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Government Bond Yield Spreads in EMU Countries: the Story of an Ephemeral Convergence

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Abstract

The inception of the European Monetary Union appeared to have accomplished the yields' convergence goal of Maastricht. Suddenly however, spreads against Germany started escalating towards the values of the early nineties. Through the usage of a fixed-effects Arellano-Bond dynamic panel estimation, this thesis tries to discern the role of liquidity and fiscal fundamentals in determining yield differentials for ten EMU countries. While markets tend to monitor high debtors via more structural fiscal measures, a late and abrupt reaction, as risk perceptions increased, unveiled the unannounced fiscal unsoundness of the peripheral. The consequent defaults will put into question the credibility of the Stability and Growth Pact. In this context, unobserved individual effects seem to be the least of our concerns.

Keywords: Fiscal Fundamentals, Yields' Convergence, Credit Risk.

1. Introduction

On the 1st of January 1999, eleven countries materialized an idea that had been conceived in Maastricht, seven years before[1]. One of the main goals of the European Monetary Union (EMU henceforth) was to help creating a more integrated bond market in Europe, as large and as liquid as the United States'. As countries adopted a common currency, the exchange rate risk was eliminated. Hence, the only two significant factors that could keep EMU member states' sovereign bonds imperfect substitutes were liquidity, as assets that can be traded instantly with low transaction costs should offer lower yields, all else being equal, and the perceived risk of default[2].

[1] Greece joined 2 years later (1/1/2001).

[2] In the late nineties, according to Favero *et* al (1997), virtually all differences in the systems of taxes on financial transactions were harmonized.

As 1999 approached, yields converged and yield spreads became virtually inexistent[3]. Nonetheless, the Euro architects saw fiscal rules as a necessary complement to market forces, thus creating the Stability and Growth Pact. In it, they included caps to certain key fiscal fundamentals (debt/GDP and deficit/GDP), and also a no-bailout clause.

As we entered the new millennium however, these limits were already being exceeded, a trend that smoothly persisted in almost all member states, for the next decade. Given the mild reaction of markets, liquidity was thought to be the most relevant determinant of yield differentials which, as raised by Codogno *et al* (2003), would mean that there was scope for greater convergence and efficiency[4]. Recently however, a greater focus has been placed on default risk, and more concretely on the soundness of fiscal policies adopted by member states. In our days, it has become absolutely critical to perfectly disentangle the extent to which these aforementioned determinants do play a role. Since the third quarter of 2008 onwards it is not anymore about creating a market for the "same bond". It is about discerning what dragged us to the place we are now.

In our work, we try to answer that question. The estimation of a dynamic panel data model allowed us to distinguish two different time periods, which shall be explored and compared. Additionally, grouping countries with similar fiscal fundamentals enriched both our estimation results, and our understanding of the behavior of government bond yield spreads since 1999. Finally, ensuring the stationarity of first-differenced yield differential series and controlling for two perilous, though often forgotten, sources of endogeneity, strengthened our econometric specification, yielding more robust results.

[3] Figure A.1. in page 37 portrays the behavior of yield spreads in 4 EMU countries from 1995 to 2013.
[4] If spreads were explained by the amount of Euro-denominated debt outstanding, then greater fiscal integration would immediately lead to higher efficiency and yields' convergence.

The report hereby presented is organized as follows[5]. Section 2. summarizes previous research on government bond yield spreads, emphasizing the literature found to be more relevant for our work. Methodological procedures are described in 3. and all the results from the various specifications employed are displayed in section 4. Section 5. derives policy implications and raises the possibilities for further investigation.

2.1. Literature overview:

The literature on government bond yield spreads is vast and the conclusions are far from consensual. Capeci (1991) considered general obligation issues by 136 US municipalities to investigate how would markets react to credit quality fluctuations, but could not find strong implications to the cost of borrowing. Eichengreen and Mody (1998) confirmed that for emerging economies, higher credit quality translates into a higher probability of issue and a lower spread, even though fiscal fundamentals could only partly explain yields' compression prior to the nineties' crises. Alesina *et al.* (1992) regressed the spread between public and private yields of 12 OECD countries on their fiscal fundamentals and found that for highly indebted countries, the differential between public and private rates of return is positively correlated to debt outstanding and to its growth. A recognized pitfall in this work is that during sovereign debt crises' periods, a generalized credit crunch will also affect also private yields, which may bias the results against finding significant risks of default.

Recently, and especially since the EMU's inception, the focus of the literature shifted towards European government bond yield spreads. In this context, a generalized approach is using the German Bund as the benchmark, "risk-free" asset. However,

[5] This report comprises 25 pages (pp. 1-25) whose content is complemented by information provided in appendix (pp. 26-39). All tables and figures included in the main text are numbered consecutively following their order of appearance. The same applies to those included in appendix, being numbers preceded by *A.* for such cases. (Table A.1. corresponds to the first of the appendix, and so forth).

common points in what concerns methodology do not go much further than that. Indeed, the extensive literature on this topic brings about various model specifications and data treatment econometric methods that may well be the root of such contrasting conclusions. In the next section, we shall briefly discuss the articles deemed more relevant to our work, placing a special focus on their methodology and results.

2.2. Most relevant research pieces for this work:

Favero *et al.* (1997) used four years' daily data (from 1992 to 1995) in trying to evaluate the determinants of yield differentials for Italy, Spain and Sweden. They identified and measured three different components of yield differentials: the expectations of exchange rate depreciation, the different taxation treatments of long-term yields and a default risk factor[6]. With a vector autoregressive approach, Favero *et al.* (1997) found evidence of cointegration between yield spreads and exchange rate factors, and of uni-directional causality running from the exchange rate factor to the yield differential. Overall, they support that there is a common trend for the analyzed yield spreads, that is independent of country-specific shocks, may those be fiscal or other. Apart from the limitations VAR methodology may have, pointed by Gale and Orszag (2003), it seems clear that daily frequencies limit the relevance fiscal fundamentals may have[7]. Another factor that Favero *et al.* (1997) disregarded is

[6] While the exchange rate risk factor was measured by the interest rate swap differential between country *i*'s and German bonds, the default risk factor was taken as the residual of the difference between the observed yield differential and the aforementioned exchange rate risk factor. This methodology, first introduced by Favero *et al.* (1997), is of great relevance in government bond yield spreads' literature, and will thus be used in our work. As to tax treatment effects, it should be noted that these were only relevant for Italy, and as was previously described in footnote 2, became irrelevant from 1995 onwards.

[7] Gale and Orszag (2003) argue that VAR projection is essentially backward looking, and in this particular context will fail to incorporate information that may be widely available to market participants about future events. Regarding the limitations daily frequencies impose on fiscal data, these arise because daily fiscal data is not available. So, either one uses linear extrapolations of quarterly or monthly data (which is not a good solution) or, like Favero *et al.* (1997), chooses to use

liquidity, which has been consistently shown to be an influential determinant of yield differentials. Considering that the use of daily frequencies allows for a thorough inclusion of liquidity determinants such as bid-ask spreads and trading volumes, the aforementioned choice becomes even more intriguing[8].

Balassone *et al.* (2004) used a sample of fourteen EU countries over the period of 1981-2003 to test whether the stance of fiscal policy reacted to either market or agency perceptions of government creditworthiness. The dependent variable used was the structural primary balance as a percentage of GDP, regressed on the debt/GDP ratio, and the formerly mentioned assessments of sovereign risk[9]. Even though it does not answer to the exact same question as ours, the work of Balassone *et al.* (2004) is of invaluable interest for two reasons. The first relates to its conclusions: they suggest that not only market reactions to deteriorating fiscal fundamentals tend to be slow and small in size, but also that fiscal corrections tend to be significantly delayed even after markets' alarms ring. The power of these conclusions begs the suggestion to extend Balassone *et al.'s* (2004) work to the field of political economy[10]. The second reason is the fact that Balassone *et al.* (2004) undoubtedly show that reverse causality should be taken into account in the literature on government bond yield spreads.

Codogno *et al.* (2003) used a dataset of monthly observations from 1991 to 2002 for 10 EMU countries, and defined liquidity and default risk as the relevant determinants of yield differentials[11]. A number of relevant controls were imposed to capture

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default risk measures such as credit ratings, which will tend to also incorporate factors other than fiscal fundamentals.

[8] Many authors such as Gómez-Puig (2006) actually dispute liquidity to be the most relevant determinant of government bond yield spreads. This option by Favero *et al.* (1997) probably lies on the unavailability of the aforementioned data, even though the author did not address that issue.

[9] All independent variables were one year lagged, which determined the use of Arellano-Bond fixed-effects dynamic panel estimation.

[10] Possible political and country-specific controls are mandates lifespan or political orientation (left-right).

[11] Different tax treatments were taken as irrelevant, even though this should be seen as a simplification in the case of Italy in the first years of the period under analysis. Furthermore, to eliminate the

banking and corporate sectors' risk and a dynamic adjustment was allowed for[12]. These variables proved significant when interacted with fiscal fundamentals, which is explained by the changing risk perceptions regarding EMU countries' bonds. Additionally, liquidity seems to play a role, though these estimations can be criticized. Codogno *et al.* (2003) could not find liquidity variables for any year other than 2002, and hence fails to regress liquidity and fiscal fundamentals altogether.

