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Sovereign Debt Spreads within the Euro Area: When Fears Become Excess Fears

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Sovereign Debt Spreads within the Euro Area: When Fears Become Excess Fears

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Abstract

The issue of divergence of sovereign spreads in the Euro area, following the deep financial crisis initiated in 2008 can only in part be related to the stability of the institutional agreements behind the common currency. There is a widespread debate as of how spreads signal a justifiable credit risk differential within the area, or, rather, reflect irrational fears and subjective and biased reasoning. In this paper we suggest a way to filter out of the observed spreads a component which we dub *physiological*, which is the reflection of the reaction to difference between expectations and realizations of economic fundamentals. Such a component is a function of market volatility, a proxy which represents well how new information is processed. The model parameters are estimated over a tranquil period (2000–2007) and then, in keeping with a substantial stream of literature on the topic, they are kept unchanged over the more recent and more turbulent period (2008–2015). We apply our procedure on nine Euro area countries and the US. The difference between observed and predicted values is what we label *excess fears*. As a result, the actual spread is much higher than it should be using as a reference a *physiological* view where news on macroeconomic fundamentals do indeed induce a reaction by the markets, but that this reaction was excessive when compared to what similar episodes had generated in the past.

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1 Introduction

Financial markets were affected by exceptional events following the subprime mortgage crisis and the subsequent credit crunch. The failure of systemically important financial institutions (starting with Bear Sterns in March 2008 and then Lehman Brothers) have sent a series of ripples through the economic system, which affected all securities including sovereign bonds. Bond yields reflect evaluations about a variety of market factors related to the underlying instruments (classes of risk, maturity, etc.), including some herding effect. Consequent to the increased level of uncertainty, the dynamics of yields have often followed divergent paths: this is true for corporate bonds by class of rating relative to the corresponding sovereign, and across sovereign bonds in different countries. Relative dynamics is summarized by spreads, and their evolution within the Euro area has received considerable attention: to be sure, until the end of 2007 it was hardly interesting, oscillating around a few basis points for most countries, reflecting essentially segmentation in market demand, home biases and some need to stimulate foreign demand. Since the beginning of 2008, phenomena of flight to quality benefited mostly the US Treasuries and, in Europe, the German bonds, at the expense of all countries in general and those of Southern Europe in particular. As the Greek situation deepened and questions about debt sustainability arose, spreads for several Euro countries (Italy, Spain, Greece, Ireland and Portugal) started diverging in a substantial way (both in level and in volatility), reaching somewhat alarming levels (just to mention Italy, in excess of 500 basis points, especially between Fall 2011 and July 2012).

Spreads within the Euro area have become – even in the popular lore – a sort of thermometer of *fears* about the stability of the institutional agreements behind the common currency. Whether this fear is justifiable based on general economic and financial conditions is an open question. The sensitivity of the spreads to news (economic, financial or political) has been so high, that throughout these years in many a commentator, there has been a well seeded doubt that the observed spread levels reflect more generic fears, speculation about unjustified doomsday scenarios, rather than truly correspond to a fundamental–based evaluation of risk differentials. Even the very activity of the rating agencies has fuelled such *irrational fears*, with announcements deriving from subjective evaluation of sovereign risk [1].

This juxtaposition between one fraction of the spread to be related to idiosyncratic factors affecting a specific country and another to be attributed to *irrational fears* (also as a consequence of herding effects), raises the important question as of how to identify the two components. The widespread interest in estimating the

[1] As a matter of fact, no econometric model can deliver a conditional expectation of probability of government default in the Euro area, in the absence of any observations as of whether or when one or more defaults have occurred in the past.

fundamental based level of spreads reveals an understandable acceptance of the fact that there is a somewhat physiological component (linked to some observable macroeconomic and financial variables) which translates the economic conditions of a country into its bond prices and, consequently, a component which is tied to (irrational) fear.

The question of how fundamentals are reflected in the interest rates and, correspondingly, in the spreads between bond yields has received substantial attention in the literature. The shared approach seems to be to specify an econometric model where the left–hand side variable is the spread itself and a score of fundamentals (debt over GDP, GDP growth, credit spreads, unemployment, etc.) are chosen as explanatory variables. Many papers deal with models for the determination of long term yields on the one hand or of long term yield spreads on the other.

The literature is rich and grows from several papers which tried to assess the impact of fiscal imbalances on interest rates (or differentials thereof), evolving into a stream of literature which addresses specifically the issue of the turbulence. The time of publication itself is therefore an indication of the concerns driving the analysis. For example, Alesina *et al.* (1992) express an early concern about the perspective of convergence of interest rates in the presence of fiscal imbalances of different importance in 12 OECD countries; Ardagna *et al.* (2004) use annual data in a 16 OECD country panel context where short term interest rates, inflation, GDP growth as well as deficit and debt (both relative to GDP) are the explanatory variables for long term interest rates. Bernoth *et al.* (2006) analyze a time period which straddles the inception of the EMU showing that yield spreads respond significantly to measures of government indebtedness, but that government debts and deficits after the introduction of the common currency were less important than debt-service ratios and liquidity premiums. Codogno *et al.* (2003) also use the period across the adoption of the Euro and are the first who introduce the global risk factors in the form of credit risk spreads as significant determinants of Government bond differentials.

The first signs of stress in the Euro area were investigated by Attinasi *et al.* (2009) in a dynamic panel context on daily data between July 2007 until March 2009, choosing the daily 10-year government bond yield spreads relative to Germany as the dependent variable finding concerns about a country's credit risk and liquidity risk as well as higher international risk aversion, as well as some European Commission forecasts on expected budget deficits and government debt relative to Germany. Using intraday European bond quotes and transactions from the MTS for 10 European Union member countries (Austria, Belgium, Finland, France, Germany Greece, Italy, The Netherlands, Portugal, and Spain) Beber *et al.* (2009) claim that credit quality matters for bond valuation but that, in times of market stress, investors chase liquidity, not credit quality.

After the explosion of the 2010-2012 crisis, the attention was devoted to a large extent to the comovement features of the spreads, having these experienced a common widening for several countries in varying degrees (cf. Favero (2013) for a long list of papers in this vein). Favero (2013) himself recognizes that the levels reached by the spreads during that crisis correspond to systematic prediction errors in an econometric model: he reckons that next to a local factor (essentially connected to debt and growth differentials) and a global credit risk factor (a credit spread) which proxies global attitudes toward risk, a third factor representing expectations (essentially for a breakdown of the Euro) should be added to the analysis. His approach follows a Global VAR modeling (Pesaran *et al.* (2004)) on monthly data (making some adjustment for quarterly data) for ten countries relative to Germany exploiting the contemporaneous correlation information across innovations within a SURE framework. By including a weighted average of the spreads of other countries (possibly capturing expectations in institutional instability) as a third risk factor Favero (2013) achieves forecasts that come closer to the observed spreads. The inclusion of the lagged spread helps in that direction, since the series is highly persistent. By the same token, he reckons that, even so, the highest levels of spreads observed during the Euro debt crisis cannot be attained and thus there is a systematic discrepancy that could be attributed to contagion (i.e. psychological) effects.

A number of contributions take the view that spreads are determined by fundamentals in a *physiological* way and that the discrepancy should be captured by an additional component determined by the reaction to the inception of the Euro debt crisis. Over a *tranquil* period (pre 2007) the latter component is absent and therefore the fundamental relationship can be isolated. Using the estimated parameters together with the observed value of macroeconomic fundamentals post 2007, one could generate admittedly inadequate forecasts, which can be identified as estimates of the physiological component of the spread over the later period. The difference between the actual spreads and such estimated component measures the extent to which spreads have been altered by the reaction to turbulence. We see this as a sound way to filter out the dynamics in the spread due to excess fears and speculative thinking.

When it comes to the choice of variables to insert as covariates in the model, there are a variety of contributions. Many studies typically use variables observed at relatively low frequency cf., as an example, Di Cesare *et al.* (2012). There are several possible criticisms of the procedures adopted by these authors and of the choice of fundamental variables: essentially the vivacity in the behavior of the high–frequency spreads cannot be seen as a reaction to just the quarterly debt to GDP ratio of a single country, subject itself to initial announcements and subsequent revisions. Even though we should keep in mind that this study was carried out at the height of the crisis when the levels of the Italian spread were in excess of 450bp, it was influential in diffusing the belief that a 'fundamental' justifiable level of the spread would be around 200 bp, an estimate evidently contradicted by subsequent events.

In this paper,

1. we work with high frequency data in order to document the time proximity between factors and reaction: we thus avoid any issue of mixed frequency connected to direct measures of fundamentals;

2. we shy away from inserting lagged values of the spread in our specifications, being fully aware that if we did so we would better capture the persistence and follow the surges in the spreads;

3. the novelty we insert is to enlist financial market volatility (variously considered) as an explanatory factor. As an outcome of market activity, volatility can be seen as the synthesis of the dominant sentiment in collective reaction to news, be it related to the entire economic and financial system and not only to the specific class of assets: as such, it has the interesting feature of being a direct measure summarizing the uncertainty floating around in financial markets. When we see, say, a sudden increase in the volatility of a stock index, we can trust that behind it there is the adjustment to some marketwide news. Relative to any macroeconomic variable typically observed at low frequency, volatility has the advantage of translating the immediacy of the reaction to the announcements irrespective of whether it is rational or not.[2]

This view is in line with a long–standing practice which was consolidated with the construction of the VIX index as the *investor's fear gauge* (cf. Whaley (1993), Whaley (2009)). As well known, VIX is a mean of implied volatilities of call and put options at the money on the S&P500 futures with one month residual maturity: it is a synthesis of forward looking market evaluation of volatility which matches well alternative –model based– measures (cf Engle and Gallo (2006)). This and other measures of volatility represent an estimate of the level of uncertainty on a given market and may even capture an overreaction to news: in this context we can safely assume that (jointly considered) they translate into an upper bound for *overall market fears*.

The question we explore is whether the spread of a sovereign bond yield relative to the German Bund may be associated with the evolution of several volatility

[2]To some extent, it is a generalization of the inclusion of the credit spread in Favero (2013) which widens at times of distress.

measures in financial markets. To be sure, we are not claiming that these volatilities may be *determinants* of the spread nor explanatory variables in strict sense, but rather we want to capture –if present– *comovements* between each spread and these volatilities (rather than among spreads by themselves).

As a result, we suggest a model that explores the common dynamics between the spread and some measures of volatility: we know that the parameters of such association would change if we took separate estimates over subperiods. As a matter of fact, estimation over a tranquil period (pre credit crunch) allows us to interpret the results as expressing a *fundamental association between fear indices.* The model can then be used over the period of turmoil, by keeping fixed the estimated parameters and generating predicted values of the spread by inserting the observed values of the variables on the right hand side of the equations. We know that the forecasts thus obtained will be inadequate, but we want to interpret the difference between the actual values of the spread and these out of sample predicted values as *excess fears* in the evaluation of the sovereign risks. The fears are in excess since they measure the extent to which spreads contain a reaction to turbulence not already absorbed by overall reactions to fundamentals included in the volatility factors.

The paper is organized as follows: in Section 2 we discuss the choice and definition of the variables to be inserted in the comovement analysis; Section 3 shows the estimated results for a number of countries as well as the graphical appraisal of the in–sample model properties. Section 4 focuses on the discussion of the calculation of the excess fear component for each spread. Concluding remarks follow.

