Sovereign Risk Premiums in the European Government Bond Market*

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Abstract:

This paper provides a study of bond yield differentials among EU government bonds issued between 1993 and 2005 on the basis of a unique dataset of issue spreads in the US and DM (Euro) bond market. Interest differentials between bonds issued by EU countries and Germany or the USA contain risk premiums which increase with fiscal imbalances and depend negatively on the issuer's relative bond market size. The start of the European Monetary Union has shifted market attention to debt service payments as the key measure of indebtedness and eliminated liquidity premiums in the euro area.

Keywords: asset pricing, determination of interest rates, fiscal policy, government debt

JEL Classification: G12, E43, E62, H63

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1. Introduction

The potential effect of public debt on government bond yields is an important issue for economists and policy makers. If government bond yields include risk premiums, increasing indebtedness may cause bond yields to go up, thus raising the cost of borrowing and imposing discipline on governments. Market discipline of this kind may be especially relevant and important in a monetary union, such as the US or the new European Monetary Union (EMU), in which the governments of the member states can issue debt, but do not have the possibility to monetize and inflate away excessive debts.

Whether such risk premiums can be identified empirically and how large they are has attracted considerable interest in recent literature. A first line of research estimates the effect of fiscal variables on interest rate levels. Gale and Orszag (2002), in a comprehensive review of the evidence for the US, conclude that expected deficits affect long-term interest rates positively, a result confirmed by Laubach (2003, 2004) and Gale and Orszag (2004). Faini (2004) estimates a positive impact of government debt on ex-post real interest rates in 10 European countries. Ardagna, Caselli, and Lane (2004) use a panel of 16 OECD countries over several decades and both static and dynamic econometric models. They find a significant positive effect of primary deficits on long-term interest rates. They also find a non-linear effect of government debt on interest rates: Only when countries have above-average debt ratios does an increase in the debt ratio cause the interest rate to rise. As explained by Gale and Orszag (2002), however, there are many reasons why interest rates may respond positively to rising government debts and deficits, and an increase in sovereign risk premiums is just one of them. Therefore, looking at the response of interest rate levels does not necessarily yield evidence of how markets price sovereign risk.

In view of this, a second line of research uses interest rate spreads between government bonds and suitable benchmark assets to estimate risk premiums related to fiscal performance. Goldstein and Woglom (1991), Bayoumi, Goldstein and Woglom (1995) and Poterba and Rueben (1997) find that the yield differentials of 39 US states relative to New Jersey depend positively on their levels of debt. Lemmen (1999) uses yields of bonds issued by state governments in Australia, Canada, and Germany and shows that yield spreads over central government bond yields depend positively on the ratio of government debt to GDP. Booth et al. (2006) find that bond yield spreads of

Canadian provinces over the federal government respond positively to measures of government debt. Since these papers relate to sub-national government debt, however, it is not clear what they tell us about the sovereign risk of national governments. Balassone et al. (2004) show that yields spreads against Germany of government bonds issued by the other EU countries in their national currencies between 1980 and 2003 depend positively on the change in the government debt-to-GDP ratio. Using issues in national currencies, however, they cannot distinguish between credit risk and exchange rate risk, which is no longer relevant in the European Monetary Union. To avoid this problem, Lonning (2000) compares the yields of a very small sample of DM issues of 11 EU governments with equivalent German government bonds in the mid-1990s and finds a positive, though not always significant impact of government debt and deficits. Gómez-Puig (2005b) uses appropriate swap rates to eliminate exchange rate uncertainty from yield spreads in different national currencies and finds that the spreads increase with increasing debt relative to Germany. Alesina, De Broeck, Prati and Tabellini (1992) use data from 12 OECD countries and show that the differential between public and private bond yields is positively related to the level of public debt. In a similar vein, Lemmen and Goodhart (1999) and Codogno, Favero and Missale (2003) show that the differential between government bond yields and the corresponding swap yield of the same maturity depends positively on the level of public debt, while Heppke-Falk and Hüffner (2004) find that expected deficits have a positive impact on this differential in Germany, France, and Italy. It is not clear, however, that these differentials properly reflect sovereign risk, since the credit risk of private issuers is likely to be correlated with the credit risk of their governments.

This paper falls into the latter line of research and makes three contributions to this literature. First, we use a new data set consisting of yield-at-issue spreads between DM (Euro after 1999) and US$ denominated bonds issued by several EU governments and Germany or the US government, respectively. Thus, we treat Euro-denominated debt issued by governments of EMU member states as foreign-currency debt of these countries. This data set has several advantages compared to those used in earlier studies. Looking at DM (Euro) and US$ denominated bonds avoids the problem of exchange rate risk that arises in the comparison of bonds denominated by governments in their national currencies. Furthermore, the comparison of spreads on such issues is not distorted by differences in national tax regimes. Looking at yields-at-issue assures the comparability

of yields at different points in time, since, in contrast to average yields on debt outstanding, the residual maturity is always the full maturity and the bonds are actively traded on the day when the yields are recorded. Finally, we consider bonds issued by national governments, which allows us to consider sovereign risk at the national rather than the sub-national level.

Our second contribution is that we use data from before and after the start of EMU. This allows us to estimate directly the effects of monetary union on the risk premiums paid by European governments. A priori, these effects are ambiguous. Monetary union may increase the default risk of member governments, since the latter have surrendered their monetary sovereignty and, therefore, the possibility to monetize their debts, and other governments and the monetary union's central bank may not be compelled to rescue governments in financial crises. This presumption is in line with the "No bail-out clause" of the Maastricht Treaty and the historical experience that state governments in the US have defaulted on their debts. However, monetary union may also have reduced the perceived default risk, if markets anticipate that member governments in fiscal troubles will be bailed out by other governments or the central bank.

Our third contribution is that our empirical analysis distinguishes between risk premiums and liquidity effects in the bond market. Identifying the liquidity component of yield spreads is important, because it points to a lack of financial market integration rather than differences in fiscal positions as a source of yield differentials.[1] Empirically, we observe that German government bond yields are still below those of bonds issued by governments with much better debt positions. This has been interpreted as showing that bond yields do not reflect fiscal performance appropriately (Reuters, June 2002). But the fact that German bonds enjoy a yield advantage compared to others may instead be due to the size of the German bond market and the fact that German bonds can be traded immediately at lower transaction costs and with a smaller risk of price changes due to individual transactions.

Our paper proceeds as follows. Section 2 presents a discrete-time, two-asset portfolio model explaining interest rate differentials between bonds issued by two different governments. It serves to motivate the empirical analysis and derive the reduced-form equation estimated subsequently. Section 3 describes the data we use for

[1] For other evidence on liquidity premiums in European bond markets see Blanco (2001), Codogno et al. (2003), and Gómez-Puig (2005a).

the estimation. Section 4 reports the estimation results, and Section 5 concludes.