Bernoth *et al.* (2004) constructed a portfolio model of bond yield differentials by maximizing a utility function depending positively on expected real wealth and negatively on its variance. By using quarterly observations between 1993 and 2005, for fourteen EU countries, and having only considered bonds denominated either in Euro or in US dollar, Bernoth *et al.* (2004) found another way to avoid dealing with exchange rate premiums[13]. The results from the estimation of a simple static panel indicate that liquidity became irrelevant after the inception of the EMU. Like Codogno *et al.* (2003), Bernoth *et al.* (2004, 2012) found fiscal fundamentals to be quite significant, especially when interacted with risk perception measures and with a *Crisis* dummy variable[14]. Interestingly enough, Bernoth *et al.* (2004, 2012) found quite robust statistical evidence for non-linear relationships between yields and fiscal fundamentals, which Bayoumi *et al.* (1995) had already described as "credit punishing" effects.

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exchange rate risk from Codogno *et al.'s* (2003) work relative assets swap spreads (RASS) were used. These RASS respect to the spread between the sovereign yield curve and the interest rate swap of the same maturity, as explained in footnote 5, p. 4.

[12] Codogno *et al.* (2003) include the spread between US' interest rate swaps and government instruments, and also between Moody's Seasoned AAA US corporate bonds and, once again, government instruments.

[13] Prior to 1999, bonds denominated in Deutsche Marks (DM) were used (instead of Euro). However, by considering yields-at-issue and all bond issues during the time period covered, it is clear that the quantity of data among time periods is heterogeneous. If such heterogeneity is related with the yields themselves, there could be some self-selection bias. Yet, this is a question our work will not address.

[14] Bernoth *et al.* (2004) computed a risk perception measure similar to Codogno *et al.'s* (2003), but used instead the yields of US BBB corporate bonds. In 2012, Bernoth *et al.* made an extension to their work, whereby the methodology used is identical. Hence, from here on, while methodology issues will only refer to the first work, those regarding results may refer to both, if applicable.

Lastly, by taking advantage of a unique dataset on liquidity variables, and by using daily data on Standard and Poor's and Moody's credit ratings to measure the risk of default, Gómez-Puig (2006) concluded that liquidity was the main determinant of government bond yield spreads in the 10 EMU countries under analysis[15]. This goes against the aforementioned findings of Bernoth *et al.* (2004, 2012). One last important aspect about the work of Gómez-Puig (2006) is the panel estimation using Feasible Generalized Least Squares, which according to Cameron and Trivedi (2005) fails to take advantage of the richness of a panel dataset.

3.1. Data description and methodology:

In our work, we used quarterly data from 1999 to 2013 for Austria, Belgium, Finland, France, Greece, Italy, Ireland, the Netherlands, Portugal and Spain[16].

The baseline specification for our long panel dataset is the following:

$$(1) \qquad YD_{it} = \lambda YD_{i,t-1} + \beta X_{it} + \alpha + u_{it}$$

YD_{it} is the yield differential and is given by:

$$(2) \qquad YD_{it} = Y_{it} - Y_{GERt}$$

Y_{it} and Y_{GERt} are the yields to maturity of 10-year government bonds issued by country *i* and Germany, respectively[17]. These daily data were collected in Bloomberg and for the sake of comparison were selected not to pay any coupon until maturity. Amemiya and Wu (1972) showed that temporal aggregation of a variable that follows an autoregressive process will create artificial serial correlation, and therefore we

[15] The liquidity variables used were bid-ask spreads and the amounts of debt outstanding. Note that the amounts of debt outstanding are quarterly data, on which Gómez-Puig (2006) undertook a linear extrapolation thus getting daily data. Such methods are subject of great discussion in the econometric community, and as a result will not be followed in our work. The sample period is between January 1996 and December 2001.

[16] Out of the 11 countries that joined the EMU in 1999, we excluded Germany (which serves as our benchmark) and Luxembourg. Greece, who joined on the 1st of January 2001, is included in our work.

[17] As mentioned in section 2.2., p. 4, this methodology has been widely used in this literature. As can be easily understandable, it controls for systemic shocks that may affect the Euro area as a whole. 10-year bonds are used both because of their liquidity in the market, and their lower volatility.

decided to use last period observations for each quarter. $YD_{i,t-1}$ is the lagged yield differential.

X_{it} comprises four different groups of regressors that we shall divide as: i) fiscal fundamentals; ii) liquidity factors; iii) risk-related factors; and iv) control variables.

The fiscal fundamentals include the commonly used debt/GDP and deficit/GDP ratios, interest payments/government revenues and the variation in expenditures with public servants. The inclusion of the interest payments/government revenues ratio is inspired in Bernoth *et al.* (2004) and tries to capture the impact that interest payments (and therefore, the debt burden) may have on governments' ability to raise taxes for any given level of GDP[18]. Note that the aforementioned fiscal variables were lagged one period in order to control for reverse causality. The variation in expenditure with public servants attempts to control for two kinds of phenomena. First, it tries to capture public over-spending especially in the years after the EMU's inception. Second, it attempts to unveil the degree of hysteresis on this kind of government expenditure, especially in the crisis period. It allows us to evaluate the credibility of expenditure cuts' announcements and the extent to which governments have the flexibility to adjust to budgetary shocks. A state that is less able to adjust to those shocks is expected to pay a premium for that lack of fiscal and political authority. All fiscal data were taken from Eurostat[19]. Liquidity was measured using the share of Euro-denominated debt outstanding, taken from the Bank of International Settlements. Two other variables could be important to assess liquidity of government bonds: the bid-ask spread and trading characteristics such as volume and intensity[20]. However, if

[18] Bernoth et al. (2004) use a ratio given by debt service payments over total government revenues.
[19] We collected not seasonally adjusted data, and then applied the tramo/seats filter package on EViews.
[20] Trading characteristics are hardly available and are therefore rarely found in the literature. As to bid-ask spreads, it should be stated that between EMU countries, secondary market characteristics such as admission and trading rules or clearing and settlement procedures tend to be relatively standardized, and hence amounts of debt outstanding is probably the liquidity measure with greatest variability. This,

one considers EMU countries it is plausible to suggest that the amounts outstanding will be the measure with the greatest variability. Indeed, Codogno *et al.* (2003) found debt volumes to be the best performing liquidity indicators and Bernoth *et al.* (2004) restricted their liquidity measures to Euro and US Dollar-denominated debt outstanding. Gómez-Puig (2006), on the other hand, attributes great importance to liquidity factors in explaining government bond yield spreads and found, unlike Codogno *et al.* (2003), that the efficiency in the secondary market is highly statistically significant[21]. Still, our liquidity measure is expected to have a significant negative impact on government bond yield spreads.

Perceived market risk is measured by the spread between the yield on Moody's Seasoned AAA US corporate bonds and the yield on 10-year US government bonds. In this particular, we took into account Kamin *et al.* (1999) and Eichengreen *et al.* (2000), whose literature on sovereign bond spreads in emerging markets shows that spreads are quite sensitive to US risk factors. Additionally, we partly followed Codogno *et al.* (2003) who used this same measure for EMU countries from 1991 to 2002. Risk-related data were taken from Bloomberg.

Finally, GDP growth was used in all specifications as a control variable[22].

As to the error u_{it}, we have that:

$$u_{it} = \mu_i + \varepsilon_{it} \quad (3)$$

Above, μ_i corresponds to the individual-specific effects and ε_{it} to the idiosyncratic error. Our methodology will be contingent upon the correlation between individual-specific effects, μ_i and the regressors X_{it} (and $YD_{i,t-1}$). As we believe that

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if true, contributes to its quality as an econometric control. Additionally, the correlation matrix in page 36 of the appendix rules out multicollinearity issues. For our work, data on bid-ask spreads could not be gathered.

[21] As discussed in section 2.2, p. 7 bid-ask spreads, that serve as a proxy for secondary markets' efficiency, were found to be highly statistically significant in the work of Gómez-Puig (2006).

[22] Table A.6 in p.35 of the appendix is a summary statistics table of the variables in our baseline specification.

unobserved heterogeneity encompasses countries' reputation and trustworthiness, we used the wide datasets provided by Reinhart and Rogoff (2009) to establish sovereigns' "track record". Unfortunately, a robust Hausman test rejected the null that the residual unobserved effects were random, thus forcing us to abandon our measures of country track record[23].

3.2. Dynamic panel estimation:

Given that our default specification includes lags of the dependent variable, we will use a Arellano-Bond fixed-effects dynamic panel estimation[24]. It is clear that within transformations yield inconsistent estimates, as $y_{i,t-1}$ is correlated with $\overline{u}$ by construction. Note additionally that first-differencing to eliminate individual effects will generate a moving average (MA) process with unit root in u_{it}. Therefore, the consistency of the Arellano-Bond estimator is contingent upon the fact that:

$$E\left[\Delta u_{it}, \Delta u_{i,t-2}\right] = 0 \qquad (4)$$

[23] Based on the work of Reinhart and Rogoff (2009), who built a comprehensive database on several types of crises in world economies, we included variables that aim to capture the "track record" effect on yield spreads. Concretely, we used variables based on the share of years country *i* faced a default or re-scheduling on its debt (both domestic and external), the share of years country *i* faced inflation peaks (with three different levels being considered: over 20%, over 40%, and hyperinflation) and the share of years country *i* had banking crises. We chose to consider information dating back to 1850, and excluding the period under analysis in our work. A detailed description of the available data for the countries in our sample is: Austria (1880), Belgium (since 1850), Finland (1914), France (1880), Germany (1880), Greece (1869), Ireland (no data), Italy (1880), Netherlands (1880), Portugal (1851) and Spain (1850). By doing so, we could present a group of time-invariant variables that may reflect the reputation and trustworthiness of a country, when controlling for all fiscal, liquidity and risk-related factors. As described by Reinhart and Rogoff (2009), although such variables do capture some of the compounding dimensions of the crisis experience, they admittedly remain incomplete measures of its severity. Moreover, giving similar weights to every year in our sample would be a clear oversimplification. Finally it should be stated that Reinhart and Rogoff (2009) developed a Composite Index of Crises that, although taking into account a time dimension, has the exact same problems ours has. Although we failed to be able to use this dataset, it is our belief that it can be extremely useful for future developments in the literature of government bond yield spreads.

