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WORKING PAPER

Sovereign credit spreads and the composition of the government budget

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Abstract

This paper investigates the relationship between sovereign credit spreads and the composition of the government budget. To the extent that sovereign credit risk depends on …scal policy, a government may be able to lower the yield on its long-term debt by altering the balance between government consumption, government investment, social security expenditure and tax receipts. The key result of this paper is that governments that invest more and spend less on consumption have signi…cantly lower sovereign credit spreads. This …nding is in accordance with the endogenous growth theory which predicts a positive impact of government investment and a negative impact of government consumption on the long-term growth rate. While social security expenditure and subsidies are expected to have a relatively small e¤ect on long-term economic growth, they do appear to signi…cantly increase sovereign credit spreads. Finally, a broader tax base signi…cantly reduces sovereign credit spreads. A possible explanation may be that governments with more tax receipts are less likely to have liquidity problems to …nance their debt charges.

The credit risk model is estimated on a panel data set of 7 EMU-countries using a one-way and a two-way …xed and random e¤ects model.

JEL: C23, G15, H30

Keywords: Sovereign credit risk, Fiscal policy, Panel data

1 Introduction

While all EMU countries succeeded in reducing their de…cit-to-GDP ratio below the 3% ceiling imposed by the Maastricht Treaty, only three of them succeeded in bringing down their debt ratio below 60% at the launch of the Euro. In an attempt to reduce the debt ratio, most countries continue to tighten their …scal policies by reducing government spending and/or increasing tax receipts. The outcome of …scal consolidation, however, varies depending on factors such as the composition of the budget, the size of the consolidation and the international economic environment (e.g. Alesina and Perotti 1995b, 1996; Giavazzi and Pagano 1990; McDermott and Wescott 1996). From the mid-1990s onwards, yield spreads between EMU-countries remarkably converged to levels below 1%. Since the introduction of the Euro, cross-exchange rate risk has disappeared and in‡ation risk has become similar in every country in the Eurozone. Yield spreads between EMU countries, however, did not disappear. Credit risk and liquidity risk are probably the two main sources of remaining risks in the EMU government debt markets (Danthine et al. 2000). As a result, factors that determine the market's perception of governments' creditworthiness will become more important. Much of the traditional discussion of sovereign credit spreads centers on the budget de…cit as a likely determinant of credit risk, without making a distinction between (the components of) the expenditure and revenue side of the government balance. The central question in this paper is whether or not governments can in‡uence the credit spread on their long-term debt by altering the balance between government consumption, government investment, social security expenditure and subsidies and tax receipts.

Studies on sovereign credit risk mainly concentrate on market-based versus rules-based …scal discipline. The former relates to the fact that markets are assumed to restrain a policy of successive de…cits by imposing a risk premium as a compensation for increased sovereign credit risk. Eventually, governments will be denied access to credit markets and encounter credit rationing. Rules-based …scal discipline, which is echoed in the Maastricht Treaty and the Stability and Growth Pact, states that constraints are needed in order to discipline …scal policy-cy. For the US, Goldstein and Woglom (1991), Capeci (1994) and Bayoumi et al. (1995) …nd a signi…cant positive correlation between budget de…cit and/or government debt and sovereign credit spreads. Similarly, for the EU, Lemmen and Goodhart (1999) show that sovereign credit spreads are positively correlated with the government debt ratio. Hence, the extant literature appears to have established that government de…cit and public debt ratios are the main factors explaining the observed sovereign credit spreads. However, an issue that has received little or no attention is the link between the composition of the government budget and sovereign credit spreads.

In an attempt to balance their budgets, some EU countries mainly increased taxes whereas others mainly focused on the expenditure side. According to the endogenous growth theory, a change of the composition of public expenditure may a¤ect the steady-state growth rate of the economy. While Landau (1983, 1986), Kormendi and Meguire (1985), Grier and Tullock (1989) and Barro (1991) …nd a negative impact of government spending, excluding government investments and transfers, on economic growth, Aschauer (1989), Munnell and Cook (1990), Munnell (1992), Easterly and Rebelo (1993), Devarajan et al. (1996) and de la Fuente (1997) present evidence that government investment stimulates economic growth. From this point of view, it may be argued that reducing the government de…cit by mainly reducing government consumption instead of government investment, is perceived as more credible by the …nancial markets. As a result, sovereign credit spreads should be lower (Sachs and Cohen 1982; Edwards 1984, 1986a, 1986b). Looking at the revenue side, tax receipts may increase sovereign credit spreads because of their negative impact on the long-run growth rate (Koester and Kormendi 1989; Easterly and Rebelo 1993; Engen and Skinner 1996; Mendoza et al. 1997). However, governments with high tax receipts are less likely to have liquidity problems to …nance their debt charges, which may in turn reduce sovereign credit spreads (Lemmen and Goodhart 1999).