2. A Portfolio Model of Bond Yield Differentials

2.1. The Basic Model

Consider a domestic investor maximizing a utility function that depends positively on expected real wealth, $E_t[w_{t+1}]$ and negatively on its variance, $Var_t[w_{t+1}]$:

$$Max\ U\ \{E_t[w_{t+1}],\ Var_t[w_{t+1}]\},\ U_1 > 0,\ U_2 < 0. \tag{1}$$

The investor allocates a fraction θ of his real wealth w_t to a domestic security D and a fraction of 1-θ to a foreign security F. Both securities and real wealth are priced in the foreign currency, so that:

$$\theta_t\, w_t = D_t \tag{2}$$

$$(1 - \theta_t)\, w_t = F_t \tag{3}$$

We assume that the domestic security is subject to default risk, while the foreign asset is considered risk-free. More specifically, with a positive probability of 1-$P(x_t)$, $0 \leq P(x_t) \leq 1$, the domestic government will be unable to fully serve its debt. Here, x_t indicates a set of variables affecting this probability. In the case of default, the investor receives a fraction τ of his gross payment, $\tau \in [0,\ 1 + r)$, where r is the interest rate on the domestic bond. Investors incur transaction costs proportional to their investment in bonds which decrease with the liquidity of the bond market. We assume that the foreign bond has benchmark status in the bond market, i.e., the foreign bond market is considered to be more liquid than the domestic bond market. Expected wealth then is:

$$E(w_{t+1}) = (1 + r_t)\,\theta_t w_t P(x_t) + \tau_t \theta_t w_t (1 - P(x_t)) - \theta_t w_t l_t + (1 + r_t^*)(1 - \theta_t)\, w_t, \tag{4}$$

where an asterix in the equation indicates the corresponding foreign variables, l is the expected transaction cost in the domestic bond market, and the transaction cost in the foreign market is normalized to zero. The objective function and the budget constraint for a representative investor in the foreign country are analogue to the equations (1) and (2) of the domestic investor. We assume no discrimination between domestic and foreign investors in the case of default, $\tau = \tau^*$. The foreign investor's expected real wealth is:

$$E(w_{t+1}^*) = (1 + r_t)\,\theta_t^* w_t^* P(x_t) + \tau_t \theta_t^* w_t^* (1 - P(x_t)) - \theta_t^* w_t^* l_t + (1 + r_t^*)(1 - \theta_t^*)\, w_t^* \tag{5}$$

Due to the uncertain investment return of domestic securities, the variance of next period's real wealth of the domestic and the foreign investor is non-zero and given by:

$$Var(w_{t+1}) = \theta_t^2 w_t^2 (1 + r_t - \tau_t)^2 P(x_t)(1 - P(x_t)), \tag{6}$$

for the domestic investor and

$$Var(w^*_{t+1}) = \theta_t^{*2} w_t^{*2} (1 + r_t - \tau_t)^2 P(x_t)(1 - P(x_t)) \tag{7}$$

for the foreign investor. Utility maximization yields the optimal shares invested in domestic securities, $\hat{\theta}_t$ and $\hat{\theta}^*_t$:

$$\hat{\theta}_t = \frac{P(x_t)(1 + r_t) + \tau_t(1 - P(x_t)) - l_t - (1 + r_t^*)}{\Phi_t (1 + r_t - \tau_t)^2 P(x_t)(1 - P(x_t))}, \tag{8}$$

$$\hat{\theta}^*_t = \frac{P(x_t)(1 + r_t) + \tau_t(1 - P(x_t)) - l_t - (1 + r_t^*)}{\Phi_t^* (1 + r_t - \tau_t)^2 P(x_t)(1 - P(x_t))}, \tag{9}$$

where $\Phi_t = -2w_t U_2 / U_1$ and $\Phi_t^* = -2w_t^* U_2^* / U_1^*$ denote the coefficients of relative risk aversion for the domestic and the foreign investor.

Let S be the total supply of bonds issued by the domestic government. Equilibrium in the domestic bond market requires:

$$S_t = D_t + D_t^* = \frac{P(x_t)(1 + r_t) + \tau_t(1 - P(x_t)) - l_t - (1 + r_t^*)}{(1 + r_t - \tau_t)^2 P(x_t)(1 - P(x_t))} \left(\frac{w_t}{\Phi_t} + \frac{w_t^*}{\Phi_t^*} \right). \tag{10}$$

This can be solved for the interest rate differential:

$$\frac{r_t - r_t^*}{1 + r_t} = (1 - P(x_t)) \left(1 - \frac{\tau_t}{1 + r_t} \right) + \frac{l_t}{1 + r_t} + \frac{S(1 + r_t - \tau_t)^2 P(x_t)(1 - P(x_t))}{(w_t / \Phi_t + w_t^* / \Phi_t^*)(1 + r_t)}. \tag{11}$$

In what follows, by the interest rate spread or differential, we mean the term on the left hand side of the equation.

Equation (11) separates the yield spread between the two bonds into three terms. The first term on the right hand side reflects the *default risk premium*. It depends positively on the default probability of the risky issuer country, (1 - $P(x_t)$). The default risk premium decreases with an increase in the fraction of repayment the investor receives in case of default, τ. Since τ ranges between 0 and (1 + r_t), the default risk premium is always positive.

Second, the bond yield differential depends on the *liquidity risk premium*. The more liquid the domestic bond market, the smaller will be the liquidity risk premium.

The third term is the *country-specific risk premium*. It depends negatively on τ and positively on the variance of the default probability $P(x_t)(1 - P(x_t))$, the gross nominal return $(1 + r_t)$, and the level of the relative risk aversion of investor Φ and Φ^*. The more investors care about the variance of their future wealth w_{t+1} (the larger U_2), the larger will be the interest rate differential between the risky and the risk-free country. Furthermore, the country specific risk premium increases with the total supply of domestic bonds, *S*, relative to total wealth.

2.2. The Reduced-form Equation

To test this model empirically, we estimate the following equation:

$$\frac{r_{it} - r_{jt}^{*}}{1 + r_{it}} = \beta_0 + \beta_1' z_{it} + \Phi_t(\gamma_0 + \gamma_1 z_{it}) + EMU(\delta_0 + \delta_1' z_{it}) + \lambda_t + \mu_i + \varepsilon_{it} \qquad (12)$$

The dependent variable is the yield spread between a bond issued in EU country *i* and the benchmark country *j*, both denominated in the same currency. z_{it} is a vector containing several variables related to fiscal performance, an indicator of the cyclical stance of the economy, a liquidity variable, and a maturity variable.

The fiscal variables reflect the government's quality as a borrower. We use three fiscal variables in our regression. The first two are motivated by their common use in policy debates and the Maastricht Treaty. These are the debt/GDP ratio and the deficit/GDP ratio. Note that deficits are defined as positive numbers. The third is the ratio of government debt service to current government revenues. This variable is closer in spirit to measures of borrower quality commonly used in corporate finance, such as the ratio of debt service to cash flow. It allows for the fact, neglected in the use of GDP as the denominator, that governments in different countries may differ in their ability to raise taxes from a given volume of GDP, and it focuses on the constraint high debt burdens impose on the annual budgetary flows. All three fiscal variables relate to the general government. They are measured as the difference relative to the benchmark country, Germany (the US) in the case of DM (Euro) bonds (in the case of US$ bonds).

We include levels and quadratic terms of the fiscal variables to allow for non-linear relationships.[2]

The inclusion of an indicator of the cyclical stance follows a suggestion of Alesina et al. (1992) that default risk depends on the overall economic situation of a country. In an economic slow-down, government revenues decrease, and the probability of default may rise. It seems likely that such effects relate more to severe recessions and strong upswings than to small cyclical movements. Therefore, our indicator takes the value 1, when the nominal GDP of a country is more than half a standard deviation above its trend (boom), -1 when it is more than half a standard deviation below its trend (recession), and 0 otherwise. Using sample standard deviations accounts for the fact that the volatility of the business cycle varies substantially across countries. The difference of this variable between the issuer and the benchmark country is zero, if both countries are in the same cyclical position; it is (-2) and (2), if one is in a strong boom and the other in a strong recession, and (-1) and 1 in the case of less severe differences in the cyclical stance.[3]

The *liquidity* variable serves to estimate the liquidity premium. Due to the lack of appropriate data, we cannot follow the conventional approach of using bid-ask spreads as a measure of trading costs in securities markets (Fleming, 2003). However, Gravelle (1999) shows that the correlation between bid-ask spreads and the total supply of debt is significantly negative. This suggests that the size of the market for a given security has a positive effect on its liquidity. In view of this, and assuming that all debt issued by a government in a given currency is homogeneous up to maturity, the liquidity premium can be expected to be proportional to the ratio of the debt issued by a government in DM (Euro) or US$ to the total debt of EU countries issued in DM (Euro) or US$.[4] We are aware that with an increase in the outstanding amount of government bonds not only the liquidity of this market increases, but also the default risk of the issuer country. By

[2] Bayoumi et al. (1995) and Flandreau et al (1998) talk about a 'credit punishing' effect, when interest rate spreads grow non-linearly with the level of fiscal variables.

