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Sovereign Spreads and Financial Market Behaviour before and during the Crisis

Los márgenes soberanos y el comportamiento del mercado financiero antes y durante de la crisis

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Abstract

This paper aims at shedding some light on the mechanisms of pricing the EMU countries' sovereign bonds in financial markets. Employing the Augmented Mean Group (AMG) estimator, we find that major changes have occurred in terms of variables underlying sovereign risk. Since 2009, macroeconomic and fiscal fundamentals has started to play a more important role, but only those that capture domestic demand evolution. In contrast, price competitiveness seems less important. The second conclusion lies in reversed attitude towards banking sector imbalances, as compared to the earlier period. One of the problems addressed concerns the horizon of projected macroeconomic and fiscal variables taken into account. The paper presents some evidence that financial markets have become more myopic and started to rely on short-term forecasts, whilst they had tended to encompass longer-term forecast horizon before the crisis.

Keywords: Financial Crisis; Fiscal Policy; EMU; Panel Estimation.

Resumen

Este trabajo tiene por objeto arrojar luz sobre los mecanismos de fijación de precios de bonos soberanos de los países de la UEM en los mercados financieros. Empleando el estimador Aumentado Medio del Grupo (Augmented Mean Group - AMG), nos encontramos grandes cambios en tẽrminos de las variables subyacentes del riesgo soberano. Desde 2009, los fundamentos macroeconómicos y fiscales han comenzado a desempeñar un papel más importante, pero sólo aquellos que captan la evolución de la demanda interna. Por el contrario, la competitividad de precios parece menos importante. La segunda conclusión radica en la actitud invertida hacia los desequilibrios del sector bancario, cuando se compara con el perĩodo anterior. En este sentido, uno de los problemas abordados se refiere al horizonte de las variables macroeconómicas y fiscales proyectadas tomadas en cuenta. El artículo presenta pruebas de que los mercados financieros se han vuelto más miopes y comenzaron a confiar en los pronósticos a corto plazo, mientras que habĩan tendido a abarcar horizontes de pronóstico a más largo plazo antes de la crisis.

Palabras clave: Crisis financiera; política fiscal; UEM; Estimación panel.

JEL Classification: C23, E43, E62, F34, G01, G12, H60

1. Introduction

The reemergence of sovereign spreads in 2008 in EMU was often interpreted as rapid improvement in the quality of credit risk assessment process in financial markets (see: Attinasi *et al.*, 2009, De Grauwe and Ji, 2012). Indeed, yields increased most for Greek, Irish and Portuguese bonds. While each of these countries had its own unique conglomerate of problems, all had accumulated massive imbalances that made them face a higher credit risk premium.

This perceived improvement in credit risk assessment pushed some governments to immediately implement actions towards reducing imbalances (mostly in public finance) in the form of austerity programs. Governments and societies in the troubled countries were cheered by some (notably liberal) economists arguing that non-Keynesian (and thus expansionary) effects might offset the Keynesian ones even in the short-run if certain conditions are satisfied – most importantly when public debt is high and adjustment is based on the expenditure side (see e.g. Borys *et al.*, 2014). To back their theoretical arguments, historical examples were brought up of expansionary consolidation episodes from Denmark and Ireland in 1980s (see: IMF, 2010). But short-run effects of fiscal consolidations did not meet these optimistic expectations. No signs of non-Keynesian effects were being noticed and disappointment grew. In consequence, theoretical opposition (broadly associated with the "saltwater" economics) started to grow against severe austerity, which was promptly spotted in the countries facing it. The possibility of non-Keynesian effects were more and more often called unfeasible in the short-run and the environment of liquidity trap (Corsetti, 2012).

Both Corsetti (2012) and Portes (2012) claimed that severe fiscal adjustments not only shrink GDP, but can also be counter-productive i.e. they can raise rather than lower the debt to GDP ratio. This is because financial markets can take both fiscal situation and growth perspectives into account when assessing credit risk. Growth-stifling austerity programs can therefore not only reduce the denominator of the debt to GDP ratio (especially under liquidity trap), but also raise the numerator due to higher interest payments. Boussard *et al.* (2012) also make the point that if financial markets are myopic, than fiscal adjustment might be counter-productive in the short-run. They add however that under realistic assumptions this phenomenon could be reversible within few years from the start of the adjustment.

The discussion reported above shows that the exact mechanisms of pricing government bonds in financial markets are not known, especially since the crisis started to spread throughout Europe. Government bond yields evolution suggest that a structural break occurred sometime around (or not long after) the Lehman Brothers collapse in September 2008. New mechanisms are not precisely known, perhaps even among the market agents that price the bonds, and understanding them requires answering several important questions, such as: Have sovereign spreads indeed increased due to a better credit-risk assessment or have global factors played a more important role? If it is credit risk which is to be blamed, how do financial markets identify factors of this risk? What is the role of the private sector (especially nested in banks) in elevating credit risk, if markets already notice that private imbalances might smoothly spill-over to the public sector, fuelling sovereign imbalances? But there are also other questions, which received little attention so far in the literature. How forward looking are financial markets? Have they become more myopic or more forward-looking during the crisis?

This paper aims at answering all the questions formulated above with respect to EMU countries. Its biggest value added lies in addressing last two questions. We construct four alternative expectation schemes and test how far did financial markets reach while pricing bonds before the crisis, and have their horizons extended or shortened in the crisis regime. Another novelty can be found in the method employed. We make use of the relatively new Augmented Mean Group (AMG) estimator, developed by Eberhardt and Bond (2009), which accommodates some of the frequent problems of panel data models.

The remainder of the paper is structured as follows. Second section contains literature review. Section three presents data and the empirical model. Section four discusses the results. Summary recapitulates main findings and also proposes directions for future research.