In order to analyze the empirical relationship between the composition of the government budget and sovereign credit spreads, we use a panel data set of 7 EMU-countries. Next to the traditional variables in a credit risk model, the estimation includes government investment, government consumption, social security expenditure and subsidies and tax receipts. The main result is that the composition of public expenditure has a signi…cant e¤ect on the observed credit risk spreads. More speci…cally, increased government investment, lower government consumption and lower social security expenditure and subsidies signi…cantly reduce sovereign credit spreads. Furthermore, the results show a signi…cant negative correlation between tax receipts and sovereign credit spreads. Hence, governments appear to be able to in‡uence sovereign credit spreads by in‡uencing the long-term sustainability of public …nances.

The organization of the paper is as follows. Section II gives a brief review of the existing literature on the relationship between sovereign credit spreads and …scal policy. Section III outlines a theoretical model to estimate sovereign credit spreads. Section IV identi…es the factors which are likely to a¤ect sovereign credit spreads. Section V gives a …rst impression of sovereign credit spreads, a description of the data and reports the results of the empirical analysis. The …nal section concludes.

2 Sovereign Credit Spreads and Fiscal Policy

Most studies on the e¤ect of market-based …scal discipline[1] versus rules-based …scal discipline concentrate on the US. While there are no federally imposed

[1] Advocates of this view state that market-based …scal discipline will work only if certain conditions are satis…ed (Goldstein and Woglom 1991). (i) Capital must move freely. (ii) Full

borrowing limits, many US states impose their own limitations on borrowing. This creates an ideal sample to test for market-based …scal discipline while leaving some scope to gauge the in‡uence of a variety of self-imposed …scal rules on borrowing costs. Goldstein and Woglom (1991) use a data set of 41 US states and conclude that states which follow a more prudent …scal policy are perceived by the …nancial markets as having lower credit risk and are therefore able to reap the bene…ts of lower borrowing costs. A more prudent …scal policy implies a lower stock of debt, a lower trend growth rate of debt relative to income and relatively stringent (albeit voluntarily imposed) constitutional limitations on de…cit-spending. They …nd that states with …scal-policy characteristics that are one standard deviation "looser" than the mean of the sample pay roughly 15-20 basis points more on their general obligation bonds than states with …scal policy characteristics one standard deviation "tighter" than the sample mean. A study of Capeci (1994), using a sample of New Jersey municipalities, concludes that even after controlling for the independent e¤ect of credit ratings, a local government's borrowing rate is positively related to the size of its debt burden, both the stock of outstanding debt and the size of its current-year bond issuance. Quantitatively, the results suggest that a one standard deviation rise in the debt burden is associated with an increase in the borrowing rate of approximately 66 basis points. Furthermore, higher debt service payments and less local aid receipts signi…cantly reduce the borrowing rate. This …nding is consistent with Robbins' model (1984) of debt service repayments as a signal of ability to repay in the future. Alternatively, high levels of aid receipts could signal an inability to repay. Bayoumi et al. (1995) …nd a non-linear relationship between the government debt ratio and the spread on twenty-year bonds of US states, relative to the yield on a comparable New Jersey twenty-year state bond. At the mean values of the sample, each percentage point increase in relative debt raises the promised yield by 23 basis points. A relative debt level one standard deviation above the mean of the sample increases the promised yield with more than 35 basis points. They also …nd that state legislative controls are consistently signi…cant, which supports their usefulness in controlling default.

Only few studies have analyzed the relationship between sovereign credit spreads and national …scal policy on a European data set. Lemmen and Goodhart (1999) …nd a signi…cant positive correlation between the …rst di¤erenced government debt ratio and sovereign credit spreads (measured as the yield on a 10-year government bond over the yield on a 10-year swap contract) in a sample of 13 EU countries. However, in the case of the EU, this relationship may be the result of a combination of market-based …scal discipline and/or the constraints imposed by the Maastricht Treaty. The authors also …nd that a higher taxation capacity signi…cantly reduces sovereign credit spreads. Alesina et al.

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information must be available on the sovereign borrower. (iii) Markets must be convinced that there are no explicit or implicit guarantees that other countries will bail out in the case of default and that a country's debt will not be monetized. A higher bailout probability will lower the size of sovereign credit risk premia. (iv) The …nancial system should be strong enough to withstand the failure of a "large" borrower.

(1992) …nd that the di¤erence between public and private bond returns is positively related to public debt outstanding and to debt growth in highly indebted OECD countries[2]. In countries with a stable and sustainable public debt ratio, this relationship does not appear. In a panel data set of 49 countries rated by Moody's and Standard and Poor's, Cantor and Packer (1996) …nd a signi…cant positive correlation between foreign currency debt and sovereign credit spreads. However, including the e¤ect of ratings renders the e¤ect of foreign currency debt insigni…cant.