2 The Data and the Model

Let us start from a concrete example, and consider a graphical representation (cf Figure 1) of the difference between the Italian 10 years BTP relative to the German Bund over the period Apr 2000 - Oct 2015 (from now on, Italian spread). The evidence is clear about the change in regime occurring at or around the end of 2007 with a substantial change in the dynamics of the series (both in the level and the volatility). Prior to the end of 2007, the average level of the spread is about 25bp; the turmoil originating with the credit crunch, the financial crisis and then the recession in the US started the leavening of the values which increased during the summer of 2011, and exploded with the political crisis in Nov 2011. The famous *whatever it takes* speech by ECB President Draghi in July 2012 marked the sudden turnover and a subsequent sharp and constant decline in the spread. Since the speech by itself did not have a direct effect on macroeconomic fundamentals of Italy, or of any other country, for that matter, this explosion and sudden and progressive reduction in the spread has mainly some herding component to be filtered out.

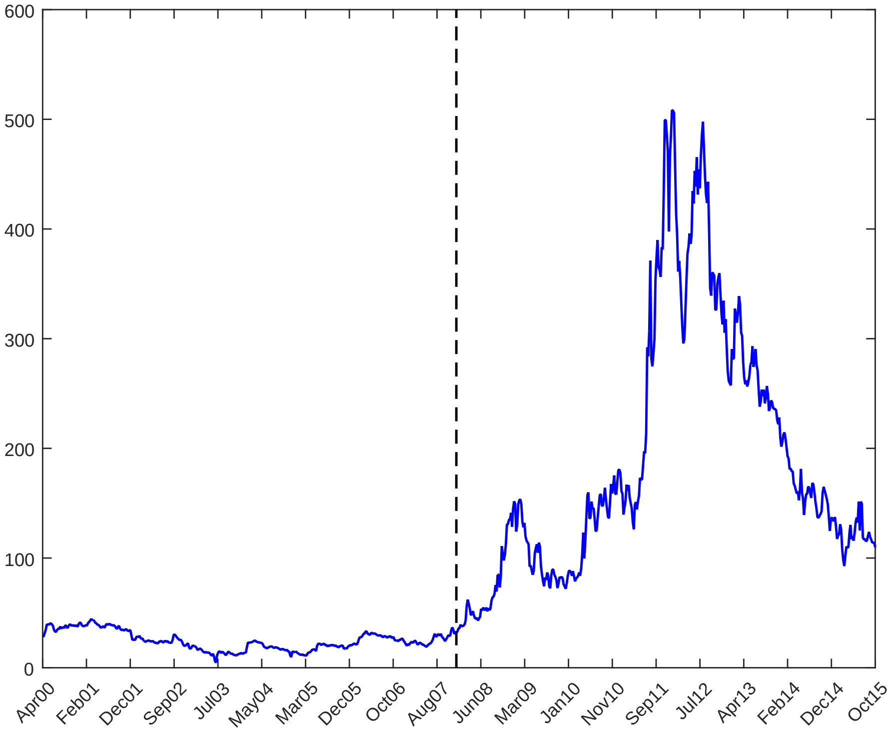

Figure 1: Spread Italian 10 years BTP – German Bund: 04/17/00 – 10/08/15

Our view is that rather than referring to a direct relationship between the spread and macroeconomic variables (possibly being hindered by the frequency of observation), we want to concentrate on the reaction to news, that is, how adjustment is made to the difference between expectations and announcements. From an econometric point of view, ideally, we would need to model first the evolution of fundamentals and the interdependence with the mechanism of expectation formation, and then to translate how asset prices adjust to that dynamics. As such the spread should be seen not just as a direct consequence of fundamentals behavior, but as the result of a *reaction function* to the difference between expectations and realizations (i.e. to surprises) to fundamentals, where time–varying psychological attitudes play an essential role (herding/imitation behavior). The schematic representation of the mechanism we have in mind is depicted in Figure 2.

We note that asset volatilities measure current market uncertainty and are a convenient summary of forward looking reaction to surprises; being observable for single assets and indices, they can capture different aspects of market sentiment and serve as partially overlapping proxies to the underlying reaction function, since they include herding and psychological effects. Together, their dynamics follow

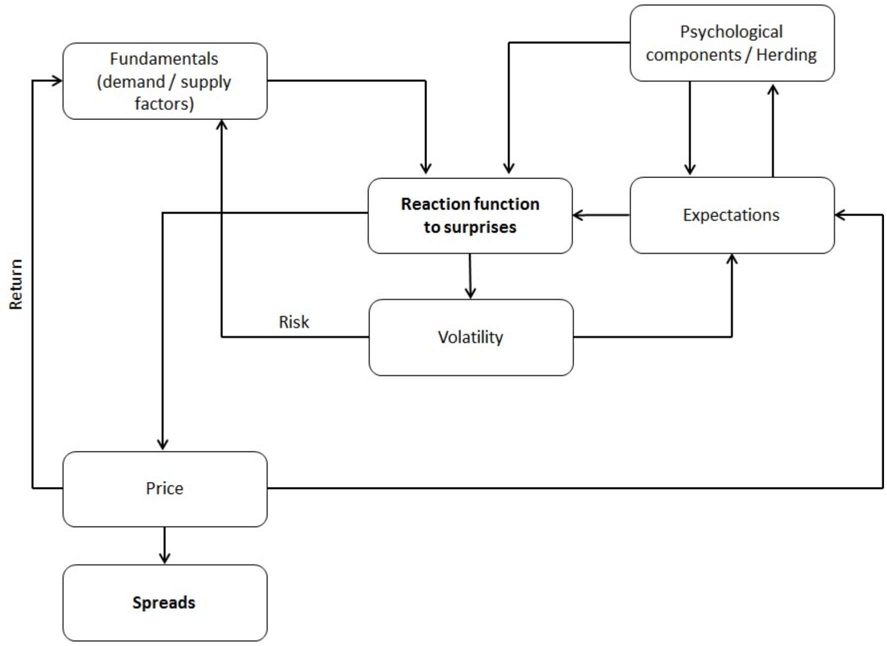

Figure 2: Scheme Summarizing the Role of Volatility as Proxy to the Reaction Function

a component common to all markets, but respond to idiosyncratic movements specific to each market as well. What links they have with the spread becomes an empirical question: in what follows, we concentrated on the period prior to the end of 2007 to establish a *physiological* relationship, if present, and then use it to derive what behavior the spread would exhibit, had the reaction to news been stable.

We isolated several variables as good candidates for a wide variety of indicators, which correspond to market sentiment in a variety of situations and countries. We measured volatility for the EuroStoxx50, the DAX, the CAC40, the FTSEMIB, the IBEX as representing common and idiosyncratic (i.e. country specific) reaction to national and world–wide conditions. In the selection of these volatility indicators, we referred to an overall European index (Eurostoxx50); the DAX and the CAC40 to represent those markets less prone to pressure; the FTSEMIB and the IBEX to represent countries under pressure post 2007. To capture bond idiosyncratic components we built a volatility measure for the spread and one for the domestic yield itself. Next to these European variables we consider an overall volatility index VIX. The other volatility measures were calculated as the daily range between the highest and the lowest value recorded within the day (cf Parkinson (1980) and Alizadeh *et al.* (2002)) for the indices, and as exponentially weighted moving averages of the squared first differences (with constant weights set to 0.06) for the volatility of the spread and the volatility of the yield. All variables are expressed in annualized percentage terms for the following list of countries: Italy, Austria, Belgium, Finland, France, Ireland, Netherlands, Portugal, Spain and United States.

The time series of the volatility measures for the EuroStoxx50, the DAX, the CAC40, the FTSEMIB, the IBEX, and the VIX are graphically represented in Figure 3. The volatilities of the yields and the spreads are in Figure 4 and 5.

For each of the following countries (Italy, Austria, Belgium, Finland, France, Ireland, Netherlands, Portugal, Spain, United States) the specification of the model is therefore the following:

- dependent variable:
  - Spread of the Country Bond relative to the German Bund;
- covariates:
  - Vol EuroSTOXX;
  - Vol DAX - Vol EuroSTOXX;
  - Vol CAC - Vol EuroSTOXX;
  - Vol FTSEMIB - Vol EuroSTOXX;
  - Vol IBEX - Vol EuroSTOXX;
  - VIX;
  - Vol SPREAD of the country;
  - Vol YIELD of the country.

Where we expressed differences in volatility for DAX, CAC, FTSEMIB, IBEX relative to EuroSTOXX in order to eliminate possible collinearity problems.

3 Estimation Results

The estimation results are reported in Table 1 in the body of the text for Italy and in the Appendix (Tables 4 to 12). We use weekly data in order to reduce the noise contained in the daily observations and we later use the estimated parameters with daily data to derive a daily estimate of the *excess fear*. In each Table, next to the parameter estimates and the usual inference diagnostics, we report some summary indices for the regression, R–squared and overall significance test. We refer to the Durbin Watson statistics mainly as an indicator of the reliability against the presence of spurious regressions, given the high persistence of the series.

In Table 2 we summarize the results by variable and country (last column refers to the US as a benchmark), indicating whether the coefficient is significantly

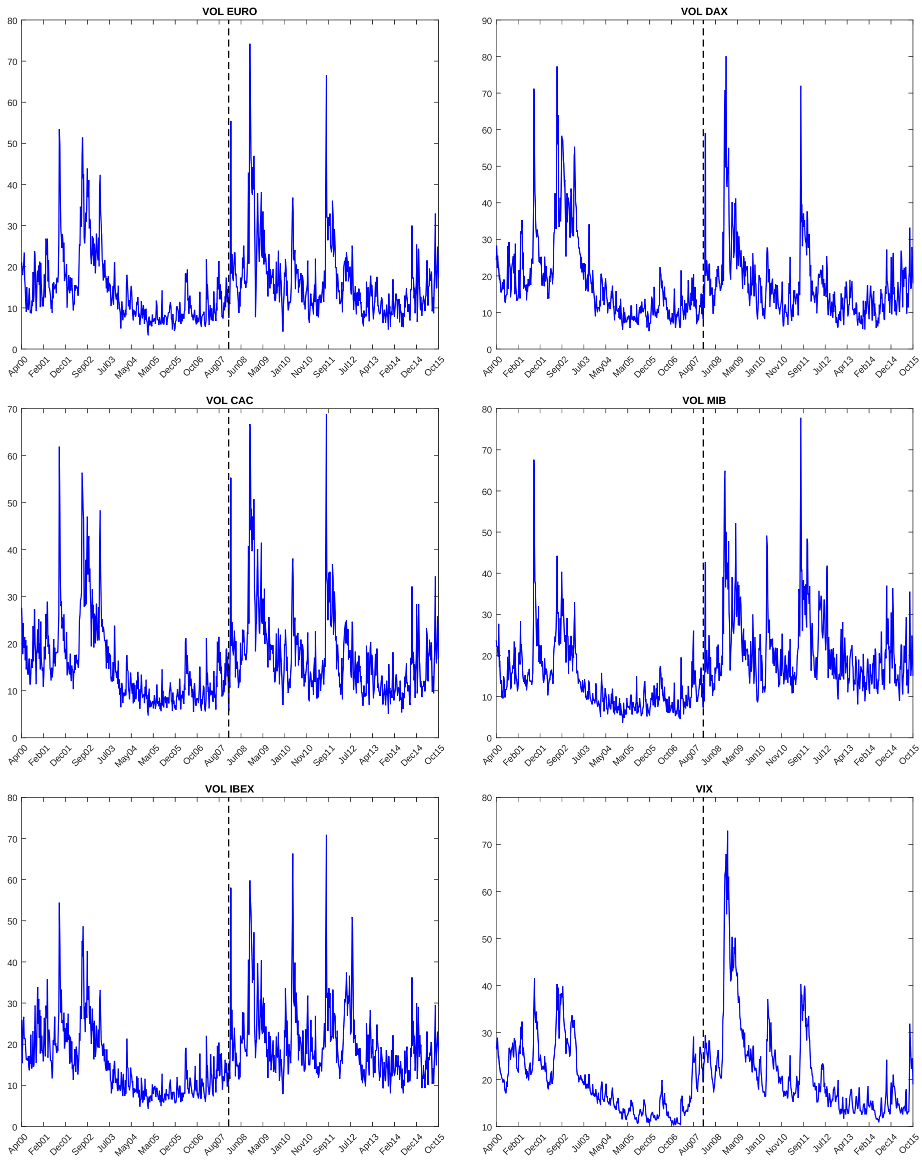

Figure 3: Volatility (range) time series for the EuroStoxx50, the DAX, the CAC40, the FTSEMIB, the IBEX, and the VIX: 04/17/00 – 10/08/15. The black dashed line represents the end of the estimation period (12/24/07).