[3] We also included the nominal GDP as a linear variable in our regressions, but it turned out to be insignificant. Intuitively it makes sense that the yield spread between two countries does not depend solely on the issuer's GDP, but on the relative size of the issuer's GDP to that of the benchmark countries, Germany and the USA. The trend of the individual GDP time series is subtracted for comparability reasons.

[4] For DM bonds market, we calculate the ratio of the outstanding debt of a country to the total debt of all EU countries except the benchmark country Germany.

including the total debt/GDP as a regressor in our estimation equation, we assure that the coefficient estimated on our liquidity variable will not be biased towards zero. [5]

The *maturity* variable contained in vector z_{it} measures the time to maturity of the bonds at the time of issue and controls for the possibility that default premiums vary with the length of the contract. In this case, an investor receives a compensation for investing in long-term bonds instead of buying short-term bonds and rolling them over.

Our model also suggests that the general *investors' risk aversion* determines the yield spread between countries. This suggestion is supported by empirical observations. Dungey et al. (2000) show strong evidence of a common international factor in many yield differentials. Deutsche Bank Research (2001) and Copeland and Jones (2001) note that interest rate differentials between EMU member countries widened in periods of financial crises such as the Russian crisis in 1998 or the Turkish currency crisis in 2001. Similarly, Lemmen (1999) observes that the difference between provincial and federal yields in Australia, Canada, Germany, Switzerland and the US widened considerably after the outbreak of the Asian crisis in 1997 and the Russian default of August 1998. Thus, it seems that in periods of global financial crises or uncertainty investors move to safer and more liquid assets and that bond yield spreads increase as a result.

Since investors' risk aversion is not directly observable, we follow Codogno et al. (2003) and Favero (2004) and use the yield spread between low grade US corporate bonds (BBB) and benchmark US government bonds as an empirical proxy for global risk aversion.[6] Figure 1 illustrates the development of this proxy between 1993 and 2005. We observe that the yield spread hovered around 130 basis points during the early years of the 90's. With the burst of the asset price bubble in 1999, and again in 2000, the spread increased sharply, illustrating the markets' increasing skepticism and risk aversion in that period. After peaking in November 2002, the yield spread decreased continuously and reached its level of the early 1990s again in March 2005.

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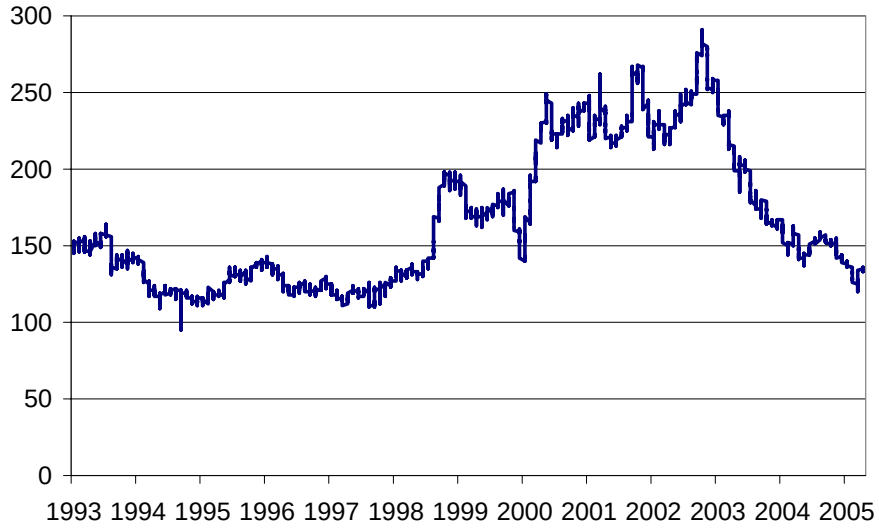
[5] We also used the issue size as an alternative proxy for liquidity, but since this variable shows insignificant coefficients, we exclude it from reported regression analysis.

[6] A variable that measures the respective corporate bond spread for the complete Euroarea is not available, but the empirical literature on sovereign bond spreads of emerging markets shows that spreads are sensitive to US risk factors (see, e.g., Barnes et al. (1997), Kamin et al. (1999), Eichengreen et al. (2000)). Therefore, data on US corporate-government bond yield spreads can be used as a good proxy for the overall investors' risk attitude.

Figure 1: Yield Spread between US low grade Corporate Bonds and US Government Bonds



To estimate the effects of EMU on yield spreads, we introduce an *EMU* dummy that takes the value of one for the initial 11 EMU member countries starting in 1999 and for Greece starting in 2001 and zero otherwise. A significant coefficient on this dummy points to a general effect of EMU on yield spreads of all member countries. Furthermore, we interact the *EMU* dummy with the fiscal variables and the liquidity variable to see whether EMU has changed the effect of the fiscal variables and market liquidity on interest rates. Finally, all regressions are estimated with and without time and country fixed effects, λ_t and μ_i.

3. Data Description

The data on the yield spreads were provided by Capital DATA Bondware. We compare government bonds issued by the 14 EU countries except Luxembourg and by the US federal government between 1993 and beginning of 2005. All bonds considered are denominated either in DM (before 1999) and Euro (since 1999), or in US$. This assures that interest differentials will be net of expected changes in exchange rates and exchange rate risk between currencies.

The interest differential for the DM (Euro) denominated bonds is measured as the difference in the yield to maturity at the time of issue between the national bond under consideration and an equivalent German government bond. Similarly, the differential for

the bonds issued in US$ is the difference to an equivalent US government bond. Capital DATA Bondware defines equivalence as meaning that the German or US benchmark bond is similar to the government bond under consideration with respect to the time of issuance, the coupon payment structure, the underlying currency, and the time to maturity. The whole data set consists of 106 DM (Euro) and 152 US$ bond issues. 48 of these DM (Euro) denominated bonds and 75 of the US$ denominated bonds were issued before the start of EMU.[7]

Figures A1 – A2 in the Appendix plot the yield spreads of EU government bond issues over time. Both figures show a cyclical pattern of European bond yields. Between 1993 and 1997, the bond yields of all EU countries except Greece converged to German and US levels. Between 1997 and 2001, one observes a general divergence of EU interest rates relative to German and US levels, the only exception is again Greece, which interest rate levels continued declining after 1997. After 2001, interest differentials across EU countries seemed to decrease again before another period of increases started in 2005 (which, however, falls largely outside the observation period of this paper).

Table A1 in the Appendix gives an overview of the foreign-currency denominated bond market in the EU and also reports the shares of DM, Euro, and US$ denominated debt outstanding. The data are provided by the DBS-online data bank of the Bank of International Settlement (BIS). The table shows that small countries tend to have larger shares of outstanding government debt issued in a foreign currency than large countries. In 1993, the outstanding amount of foreign-currency denominated debt ranged between zero percent in Germany and the Netherlands and 46 percent in Finland. With the introduction of the Euro, the share of debt issued in other currencies decreased substantially for all countries except Germany and Italy. In the first quarter of 2005, only two EMU countries, Austria and Finland, had more than ten percent of their total public debt denominated in a currency other than the Euro, and Denmark and Sweden were the two non-EMU countries which had more than ten percent of their total public debt denominated in a foreign currency including the Euro.

