79%	17.11%
Pre crisis average	21.64%	21.29%	9.81%
Post crisis average	-2.92%	-6.21%	21.28%

Table 1: PSI 20 TR and PSI Geral volatility (HV) and return evolution
AM - arithmetic mean, GM - geometric mean

4.3 PSI Setorial evolution

According to table 2 it is evident that the most affected sectors by the crisis were the Financial (PTFIN), the Technology (PTTEC) and Industrial (PTIN) sector, showing a negative performance between 2008 and 2014. The return of the Financial and the Industrial sector between 2004 and 2007 greatly contrast with the return earned after the crisis. Furthermore the Financial sector (PTFIN) along with the Telecommunication sector (PTTEL) and the Technology sector (PTTEC) are the riskiest ones, with a volatility superior to 26.00% between 2004 and 2014.

The Basic Materials sector (PTBM) corresponds to the most stable sector in the all period of analysis, not only in terms of return but also in terms of volatility. The volatility of an asset tends to be lower when the market is in expansion and higher when the market is shrinking.

Finally, the results of the Levene test are transversal to all sector indexes, indicating the non-homogeneity of the returns obtained in the pre and post crisis periods.

		PTFIN	PTTEC	PTCS	PTCG	PTBM	PTIN	PTTEL	PTUT
HV	Global average	30.12%	27.37%	23.09%	23.51%	20.67%	21.28%	26.12%	21.69%
	Pre crisis average	13.36%	20.56%	13.81%	18.20%	14.50%	17.56%	16.33%	17.31%
	Post crisis average	39.70%	31.26%	25.74%	26.55%	24.20%	23.40%	31.72%	24.19%
Return (AM)	Global average	-4.85%	-5.78%	13.14%	11.24%	18.18%	11.22%	3.57%	13.52%
	Pre crisis average	19.22%	-4.57%	21.82%	13.58%	17.38%	38.43%	16.33%	28.65%
	Post crisis average	-18.61%	-6.48%	10.66%	9.89%	18.64%	-4.33%	-3.72%	4.87%
Return (GM)	Global average	-8.27%	-9.79%	9.64%	7.84%	15.56%	8.25%	-0.02%	10.69%
	Pre crisis average	18.39%	-7.01%	21.07%	11.51%	15.51%	35.65%	14.71%	26.97%
	Post crisis average	-23.51%	-11.39%	6.37%	5.74%	15.59%	-7.40%	-8.44%	1.38%

Table 2: PSI Setorial return evolution

The t-test showed a p-value greater than 0.05 for the following sectors: Consumer Goods (PTCG), Technology (PTTEC), Utilities (PTUT), Telecommunications (PTTEL), Basic Materials (PTBM) and Services (PTCS). Therefore the t-test is not statistically significant and it is not possible to reject the null hypothesis. This result shows that no evidence was found to support the statement "the average return of the sector indexes is different for both sub-periods". In contrast the t-test is statistically significant to reject the null hypothesis for the Industrial Sector (PTIN) and the Financial Sector (PTFIN).

4.4 PSI 20 stocks evolution

The table 3 shows the volatility and the return obtained for each selected stock. There is a clear increasing trend of volatility between the two sub-periods under analysis. There are however two exceptions - ALTR and RENE stocks. The IPR stock stands out as the only stock that goes against the general market contraction trend, with a considerable return increase in the post crisis period. Once again there are discrepancies in the values found by the arithmetic and geometric mean.

The result of the Levene test is only different for the ALTR stock. In this case the variance is considered to be equal for the two sub-periods, since the significance level is greater than 0.05 (0.948). Finally the t-test is only statistically significant for the following stocks: ALTR, EDPR and SON, since their p-value is less than 0.05 and therefore the null hypothesis is rejected.

4.5 Systematic risk coefficient evolution of PSI 20 stocks

The way the systematic risk of the PSI 20 stocks progressed is presented in Table 4. The table does not include all the selected stocks, such as CTT, EDPR and TDSA since they only have data for the post crisis period. The BANIF stock was also left out due to its restructuring process. The beta coefficient shows overall a higher value for the PSI Geral than for PSI 20 TR. It is not possible to imply that there is an evident trend across the stocks between the pre crisis and the post crisis period.

