A problem in the bank is a problem in the street. Forecasting sovereign yield spreads during one (or two) financial crisis.

Msc. Dissertation

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Word Count: 6000
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September 30, 2016

Abstract

Considering three countries I study impacts of the financial sector of important but peripherical countries (Italy, Portugal and Spain) on the sovereign yields. At the core of the idea are the recent international interventions on the aftermath of the Greek/Euro crisis. While the focus has been on the role of public deficits and high levels of public indebtedness the role of the fragile financial sector has been ignored in most debates. A weak and capital deprived financial system might create a self fulfilling circle of economic and financial crisis. A financial crisis might lead to a programme of public assistance (particularly if there is a "too big too fail" financial sector), and therefore increase that the government that implements the programme also runs out of funding options. In this paper I used data for the period 2001-2014 to construct different econometric models that confirm the existence of a negative effect created by the financial sector. This effect is so relevant that it leads to a profitable trading model where bond returns are dictated by the past perfomance of bank equity prices.

"Ega's book! During his last two years in Coimbra, he began to speak of his book, telling the plan, releasing titles of chapters, quoting great sounding phrases in the cafes. And among Ega's friends it was already discussed how the book should start, the shape and the idea, of a new literary revolution. In Lisbon (..) the book was announced as an event. Graduates, contemporary and his associates had taken from Coimbra Ega's book fame and scattered by the provinces and the islands. The news had even reached Brazil ... and feeling this anxious expectation around his book - Ega had finally decided to write it."[1]

The Maias, José Maria de Eça de Queirós

"O Livro do Ega! Fora em Coimbra, nos dois últimos anos, que ele começara a falar do seu livro, contando o plano, soltando títulos de capítulos, citando pelos cafés frases de grande sonoridade. E entre os amigos do Ega discutia-se já o livro do Ega como devendo iniciar, pela forma e pela ideia, uma evolução literária. Em Lisboa (...) o livro fora anunciado como um acontecimento. Bacharéis, contemporâneos ou seus condiscípulos, tinham levado de Coimbra, espalhado pelas províncias e pelas ilhas a fama do livro do Ega. Já de qualquer modo essa noticia chegara ao Brasil... E sentindo esta ansiosa expectativa em torno do seu livro - o Ega decidira-se enfim a escrevê-lo."

Os Maias, José Maria de Eça de Queirós

[1] My translation

Contents

1 Introduction

The macroeconomic developments of the last 15 years in Europe and US have highlighted the strong linkage between the financial sector and the overall direction of the economy. In the US a fast growing financial sector created more aggressive practices of secularization, risk sharing and financial innovation that eventually lead to the subprime crisis and a global economic slowdown now know as the great recession. In Europe the creation of the eurozone also lead to the expansion of the financial sector in some peripheral economies, aided by the availability of cheap credit. This problem, associated with the perception of increasingly frequency of financial crisis created a trend on assessing if there is something as an optimal size of the financial sector. Jean-Louis Arcand et al. (2015) shows that there is indeed such thing as "too much finance".

I suggest that the interconnection between the future of the financial sector and the public finances is more deep than previously discussed. Particularly in the context of a monetary union, there are systemically important banks at the national level that aren't so at the level of the union. If a bank operates with a strong focus and dependency on their national economy, automatically become highly dependant of the outcome of that same economy. If this is the case, it means that a feedback loop can be created (as a crisis in the banking system can lead to an economic crisis that in turn accentuates the banking crisis)[2]. However the current policy framework does not seem to acknowledge this directly as capital requirements of investments in bonds of the national economy have the same capital requirements than investments of similar risk level[3]. Given that this idea is inspired in the recent developments of the European economy it might sound a very regional-specific problem, but it generalizes in several different ways.

2 What's the role of home country bias in a sovereign debt crisis?

The disproportionate size of the financial system in some European countries led to an additional level of instability in the past decade[4]. Several European banks though are not *too big to fail* for the eurozone are definitely to their local economy. Bank nationalizations, or massive programs of public assistance have been pretty common during the last decade and have included giants like RBS, Lloyds, Anglo-Irish Bank and arguably Citigroup. Given the sheer significance of the involved amounts this has created threats to the solvability of some sovereign nations. Consider for instance Ireland where the nationalisation of Anglo Irish Bank and Irish Nationwide Bank cost amounted to 34.7 billion euros more than 20% of the country GDP. To some extent this proves that the activity of the financial sector has a high degree of political setting that is not fully explained by a profit maximization behaviour. Fernández-Villaverde et al. (2013) provides an extensive and interesting narrative for the case of political credit cycles in Europe.

[2]The inadequacy of proper policy measures in the European union is not necessarily a surprise given the drawbacks from the original design, see De Grauwe (2000) and De Grauwe and Aksoy (1999)

[3]This has been partly been addressed recently with the introduction of Stress tests that assess the impact of some adverse economic scenarios in the banks capital position

[4]Clearly Jean-Louis Arcand et al. (2015) shows the effect on large financial systems in individual banks. Kindleberger (2001) is also the seminal contribution on showing that instability of the financial system is not so much a bug but a *feature* of the market economy

There is early evidence on the role of home country bias. Just recently a study by the IMF, Asonuma et al. (2015),conducted an analysis of advanced and emerging markets and showed that home country bias is used as a cost saving mechanism, but that indeed creates some fragility as in the presence of worsening market situations decreases the effectiveness of fiscal policy.

This research line seems to be gaining some attention Cornand et al. (2014) is a recent working paper that models the impact of home country bias and, in my opinion, finds a particularly striking finding that home country bias is not destabilizing. I argue that the source of this result is some deficient modelling of the financial sector in their theoretical approach. Their view is that the government chooses to pay/default based on their observation of the level of debt owned by home households - it fails to introduce the mechanism that the cost of that debt might be externally affected by the amount of bias.

The role of the financial system in the realization of a sovereign debt crisis has been mostly ignored in academic research where often subjects are studied separately (banking crisis on one side, sovereign debt crisis in a different one). The IMF in IMF (2014) however shed some light on this dynamics and specifically highlights that most governments do not discuss the fiscal risks associated with supporting the banking sector as a major problem[5]. Arellano and Bai (2012) showed that sovereign default events are historically interlinked, as a default of one nation increases the probability of other nation's default. In their multi-country model nations are linked to one another by borrowing from and renegotiating with common lenders. However this propagation mechanism is not completely realistic I would argue, as it relies on a strong assumption about common lenders that does not particularly hold. And when it holds, those lenders tend to be international Institutions like the IMF or ESM that have a core concern on avoiding the contagion of default events. In my theoretical approach the contagion mechanism is made through the fragility of the national financial system. As presented in the diagram below banks limited profitability and failure risk increase the chance of a bailout, that in turn puts pressure on the yields of sovereign debt and has banks are heavily exposed to sovereign debt the circle starts all over again.

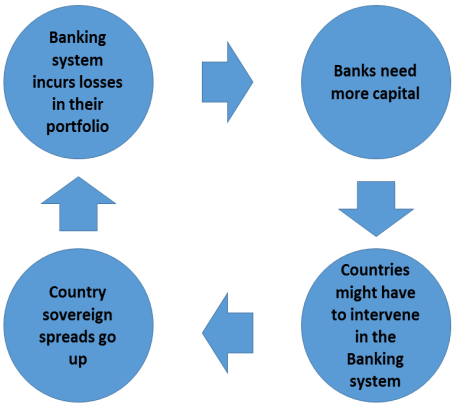

Figure 1: Sovereign feedback effects in a Banking Crisis

[5]Also interesting to note that the IMF has a long standing tradition in understanding the role of a correct sovereign debt design in preventing economic crisis - see for instance Borensztein et al. (2005). Even latest model generations of sovereign default and debt restructuring fail to incorporate the feedback effects of a strong bank exposure (see for instance Yue (2010)

2.1 Theoretical framework

The recent research on sovereign debt and the linkages with the current political debate is discussed at length in Aguiar and Amador (2015). They show the specific dynamics of the sovereign debt markets, defined by the limited commitment; political economy frictions; the possibility of unobserved or unverifiable shocks in limiting risk sharing; the vulnerability to self-fulfilling debt crises; the difficulties in renegotiating debt in a timely and efficient manner. My research idea clearly fits into this agenda. First of all I would like to consider the hypothesis that the degree of home country bias can have an effect on the final outcome/equilibria. ***Conceptually, I argue that a country where the banking system has a higher exposure to the nation sovereign debt is more likely to have sovereign default mostly justified by the feedback loop discussed in the previous point.***

De Marco (2013) using data for European banks during the sovereign debt crisis in southern Europe shows that for a 1% increase in the sovereign losses over total assets, on average, the growth rate in loans declines by 5.3%. This is particularly worrying as in the limit the financial system can be seen as an inefficient leveraged bet on sovereign debt. European banks benefited from cheap liquidity assistance, and in some cases public capital and use that to passively invest in sovereign debt[6]. It adds to the inefficiency that countries like Ireland, Portugal, Spain and Greece injected capital in their banking system at a cost lower cost than their cost in the international market. This situation represents to some extent a capture of the political system, that is trapped in a situation where effectively is subsidizing the financial system to buy sovereign debt. Using data from European Banks Battistini et al. (2013) finds supporting evidence to this view, they concluded that in the periphery, banks respond to increases in country risk by increasing their domestic exposure, while in core countries they do not. By their risk taking actions, banks in the periphery increased the likelihood of a sovereign default as they added to the fragility of the banking system.

