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Debt and interest rates: lessons from european monetary union

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Abstract

This paper addresses the relationship between debt and interest rates within the context of the European Monetary Union which, after ten years since its creation, constitutes a convenient framework to test any sensible explanation. My findings highlight that a substantial fraction of European interest rate is accounted for by domestic fiscal fundamentals. Identification of the relative importance of fiscal variables requires joint modelling of international rates to distinguish between the effects of their common dynamics from credit risk implications of worsening fiscal conditions. The estimated model also quantifies liquidity premia.

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1 Introduction

Explaining persistent though time-varying differences in European rates poses a twofold problem. Challenges consist both in identifying global and local forces behind the dynamics of interest rates and in understanding possible interactions between the two in order to disentangle and quantify individual effects. The role of global factors, however, has remained, to a large extent, hidden behind the standard definition of European yield spread, namely the excess yield over the German rate. Much literature has indeed focused mainly on idiosyncratic features of bonds and issuers confident that the external sources of variation, albeit important, would be netted out by the definition of the dependent variable. Unfortunately, high correlations of so-defined yield spreads show that such a solution is not sufficient to confine the analysis to local factors as sole determinants of spreads. Neither common measures of liquidity nor individual debt-GDP ratios display common variation (see Favero *et al.* 2007) and, as such, explanations of highly correlated fluctuations of yield differentials relative to the German Bund have to be found elsewhere.

This paper argues that the link between debt and interest rates clearly emerges if the joint dynamics of international rates is properly characterized. The effect of debt on interest rates works via its credit risk implications. Equivalently, European interest rate spreads can be decomposed in three factor: an international risk term (*global* factor); a credit risk term and a liquidity premium (*local* factors). Quantification of those effects leads to the conclusion that both fiscal fundamentals and liquidity conditions are priced; that debt/GDP ratios explain a large share of yield differentials and that liquidity premia are roughly proportional to average levels of bonds outstanding.

Next section briefly overviews difficulties connected with the empirical research in the field and discusses proposed solutions. Section 3 presents the data and the model. Results are described in section 4. Last section concludes.

2 Motivation

The empirical literature has tested the role of fiscal fundamentals (debt-GDP or deficit-GDP) on either levels of long-term rates (Faini 2005; Ardagna *et al.* 2004; Ardagna 2004) or, with regard to European rates, interest rate spreads (Codogno *et al.* 2003; Favero *et al.* 2007; Gomez-Puig, 2006; Bernoth *et al.* 2006; Pozzi and Wolswijk, 2008; Manganelli and Wolswijk, 2009). As briefly outlined in the introduction, however, joint and simultaneous effects of both global and local factors determine the behavior of bond yields. The standard definition of European yield differentials, namely the excess yield over the German rate, potentially neglects part of the external source of variation. Relating interest rate levels to fiscal variable may be equally misplaced if global determinants are not properly characterized. This sort of concerns has been acknowledged in the literature. Instrumental to quantify the effect of debt on interest rate levels, several variables complement standard regressions. Stock market prices - as proxy for anticipated investment profitability - expected growth rates and monetary policy, worldwide debt but also measures of financial integration and liberalization are used. This highlights that conditioning on common external factors is regarded as essential to detect any effect.

This paper addresses the relationship between debt and interest rate from a new perspective. I investigate spreads relative to the U.S. rate. This strategy is motivated by the theoretical discussion presented in Faini (2006). An expansionary fiscal policy in one EMU country, he argues, may have no impact on its spreads (relative to other EMU members) but, in a large class of models, affect the aggregate level of the interest rate. In this way he stresses the importance of fiscal spill-overs among EMU members. That might conceivably explain difficulties to identify unambiguously the credit risk component of the spread. More generally, if European rates share a common trend, investigating spreads over the German rate would be frustrating. The observed co-movement of spreads may eventually reflect different sensitivities to one or more prime drivers. Taking the difference with reference to an exogenous benchmark - the U.S. rate - would widen the scope of the study and improve chances of identification.

However, I don't take the stationarity of such a spread for granted as in most of the literature. I rather examine whether movements of European rates are linked to the corresponding U.S. rate in an equilibrium relationship. The VECM technology then provides a suitable framework. Building on the findings of Lo Conte (2008), I argue that, the observed non-stationarity nature of spreads, suggests that stochastic trend(s) are not shared in the same proportions among European and U.S. rates. Had the inclusion of a variable to re-establish a stationary equilibrium relationship with the spread, that variable would describe the common stochastic trend or equivalently the common *global* component of the spreads. Such a way of proceeding is convenient because it allows to characterize spreads in terms of exogenous factors: an assumption that can be easily tested in a VECM setting. Moreover, given the definition of spread I use here, results shall be interpreted in a fairly straight way. The correction with the swap curve, leaves the spreads as proxies of few residual factors. Only differences in the credit risk, properly called risk premium, liquidity premium, taxes and other minor distortions should account for yields differentials.

The present paper extends the results of Lo Conte (2008). There it is shown that the dynamics of European spreads is led by two exogenous trends which are best characterized by the yield-to-maturity on the 10-years U.S. Treasury note and the yield-to-maturity on high-rated U.S. corporate bonds. Being the U.S. financial market far the most important in the world and the 10-years note the most widespread risk free security for that maturity, information conveyed in their yields are valid syntheses of developments in international capital markets: the 10-years U.S. Treasury note is found to be the benchmark against which European bonds are priced. Here I study the role of fiscal fundamentals in a partial model. This choice is motivated by the fact that such type of statistical formulation is suitable to model cases where some variables are determined within the system but others are under the full or partial control of the government or a decision of the policy maker (Lutkepohl, 2005). In my case arbitrage forces prevent yield differentials to deviate from an estimated long-run equilibrium. The equilibrium level is beyond the control of each single issuer in that it stems from a convolution of global investment decisions and policy actions which can at best be listed. Nonetheless, local factors are the *terms* at which fluctuations around the equilibrium level occur or, equivalently, the exogenous conditions upon which pulling and pushing forces operates.