	Beta - PSI 20 TR Index		Beta - PSI Geral Index	
	Pre crisis	Post crisis	Pre crisis	Post crisis
ALTR	1.22	1.02	1.35	1.08
BPI	0.78	1.25	0.81	1.28
PTI	0.63	0.67	0.74	0.73
GALP	1.37	1.05	1.39	1.18
PHR	1.01	1.00	1.06	0.99
RENE	0.98	0.50	0.99	0.54
JMT	0.55	0.86	0.63	0.94
SEM	0.56	0.65	0.66	0.70
EDP	0.97	0.91	0.92	0.99
NOS	0.61	0.89	0.69	0.92
SON	1.39	1.12	1.51	1.18
EGL	0.86	1.04	0.97	1.10
BCP	1.50	1.40	1.49	1.38
IPR	0.76	0.59	0.86	0.65

Table 4: Systematic risk coefficient (Beta) evolution of PSI 20 stocks

On one hand, there is a significant beta increase for the BPI, JMT, SEM, NOS and

	HV			Return (AM)			Return (GM)		
	Global	Pre crisis	Post	Global	Pre crisis	Post	Global	Pre crisis	Post
ALTR	36.39%	38.29%	35.57%	55.62%	142.80%	18.26%	44.83%	125.34%	10.33%
BPI	34.96%	20.65%	43.14%	13.18%	24.80%	6.60%	4.86%	21.61%	-4.70%
PTI	23.40%	19.47%	25.64%	19.68%	19.70%	19.66%	16.03%	17.29%	15.31%
EDPR	31.47%	n.a.	31.47%	3.80%	n.a	3.80%	-2.25%	n.a	-2.25%
GALP	30.96%	23.84%	33.00%	27.86%	109.66%	4.49%	21.33%	98.34%	-0.67%
PHR	28.84%	18.48%	34.76%	1.32%	13.83%	-5.82%	-2.95%	12.07%	-11.54%
RENE	22.42%	35.47%	20.56%	8.03%	39.62%	3.52%	5.36%	31.63%	1.60%
JMT	29.33%	20.66%	34.20%	28.86%	38.29%	23.47%	21.82%	34.02%	14.90%
SEM	24.59%	20.55%	26.90%	20.79%	33.59%	13.48%	16.42%	31.43%	7.84%
EDP	23.65%	17.44%	27.21%	15.38%	28.76%	7.73%	11.66%	27.05%	2.86%
NOS	27.05%	17.26%	32.70%	10.58%	9.46%	11.23%	5.25%	8.04%	3.65%
SON	31.01%	24.94%	34.47%	31.73%	48.90%	21.92%	24.35%	43.90%	13.18%
EGL	34.42%	25.15%	39.72%	36.36%	45.36%	31.23%	26.97%	40.19%	19.42%
CTT	18.44%	n.a.	18.44%	30.24%	n.a.	30.24%	27.07%	n.a.	27.07%
BCP	39.36%	22.47%	49.01%	5.98%	19.58%	-1.79%	-3.98%	16.13%	-15.48%
TDSA	50.65%	n.a.	50.65%	44.78%	n.a.	44.78%	18.14%	n.a.	18.14%
IPR	42.08%	23.11%	52.91%	31.94%	10.95%	43.93%	16.94%	8.02%	22.04%
BANIF	51.78%	n.a.	51.78%	-45.84%	n.a.	-45.84%	-79.85%	n.a.	-79.85%

Table 3: Stock volatility (HV) and return evolution
AM – arithmetic mean, GM – geometric mean

EGL stocks, while for the PTI and PHR the beta coefficient has practically unchanged between the two periods. The remaining stocks show a decrease of its coefficient. The BPI stands out as the stock with the highest positive change between the two periods going from a beta of 0.78 to a beta of 1.25. Furthermore ALTR, BPI, GALP, PHR, SON, EGL and BCP correspond to the most affected stocks by variations in the PSI 20 TR and in the PSI Geral index since their beta is greater than 1.00, mainly in the post crisis period. Once again it is observed that the Financial sector is one of the most impacted after the 2008 financial crisis.

4.6 Market, sector and stock risk premium evolution

The following tables represent the several risk premiums determined by index, sector and stock.