2.2 Empirical strategy

Using daily data for bank equity prices and sovereign bond yields in three different countries (Portugal, Spain and Italy) I will assess the interconnection between the financial sector and government public finance decision. The use of financial data for highly liquid and trade products makes the identification strategy straightforward and easily extendable to other countries.

2.3 Policy implications

The most straightforward implication is that an optimal level of capital requirements should be influenced by the degree of home country bias. If a bank is basically using the public guarantees to buy sovereign debt it is effectively receiving a subsidy from the government. Research like Clerc et al. (2014) and Mendicino (2014) already shows that optimum levels of capital might be significantly higher than the ones proposed in Basel, it is likely that this optimal level might be higher in the presence of bias, or lower in the case of a country where the Banking system is well diversified.

[6]The financial system also benefit from other surprising defenses from the regulators, like short selling bans that were at best ineffective as seen in Lioui (2009)

3 Modelling

3.1 Data

The data used covers the equity prices of the public listed Banks and the sovereign yield spread of a Italian, Portuguese and Spanish 10 year bond to the equivalent Germand Bond (often referred as the Bund). The tickers used for the Italian are refer to the instituions listed in the main local Index MIB40[7]. The data for the portuguese banks refers to the the tickers BES[8], BPI and BCP. For Spain I used the banks listed in the IBEX35 [9]. Data for publicly trade companies is easily available from different sources like Yahoo Finance, Google Finance or professional providers like Reuters and Bloomberg. Data for the italian, portuguese and spanish 10 year bond is obtained from the respective Bloomberg Index (GBTPGR10:IND, GSPT10YR:IND, GSPG10YR:IND). Data for the German 10 year Bond was also obtained from Bloomberg (GDBR10:IND) and used as a proxy for the risk-free interest rate.

The data refers to the period from the beginning of 2001 to mid 2014. During those 13 years, the situation has moved for an euphoria moment where perepherical bond yields were basically on par with the ones from Germany to the heights of the euro crisis where a default looked almost unavoidable(see the influence of Reinhart and Rogoff (2009) during the aftermath of the US crisis) to finally a period of recovery after the commitment to do "whatever it takes" by the ECB governor Mario Draghi[10].

Looking at the figure below we see the evolution of the Italian banking sector and the Italian sovereign yield spread. For the majority of the period up to the aftermath of 2007-8 Financial crisis the yield spread remained virtually unchanged despite significant swings and cycles in equity prices.

[7]Namely ISP, BMPS, UCG, BPE, MB, PMI, BP and UBI.

[8]Disclosure: I started my professional career at Banco Espirito Santo as Junior analyst in 2007-9. Banco Espirito Santo collapsed in August 2014, mostly due to some accounting shenanigans that probably were already in practice during my career at the bank, but obviously as a junior employee of a major bank I was completely oblivious to it. However the collapse of the bank, and its effects in the Portuguese economy were clearly an intellectual motivation for this thesis.

[9]Namely BBVA, BKT, POP, SAB and SAN.

[10]In the know well known "whatever it takes speech" in a London Investor Conference in June 2012, "But there is another message I want to tell you. Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough." https://www.ecb.europa.eu/press/key/date/2012/html/sp120726.en.html

Figure 2: **Italy**: Evolution of Bank equity prices (Jan2001 = 100) and sovereign bond yield spread (%)

Portuguese data shows the same overall pattern: a cycle of virtually unchanged yield spreads followed by a higher degree of synchronicity between equity prices and yield spreads. From the next figure we see that the Portuguese spread was as low as 0% in 2006 and as high as 16% in 2012. The equity prices of the different banks are now significantly lower than in the early 2000's but have shown different patterns and cycles that do not necessarily match the evolution of the sovereign yield

Figure 3: **Portugal**: Evolution of Bank equity prices (Jan2001 = 100) and sovereign bond yield spread (%)

The Spanish market shared some of the same pattern. However the cycle of devaluation of the financial sector seems to have been way smaller than in the other two countries. The Spanish banking system is more internationalised than the Portuguese and Italian counterparts and thus more resilient. This is particularly driven by Banco Santander and Banco Bilbao Vizcaya that have large operations in South America and the UK.

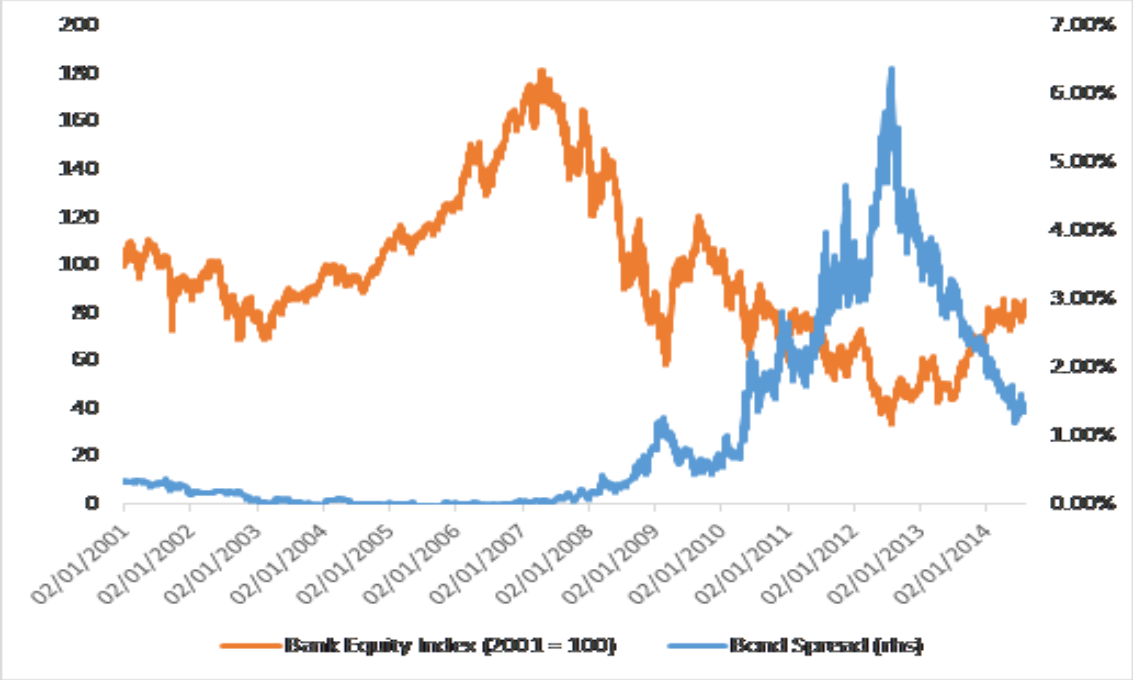

Figure 4: **Spain**: Evolution of Bank equity prices (Jan2001 = 100) and sovereign bond yield spread (%)