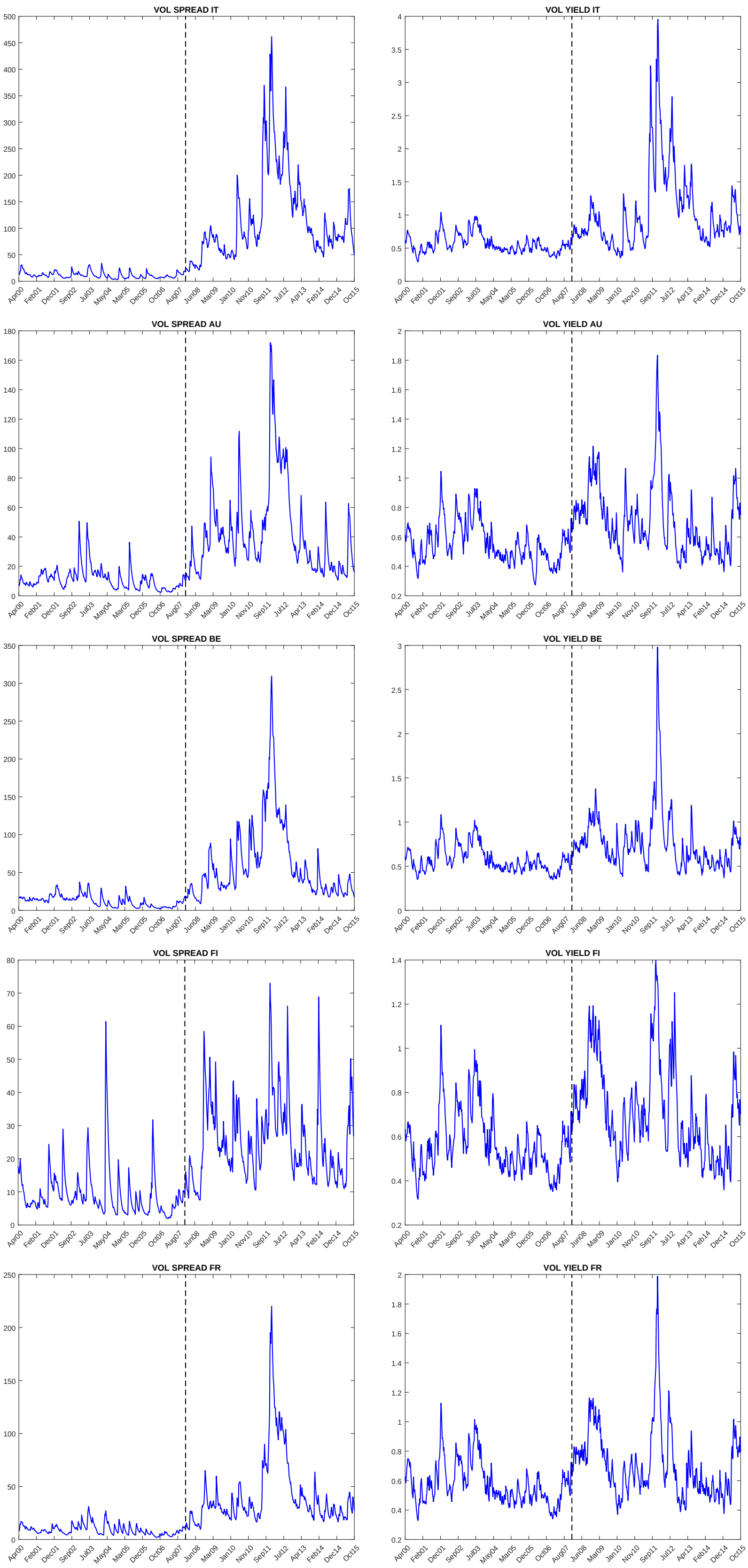

Figure 4: Time series of the volatility of spread and yields for Italy, Austria, Belgium, Finland and France: 04/17/00 – 10/08/15. The black dashed line represents the end of the estimation period (12/24/07)

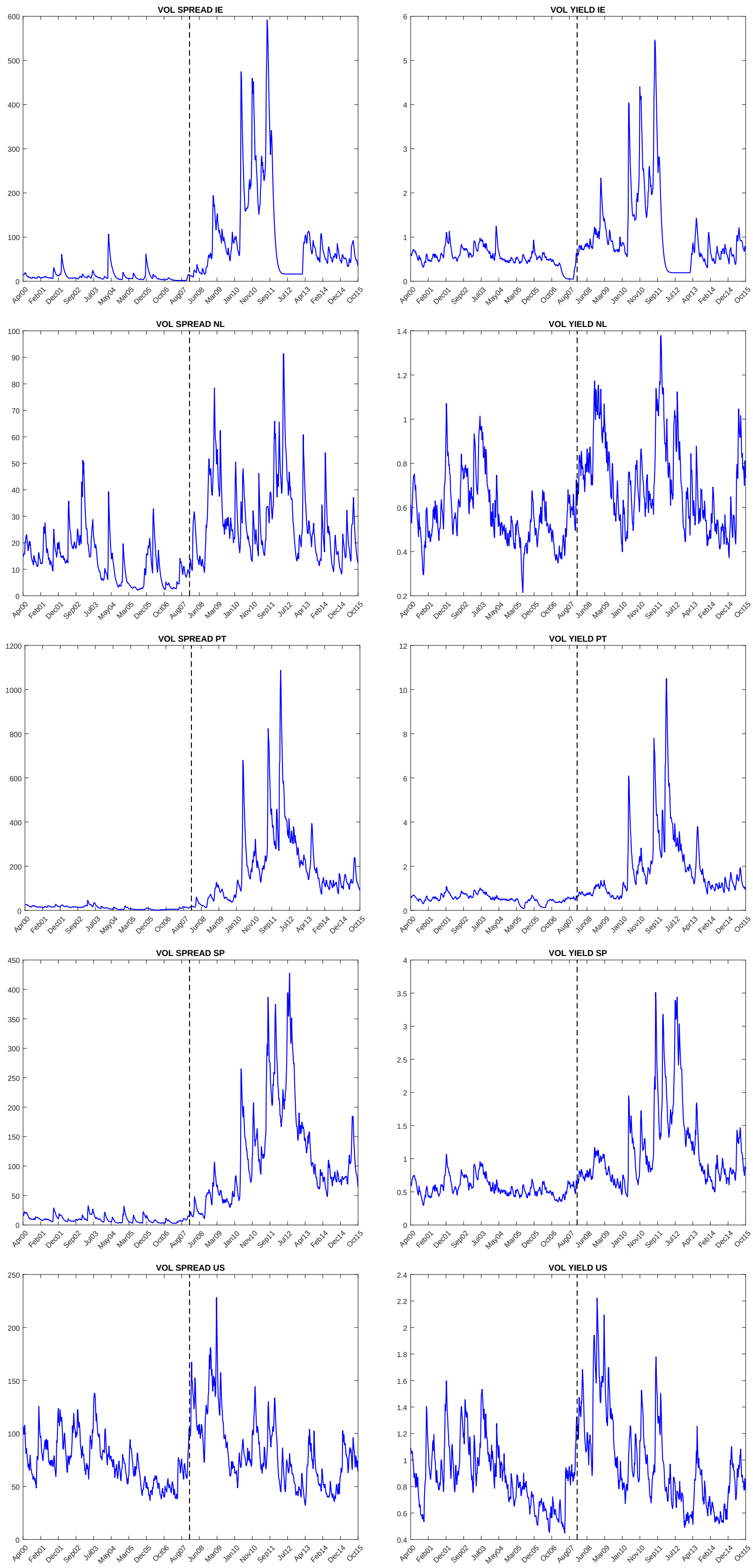

Figure 5: Time series of the volatility of spread and yields for Ireland, Netherlands, Portugal, Spain and United States: 04/17/00 – 10/08/15. The black dashed line represents the end of the estimation period (12/24/07)

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	20.2489	1.5074	13.4328	0.0000
VOL EURO	0.3112	0.0904	3.4415	0.0006
VOL DAX-VOL EURO	-0.5483	0.1047	-5.2387	0.0000
VOL CAC-VOL EURO	0.0682	0.1621	0.4205	0.6744
VOL MIB-VOL EURO	0.5028	0.1145	4.3911	0.0000
VOL IBEX-VOL EURO	0.8375	0.1068	7.8423	0.0000
VIX	0.5408	0.1015	5.3284	0.0000
VOL SPREAD IT	0.2677	0.0603	4.4376	0.0000
VOL YIELD IT	-20.4433	2.7385	-7.4652	0.0000
R–squared	0.5531	Mean dependent var		24.8340
Adjusted R–squared	0.5440	S.D. dependent var		8.6441
F–statistic	60.7988	Durbin–Watson stat		0.3838
Prob(F–statistic)	0.0000			

Table 1: Estimation results table for Italy (sample: 04/17/00 – 12/24/07).

positive (+), negative (-) or not significant (0). Strikingly, and leaving the US aside, we get some coherent results across countries: the volatilities of the DAX and of the own yield (except Austria) have always a negative effect on the spread, the volatility of the IBEX and of the own spread (except Austria) as well as the VIX have always a positive effect. The evidence on the others is mixed: not much significance for the volatility of the Eurostoxx50 and a somewhat positive effect of the CAC and the MIB. The R-squared are fairly similar to one another and relatively high ranging from 0.55 (Italy) to 0.72 (Spain).

The comment on the estimation results can be complemented by the visual inspection of the in–sample graphs of actual and predicted values. As before, we take Italy as a leading case (Figure 6), moving to the Appendix the graphs for the other countries (Figures 10 to 18). In line with the R–squared results, the actual and predicted line are very close to one another, the most notable exceptions being the period between Sep 04 to Jul 05 (actual systematically lower than predicted) and Mar 06 to Nov 06 (actual higher than predicted). Overall, the model has a good performance for Italy (and for the other countries as well). Residual autocorrelation points to some persistent unexplained component in the spread which may call for some other covariates to be inserted in the model.

	IT	AT	BE	FI	FR	IE	NL	PT	SP	US
VOL EURO	+	0	0	0	0	-	0	0	0	+
VOL DAX-VOL EURO	-	-	-	0	-	-	-	-	-	-
VOL CAC-VOL EURO	0	0	0	0	+	+	0	+	0	0
VOL MIB-VOL EURO	+	+	0	0	+	0	0	0	+	+
VOL IBEX-VOL EURO	+	+	+	+	+	+	+	+	+	0
VIX	+	+	+	+	+	+	+	+	+	-
VOL SPREAD	+	0	+	+	+	+	+	+	+	0
VOL YIELD	-	0	-	-	-	-	-	-	-	-
R-squared	0.55	0.62	0.70	0.71	0.64	0.59	0.64	0.62	0.72	0.59

Table 2: Comparison of sign and significativity of the parameters in the estimated spread relationship. 04/17/00 – 12/24/07.