[24] Alternatively, a random-effects model would regard individual heterogeneity, μ_i, as being uncorrelated with the independent variables. As stated beforehand, robust Hausman test results reject such scenario, meaning that the random-effects estimator would be inconsistent under the alternative hypothesis. The p-value of the test is 0.0057, thus leading us to reject the null for any conventional significance level.

Arellano and Bond (1991) proposed panel GMM estimators that use unbalanced instrument sets. By using additional lags of the dependent variable as instruments, more efficient estimation is attained. Ahn and Schmidt (1995) later derived additional nonlinear moment conditions, by making use of second moment assumptions[25]. In this context, large time dimensions generate many instruments that can, according to Cameron and Trivedi (2005), lead to poor asymptotic performances. Hence, while performing computations, it was important to restrict the number of instruments used[26]. Our estimation follows Windmeijer (2005) in the sense that it gives us robust standard errors that allow for heteroskedasticity in u_{it}.

It should be noted that our model specification improves those of Bernoth *et al.* (2004, 2012), Codogno *et al.* (2003), Gómez-Puig (2006), from an econometric point of view, yielding in our opinion, more consistent results. The literature on government bond yield spreads tends to suffer from two important sources of endogeneity, that may compromise the robustness of the estimates. First, it seems clear that even when working with last period quarterly observations, lagged yield differentials are extremely powerful in explaining current yield differentials. In addition, they are highly correlated with current and future fiscal fundamentals, thus clearing the way for a harmful omitted variable bias problem. Second, endogeneity can also be brought into our model via reverse causality[27]. By lagging fiscal variables one period, we sacrifice some of the power of our results, but ensure their consistency, which is disregarded in the abovementioned literature. Last but not the least, most of the aforementioned works rely on the stationarity of the yield differential series. This

[25] $E[u_{it}\Delta u_{it}] = 0$. Arellano and Bover (1995) and Blundell and Bond (1998) developed these works, reaching even more efficient estimation methods to consider in short panels.
[26] For one-lag estimations, we allowed for two-lag instruments at most.
[27] Balassone *et al*. (2004), regress the structural primary balance as a percentage of GDP on the lagged government bond yield spread of 14 EU countries relative to Germany (among other variables).

could pose serious problems if that assumption is not verified[28]. Fisher-type unit-root tests fail to reject the null that the yield spreads series are non-stationary, and reject it regarding the series' first differences. Hence, our procedure seems valid for these matters[29].

4.1. Baseline specification results:

By analysing the results in Table 1 we confirm our conjecture about the considerable explanatory power of the first lag of the dependent variable, even though subsequent lags proved rather insignificant. Our baseline specification includes the two main fiscal fundamentals, debt/GDP and deficit/GDP, and the third variable with which we tried to capture fiscal imprudence, interest payments/government revenues. All these variables are lagged one period to control for reverse causality. Due to a noticeable degree of correlation we computed different equations for each of the aforementioned fiscal variables, to which we shall devote our attention[30]. From column B we conclude that a 10 percentage points increase in the debt/GDP ratio yields an average increase of 38 basis points in the yield differential. As to the deficit/GDP ratio, a 1 percentage point increase is expected to drive yield differentials up by an average amount of 13.3 basis points. Finally, if interest payments as a percentage of government revenues go up by 1 percentage point, yield differentials are supposed to increase 34.9 basis points. Overall, the size of these coefficients seems quite reasonable. The results of Kamin *et al.* (1999) and Eichengreen *et al.* (2000) regarding the spread between US corporate bonds (in our case, Moody's Seasoned AAA) and 10-year government bonds are corroborated in our

[28] According to Brooks (2008), may the variables employed in a regression model be non-stationary, and all standard assumptions for asymptotic results will cease to be valid, thus harming all inference one may conduct.

[29] Phillips-Perron tests for yield differentials and yield differentials' first differences have p-values of 0.7984 and 0.0000 respectively. Panel Augmented Dickey-Fuller tests mimic the results. Estimations were carried away for 4 lags, thus controlling for potential seasonal effects.

[30] A correlation matrix is displayed on page 36 of the appendix.

estimations with appreciable robustness. Considering the specifications in Table 1, if the abovementioned spread widens by one percentage point, yield differentials will increase by an amount between 18.3 and 31.5 basis points. The share of Euro-denominated debt fails to present a robust effect on yield differentials in our baseline specification. Yet, column D allows us to conclude that, keeping other factors fixed, a 1 percentage point increase in the share of Euro-denominated debt outstanding will decrease yield differentials by 34.6 basis points, which follows our expectation described in section 3.1. Finally, the coefficient for the variation of public employment's expenditure is neither statistically significant, nor it bears the expected sign.

Table 1. Baseline specification

	Yield differential of country *i* relative to Germany							
	A		B		C		D	
Lagged yield differential	0.596***	(72.2)	0.612***	(15.9)	0.748***	(59.2)	0.672***	(25.1)
Corporate Spread (1)	0.183***	(4.39)	0.263***	(6.72)	0.315***	(3.61)	0.192***	(3.25)
Liquidity	-0.180***	(2.81)	0.120	(0.59)	-0.040	(0.33)	-0.346***	(2.71)
Debt/GDP	0.025	(1.57)	0.038***	(4.57)				
Deficit/GDP	-0.051	(0.25)			0.133*	(1.95)		
Interest payments/ government revenues	0.275***	(4.05)					0.349***	(3.89)
Variation of expenditure with public servants	-0.037	(0.92)	-0.039	(0.98)	-0.043	(0.87)	-0.039	(1.00)
Econometric Controls								
GDP growth	-0.010	(1.19)	0.023	(1.01)	0.050**	(2.35)	-0.039	(0.94)
Constant	-2.392	(1.53)	-3.844*	(1.90)	-0.015	(0.01)	0.147	(0.18)
Relevant Statistics								
Arellano-Bond p-value (2)	0.4000		0.3959		0.4104		0.4417	
Observations	560		560		560		560	

Notes:
(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.
(2) Second order serial correlation test of the Arellano-Bond estimation procedure (see equation 4, p. 11).
Absolute z-statistics are given in parenthesis.
Significance at 1% denoted by ***; significance at 5% denoted by **; significance at 10% denoted by *.
The three main fiscal fundamentals were lagged one period to account for endogeneity.

4.2. Low debtors *versus* high debtors:

Following the results of Table 1, and taking into account the substantial degree of heterogeneity between the countries in our sample, it was deemed relevant to attempt to disentangle some of preceding effects. It should be noted that country fixed-effects

would vanish in our dynamic panel estimation. Additionally, the author decided not to follow the work of Codogno *et al.* (2003) and chose not to analyse countries individually[31]. Hence, we divided these 10 countries into two groups: low debtors and high debtors. The critical decision factor was the debt/GDP ratio over the period under analysis for two main reasons: first, debt/GDP is one of the two fiscal indicators with greatest explanatory power in our baseline specification, and second, it is one of the two fiscal fundamentals applicable for the Stability and Growth Pact[32]. Table A.1 portrays the results for our baseline specification for high and low debtors and the differences are remarkable. The lagged dependent variable seems to exert a greater influence for low debtors, as the associated coefficient is between 15.6 and 25.3 basis points higher. Fiscal variables display impressive contrasts when one compares low and high debtors. Regarding the debt/GDP ratio, a 10 percentage points increase leads to an average 47 basis points widening in yield differentials for high debtors. For low debtors on the other hand, this coefficient is not only quite smaller, it also fails to be significant. Columns D and H evaluate the impact interest payments/government revenues may have on yield differentials, and the discrepancy between low and high debtors is also noteworthy. Following a 1 percentage point increase in the stated variable, a high debtor will face an increase in its yield differential that is on average 36.6 basis points higher than a low debtor. The aforestated comparisons seem to indicate that markets look at slightly different fiscal indicators when comparing high and low debtors. For the former, the structural stance of fiscal policy is seriously

[31] The author considers that a sample with 56 observations is not big enough to make robust inference. Note that Codogno *et al.* (2003) used 156 monthly observations. It is not explicit if those were got by using linear interpolations of quarterly data, or if monthly data were available. Either way, given our dataset, we will not follow such procedure.