Although most studies …nd a positive correlation between sovereign credit spreads and government debt ratios, market-based …scal discipline is often questioned on various grounds in the case of EU/EMU (Alesina and Tabellini 1990; Emerson et al. 1992; Lane 1993). First, although the Maastricht Treaty explicitly prohibits bailouts, …nancial markets may regard this provision as less than fully credible. Forcing an indebted country into default may threaten the …nancial stability of the entire Eurozone. As a result, a bailout cannot be excluded. Second, the track record of markets in assessing government credit risk is disputed. Although some research …nds evidence in favor of market-based …scal discipline, the case of the Latin American debt crisis of 1979-81, the developing country debt crisis of 1982, the Mexican crisis of 1994-95, the Asian crisis of 1997-98, the Russian crisis of 1998 and the Brazilian crisis of 1999 exempli…es the weakness of pure market discipline[3]. Underpricing of sovereign credit risk may induce governments to follow a policy of excessive de…cits. Third, fractionalization and polarization of governments, distributional con‡icts over the allocation of resources, the intertemporal nature of …scal decisions, etc. can make budgetary policy less sensitive to increasing interest rates (e.g. Alesina and Perotti 1995a; Persson and Tabellini 1999).

In assessing the presence of market-based versus rules-based …scal discipline, the experience of the US is often taken as a guidance for EMU. However, a given government debt ratio may not generate the same credit risk premium in Europe as in the US, since there are important structural and institutional di¤erences. Eichengreen (1990) argues that government debt ratios are much higher in Europe than in the US. Also, the size of the federal …scal authority is much larger in the US than in Europe. Hence, European national …scal authorities ful…ll the role of the US federal …scal authority because they have full access to their residents' income. Finally, labor mobility is much higher in the US than in Europe. This should make it easier for Americans to discipline local authorities with higher spending by ‡eeing states where higher taxes are not o¤set by providing more public goods.

[2] The authors use a panel data set of 8 EU countries, Australia, Canada, Japan and US.

[3] One could, however, argue that this may be due to violations of the conditions which are required for market discipline to work e¤ectively or by inadequate reactions of the borrowers.

3 Modeling Sovereign Credit Risk

In the case of government bonds, sovereign credit risk involves two major sources of risk: (1) default risk and (2) recovery risk. Default risk refers to the probability that a country is unable or unwilling to pay its interest charges or principal amounts (timely). Although default may seem beneficial to governments because it replaces a range of distortionary taxes, it may provoke very high costs (Alesina et al. 1992). Defaulting governments will lose reputation and may be denied access to the private capital market. If financial institutions hold large amounts of government debt, default may also cause financial instability and bankruptcies in the financial sector. Finally, default may cause income redistribution. The experience of European fiscal policy over the last three decades shows that the costs of default are strong enough to make default an exceptional situation. However, EU countries have different sovereign ratings and financial markets still attach a risk premium to the associated default risk. Recovery risk relates to the uncertainty about the amount the bond holders will recover in the event of default. This will mainly depend on the probability of a public bailout and/or central bank intervention.

As in Favero et al. (1997), the credit risk model starts by assuming that the covered interest rate parity condition (CIP) describes the link between yields on government bonds issued by different countries. CIP has been investigated in an extensive literature and the empirical results often reject the CIP hypothesis. However, most authors try to rationalize observed deviations by including factors such as default risk (e.g. Stoll 1972; Adler and Dumas 1976), taxation (e.g. Levi 1977), capital market imperfections (e.g. Frenkel 1973) and transaction costs (e.g. Frenkel and Levich 1977, 1981). Levi (1990) highlights that deviations from CIP may occur due to transaction costs, political risk, potential tax advantages and liquidity preferences. Contrary to most studies evaluating interest disparities, this paper uses long-term financial assets. Popper (1993), however, concludes that deviations from long-term interest parity are slightly greater than the deviations measured among short-term assets but that the differences are small. In this paper, the model is explicitly adjusted for credit risk and taxation. Despite the liberalization of capital markets across the EU, technical and administrative features of bond markets still differ across countries (Danthine et al. 2000). As a result, yield spreads are decomposed into four main components : (1) a credit risk component, (2) an exchange rate component, (3) a tax component, and (4) a technical component.

Consider the covered interest rate parity between two default-free assets:

$$(1 + is_{j,t}) = (1 + is_{k,t}) \left(\frac{F_{t+m}}{S_t} \right)^{1/m} \tag{1}$$

$is_{j,t}$ and $is_{k,t}$ are the annualized interest rates on identical default-free assets issued at time t (maturing at time $t + m$) in country j (k) and denominated in currency j (k). S_t refers to the spot exchange rate at time t, which is measured as the price of currency k in units of currency j. F_{t+m} refers to the forward value of the spot exchange rate S for a contract expiring at time t + m.