3.1.1 Data transformation

Traditionally the overall level of the bond yield is not very informative as one of the main components is the risk-free interest rate. Following the usual convention in financial markets and economic theory, I used the bond yield of the German equivalent bond as a proxy for the risk-free interest rate. In this way I created the sovereign spread of each country (Italy, Portugal and Spain) in relation to the german Bond. Considering for example the Portuguese bond spread (lets call it PTSpread) is just the difference between the portuguese bond yield and the german yield. Because we are interested in assessing the results on the changes of the spread we can additionally define:

$$PTVar_t = PTSpread_t - PTSpread_{t-1} \tag{1}$$

For the equity data, we are not interested in the overall price level of each of the individual banks (in the portuguese case BES, BPI, BCP) but their daily changed defined as:

$$VARBank_t = (BankPrice_t / BankPrice_{t-1}) - 1 \tag{2}$$

3.1.2 Specific model considerations

In this section I will build four econometric models that will incrementally add some more depth to the analysis and will work in turn as sensitivity tests. The data set, covering approximately 15 years should provide space to different approaches while covering different economic moments (expansions, recessions, international events and local events). I will first introduce a simplistic model where the variation of the yield spread is just a function of the contemporaneous changes

in equity prices. The model has a naive dimension as the causality mechanism is not clear, given that it is possible that yield spread changes *cause* the changes in equity prices. A second more complete model, denoted *a model of bad and good news* builds on my argument that the feedback loop is caused by the perception that stress in the financial system might increase the chance of a public intervention. If this is the case one would expect that negative impacts in equity prices should have a bigger impact than similar magnitude positive shocks. The third model explores the time-series structure of the data set, showing that decreases/increases in bank equity prices precede increases/decreases in the sovereign bond yield spread. The fourth and last model is a direct application of the time series framework. I will argue that the effect of bank equity prices is of such magnitude that it allows to forecast in a profitable way the sovereign bond yields spread[11]. I will do this by running a trading algorithm that each day will produce a one day ahead out of sample forecast and trade on that forecast.

3.2 A Naive Baseline Model

The first model is a naive formulation that will work as a preliminary exploration and as a baseline result. If my theoretical approach is correct, I should be able to find in a regression context the negative correlation mentioned between the Banks equity prices and the Portuguese Sovereign bond yield. As I'm not interested in the levels of any of the variables, I will use the daily appreciation/depreciation of the individual prices of the three main banks and it's effects on the sovereign yields - the changes in the total yield.

I have run for each of the three countries the following regression:

$$CuntrySpreadVar_t = \beta_0 + \beta_1 VARBank_{1,t} + ... + \beta_1 VARBank_{n,t}$$

(3)

Looking at the same period effect of bank equity price changes on the change of the spread. This model is naive in the sense it does not specifically adress the causation meachanism, as it might be in the opposite direction (changes in country spread causing changes in equity prices).

3.2.1 Italy

The model for italy includes the eight banks listed in the italian MIB40. Looking at the formulation with roboust standard errors, we see that the majority of banks have coefficients statistically significant. More importantly, all the estimated effects indicate that an increase/decrease in equity prices causes a decrease/increase in the sovereign bond spread. Given the specific formulation of the model we see that a 1% decrease in the equity prices of banks causes an increase of 1.4 to 6.2 basis points.

[11] This idea of testing an idea by its profitability is not necessarly new or unrelated to this topic, as see in Easton and Gao (2009) and the results of pre-earnings announcement drifts.

Table 1: Italian Sovereign bond yield spread and the changes in the Italian Bank's equity prices

	Dependent variable:	
	IT_var	
	default	robust
	(1)	(2)
Var_ISP	-0.238***	-0.238**
	(0.040)	(0.119)
Var_BMPS	-0.272***	-0.272***
	(0.045)	(0.070)
Var_UCG	-0.061*	-0.061*
	(0.033)	(0.036)
Var_BPE	-0.629***	-0.629***
	(0.049)	(0.124)
Var_MB	-0.148**	-0.148
	(0.067)	(0.096)
Var_PMI	-0.264***	-0.264***
	(0.048)	(0.075)
Var_BP	-0.146***	-0.146**
	(0.036)	(0.065)
Var_UBI	-0.002	-0.002
	(0.003)	(0.004)
Constant	0.001	0.001
	(0.001)	(0.001)
Observations	3,544	3,544
R^2	0.263	0.263
Adjusted R^2	0.261	0.261
Residual Std. Error (df = 3535)	0.057	0.057
F Statistic (df = 8; 3535)	157.443***	157.443***
Note:	*p<0.1; **p<0.05; ***p<0.01	

3.2.2 Portugal

The results for Portugal also support the argument that Positive (negative) impacts in equity prices cause decreases (increases) in the sovereign yield. The results suggest that a 1% decrease in the equity prices of banks causes an increase of 5.1 to 7.4 basis points in the Portuguese bond yield spread [12] All this results are significant to the 1% level. Given that Portugal is a smaller country the relative importance of each single bank is greater, and that seems to be reflected in the result as all the banks are considered relevant in the model and the absolute impacts are also greater than the one founds in the italian model. Finally, but also relevant, the constant is statistically insignificant which is to be expected as the changes of yields are not expected to have a drift element.

Table 2: Portuguese Sovereign bond yield spread and the changes in the Portuguese Bank's equity prices

	Dependent variable:	
	PT_var	
	default	robust
	(1)	(2)
Var_BCP	-0.513***	-0.513***
	(0.102)	(0.159)
Var_BES	-0.749***	-0.749***
	(0.097)	(0.149)
Var_BPI	-0.749***	-0.749***
	(0.118)	(0.162)
Constant	-0.0002	-0.0002
	(0.002)	(0.002)
Observations	3,535	3,535
R^2	0.094	0.094
Adjusted R^2	0.093	0.093
Residual Std. Error (df = 3531)	0.121	0.121
F Statistic (df = 3; 3531)	121.705***	121.705***
Note:	*p<0.1; **p<0.05; ***p<0.01	

3.2.3 Spain

For the Spanish model the results indicate that 4 out of the 7 banks are considered significant, and once again in the direction that supports the argument that a increase(decrease) of equity prices

[12] Please note that there's an inverse relationship between bond yields, and bond prices. Thus if a bond yield goes up the corresponding price goes down, leading to a higher cost of funding for the sovereign.

is related with decrease(increases) in the sovereign bond yield spread. The range of impacts goes from 3 to 7 basis point for a 1% change in an individual bank equity price.

Table 3: Spanish Sovereign bond yield spread and the changes in the Spanish Bank's equity prices

	Dependent variable:	
	ES_var	
	default	robust
	(1)	(2)
Var_BBVA	-0.727***	-0.727***
	(0.124)	(0.135)
Var_BKIA	-0.038	-0.038
	(0.024)	(0.027)
Var_BKT	-0.315***	-0.315***
	(0.064)	(0.079)
Var_CABK	-0.442***	-0.442**
	(0.090)	(0.175)
Var_POP	-0.352***	-0.352***
	(0.075)	(0.107)
Var_SAB	-0.063	-0.063
	(0.076)	(0.117)
Var_SAN	0.182	0.182
	(0.117)	(0.113)
Constant	0.001	0.001
	(0.001)	(0.001)
Observations	3,539	3,539
R^2	0.175	0.175
Adjusted R^2	0.174	0.174
Residual Std. Error (df = 3531)	0.062	0.062
F Statistic (df = 7; 3531)	107.271***	107.271***
Note:	*p<0.1; **p<0.05; ***p<0.01	

3.2.4 Summary

The summary of results for the three countries show that in total 18 banks were considered and I found significant effects in 12. In each of those 12 banks the effects detected had the right sign, supporting the thesis that negative shocks in equity prices have adverse effects on the sovereign yield. The constant was not found significant in any of the models, showing that the returns do not exhibit any fixed pattern or drift (which would be problematic as equity returns are supposed to be I(0)).

Table 4: Analysis of the naive model

	Italy	**Portugal**	**Spain**
Banks Considered	8	3	7
Effects detected	5/8	3/3	4/7
"Right" sign identified	**5/5**	**3/3**	**4/4**
Constant statistically significant	No	No	No

3.3 A model of bad and good news

One important transmission mechanism is the moral hazard element introduced by the "too big too fail" phenomena, where the government might be required to intervene in the banks. This moral hazard element is marked by an asymmetric payoff structure. Bad news for the financial institutions are bad news for the sovereign yields as it might indicate the necessity of intervention, while good news for the financial institutions are just neutral to the sovereign yields (as the government does not receive any sort of payout for banks not going into bankruptcy). With this in mind the model of this section decomposes the changes in equity prices into Positive and negative. Where positive changes are:

$$VARPositive_t = VARBank_t \text{ ,if VARBank greater or equal than 0} \tag{4}$$

and

$$VARPositive_t = 0 \text{ ,elsewhere} \tag{5}$$

Conversely negative changes are defined for each bank as:

$$VARNegative_t = VARBank_t \text{ ,if VARBank less than 0} \tag{6}$$

and

$$VARNegative_t = 0 \text{ ,elsewhere} \tag{7}$$

For interpretation of the regression results please note that VARPositive will be either zero or a positive figure, whilst VARNegative will always be negative or zero.