2. RELATED LITERATURE

The run-up period towards creating the EMU in mid-1990s resulted in steady equalization of government bond yields across its founding member states. This phenomenon was triggered by eliminating exchange rate risk and a credit of trust given by financial markets to countries with less solid macroeconomic fundamentals. The credit was anticipated to be guaranteed exogenously - by the most credible states as well as endogenously – by policy efforts to fulfill the Maastricht criteria and thus eliminate major internal imbalances.

In this environment, mechanisms of bond yield determination in financial markets have become less an issue of interest. Having said that, there were several important contributions in the field, just to mention Codogno *et al.* (2003), Geyer *et al.* (2004), Pagano and von Thadden (2004), Favero *et al.* (2005) or Gómez-Puig (2008). But indeed, it was not before the rapid emergence of spreads activated by the financial crisis in 2008, when its determinants attracted a lot of attention and numerous papers started to appear.

Generally, two approaches towards analyzing spread determinants can be identified. The first approach is focused on high-frequency fluctuations, driven by financial variables, associated with e.g. risk perception volatility, liquidity factors and all kinds of "events", such as new data releases, policy announcements and political events. This approach, based on high-frequency data, is also very useful for tracking contagion effects, but it is less handy at exploring the role of macroeconomic and fiscal fundamentals.

The second approach is complementary to the previous one with its aim to unveil long-run determinants of spreads. From a theoretical point of view, bond yield of an EMU member state contains a risk-free asset interest rate, an EMU common factor (related to expected exchange rate volatility and monetary policy stance), country-specific credit risk premiums and also global risk aversion factor. Modeling deviations from yields on German bunds leaves us with all but first two components, but what remains is sufficiently complex. We are also far from reaching consensus on precisely which variables are responsible for driving the spreads.

The least controversial seems to be the global risk factor - most of studies find some measure of it to significantly determine sovereign bond spreads. For example, Codogno *et al.* (2003) reach such conclusion analyzing the pre-EMU period as well as its first years. Unsurprisingly, global risks also turns out to be significant in later studies, especially those encompassing some episodes of the crisis (see: Attinasi, *et al.* 2009, Gerlach *et al.*, 2010, Caggiano and Greco, 2011). Global risk fluctuations are normally approximated by spreads between interest rates on (safe haven) US Treasuries and medium-risk corporate bonds (e.g. Bernoth *et al.*, 2003, Codogno, *et al.*, 2003, Gerlach *et al.*, 2010, Schuknecht *et al.* 2010). A frequently used alternative variable is the VIX index[1]. Arghyrou and Kontonikas (2010) show that the choice between the two approaches to capture global risk is not very important because both do the job quite well and in a similar way.

There are more doubts regarding bond market liquidity, encompassing market depth (volume of transactions) and market breadth (market price sensitivity to large-scale transactions, see: Barrios, *et al.*, 2009). Low liquidity means the risk of accepting high bid-ask spreads. Variables used to capture liquidity risk are: bid-ask spreads, value of debt outstanding or volume of bonds exchanged within a unit of time. Empirical evidence for their significance is mixed. Attinasi *et al.* (2009), Barrios *et al.* (2009),Gerlach et al (2010) find liquidity risk to be significant while Bernoth and Erdogan (2010) as well as Schuknecht *et al.* (2010) arrive at opposite conclusions, regardless the period under consideration. Codogno *et al.* (2003) claim that importance of liquidity in the early days of EMU was already limited. Barrios *et al.* (2009) note an important complication related to using liquidity variables in spread equations. While credit risk is determined by slow-moving fiscal and macroeconomic variables, liquidity-related factors influence yields at higher frequencies.

[1] *Chicago Board Options Exchange Market Volatility Index* – an implied volatility index of S&P 500 options.

Conclusions on factors influencing credit risk premium differ considerably, depending on selected variables and estimation method. Indeed, general macroeconomic and fiscal position can be described with plethora of variables. If we additionally account for possible nonlinearities, the task to model credit risk determinants of spreads becomes even more complicated.

First of all, selected variables must cover the situation of at least three broad sectors: public finance, real economy and banking sector (which, to some extent reflects private sector imbalances). It seems that while first two are always given sufficient attention, the banking sector is not always appreciated.

The relationship between public debt and sovereign spreads had been documented even before the EMU was established (see: Alesina, *et al.*, 1992, Goldstein and Woglom, 1992). More recent results have been mixed. Schuknecht *et al.* (2010) show that the estimated parameters capturing impact of public debt changes on spreads have become several times larger since the crisis began in 2008. Some studies, like Barrios *et al.* (2010) or Caggiano and Greco (2011) show that this impact has been nonlinear, i.e. high-debt countries were punished relatively severely in financial markets. Afonso *et al.* (2012) find the debt/GDP ratio to be insignificant. Most papers also confirm the importance of general government balance, but (again) Afonso *et al.* (2012) provide only weak support here.

From an investor's point of view, factors important for assessing credit risk can be found in real economy. Codogno *et al.* (2003) argue that future ability to service debt depends on actual and future level of investment and income. High GDP dynamics on the one hand helps to regain/keep public finance sustainable and, on the other hand, can signal solid competitiveness. Caggiano and Greco (2011) show that the impact of short-run GDP dynamics expectations has become more important in the crisis period, as compared to earlier years.

Competitiveness developments is indeed identified as potentially important factor and is therefore sometimes modeled explicitly. Barrios *et al.* (2010) rely on current account balance (in per cent of GDP) and confirm its significance. Afonso *et al.* (2012) use real exchange rate measure to capture external competitiveness and find it to be significant only in the crisis period.