[32] Deficit/GDP is the worst-performing fiscal variable in our baseline model, and interest payments/government revenues is not a monitored target for the Stability and Growth Pact. Hence, low debtors are Austria, France, Finland, the Netherlands and Spain. High debtors are Belgium, Greece, Ireland, Italy and Portugal. The period under analysis for the decision is our sample period, 1999-2013.

taken into account, as the debt/GDP ratio is given considerable importance. For the latter, debt/GDP fails to be significant along our dataset and more relevance seems to be given to short-term indicators. These results clearly support the idea that a systemic shock tends to have quite heterogeneous effects in EMU countries. The nature of such heterogeneity is conditional on the fiscal position of those countries, hence reinforcing the importance of the Maastricht criteria. Another relevant fact is that high debtors seem to be more exposed to general risk aversion, as the coefficient for the spread between US corporate and government bonds is consistently higher for them. On the other hand, liquidity is persistently more relevant for high debtors than for low debtors, given the magnitude of the coefficients. Finally, the variation of the expenditure with public servants seems to be statistically significant for the sub-sample of low debtors, bearing the expected positive signal. A possible explanation for this phenomenon lies on the sample period under analysis. As the Global Financial Crisis erupted in 2008, high debtors may have been forced to cut public expenditure. Under that likely scenario, decreasing expenditures with public servants and increasing yield differentials may have coexisted, thus undermining the significance relationship proposed prior in our work. This is especially relevant if we admit that personnel expenditure cuts convey a stronger signal than personnel expenditure increases (keeping size constant)[33].

4.3. Credit Punishing Effects:

A natural extension to our baseline specification is following Bayoumi *et al.* (1995) that described non-linear responses from interest rate spreads to changes in fiscal fundamentals as "credit punishing" effects. Table A.2 shows that we found little

[33] On the other hand, when we take the sub-sample of low debtors into account, we obtain a subtle positive correlation, that raises the question whether markets do punish what was above described as the lack of political and fiscal authority, or not.

statistical evidence of such phenomena in our sample. Although the coefficient on debt/GDP doubles relative to the one in Table 1, only one of the squared variables proves to be significant (interest payments/government revenues), which contrasts with the results of Bernoth *et al.* (2004, 2012). In part II of Table A.2 (p. 28) we depict the same estimation procedures for low and high debtors and our conclusions are identical.

4.4. Crisis

The closing argument of section 4.2. begged the question whether our estimation results could be significantly influenced by the fact that our dataset comprises data both before and after 2008. Specifically, it is of extreme importance to unveil if markets reacted differently to unsound fiscal policies as the Global Financial Crisis erupted, and also the extent to which that happened, if it did. To help answering such questions we created two sets of new interaction variables. On the one hand, we included a dummy variable, *Crisis*, that takes the value of zero until the third quarter of 2008 and one henceforth[34]. Additionally, we interacted it with the three variables that try to capture the stance of fiscal policy. On the other hand, we interacted those same fiscal variables with our measure of general risk aversion, creating thus an alternative path to capture markets' reaction to fiscal unsoundness when the Global Financial Crisis began. Table A.3 displays our results. From the analysis of column A (in part I) we conclude that a 10 percentage points increase in the debt/GDP ratio would yield a 24 basis points average increase in yield differentials until the third quarter of 2008, against a 29 basis points average increase afterwards. This may seem like a modest impact. However, by looking at column C, one can conclude that the

[34] The turning point is the collapse of Lehman Brothers on the 18th of September, 2008.

impact of a 1 percentage point increase in the interest payments/government revenues ratio is four times larger in the Crisis period[35]. Still, by looking at parts II and III of Table A.3 (pp. 30-31), one can extend this analysis to low and high debtors, following the aforementioned designation. The results are, indeed, impressive. Considering the same 1 percentage point increase in interest payments/government revenues, for a high debtor the Crisis burden converts an 11.5 basis points spread increase, into a 64.7 basis points spread increase, whereas for a low debtor, it just changes from 3.1 to a 10.4 basis points yield differential increase[36]. As to the interactions of fiscal variables with our measure of general risk aversion, robust results were not attained, except for the deficit/GDP ratio[37].

4.5. A Two-period analysis:

Given the results described above, we found interesting to further explore the comparison between the two relevant periods under analysis: pre-GFC and post-GFC. Hence, we computed our baseline specification as well as the extensions previously undertaken for the two different time periods. The first point that deserves our attention is the estimation of our baseline specification for the two time periods, shown in Table A.4. During the pre-crisis period, a 10 percentage points increase in debt/GDP would yield an average increase of 10 basis points on yield differentials. After this period however, the same 10 percentage points increase corresponded, on

[35] While for the period prior to the third quarter of 2008, we have an impact of 14.1 basis points; in the Crisis period this goes up to 57.1 basis points, on average.

[36] Also, while for low debtors the impact of the debt/GDP ratio seems not to be negatively affected by the Crisis event, for high debtors it almost doubles in the period after the third quarter of 2008.

[37] Still, this is acceptable if one considers the time series of our measure of general risk aversion. In the first years of our sample (1999-2001), both yield differentials and fiscal fundamentals were quite moderate for EMU countries, as the Maastricht criteria had just been enforced (see Figure A.1. p.37). However, these were rough times for corporate America, namely due to events such as the burst of the dot.com bubble (March, 2010), Enron's collapse (December, 2001) and also, to some extent, 9/11. Therefore, the spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds widened during these years, which may impact the significance of the aforementioned variables.

average, to a 44.5 basis points spread widening between the 10-year government bond yields of EMU countries and Germany. Strikingly enough, during that same period, a 1 percentage point increase in interest payments/government revenues would result on an 86.7 basis points increase on yield differentials, whereas prior to the GFC this variable seemed statistically insignificant. Apart from the already mentioned spreads widening effect the GFC had by taking into account countries' fiscal fundamentals, another phenomenon should be acknowledged. As risk perceptions increased, it seems that markets started pricing sovereign risk slightly differently. Indeed, interest payments/government revenues may have been given more weight as the bubble burst. A possible explanation is the fact that sustainability of public finances of EMU countries is mostly assessed by the debt/GDP and deficit/GDP ratios, the two variables for which caps were established by Maastricht. Hence, and as was noted by Bernoth *et al.* (2004), they have become highly politicized instruments and are possibly subject to creative accounting. By fearing that governments may mask the degree of their fiscal imbalances, markets may have felt the need to turn to other fiscal fundamentals[38]. Table A.5 displays the previously discussed data with yet another dimension: high and low debtors. By looking at the pre-GFC period (part I), we conclude that, for low debtors, a 10 and a 1 percentage points increases in debt/GDP and interest payments/government revenues lead to a 10 and a 5.7 basis points increases in yield differentials, respectively. Furthermore, we recognize that we fail to reject the null that such variables are insignificant to explain yield spreads for the group of high debtors. Nonetheless, if we consider the estimation results for the time period between the 3rd quarter of 2008 and 2013 (part II), our conclusions will change dramatically. The effects that deteriorating fiscal fundamentals have on yield

[38] Note that both these results and this argument are consistent with the previous results from Table A.3.

spreads increased for low debtors, and are now colossal (and highly statistically significant) for the group of high debtors[39]. These so-called high debtors are a group of countries that tend to follow unsound fiscal policies, and did so ever since they stepped into the Eurozone. Notwithstanding, markets did not seem to take that into account while pricing those countries' sovereign risk, and that may be the reason why we fail to have a statistically significant relationship in I.F and I.H. Figure A.1 (p. 37) proves that a substantial component of the risk associated with investing in high debtors' sovereign instruments vanished in 1999, as they joined the EMU. Moreover, Reinhart and Rogoff (2009) dubbed them as the countries in the EMU with the most severe track record in what concerns high inflation episodes, but not necessarily in what concerns past defaults[40]. Therefore, an erroneous message regarding high debtors sovereign risk may have been conveyed into the market as they became unable to use monetary policy. A second (and more convincing) explanation may lie in the lack of credibility of the Stability and Growth Pact's rules, namely, the no-bailout clause. As discussed by Balassone *et al.* (2004), the credibility of this clause should be closely linked with the capability of the whole system to sustain member states' defaults. Probably the costs of bailing Portugal or France out outweigh the consequences of their failure. The difference may thus have been on the perceived ability to bailout one and the other. Previous extensions do not allow for any new findings when estimated with these datasets. Hence, and for the sake of parsimony, they will not be included in our work.

[39] In columns II.F and II.H one can confirm that a 10 percentage point increase in the debt/GDP ratio and a 1 percentage point increase in interest payments/government revenues, lead respectively to a 65 and an 85.1 basis points average increase on yield differentials.

[40] Reinhart and Rogoff (2009) gathered a very complete database of all historical crises in over 100 world countries. If we take into account the EMU countries in 2002, Austria, Belgium, Greece, Italy and Portugal are the ones that had the greatest share of years since 1850 with inflation over 20 and 40%. The last four of this group comprise our group of high debtors. Data for Ireland is not presented in the book. As to the countries that spent more time in default or re-scheduling of their debts, we fail to confirm that our group of today's high debtors corresponds to past high debtors.