Taking the natural logarithm of the above equation[4] gives:

$$is_{j,t} - is_{k,t} = \frac{1}{m}\left[f_{t+m} - s_t\right] \qquad (2)$$

The logarithm of F and S are indicated with lower-case letters (f and s). Equation (2) is the logarithmic transformation of the CIP condition which states that the expected return from investing abroad at time t and repatriating this money at time t+m will equal the expected return from investing in a similar financial asset at home. The CIP requires free capital movement (i.e. no political barriers nor transaction costs) and absence of country risk (i.e. assets are default free and there is no threat of future capital controls).

Introducing credit risk and assuming risk neutral creditors, the covered interest rate parity condition becomes

$$[1 - p_j(x_j, x_c)](1 + i_{j,t}) + p_j(x_j, x_c)(1 - \alpha_j)(1 + i_{j,t}) =$$
$$[1 - p_k(x_k, x_c)](1 + i_{k,t})\left(\frac{F_{t+m}}{S_t}\right)^{1/m} + p_k(x_k, x_c)(1 - \alpha_k)(1 + i_{k,t})\left(\frac{F_{t+m}}{S_t}\right)^{1/m} \qquad (3)$$

where $i_{j,t}$ and $i_{k,t}$ are the annualized interest rates on a government bond issued at time t (maturing at time t + m) in country j (k) and denominated in currency j (k). Let p_j (p_k) represent the time-independent probability of default in country j (k). The determinants of the probability of default can be decomposed into an idiosyncratic component, x_j, respectively x_k, which is unique to the country analyzed and a systematic component, x_c, which is shared by all countries. ($1-\alpha_j$), respectively ($1-\alpha_k$) can be seen as the (partial) recovery rate in the case of default of country j, respectively country k. After some rearrangement equation (3) can be written as

$$(1 + i_{j,t})[1 - \alpha_j p_j(x_j, x_c)] = (1 + i_{k,t})[1 - \alpha_k p_k(x_k, x_c)]\left(\frac{F_{t+m}}{S_t}\right)^{1/m} \qquad (4)$$

Suppose that cr_t is a measure of the incidence of default at time t for a government bond (time to maturity m), which takes account of the cost to the creditor in the case of default [Favero et al. (1997)]:

$$cr_{i,t} = \frac{\alpha_i p(x_i, x_c)}{1 - \alpha_i p(x_i, x_c)} \qquad i = j, k \qquad (5)$$

[4] Note that $\ln(1 + x) \approx x$ for small values of x.

cr will be zero when $p()$ is zero and will become infinity when both α and $p()$ are one. Substituting the measure of the incidence of default in equation (4) and taking the natural logarithm[^5], the yield spread can be decomposed into two components: (1) the expected exchange rate change and (2) the credit spread between country j and country k.

$$i_{j;t} - i_{k;t} = cr_{j;t} - cr_{k;t} + \frac{1}{m}[f_{t+m} - s_t] \tag{6}$$

In a next step, the taxation system is introduced. Taxing interest income and capital gains may also explain deviations from CIP. To evaluate the effect of taxes, consider assets with a time to maturity one ($m = 1$). Let the tax rate on interest income and foreign exchange (capital) gains in country j (respectively country k) be τ_j^y and τ_j^c (respectively τ_k^y and τ_k^c). In the case of no default risk, the return from an asset issued in country j and denominated in currency j will be reduced to $1 + i_j(1 - \tau_j^y)$. The return from an asset issued in country k and denominated in currency k can be expressed as the sum of interest income and foreign exchange rate gains (losses).

$$(1 + i_{k;t})\left(\frac{F_{t+1}}{S_t}\right) = (1 + i_{k;t}) + (1 + i_{k;t})\left(\frac{F_{t+1} - S_t}{S_t}\right) \tag{7}$$

In the presence of taxes on interest income and foreign exchange gains, the return on this investment for an investor in country j becomes:

$$1 + i_{k;t}(1 - \tau_j^y) + \left(1 - \tau_j^c\right)(1 + i_{k;t})\left(\frac{F_{t+1} - S_t}{S_t}\right) \tag{8}$$

In a two-country context with highly substitutable assets (time to maturity one), international portfolio equilibrium adjusted for the effect of taxes and credit risk is specified as:

$$\left[1 + i_{j;t}\left(1 - \tau_j^y\right)\right][1 - \alpha_j p_j(x_j; x_c)] = [1 - \alpha_k p_k(x_k; x_c)]\left[1 + i_{k;t}\left(1 - \tau_j^y\right) + \left(1 - \tau_j^c\right)(1 + i_{k;t})\left(\frac{F_{t+1} - S_t}{S_t}\right)\right] \tag{9}$$

It becomes even more complicated if a country imposes a withholding tax on non-residents. In that case, the investor is liable to double taxation, which may further affect the yield spread. To avoid this problem, government bonds held by non-residents are exempt from withholding tax in all European countries except Italy[6] and Belgium[7]. However, if the withholding tax is reimbursable to

[^5]: It is assumed that cr is small enough for $\ln(1 + cr) \approx cr$ to hold. In a sample of EMU countries, where α and especially p are likely to be small, this is a reasonable assumption.