3 The model

Following Favero *et al.* (1997), I define the spread as follows:

$$Sp_t^i = (Y_t^i - Y_t^{US}) - (Y_t^{Sw€} - Y_t^{Sw\$}) \tag{1}$$

where Sp_t^i is the spread of country i at time t; Y_t^i is the yield to maturity of the 10-years constant maturity government bond index of country i at time t; Y_t^{US} is the yield to maturity of the 10-years constant maturity bond index of United States' government at time t; $Y_t^{Sw€}$ and $Y_t^{Sw\$}$ are the 10-years fixed interest rate (middle rate) on swap denominated in Euro and U.S. Dollar respectively. The baseline model is a VEC(1) with two exogenous variables which takes the following form:

$$\Delta x_t = \Pi x_{t-1} + \gamma z_t + \varepsilon_t \tag{2}$$

where Δ is the first difference operator, x_t is a (3 X 1) vector of endogenous variables, $\Pi = \alpha\beta'$ is a (3 X 3) matrix of parameters, γ is a (3 X 2) matrix of parameters, z_t is a (2 X 1) vector of exogenous variables and ε_t is a (3 X 1) vector of Gaussian residuals. Endogenous variables are the spread as in (1) for country i, the yield-to-maturity of the 10-years constant maturity U.S. government bond index and the yield-to-maturity of the Moody's Aaa seasoned bond index. Debt-GDP ratio of country i and outstanding amounts of country i's bond index are my proxy for fiscal fundamentals and liquidity respectively and they are both gathered in the vector z_t. *Datastream* is the source for monthly financial data, debt-GDP ratios are collected from Eurostat (OECD data for the U.S.) at annual frequency, monthly data on outstanding amounts come from national sources[1]. The sample goes from January 1999 to December 2007.

In Codogno *et al.* (2003), trading volumes are the best performing liquidity indicator; Favero *et al.* (2007) prefers bid-ask spreads out of a set of five alternative measures. None of them use outstanding amounts which first appear in Gomez-Puig (2006) where, however, the whole bunch of domestic debt securities is claimed to be a valid proxy of liquidity. Similarly, Bernoth *et al.* (2006) uses share of domestic debt outstanding over total debt of EU countries. Finally, in Manganelli and Wolswijk (2007) liquidity premia are determined residually. Admittedly, outstanding amounts are not the only possible proxy of liquidity, not even the most direct measure of transaction costs. However, they are truly exogenous (Codogno *et al.* 2003): a feature that is not shared by other candidates such as bid-ask spreads, turnover ratios, quote sizes which are derived directly from the marketplace. In addition my proxy traces exactly benchmark changes that occur in the domestic indexes and, contrary to aforementioned alternatives, it is invariant to changes in the market where data are collected. The latter is a somewhat desirable property given different constraints placed on dealers in distinct markets. Time and price parameters are often set among markets' rule and participants are required to comply with them in order to retain their membership or their primary dealer status (Dunne *et al.* 2006). An example is the maximum spread requirement on the pan-European trading platform MTS, which adds to informal pressure exerted by issuers to dealers in order to quote tightest possible bid-ask spreads (Pagano and Von-Thadden, 2004).

As far as fiscal fundamentals are concerned, debt-GDP ratio is the most popular measure. Table I presents summary statistics and Figure 1 plots debt-GDP ratios for the seven EMU members in the sample. A first glance at the data describes very different conditions: Italy and Belgium show highest ratios; Germany, France and Austria display on average pretty much the same level of relative indebtedness; Spanish series lies below any others. It's interestingly to note that individual ratios do not share a common trend. Belgium and Spain's debt ratios have fallen monotonically; German and France series show similar profiles alternating ascending and descending broken trends; Austrian series stays stable and, overall, shows the smallest standard deviation. So made series

[1] For complete description and summary statistics of bond indexes, outstanding amounts and data source see Lo Conte (2008).

should rule out the chance of being substitutes of a specific deterministic trend in the data. Figure 2 plots spreads against debt-GDP ratios. It shows that there is no obvious relationship with spreads: unconditionally, larger ratios correspond to both higher (Italy, Belgium, Austria, Netherlands, Spain) and lower (France, Germany) spreads. Although debt-GDP data are available at quarterly frequency, the additional variation due to the seasonality of tax revenues would harm estimates without adding any relevant information. Fully comprehensive measure of creditworthiness would be more appropriate to quantify credit risk - implicit obligations such as pensions and government guarantees (Draghi *et al.* 2003) make debt-GDP ratio a weak indicator for potential default - but the lack of comparable data explains my choice.

4 Evidence

Table II presents estimates of the model (2) outlined in the previous section. First three columns in the tables report the roots of the system. The trace test is a standard procedure to test for the presence of cointegrating relations. Unfortunately, its critical values are not valid when exogenous series enter the model. A look at how close roots are to the unit circle is informative though not a rigorous test. In my case, however, (weak exogeneity) restrictions on the two U.S. variables overidentify the model and therefore the LR test in the last column turns out to be a valid alternative. The loading factor (α^{sp}) and the betas coefficients (β_{US}; $\beta_{Aaa.}$; c) are reported in the tables together with the coefficients (γ^{sp}_{debt}; γ^{sp}_{liq}) in the spread's equation attached to the two exogenous variables namely the debt-GDP ratio and the liquidity proxy. In the cointegrating vector spread's coefficient is normalized to one and it is not reported in the table.

Consistently with the findings in Lo Conte (2008) a single long-run equilibrium relationship is spotted in each model: both the U.S. rate and the corporate index affect significantly the equilibrium level of European yield spreads relative to the U.S. Yield differentials also react to levels of both the debt-GDP ratio and the amount of the benchmark bond outstanding at that date. The debt variable turns out to be significant in each model with the only exception of the Austrian case. The sign is always positive as expected. A 10% increase in the debt-GDP ratio implies a response of the relevant spread that goes from two basis points for Italy and Belgium to seven basis points for Germany. The liquidity proxy affects negatively spreads and it is significant for France, Belgium, Austria, Spain and The Netherlands, it is virtually zero for Italy and Germany, the countries with the two most liquid bonds. Cross-country variation of the coefficient γ^{sp}_{liq} delivers a simple message. A concave relationship is apparent between the degree of liquidity and the “gains”from liquidity a bond enjoys: whenever the availability of a benchmark bond reaches a given threshold in the market, no additional liquidity advantage arises from even larger issues. Marginal “gains”are, however, increasing the larger the gap from the threshold. Austria, which shows the smallest amount of bonds outstanding in the sample would observe a 1,3 basis points reduction of its spread increasing the average issue size of one billion. Restrictions placed on the loading factors are not rejected in any model.