There has been growing literature recently, focusing on the sovereign-banking nexus and revealing links between banking sector imbalances and sovereign spreads. Indeed, financial markets might be increasingly aware of this problem, especially after the events in Ireland, where the need to recapitalize banks added nearly 50 per cent to the debt/GDP ratio within just four years. This meant advancing from one the lowest to fourth highest public debt ratio among all EU countries. Other countries offered guarantees to support banking sector, but even in absence of explicit guarantees, it is obvious that banks can raise sovereign credit risk at least until full-scale banking union with credible resolution mechanisms is firmly in place. It should be emphasized that depending on macroeconomic situation, positive or negative feedback loops

can be generated by the banking sector. In good times, large banking sector supports growth and is also a source of revenues (see. Gerlach *et al.* 2010). In bad times however, quality of assets tend to deteriorate and public funds can get under pressure as the bail-out risk increases.

Even if direct bailing out is not a necessity, support for the banks may be exercised as an alternative to the painful strong deleveraging, leading to credit crunch that further stifles consumption and investment demand, if the latter is perceived more costly. On top of this, banks' balance sheets reflect in part private sector imbalances (like indebtness of households and non-financial enterprises), which are another potential source of sovereign credit risk. Empirical evidence for the impact of public support action announcements of sovereign spreads are provided by Acharya *et al.* (2011). Also Gerlach *et al.* (2010) claim that the size of the banking sector has become a factor raising risk premium, especially during high global risk aversion periods.

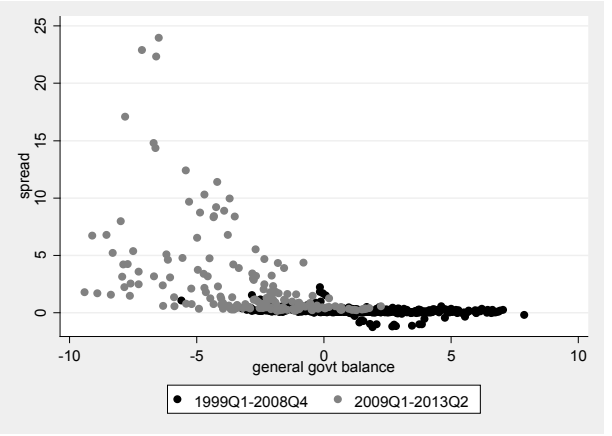
In addition to the variables discussed above, some studies use credit ratings as regressors (Manganelli and Wolswijk, 2009, De Santis, 2012). We should keep in mind however that ratings are subject to limited variability and can introduce endogeneity in the model as they themselves are influenced by the evolution of (mostly) macroeconomic, fiscal and financial variables and also tend to react to spreads rather than drive them (Gonzales-Rozada, *et al.*, 2008).

3. Data

In line with most empirical studies, we assume that sovereign spreads are determined by a number of factors, related to developments in real economy, public finance, financial sector and international risk aversion. The dependent variable is deviation of benchmark 10-years government bond yield from its German counterpart and these data are taken from Eurostat.

Before performing quantitative analysis, we need to decide on the type of fiscal and macroeconomic variables used: historical versus expected. Historical data are readily available in statistical databases, which simplifies research and saves time. The relatively high popularity of employing historical data could have been observed mostly before the outbreak of the crisis (Bernoth *et al.*, 2003, Codogno *et al.*, 2003) but some studies relied on them also more recently (e.g. Aβmann and Boysen-Hogrefe, 2009, De Grauwe and Ji, 2012). The majority of papers however use expected data (real-time forecasts) in view that financial markets must be trying to discount future economic developments since they determine the expected return. This is the view to which we subscribe in our paper.

FIGURE 1. GOVERNMENT BOND SPREADS (IN BASIS POINTS) AND CURRENT YEAR EXPECTED GENERAL GOVERNMENT BALANCE (IN PERCENT OF GDP)



Notes: General government balance – deviations from German.

Source: Eurostat data.

There is a number of candidate variables to capture various dimensions of credit risk. Fig. 1 shows that the state of public finance could have played an important role for determining yields, but only in the crisis period, since 2009. During "normal times" any deviations from the German government balance seem to exert no impact on government bond spreads. Another important factors might be tracked in real economy. When proxied by GDP growth rate, real sphere developments are indeed associated with spreads, at least as long as the crisis period is considered (see: fig. 2). It is more difficult to reveal any relationships between the two plotted variables during normal times.

We use the following variables as regressors to model sovereign spreads in EMU. The real economy situation is covered by (expected) GDP growth (annualized, in per cent), unemployment rate (in per cent), unit labour cost (index) and current account balance (in per cent of GDP). To define fiscal position we have at our disposal (expected) general government deficit and debt (both in per cent of GDP). We made attempts to replace general government balance by cyclically-adjusted general government balance (in per cent of potential GDP), but they were not successful[2]. Macroeconomic and fiscal data come from bi-annual OECD Economic Outlooks. Risk from the banking sector is covered by three alternative ratios: total assets to GDP, total loans to private deposits and credit to depo-

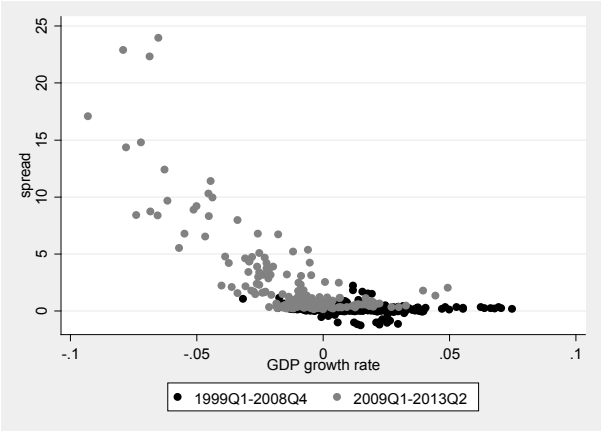
[2] One of the important problems might be the measurement problem related to low credibility of current potential GDP and output gaps estimates.

sits. These data come from ECB Statistical Data Warehouse. Because we model spreads deviations from German bond yields, all the above country-specific variables are also deviations from their respective values in Germany.