3.3.1 Italy

The first model, for Italy shows that there is a logic to separate the two distinct effects. For some banks, like ISP, only the negative changes to equity prices seem to relevant. Several of the banks included in the previous model continue to be significant thus validating the idea that changes in equity prices are determinant factors to the evolution of sovereign spreads.

Table 5: Italy: A model of sovereign yield spread with negative and positive impacts

	Dependent variable:	
	IT_var	
	default	robust
	(1)	(2)
BMPS_Negative	-0.235***	-0.235**
	(0.067)	(0.115)
BMPS_Positive	-0.214***	-0.214**
	(0.077)	(0.097)
BPE_Negative	-0.391***	-0.391***
	(0.061)	(0.129)
BPE_Positive	-1.180***	-1.180***
	(0.101)	(0.160)
FBK_Positive	1.937	1.937**
	(1.395)	(0.829)
ISP_Negative	-0.466***	-0.466***
	(0.077)	(0.131)
PMI_Negative	-0.201***	-0.201**
	(0.071)	(0.101)
PMI_Positive	-0.290***	-0.290**
	(0.089)	(0.133)
UBI_Positive	0.039***	0.039***
	(0.009)	(0.014)
Constant	-0.001	-0.001
	(0.002)	(0.002)
Observations	3,539	3,539
R^2	0.278	0.278
Adjusted R^2	0.275	0.275
Residual Std. Error (df = 3520)	0.056	0.056
F Statistic (df = 18; 3520)	75.405***	75.405***
Note:	*p<0.1; **p<0.05; ***p<0.01	

3.3.2 Portugal

The regression coefficients have all negative signs, consistent with the hypothesis presented in this paper. A negative impact in the equity prices will have a positive impact in the overall yield spread, whilst a positive impact leads to a decrease in the yield spread. There seems to be some evidence of heterokedasticity in these regression, so looking at the roubust specification we see that for Banco Espirito Santo both negative and positive shocks are statistically significant, and the coefficient for negative shocks is larger. This is particularly interesting as Banco Espirito Santo eventually was declared bankrupt and had to be nationalised effectively costing several billion euros to the taxpayers. For BPI and BCP only positive impacts seem to affect the sovereig yield spread. This seems to indicate a channel of transmission that positive impacts lead to a reduced probability of intervention by public authorities thus reducing the likelihood of a public cost. Once again the constant was found to be statistically insignificant which once again supports the idea that there is no fixed component in the changes of the bond yields spread.

Table 6: Portugal: A model of sovereign yield spread with negative and positive impacts

	Dependent variable:	
	PT_var	
	default	robust
	(1)	(2)
BCP_Negative	-0.316**	-0.316
	(0.156)	(0.276)
BCP_Positive	-0.615***	-0.615**
	(0.176)	(0.240)
BPI_Positive	-1.264***	-1.264***
	(0.208)	(0.302)
BES_Negative	-1.381***	-1.381***
	(0.177)	(0.282)
BES_Positive	-0.397***	-0.397***
	(0.126)	(0.131)
Constant	-0.003	-0.003
	(0.003)	(0.004)
Observations	3,535	3,535
R^2	0.100	0.100
Adjusted R^2	0.098	0.098
Residual Std. Error (df = 3528)	0.121	0.121
F Statistic (df = 6; 3528)	65.310***	65.310***
Note:	*p<0.1; **p<0.05; ***p<0.01	

3.3.3 Spain

The Spanish model found statistically significant effect for three banks, for a total of 6 different coefficients. All the estimated coefficients have the sign that supports the overall idea that negative consequence for equity prices are translated into increases in the sovereign spread yield.

Table 7: Spain: A model of sovereign yield spread with negative and positive impacts

	Dependent variable:	
	ES_var	
	default	robust
	(1)	(2)
BBVA_Negative	-0.773***	-0.773***
	(0.178)	(0.217)
BBVA_Positive	-0.661***	-0.661***
	(0.197)	(0.199)
BKT_Negative	-0.432***	-0.432***
	(0.099)	(0.141)
BKT_Positive	-0.196*	-0.196**
	(0.102)	(0.090)
CABK_Negative	-0.393***	-0.393**
	(0.127)	(0.195)
CABK_Positive	-0.499***	-0.499
	(0.142)	(0.339)
POP_Positive	-0.568***	-0.568***
	(0.128)	(0.179)
Constant	0.00003	0.00003
	(0.002)	(0.002)
Observations	3,538	3,538
R^2	0.178	0.178
Adjusted R^2	0.175	0.175
Residual Std. Error (df = 3523)	0.062	0.062
F Statistic (df = 14; 3523)	54.525***	54.525***
Note:	*p<0.1; **p<0.05; ***p<0.01	

3.3.4 Summary

The following table summarises the results for the three countries studied. A total of 20 coefficients were estimated, and 19 with the sign consistent with the dissertation key idea.

Table 8: Analysis of Positive and negative effects model

	Italy	Portugal	Spain
Banks Considered	8	3	7
Positive Effects detected	5/8	3/3	3/7
Negative Effects detected	4/8	2/3	3/7
"Right" sign identified	**8/9**	**5/5**	**6/6**
Constant statistically significant	No	No	No

3.4 A time series model

The model of the previous subsection only looked at the contemporaneous effect of bank equity prices on the sovereign yield spread. In this section I develop that model by adding a time-series component. After several iterations to find the optimal lag length I developed a model with only two lags. This short period of time is not improbable, as one would imagine that financial markets incorporate information almost instantaneously.

3.4.1 Italy

The time series model found that two out three banks have effects of such magnitude that precede the negative impacts on the overall yield spreads. The range of effects however is smaller than the effects estimated in the contemporaneous impact. This suggests that the results in the previous section might have been to certain extent influenced by common effects to the yield spread and equity prices.

Table 9: Italy: Time Series Model

	Dependent variable:	
	IT_var	
	default	robust
	(1)	(2)
Lag2_Var_BMPS	0.105**	0.105*
	(0.053)	(0.060)
Lag1_Var_PMI	-0.102*	-0.102
	(0.056)	(0.075)
Lag1_Var_UBI	-0.010***	-0.010*
	(0.003)	(0.006)
Constant	0.001	0.001
	(0.001)	(0.001)
Observations	3,544	3,544
R^2	0.010	0.010
Adjusted R^2	0.007	0.007
Residual Std. Error (df = 3529)	0.066	0.066
F Statistic (df = 14; 3529)	2.673***	2.673***
Note:	*p<0.1; **p<0.05; ***p<0.01	

3.4.2 Portugal

The results, in the table below, show that the impact of the identified banks in Portugal are negative as in the previous models. The only noticeable difference is that the effects from BCP are not statistically significant. But the results from BES and BPI are in the direction expected by my hypothesis and add to the evidence that a negative impact in the financial sector creates a cost to the sovereign yield spread. As seen in the Italian model, the range of effects seems to be smaller than the estimated in the naive model.

Table 10: Portugal: Time Series Model

	Dependent variable:	
	Change in Portuguese Spread	
	default	robust
	(1)	(2)
Lag1_BES	-0.340***	-0.340**
	(0.106)	(0.132)
Lag1_BPI	-0.260**	-0.260*
	(0.124)	(0.147)
Lag2_BPI	-0.299**	-0.299**
	(0.125)	(0.150)
Constant	0.0004	0.0004
	(0.002)	(0.002)
Observations	3,532	3,532
R^2	0.014	0.014
Adjusted R^2	0.013	0.013
Residual Std. Error (df = 3525)	0.127	0.127
F Statistic (df = 6; 3525)	8.602***	8.602***
Note:	*p<0.1; **p<0.05; ***p<0.01	

3.4.3 Spain

The Spanish model also found statistically significant results for two of the banks considered. For BBVA the lag two has a positive effect, that to same extent contradicts the model where a negative impact leads to an increase of the yield sprad. However, even in the case of BBVA, the net impact (-0.296 + 0.248) still has a negative sign. As found in the two other countries the impacts are smaller than the ones found in the naive model.