4.6. Evidence from credit default swaps:

Having followed a fixed-effects estimation procedure guaranteed the consistency of our estimates at the cost of preventing us to get a glimpse at individual time-invariant effects. These would encompass sources of unobserved individual heterogeneity such as countries' reputation and trustworthiness. With this last extension from our baseline specification, we try to infer the extent to which those individual effects impact the way markets price sovereigns' debt. Credit default swaps (CDS) are risk-transferring contracts conceived to transfer the credit exposure of fixed income products between financial agents. The purchaser of the CDS should make period payments up until maturity to the swap seller. Should a default event occur, the CDS seller becomes liable for the difference between the face value and the recovery value of the fixed income asset. Hence, a CDS is considered insurance against non-payment. More importantly, and as described by Codogno *et al.* (2003), if applied to government bonds, it provides a market-based measure of the credit-risk premium. By including CDS spreads (relative to Germany) in our baseline model, we will be able to assess if the market is taking individual fixed-effects, or variables other than the ones included in the base case, into consideration when it prices countries' credit risk. Table 2 portrays the results[41]. In it, the lagged CDS spread of country *i* relative to Germany is used, so as to control for reverse causality. As expected, the CDS spread is highly statistically significant. On the other hand, we fail to reject the null that each one of our three main fiscal variables is not significant to explain yield spreads. Hence, we conclude that CDS traders monitor closely these three fiscal variables when

[41] A one percentage point increase in the CDS spread leads to an average impact between 13.9 and 16.6 basis points, depending on the specification considered. Also, it should be noted that this specification includes only Austria, France, Greece, Italy, Portugal and Spain, and starts on the first quarter of 2003. Additionally, there are some missing values within this dataset. CDS data was taken from Bloomberg.

pricing sovereigns' debt. Moreover, it tempts us to follow the argument that factors such as countries' reputation and trustworthiness play a lower role than what was previously expected.

Table 2. Baseline specification with credit default swaps

	Yield differential of country *i* relative to Germany							
	A		B		C		D	
Lagged yield differential	0.653***	(5.61)	0.636***	(12.5)	0.807***	(5.28)	0.792***	(6.29)
Corporate Spread (1)	0.300***	(2.95)	0.338***	(2.97)	0.294***	(2.91)	0.299**	(2.16)
Liquidity	-0.633***	(2.82)	-0.620***	(2.84)	-0.638***	(3.00)	-0.648***	(3.47)
CDS Spread	0.161***	(4.03)	0.166***	(4.53)	0.155***	(2.66)	0.139**	(2.53)
Debt/GDP	0.021	(0.84)	0.028	(1.23)				
Deficit/GDP	0.051	(0.22)			0.192	(1.09)		
Interest payments/ government revenues	0.082	(0.85)					0.141	(1.20)
Variation of expenditure with public servants	-0.010	(0.51)	-1.136	(0.55)	-0.006	(0.30)	-0.013	(0.54)
Econometric Controls								
GDP growth	-0.048	(0.99)	-0.039	(1.25)	-0.030	(1.27)	-0.048	(1.02)
Constant	4.745	(1.55)	4.653*	(1.79)	6.855***	(5.13)	6.127***	(3.38)
Relevant Statistics								
Arellano-Bond p-value (2)	0.3340		0.3539		0.3269		0.4766	
Observations	199		199		199		199	

Notes:
(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.
(2) Second order serial correlation test of the Arellano-Bond estimation procedure (see equation 4, p. 11).
10-year CDS data was gathered for Austria, France, Greece, Italy, Portugal and Spain from 2003 to 2013.
Absolute z-statistics are given in parenthesis.
Significance at 1% denoted by ***; significance at 5% denoted by **; significance at 10% denoted by *.
The three main fiscal fundamentals and the CDS Spread were lagged one period to account for endogeneity.

Overall, the estimation results presented in our work are in agreement with those of Bernoth *et al*. (2004, 2012) even though some of the extensions we tried do not yield significant results[42]. Yet, we believe our work presents a much robust econometric treatment of the data, as it controls for two very important sources of endogeneity in the literature of government bond yield spreads. The first one refers to the dynamic dimension of our panel. Indeed, the high z-statistics associated with the lagged dependent variable prove there could be severe omitted variable bias issues as a result

[42] The analysis of credit punishing effects, which Bernoth *et al.* (2004, 2012) found highly statistically significant, is an example of this.

of its exclusion. The second one is the threat reverse causality can pose. While lagging fiscal variables one period may weaken the robustness of our results, not doing it will probably affect its consistency.

5. Final remarks and policy implications:

Fourteen years after the inception of the EMU, government bond yield spreads have widened to the values of the early nineties, thus displaying the failure of one of the Euro's flagships. More importantly, as the GFC erupted, some of Eurozone's peripheral defaulted on their debts, thus magnifying the need to comprehend the determinants of yield spreads. Data on ten EMU countries from 1999 to 2013 allowed us to confirm the significance of both liquidity and fiscal fundamentals. By establishing two groups of countries based on their debt/GDP ratio, we could discern that markets do punish an unsound fiscal policy and pay a closer look at structural indicators for the high debtors group. With the extensions to our baseline specification, we did not find evidence of credit punishing effects. Furthermore estimation including credit default swaps leads us to call into question unobserved heterogeneity factors such as country's reputation and trustworthiness. An important contribution of our work comes by disentangling the Crisis period in our dynamic panel dataset, whereby we conclude that before 2008, the pricing of peripheral sovereigns' debt failed to punish irresponsible fiscal action. In that context, we propose two possible explanations. First, the fact that distrust regarding these countries used to come from monetary, rather than fiscal policy. Second, the fact that the Stability and Growth Pact's rules, namely the no-bailout clause, although necessary were never credible. The second explanation bears important policy implications that we leave for future research. Our second contribution relates to our methodology, namely the tackling of

two very important sources of endogeneity. First, we allow for a dynamic adjustment of the dependent variable, thus precluding omitted variable bias issues. Second, by lagging our fiscal fundamentals one period, we control for reverse causality[43].

In the future, one expects developments in what concerns the methodology employed, given that panel methods for unit roots and cointegration are currently an active area of research. Furthermore, computation of new regressors possibly related to the ideological stance of the party/coalition leading member states' governments should enable to scan the behaviour of residuals. With this report, we confirmed conclusions of previous works that fiscal responsibility is a necessary condition for yields' convergence. Bearing that in mind, we propose two future research areas with policy-making implications of great importance for the prosperity of the EMU. The first should try to explain the lagged markets' reaction to deteriorating fiscal positions. Issues such as the design of the Stability and Growth Pact, creative accounting possibilities and the imperfectness of the information available in the markets at any given point in time should be tackled by both research and policy-making. The second should account for the lagged policy-makers' reaction to market signals. Building on the works of Alesina and Drazen (1991) and Spolaore (2004), and adapting them to the EMU's framework is one possible direction[44].

References

[43] See section 3.2., p. 11 for a greater detail on this issue.

[44] Alesina and Drazen (1991) develop a model that aims at explaining why are stabilizations delayed in a context where there are significant distributional implications. Spolaore (2004) develops another theoretical model in which agents dispute about the policy adjustment instrument to use in the aftermath of a shock.

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Table A.1. Baseline specification for two different groups of countries: low debtors and high debtors

	Yield differential of country *i* relative to Germany															
	Low debtors								High debtors							
	A		B		C		D		E		F		G		H	
Lagged yield differential	0.767***	(18.6)	0.779***	(30.1)	0.901***	(13.2)	0.888***	(12.2)	0.580***	(93.2)	0.610***	(11.7)	0.745***	(45.6)	0.635***	(23.0)
Corporate Spread	0.120***	(4.53)	0.118***	(4.58)	0.099***	(5.43)	0.097***	(4.77)	0.199**	(2.40)	0.289***	(8.42)	0.430***	(3.50)	0.229**	(2.37)
Liquidity	-0.162*	(1.73)	-0.159*	(1.75)	-0.110*	(1.69)	-0.096*	(1.86)	-0.310*	(1.77)	0.206	(0.71)	-0.119***	(11.1)	-0.556*	(1.93)
Debt/GDP	0.015	(1.54)	0.013	(1.33)					0.026	(1.51)	0.047***	(5.51)				
Deficit/GDP	-0.022	(1.21)			0.029	(0.65)			-0.072	(0.27)			0.131	(1.09)		
Interest payments/ government revenues	0.004	(0.12)					0.025**	(2.09)	0.314***	(5.07)					0.392***	(5.06)
Variation of expenditure with public servants	0.007*	(1.84)	0.007**	(2.07)	0.007	(1.44)	0.007	(1.58)	-0.060	(1.06)	-0.058	(1.12)	-0.067	(0.94)	-0.063	(1.14)
Econometric Controls																
GDP growth	-0.011*	(1.67)	-0.009	(1.44)	0.001	(0.10)	-0.001	(0.04)	-0.023**	(2.06)	0.023	(0.91)	0.061***	(5.99)	-0.018**	(2.50)
Constant	0.209	(0.43)	0.310	(0.88)	0.708	(1.22)	0.488	(0.89)	-2.372*	(1.77)	-5.673***	(2.61)	0.584	(0.95)	0.955	(0.66)
Relevant Statistics																
Arellano-Bond p-value (2)	0.2602		0.3276		0.4781		0.4505		0.4036		0.3857		0.4090		0.4490	
Observations	280		280		280		280		280		280		280		280	

Notes:

(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.

(2) Second order serial correlation test of the Arellano-Bond estimation procedure (see equation 4, p. 11).

Absolute z-statistics are given in parenthesis.

Significance at 1% denoted by ***; significance at 5% denoted by **; significance at 10% denoted by *.

The three main fiscal fundamentals were lagged one period to account for endogeneity.