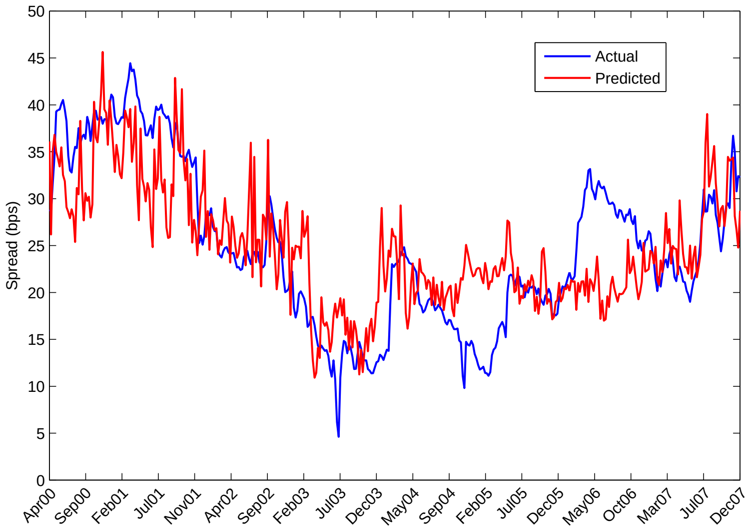

Figure 6: In–sample actual versus predicted values of the spread of Italy: 04/17/00 – 12/24/07.

4 The Excess Fear Component in the Spread

The estimated coefficients in Section 3 are now kept unchanged in an out–of–sample exercise in which the actual values of the variables on the right–hand side are inserted in the equation and the corresponding values of the spread are calculated. The aim is to show visually a reference time series if the behavior of the spread had reacted to the financial market volatilities with the same parameters as in the tranquil period. As before, we present the results for Italy in the main text and, with a similar structure, in the Appendix for the other countries.

The results show that the pseudo–spread (predicted) values are much more stable and roughly oscillating around the same in–sample mean. The model reacts to the bursts of volatility in this period (2008-2015), so that individual episodes of sharp increase (and subsequent decrease) in volatility can be recognized both in the observed spread and in predicted series. The scale of the movements in either series are obviusly different. What we want to remark is that past the Draghi speech of July 2012, the descent of the actual spread occurs at a considerable speed, while the predicted values have a moderately declining or flat behavior, substantiating the claim that the physiological component of the spread was fairly stable and excess fears decreased substantially. To confirm this interpretation we can notice that the last portion of this out–of–sample period is characterized by a specific increase in the spread, coinciding with the intensification of the uncertainty surrounding the Greek situation associated with an increase in the physiological component of the spread as well.

It is interesting to look at the specific results for the US Treasury spread rel-

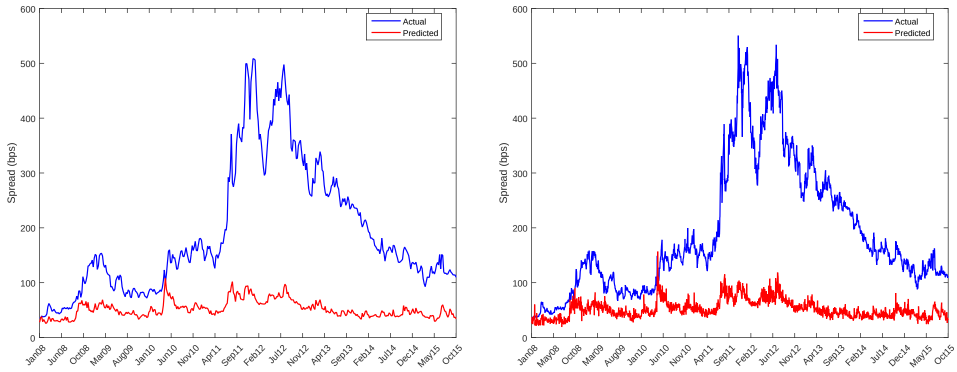

Figure 7: Left panel: out of sample actual versus predicted values of the weekly spread of Italy: 01/07/08 – 10/05/15. Right panel: actual versus predicted values of the daily spread of Italy: 01/02/08 – 10/08/15.

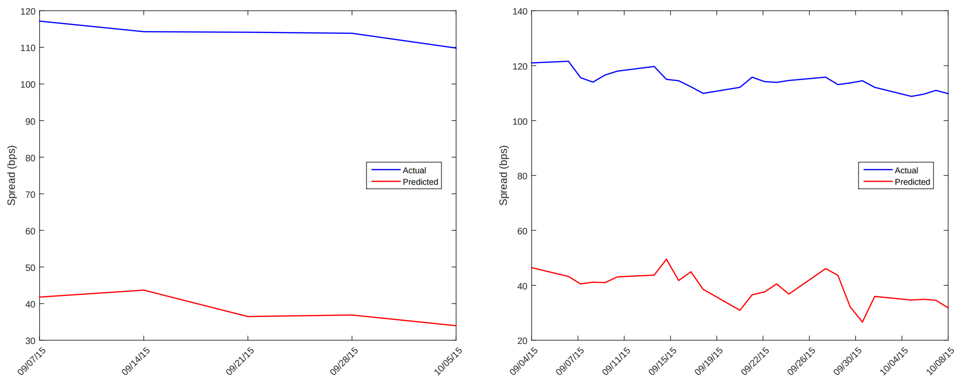

Figure 8: Left panel: out of sample actual versus predicted values of the weekly spread of Italy (zoom on the last 5 weeks: 09/07/15 – 10/08/15). Right panel: out of sample actual versus predicted values of the daily spread of Italy (zoom on the last 25 days: 09/04/15 – 10/08/15).

atively to the German Bund. The logic of the model is exactly the same, with the process of news and surprises transferring to volatility and then to the spread. Looking at the picture where actual spreads and predicted spreads are compared (Figure 9) we see that the model produces a predicted behavior which follows much more closely the actual time series. We interpret this outcome as the result of there being no substantial departure (as it happens, instead, with the European countries) from what the model predicts. If one looks in particular at the first part of the prediction sample, the matching capability of the model between, say, Oct 2008 and the Summer of 2010 is quite remarkable.

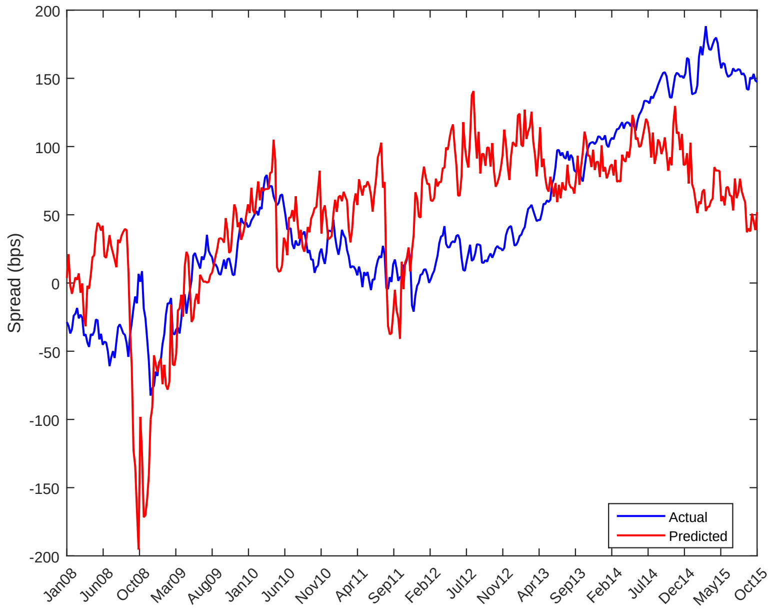

Figure 9: Out of sample actual versus predicted values of the weekly spread of United States: 01/07/08 – 10/08/15.

To summarize result,and point out possible commonalities across countries, we conveniently report the correlations between pairs of excess fears series in the lower portion of Table 3. We point out that five countries (BE, FR, IT, SP and PT) have correlation coefficients greater than 0.85. In the upper portion, we report the correlation coefficients between predicted spreads: here we have two groups (AT, FI and NL) on the one side, and the same countries as above on the other. Remarkably, the US shows a negative correlation with excess fears and with predicted spreads as well (IT and PT being exceptions in the latter case).

	AU	BE	FI	FR	IE	IT	NL	PT	SP	US
AU	–	0.7425	0.9170	0.6931	0.5545	0.4243	0.9398	0.3256	0.6602	-0.6208
BE	0.8125	–	0.8348	0.9482	0.6613	0.8440	0.8470	0.7501	0.9300	-0.4280
FI	0.7192	0.5928	–	0.8384	0.5422	0.5201	0.9800	0.4219	0.7200	-0.6797
FR	0.7562	0.8608	0.4993	–	0.4714	0.8094	0.8420	0.6996	0.8811	-0.4389
IE	0.5507	0.7771	0.3743	0.5605	–	0.5057	0.5604	0.5137	0.5913	-0.4232
IT	0.6196	0.8232	0.3375	0.9158	0.6090	–	0.5270	0.8615	0.9390	-0.0071
NL	0.7182	0.5593	0.8095	0.5969	0.3252	0.4767	–	0.4234	0.7270	-0.7057
PT	0.6528	0.8855	0.3585	0.8670	0.8076	0.9123	0.4223	–	0.8126	0.0243
SP	0.4687	0.7161	0.2227	0.8281	0.6546	0.9419	0.3885	0.8756	–	-0.2188
US	-0.3106	-0.3911	-0.2373	-0.3324	-0.5043	-0.3801	-0.2054	-0.4370	-0.4418	–

Table 3: The lower triangular portion of the matrix shows the correlation between the excess fear components of each pair of countries, the upper triangular portion of the matrix shows the correlation between the predicted spreads of each pair of countries (sample: 01/07/08 – 10/08/15).

5 Concluding Remarks

In this paper we addressed the concern that the observed sovereign yield spread across countries and within the Euro area in particular, may reflect *excess fears* in the solidity of the institutional agreements behind the Euro. As a result, the actual spread is much higher than it should be, if one took a *physiological* view that news on macroeconomic fundamentals do indeed induce a reaction by the markets, but that this reaction has been excessive when compared to what similar episodes have generated in the past.

We took an approach of investigating how volatility measures for a variety of markets affect the spread, taking volatility to be a convenient synthesis that combines reaction to the difference between fundamentals and expectations thereof, keeping into consideration also overreaction to bad news. Our results show that the relationships estimated across a wide range of Euro countries and the US are satisfactory in terms of in–sample fitting over a tranquil period. We extrapolate the behavior of the spread as predicted by the model to the period marked by turmoil affecting the financial markets with the crisis of Sep-Oct 2008, the inception of the Greek crisis in 2010, the debt–ceiling crisis of 2011 and subsequent episodes affecting other countries of the Euro area among which Italy.

The graphs show that for countries with reputation problems (not just the Southern European countries but also Austria, Belgium, France and Ireland), the actual spread went way above what can be associated with what proves to be a reasonable reaction function. The comparison of the results with Finland and the US shows that when such a reputation problem is not present, the model tracks fairly well the behavior of the observed spread.

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6 Appendix

6.1 Estimation Results – Other Countries

Austria

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	-8.9629	1.6717	-5.3617	0.0000
VOL EURO	-0.0697	0.1074	-0.6491	0.5167
VOL DAX-VOL EURO	-0.2881	0.1230	-2.3430	0.0196
VOL CAC-VOL EURO	0.2673	0.1897	1.4091	0.1596
VOL MIB-VOL EURO	0.2391	0.1346	1.7768	0.0764
VOL IBEX-VOL EURO	1.3535	0.1247	10.8564	0.0000
VIX	1.2411	0.1211	10.2514	0.0000
VOL SPREAD AT	-0.0747	0.0583	-1.2813	0.2008
VOL YIELD AT	-4.3378	3.2505	-1.3345	0.1828
R–squared	0.6336	Mean dependent var		11.0122
Adjusted R–squared	0.6262	S.D. dependent var		11.1871
F–statistic	84.9575	Durbin–Watson stat		0.5064
Prob(F–statistic)	0.0000			

Table 4: Estimation results table for Austria (sample: 04/17/00 – 12/24/07).