Global risk aversion factor is proxied by the deviation between yield on 10-year US Treasuries and average yield on Baa-rated corporate bonds. The source of these data is Bureau for Economic Analysis (BEA). We decided not to include any proxy for liquidity of domestic government bond market due to the problems with different frequency of credit and liquidity risk determinants (Barrios *et al.*, 2009) and the likely collinearity with debt to GDP ratio.

Figure 2. Government bond spreads (in basis points) and current year expected GDP growth rate (in percent)

Notes: GDP growth rate – deviations from the value in Germany.



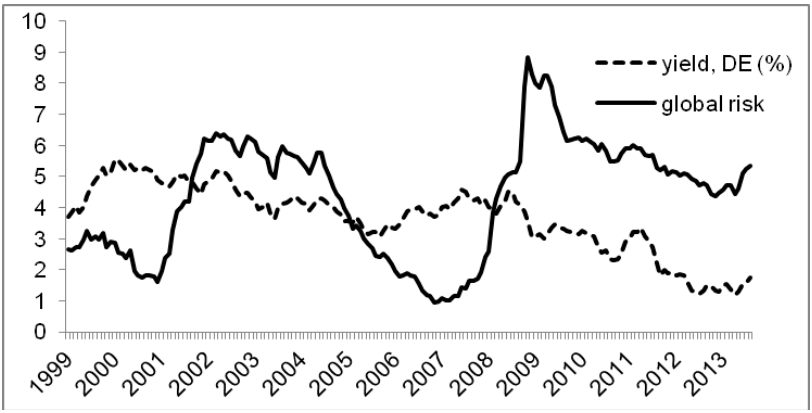
Source: Eurostat data.

The biggest problem with the created dataset is mixed-frequency of data. Especially macroeconomic and fiscal projected data come at low frequency (bi-annually). This problem is usually solved by linear or cubic interpolation to quarterly or even monthly frequency (see: Alexopoulou *et al.*, 2009, Schuknecht et al, 2010, among others).

Instead of simple interpolation, we provide a model-based way of solving this problem by constructing four alternative, testable expectation schemes. Before putting forward the proposed expectation schemes, basic assumptions should be unveiled. OECD Economic Outlook is released every June and December. Since projections are based on a pool of data available by that time, we assume that they are fully anticipated in (respectively) second and fourth quarter. The questions are: how do expectations evolve between subsequently released projections? Do financial markets, while assessing sovereign risk, take

account of forecasts for the current year, the next year, or gradually extend their horizon?[3]

FIGURE 3. 10-YEAR GERMAN GOVERNMENT BOND YIELDS AND GLOBAL RISK INDICATOR (SPREAD BETWEEN YIELD ON 10-YEAR US TREASURIES AND AVERAGE YIELD ON BAA-RATED CORPORATE BONDS)



Source of data: Eurostat.

To get at least partial insight into financial markets' behavior, four following alternative expectation schemes, based on linear interpolation, are constructed[4]:

1. Smoothed current-year projections: in the second and fourth quarter they are taken from OECD Economic Outlooks, whilst in the first and third quarter interpolated current-year forecasts are used. This is an assumption consistent with myopic financial markets.
2. Forecasts smoothed as in scheme (1), but referring to next year. In this scheme financial markets react to the newest forecasts (and are therefore more forward-looking), since current-year forecasts are already discounted in yields.
3. Weighted forecasts for the recently passed year, current and next year (gradual shift).
4. Forecasts interpolated as in schemes (1) and (2) and then, in second and fourth quarter, weighted as in scheme (3). This scheme also reflects gradual shift and additionally smooth adjustment of forecasts.

Descriptive statistics of the complete data set is provided in table 1.

[3] Due to lack of longer-term forecasts of some variables it is assumed that only current and next year forecasts can determine credit risk.
[4] Details of the four expectation schemes construction are presented in Annex.

Table 1. Descriptive statistics.

Variable*	Description	Expectation scheme	Obs	Mean	Std. dev.	Min	Max
spr	Spread of 10Y government bond over 10Y German Bunds (in %)	-	627	0.91	2.47	-1.25	23.98
risk	Spread between US Treasuries and Baa-rated corporate bonds (in %)	-	638	4.34	1.87	1.03	8.33
loandep	Loan to deposit ratio	-	620	0.05	0.41	-0.86	1.50
capass	Capital to asset ratio	-	638	0.02	0.02	-0.02	0.08
crdep	Credit to deposit ratio	-	621	0.23	0.44	-0.74	1.96
ggbal1	General government balance (per cent of GDP)	1	630	0.05	3.50	-28.34	7.88
ggbal2		2	620	0.21	2.74	-7.64	8.23
ggbal3		3	629	0.21	3.08	-17.49	7.21
ggbal4		4	619	0.09	3.31	-20.71	7.04
ca1	Current account balance (per cent of GDP)	1	629	-3.84	6.03	-23.24	11.52
ca2		2	618	-4.06	5.90	-22.94	12.36
ca3		3	627	-3.86	5.99	-23.24	11.73
ca4		4	618	-3.96	5.97	-23.24	11.52
debt1	General government debt (per cent of GDP)	1	630	0.54	31.21	-64.48	94.88
debt2		2	620	0.52	31.42	-62.47	109.38
debt3		3	630	0.53	31.21	-64.48	104.84
debt4		4	620	0.39	31.28	-64.48	101.52
gdp1	GDP growth rate (in %)	1	638	0.38	2.05	-9.31	7.47
gdp2		2	627	0.43	1.39	-5.21	5.07
gdp3		3	627	0.41	1.80	-6.52	6.63
gdp4		4	627	0.38	1.91	-8.26	6.83
ulc1	Unit labour cost (index)	1	599	0.13	0.11	-0.57	0.93
ulc2		2	589	0.15	0.12	-0.63	0.96
ulc3		3	594	0.14	0.11	-0.13	0.93
ulc4		4	588	0.14	0.11	-0.59	0.93
unr1	Unemployment rate (in %)	1	638	0.44	4.52	-7.58	22.77
unr2		2	627	0.63	4.63	-6.99	23.56
unr3		3	638	0.42	4.50	-7.58	22.77
unr4		4	627	0.50	4.53	-7.58	22.77

gass1	Gross government assets (per cent of GDP)	1	585	8.71	25.16	-19.43	98.88
gass2		2	575	9.31	25.57	-19.33	100.05
gass3		3	581	8.92	25.28	-19.33	99.17
gass4		4	573	8.93	25.29	-19.33	98.88

*all variables expressed as deviation from the respective values in Germany.