Table A.2. Baseline specification with credit punishing effects (Part I)

	Yield differential of country *i* relative to Germany					
	All					
	A		B		C	
Lagged yield differential	0.617***	(18.8)	0.749***	(57.4)	0.691***	(25.0)
Corporate Spread	0.269***	(6.26)	0.317***	(3.61)	0.207***	(3.20)
Liquidity	0.071	(0.41)	-0.044	(0.36)	-0.383***	(3.66)
Debt/GDP	0.081*	(1.69)				
Debt/GDP^2	-0.023	(1.27)				
Deficit/GDP			0.109*	(1.74)		
Deficit/GDP^2			0.469	(0.66)		
Interest payments/ government revenues					-0.108	(0.43)
Interest payments/ government revenues^2					2.061*	(1.95)
Variation of expenditure with public servants	-0.035	(0.93)	-0.043	(0.88)	-0.037	(0.96)
Econometric Controls						
GDP growth	0.024	(1.02)	0.050**	(2.21)	-0.006	(0.78)
Constant	-5.243	(1.45)	0.021	(0.02)	2.401**	(2.24)
Relevant Statistics						
Arellano-Bond p-value (2)	0.4290		0.4037		0.4477	
Observations	560		560		560	

Notes:
(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.
(2) Second order serial correlation test of the Arellano-Bond estimation procedure (see equation 4, p. 11).
Absolute z-statistics are given in parenthesis.
Significance at 1% denoted by ***; significance at 5% denoted by **; significance at 10% denoted by *.
The three main fiscal fundamentals were lagged one period to account for endogeneity.
Table 2. Baseline specification with credit punishing effects.

Table A.2. Baseline specification with credit punishing effects (Part II)

	Yield differential of country *i* relative to Germany											
	Low debtors						High debtors					
	D		E		F		G		H		I	
Lagged yield differential	0.814***	(11.5)	0.893***	(13.5)	0.894***	(13.7)	0.615***	(13.8)	0.742***	(44.2)	0.636***	(34.9)
Corporate Spread	0.114***	(6.74)	0.104***	(6.37)	0.084***	(5.08)	0.286***	(9.62)	0.448***	(3.23)	0.231***	(4.01)
Liquidity	-0.141*	(1.80)	-0.099*	(1.74)	-0.098	(1.58)	0.165	(0.62)	-0.143***	(6.29)	-0563**	(2.33)
Debt/GDP	0.044	(0.99)					0.113**	(2.12)				
Debt/GDP^2	-0.026	(0.85)					-0.033**	(2.01)				
Deficit/GDP			0.063	(0.72)					-0.043	(0.19)		
Deficit/GDP^2			-2.745	(0.98)					2.512	(1.39)		
Interest payments/ government revenues					0.333	(0.84)					0.361	(0.67)
Interest payments/ government revenues^2					-2.332	(0.81)					0.115	(0.06)
Variation of expenditure with public servants	0.009	(1.44)	0.006	(1.42)	0.006	(1.37)	-0.050	(1.04)	-0.069	(0.97)	-0.064	(1.11)
Econometric Controls												
GDP growth	-0.008	(1.01)	0.003	(0.21)	0.001	(0.03)	0.027	(1.05)	0.055***	(5.25)	-0.017*	(1.95)
Constant	-0.712	(0.61)	0.626	(1.21)	-0.403	(0.50)	-8.316*	(1.78)	0.875	(1.16)	1.183	(0.57)
Relevant Statistics												
Arellano-Bond p-value (2)	0.4257		0.5151		0.4555		0.4145		0.3946		0.4602	
Observations	280		280		280		280		280		280	

Notes:

(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.

(2) Second order serial correlation test of the Arellano-Bond estimation procedure (see equation 4, p. 11).

Absolute z-statistics are given in parenthesis.

Significance at 1% denoted by ***; significance at 5% denoted by **; significance at 10% denoted by *.

The three main fiscal fundamentals were lagged one period to account for endogeneity.

Table A.3. Baseline specification including interactions with a Crisis dummy variable and the general risk-aversion measure (Part I)

	Yield differential of country *i* relative to Germany											
	I. All											
	A		B		C		D		E		F	
Lagged yield differential	0.617***	(17.8)	0.714***	(43.4)	0.628***	(10.9)	0.610***	(16.1)	0.743***	(56.5)	0.668***	(25.9)
Corporate Spread	0.207***	(6.58)	0.105	(1.04)	0.111*	(1.85)	-0.380	(0.94)	0.146***	(2.86)	-0.250	(0.78)
Liquidity	0.137	(0.66)	0.004	(0.03)	-0.184	(0.97)	0.117	(0.58)	-0.041	(0.34)	-0.341***	(2.60)
Debt/GDP	0.024***	(3.72)					0.022***	(5.45)				
Debt/GDP*Crisis	0.011**	(2.40)										
Debt/GDP*Corp. Spread							0.008	(1.61)				
Deficit/GDP			-0.056	(0.69)					-0.277*	(1.84)		
Deficit/GDP*Crisis			0.012	(0.06)								
Deficit/GDP*Corp. Spread									0.249***	(3.43)		
Interest payments/ government revenues					0.141***	(3.82)					0.249***	(6.20)
Interest/G.Revenues* Crisis					0.461***	(6.30)						
Interest/G.Revenues* Corporate Spread											0.0547	(1.34)
Variation of expenditure with public servants	-0.038	(0.95)	-0.039	(0.88)	-0.026	(0.92)	-0.040	(0.96)	-0.045	(0.89)	-0.039	(0.99)
Crisis (dummy variable)	-0.006*	(1.83)	0.008	(0.98)	-0.031***	(3.90)						
Econometric Controls												
GDP growth	0.037*	(1.79)	0.076**	(2.10)	0.021**	(2.07)	0.024	(1.06)	0.053**	(2.46)	-0.007	(1.45)
Constant	-2.896*	(1.66)	-0.150	(0.14)	0.545	(0.41)	-2.587*	(1.87)	0.254	(0.29)	0.924	(0.93)
Relevant Statistics												
Arellano-Bond p-value (2)	0.3975		0.4089		0.4189		0.4017		0.4308		0.4433	
Observations	560		560		560		560		560		560	

Notes:
(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.
(2) Second order serial correlation test of the Arellano-Bond estimation procedure (see equation 4, p. 11).
Absolute z-statistics are given in parenthesis.
Significance at 1% denoted by ***; significance at 5% denoted by **; significance at 10% denoted by *.
The three main fiscal fundamentals were lagged one period to account for endogeneity.

Table A.3. Baseline specification including interactions with a Crisis dummy variable and the general risk-aversion measure (Part II)

	Yield differential of country *i* relative to Germany											
	II. Low debtors											
	A		B		C		D		E		F	
Lagged yield differential	0.787***	(24.4)	0.888***	(12.7)	0.802***	(13.2)	0.778***	(29.3)	0.882***	(14.8)	0.886***	(11.8)
Corporate Spread	0.108***	(7.34)	0.060***	(3.95)	0.069***	(3.60)	0.014	(0.33)	0.092***	(5.34)	0.178*	(1.69)
Liquidity	0.154*	(1.76)	-0.101	(1.58)	0.116*	(1.80)	-0.158*	(1.71)	-0.103*	(1.73)	-0.093*	(1.66)
Debt/GDP	0.014*	(1.77)					0.010	(1.21)				
Debt/GDP*Crisis	0.002**	(1.96)										
Debt/GDP*Corp. Spread							0.002	(1.50)				
Deficit/GDP			0.028	(0.74)					-0.073**	(2.08)		
Deficit/GDP*Crisis			0.082*	(1.74)								
Deficit/GDP*Corp. Spread									0.063	(1.34)		
Interest payments/ government revenues					0.031**	(2.18)					0.050	(1.33)
Interest/G.Revenues* Crisis					0.073***	(5.79)						
Interest/G.Revenues* Corporate Spread											-0.015	(0.72)
Variation of expenditure with public servants	0.007**	(1.96)	0.007	(1.44)	0.006	(1.60)	0.007**	(2.02)	0.006	(1.61)	0.006	(1.45)
Crisis (dummy variable)	0.002***	(5.74)	0.002**	(2.57)	-0.002	(1.42)						
Econometric Controls												
GDP growth	-0.006	(0.71)	0.012	(0.78)	0.007	(0.42)	-0.010	(1.62)	0.003	(0.19)	0.002	(0.20)
Constant	0.245	(0.63)	0.662	(1.19)	0.626	(1.09)	0.502	(1.25)	0.662	(1.18)	0.327	(0.45)
Relevant Statistics												
Arellano-Bond p-value (2)	0.2868		0.3093		0.4860		0.3505		0.4380		0.3956	
Observations	280		280		280		280		280		280	

Notes:
(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.
(2) Second order serial correlation test of the Arellano-Bond estimation procedure (see equation 4, p. 11).
Absolute z-statistics are given in parenthesis.
Significance at 1% denoted by ***; significance at 5% denoted by **; significance at 10% denoted by *.
The three main fiscal fundamentals were lagged one period to account for endogeneity.