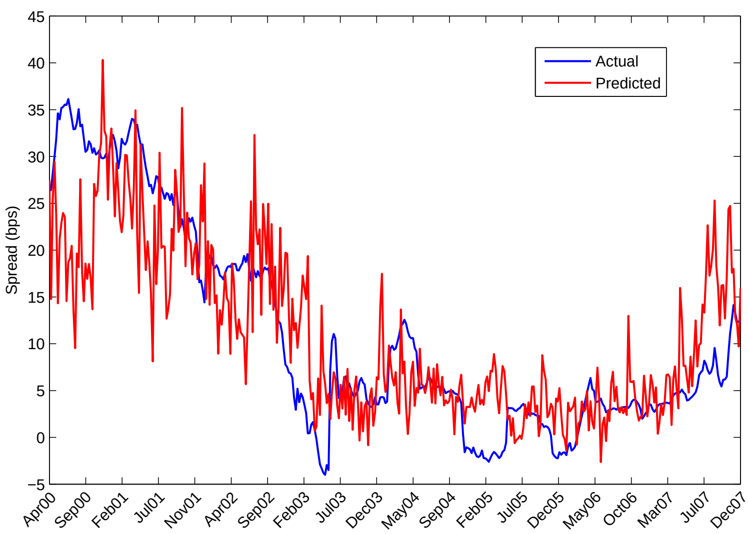

Figure 10: In–sample actual versus predicted values of the spread of Austria: 04/17/00 – 12/24/07.

Belgium

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	-5.0194	1.6760	-2.9949	0.0029
VOL EURO	-0.0686	0.0994	-0.6901	0.4905
VOL DAX-VOL EURO	-0.3649	0.1147	-3.1804	0.0016
VOL CAC-VOL EURO	0.3455	0.1778	1.9425	0.0528
VOL MIB-VOL EURO	0.2076	0.1247	1.6647	0.0968
VOL IBEX-VOL EURO	1.2462	0.1180	10.5647	0.0000
VIX	1.3461	0.1151	11.6943	0.0000
VOL SPREAD BE	0.2384	0.0604	3.9493	0.0001
VOL YIELD BE	-14.3895	2.9290	-4.9129	0.0000
R–squared	0.7088	Mean dependent var		14.6210
Adjusted R–squared	0.7029	S.D. dependent var		11.7136
F–statistic	119.5732	Durbin–Watson stat		0.5365
Prob(F–statistic)	0.0000			

Table 5: Estimation results table for Belgium (sample: 04/17/00 – 12/24/07).

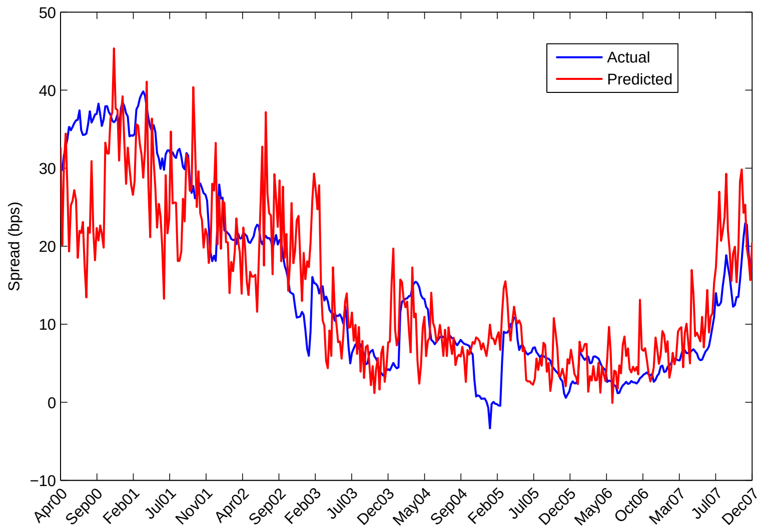

Figure 11: In–sample actual versus predicted values of the spread of Belgium: 04/17/00 – 12/24/07.

Finland

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	-10.4653	1.3923	-7.5166	0.0000
VOL EURO	-0.0455	0.0844	-0.5397	0.5897
VOL DAX-VOL EURO	-0.1455	0.0976	-1.4907	0.1369
VOL CAC-VOL EURO	0.2938	0.1519	1.9345	0.0538
VOL MIB-VOL EURO	0.0220	0.1071	0.2057	0.8371
VOL IBEX-VOL EURO	0.9644	0.0999	9.6571	0.0000
VIX	1.2036	0.0942	12.7831	0.0000
VOL SPREAD FI	0.2749	0.0424	6.4774	0.0000
VOL YIELD FI	-12.2026	2.3752	-5.1374	0.0000
R–squared	0.7118	Mean dependent var		8.4547
Adjusted R–squared	0.7060	S.D. dependent var		10.0961
F–statistic	121.3474	Durbin–Watson stat		0.4597
Prob(F–statistic)	0.0000			

Table 6: Estimation results table for Finland (sample: 04/17/00 – 12/24/07).

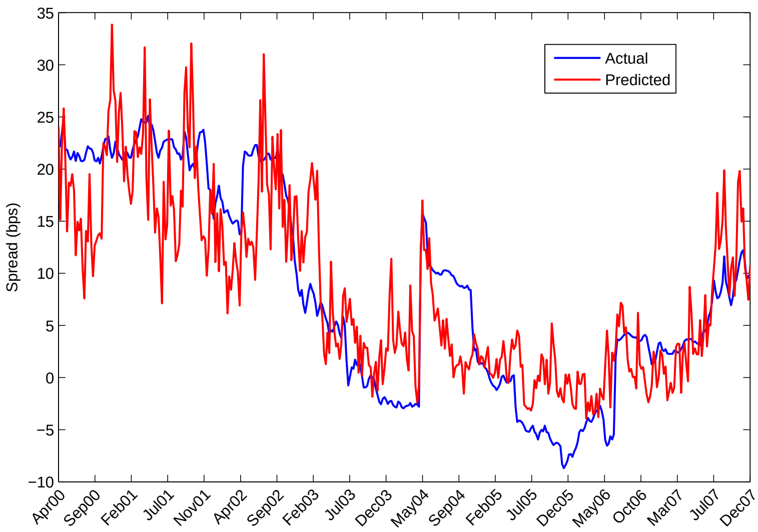

Figure 12: In–sample actual versus predicted values of the spread of Finland: 04/17/00 – 12/24/07.

France

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	-2.6638	0.7285	-3.6566	0.0003
VOL EURO	-0.0145	0.0459	-0.3154	0.7526
VOL DAX-VOL EURO	-0.2520	0.0526	-4.7892	0.0000
VOL CAC-VOL EURO	0.2236	0.0814	2.7453	0.0063
VOL MIB-VOL EURO	0.1149	0.0581	1.9789	0.0485
VOL IBEX-VOL EURO	0.4340	0.0534	8.1221	0.0000
VIX	0.6088	0.0509	11.9543	0.0000
VOL SPREAD FR	0.1410	0.0372	3.7961	0.0002
VOL YIELD FR	-5.8154	1.3698	-4.2454	0.0000
R–squared	0.6485	Mean dependent var		6.3786
Adjusted R–squared	0.6414	S.D. dependent var		4.9070
F–statistic	90.6477	Durbin–Watson stat		0.5084
Prob(F–statistic)	0.0000			

Table 7: Estimation results table for France (sample: 04/17/00 – 12/24/07).

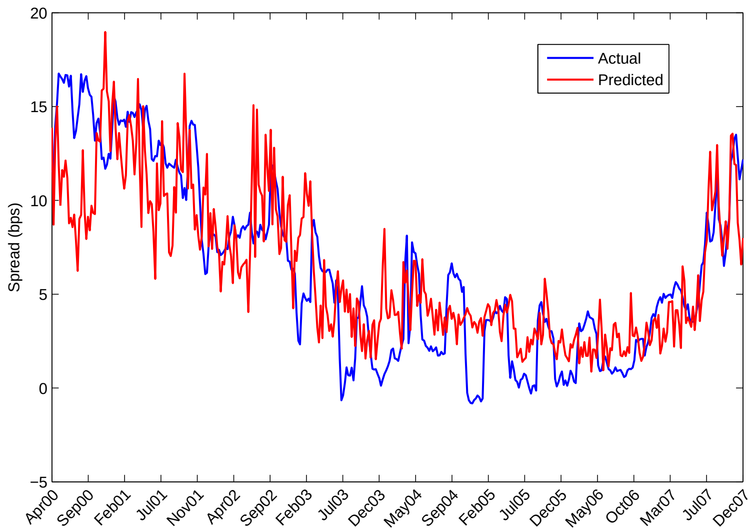

Figure 13: In–sample actual versus predicted values of the spread of France: 04/17/00 – 12/24/07.

Ireland

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	-9.6176	1.4349	-6.7026	0.0000
VOL EURO	-0.2994	0.0996	-3.0053	0.0028
VOL DAX-VOL EURO	-0.2539	0.1198	-2.1199	0.0346
VOL CAC-VOL EURO	0.6073	0.1817	3.3418	0.0009
VOL MIB-VOL EURO	-0.1726	0.1274	-1.3553	0.1761
VOL IBEX-VOL EURO	0.6267	0.1167	5.3695	0.0000
VIX	1.3338	0.1103	12.0926	0.0000
VOL SPREAD IE	0.2963	0.0333	8.9096	0.0000
VOL YIELD IE	-8.2836	2.1301	-3.8889	0.0001
R–squared	0.5955	Mean dependent var		11.1844
Adjusted R–squared	0.5873	S.D. dependent var		10.0621
F–statistic	72.3346	Durbin–Watson stat		0.2860
Prob(F–statistic)	0.0000			

Table 8: Estimation results table for Ireland (sample: 04/17/00 – 12/24/07).

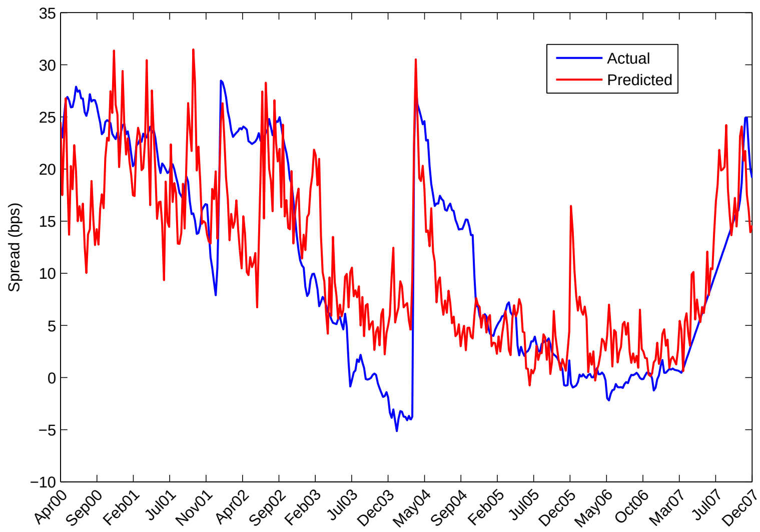

Figure 14: In–sample actual versus predicted values of the spread of Ireland: 04/17/00 – 12/24/07.