The risk premium for the PSI 20 TR and PSI Geral for the overall period (2004-2014) shows different values depending on the calculation method adopted and the risk-free asset considered. Yet both indexes present a positive risk premium in the overall period and in the pre crisis period, considering the 5 and 10 years German t-bonds. On the other hand, the risk premium calculated by the 5 and 10 years Portuguese t-bonds has a negative value for the overall period given the strong impact of the crisis after 2008 on the return of the Portuguese t-bonds. So in general it is observed a positive risk premium in the pre crisis period and a negative risk premium in the post crisis period. The risk premium in the overall period is positive when obtained through the German yields and negative when obtained by the Portuguese yields.
The risk premium for the sector index show the same trend as the PSI 20 TR and PSI Geral with its value being positive in the pre crisis period and negative in the post crisis period.

Yet the Technologic sector (PT TEC) shows a negative value in the pre crisis period, becoming the index with the lowest average risk premium between 2004 and 2014.

In contrast, the Basic Material index (PT BM) presents the higher risk premium in the overall period, regardless of the risk-free asset considered, with a risk premium value greater than 10.42% for the pre crisis period and greater than 10.99% for the post crisis period by the arithmetic mean. In other hand the Industrial Sector (PT IN) was the one with a higher risk premium in the pre crisis period, having been heavily impacted by the crisis, achieving negative values in the post crisis period.
Finally focusing on the selected stocks it is also evident that the risk premium has decreased between the pre crisis and the post crisis period. Notwithstanding, two stocks stands out, PTI and IPR. Their risk premium value has increased between 2008 and 2014. However, TDSA is the stock with the highest risk premium in the post crisis period.

ALTR presents the highest value of the risk premium (more than 42.49%) for the global period of analysis, despite the fact its value decreased in the post crisis period, while TDSA and IPR present the highest value (more than 36.00%) for the post crisis period, depending on which t-bond is used. GALP showed the higher risk premium in the pre crisis period (circa 100.00%), however, its value has dropped significantly in the post crisis period for a value below 1.78% and -2.52% considering the 5 years German t-bond rates and the Portuguese t-bonds rates, respectively.

On the other hand NOS and BANIF are the stocks with the average lowest risk premium in the pre crisis and post crisis period, respectively.

	Risk premium of the PSI 20 TR index							
	OTs GR 10 years		OTs GR 5 years		OTs PT 10 years		OTs PT 5 years	
	MA	MG	MA	MG	MA	MG	MA	MG
Global average	1.43%	-0.68%	2.10%	-0.02%	-1.09%	-3.20%	-0.65%	-2.77%
Pre crisis average	15.51%	14.82%	15.90%	15.20%	15.39%	14.69%	15.86%	15.16%
Post crisis average	-6.62%	-9.53%	-5.79%	-8.71%	-10.50%	-13.42%	-10.09%	-13.01%

	Risk premium of the PSI Geral index							
	OTs GR 10 years		OTs GR 5 years		OTs PT 10 years		OTs PT 5 years	
	MA	MG	MA	MG	MA	MG	MA	MG
Global average	1.24%	-0.94%	1.91%	-0.27%	-1.27%	-3.45%	-0.84%	-3.02%
Pre crisis average	14.70%	14.36%	15.10%	14.75%	14.58%	14.24%	15.05%	14.71%
Post crisis average	-6.45%	-9.68%	-5.62%	-8.85%	-10.33%	-13.56%	-9.92%	-13.15%

Table 5: PSI 20 TR and PSI Geral risk premium
OTs – treasury bonds, GR – Germany, PT - Portugal