In Table III, I add as additional exogenous variable the debt-GDP ratio of United States while in Table IV both the domestic and the U.S. debt-GDP ratios are consolidated in one variable given by their difference. Individually the two debt series are significant in five and four cases respectively. The domestic debt-GDP ratio displays always a positive coefficient; negative coefficients appear in front of the U.S. debt-GDP ratio except in the

German and Austrian cases where, however, they are highly not significant. Larger debt ratios imply higher yield on long-term bonds. This occurs both for European and for U.S. government bonds. As a consequence, spreads relative to the U.S. rate, are increasing functions of domestic debt and decreasing functions of U.S. debt. When the difference in debt ratios is included (Table IV), positive and significant effects are shown. As the gap in debt ratios widens, so does the spread. The Italian case is of special interest. Italy has the largest level of relative indebtdness in the sample. Its coefficient on the debt variable of Table IV is the largest (0.011). It is almost twice as much that of Spain and more than three time the corresponding value in the model for the France and German spread. The magnitude of the coefficient implies that the entire Italian spread would vanish had the difference between the Italian debt-GDP ratio and the U.S. equivalent to narrow from an average actual level of 71 to 16 percentage points (Table V). For remaining countries, even if debt-GDP ratios were to fully converge to the U.S. level and the difference to close, the reduction I shall observe on spreads would not account more than 25% of the current average level. Results, both in Table III and in Table IV, are not quantitatively different for what concerns estimated liquidity effects which preserve their significance. The LR tests in the last column validate the restrictions imposed.

To the specification of Table IV, I add as an additional regressor the debt-GDP ratio of the Euro Area 12 (Euro Area)[2] to control for independent effects of aggregate debt on the general level of interest rates in the entire market of European government securities. This choice is motivated by evidence in both Faini (2005) and Ardagna (2004) who point out that, in a financially integrated area, national fiscal policies affect interest rates primarily to the extent that they influence aggregate fiscal balances. Table VI report estimation results. Although coefficients on differences between domestic and U.S. debt-GDP ratios continue to be positive and significantly different from zero for most countries (negative but not significant in the Austrian model), the evidence regarding the role of aggregate debt is mixed. Out of seven sovereign spreads analyzed, three are positively affected by shocks to the debt-GDP ratio of the Euro Area (German, French, Austrian). For the Spanish and the Belgian spread the effect, albeit positive, is not significantly different from zero; virtually nil response is observed for the Italian case, where, however, I observe a negative sign; finally, worsening of the fiscal situation of the Euro Area leads to a contraction of the Dutch spread. In Table VII, I use a distinct measure of aggregate debt-GDP for each country. Such a measure is given by the Euro Area debt-GDP ratio net of the contribution of the country whose spread is being modelled. This solution eliminates the overlapping information content of the two debt-related exogenous variables and as such I expect it to improve upon results of Table VI especially for those countries which experienced a steady decline in their domestic debt-GDP ratios and therefore largely contributed to dynamics of the debt-GDP ratio of the Euro Area. The new variable turns out to be significant in five cases: France, Germany, Austria but also Spain and Belgium; it is still not significant for Italy and it remains negative and highly significant in the Dutch case. More importantly, remaining coefficients are not affected by the change in the aggregate debt measure and their estimates are consistent with the previous results.

To summarize, I tested the role of domestic fiscal balances (debt-GDP ratio) in a partial model. Much of the evidence presented points to a significant effect of fiscal conditions on domestic spreads. Consistent results are found for what regards liquidity

[2]The Euro Area 12 includes Germany, France, Italy, Spain, Belgium, The Netherlands, Austria, Portugal, Ireland, Greece, Finland, Luxembourg.

effects. Estimates show that the magnitude of liquidity premia depends on the availability of bonds in the market, strictly measured by a narrow definition of outstanding amounts. The paper also addresses the importance of fiscal variables of the entire Euro Area and their effects on the overall level of European rates. I complement the baseline specifications of Table IV with measures of aggregate debt to show that in a financially integrated area, additional effects on interest rates arise from common macroeconomic fundamentals.

5 Conclusion

This paper investigates the relationship between fiscal fundamentals and interest rates within the framework developed in the literature on European yield differentials. It naturally extends previous findings (Lo Conte, 2008) but also borrows from the literature on the macroeconomic effects of debt (Faini, 2005; Ardagna *et al.* 2004). Results contribute to both fields.

The challenge posed by the persistence of yield spreads in the Monetary Union is the characterization of the types of risks embedded in bonds issued in the same currency by different, though economically integrated, sovereign governments and the quantification of their pricing. Major complications arise from difficulties to disentangle local and global factors. The task is far from trivial because effects are intertwined. Multiple global factors can hardly be identified in isolation and the influence they exert on interest rates is likely to depend on idiosyncratic features. This paper claims that joint modelling of international rates provides a sufficient solution to account for the effects of global determinants and allows to quantify the relative importance of idiosyncratic features of bonds and issuers.

Results provide additional evidence to the link between debt and interest rate. Although the paper is aimed at quantifying the credit risk component of yield differentials and to assess the role of fiscal variables in the determination of the spreads and is not intended to give a fully-fledged description of the channels through which government debt affects domestic interest rates, nonetheless it offers a suitable framework to check the predictions of the theory. Consistently with previous finding, this paper documents the role of both domestic and aggregate debt with corroborating evidence.