Netherlands

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	-5.5509	0.9007	-6.1628	0.0000
VOL EURO	-0.0372	0.0569	-0.6543	0.5133
VOL DAX-VOL EURO	-0.2546	0.0677	-3.7617	0.0002
VOL CAC-VOL EURO	0.1455	0.1019	1.4284	0.1540
VOL MIB-VOL EURO	0.0701	0.0719	0.9746	0.3304
VOL IBEX-VOL EURO	0.5433	0.0670	8.1044	0.0000
VIX	0.7398	0.0653	11.3254	0.0000
VOL SPREAD NL	0.0760	0.0285	2.6662	0.0080
VOL YIELD NL	-3.8187	1.5302	-2.4956	0.0130
R–squared	0.6479	Mean dependent var		6.6239
Adjusted R–squared	0.6407	S.D. dependent var		6.1337
F–statistic	90.3876	Durbin–Watson stat		0.3862
Prob(F–statistic)	0.0000			

Table 9: Estimation results table for Netherlands (sample: 04/17/00 – 12/24/07).

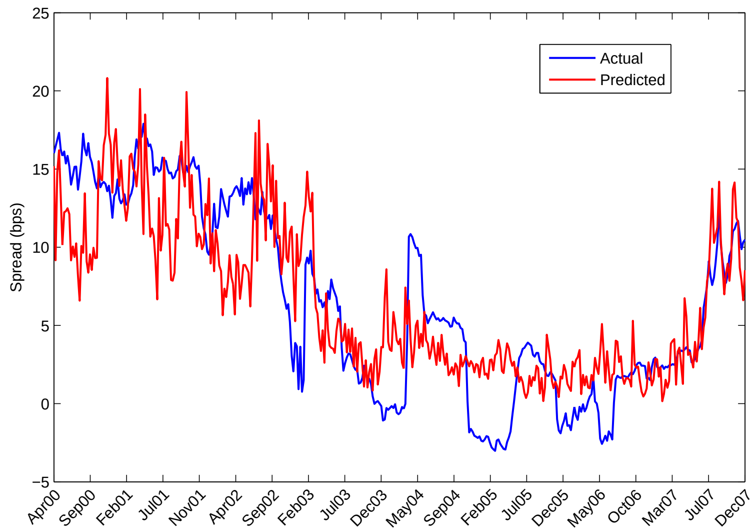

Figure 15: In–sample actual versus predicted values of the spread of Netherlands: 04/17/00 – 12/24/07.

Portugal

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	2.3098	1.4847	1.5557	0.1206
VOL EURO	0.1219	0.1071	1.1378	0.2559
VOL DAX-VOL EURO	-0.5808	0.1248	-4.6538	0.0000
VOL CAC-VOL EURO	0.3959	0.1939	2.0420	0.0418
VOL MIB-VOL EURO	0.1947	0.1354	1.4371	0.1515
VOL IBEX-VOL EURO	1.2311	0.1258	9.7878	0.0000
VIX	1.0609	0.1261	8.4148	0.0000
VOL SPREAD PT	0.2751	0.0743	3.7017	0.0002
VOL YIELD PT	-14.3340	2.7135	-5.2825	0.0000
R–squared	0.6280	Mean dependent var		19.2909
Adjusted R–squared	0.6204	S.D. dependent var		11.2297
F–statistic	82.9221	Durbin–Watson stat		0.4568
Prob(F–statistic)	0.0000			

Table 10: Estimation results table for Portugal (sample: 04/17/00 – 12/24/07).

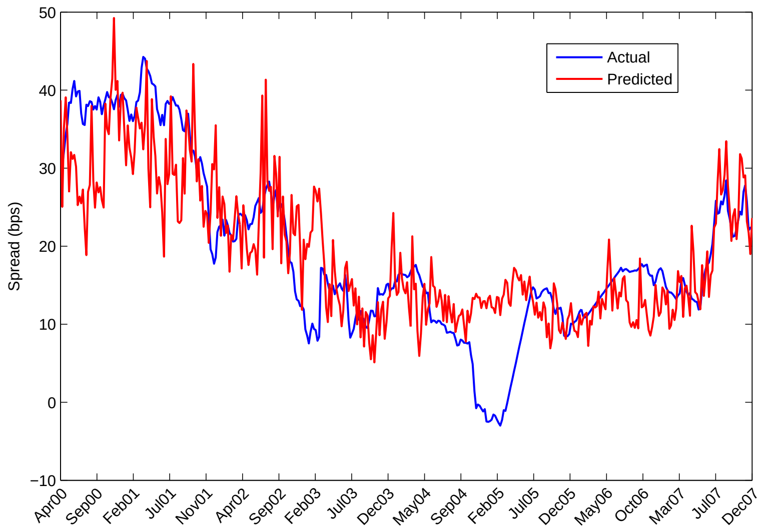

Figure 16: In–sample actual versus predicted values of the spread of Portugal: 04/17/00 – 12/24/07.

Spain

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	-9.1877	1.6043	-5.7268	0.0000
VOL EURO	0.0645	0.0966	0.6670	0.5052
VOL DAX-VOL EURO	-0.4513	0.1116	-4.0455	0.0001
VOL CAC-VOL EURO	0.2120	0.1739	1.2192	0.2235
VOL MIB-VOL EURO	0.2813	0.1231	2.2850	0.0228
VOL IBEX-VOL EURO	1.4518	0.1153	12.5871	0.0000
VIX	1.2790	0.1082	11.8258	0.0000
VOL SPREAD SP	0.2063	0.0646	3.1921	0.0015
VOL YIELD SP	-12.6276	2.8875	-4.3731	0.0000
R–squared	0.7216	Mean dependent var		10.8344
Adjusted R–squared	0.7159	S.D. dependent var		11.7607
F–statistic	127.3051	Durbin–Watson stat		0.6579
Prob(F–statistic)	0.0000			

Table 11: Estimation results table for Spain (sample: 04/17/00 – 12/24/07).

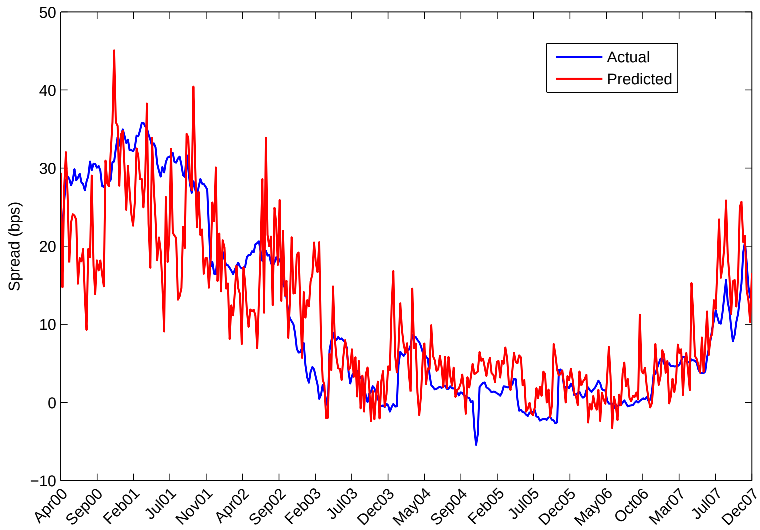

Figure 17: In–sample actual versus predicted values of the spread of Spain: 04/17/00 – 12/24/07.

United States

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	153.5092	6.3645	24.1197	0.0000
VOL EURO	1.1029	0.4681	2.3563	0.0190
VOL DAX-VOL EURO	-2.2219	0.5288	-4.2018	0.0000
VOL CAC-VOL EURO	0.5485	0.8205	0.6685	0.5042
VOL MIB-VOL EURO	2.9086	0.5800	5.0146	0.0000
VOL IBEX-VOL EURO	0.4021	0.5513	0.7294	0.4662
VIX	-3.3044	0.5480	-6.0300	0.0000
VOL SPREAD US	0.2427	0.1829	1.3269	0.1853
VOL YIELD US	-84.9602	16.4414	-5.1675	0.0000
R–squared	0.6041	Mean dependent var		36.8176
Adjusted R–squared	0.5961	S.D. dependent var		46.6197
F–statistic	74.9655	Durbin–Watson stat		0.2015
Prob(F–statistic)	0.0000			

Table 12: Estimation results table for United States (sample: 04/17/00 – 12/24/07).

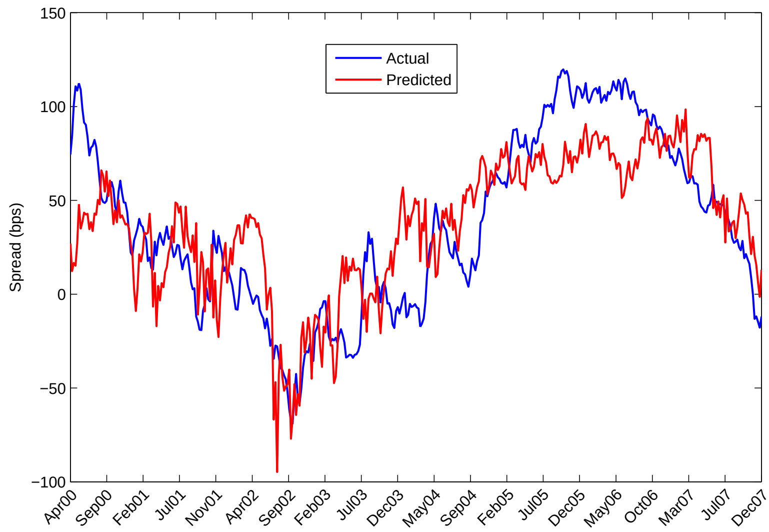

Figure 18: In–sample actual versus predicted values of the spread of United States: 04/17/00 – 12/24/07.

6.2 The Excess Fear Component in the Spread – Other Countries

Austria

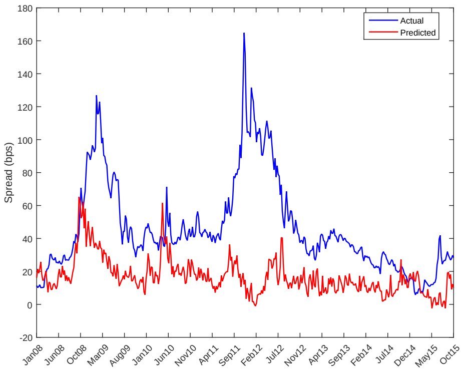

Figure 19: Left panel: out of sample actual versus predicted values of the weekly spread of Austria: 01/07/08 – 10/05/15. Right panel: actual versus predicted values of the daily spread of Austria: 01/02/08 – 10/08/15.

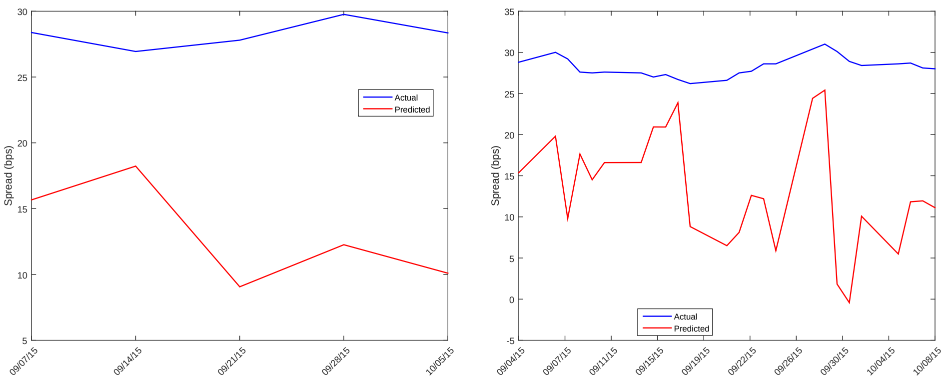

Figure 20: Left panel: out of sample actual versus predicted values of the weekly spread of Austria (zoom on the last 5 weeks: 09/07/15 – 10/05/15). Right panel: out of sample actual versus predicted values of the daily spread of Austria (zoom on the last 25 days: 09/04/15 – 10/08/15).