4. EMPIRICAL MODEL

Having constructed the four sets of expected macro and fiscal variables, we use them as regressors, along with banking sector variables and the global risk factor proxy, to model sovereign spreads. The equation parameters are estimated with the Augmented Mean Group (AMG) estimator, introduced by Eberhardt and Bond (2009), that allows for cross-sectional dependence by including a "common dynamic process" in the group regressions (see: Afonso, Jalles, 2011). The multi-factor framework of AMG estimation also accommodates endogeneity when it arises from common factors driving both dependent and independent variables (Lanzafame, 2013).

The AMG approach refers to the following three-stage procedure. The first stage relies on the pooled OLS model, which is estimated in first-differences, augmented with T-1 (first-differenced) time dummies:

$$\Delta s_{it} = \beta' d_{it} + \sum_{t=2}^{T} c_t \Delta D_t + \varepsilon_{it} \quad (1)$$

Where d_{it} is a vector of first-differenced dependent variables X_{it} and coefficients $C_t = \mu_t^*$ on the first-differenced year dummies represent an estimated cross-section average unobservable component driving sovereign spreads, referred to as "common dynamic process".

In the second stage, coefficients c_t (relabeled as μ_t^*) are used as explicit variables in the group-specific regressions:

$$s_{it} = \alpha_i + \beta_i' x_{it} + \lambda r_t + \gamma_i \mu_t^* + \varepsilon_{it} \quad (2)$$

where γ_i represent country-specific factor loadings on the common, unobservable dynamic process and r_t is a measure of global risk aversion. The common dynamic process therefore encompasses all the remaining (auxiliary to global risk) unobservable factors that drive sovereign spreads and are not country-specific. There are various potential factors which build this process, such as the risk of EMU break-up or changes in investors' preferences, but also investing opportunities in other parts of the World, which may have an impact on capital flows and thus spreads. For example, a reduced pool of world safe-haven assets increases demand for German (safe-haven) bonds and dri-

ves EMU sovereign spreads symmetrically up. Filtering out these information should reduce bias on observable fundamental macro and fiscal variables that will be included in the x_{it} vector.

In the third stage, the group-specific model parameters are averaged across the panel, just like in the Mean Group (MG) and Common Correlated Effects Mean Group (CCEMG) estimators:

$$\beta_{aug} = \frac{1}{N}\sum_{i=1}^{N}\beta_i \tag{3}$$

In addition to dealing with the cross-section dependence and endogeneity problems, AMG estimator allows us to estimate a model with a mixture of stationary and nonstationary variables (regardless whether cointegrated or not). Consequently, performing unit root diagnostics of our time-series is redundant and we omit this step.

5. Results

In the first, pre-crisis period, lowest root mean squared errors were generated in models based on the fourth expectations scheme (weighted and smoothed forecasts, encompassing both current year and one year ahead). The respective results are shown in table 2 below[5]. The first (myopic) expectations scheme produced only marginally worse results: RMSEs within this scheme were 1.6-10% higher in 8 out of 9 estimates and lower in one remaining case. All the other schemes turned out to be significantly worse.

Turning to the assessment of country-specific fundamentals as determinants of sovereign spreads, the results suggest their impact to be relatively weak. Despite allowing for non-linearity in the impact of government debt, its ratio to GDP was not found to be significant in any specification. Even the dummy variable capturing debt/GDP ratio exceeding its value in Germany by more than 30 percentage points (debt30) did not appear important. Some evidence was found for significance of general government balance, although its impact was not found to be strong. Macroeconomic fundamentals which proved significant in our estimations were (usually) current account to GDP ratio and the unemployment rate. Unit labour costs and GDP growth did not make important determinants. The significance of unemployment rate and insignificance of GDP growth may suggest that output gap was more important than potential GDP growth rate (as low unemployment and low GDP growth was preferred to high unemployment combined with fast GDP growth). Insignificance of labour costs can be easily reconciled with significance of current account, even if so much has been said about Greece's loss of competitiveness during the EMU period. In the EMU advanced economies, non-price compe-

[5] The remaining estimates results are not reported to save space and are available upon request.

titiveness can matter more than price competitiveness. Rising costs of labour do not affect credit risk if current account is still able to improve which, by the way, was not the case in Greece.

All in all however, the results are generally consistent with numerous papers suggesting mispricing sovereign risk prior to the crisis and the detachment of credit risk assessment from country-specific macroeconomic and fiscal fundamentals (Attinasi, *et al.*, 2009, De Grauwe and Ji, 2012).

The estimated parameters of financial variables are interesting. Be it credit to deposit or loan to deposit ratio, coefficients on these variables appear significantly negative, suggesting that financial markets favoured countries with aggressive banks, maintaining high leverage ratios. However, the structure of liabilities might also have mattered. When capital to asset ratio is used, the coefficient loses significance, which suggests that even before the crisis raising capital was preferred to other types of funding.

The most puzzling are some weak signs of positive relationship between government assets and sovereign spreads. While in principle large values of assets could be treated as a factor that increases public finance sustainability, this not necessarily must have been appreciated before 2008. Freeing up public assets via e.g. privatization usually increases efficiency and returns. As banking sector variable coefficients show, efficiency had been preferred to safety.