Table A1 also shows that the DM (Euro) and the US$ are the most important currencies in which the sample countries issued foreign-currency denominated debt

[7] Recall that, in view of equation (11), all interest differentials are divided by the gross interest rate factor of the respective national bond.

during the period under consideration. In 1993, more than 40 percent of the outstanding foreign-currency debt of the EU countries except Germany and France was denominated in one of these two currencies. In Belgium, the UK, and Italy, the share of DM and US$ denominated debt securities in total foreign-currency debt was even larger than 60 percent. This is in line with Cohen (2005), who shows that, before 1999, the US$ and DM represented the largest and third largest currency shares in international bond and note issuance. As shown in Table A1, the share of US$ denominated government securities outstanding increased with the introduction of the Euro in almost all countries except France and Portugal. Regarding the non-EMU countries, the UK had switched entirely to US$ denominated debt and Denmark almost entirely to Euro-denominated debt by 2005. Sweden maintained large shares of her foreign-currency denominated debt in both Euro and US$.

Tables A2 and A3 in the Appendix report the shares of the outstanding debt of EU countries (except Luxembourg) denominated in DM before 1999 and subsequently in Euro and US$ relative to the total debt of EU countries issued in DM (Euro) and US$, respectively. Not surprisingly, Germany strongly dominates the DM bond market with a share of around 92 percent. With the introduction of the Euro, the market shares in the Euro denominated bond market roughly correspond to the size of the EU countries and their overall amount of debt outstanding. With 26 percent of the total market, Italy had the largest share of Euro denominated debt outstanding in 2005, followed by Germany and France with 22 percent and 20 percent, respectively. Regarding the US$ denominated bond market, Table A3 shows that Italy had the largest share of all EU countries in 2005.

The corporate yield spreads variable, which measures the difference between 7 to 10 year low grade corporate bonds (BBB) and 7 to 10 year benchmark government bonds in the USA, is provided by Merrill Lynch. All other macro variables like the debt/GDP, deficit/GDP, debt service/revenue are provided by the European Commission's annual data base, Ameco.

Detailed summary statistics of all variables used in the regressions are reported in Table A4 in the Appendix.

4. Estimation Setup and Results

A number of considerations regarding the estimation setup are warranted. Since we use data from two different markets, DM (Euro) and US$ denominated bonds, we first check whether we can pool these data to increase the number of observations available for the estimation of the model and, thus, improve the quality of the estimates. We use a standard poolability test for that purpose. More specifically, we interact all independent variables of equation (12) with a dummy taking the value of one, if a bond is issued in US$, and zero otherwise. Next, we estimate the model using data from both markets and including all explanatory variables considered together with these interacted terms. In this regression, the *t*-ratios on the interacted terms can be regarded as significance tests of the hypothesis that the relevant coefficients are equal in both markets. Next, we eliminate the interacted variables with the smallest *t*-ratios in a series of steps until no insignificant interactive variables were left. Table A5 in the Appendix shows the order of elimination and the *t*-values of the relevant variables. We also use an *F*-test of the hypothesis that the excluded interactive variables are jointly significant as a summary statistic. This test, which is reported in table A5, too, confirms that the restriction of equal coefficients in both markets is valid. We reject the hypothesis of poolability only three variables, namely the quadratic debt ratio, the debt-service ratio, and our measure of international risk-aversion. In the subsequent regressions, we keep these three variables together with their interactive terms in the model. Only in one version of the model – regression C reported below – we also find significantly different coefficients on the deficit variable between DM (Euro) denominated bonds and US$ denominated bonds.

Below, variables interacted with the EMU dummy are denoted as "*EMU", while variables interacted with the US dummy are denoted as "*US". We estimate two versions of our model, one using the debt ratio and the deficit ratio as our fiscal variables, and one using the debt ratio and the debt-service ratio. Furthermore, we estimate both version with neither time nor country fixed effects, with time fixed effects, and with country fixed effects. Since the deficit and debt service contain interest payments by the governments and, therefore, could be affected by changes in risk premiums, we perform Durbin-Wu-Hausman tests for endogeneity of the explanatory

variables for each regression.[8] The results, reported in Table 2 below, indicate that the exogeneity of the deficit variable cannot be rejected at standard significance levels. We do, however, reject the exogeneity of the debt service variable in all three regressions. In Appendix Table A6, we report the result of estimating the model using the debt service variable with an instrumental variables estimator and the same instruments we used for the Durbin-Wu-Hausman test. The instrumental variables estimator changes the magnitude of the coefficients but neither their signs nor their significance. In light of this, the following discussion focuses on the results using OLS estimation.

Table 2 reports the estimation results for the pooled data.[9] They indicate, first, that a positive relationship between yield spreads and the fiscal variables exists. This suggests that markets perceive and price sovereign risk in the European bond market. Second, the results show that the start of EMU has changed this relation significantly.

Consider first regressions A-C, which use public debt and deficits as fiscal variables. The coefficients for public debt are significant and robust in explaining yield spreads, while the deficit has the right sign but is not significant when the estimations include fixed effects. The squared deficit terms, however, are consistently positive and significant in these regressions. Thus, rising deficit ratios relative to Germany increase yield spreads with an increasing marginal effect. In contrast, the marginal effect for higher public debt ratios is slightly declining with higher fiscal imbalances. According to regression A, a debt ratio exceeding Germany's by 10 percent causes a yield spread of around 7.7 basis points, while a debt ratio exceeding Germany's by 30 percent results in a yield spread of 17.1 basis points. For US$ denominated bonds, the risk premium asked by financial markets for an increase in the debt level is somewhat smaller. A debt differential towards the USA of 10 (30) percent results in an interest differential of 7.3 (13.5) basis points. Neglecting the deficit term and considering the squared deficit term, the regression with country fixed effects suggests that a deficit ratio exceeding that of the benchmark countries (Germany and the USA) by one percent results in a yield spread of 0.64 basis points, while a deficit ratio exceeding that of the benchmark countries by 2 percent results in a yield spread of 2.56 basis points.

[8] Following Tujula and Wolswijk (2004), we use the unemployment rate, GDP growth, the inflation rate, and the primary deficit, all measured relative to the benchmark country, as instruments for the deficit and debt service. Note that we cannot use institutional variables such as measures of fiscal or political characteristics of the sample countries as instruments, since such variables do not have sufficient time variation.

[9] Results for the individual currencies are available from the authors upon request.

Table 2: Estimation Results for pooled DM (Euro) and US$ Denominated Government Bond