Belgium

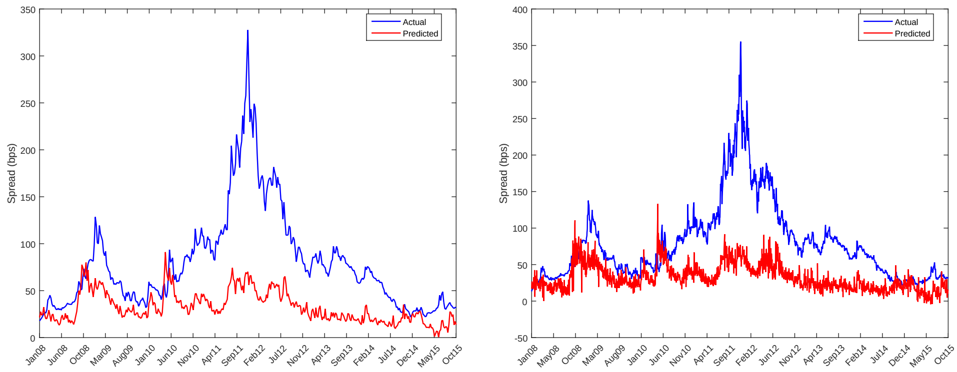

Figure 21: Left panel: out of sample actual versus predicted values of the weekly spread of Belgium: 01/07/08 – 10/05/15. Right panel: actual versus predicted values of the daily spread of Belgium: 01/02/08 – 10/08/15.

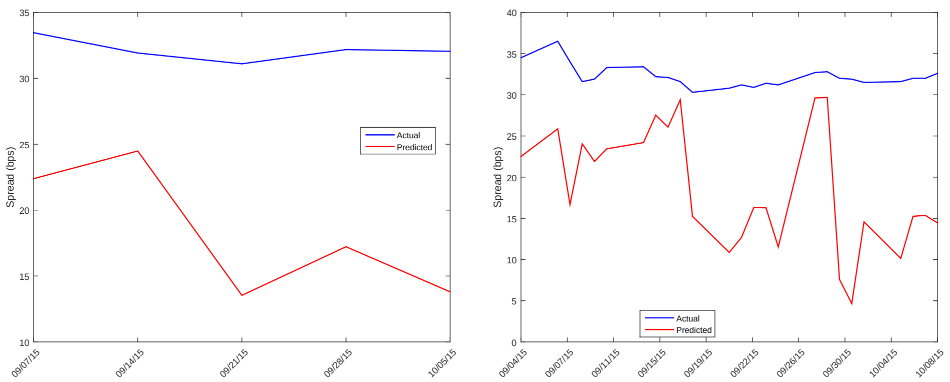

Figure 22: Left panel: out of sample actual versus predicted values of the weekly spread of Belgium (zoom on the last 5 weeks: 09/07/15 – 10/05/15). Right panel: out of sample actual versus predicted values of the daily spread of Belgium (zoom on the last 25 days: 09/04/15 – 10/08/15).

Finland

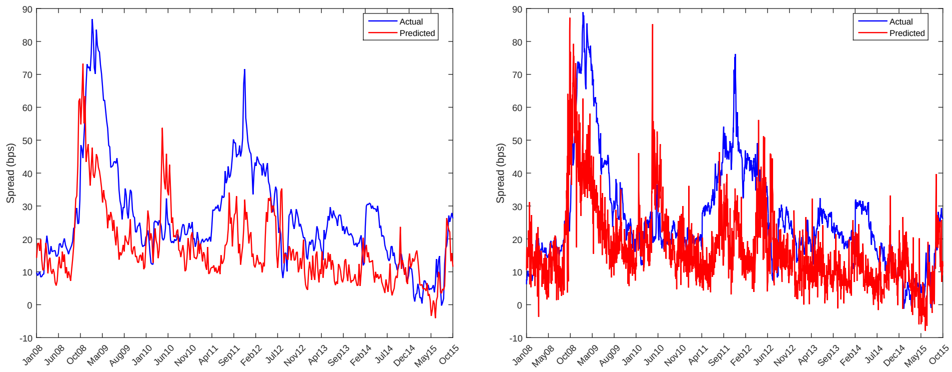

Figure 23: Left panel: out of sample actual versus predicted values of the weekly spread of Finland: 01/07/08 – 10/05/15. Right panel: actual versus predicted values of the daily spread of Finland: 01/02/08 – 10/08/15.

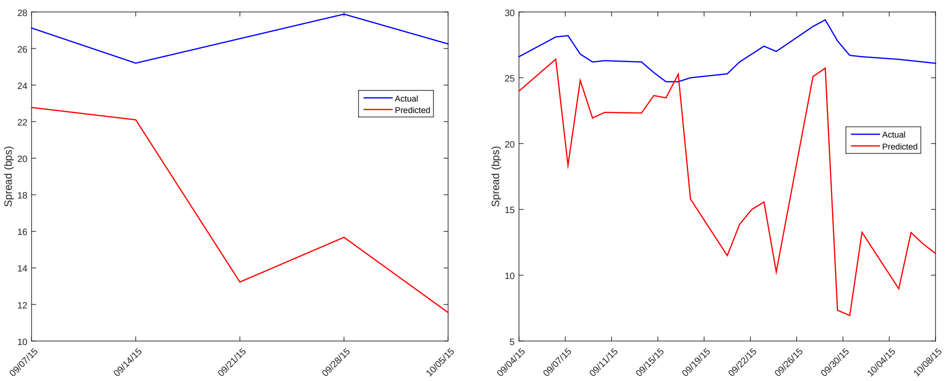

Figure 24: Left panel: out of sample actual versus predicted values of the weekly spread of Finland (zoom on the last 5 weeks: 09/07/15 – 10/05/15). Right panel: out of sample actual versus predicted values of the daily spread of Finland (zoom on the last 25 days: 09/04/15 – 10/08/15).

France

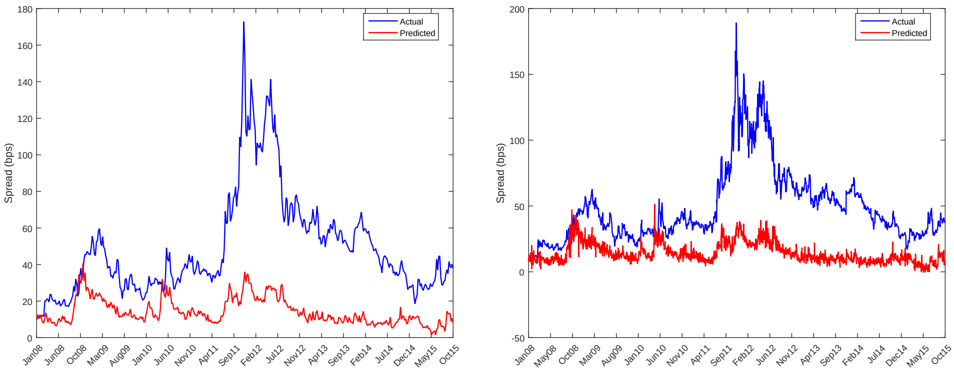

Figure 25: Left panel: out of sample actual versus predicted values of the weekly spread of France: 01/07/08 – 10/05/15. Right panel: actual versus predicted values of the daily spread of France: 01/02/08 – 10/08/15.

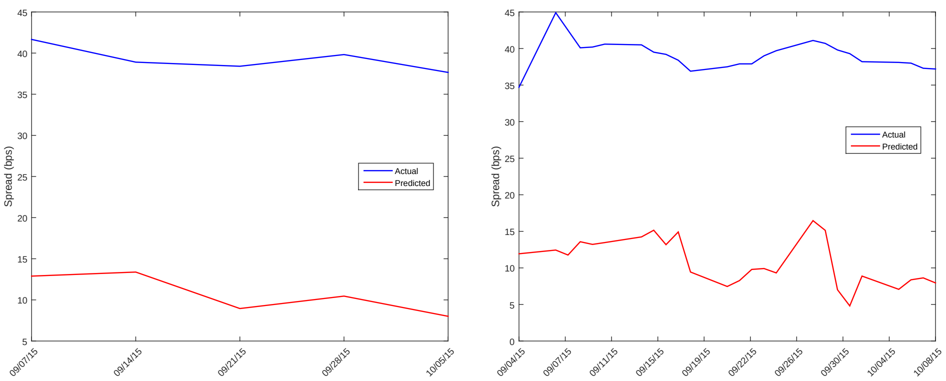

Figure 26: Left panel: out of sample actual versus predicted values of the weekly spread of France (zoom on the last 5 weeks: 09/07/15 – 10/05/15). Right panel: out of sample actual versus predicted values of the daily spread of France (zoom on the last 25 days: 09/04/15 – 10/08/15).

Ireland

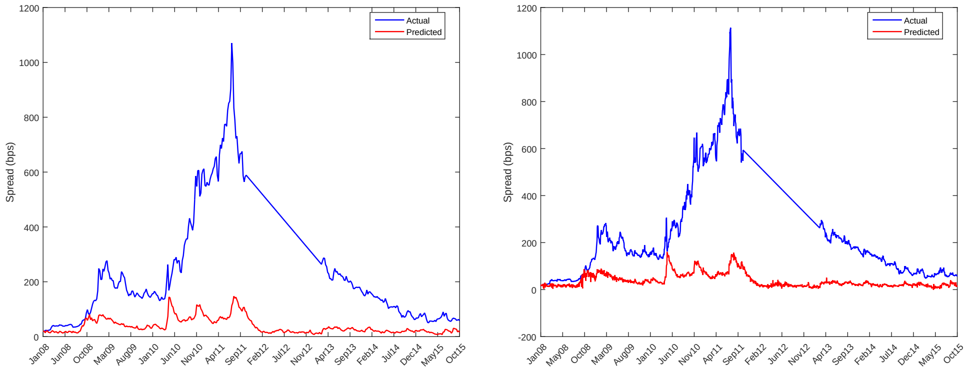

Figure 27: Left panel: out of sample actual versus predicted values of the weekly spread of Ireland: 01/07/08 – 10/05/15. Right panel: actual versus predicted values of the daily spread of Ireland: 01/02/08 – 10/08/15.

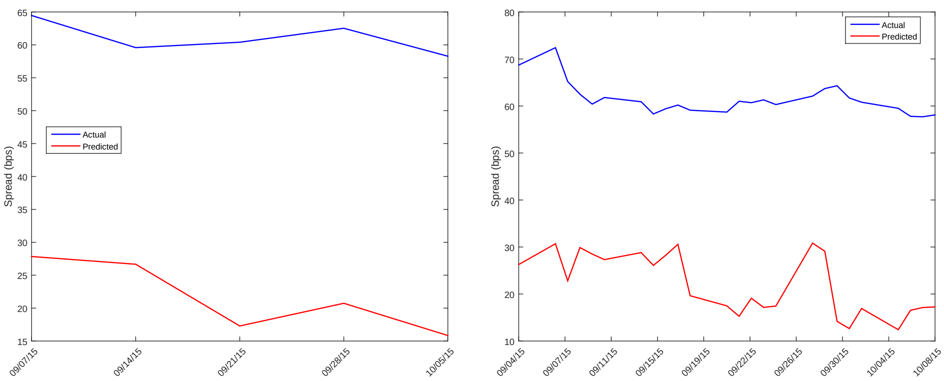

Figure 28: Left panel: out of sample actual versus predicted values of the weekly spread of Ireland (zoom on the last 5 weeks: 09/07/15 – 10/05/15). Right panel: out of sample actual versus predicted values of the daily spread of Ireland (zoom on the last 25 days: 09/04/15 – 10/08/15).