Two variables are found to be strongly significant, regardless the estimated specification and both are unrelated to country-specific fundamentals. The first one is global risk factor (spread between US Treasuries and medium-risk US corporate bonds), while the second captures the common dynamic factors, which influence spreads in a symmetric way.

Our results show that the crisis has fundamentally changed the behavior of financial markets. Spreads started to increase around mid-2008 and this process intensified after the collapse of the Lehman Brothers in September 2008, which is reflected by the statistically significant dummy variable for the fourth quarter of 2008. Estimations conducted on the crisis period (starting from 2009) reveal a structural shift in the sovereign risk assessment.

First, the financial markets have become more myopic. This is confirmed by the first expectations scheme outperforming all the other in the second period (table 3)[6]. This finding is justified by the fact that short-term forecast revisions in turbulent times are important and contain high information loading, while longer-term forecasts are subject to elevated uncertainty, which reduce their relevance.

[6] With one exception of specification (5), which performed better under fourth expectations scheme. However, RMSEs guide us to focus on first two specifications in the crisis period. Tables with estimations based on other expectations schemes are available upon request.

Table 2. Estimation results of sovereign spreads determinants in the pre-crisis period (1st quarter 1999 – 4th quarter 2008), 4th expectation scheme

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
risk	0.058***	0.057***	0.053***	0.050***	0.047***	0.046***	0.043***	0.043***	0.041***
	(9.43)	(9.35)	(8.48)	(8.81)	(8.55)	(7.46)	(8.31)	(7.26)	(6.86)
debt	-0.011	-0.011	-0.007	0.000	0.000	0.002	-	-	-
	(-0.97)	(-0.99)	(-0.74)	(0.01)	(0.16)	(0.55)			
debt^2	0.000	-0.000	0.000	-	-	-	-	-	-
	0.03	(0.26)	(0.05)						
gass	0.003*	0.002	0.002	0.002**	0.002*	0.001	0.002**	0.002**	0.001
	(1.82)	(1.64)	(1.34)	(2.14)	(1.91)	(1.33)	(2.03)	(1.97)	(1.28)
ggbal	-0.016*	-0.014	-0.012	-0.020**	-0.019**	-0.015*	-0.018***	-0.018***	-0.017***
	(-1.72)	(-1.58)	(-1.40)	(-2.44)	(-2.43)	(-1.79)	(-3.25)	(-3.66)	(-4.11)
gdp	0.309	0.523	0.698	0.852	1.100	1.169	0.772	0.890	0.967
	(0.32)	(0.66)	(0.85)	(1.00)	(1.47)	(1.54)	(0.77)	(0.82)	(0.98)
ulc	0.337	0.284	0.305	0.336	0.295	0.282	0.022	-0.011	0.037
	(1.28)	(1.15)	(1.19)	(1.27)	(1.19)	(1.08)	(0.16)	(-0.10)	(0.39)
ca	-0.008*	-0.008*	-0.009	-0.008*	-0.007	-0.009	-0.011*	-0.009	-0.009**
	(-1.68)	(-1.68)	(-1.43)	(-1.65)	(-1.58)	(-1.58)	(-1.73)	(-1.48)	(-2.42)
unr	0.018	0.015	0.014	0.021**	0.020**	0.015**	0.017*	0.019**	0.012**
	(1.55)	(1.18)	(1.63)	(2.33)	(2.13)	(2.50)	(1.95)	(2.17)	(2.12)
2008Q4	0.019***	0.019***	0.021***	0.027***	0.028***	0.027***	0.033***	0.033***	0.030***
	(2.83)	(2.67)	(2.98)	(3.80)	(3.73)	(3.75)	(4.09)	(4.33)	(4.66)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(8)
c-dyn	0.956***	0.949***	0.960***	0.977***	0.970***	0.956***	1.037***	1.027***	0.991***
	(11.72)	(10.61)	(10.35)	(11.27)	(10.42)	(9.16)	(9.62)	(9.13)	(8.23)
crdep	-0.151**	-	-	-0.185***	-	-	-0.192***	-	-
	(-2.24)			(-2.85)			(-2.85)		
loandep	-	-0.120*	-	-	-0.160***	-	-	-0.149*	-
		(-1.90)			(-2.58)			(-1.77)	
capass	-	-	-0.676	-	-	-0.888	-	-	-0.421
			(-0.55)			(-0.62)			(-0.26)
debt30	-	-	-	-	-	-	0.010	0.011	0.010
							(1.00)	(1.00)	(1.00)
intercept	-0.088	-0.088	-0.039	0.092	0.093	0.110	0.076*	0.060	0.073
	(-0.45)	(-0.46)	(-0.25)	(0.99)	(1.12)	(1.40)	(1.65)	(1.06)	(0.96)
Obs.	343	343	343	343	343	343	343	343	343
chi2	168.91	416.06	921.91	311.30	481.61	1485.78	490.52	34035.76	584.68
RMSE	0.022	0.023	0.023	0.024	0.024	0.024	0.026	0.026	0.027

Notes: risk-international risk factor, debt-general government debt to GDP ratio, gass-general government assets to GDP ratio, ggbal-general government balance to GDP ratio, gdp-annual GDP growth rate, ulc-unit labour cost index, ca-current account to GDP ratio, unr-unemployment rate in per cent, c-dyn-common dynamic process, crdep-credit to deposit ratio, loandep-loan to deposit ratio, capass-bank capital to asset ratio, debt30-dummy variable = 1 if debt to GDP ratio exceeds its value in Germany by 30 per cent of GDP or more). ***,**,* denote significance at 1%, 5% and 10%, respectively. t-stats in parentheses.