	A		B		C		D		E		F	
Debt	0.87	**	0.87	**	0.70	**	0.32	**	0.28	*	0.39	**
	(3.77)		(3.72)		(3.83)		(2.27)		(1.87)		(2.81)	
$Debt^2$	-0.01	**	-0.01	**	-0.01	**	-0.01	**	-0.01	**	-0.01	**
	(-3.43)		(-3.25)		(-3.68)		(-4.46)		(-3.94)		(-3.31)	
$Debt^{2*}$US	-0.004	**	-0.005	**	-0.006	**	-0.004		-0.006	**	-0.005	**
	(-2.23)		(-2.78)		(-2.87)		(-1.51)		(-2.06)		(-2.00)	
Debt*EMU	-0.73	**	-0.88	**	-0.61	*	-0.71	**	-0.64	**	-0.88	**
	(-2.53)		(-2.89)		(-1.88)		(-2.57)		(-2.24)		(-2.37)	
$Debt^2$*EMU	0.01	**	0.01	**	0.00							
	(2.13)		(2.41)		(0.18)							
Deficit	1.85	**	1.24		0.81							
	(2.53)		(1.40)		(1.07)							
$Deficit^2$	0.81	**	0.99	**	0.64	**						
	(4.18)		(4.66)		(3.64)							
Deficit*EMU*US	0.76		1.16		2.46	**						
	(0.73)		(1.09)		(2.43)							
$Deficit^2$*EMU	-0.60	**	-0.98	**	-0.65	**						
	(-2.50)		(-3.29)		(-2.68)							
Debt Service*US							2.24	**	2.31	**	3.00	**
							(2.78)		(3.21)		(4.92)	
$Debt\ Service^2$							0.15	**	0.16	**	0.14	**
							(5.97)		(6.17)		(5.07)	
Debt Sevice*EMU							5.63	**	4.84	**	6.39	**
							(3.18)		(2.71)		(2.57)	
Liquidity	-117.09	**	-136.49	**	-62.98	**	-64.66	**	-67.42	**	-44.89	
	(-2.79)		(-2.99)		(-2.18)		(-2.13)		(-2.04)		(-1.50)	
Liquidity*EMU	115.69	**	140.59	**	130.57	**	59.67	*	76.78	*	104.45	**
	(2.81)		(3.13)		(3.02)		(1.71)		(1.92)		(2.73)	
EMU	-9.18		-5.43		-8.55		-10.60	**	-12.69	**	-10.63	**
	(-1.51)		(-0.69)		(-1.30)		(-2.25)		(-2.15)		(-2.10)	
EMU*US							28.73	**	25.19	**	23.85	**
							(3.18)		(2.85)		(2.25)	
Corp.-Gov.spread	6.94		-5.21		1.57		6.70		-4.15		2.81	
	(1.59)		(-0.64)		(0.28)		(1.48)		(-0.49)		(0.59)	
Corp.-Gov.spread*US	28.96	**	29.43	**	37.87	**	30.23	**	29.46	**	37.01	**
	(4.88)		(5.36)		(6.43)		(4.87)		(4.60)		(5.69)	
Maturity	0.90	**	1.00	**	0.58	*	0.76	**	0.89	**	0.65	**
	(3.31)		(3.69)		(1.83)		(2.75)		(3.18)		(2.41)	
US	-14.65		-13.40		-28.19	**	-19.83	*	-17.68	*	-23.75	**
	(-1.26)		(-1.29)		(-2.68)		(-1.92)		(-1.70)		(-2.39)	
Constant	5.48		16.70		9.75		8.76		16.59		6.15	
	(0.76)		(1.22)		(1.00)		(1.12)		(1.15)		(0.75)	
Country dummies	no		no		yes		no		no		yes	
Time dummies	no		yes		no		no		yes		no	
Durbin-Wu-Hausman test[1)]	0.79		0.72		0.30		0.00		0.00		0.01	
N	236		236		236		236		236		236	
r2	0.58		0.62		0.66		0.65		0.69		0.71	

[1)] Instruments are GDP growth rate, unemployment rate, primary deficit, and inflation rate.

The terms interacting the debt ratio and its square with the EMU dummy show how this relationship has changed with the beginning of EMU. The coefficient on the debt ratio is significantly negative and the coefficient on the squared debt ratio is significantly positive. Comparing these coefficients with those on the debt ratio and its square reveals that they are almost exactly offsetting in magnitude. In fact, an *F-test* of the hypothesis that the sum of the coefficients on *debt* and *debt*EMU* and on $debt^2$ and $debt^2$*EMU* is zero cannot be rejected at standard significance levels. This indicates that, since the start of EMU, debt ratios no longer affect yield spreads on bonds issued by EMU member states neither in the Euro nor in the US$ market. Similarly, the effects of the squared deficit ratio disappear for EMU member countries with the start of EMU. An *F-test* shows that the hypothesis that the sum of the coefficients on $deficit^2$ and $deficit^2$*EMU zero cannot be rejected.[10]

Next, consider regressions D - F, which use the debt ratio and the debt service ratio as indicators of fiscal performance. The results concerning the debt ratio are similar to those in regressions A-C. In addition, we find that the squared debt service ratio has a positive and significant coefficient in all three regressions. Thus, a debt service ratio of five percent above Germany's results in a yield spread of 3.75 basis points, while a debt service ratio exceeding Germany's by 10 percent results in a yield spread of 15 basis points. For US$ denominated government bonds, there is an additional, linear effect of the debt service ratio. Accordingly, a debt service ratio exceeding that of the US by five percent results in a yield spread of 15 basis points over US federal government bonds.

In contrast to the results for the debt and the deficit ratio, we find that the debt service ratio gains importance with EMU. This is indicated by the positive and significant coefficients on the term interacting the debt service ratio with the EMU dummy. Our estimates did not indicate that the coefficient on the squared debt service ratio changed with the start of EMU. Thus, after the start of EMU, a debt service ratio of five percent above Germany's results in an interest spread of 31.9 basis points in the Euro-denominated bond market, while a debt service ratio exceeding that of the US by five percent results in a yield spread of 46.8 basis points over US federal government bonds.

[10] The positive coefficient on the term *deficit*EMU*US* measures the effect of the deficit ratio relative to that of the USA in the US$ market after the start of EMU. This coefficient is positive indicating a positive effect on the yield spread, but it is significantly different from zero only in the estimation using country fixed effects.

Comparing the two sets of regressions on indicators of fiscal imbalances suggests a striking change in the way bond market price sovereign risk since the start of EMU. Specifically, the results indicate that markets pay less attention to the debt and the deficit ratios, but they give more weight to the debt service ratio in the assessment of credit risk. This would imply that market discipline did not vanish with the start of EMU, but that the focus of financial markets changed. A possible explanation is that the debt and the deficit ratio are commonly used in European policy discussions and the European Commission's official assessments of the sustainability of the public finances of the EU member states. As such, they have become the object of highly politicized debates and are subject to creative accounting as governments try to stay within the limits of the Maastricht Treaty. [11] Markets may perceive that this has reduced the information content of these variables for the governments' true credit risk.

Turning to the results for the other variables, our estimates show that yield spreads were significantly affected by liquidity premiums before the start of EMU. An increase in the relative market size by one percent caused a reduction of the issuer country's interest rate by around one basis point. This liquidity effect largely vanished with EMU, as shown by the positive and significant coefficients on *Liquidity*EMU*. An *F*-test does not reject the hypothesis that the sum of the coefficients on *Liquidity* and *Liquidity*EMU* is zero. We attribute this result to the fact that, after the conversion of all existing government debt of the EMU member states into Euros, the market for Euro-denominated debt became much larger for all countries. The result is also consistent with an increasing degree of financial market integration in the Europe.[12] Note that, for non-EMU countries, the liquidity premium remains unchanged after the start of EMU.

The negative coefficient of the EMU dummy indicates that average yield differentials of EMU member states have declined since the start of EMU, although this effect is significant only in the regressions D-F. This decline in spreads could be attributed either to a reduction in the average risk premiums for EMU members or a reduction in average liquidity premiums. The first interpretation would suggest a presumption, on the part of investors, that EMU member countries will come to each others' rescue in the case of fiscal crises. However, such a presumption should also have

[11] On the rise of creative accounting affecting deficits in particular see von Hagen and Wolff (2005) and Buti et al (2006).
[12] Similarly, Pagano and von Thadden (2004) conclude that liquidity premiums play only a minor role in explaining yield differentials in the Euro area.

reduced the risk premium on US$ denominated debt, where we find a general increase in the spreads after the start of EMU. Since the market shares of most European countries in the US$ market have declined after 1999, implying a reduction in liquidity in that market, we find the second interpretation more plausible.

For US$ denominated bonds, we find a positive and significant effect of the *Corporate Spread* variable in all six regressions. For bonds issued in DM (Euro), only regression A suggests that spreads rise with the *Corporate Spread* variable. Accordingly, in periods of high global risk aversion, the interest differentials of EU countries versus the USA rise. This confirms the results of Codogno et al. (2003) and Gómez-Puig (2005b) and underlines the 'safe haven' status of the US government bond market, which the DM (Euro) market does not enjoy during our sample period.