Netherlands

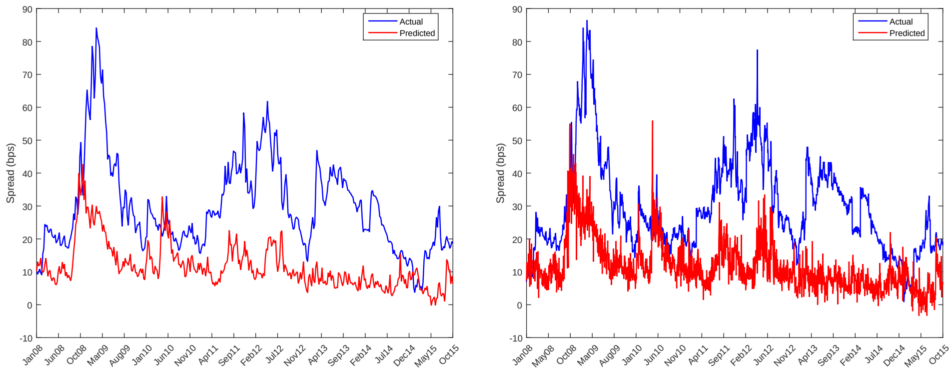

Figure 29: Left panel: out of sample actual versus predicted values of the weekly spread of Netherlands: 01/07/08 – 10/05/15. Right panel: actual versus predicted values of the daily spread of Netherlands: 01/02/08 – 10/08/15.

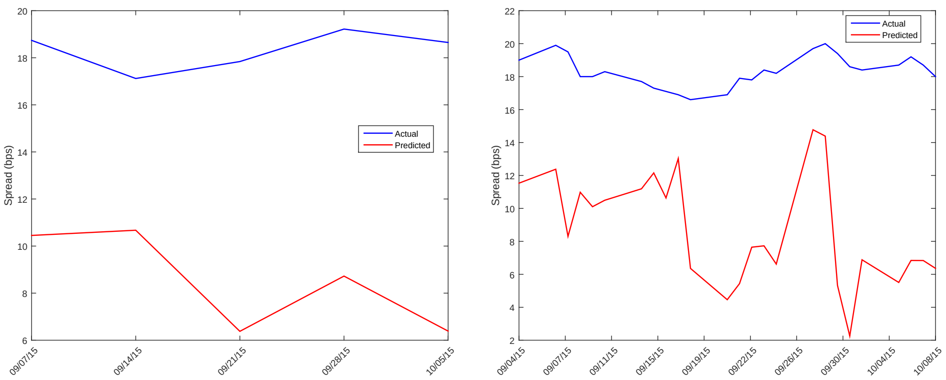

Figure 30: Left panel: out of sample actual versus predicted values of the weekly spread of Netherlands (zoom on the last 5 weeks: 09/07/15 – 10/05/15). Right panel: out of sample actual versus predicted values of the daily spread of Netherlands (zoom on the last 25 days: 09/04/15 – 10/08/15).

Portugal

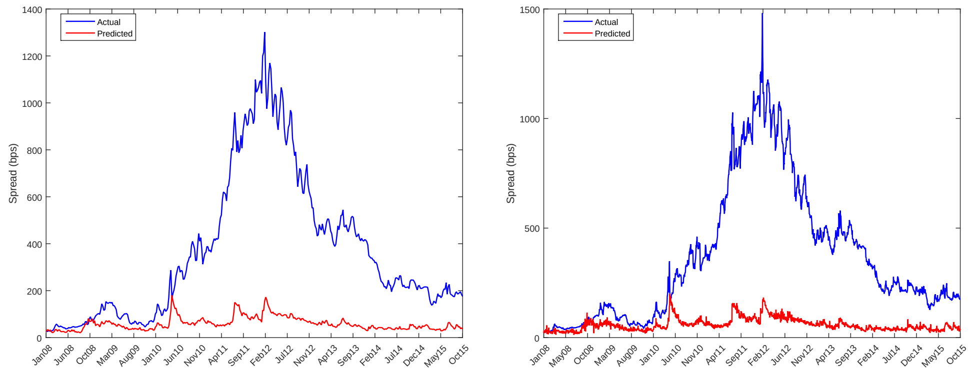

Figure 31: Left panel: out of sample actual versus predicted values of the weekly spread of Portugal: 01/07/08 – 10/05/15. Right panel: actual versus predicted values of the daily spread of Portugal: 01/02/08 – 10/08/15.

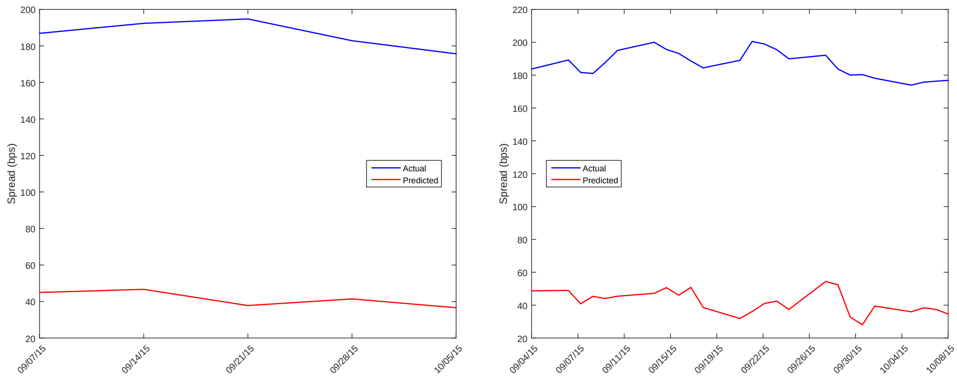

Figure 32: Left panel: out of sample actual versus predicted values of the weekly spread of Portugal (zoom on the last 5 weeks: 09/07/15 – 10/05/15). Right panel: out of sample actual versus predicted values of the daily spread of Portugal (zoom on the last 25 days: 09/04/15 – 10/08/15).

Spain

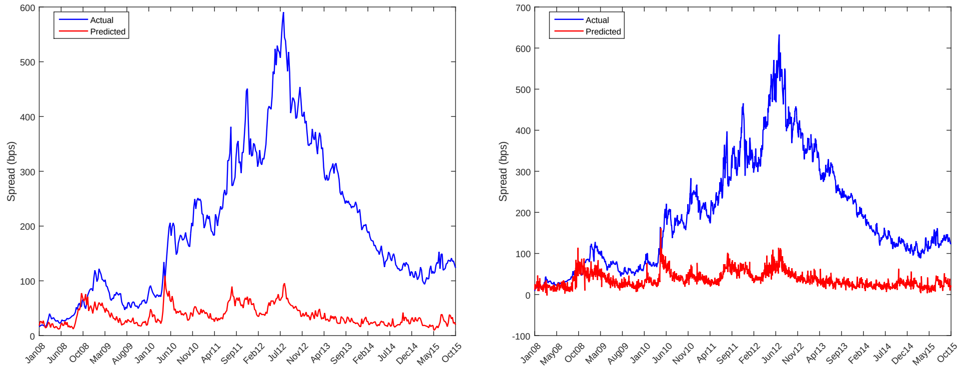

Figure 33: Left panel: out of sample actual versus predicted values of the weekly spread of Spain: 01/07/08 – 10/05/15. Right panel: actual versus predicted values of the daily spread of Spain: 01/02/08 – 10/08/15.

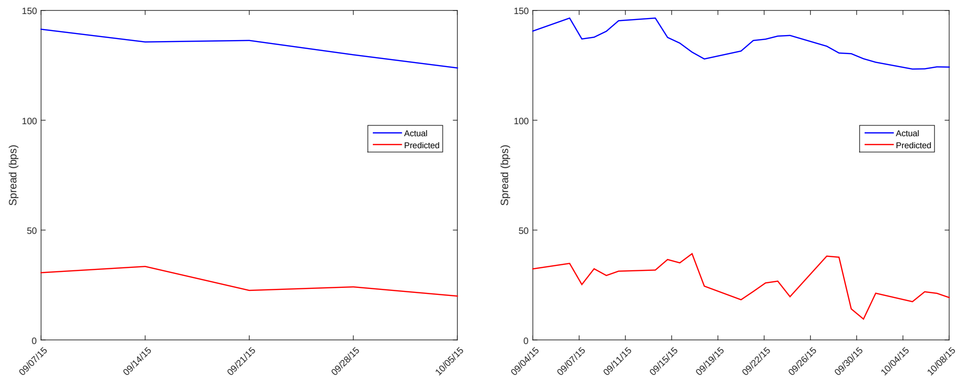

Figure 34: Left panel: out of sample actual versus predicted values of the weekly spread of Spain (zoom on the last 5 weeks: 09/07/15 – 10/05/15). Right panel: out of sample actual versus predicted values of the daily spread of Spain (zoom on the last 25 days: 09/04/15 – 10/08/15).

United States

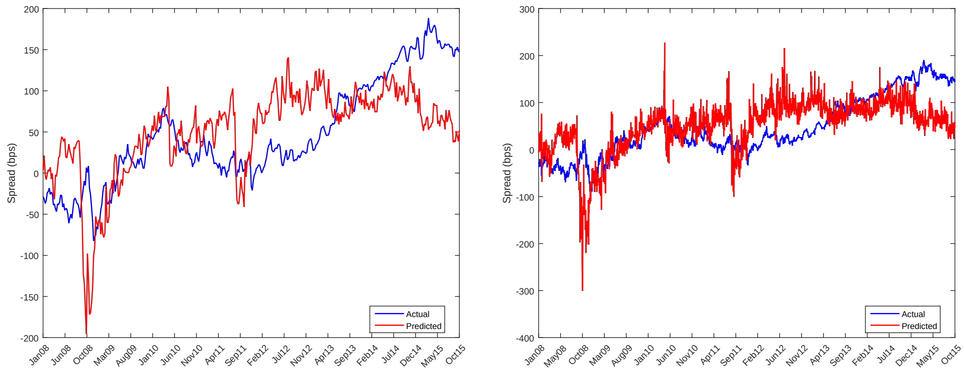

Figure 35: Left panel: out of sample actual versus predicted values of the weekly spread of United States: 01/07/08 – 10/05/15. Right panel: actual versus predicted values of the daily spread of United States: 01/02/08 – 10/08/15.

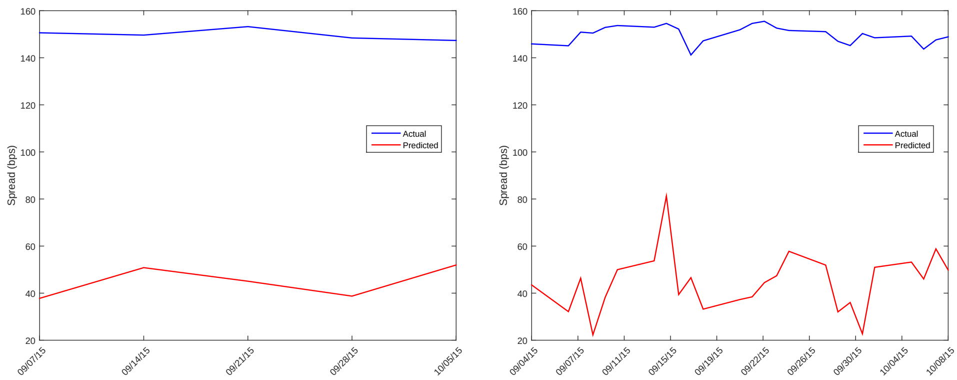

Figure 36: Left panel: out of sample actual versus predicted values of the weekly spread of United States (zoom on the last 5 weeks: 09/07/15 – 10/05/15). Right panel: out of sample actual versus predicted values of the daily spread of United States (zoom on the last 25 days: 09/04/15 – 10/08/15).