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Table I: descriptive statistics

debt/GDP ratio
(percentage points)

	Ger	Fra	Ita	Net	Spa	Bel	Aus
mean	63.28	61.54	106.87	51.78	49.26	98.81	64.32
median	63.80	62.90	105.80	52.00	48.70	98.60	64.80
st.dev.	3.27	3.38	3.03	4.10	8.41	9.18	2.13

Table II: domestic debt model

	r_1	r_2	r_3	α^{sp}	β_{US}	β_{Aaa}	c	γ^{sp}_{debt}	γ^{sp}_{liq}	$chi\hat{}2(2)$
Ger	0.33	0.79	0.90	**−0.645**	−0.055	−0.115	1.300	**0.007**	−0.001	1.71
				[−7.21]	[−1.33]	[−1.87]	[1.47]	[6.32]	[−0.50]	(0.42)
Fra	0.21	0.84	0.87	**−0.751**	**−0.081**	**−0.125**	0.902	**0.003**	**−0.005**	2.00
				[−8.20]	[−2.80]	[−2.66]	[1.24]	[4.55]	[−2.23]	(0.36)
Ita	0.41	0.89	0.89	**−0.574**	**−0.109**	**−0.100**	0.829	**0.002**	−0.000	0.86
				[−6.9]	[−2.88]	[−3.03]	[1.34]	[3.95]	[−0.15]	(0.65)
Net	0.40	0.94	0.94	**−0.567**	−0.061	**−0.111**	**0.684**	**0.003**	**−0.007**	1.32
				[−6.62]	[−1.87]	[−3.94]	[2.68]	[4.32]	[−2.49]	(0.51)
Spa	0..37	0.91	0.91	**−0.581**	**−0.105**	**−0.107**	**0.902**	**0.004**	**−0.009**	1.31
				[−7.20]	[−2.90]	[−2.29]	[7.94]	[5.27]	[−2.81]	(0.52)
Bel	0.43	0.91	0.91	**−0.535**	−0.079	**−0.153**	**0.939**	**0.002**	**−0.010**	1.35
				[−6.84]	[−1.92]	[−3.01]	[4.59]	[4.15]	[−2.75]	(0.50)
Aus	0.38	0.92	0.92	**−0.560**	**−0.102**	**−0.178**	1.049	0.001	**−0.013**	2.68
				[−7.23]	[−2.31]	[−3.99]	[1.64]	[1.25]	[−2.10]	(0.26)

VEC estimates [t-values] (p-values).
Sample: Austria (2000:01-2007:12); Netherlands (1999:12-2007:12); others (1999:01-2007:12).
sp^i_t is the spread of country i;
$debt^i_t$ is the debt-GDP ratio of country i;
liq^i_t is the outstanding amount of country i 10-years constant maturity bond index;
US_t is the yield to maturity on the 10-years constant maturity US government bond index;
Aaa_t is the yield to maturity of the Moody's Aaa seasoned bond index.

$$\begin{bmatrix} \Delta sp^i_t \\ \Delta US_t \\ \Delta Aaa_t \end{bmatrix} = \begin{bmatrix} \alpha^{sp} \\ 0 \\ 0 \end{bmatrix} * \begin{bmatrix} 1 & \beta_{US} & \beta_{Aaa} & c \end{bmatrix} * \begin{bmatrix} sp^i_{t-1} \\ US_{t-1} \\ Aaa_{t-1} \\ 1 \end{bmatrix} + \begin{bmatrix} \gamma^{sp}_{debt} & \gamma^{sp}_{liq} \\ \gamma^{US}_{debt} & \gamma^{US}_{liq} \\ \gamma^{Aaa}_{debt} & \gamma^{Aaa}_{liq} \end{bmatrix} * \begin{bmatrix} debt^i_t \\ liq^i_t \end{bmatrix} + \begin{bmatrix} \varepsilon^{sp}_t \\ \varepsilon^{US}_t \\ \varepsilon^{Aaa}_t \end{bmatrix}$$

Table III: domestic and us debt model

	r_1	r_2	r_3	α^{sp}	β_{US}	β_{Aaa}	c	γ^{sp}_{debt}	γ^{sp}_{debtUS}	γ^{sp}_{liq}	$chi\hat{}2(2)$
Ger	0.34	0.79	0.87	**−0.645** [−7.17]	−0.057 [−1.33]	−0.114 [−1.84]	1.269 [1.40]	**0.006** [2.34]	0.000 [0.08]	−0.001 [−0.47]	2.09 (0.35)
Fra	0.20	0.83	0.83	**−0.751** [−8.20]	**−0.086** [−2.78]	**−0.125** [−2.63]	0.884 [1.20]	0.003 [1.29]	−0.000 [−0.11]	**−0.005** [−2.22]	2.90 (0.23)
Ita	0.36	0.88	0.88	**−0.619** [−7.32]	**−0.143** [−3.75]	−0.023 [−0.50]	1.061 [1.85]	**0.010** [4.81]	**−0.015** [−2.94]	−0.001 [−0.39]	1.29 (0.52)
Net	0.39	0.89	0.89	**−0.588** [−6.85]	**−0.121** [−2.65]	−0.022 [−0.39]	−0.473 [−0.66]	**0.006** [2.68]	**−0.019** [−4.26]	**−0.007** [2.41]	0.82 (0.66)
Spa	0.37	0.86	0.86	**−0.584** [−7.17]	**−0.139** [−2.71]	−0.057 [−0.77]	0.496 [1.05]	**0.006** [4.76]	**−0.006** [−3.26]	**−0.009** [−2.39]	1.68 (0.43)
Bel	0.43	0.86	0.86	**−0.535** [−6.83]	**−0.118** [−2.03]	−0.095 [−1.19]	0.594 [1.38]	**0.003** [3.24]	**−0.006** [−2.24]	**−0.010** [−2.68]	1.68 (0.43)
Aus	0.37	0.88	0.88	**−0.561** [−7.18]	−0.098 [−1.82]	**−0.185** [−2.73]	1.183 [0.97]	0.000 [0.21]	0.003 [0.74]	**−0.013** [2.08]	2.96 (0.23)

VEC estimates [t-values] (p-values).