Finally and unsurprisingly, we find that the time to maturity matters for the interest differential. With every additional year to maturity, the interest rate increases by around one basis point.[13]

5. Conclusions

This paper contributes to the literature on the impact of fiscal policies on interest rates by analyzing the role of capital markets on the sustainability of public finances in the euroarea. We examine whether government bond yield differentials across EU countries are determined by credit and liquidity risk, and whether EMU had significant impact on bond pricing. We exploit a unique data set of US$, DM, and, after 1998, Euro denominated government bond issue spreads between 1993 and 2005, which has the advantage that we can ignore exchange risks and distortions by differences in national tax regimes.

Our results show that yield spreads respond significantly to measures of government indebtedness both before and after the start of EMU. Interestingly, after the start of EMU, markets seem to have shifted their attention from government debts and deficits as indicators of creditworthiness to debt-service ratios, perhaps reflecting the fact that the former have become very politicized in the debates over the fiscal framework of EMU. Nevertheless, the empirical evidence suggests that credit markets continue to

[13] Note that the *Business Cycle* indicate never had significant coefficients and was therefore dropped from the regressions.

monitor fiscal performance and exert disciplinary pressure on governments. In other words, markets do not expect that countries in fiscal troubles will be fully bailed out by other countries in the EMU or the ECB.

Furthermore, yield spreads are affected by liquidity premiums. Countries with larger market shares in the DM (Euro) or US$ markets pay significantly lower interest rates than EU countries with smaller market shares. In the euro-denominated debt market, however, these liquidity risk premiums have vanished with the start of EMU..

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Appendix

Table A1: Outstanding Amount of Foreign Currency Bonds (continued on next page)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	Oustanding amount (in Mill. US$)	**18538**	**24326**	**29219**	**28908**	**26669**	**33593**	**27325**	**23446**	**22165**	**26918**	**30916**	**33458**	**31993**
	of which DM denominated debt (%)	21.88%	22.20%	25.32%	31.00%	29.80%	27.46%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	22.06%	19.58%	16.48%	14.28%	12.66%	9.76%	18.62%	19.89%	27.75%	28.95%	37.09%	42.90%	50.78%
	Oustanding amount/Total Debt	15.90%	18.83%	18.53%	18.19%	19.92%	24.42%	19.27%	18.37%	17.32%	19.64%	18.70%	17.85%	16.21%
Belgium	Oustanding amount (in Mill. US$)	**15531**	**18703**	**20479**	**15434**	**15266**	**12893**	**9606**	**8204**	**6259**	**4605**	**3439**	**2876**	**2158**
	of which DM denominated debt (%)	18.32%	20.45%	21.23%	22.09%	24.85%	23.18%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	45.37%	42.21%	41.90%	45.03%	44.90%	43.47%	43.51%	43.88%	39.94%	43.43%	29.08%	34.77%	46.34%
	Oustanding amount/Total Debt	5.06%	5.85%	5.72%	4.43%	4.97%	4.30%	3.33%	3.29%	2.55%	1.78%	1.13%	0.85%	0.61%
Germany	Oustanding amount (in Mill. US$)	**0**	**0**	**0**	**0**	**0**	**0**	**90**	**254**	**292**	**1714**	**4317**	**6080**	**10551**
	of which US$ denominated debt (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	94.44%	0.00%	3.42%	0.58%	12.05%	19.42%	59.84%
	Oustanding amount/Total Debt	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.14%	0.28%	0.34%	0.55%
Denmark	Oustanding amount (in Mill. US$)	**21889**	**20359**	**19509**	**18374**	**16955**	**14107**	**12791**	**11409**	**10186**	**9134**	**10023**	**11739**	**11432**
	of which DM denominated debt (%)	8.09%	8.78%	13.51%	21.76%	23.64%	23.90%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	39.02%	34.97%	25.62%	23.10%	23.65%	22.41%	34.50%	43.54%	57.46%	49.15%	30.83%	17.55%	13.65%
	of which Euro denominated debt (%)	-	-	-	-	-	-	4.32%	1.23%	1.30%	18.94%	48.83%	69.33%	82.24%
	Oustanding amount/Total Debt	19.47%	17.24%	14.75%	14.44%	15.20%	13.38%	12.84%	13.75%	13.41%	11.19%	10.55%	11.37%	10.71%
Spain	Oustanding amount (in Mill. US$)	**13103**	**16001**	**19636**	**21528**	**22433**	**27529**	**24042**	**22126**	**20748**	**20411**	**19475**	**17200**	**14205**
	of which DM denominated debt (%)	30.06%	26.63%	33.21%	28.71%	28.23%	24.58%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	24.38%	20.24%	17.01%	15.38%	15.43%	17.55%	19.01%	24.61%	30.25%	30.62%	31.27%	32.35%	37.76%
	Oustanding amount/Total Debt	4.89%	5.34%	5.31%	5.27%	6.02%	7.25%	6.32%	6.43%	6.12%	5.64%	4.50%	3.55%	2.79%
Finland	Oustanding amount (in Mill. US$)	**25624**	**35825**	**37325**	**36376**	**28121**	**28016**	**24691**	**18828**	**15520**	**16016**	**12841**	**11374**	**9514**
	of which DM denominated debt (%)	18.54%	20.37%	20.56%	20.77%	21.33%	24.75%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	24.80%	25.07%	24.22%	25.68%	16.86%	10.85%	12.32%	15.94%	19.21%	27.47%	33.88%	38.68%	46.25%
	Oustanding amount/Total Debt	45.94%	58.26%	51.91%	50.00%	42.90%	44.51%	41.04%	35.21%	29.18%	28.54%	17.50%	13.55%	10.23%
France	Oustanding amount (in Mill. US$)	**1223**	**1504**	**2080**	**1899**	**1735**	**2157**	**1670**	**1358**	**1080**	**818**	**894**	**800**	**713**
	of which DM denominated debt (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	0.00%	0.00%	9.62%	10.53%	11.53%	9.27%	11.98%	14.73%	18.52%	24.45%	27.96%	31.25%	7.01%
	Oustanding amount/Total Debt	0.20%	0.23%	0.24%	0.21%	0.21%	0.25%	0.20%	0.18%	0.14%	0.10%	0.08%	0.06%	0.05%