		Risk premium by sector index and by period															
		PT FIN		PT TEC		PT PTCS		PT CG		PT BM		PT IN		PT TEL		PT UT	
		MA	MG	MA	MG	MA	MG	MA	MG	MA	MG	MA	MG	MA	MG	MA	MG
OTs GR 10 years	Global average	-9.47%	-12.80%	-10.31%	-14.22%	5.98%	3.16%	3.04%	3.06%	13.29%	10.74%	6.37%	3.46%	-1.16%	-4.69%	8.61%	5.84%
	Pre crisis average	12.34%	11.55%	-10.81%	-13.18%	4.24%	3.89%	4.82%	4.84%	10.54%	8.74%	31.10%	28.40%	9.53%	7.97%	21.52%	19.90%
	Post crisis average	-21.92%	-26.71%	-10.02%	-14.82%	6.97%	2.75%	2.03%	2.04%	14.87%	11.88%	-7.75%	-10.79%	-7.26%	-11.92%	1.24%	-2.19%
OTs PT 10 years	Global average	-11.98%	-15.32%	-12.82%	-16.74%	3.47%	0.64%	3.88%	0.54%	10.78%	8.22%	3.86%	0.94%	-3.67%	-7.20%	6.10%	3.32%
	Pre crisis average	12.22%	11.42%	-10.93%	-13.31%	4.12%	3.76%	6.72%	4.70%	10.42%	8.60%	30.98%	28.26%	9.41%	7.84%	21.40%	19.76%
	Post crisis average	-25.80%	-30.59%	-13.90%	-18.70%	3.09%	-1.13%	2.25%	-1.84%	10.99%	8.00%	-11.63%	-14.67%	-11.14%	-15.80%	-2.64%	-6.07%
OTs GR 5 years	Global average	-8.79%	-12.14%	-9.64%	-13.56%	6.65%	3.82%	7.06%	3.72%	13.97%	11.40%	7.05%	4.12%	-0.49%	-4.03%	9.28%	6.50%
	Pre crisis average	12.73%	11.93%	-10.42%	-12.80%	4.64%	4.27%	7.23%	5.21%	10.94%	9.12%	31.49%	28.77%	9.92%	8.35%	21.91%	20.27%
	Post crisis average	-21.09%	-25.89%	-9.19%	-14.00%	7.80%	3.57%	6.96%	2.86%	15.70%	12.70%	-6.92%	-9.97%	-6.43%	-11.10%	2.07%	-1.37%
OTs PT 5 years	Global average	-11.54%	-14.88%	-12.39%	-16.30%	3.90%	1.09%	4.31%	0.98%	11.22%	8.66%	4.30%	1.38%	-3.23%	-6.76%	6.53%	3.77%
	Pre crisis average	12.69%	11.89%	-10.46%	-12.84%	4.59%	4.23%	7.19%	5.17%	10.89%	9.07%	31.45%	28.73%	9.88%	8.31%	21.87%	20.23%
	Post crisis average	-25.39%	-30.17%	-13.49%	-18.28%	3.50%	-0.71%	2.66%	-1.42%	11.40%	8.42%	-11.22%	-14.25%	-10.73%	-15.38%	-2.23%	-5.64%

Table 6: Risk premium evolution by PSI Setorial

		Risk premium by stock and by period																	
		ALTR	BPI	PTI	EDPR	GALP	PHR	RENE	JMT	SEM	EDP	NOS	SON	EGL	CTT	BCP	TDSA	IPR	BANIF
OTs GR 10 years	Global average	45.00%	8.28%	14.74%	6.24%	23.00%	-3.38%	3.85%	23.65%	15.87%	10.43%	5.88%	26.74%	31.31%	28.90%	1.45%	41.19%	27.53%	-48.06%
	Pre crisis average	97.94%	17.75%	12.79%		100.20%	7.09%	31.99%	30.94%	26.38%	21.62%	2.85%	41.33%	37.83%		12.71%		4.33%	
	Post crisis average	14.74%	2.86%	15.86%	6.24%	0.95%	-9.37%	-0.17%	19.48%	9.86%	4.04%	7.61%	18.41%	27.59%	28.90%	-4.99%	41.19%	40.78%	-48.06%
OTs PT 10 years	Global average	42.49%	5.77%	12.23%	1.81%	19.96%	-5.90%	0.43%	21.14%	13.36%	7.92%	3.37%	24.23%	28.80%	25.36%	-1.06%	36.05%	25.02%	-53.37%
	Pre crisis average	97.82%	17.63%	12.67%		100.06%	6.97%	31.80%	30.82%	26.27%	21.50%	2.73%	41.21%	37.71%		12.59%		4.21%	
	Post crisis average	10.87%	-1.01%	11.98%	1.81%	-2.93%	-13.25%	-4.05%	15.60%	5.98%	0.17%	3.73%	14.53%	23.71%	25.36%	-8.86%	36.05%	36.91%	-53.37%
OTs GR 5 years	Global average	45.67%	8.95%	15.41%	7.16%	23.68%	-2.71%	4.59%	24.32%	16.54%	11.11%	6.55%	27.42%	31.98%	29.81%	2.12%	42.12%	28.20%	-47.12%
	Pre crisis average	98.33%	18.14%	13.18%		100.34%	7.48%	32.08%	31.34%	26.78%	22.01%	3.25%	41.73%	38.22%		13.10%		4.72%	
	Post crisis average	15.57%	3.70%	16.69%	7.16%	1.78%	-8.54%	0.66%	20.31%	10.69%	4.87%	8.44%	19.24%	28.42%	29.81%	-4.16%	42.12%	41.61%	-47.12%
OTs PT 5 years	Global average	42.92%	6.20%	12.66%	2.22%	20.32%	-5.46%	0.82%	21.57%	13.79%	8.36%	3.80%	24.67%	29.23%	26.50%	-0.63%	36.34%	25.45%	-52.70%
	Pre crisis average	98.29%	18.10%	13.14%		100.24%	7.44%	31.99%	31.29%	26.73%	21.97%	3.20%	41.68%	38.18%		13.06%		4.68%	
	Post crisis average	11.28%	-0.60%	12.40%	2.22%	-2.52%	-12.83%	-3.63%	16.01%	6.39%	0.58%	4.14%	14.94%	24.12%	26.50%	-8.45%	36.34%	37.32%	-52.70%