Table 11: Spain: Time Series Model

	Dependent variable:	
	ES_var	
	default	robust
	(1)	(2)
Lag1_Var_BBVA	-0.298**	-0.298**
	(0.137)	(0.143)
Lag2_Var_BBVA	0.248*	0.248**
	(0.137)	(0.118)
Lag1_Var_SAB	-0.230***	-0.230*
	(0.084)	(0.127)
Constant	0.0003	0.0003
	(0.001)	(0.001)
Observations	3,538	3,538
R^2	0.011	0.011
Adjusted R^2	0.007	0.007
Residual Std. Error (df = 3523)	0.068	0.068
F Statistic (df = 14; 3523)	2.797***	2.797***
Note:	*p<0.1; **p<0.05; ***p<0.01	

3.4.4 Summary

The models estimated in this subsection seem to indicate that from a time series perspective, negative news *precede* increases in the sovereign yield spread. This was clearly the case for two of the countries (Portugal and Spain) but with mixed results in the case of Italy.

Table 12: Analysis of Positive and negative effects model

	Italy	Portugal	Spain
Banks Considered	8	3	7
Effects detected	2/8	3/3	2/7
"Right" sign identified	**1/2**	**3/3**	**2/2**
Constant statistically significant	No	No	No

3.5 Introducing Forecasts and a Profitable trading model

Until now we have conclusively established that there seems to be a direct relationship between the evolution of bank equity prices and the evolution of yield spreads. The naive model showed a very strong relationship for all countries, however given that the effect were contemporaneously related the causation mechanism was not clear. A model that separated positive changes in equity prices from negative changes, found evidence that the magnitude of the effects are different. This is in line with the expectation that negative changes in equity prices are more relevant that positive changes. Finally a time-series model proved that changes in equity prices precede and have a casual effect into sovereign yield spreads. This section explores all this results, with a strong focus on the time-series model. If this effect is of real magnitude I propose that it should have a real forecasting power. Instead of measuring through statistical measures of forecasting fit, I suggest that a trading model a more appropriate mechanism. By using a trading model I can directly assess the robustness of the forecasts by its profitability. The following trading algorithm was implemented after the first 50 observations.

1. With the information available at period t, estimate the model of the previous section by an OLS model similar to the one developed in the time series model.
2. Compute the t+1 forecast
3. If the forecast is of an increase in Yield short the Bond, if it is of a decrease go long the Bond
4. Check the actual realization of the yield at t+1. Add/Subtract the corresponding basis point changes to the strategy profit
5. If t+1 still inside the data set range go back to 1.
6. Finish

This means that the trading decision are made with an out-of-sample forecast, and this loop estimated over 3,500 regressions (one for each day in the testing dataset). The idea of this section

is not to provide a profitable trading strategy, but using a trading environment as a testing ground of the idea presented in this paper. This exercise does not consider trading costs, liquidity concerns and other situations relevant for a actual trading strategy. There are two different trading options,

A.Going long the spread: This means that a profit is made if the spread increases. This is done by selling the sovereign bond and buying an equivalent amount of the risk free bond.

B.Going short the spread: Conversely this means that a profit is made if the spread decreases. This is done by buying the sovereign bond and selling an equivalent amount of the risk free bond.

To provide some context and comparison term in addition to the trading algorithm results results for strategy of always going short the sovereign yield bond and always going long the sovereign yield spread are also provided.

3.5.1 Italy

The chart below shows the value of a 100 euro portfolio that on a daily basis goes long the sovereign yield. Not surprisingly the return profile is very similar to the evolution of the yield spread. Remaining virtually unchanged up to the beginning of the financial crisis, followed by a period of huge profitability and finally of loses as yield spreads returned to a lower level.

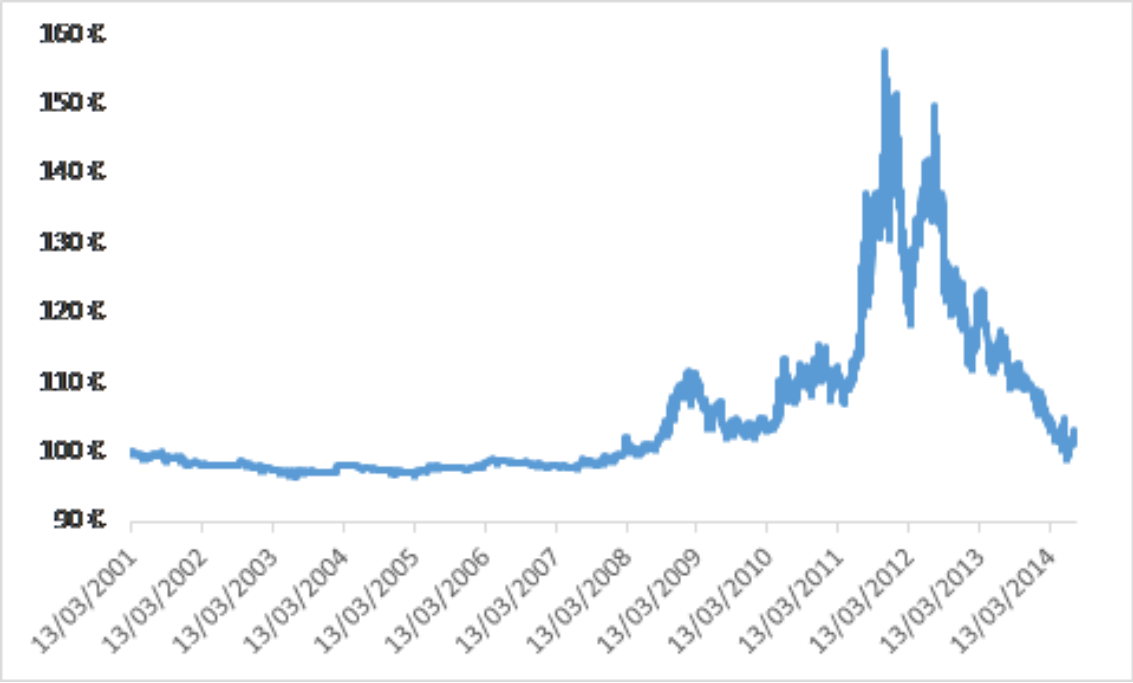

Figure 5: **Italy**: Results for an hypothetical 100 euro portfolio always going long the sovereign spread

The strategy of always going short shows the opposite profile, with a period of heavy losses

as yield spreads rocketed on the aftermath of the financial crisis and then recovered as the ECB implement its unconventional monetary policy of aggressive asset purchases.

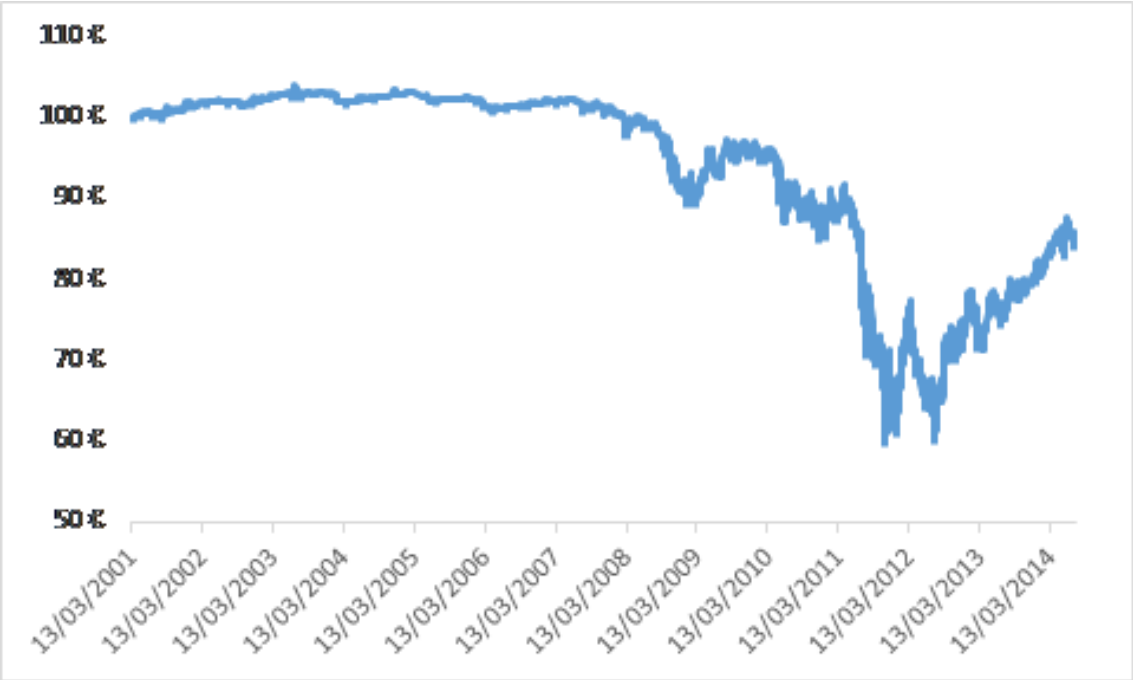

Figure 6: **Italy**: Results for an hypothetical 100 euro portfolio always going short the sovereign spread

The results of the trading model are very similar for the period to the financial crisis, essentially flat returns. However it gradually picks up coinciding with the cycle of raising yields, without the same degree of volatility. More importantly, as yields start to decrease despite the increased volatility of returns the profitability continues to increase.