Table A1: Outstanding Amount of Foreign Currency Bonds (continue)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
UK	Oustanding amount (in Mill. US$)	**13273**	**13941**	**14458**	**13983**	**10037**	**11958**	**11269**	**10954**	**3000**	**0**	**3000**	**3000**	**3000**
	of which DM denominated debt (%)	24.00%	25.47%	26.54%	25.30%	0.00%	0.00%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	52.79%	50.26%	48.46%	50.06%	69.74%	58.54%	62.12%	63.90%	100.00%	0.00%	100.00%	100.00%	100.00%
	of which Euro denominated debt (%)	-	-	-	-	-	-	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Oustanding amount/Total Debt	3.03%	2.75%	2.46%	2.25%	1.49%	1.76%	1.71%	1.81%	0.54%	0.00%	0.42%	0.34%	0.30%
Greece	Oustanding amount (in Mill. US$)	**11061**	**15265**	**15849**	**18252**	**18451**	**21414**	**20757**	**19778**	**13158**	**13395**	**12759**	**12976**	**11546**
	of which DM denominated debt (%)	11.26%	12.48%	13.86%	18.57%	24.25%	20.16%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	24.19%	22.03%	19.95%	20.94%	19.02%	17.49%	13.19%	12.57%	17.00%	16.70%	14.89%	14.64%	16.46%
	Oustanding amount/Total Debt	13.29%	16.43%	13.79%	14.45%	15.48%	17.19%	16.42%	15.46%	9.75%	8.95%	6.73%	5.72%	4.69%
Ireland	Oustanding amount (in Mill. US$)	**10528**	**10431**	**10924**	**8633**	**6754**	**6644**	**6113**	**4791**	**7218**	**4473**	**2539**	**770**	**639**
	of which DM denominated debt (%)	34.57%	31.78%	28.31%	29.68%	24.24%	25.86%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	23.56%	21.57%	20.14%	17.95%	22.95%	23.33%	33.89%	33.40%	62.80%	39.17%	52.82%	24.68%	78.25%
	Oustanding amount/Total Debt	21.30%	20.74%	19.18%	15.70%	13.76%	14.32%	13.17%	13.16%	19.48%	11.37%	5.21%	1.42%	1.05%
Italy	Oustanding amount (in Mill. US$)	**29317**	**40610**	**48408**	**50093**	**50820**	**57471**	**48851**	**52804**	**53510**	**65130**	**79205**	**85345**	**83185**
	of which DM denominated debt (%)	9.88%	9.94%	9.01%	8.03%	10.16%	4.52%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	60.85%	43.91%	38.05%	41.82%	41.93%	42.48%	44.57%	47.69%	51.54%	54.20%	56.47%	56.92%	61.95%
	Oustanding amount/Total Debt	2.55%	3.16%	3.19%	3.20%	3.63%	4.12%	3.58%	4.42%	4.43%	5.08%	5.07%	4.81%	4.37%
Netherlands	Oustanding amount (in Mill. US$)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**225**	**312**	**304**
	of which DM denominated debt (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Oustanding amount/Total Debt	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.08%	0.10%	0.09%
Portugal	Oustanding amount (in Mill. US$)	**3624**	**6672**	**9839**	**10447**	**11118**	**12671**	**9369**	**7786**	**7272**	**6323**	**4748**	**3240**	**1904**
	of which DM denominated debt (%)	31.98%	43.33%	36.78%	38.14%	32.87%	37.03%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	27.59%	14.99%	12.20%	10.19%	11.83%	10.38%	27.76%	30.63%	46.30%	38.75%	24.22%	4.63%	7.88%
	Oustanding amount/Total Debt	7.37%	11.88%	14.31%	14.90%	17.85%	20.52%	14.98%	13.72%	11.85%	8.93%	5.36%	3.12%	1.58%
Sweden	Oustanding amount (in Mill. US$)	**33164**	**50723**	**57675**	**58534**	**50429**	**47084**	**37059**	**28329**	**23287**	**25586**	**26163**	**27560**	**25277**
	of which DM denominated debt (%)	8.07%	8.48%	11.66%	12.08%	9.21%	9.46%	-	-	-	-	-	-	-
	of which US$ denominated debt (%)	47.11%	42.61%	27.19%	25.85%	32.81%	30.04%	19.96%	19.91%	21.94%	28.22%	26.94%	27.72%	38.23%
	of which Euro denominated debt (%)	-	-	-	-	-	-	8.74%	10.85%	13.32%	15.27%	19.55%	23.97%	27.38%
	Oustanding amount/Total Debt	23.16%	32.10%	31.57%	29.43%	28.89%	27.83%	23.51%	22.41%	19.49%	20.13%	16.64%	15.57%	13.70%

Source: Bank of International Settlement (BIS) and own calculations

Table A2: Market shares of debt outstanding denominated in DM before 1998 and Euro thereafter in the EU

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
bel	0.59%	0.78%	0.75%	0.53%	0.59%	0.49%	7.45%	7.50%	7.60%	7.76%	7.59%	7.24%	6.77%
dnk	0.37%	0.36%	0.45%	0.62%	0.62%	0.55%	0.02%	0.00%	0.00%	0.05%	0.12%	0.15%	0.15%
deu	93.31%	91.36%	90.96%	91.51%	92.62%	92.29%	18.06%	18.79%	19.49%	20.41%	21.46%	21.99%	22.29%
grc	0.26%	0.39%	0.38%	0.53%	0.69%	0.71%	2.78%	2.83%	2.97%	3.51%	4.08%	4.34%	4.84%
esp	0.82%	0.86%	1.12%	0.96%	0.98%	1.11%	8.82%	8.85%	8.87%	8.63%	8.49%	8.12%	8.03%
fra	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	18.48%	18.37%	18.70%	18.47%	18.42%	19.29%	19.63%
irl	0.76%	0.67%	0.53%	0.40%	0.25%	0.28%	0.71%	0.76%	0.71%	0.61%	0.58%	0.66%	0.70%
ita	0.60%	0.82%	0.75%	0.62%	0.80%	0.43%	33.30%	31.94%	30.73%	29.40%	27.72%	26.90%	26.24%
nld	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.52%	5.49%	5.11%	4.83%	4.67%	4.72%	4.79%
aut	0.84%	1.10%	1.28%	1.39%	1.23%	1.51%	2.18%	2.58%	2.73%	2.83%	2.88%	2.56%	2.51%
prt	0.24%	0.59%	0.62%	0.62%	0.57%	0.77%	1.18%	1.34%	1.44%	1.66%	1.95%	1.94%	2.03%
fin	0.99%	1.48%	1.32%	1.17%	0.93%	1.14%	1.42%	1.47%	1.55%	1.70%	1.92%	1.97%	1.91%
swe	0.56%	0.87%	1.16%	1.10%	0.72%	0.73%	0.09%	0.09%	0.10%	0.12%	0.12%	0.12%	0.11%
gbr	0.66%	0.72%	0.66%	0.55%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
eu	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Bank of International Settlement (BIS) and own calculations

Table A3: Market shares of debt outstanding denominated in US$ in the EU

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
bel	9.29%	9.28%	10.91%	8.95%	9.28%	7.75%	6.41%	5.44%	3.58%	2.70%	1.16%	1.11%	0.98%
dnk	11.26%	8.37%	6.36%	5.46%	5.43%	4.37%	6.77%	7.51%	8.39%	6.06%	3.60%	2.28%	1.53%
deu	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.01%	0.01%	0.61%	1.31%	6.21%
grc	3.53%	3.95%	4.02%	4.92%	4.75%	5.18%	4.20%	3.76%	3.21%	3.02%	2.21%	2.10%	1.87%
esp	4.21%	3.81%	4.25%	4.26%	4.69%	6.68%	7.01%	8.23%	8.99%	8.43%	7.09%	6.16%	5.28%
fra	0.00%	0.00%	0.25%	0.26%	0.27%	0.28%	0.31%	0.30%	0.29%	0.27%	0.29%	0.28%	0.05%
irl	3.27%	2.65%	2.80%	2.00%	2.10%	2.14%	3.18%	2.42%	6.49%	2.36%	1.56%	0.21%	0.49%
ita	23.52%	20.96%	23.42%	26.96%	28.84%	33.77%	33.42%	38.06%	39.51%	47.64%	52.05%	53.82%	50.68%
nld	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
aut	5.39%	5.60%	6.12%	5.31%	4.57%	4.53%	7.81%	7.05%	8.81%	10.52%	13.34%	15.90%	15.98%
prt	1.32%	1.18%	1.53%	1.37%	1.78%	1.82%	3.99%	3.60%	4.82%	3.31%	1.34%	0.17%	0.15%
fin	8.38%	10.56%	11.50%	12.02%	6.42%	4.21%	4.67%	4.54%	4.27%	5.94%	5.06%	4.87%	4.33%
swe	20.60%	25.41%	19.94%	19.48%	22.40%	19.57%	11.35%	8.52%	7.32%	9.74%	8.20%	8.46%	9.50%
gbr	9.24%	8.24%	8.91%	9.01%	9.48%	9.68%	10.74%	10.58%	4.30%	0.00%	3.49%	3.32%	2.95%
EU	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Bank of International Settlement (BIS) and own calculations