[6] Before 1 January 1997, Italy subjected all interest payments to a withholding tax of 12.5%. The non-resident withholding tax was reimbursable to non-residents established in countries with which Italy has a bilateral tax treaty. From 1 January 1997 the withholding tax has been abolished for all non-residents.

[7] Belgium removed its withholding tax to foreigners in June 1994.

foreigners and the creditors believe that they will be paid, the total yield spread should not be influenced by this tax (Favero et al. 1997).

Finally, the yield spread should be adjusted for differences in transaction and administration costs, trading rules, issuing and selling techniques between country j and country k, as well as differences in regulatory and market conventions between the government bond market and the swap market. η represents these differences and is called the technical component. As a result, the sovereign credit spread of a country j compared to country k, $[cr_{j;t} - cr_{k;t}]$, can be estimated as the yield spread between country j and country k, $[i_{j;t} - i_{k;t}]$, minus the exchange rate risk component, $[ExR_t]$, the tax component, $[TAX]$, and the technical component η. While $[i_{j;t} - i_{k;t}]$ and ExR_t are assumed to be a function of time, TAX and η are assumed to be constant through time.

$$cr_{j;t} - cr_{k;t} = (i_{j;t} - i_{k;t}) - ExR_t - TAX - \eta \tag{10}$$

As is the case for most conventional measures of default risk, this measure is not able to distinguish between credit and liquidity risk. Since markets may attach a higher/lower liquidity risk to the bond market in country j compared to country k, the yield spread may be influenced. In addition, differences in liquidity risk between the bond market and the swap market, may also affect the measure of sovereign credit risk. Keeping this caveat in mind, the results should be interpreted with caution.

Once credit risk spreads are introduced, assumptions about the functional form of the probability of default and the loss rate in the case of default have to be made. For simplicity, it is assumed that in the case of default, the borrower repays nothing ($\alpha = 1$). In accordance with Edwards (1986a) and Bayoumi et al. (1995), the following functional form of the probability of default in country j is used

$$p_j(x_j; x_c) = 1 - \exp\left(-\sum_{i=1}^{s_j} \beta_j^i x_{j;t}^i - \sum_{i=1}^{s_c} \beta_c^i x_{c;t}^i\right) \tag{11}$$

with s_j the number of country-j-specific determinants of the probability of default and s_c the number of common determinants of the probability of default in country j and country k. The same functional form of the probability of default is introduced for country k. Substituting the probability of default into equation (5), the sovereign credit spread between a country j and a country k can be written as

$$cr_{j;t} - cr_{k;t} = \sum_{i=1}^{s_j} \beta_j^i x_{j;t}^i - \sum_{i=1}^{s_k} \beta_k^i x_{k;t}^i \tag{12}$$

The systematic component which affects the yield spread in the same way, drops out because differences between yields are used. Hence, only the idiosyncratic component remains. If government bonds issued in country k are default free $p_k(x_k; x_c) = 0$, the term $x_k'\beta_k$ becomes zero and the credit spread on government bonds issued by country j and denominated in currency j can be written as a function of country-j-specific determinants of the probability of default.

4 Determinants of Credit Risk

4.1 Public Debt

According to the market-based fiscal discipline hypothesis, yields rise smoothly with the level of borrowing when sovereign debt stays below a 'critical value'. Once sovereign debt exceeds this 'critical level', credit spreads go up at an increasing rate until the offending country is denied access to credit markets. In line with Goldstein and Woglom (1991) and Lemmen (1999), this paper assumes that the non-linearity between government debt and sovereign credit spreads can be approximated by a quadratic function in the debt ratios. To allow for the possibility that public debt (excluding debt interest charges) and debt interest charges affect sovereign credit spreads differently, both are included in the analysis (Capeci 1994).