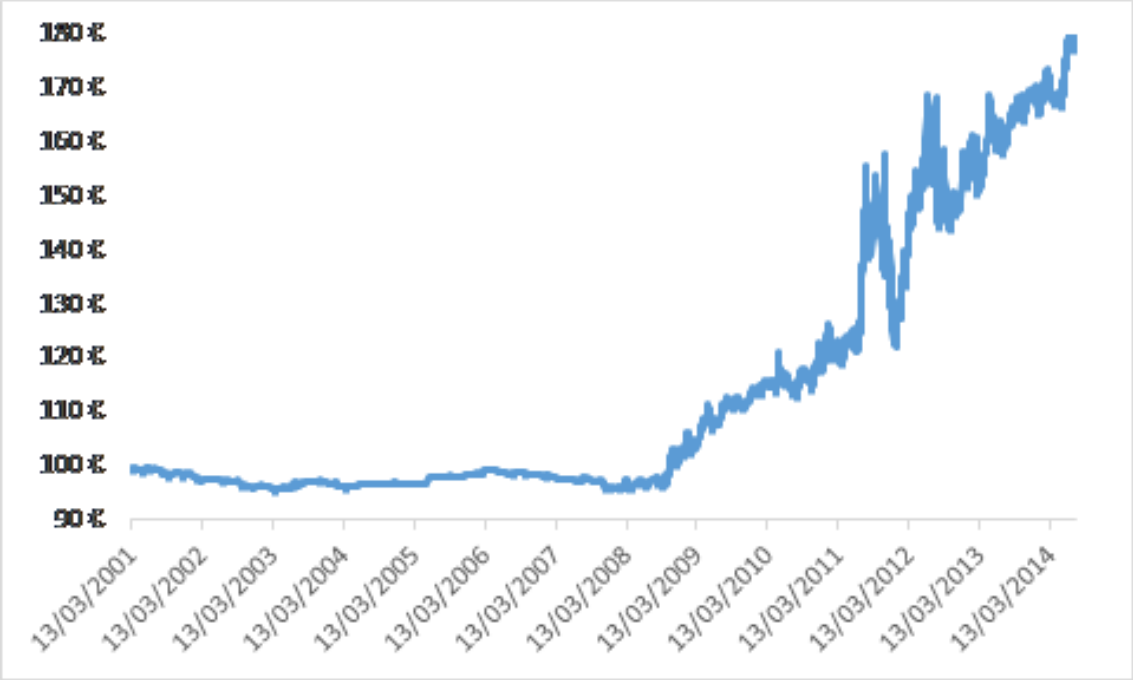

Figure 7: Sum of basis points gained (in % points) by timing the trading direction according to the estimated model

3.5.2 Portugal

Building the results for Portugal we see that once again the results of always going long the yield spread mimics the evolution of the yield spread. It generated a profit while the Portuguese bonds were under pressure after 2009, but it generated a loss as the bond yield returned to lower levels.

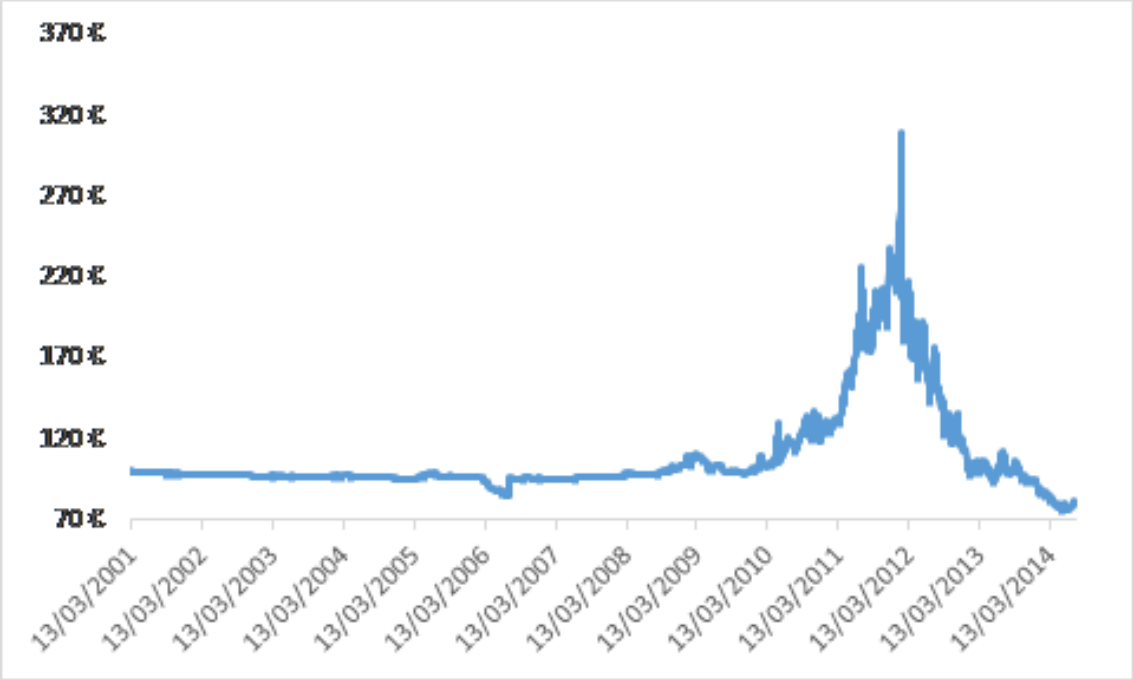

Figure 8: **Portugal**: Results for an hypothetical 100 euro portfolio always going long the sovereign spread

The different naive strategy of always going short the yield spread also does not seem to be profitable over the whole period. The figure below is just the inverse from the previous one and shows that tough it was profitable in the later periods (as bond prices recovered) it incurred in significant losses during the height of the sovereign bond crisis.

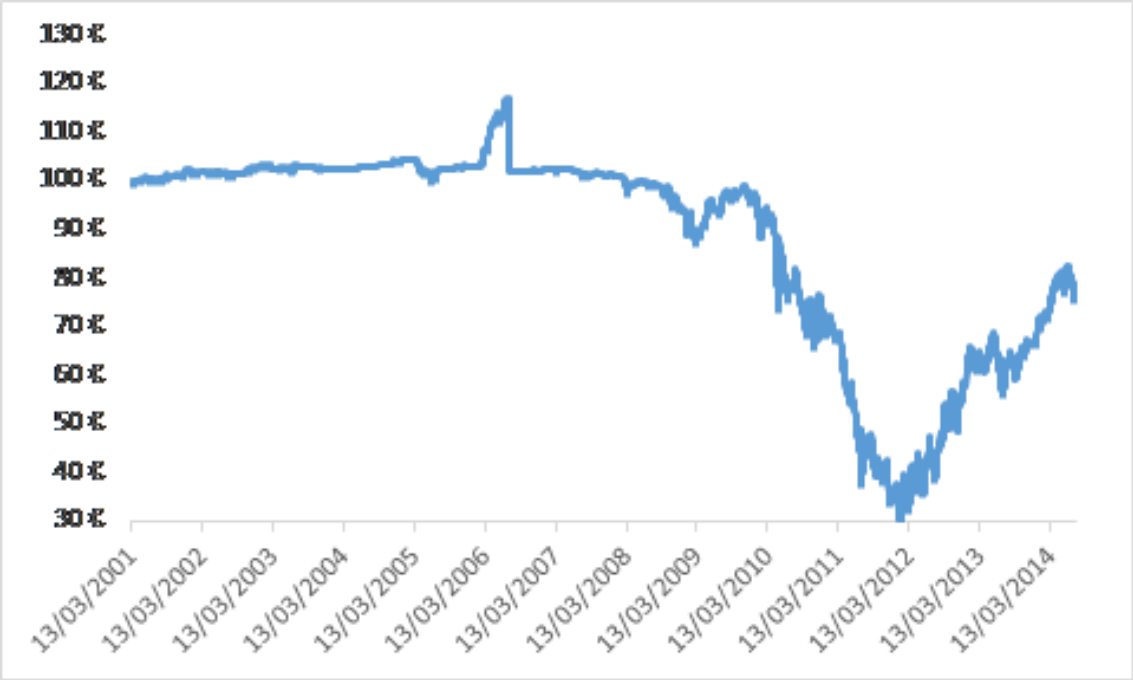

Figure 9: **Portugal**: Results for an hypothetical 100 euro portfolio always going short the sovereign spread

Which lead us to the results of the devised trading algorithm. Again we see that the forecasting model seems to pass with distinction the market test. It generates excess returns that are not dependent of the overall trend of the yield spread. It generates profits in the phase of ascending yields, but also once the yields returned to lower levels. Of particular interest is the fact for the first 2,000 days in the sample the trading strategy produces null returns. The profitability of the strategy only starts to be shown from 2009, exactly the moment where the attention of international markets focused on the sovereign yield spread. This result is a strong piece of evidence that the performance of the sovereign yield spread is closely linked (and even determined) by the overall situation of the financial sector.