Sample: Austria (2000:01-2007:12); Netherlands (1999:12-2007:12); others (1999:01-2007:12).

sp^i_t is the spread of country i;

$debt^i_t$ is the debt-GDP ratio of country i;

$debtUS_t$ is the debt-GDP ratio of US;

liq^i_t is the outstanding amount of country i 10-years constant maturity bond index;

US_t is the yield to maturity on the 10-years constant maturity US government bond index;

Aaa_t is the yield to maturity of the Moody's Aaa seasoned bond index.

$$\begin{bmatrix} \Delta sp^i_t \\ \Delta US_t \\ \Delta Aaa_t \end{bmatrix} = \begin{bmatrix} \alpha^{sp} \\ 0 \\ 0 \end{bmatrix} * \begin{bmatrix} 1 & \beta_{US} & \beta_{Aaa} & c \end{bmatrix} * \begin{bmatrix} sp^i_{t-1} \\ US_{t-1} \\ Aaa_{t-1} \\ 1 \end{bmatrix} + \begin{bmatrix} \gamma^{sp}_{debt} & \gamma^{sp}_{debtUS} & \gamma^{sp}_{liq} \\ \gamma^{US}_{debt} & \gamma^{US}_{debtUS} & \gamma^{US}_{liq} \\ \gamma^{Aaa}_{debt} & \gamma^{Aaa}_{debtUS} & \gamma^{Aaa}_{liq} \end{bmatrix} * \begin{bmatrix} debt^i_t \\ debtUS_t \\ liq^i_t \end{bmatrix} + \begin{bmatrix} \varepsilon^{sp}_t \\ \varepsilon^{US}_t \\ \varepsilon^{Aaa}_t \end{bmatrix}$$

TABLE IV: DOMESTIC VERSUS US DEBT MODEL

	r_1	r_2	r_3	α^{sp}	β_{US}	β_{Aaa}	c	γ^{sp}_{debt}	γ^{sp}_{liq}	$chi\hat{}2(2)$
Ger	0.35	0.90	0.90	**−0.634** [−7.17]	**−0.083** [−2.67]	**−0.072** [−2.04]	0.599 [1.85]	**0.003** [2.71]	−0.001 [−0.54]	2.72 (0.25)
Fra	0.21	0.88	0.88	**−0.751** [−8.24]	**−0.091** [−3.69]	**−0.114** [−4.28]	**0.714** [2.51]	**0.003** [2.13]	**−0.004** [−2.27]	3.09 (0.21)
Ita	0.39	0.90	0.90	**−0.607** [−7.22]	**−0.123** [−3.58]	−0.042 [−0.96]	**1.449** [2.99]	**0.011** [6.76]	−0.000 [−0.23]	0.75 (0.68)
Net	0.40	0.94	0.94	**−0.578** [−6.89]	**−0.078** [−2.25]	**−0.083** [−2.33]	**0.459** [3.76]	**0.005** [2.97]	**−0.007** [3.19]	1.05 (0.59)
Spa	0.37	0.89	0.89	**−0.584** [−7.47]	**−0.137** [−3.29]	−0.059 [−0.97]	**0.520** [2.57]	**0.006** [4.87]	**−0.008** [−4.98]	1.07 (0.58)
Bel	0.43	0.90	0.90	**−0.537** [−6.96]	**−0.097** [−2.08]	−0.123 [−1.90]	**0.831** [5.75]	**0.002** [4.37]	**−0.010** [−3.03]	1.00 (0.60)
Aus	0.38	0.90	0.90	**−0.559** [−7.42]	**−0.101** [−1.98]	**−0.179** [−2.99]	**0.967** [4.80]	0.001 [0.29]	**−0.013** [−2.27]	2.21 (0.33)

VEC estimates [t-values] (p-values).

Sample: Austria (2000:01-2007:12); Netherlands (1999:12-2007:12); others (1999:01-2007:12).

sp^i_t is the spread of country i;

$debt^i_t$ is the debt-GDP ratio of country i minus the debt-GDP ratio of US;

liq^i_t is the outstanding amount of country i 10-years constant maturity bond index;

US_t is the yield to maturity on the 10-years constant maturity US government bond index;

Aaa_t is the yield to maturity of the Moody's Aaa seasoned bond index.

$$\begin{bmatrix} \Delta sp^i_t \\ \Delta US_t \\ \Delta Aaa_t \end{bmatrix} = \begin{bmatrix} \alpha^{sp} \\ 0 \\ 0 \end{bmatrix} * \begin{bmatrix} 1 & \beta_{US} & \beta_{Aaa} & c \end{bmatrix} * \begin{bmatrix} sp^i_{t-1} \\ US_{t-1} \\ Aaa_{t-1} \\ 1 \end{bmatrix} + \begin{bmatrix} \gamma^{sp}_{debt} & \gamma^{sp}_{liq} \\ \gamma^{US}_{debt} & \gamma^{US}_{liq} \\ \gamma^{Aaa}_{debt} & \gamma^{Aaa}_{liq} \end{bmatrix} * \begin{bmatrix} debt^i_t \\ liq^i_t \end{bmatrix} + \begin{bmatrix} \varepsilon^{sp}_t \\ \varepsilon^{US}_t \\ \varepsilon^{Aaa}_t \end{bmatrix}$$

Table V: credit risk component
(percentage points)

	Ger	Fra	Ita	Net	Spa	Bel	Aus
A: debt-GDP gap (mean)	27.52	25.75	71.11	15.37	13.5	63.04	28.73
B: spread (mean)	0.363	0.428	0.606	0.416	0.484	0.514	0.449
C: γ_{debt}^{sp} (Table IV)	0.003	0.003	0.011	0.005	0.006	0.002	0.001
D: A*C	0.083	0.077	0.782	0.077	0.081	0.126	0.029
E: D/B	22.7	18.1	129.1	18.5	16.7	24.5	6.4

Sample: Austria (2000:01-2007:12); Netherlands (1999:12-2007:12); others (1999:01-2007:12).
debt-GDP gap is the debt-GDP ratio of country i minus the debt-GDP ratio of U.S.