Second, factors driving sovereign spreads became different. It is much easier to select best specifications in the crisis period. Errors generated in specifications (1) and (2) clearly outperform the other. Global risk factor is now 4-5 times stronger as a spread determinant compared to the pre-crisis times. Other macroeconomic variables that strongly influenced spreads during the crisis have been the general government balance and unemployment rate. The latter might be used as a better indicator of domestic demand perspectives than expected GDP growth (again not significant), which was largely influenced by net exports during the crisis. Consequently, a one percentage point increase in expected unemployment rate boosts government spread inasmuch. High (negative) coefficients on expected general government balance provide an evidence of financial markets' return to fundamentals-based sovereign risk assessment, in line with arguments of De Grauwe and Ji (2012). At the same time, the sudden simultaneous increase in importance of domestic demand and fiscal balance short-run perspectives reflect a trap, in which some fiscally stressed countries found themselves. It was manifested by the IMF's Olivier Blanchard "damned if you do, damned if you don't" in April 2012[7]. It should be noted however, that the postulated improvement in the risk assessment quality was not complete. It appears that controlling for other determinants, including the (again highly significant) "common dynamic factors", public debt/GDP ratio was not a significant driver of sovereign spreads. Indeed, this is a very slow-moving variable and general government balance developments started to be more closely tracked as indices of public finance sustainability.

A major change also occurred in the perception of banking sector and sovereign risk nexus. Following the problems observed in highly-leveraged financial systems and episodes of debt transfer from the private to public sector, banking leverage (measured by loan-to-deposit ratio) has started to be perceived as hazardous imbalances rather than indicate entrepreneurship. Indeed, increasing loan-to-deposit ratio by 1 percentage point raises government spread by 1.5 percentage points in the crisis period.

[7] These words were uttered as a comment on a warning addressed at the Spanish government of a potentially negative consequences of fiscal tightening and were widely interpreted as accusing financial markets of "schizophrenia" in assessing sovereign credit risk.

Table 3. Estimation results of sovereign spreads determinants in the crisis period (1st quarter 2009 – 2nd quarter 2013), 1st expectation scheme

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
risk	0.134**	0.175***	0.179*	0.001	0.093	0.186***	0.033	0.061	0.100
	(2.30)	(2.63)	(1.83)	(0.01)	(1.62)	(2.93)	(0.82)	(0.89)	(1.54)
debt	-0.081	-0.105	-0.004	-0.118	-0.123	0.005	-	-	-
	(-0.33)	(-0.47)	(-0.02)	(-1.07)	(-1.15)	(0.05)			
debt^2	-0.016	-0.015	-0.016	-	-	-	-	-	-
	(-1.35)	(-1.35)	(-1.20)						
gass	0.144	0.122	0.102	0.076***	0.092**	0.102***	0.173*	0.187*	0.194**
	(1.90)	(1.96)	(1.32)	(1.73)	(1.88)	(0.93)	(1.79)	(1.82)	(2.06)
ggbal	-0.262*	-0.235*	-0.045	-0.157	-0.150	-0.036	-0.168**	-0.154**	0.002
	(-1.73)	(-1.86)	(-0.30)	(-1.49)	(-1.43)	(-0.35)	(-2.40)	(-2.05)	(0.05)
gdp	3.182	1.181	-15.238	-15.506	-4.898	-34.283	2.744	9.028	4.503
	(0.24)	(0.08)	(-0.83)	(-1.07)	(-0.59)	(-1.24)	(0.45)	(0.70)	(0.88)
ulc	-0.147	-2.315	-2.169	0.825	1.911	-3.986	6.663	6.464	2.500
	(-0.02)	(-0.30)	(-0.39)	(0.21)	(0.29)	(-0.75)	(1.00)	(0.79)	(0.48)
ca	0.061	-0.006	0.020	0.065	0.037	0.008	0.044	0.032	-0.083
	(0.49)	(-0.06)	(0.12)	(0.80)	(0.39)	(0.06)	(0.69)	(0.45)	(-0.85)
unr	0.957**	1.021**	0.409	0.588	0.807**	0.110	0.581*	0.641*	0.583**
	(2.33)	(2.25)	(1.34)	(1.55)	(2.06)	(0.23)	(1.89)	(1.83)	(2.04)
2011Q4	0.369***	0.382***	0.561***	0.377***	0.325***	0.556***	0.251***	0.227***	0.300***
	2.78	2.99	3.27	3.27	2.88	3.20	4.40	3.48	4.19

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
c-dyn	1.282***	1.284***	1.209***	1.144***	0.952**	1.191***	0.972***	0.911***	0.951***
	(2.59)	(2.74)	(3.19)	(2.88)	(2.23)	(2.99)	(3.70)	(2.95)	(4.29)
crdep	-0.276	-	-	0.742	-	-	1.092**	-	-
	(-0.40)			(0.85)			(2.14)		
loandep	-	1.554**	-	-	2.408***	-	-	2.595***	-
		(2.06)			(3.51)			(5.60)	
capass	-	-	-18.794	-	-	-15.137**	-	-	-4.875
			(-1.15)			(-2.38)			(-0.68)
debt30	-	-	-	-	-	-	-0.073	-0.069	-0.058
							(-0.95)	(-0.94)	(-0.880
intercept	0.925	-1.852	-0.627	4.087	1.549	4.436	0.463	-0.718	-0.582
	(0.23)	(-0.45)	(-0.19)	(1.07)	(0.37)	(1.48)	(0.11)	(-0.15)	(-0.13)
Obs.	130	130	144	130	130	144	130	130	144
chi2	230.42	270.51	790.18	5700.05	1160.75	19430.50	330.31	2410.54	2410.05
RMSE	0.059	0.059	0.074	0.085	0.088	0.098	0.096	0.090	0.104

Notes: see table 2.