4.2 The Composition of the Government Budget

The main hypothesis in this paper is that the components of the government budget have an identifiable effect on sovereign credit spreads. Barro (1990), Barro and Sala-i-Martin (1992, 1995) and Mendoza et al. (1997) have developed public-policy endogenous growth models in which the composition of public expenditure affects both the level of output and its long-run growth rate. The temporary growth effects of fiscal policy implied by the neoclassical models are transformed into permanent growth effects in the endogenous growth models. Typically this is done by introducing government expenditure as an argument in the production function. In a pioneering study of Barro (1990), it is assumed that all government spending is productive. Meanwhile, empirical studies on the link between government expenditure and long-run growth have highlighted the differentiation of government expenditure according to whether they are included in the production function or not. If they are, they are classified as productive and have a direct effect on the long-term growth rate. Kneller et al. (1999) use a panel of 22 OECD countries and find that productive government expenditures enhance growth, whilst non-productive expenditures do not. Although the existing literature on the growth effects of fiscal policy is far from conclusive, probably the most robust finding is the negative partial correlation between government consumption and output growth (e.g. Landau 1983, 1986; Kormendi and Meguire 1985; Grier and Tullock 1989; Barro 1991; de la Fuente

1997; Fölster and Henrekson 2001)[8]. A possible explanation for this negative correlation may be that government consumption reduces private savings because economic agents consider the former as a less-than-perfect substitute for private consumption.

As to government investment, Aschauer (1989), Munnell and Cook (1990), Easterly and Rebelo (1993), Evans and Karras (1994) among others support the idea that investment supports long-run growth. Levine and Renelt (1992), however, conclude that the growth e¤ects of government investment are not robust. Devarajan et al. (1996) show that expenditures which are normally considered productive, such as government investments, may become unproductive if there is an excessive amount of them. de la Fuente (1997) also …nds that, although public investment has a positive impact on productivity growth, it is subject to sharply diminishing returns.

Results concerning the e¤ect of social security expenditures and subsidies on economic growth are inconclusive and typically point to small growth e¤ects. Landau (1985) shows that the net growth e¤ect of transfers (as a percentage of GDP) is slightly positive and signi…cant. However, including private investment and total government expenditure in the analysis renders the e¤ect insigni…cant. Barro (1991) shows that this may be due to endogeneity of the share of transfers. The results of de la Fuente (1997) show that subsidies have a positive, although not signi…cant, e¤ect on economic growth. The sign and magnitude of the coe¢cient of transfers is very sensitive to the model speci…cations, more speci…cally, the inclusion of other budgetary policy variables. In most of the regressions the e¤ect of transfers is not signi…cant. Kneller et al. (1999) report a positive, however not signi…cant, correlation between economic growth and non-productive government expenditures of which social security expenditure is the major component.

Fiscal policy variables that a¤ect the steady-state growth rate may in turn a¤ect governments' credibility and hence sovereign credit spreads. In accordance with the endogenous growth models, government investment is expected to decrease sovereign credit spreads because it captures a country's perspectives for future growth. Government consumption, on the other hand, is expected to increase sovereign credit spreads. The e¤ect of social security expenditure and subsidies is uncertain. An empirical analysis of developing countries by Edwards (1984, 1986a, 1986b) and Sachs and Cohen (1982) shows that a higher investment-to-GDP ratio is associated with lower sovereign credit spreads. Edwards (1984) …nds a negative but not signi…cant correlation between total government expenditure and sovereign credit spreads.

At the revenue side, most growth models predict that increases of taxes on investment and income are growth reducing. These taxes discourage private in-

[8] Ram (1986), however, …nds a positive correlation between government consumption and economic growth. Dowrick (1996) argues that this …nding could be attributed to endogeneity. The author shows that the positive correlation disappears when the model is estimated using instrumental variables techniques.

vestment by reducing the private returns to capital accumulation. The growth e¤ect of consumption taxes depends on the elasticity of labor supply. If labor supply is exogenous, the level of consumption taxes leaves the growth rate unaffected. Contrary to the theoretical predictions, the empirical evidence is fragile. Growth e¤ects of di¤erent types of taxes are often small and/or sensitive to various speci…cations, particularly with respect to the list of nontax variables included in the analysis (e.g. Koester and Kormendi 1989; Easterly and Rebelo 1993; Engen and Skinner 1996; de la Fuente 1997; Mendoza et al. 1997). Engen and Skinner (1996), however, conclude that even small growth e¤ects can have a large cumulative impact on living standards. Kneller et al. (1999) …nd that distortionary taxation signi…cantly reduces growth whereas non-distortionary taxation do not have a signi…cant e¤ect. From this point of view, more tax receipts may increase sovereign credit spreads by reducing the long-term growth rate. On the other hand, the higher tax receipts, the less likely that a government will have liquidity problems to …nance its interest charges and principal amount of debt and the lower a governments' default probability. From this point of view, tax receipts may be negatively correlated with sovereign credit spreads (e.g. Lemmen and Goodhart 1999).