Table VI: EU DEBT MODEL (1)

	r_1	r_2	r_3	α^{sp}	β_{US}	β_{Aaa}	c	γ^{sp}_{debt}	γ^{sp}_{debtEU}	γ^{sp}_{liq}	chiˆ2(2)
Ger	0.30	0.89	0.89	**−0.683** [−7.53]	**−0.069** [−2.41]	**−0.095** [−2.79]	**2.196** [2.74]	**0.008** [2.86]	**0.013** [6.35]	−0.001 [−0.66]	1.38 (0.50)
Fra	0.20	0.88	0.88	**−0.759** [−8.31]	**−0.087** [−3.61]	**−0.125** [−4.50]	1.488 [1.98]	**0.005** [2.01]	**0.007** [5.17]	**−0.004** [−2.07]	2.68 (0.26)
Ita	0.37	0.89	0.89	**−0.613** [−7.22]	**−0.126** [−3.65]	−0.038 [−0.87]	1.147 [1.61]	**0.011** [3.55]	−0.003 [−1.07]	−0.001 [−0.34]	0.97 (0.61)
Net	0.38	0.79	0.92	**−0.602** [−7.01]	**−0.143** [−3.14]	0.023 [0.36]	−3.104 [−1.68]	**0.020** [5.01]	**−0.031** [−6.29]	**−0.008** [−2.58]	0.63 (0.73)
Spa	0.37	0.76	0.89	**−0.583** [−7.17]	**−0.136** [−2.55]	−0.062 [−0.73]	0.570 [0.50]	**0.006** [4.60]	0.000 [0.66]	**−0.009** [−2.35]	1.26 (0.53)
Bel	0.42	0.81	0.87	**−0.538** [−6.75]	−0.090 [−1.55]	−0.134 [−1.55]	1.012 [1.04]	**0.002** [2.05]	0.001 [1.50]	**−0.010** [−2.50]	1.13 (0.56)
Aus	0.35	0.87	0.87	**−0.574** [−7.29]	−0.076 [−1.43]	**−0.215** [−3.23]	2.005 [1.95]	−0.004 [−1.52]	**0.009** [5.61]	−0.012 [−1.87]	3.29 (0.19)

VEC estimates [t-values] (p-values).
Sample: Austria (2000:01-2007:12); Netherlands (1999:12-2007:12); others (1999:01-2007:12).
sp^i_t is the spread of country i;
$debt^i_t$ is the debt-GDP ratio of country i minus the debt-GDP ratio of US;
$debtEU_t$ is the debt-GDP ratio of Euro-Area 12;
liq^i_t is the outstanding amount of country i 10-years constant maturity bond index;
US_t is the yield to maturity on the 10-years constant maturity US government bond index;
Aaa_t is the yield to maturity of the Moody's Aaa seasoned bond index.

$$\begin{bmatrix} \Delta sp^i_t \\ \Delta US_t \\ \Delta Aaa_t \end{bmatrix} = \begin{bmatrix} \alpha^{sp} \\ 0 \\ 0 \end{bmatrix} * \begin{bmatrix} 1 & \beta_{US} & \beta_{Aaa} & c \end{bmatrix} * \begin{bmatrix} sp^i_{t-1} \\ US_{t-1} \\ Aaa_{t-1} \\ 1 \end{bmatrix} + \begin{bmatrix} \gamma^{sp}_{debt} & \gamma^{sp}_{debtEU} & \gamma^{sp}_{liq} \\ \gamma^{US}_{debt} & \gamma^{US}_{debtEU} & \gamma^{US}_{liq} \\ \gamma^{Aaa}_{debt} & \gamma^{Aaa}_{debtEU} & \gamma^{Aaa}_{liq} \end{bmatrix} * \begin{bmatrix} debt^i_t \\ debtEU_t \\ liq^i_t \end{bmatrix} + \begin{bmatrix} \varepsilon^{sp}_t \\ \varepsilon^{US}_t \\ \varepsilon^{Aaa}_t \end{bmatrix}$$

Table VII: eu debt model (2)

	r_1	r_2	r_3	α^{sp}	β_{US}	β_{Aaa}	c	γ^{sp}_{debt}	γ^{sp}_{debtEU}	γ^{sp}_{liq}	$chi\hat{}2(2)$
Ger	0.29	0.90	0.90	**−0.690** [−7.62]	**−0.084** [−2.98]	**−0.069** [−2.15]	**2.099** [2.96]	**0.011** [4.18]	**0.011** [6.54]	−0.001 [−0.72]	1.29 (0.52)
Fra	0.20	0.88	0.88	**−0.762** [−8.34]	**−0.091** [−3.78]	**−0.117** [−4.44]	**1.528** [2.18]	**0.006** [2.68]	**0.007** [5.57]	**−0.004** [−2.06]	2.55 (0.28)
Ita	0.38	0.90	0.90	**−0.610** [−7.19]	**−0.124** [−3.60]	−0.041 [−0.92]	1.274 [1.68]	**0.010** [3.89]	−0.002 [−0.63]	−0.001 [−0.28]	0.88 (0.64)
Net	0.38	0.79	0.92	**−0.599** [−6.97]	**−0.138** [−3.06]	0.016 [0.25]	−2.956 [−1.57]	**0.018** [4.79]	**−0.028** [−6.25]	**−0.008** [−2.61]	0.57 (0.75)
Spa	0.37	0.75	0.89	**−0.584** [−7.17]	**−0.130** [−2.44]	−0.071 [−0.85]	0.776 [0.61]	**0.005** [4.57]	**0.002** [3.23]	**−0.009** [−2.38]	1.24 (0.53)
Bel	0.42	0.81	0.86	**−0.539** [−6.75]	−0.086 [−1.50]	−0.142 [−1.65]	1.142 [1.13]	**0.002** [1.96]	**0.002** [2.48]	**−0.010** [−2.49]	1.20 (0.54)
Aus	0.36	0.87	0.87	**−0.575** [−7.29]	−0.076 [−1.42]	**−0.216** [−3.24]	1.993 [1.98]	−0.004 [−1.46]	**0.009** [5.59]	−0.012 [−1.87]	3.29 (0.19)

VEC estimates [t-values] (p-values).