Table A4: Variable Description and Summary Statistics

Variable	Desciption	Average	Std. Dev.	Min.	Max.
Spread S_{it}	The spread between the yield of a government bond issue of an EU country and a comparable goverment bond issued in the same currency related to the gross nominal return of the government bond issue. Expressed in basis points. Compare equation (11). Source: Capital DATA Bondware	37.91	30.20	-5.00	198.00
Debt	Difference of debt to GDP outstanding at the end of the fiscal year between the issuer country and the benchmark country (expressed in percent). *Source:* European Commission (Ameco database)	14.24	28.04	-46.11	91.65
Deficit	Difference of deficit to GDP (including debt service payments) at the end of the fiscal year between the issuer country and the benchmark country. *Source:* European Commission (Ameco database)	-0.12	3.15	-8.10	10.30
Debt Service	Difference of debt service payments to total revenue in the current fiscal year between the issuer country and the benchmark country (expressed in percent). *Source*: European Commission (Ameco database)	0.77	6.18	-13.50	28.40
Corp. Spread	Spread between 7 to 10 years low grade corporate bonds (BBB) and 7 to 10 government bonds in the US to the time of issuance (expressed in basis points). *Source:* Datastream	1.71	0.44	1.13	2.89
Maturity	Time to maturity of the government bond issue measured in years. *Source:* Capital DATA Bondware.	7.31	4.93	1.60	32.50
Liquidity	The ratio of the total debt of the issuer country denominated in DM (Euro) or US$ over the total debt of the EU issued in DM (Euro) or US$.[i)] *Source:* DBSonline, BIS and own calculations.	13.60	12.88	0.11	53.82
Business Cycle	The difference of the business cycle variable between the issuer country and the benchmark county, which collates the value 1 when the detrended and standardized nominal GDP is bigger than 0.5, the value 1, when it is smaller then -0.5 and 0 otherwise.	-0.05	1.05	-2.00	2.00
EMU	Dummy variable for all member countries of the EMU after 1998.	0.42	0.49	0.00	1.00

[i)] For the DM bond market, we calculate the ratio of the outstanding debt of a country to the total debt of all EU countries except the benchmark country Germany.

Table A5: Poolability tests

	A	B	C
Liquidity*US	-1.61	-0.73	-1.41
Deficit^2*US	0.07	0.44	0.12
EMU*US	0.28	-0.44	0.63
Debt*US	0.97	0.63	0.81
Maturity*US	0.82	1.00	0.69
Deficit*US	0.80	0.09	1.31
Cycle*US	0.71	-1.43	1.58
Debt^2*EMU*US	-1.28	-1.56	0.12
Debt*EMU*US	-0.36	-1.47	0.11
Deficit^2*EMU*US	-1.22	-1.22	-0.59
Liquidity*EMU*US	1.36	1.19	-0.77
F-test	**0.27**	**0.24**	**0.57**
	D	E	F
liquidity*US	-1.03	-0.42	-0.21
Debt*US	-0.86	-1.18	-0.54
Maturity*US	1.01	1.19	0.52
Cycle*US	1.05	-1.08	1.81
Debt Service^2*US	-0.83	-0.77	-0.19
Debt service^2*EMU*US	1.11	0.64	1.15
Debt*EMU*US	-0.85	-1.27	-1.77
liquidity*EMU*US	0.64	1.87	-1.52
Debt^2*EMU*US	-1.52	-1.49	-1.62
Debt service*EMU*US	1.32	0.74	-0.40
F-test	**0.32**	**0.32**	**0.32**

Note: Entries in this table record the t-ratios of the poolability tests for individual variables and the corresponding overall F-test. Variables denoted "*US" are interacted with a dummy for the US$ market.

Table A6: Estimation Results of Instrumental Variables 2-Stage Least-Squares Regression

	IV-Estimator [1]		
	D	E	F
Debt	0.83 **	0.70 *	1.87 **
	(2.05)	(1.93)	(2.83)
$Debt^2$	-0.01 **	-0.01 **	-0.01 **
	(3.47)	(2.84)	(2.41)
$Debt^{2*}$US	-0.01 **	-0.01 **	-0.01 **
	(2.74)	(3.04)	(2.96)
Debt*EMU	-1.66 **	-1.38 **	1.92
	(2.61)	(2.44)	(1.16)
$Debt^{2*}$EMU	0.00	0.00	0.02
	(0.66)	(0.46)	(1.33)
Debt Service	-5.16 *	-4.36 *	-11.65 **
	(1.89)	(1.82)	(2.55)
Debt Service*US	5.81 **	5.34 **	7.83 **
	(3.94)	(3.86)	(3.78)
Debt $Service^2$	0.32 **	0.30 **	0.43 **
	(4.30)	(4.52)	(3.78)
Debt Sevice*EMU	14.36 **	11.51 **	-19.19
	(2.85)	(2.70)	(1.25)
Liquidity	-83.57 **	-85.68 **	-58.08
	(2.58)	(2.38)	(1.45)
Liquidity*EMU	82.75 **	96.35 **	3.17
	(2.13)	(2.15)	(0.05)
EMU	-15.32 **	-15.82 **	-28.75 **
	(2.28)	(2.18)	(2.34)
EMU*US	62.77 **	51.14 **	-46.68
	(3.04)	(3.15)	(0.92)
Corp.-Gov.spread	4.58	-5.04	11.06
	(0.86)	(0.57)	(1.16)
Corp.-Gov.spread*US	34.22 **	32.42 **	18.83
	(5.13)	(4.63)	(1.39)
Maturity	0.87 **	0.96 **	0.67 *
	(2.90)	(3.34)	(1.69)
US	-36.61 **	-30.58 **	-26.82
	(2.88)	(2.46)	(1.21)
Constant	16.17 *	21.51	41.14 **
	(1.85)	(1.43)	(2.29)
Country dummies	no	no	yes
Time dummies	no	yes	no
N	236	236	236
r2	0.64	0.68	0.55

[1] Instruments are GDP growth rate, unemployment rate, inflation rate, and primary deficit.

Figure A1: DM (Euro) Bond Yield Spreads between 1993-2005

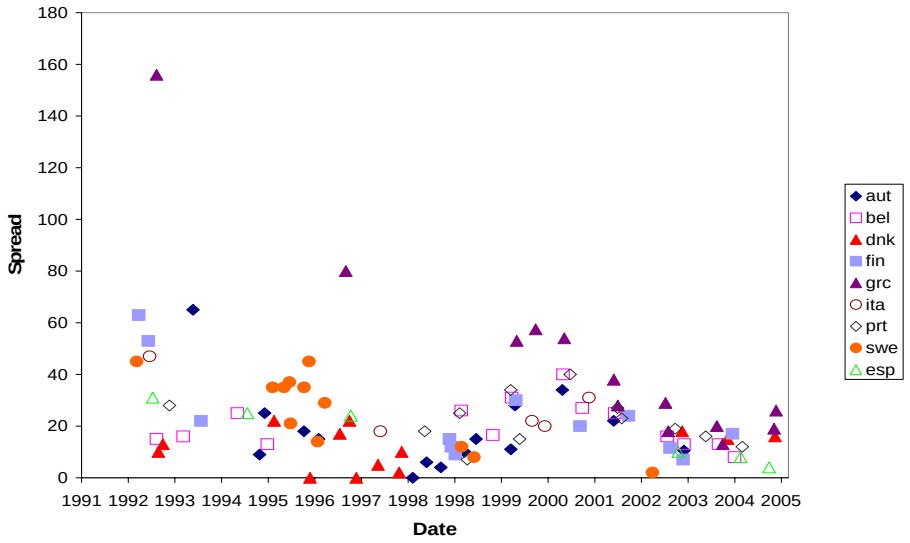

Figure A2: US$ Bond Yield Spreads between 1993-2005