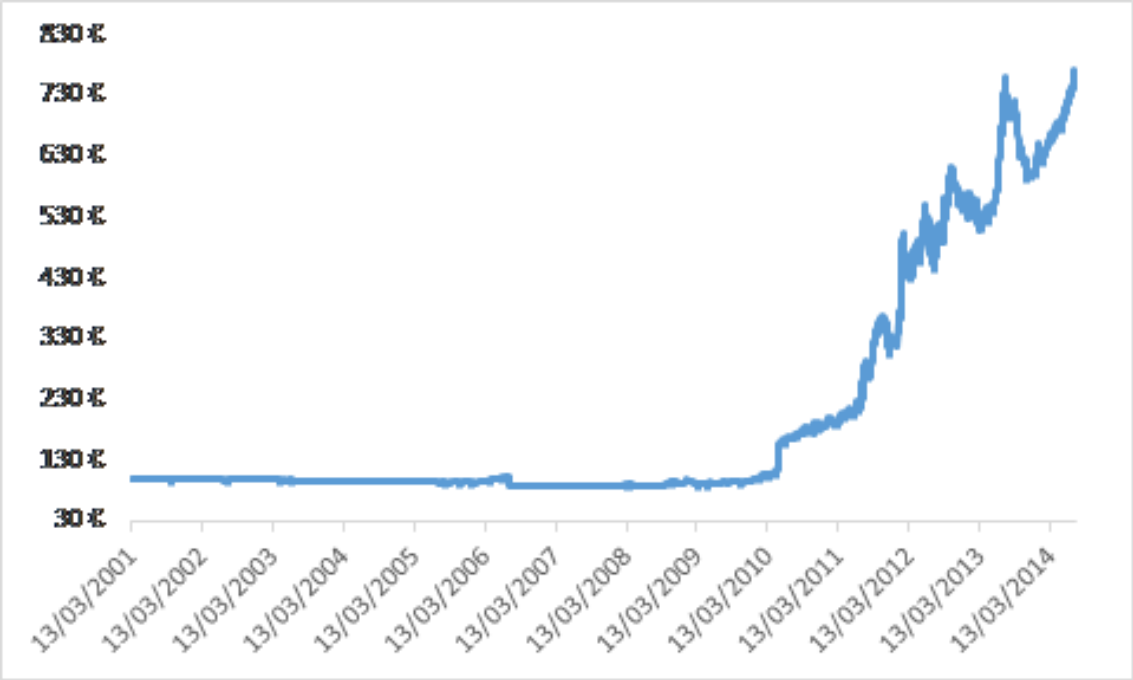

Figure 10: Sum of basis points gained (in % points) by timing the trading direction according to the estimated model

3.5.3 Spain

Moving to the last country in our sample, we see that going long the sovereign spread follows the same pattern than the other countries. A period of essentially flat returns, followed by a profitable period in the ascending period before finally losing all the gains as yields returned to normal levels.

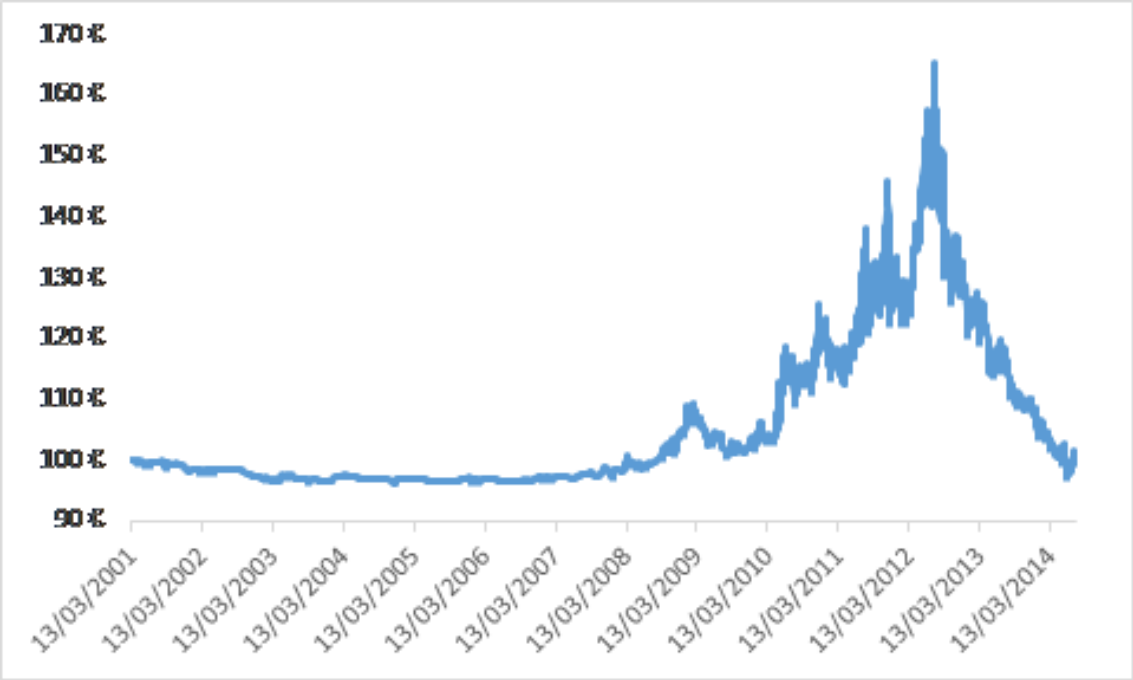

Figure 11: **Spain**: Results for an hypothetical 100 euro portfolio always going long the sovereign spread

The strategy of always going short the yield spread returns a symmetric profile of returns.

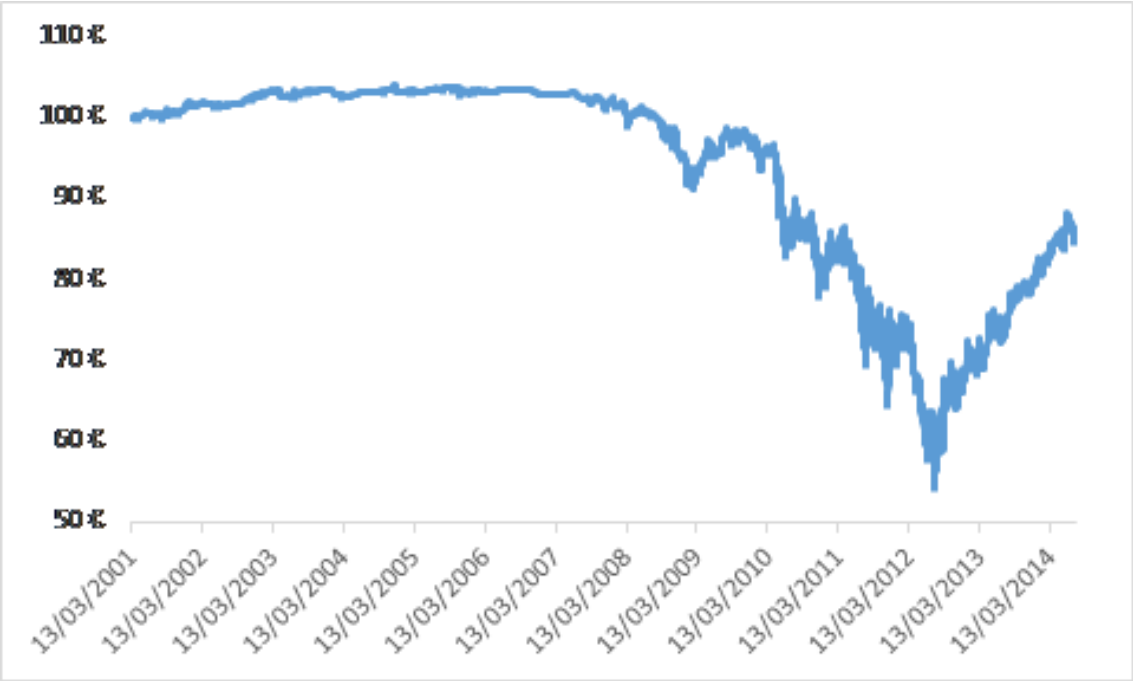

Figure 12: **Spain**: Results for an hypothetical 100 euro portfolio always going short the sovereign spread