Sample: Austria (2000:01-2007:12); Netherlands (1999:12-2007:12); others (1999:01-2007:12)

sp_t^i is the spread of country i;

$debt_t^i$ is the debt-GDP ratio of country i minus the debt-GDP ratio of US;

$debtEU_t$ is the debt-GDP ratio of Euro-Area 12 net of country i's contribution;

liq_t^i is the outstanding amount of country i 10-years constant maturity bond index;

US_t is the yield to maturity on the 10-years constant maturity US government bond index;

Aaa_t is the yield to maturity of the Moody's Aaa seasoned bond index.

$$\begin{bmatrix} \Delta sp_t^i \\ \Delta US_t \\ \Delta Aaa_t \end{bmatrix} = \begin{bmatrix} \alpha^{sp} \\ 0 \\ 0 \end{bmatrix} * \begin{bmatrix} 1 & \beta_{US} & \beta_{Aaa} & c \end{bmatrix} * \begin{bmatrix} sp_{t-1}^i \\ US_{t-1} \\ Aaa_{t-1} \\ 1 \end{bmatrix} + \begin{bmatrix} \gamma^{sp}_{debt} & \gamma^{sp}_{debtEU} & \gamma^{sp}_{liq} \\ \gamma^{US}_{debt} & \gamma^{US}_{debtEU} & \gamma^{US}_{liq} \\ \gamma^{Aaa}_{debt} & \gamma^{Aaa}_{debtEU} & \gamma^{Aaa}_{liq} \end{bmatrix} * \begin{bmatrix} debt_t^i \\ debtEU_t \\ liq_t^i \end{bmatrix} + \begin{bmatrix} \varepsilon_t^{sp} \\ \varepsilon_t^{US} \\ \varepsilon_t^{Aaa} \end{bmatrix}$$

Figure 1: debt-GDP ratios

(percentage points)

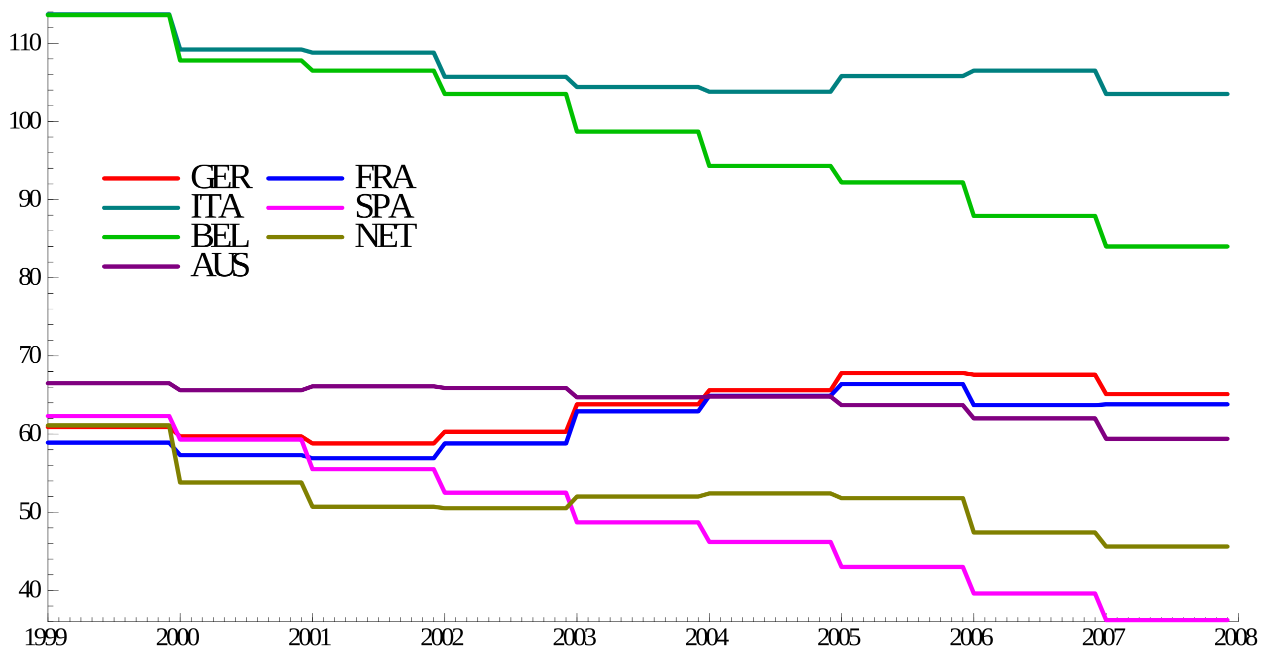

FIGURE 2 (A): SPREAD VS DEBT-GDP RATIOS

(percentage points)