6. SUMMARY

The financial crisis has led to important changes in the process of sovereign risk assessment. More importantly, these changes have not been well recognized by economic policymakers and much justifiable doubt has been raised on consistency and rationality of financial markets' behavior towards sovereigns. In this paper we check whether this change has occurred only with respect to variables considered or whether the expectation scheme has changed, i.e. financial markets have started discounting information from other forecast horizon.

Our results show that indeed major changes occurred in both these dimensions. Since 2009 financial markets became more myopic, compared to the "normal times" from before the crisis. As it is also found in some other papers, fundamental macroeconomic and fiscal variables started to play a more important role in driving the spreads, but the story seems to me more subtle. Fiscal balance is found to be more important than government debt (the latter being a very slow-moving variable) and short-run growth perspectives seem to started being assessed based on domestic demand indicators (such as unemployment rate evolution) rather than simply expected GDP growth. Indeed, we observed some countries experiencing a slump in demand during the crisis, which was largely offset by positive contributions of net exports due to strong declines in imports. The results also suggest that the role of exports price competitiveness, measured by ULC developments might have been exaggerated as a factor of sovereign risk. Most EMU countries rely on non-price competitiveness of their goods and services, so it is directly the current account to GDP ratio which matters more for influencing the overall economy competitiveness, while labor costs do not matter that much.

Another finding of our exercise was related to the perception of banking sector leverage. In line with a common belief we show evidence that the impact of raising this leverage on sovereign risk reversed as the crisis struck, which must have contributed to the sudden, substantial increase in sovereign spreads in some countries, formerly appreciated by the financial markets.

It is a common conclusion of earlier studies that global risk started to become an ample driver of sovereign spreads in the crisis regime. We confirm this finding, but we also show that global risk was important even before the crisis. Moreover, there were some additional common factors influencing spreads before as well as during the crisis, which are aggregated in the "common dynamic process" extracted in the AMG procedure, which was employed in this paper.

Our paper has provided some new insights on how sovereign spreads are determined, but it has also indicated some new research problems for future. First, the time horizon of forecasted variables in the sovereign credit risk assessment mechanism are worth analyzing in more detail. Second, since the "common dynamic process" indicates that some variables auxiliary to global risk play a role in pricing bonds, it might be important to try to identify these factors explicitly to check whether they have a truly symmetric impact on the governments spreads.

As for the policy implications, our results offer limited support for the drive towards achieving fiscal sustainability in the desire to lower government bond yields, commonly observed in Eurozone (e.g. in't Veld *et al.*, 2012), but also in other countries (e.g. Krajewski *et al.*, 2015). While the general government balance is taken into account in pricing the yields, the role of public debt was not found to be significant, after controlling for other variables. It seems that prudence in the financial sector (including preventing risks of spillovers from financial sector to public finance) is a stronger guarantee of low yields during economic havoc. Further policy implications will follow the uncovering of the common dynamic process, but its revealed significance might already suggest the need for more policy coordination at the Eurozone level.

Annex

Presentation of expectation schemes.

Let $x_{i\tau}^{J(D)\tau-1}$ be the forecast of variable x_i for year τ, published in the June (December) OECD economic outlook of year τ-1. For each expectation scheme our dataset forms a matrix with elements $x_{it,n}$, where $n\varepsilon\{1,2,3,4\}$ denotes quarter of year t:

A) Scheme 1 (myopic markets)

$$\begin{bmatrix} x_{it,1} \\ x_{it,2} \\ x_{it,3} \\ x_{it,4} \end{bmatrix} = \begin{bmatrix} (x_{i\tau}^{D\tau-1} + x_{i\tau}^{J\tau})/2 \\ x_{i\tau}^{J\tau} \\ (x_{i\tau}^{J\tau} + x_{i\tau}^{D\tau})/2 \\ x_{i\tau}^{D\tau} \end{bmatrix}$$

B) Scheme 2 (forward-looking markets)

$$\begin{bmatrix} x_{it,1} \\ x_{it,2} \\ x_{it,3} \\ x_{it,4} \end{bmatrix} = \begin{bmatrix} (x_{i\tau+1}^{D\tau-1} + x_{i\tau+1}^{J\tau})/2 \\ x_{i\tau+1}^{J\tau} \\ (x_{i\tau+1}^{J\tau} + x_{i\tau+1}^{D\tau})/2 \\ x_{i\tau+1}^{D\tau} \end{bmatrix}$$

C) Scheme 3 (gradual shift)

$$\begin{bmatrix} x_{it,1} \\ x_{it,2} \\ x_{it,3} \\ x_{it,4} \end{bmatrix} = \begin{bmatrix} x_{i\tau-1}^{D\tau\text{-}1} \cdot 0.25 + x_{i\tau}^{D\tau\text{-}1} \cdot 0.75 \\ x_{i\tau}^{J\tau} \\ x_{i\tau}^{J\tau} \cdot 0.75 + x_{i\tau+1}^{J\tau} \cdot 0.25 \\ x_{i\tau}^{D\tau} \cdot 0.5 + x_{i\tau+1}^{D\tau} \cdot 0.5 \end{bmatrix}$$

D) Scheme 4 (gradual shift with smoothing)

$$\begin{bmatrix} x_{it,1} \\ x_{it,2} \\ x_{it,3} \\ x_{it,4} \end{bmatrix} = \begin{bmatrix} x_{i\tau-1}^{D\tau\text{-}1} \cdot 0.25 + [(x_{i\tau}^{D\tau\text{-}1} + x_{i\tau}^{J\tau})/2] \cdot 0.75 \\ x_{i\tau}^{J\tau} \\ [(x_{i\tau}^{J\tau} + x_{i\tau}^{D\tau})/2] \cdot 0.75 + [(x_{i\tau+1}^{J\tau} + x_{i\tau+1}^{D\tau})/2] \cdot 0.25 \\ x_{i\tau}^{D\tau} \cdot 0.5 + x_{i\tau+1}^{D\tau} \cdot 0.5 \end{bmatrix}$$

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