Table A.3. Baseline specification including interactions with a Crisis dummy variable and the general risk-aversion measure (Part III)

	Yield differential of country *i* relative to Germany											
	III. High debtors											
	A		B		C		D		E		F	
Lagged yield differential	0.615***	(13.0)	0.713***	(33.2)	0.623***	(11.9)	0.608***	(11.7)	0.744***	(45.0)	0.635***	(22.3)
Corporate Spread	0.214***	(3.88)	0.134	(0.98)	0.170	(1.32)	-0.492	(0.60)	0.151	(1.57)	-0.213	(0.34)
Liquidity	0.265	(0.84)	-0.022	(0.22)	-0.209	(0.60)	(0.213)	(0.72)	-0.111***	(6.65)	-0.548**	(1.96)
Debt/GDP	0.025***	(7.38)					0.031***	(3.57)	0.062***			
Debt/GDP*Crisis	0.021**	(2.15)										
Debt/GDP*Corp. Spread							0.009	(0.98)				
Deficit/GDP			-0.062	(1.62)					-0.320*	(1.81)		
Deficit/GDP*Crisis			0.016	(0.05)								
Deficit/GDP*Corp. Spread									0.279***	(3.87)		
Interest payments/ government revenues					0.115***	(3.45)					0.309***	(5.30)
Interest/G.Revenues* Crisis					0.581***	(6.12)						
Interest/G.Revenues* Corporate Spread											0.046	(0.69)
Variation of expenditure with public servants	-0.056	(1.07)	-0.057	(0.96)	-0.041	(1.20)	-0.059	(1.09)	-0.068	(0.94)	-0.064	(1.12)
Crisis (dummy variable)	-0.016	(1.48)	0.010	(0.84)	-0.049***	(3.53)						
Econometric Controls												
GDP growth	0.038**	(2.28)	0.086**	(4.04)	0.020*	(1.74)	0.021	(0.85)	0.062***	(6.40)	-0.022**	(2.01)
Constant	-4.249**	(2.52)	0.167	(0.25)	0.721	(0.29)	-4.293***	(3.49)	0.945*	(1.75)	1.690	(0.78)
Relevant Statistics												
Arellano-Bond p-value (2)	0.3901		0.3963		0.4343		0.3954		0.4292		0.4510	
Observations	280		280		280		280		280		280	

Notes:

(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.

(2) Second order serial correlation test of the Arellano-Bond estimation procedure (see equation 4, p. 11).

Absolute z-statistics are given in parenthesis.

Significance at 1% denoted by ***; significance at 5% denoted by **; significance at 10% denoted by *.

The three main fiscal fundamentals were lagged one period to account for endogeneity.

Table A.4. Baseline specification for two different time periods: pre-GFC (1999-2008, 2nd quarter) and post-GFC (2008, 3rd quarter-2013)

	Yield differential of country *i* relative to Germany															
	I. pre-GFC								II. post-GFC							
	A		B		C		D		E		F		G		H	
Lagged yield differential	0.416***	(3.89)	0.455***	(4.02)	0.520***	(5.60)	0.448***	(5.13)	0.580***	(37.0)	0.617***	(10.2)	0.700***	(32.4)	0.595***	(7.96)
Corporate Spread	0.097***	(3.82)	0.100***	(4.13)	0.082***	(4.33)	0.084***	(4.52)	0.525*	(1.70)	1.071**	(1.70)	0.624**	(1.96)	0.810*	(1.71)
Liquidity	0.035**	1.99)	0.039*	(1.87)	0.056*	(1.90)	0.042**	(2.06)	-0.274	(1.08)	0.432	(1.08)	0.076	(0.21)	-0.248	(0.56)
Debt/GDP	0.008	(1.59)	0.010**	(2.15)					-0.005	(0.19)	0.045***	(1.65)				
Deficit/GDP	-0.018	(1.20)			-0.018	(0.95)			-0.261	(0.53)			-0.154	(0.31)		
Interest payments/ government revenues	0.009	(0.59)					0.017	(1.26)	0.896***	(14.4)					0.867***	(9.28)
Variation of expenditure with public servants	0.002	(0.60)	0.002	(0.65)	0.002	(0.43)	0.002	(0.50)	-0.058	(0.85)	-0.100	(0.96)	-0.100	(0.84)	-0.056	(0.92)
Econometric Controls																
GDP growth	0.019**	(2.40)	0.020	(2.44)	0.026***	(2.90)	0.024**	(2.55)	0.105*	(1.65)	0.201	(1.43)	0.278	(1.38)	0.084	(1.42)
Constant	-0.941**	(2.33)	-1.052**	(2.55)	-0.493***	(2.94)	-0.051**	(2.33)	-3.277*	(1.95)	-8.239*	(1.69)	-0.594	(0.30)	-4.713*	(1.82)
Relevant Statistics																
Arellano-Bond p-value (2)	0.1216		0.1175		0.1211		0.1203		0.4197		0.3949		0.3766		0.4298	
Observations	359		359		359		359		180		180		180		180	

Notes:

(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.

(2) Second order serial correlation test of the Arellano-Bond estimation procedure (see equation 4, p. 11).

Absolute z-statistics are given in parenthesis.

Significance at 1% denoted by ***; significance at 5% denoted by **; significance at 10% denoted by *.

The three main fiscal fundamentals were lagged one period to account for endogeneity.

Table A.5. Baseline specification for two different time periods: pre-GFC (1999-2008, 2nd quarter) and post-GFC (2008, 3rd quarter-2013), and two different groups of countries: low debtors and high debtors (Part I)

	Yield differential of country *i* relative to Germany															
	I. pre-GFC															
	Low debtors								High debtors							
	A		B		C		D		E		F		G		H	
Lagged yield differential	0.490***	(6.27)	0.655***	(8.05)	0.753***	(19.5)	0.476***	(6.23)	0.441***	(3.44)	0.419***	(3.36)	0.465***	(4.65)	0.494***	(4.33)
Corporate Spread	0.048***	(5.32)	0.052***	(5.31)	0.038***	(3.63)	0.044***	(6.30)	0.128***	(4.18)	0.127***	(4.13)	0.105***	(4.53)	0.106***	(5.26)
Liquidity	-0.004	(0.25)	-0.020	(0.91)	-0.018	(0.71)	0.001	(0.05)	0.030	(1.28)	0.021	(0.84)	0.043	(1.25)	0.049	(1.58)
Debt/GDP	0.004	(0.17)	0.010***	(3.47)					0.010*	(1.68)	0.010	(1.51)				
Deficit/GDP	0.021	(1.18)			0.023	(1.32)			-0.033	(1.43)			-0.039	(1.29)		
Interest payments/ government revenues	0.054***	(9.50)					0.057***	(5.24)	-0.009	(0.69)					-0.003	(0.20)
Variation of expenditure with public servants	0.005*	(1.72)	0.006**	(1.97)	0.006	(1.59)	0.005	(1.79)	0.002	(0.49)	0.002	(0.52)	0.001	(0.28)	0.002	(0.38)
Econometric Controls																
GDP growth	-0.001	(0.15)	-0.008	(1.00)	-0.001	(0.10)	-0.001	(0.11)	0.026***	(10.02)	0.026***	(8.41)	0.030	(6.41)	0.032***	(6.88)
Constant	-0.314	(1.55)	-0.441**	(2.49)	0.100	(0.64)	-0.333**	(2.18)	-1.074*	(2.09)	-1.059	(1.86)	-0.387**	(3.01)	-0.452***	(3.18)
Relevant Statistics																
Arellano-Bond p-value (2)	0.6537		0.1721		0.1401		0.5420		0.2505		0.1996		0.2405		0.2142	
Observations	180		180		180		180		179		179		179		179	

Notes:

(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.

(2) Second order serial correlation test of the Arellano-Bond estimation procedure (see equation 4, p. 11).

Absolute z-statistics are given in parenthesis.

Significance at 1% denoted by ***; significance at 5% denoted by **; significance at 10% denoted by *.

The three main fiscal fundamentals were lagged one period to account for endogeneity.

Table A.6. Baseline specification for two different time periods: pre-GFC (1999-2008, 2nd quarter) and post-GFC (2008, 3rd quarter-2013), and two different groups of countries: low debtors and high debtors (Part II)

	Yield differential of country *i* relative to Germany															
	II. post-GFC															
	Low debtors								High debtors							
	A		B		C		D		E		F		G		H	
Lagged yield differential	0.723***	(6.47)	0.783***	(10.8)	0.938***	(10.2)	0.821***	(9.87)	0.588***	(21.6)	0.652***	(8.07)	0.728***	(27.7)	0.606***	(11.0)
Corporate Spread	0.258***	(5.30)	0.398***	(10.3)	0.192***	(2.77)	0.259***	(3.20)	1.080*	(1.82)	1.883*	(1.69)	1.401***	(3.70)	1.424	(1.58)
Liquidity	-0.298**	(2.41)	-0.298**	(2.21)	-0.187**	(2.24)	-0.224**	(2.27)	-0.293	(0.70)	0.958**	(2.19)	0.213	(0.66)	-0.196	(0.30)
Debt/GDP	0.019**	(2.19)	0.022**	(2.27)					-0.858	(0.35)	0.065***	(3.25)				
Deficit/GDP	-0.157***	(4.96)			-0.086***	(2.88)			-0.261	(0.50)			-0.144	(0.26)		
Interest payments/ government revenues	0.114	(1.43)					0.170***	(6.88)	0.900***	(12.5)					0.851***	(7.31)
Variation of expenditure with public servants	0.007	(0.90)	0.006	(0.86)	0.008	(0.89)	0.006	(0.77)	-0.162	(1.57)	0.260	(1.26)	0.268	(1.05)	-0.158*	(1.93)
Econometric Controls																
GDP growth	0.038	(1.48)	0.027	(1.06)	0.048	(1.55)	0.046	(1.41)	0.216**	(1.96)	0.431**	(2.14)	0.558**	(1.96)	0.193**	(1.99)
Constant	0.471	(0.38)	0.325	(0.32)	1.309	(1.17)	0.668	(0.53)	-0.051	(1.93)	-16.04**	(2.46)	-2.468*	(1.74)	-7.579**	(2.48)
Relevant Statistics																
Arellano-Bond p-value (2)	0.8251		0.8906		0.5806		0.9035		0.3799		0.3961		0.3604		0.4103	
Observations	90		90		90		90		90		90		90		90	

Notes:

(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.