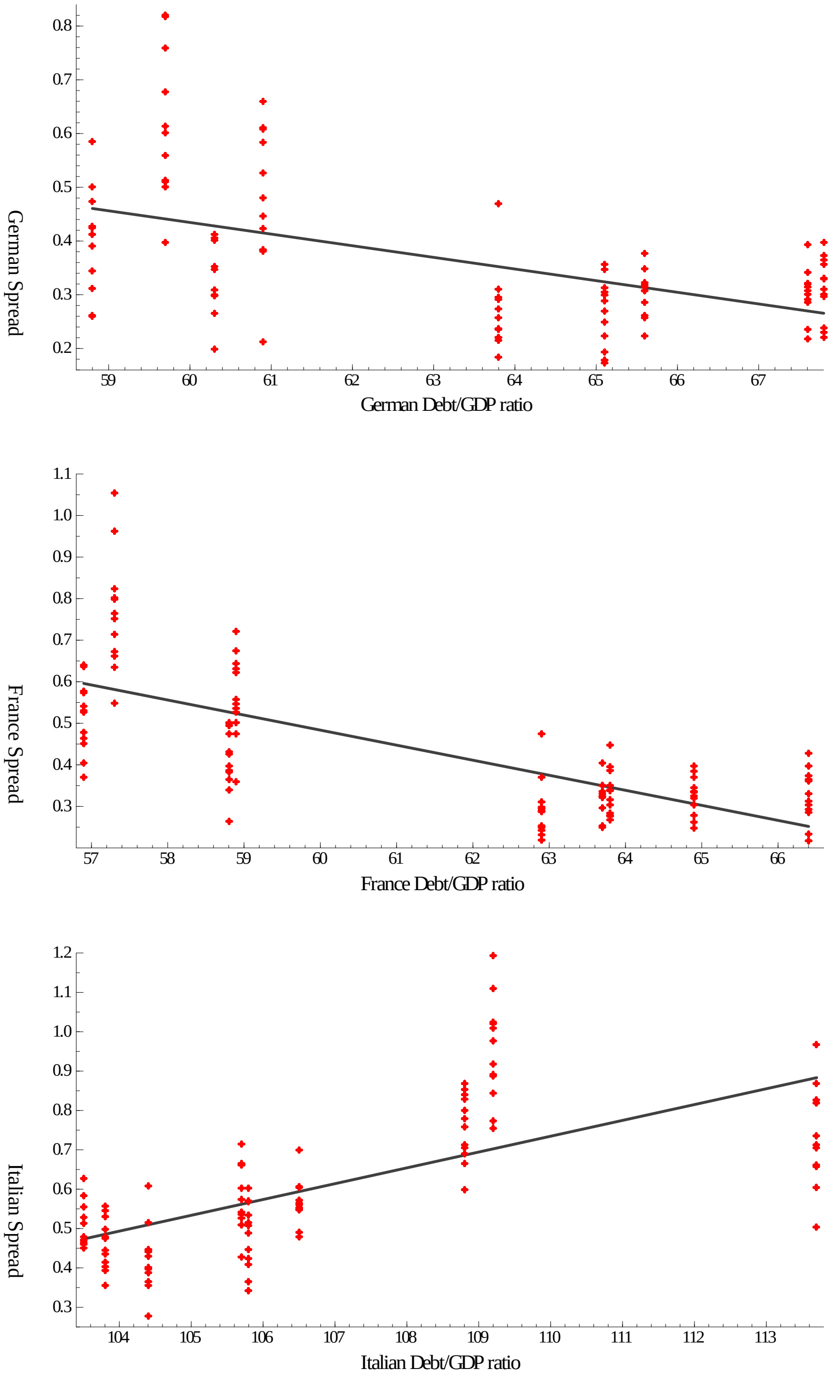

FIGURE 2 (B): SPREAD VS DEBT-GDP RATIOS

(percentage points)

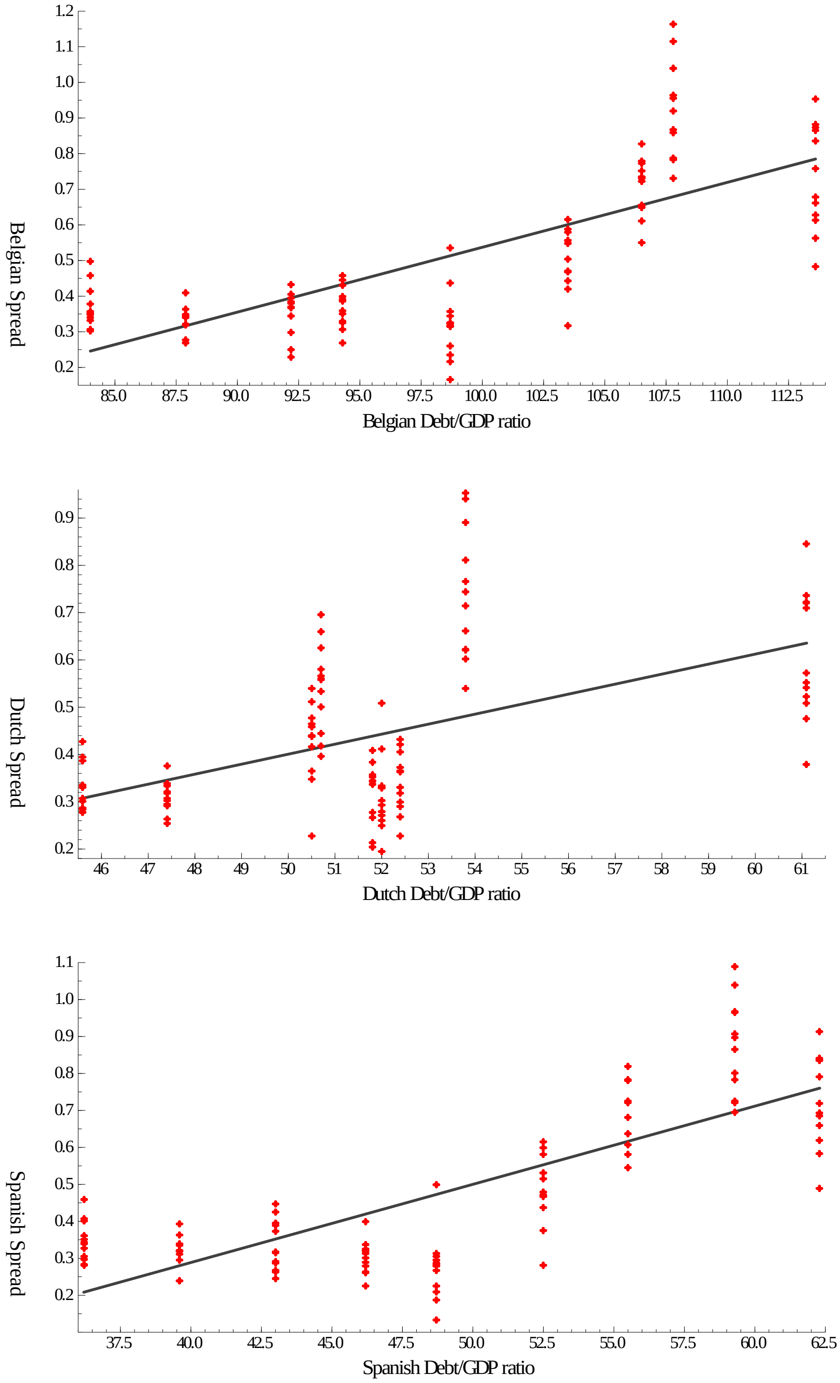

Figure 2 (c): spread vs debt-GDP ratios

(percentage points)