Table 7: Risk premium evolution by PSI 20 stock

5. Conclusions

Portuguese interest rates proved to be fairly close to the German ones until 2007 for most maturities, but from 2008, with the fall of Lehman Brothers, several revisions of the Portuguese sovereign debt rating and the uncertainty of economic developments it was observed an increasing discrepancy between the German and Portuguese yields, reaching its maximum between 2011 and 2012. The increasing Portuguese interest rate raised strong concerns in the Portuguese Government, culminating in the Memorandum of Understanding between Portugal, the EU, ECB and the IMF in May 2011. Using the statistical tool "t-test" it was proved that the differences between the pre crisis return mean and the post crisis return mean is statistically significant for all instruments of public debt.
The profitability of the Portuguese market was carried out mainly through the PSI 20 TR and PSI Geral. Until 2007 the daily returns had low fluctuations for both indexes but from 2008 the returns observed varied between -10.00% and 10.00%. The profitability of the PSI 20 TR index in the pre crisis period had a value of 22.47% in contrast to the value obtained in the post crisis period of -3.11%, according to the arithmetic mean. The PSI Geral follows the same trend showing a return of 21.64% for the pre crisis period and -2.92% for the post crisis period.

Regarding the 18 selected stocks it can be seen that once again the overall return has been impacted by the 2008 crisis. The most affected stocks were the BPI, EDPR, GALP, PHR, BCP, BANIF and RENE. Furthermore, when looking for the most affected sectors, the Financial sector (PTFIN) is highlighted with a clear difference between profitability in the pre and post crisis periods.

Also, the difference in the average return between the two periods is statistically significant for both PSI 20 TR, PSI Geral and also for the Financial sector (PTFIN) and Industrial sector (PTIN) showing again the Financial sector as one of the most affected in terms of profitability.

In terms of risk premiums, the PSI 20 TR and PSI Geral showed considerable differences for the risk premium estimated with the 10 years German t-bonds, presenting a risk premium of 15.51% and 14.70% in the pre crisis period and of -6.62% and -6.45% in the post crisis period, respectively. In sector terms, the Basic Materials sector (PT BM) was the exception with a higher risk premium in the post crisis (14.87%) than in the pre crisis period (10.54%), also for the 10 years German t-bonds. The sectors PTFIN, PTTEC, PTIN, PTTEL and PTUT showed a negative risk premium values in the post crisis differing from the positive values of the pre crisis period.

Individually the IPR and TDSA stocks were the only ones performing better in the post crisis and the BANIF and GALP were the ones performing worse on the same period.

The beta, measuring the systematic risk, showed a slightly higher coefficient for the PSI Geral in comparison with the PSI 20 TR on both pre and post crisis but it was not possible to establish any transversal tendency for the beta values on the majority of individual stocks with some of them increasing, some decreasing and some even keeping the same values between pre and post crisis periods.

In conclusion, the methodology adopted shows that in fact the economic and financial crisis had an impact on the Portuguese stock market, public debt interest rates and the risk premiums, and that the political measures of The Memorandum of Economic and Financial Policies signed by the Portuguese Government with the *"Troika"* in May 2011 as part of the foreign aid program, created even more pressure on the Portuguese market.

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