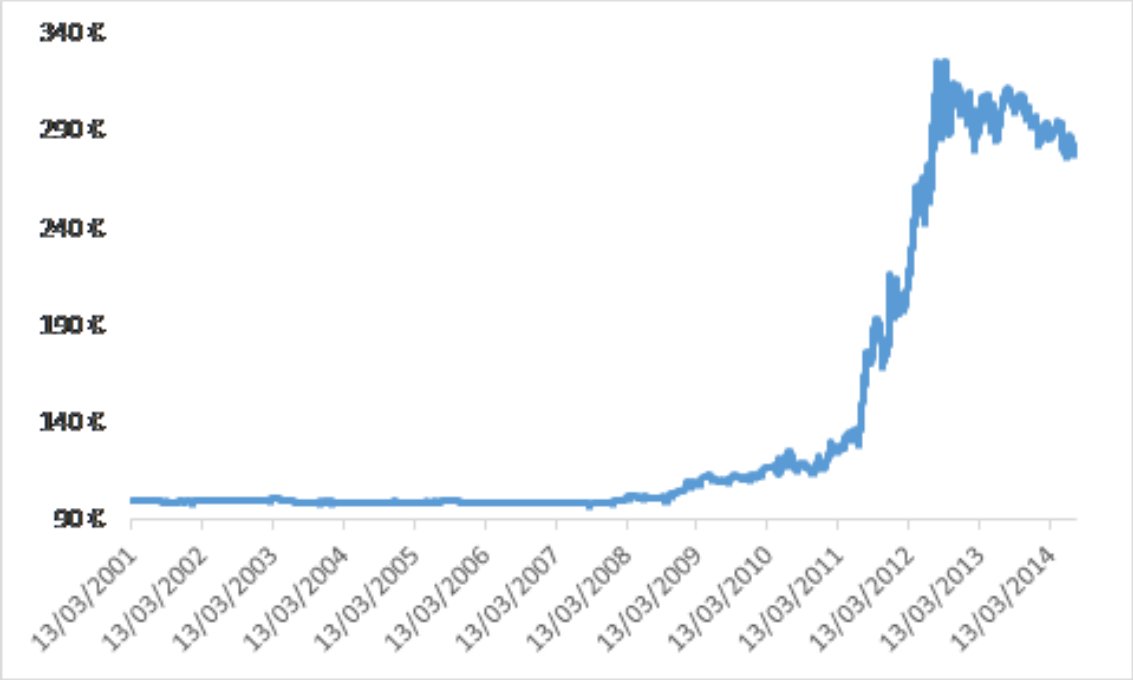

Figure 13: Sum of basis points gained (in % points) by timing the trading direction according to the estimated model

3.5.4 Summary

The summary of returns of the trading algo shows an overall common pattern. Despite the occasional blip of positive returns the average of the three countries shows that the *algo* was unprofitable until 2008. Given the central thesis that negative impacts are an important determinant of yield spreads this cut-off period does not seem to be accidental. Looking at the profile of returns is also significant to see that the returns for 2008-10 despite positive do not seem to be out of the ordinary, it really is during the height of the southern European (triggered by Greece) crisis that the algo posts double digit growth. In a very interesting and encouraging result the degree of profitability across the three countries studied overlaps perfectly the ”level of stress” that the countries experienced. Portugal had to seek international assistance from the IMF, ECB and European Commission and it is the country in our sample where the trading algo best performs. Spain despite avoiding a major international assistance programme, received significant amount of financial support from the European Institutions particularly to capitalize its financial system. Italy, was the country of the group that experienced a smaller level of stress in its sovereign yield spread. Finally, but not leas interesting, we see that the trading algo does not seem to be profitable for Spain in the last two years. This seems to be in line with the perception that Spain was the first country to sail off the financial crisis. In this way the success of the trading strategy seems to work as an indicator of stress in the financial system, that is highly profitable in moments of stress and that returns dissipate once a country economy turns to a more stable environment.

Table 13: Summary return of the trading model for the three countries

	Italy	Portugal	Spain	Average
2001	-1.6%	-0.8%	-0.3%	**-0.9%**
2002	-2.3%	0.0%	0.4%	**-0.6%**
2003	0.8%	-2.9%	-0.4%	**-0.9%**
2004	-0.3%	0.5%	-0.4%	**-0.1%**
2005	2.1%	-3.0%	0.2%	**-0.2%**
2006	-0.4%	-4.9%	-0.5%	**-1.9%**
2007	-2.7%	-0.1%	0.3%	**-0.8%**
2008	7.5%	4.4%	6.4%	**6.1%**
2009	11.0%	6.0%	7.5%	**8.1%**
2010	5.2%	87.3%	3.1%	**31.8%**
2011	4.4%	76.6%	69.1%	**50.0%**
2012	26.5%	70.9%	54.7%	**50.7%**
2013	7.2%	9.3%	-2.4%	**4.7%**
2014	4.5%	23.6%	-6.5%	**7.2%**
2001-14	***77.6%***	***653.2%***	***180.1%***	***303.7%***

4 Conclusion

This paper presented several empirical models to assess the impact of the financial sector perceived situation on the sovereign yield spread of a country. The analysis focused on Italy, Portugal and Spain during a period over a decade covering times of tranquility in the financial sector, but also two financial crisis (the world 2007/8 financial crisis, and the euro-specific related in the subsequent years).

The first model simply described the evolution of the sovereign yield spread as the function of the bank equity prices on that same day. This showed that for the three countries banks negatively impacted the yield spread of the local government. The estimated range showed that a 1% increase/decrease in equity prices of an individual bank would lead to a decrease/increase of 5 to 7 basis points in the sovereign yield spread.

In a second model I addressed the possibility that the nature of the effects might not be symmetric. Meaning, that an increase in the bank's equity prices might have a greater or smaller effect than a decrease. The model decomposed the changes of equity prices into positive and negative effects. The results supported this idea, has for the three countries we found evidence that the effects are different depending on the direction of the movement. But still the main result that bad news in the equity prices are bad news for the yield spread was maintained.

A third model also explored the time-series dynamic of the dataset, specifically for the purpose of forecasting. I developed a model where the change in the sovereign yield spread is a function of 2 lags in the changes in the banks equity prices. Again the results seem to have generalised in a very solid way to all countries.

For the fourth model instead of assessing the forecasts with traditional statistical metrics I did something more ambitious. I assessed if the forecasts were capable of generating positive returns

in trading the sovereign yield spread. The results were quite conclusive, by running an equation for each trading day I was able to generate a 1 step ahead out-of-sample forecast. Those forecasts generated an astonishing return (excluding transaction costs). The profitability was quite significant for the three countries and followed a similar pattern. The returns are mostly concentrated in the post 2009 period, a period of high volatility in the sovereign yield. This suggests that in the post 2009 period in broader terms the faith of the financial sector determined the cost of funding of the governments of these countries.

Overall I presented 4 different approaches to assess the impact of the financial sector in the sovereign yield spread. All the models to some extent have showed a non-trivial negative effect. A main result is that a 1% decrease in a single bank might lead to a 5-8 basis point increases in the sovereign yield spread. Also as a financial asset the financial sector shares seem to have worked as a leveraged bet on the local sovereign yield as it was possible to forecast the return of the bonds just looking at the two day returns of the financial sector. This is a strong indication that a home country bias with strong cost exists and that it must be addressed with adequate capital requirements. By looking at the historical narrative of the European crisis I showed that the overall level of returns works as good indicator of the level of stress in the financial sector of a given country.

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