(2) Second order serial correlation test of the Arellano-Bond estimation procedure (see equation 4, p. 11).

Absolute z-statistics are given in parenthesis.

Significance at 1% denoted by ***; significance at 5% denoted by **; significance at 10% denoted by *.

The three main fiscal fundamentals were lagged one period to account for endogeneity.

Table A.6. Summary of statistics: baseline specification

Variables	Observations	Mean	Std. Dev.	Min.	-	Max	Expectation
Dependent Variable							
Yield differential	590	1.04054	2.63695	-0.087	-	30.875	N/A
Lagged yield differential	590	1.04054	2.63695	-0.087	-	30.875	+
Corporate Spread (1)	590	1.61374	0.50022	0.622	-	2.6747	+
CDS Spread (2)	210	1.27378	3.60607	-0.097	-	44.919	+
Liquidity	590	7.70620	8.63661	0	-	31.552	-
Debt/GDP	570	76.4480	28.7869	26.89166	-	175.3458	+
Deficit/GDP	580	0.77065	1.17102	-2.09231	-	9.41639	+
Interest payments/ government revenues	579	7.4768	3.5129	1.90249	-	18.3846	+
Variation of expenditure with public servants	570	0.8434	2.1611	-16.956	-	16.097	+
Econometric Controls							
GDP growth	570	0.8226	1.3986	-4.4516	-	14.163	-

Notes:

(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds.

(2) The summary of statistics for the CDS Spread encompasses a different dataset than the default one, on which the other summary statistics were calculated upon. Its statistics correspond to the period of 2003-2013 for Austria, France, Greece, Italy, Portugal and Spain.

Table A.7. Correlation matrix for the dependent and independent variables

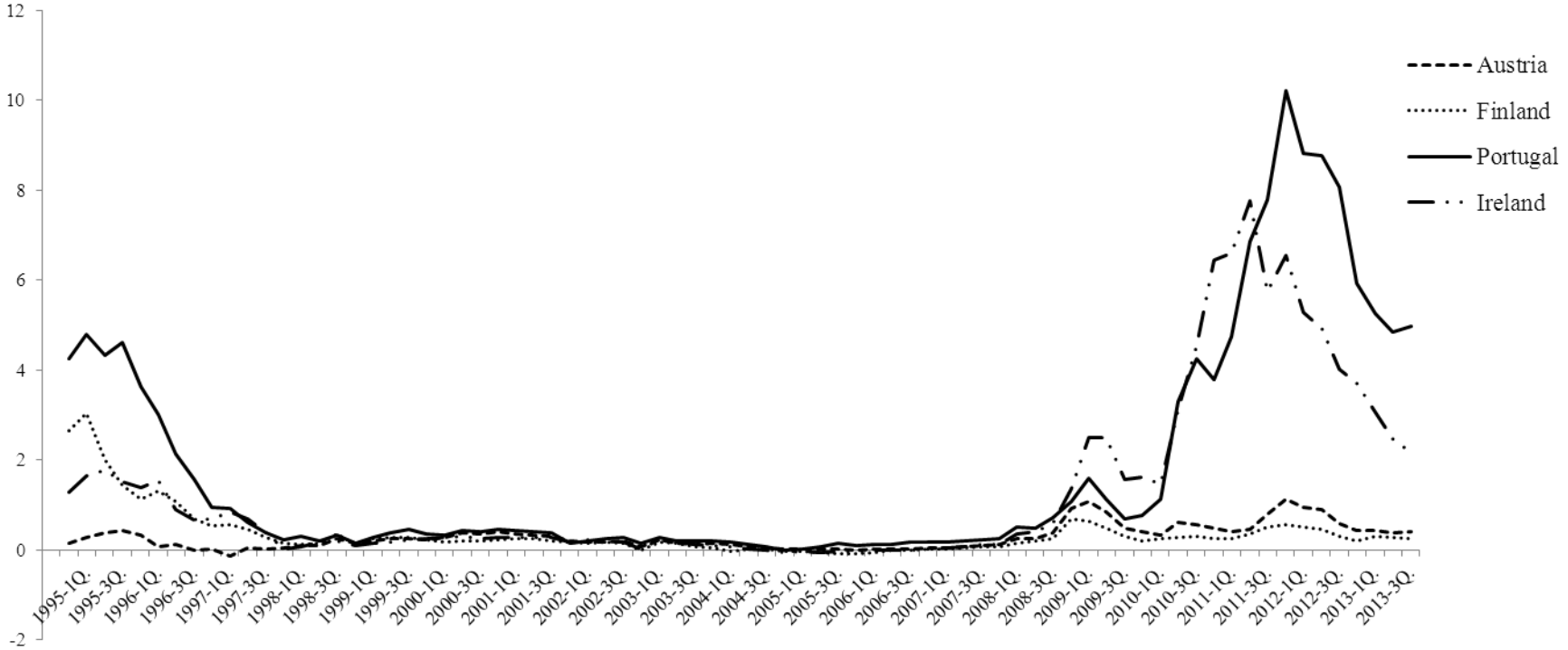
	Variables	1	2	3	4	5	6	7	8	9	10	11
1	Yield differential	1.00										
2	Lagged yield differential	0.93	1.00									
3	Corporate Spread (1)	0.21	0.19	1.00								
4	CDS Spread (2)	0.86	0.81	0.20	1.00							
5	Liquidity	-0.08	-0.08	0.00	-0.13	1.00						
6	Debt/GDP	0.52	0.52	0.12	0.48	0.38	1.00					
7	Deficit/GDP	0.44	0.41	0.14	0.26	0.05	0.49	1.00				
8	Interest payments/ government revenues	0.31	0.29	0.10	0.42	0.27	0.81	0.33	1.00			
9	Variation of expenditure with public servants	-0.29	-0.27	-0.07	-0.24	-0.03	-0.22	-0.25	-0.06	1.00		
10	GDP growth	-0.38	-0.38	-0.35	-0.40	-0.05	-0.23	-0.32	-0.01	0.28	1.00	
11	Crisis	0.44	0.42	0.47	0.30	-0.01	0.32	0.52	-0.07	-0.28	0.50	1.00

Notes:

(1) Yield spread between Moody's Seasoned US AAA corporate bonds and 10-year US government bonds

(2) The summary of statistics for the CDS Spread encompasses a different dataset than the default one, on which the other summary statistics were calculated upon. Its statistics correspond to the period of 2003-2013 for Austria, France, Greece, Italy, Portugal and Spain.

Figure A.1. Government bond yield spreads relative to Germany



Notes: the vertical axis measures basis points

Appendix:

The Arellano-Bond estimator is given by the following expression[45]:

$$\hat{\beta}_{AB} = \left[\left(\sum_{i=1}^{N} \tilde{\boldsymbol{X}}_i' \boldsymbol{Z}_i\right) \boldsymbol{W}_N \left(\sum_{i=1}^{N} \boldsymbol{Z}_i' \tilde{\boldsymbol{X}}_i\right)\right]^{-1} \left(\sum_{i=1}^{N} \tilde{\boldsymbol{X}}_i' \boldsymbol{Z}_i\right) \boldsymbol{W}_N \left(\sum_{i=1}^{N} \boldsymbol{Z}_i' \tilde{\boldsymbol{y}}_i\right)$$

where $\tilde{X}_i$ is a $(T-2) \times (K+1)$ matrix with t^{th} row $\left(\Delta y_{i,t-1}, \Delta \boldsymbol{x}_{it}'\right), t = 3, \ldots, T$, $\tilde{\boldsymbol{y}}_i$ is a $(T-2) \times 1$ vector with t^{th} row Δy_{i1}, and $\boldsymbol{Z}_i$ is a $(T-2) \times r$ matrix of instruments

$$\boldsymbol{Z}_i = \begin{bmatrix} \boldsymbol{z}_{i3}' & 0 & \cdots & 0 \\ 0 & \boldsymbol{z}_{i4}' & 0 & \vdots \\ \vdots & 0 & \ddots & 0 \\ 0 & \cdots & 0 & \boldsymbol{z}_{iT}' \end{bmatrix},$$

where $\boldsymbol{z}_{it}' = \left[y_{i,t-2}, y_{i,t-3}, \ldots, y_{i1}, \Delta \boldsymbol{x}_{it}'\right]$. Lags of $\boldsymbol{x}_{it}$ or $\Delta \boldsymbol{x}_{it}$ can additionally be used as instruments if deemed necessary.

[45] This derivation follows Cameron and Trivedi (2005).

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