4.3 Other Determinants

To take account of business cycle conditions, the model includes real GDP growth. It is expected that real GDP growth and sovereign credit spreads are negatively correlated. When the economy is expanding, the government's creditworthiness will improve because a higher output growth will lower the debt burden and improve the cyclical component of the primary balance. Alesina et al. (1992) …nd a signi…cant negative correlation between the growth rate of industrial production and the interest di¤erential between public and private debt. Bayoumi et al. (1995) …nd a positive correlation between the unemployment rate and the credit spreads on US state debt. Another variable that may e¤ect sovereign credit spreads is in‡ation. Cantor and Packer (1996) state that a high rate of in‡ation points to structural problems in the government's …nances. The authors …nd a signi…cant negative correlation between in‡ation and sovereign credit ratings. The correlation between in‡ation and sovereign credit spreads is, however, not signi…cant. Lemmen and Goodhart (1999) …nd a negative correlation between in‡ation and sovereign credit spreads and a positive correlation between in‡ation variability and sovereign credit spreads. The current account balance gives an indication of the change in the external debt position of a country. A persistent negative current account implies that private domestic investment is persistently being …nanced with capital in‡ows. It is generally expected that in this case the perceived probability of default is higher. Studies of Edwards (1986a) and Cantor and Packer (1996) …nd a positive, however not signi…cant, correlation between the current account de…cit and sovereign credit spreads.

5 Empirical framework

5.1 Measuring Sovereign Credit Spreads

Ideally, sovereign credit spreads should be measured directly by comparing yields of identical assets denominated in the same currency but issued by di¤erent countries or institutions. Since there is no exchange rate risk within the US states, Goldstein and Woglom (1991), Bayoumi et al.(1995) used the yield differential between similar municipal bonds as a measure of sovereign credit risk. In the context of European countries, one alternative would be to use euro-denominated issues of government bonds (or ECU-denominated bonds before the start of EMU in 1999). However, the liquidity of euro (or ECU) issues of government debt is much lower than that of conventional government bond markets, which may a¤ect observed credit spreads. Giovannini and Piga (1994) use the yield di¤erential between a government bond and a similar bond denominated in the same currency but issued by a supranational institution, such as the World Bank. However, the secondary market for bonds issued by supranational institutions is often illiquid, and for some currencies even non-existent. Moreover, as mentioned by Favero et al. (1997), issues in individual currencies by supranational institutions have the disadvantage of being intermittent. Alesina et al. (1992) compared yields on public and private debt, issued in the same currency in 12 OECD countries, to capture sovereign credit risk. However, this variable is to a large extent a measure of corporate credit risk, which may be far more volatile than government credit risk. In addition, it may be di¢cult to …nd more or less identical government and corporate bonds.

In accordance with Tosato (1996), Seghelini (1996), Favero et al. (1997) and D'Amato and Pistoresi (1999), this paper identi…es the exchange rate component in European government bond yield spreads and subtracts it from the total yield spread in order to obtain the sovereign credit spreads. The exchange rate component is measured as the spread between the o¤er rate on the …xed income side of 10-year swap contracts with the same maturity. The principal amount of a swap contract is not exchanged in a transaction, which means that no credit risk arises with respect to the amount of the principal advanced by a lender to a borrower. The swap rate (…xed interest rate) of a particular currency is quoted for equally rated customers in the di¤erent currencies. Thus, the credit risk incorporated in the swap rate should be similar across currencies and maturities. Further, swap markets are very liquid, and contracts, including tax treatment, are standardized across currencies (Söderlind and Svensson 1997)[9].

[9] However, using swap rates may entail a few problems. (1) The swap rate is usually a counterpayment to the LIBOR, which will be a¤ected by outright government default. This may be re‡ected in the swap rate and thus may not cancel out when swap rate di¤erentials are used. However, in the case of rescheduling, partial consolidation or delays in payments of interest rates, the LIBOR rate is likely to be much less a¤ected (Favero et al. 1997). Since outright default is not very likely in Europe, this problem is only of minor importance. (2) The swap rate di¤erentials may be a¤ected by …nancial di¢culties in the banking sector of one country, which may in turn a¤ect the swap spread.

Spot rates on 10-year government benchmark bonds are used to calculate the total yield spreads between EMU countries. Using spot rates, which is equivalent to the rate on a zero-coupon bond, instead of redemption yields has the advantage that (1) it eliminates the coupon effect, which refers to the phenomenon observed in markets that the yield to maturity of bonds with the same maturity but different coupons may vary considerably, (2) it does not involve any assumptions on the reinvestment rate applicable to any intermediate cash flows and (3) every maturity is identified with a unique interest rate (Svensson 1994). Since few pure discount bonds beyond maturities of one year exist, spot rates are not directly observable. They are calculated using a bootstrapping method whereby the 10-year spot rates are determined from the available redemption yields of shorter maturities. One-year rates on Euro-deposits and redemption yields on 2, 3, 5, 7 and 10 year maturity government bonds are used to bootstrap the spot rates. It is assumed that the one-year rate on Euro-deposits, which are one-year zero-coupon instruments, is equal to the one-year spot rate. The spot rate i_2 on a two-year government bond with a face value of 100 is calculated according to the following equation:

$$c_2 \exp(-r_2) + (100 + c_2)\exp(-2r_2) = c_2 \exp(-i_1) + (100 + c_2)\exp(-2i_2) \quad (13)$$

where c represents the coupon rate and r the continuously compounded yield to maturity. Given i_1; r_1 and c_2, the spot rate on a 2-year government bond can be calculated. This procedure is repeated for each subsequent maturity until spot rates on 10-year government bond are obtained for each country[10]. The same calculations are performed to obtain the spot rates on 10-year swap contracts.

Finally, based on equation (10), a clean sovereign yield spread is obtained, not only by eliminating the exchange rate component from the total yield differential, but also by subtracting the tax component and the technical component. However, in our sample of EMU countries, the impact of the taxation systems on realized interest income has remained fairly constant over the sample period (Battley 1997). A similar observation holds for the technical aspects of trading and settlement (see Danthine et al. 1999). Consequently, if the tax and the technical factors can be assumed constant over the sample period, their effect will be captured by the fixed effects in the estimation model.

5.2 Data

The analysis includes 7 EMU-countries: Belgium, Finland, France, Germany, Italy, Netherlands and Spain. Redemption yields and swap yields are downloaded from Datastream on a daily basis. Table 4 in appendix A presents the sample period covered by the yield data. Panel A of table 1 presents the mean

[10] In the case of Italy, the bootstrapping method is adjusted because coupons are paid on a semi-annual basis.

and standard deviation of the yield spreads and sovereign credit spreads compared to German bunds, as well as the sovereign ratings on long-term debt. Although sovereign credit spreads are relatively small, they can vary substantially over time. 'High yielders' such as Spain and Finland do not have substantially higher sovereign credit spreads than the Netherlands, Belgium and France. Credit spreads on Italian government bonds, on the other hand, are much higher. At the end of the 1990's, Italian credit spreads converged to levels below 40bp.

Table 1: Summary statistics of yield spreads and credit spreads and sovereign ratings

	Yield Spread[1]		Credit Spread[1]		Sovereign ratings[2]	
	mean	st.dev.	mean	st.dev.	S&P	Moody's
Panel A: Spreads compared to Germany						
France	63	66	-5	19	AAA	Aaa
Netherlands	12	23	2	13	AAA	Aaa
Belgium	60	34	23	10	AA+	Aa1
Finland	184	147	15	27	AA+	Aaa ("")
Spain	240	161	16	15	AA+	Aa2
Italy	365	216	91	61	AA	Aa3 ("")
Panel B: Spreads compared to France						
Germany	-63	66	5	19	AAA	Aaa
Netherlands	-52	56	7	22	AAA	Aaa
Belgium	26	28	25	19	AA+	Aa1
Finland	152	119	14	32	AA+	Aaa ("")
Spain	217	139	12	13	AA+	Aa2
Italy	334	189	90	70	AA	Aa3 ("")

Note: [1] The mean and standard deviation are given in basis points. [2] For S&P, the ratings for participating EMU-countries are foreign currency ratings as of May 6, 1998, except for Spain (upgraded on 31/3/'99) and Finland (upgraded on 1/9/'99). For Moody's, the ratings for participating EMU-countries are identical for all types of debt. " represents an upgrading of sovereign rating.

Until May 1998, sovereign credit spreads represented only a minor part of yield spreads, suggesting that the market worried more about currency risk than about credit risk. However, in Belgium and Italy, the average credit spread represented one third, respectively one fourth of the average yield spread. The mean of the credit spreads varied between -5 basis points in the case of France to +91 basis points in the case of Italy. On average, French government bonds seem to have a lower default probability then German bunds during the sample period. Therefore, panel B of table 1 presents the mean and standard deviation of the yield spreads and credit spreads compared to French government bonds. While yield spreads on German and Dutch government bonds are negative, average credit spreads are positive. Credit spreads on Belgian, Finnish, Spanish and

Italian government bonds compared to German and French government bonds are broadly similar. Higher-rated EMU-countries (AAA) seem to have lower credit spreads than lower-rated EMU countries (AA). From the mid 1990's, Moody's has upgraded sovereign rating on foreign currency debt of Finland and Italy. The convergence of sovereign credit spreads during the second half of the 1990's coincided with a convergence of sovereign debt ratings towards the highest level. Financial markets seem to have interpreted the formation of the EMU as an upgrading of the creditworthiness of the member countries, especially the high yielders.

Table 5 in appendix A shows the summary statistics of the dependent and explanatory variables in the analysis. All data used are obtained from Datastream or the OECD[11]. Debt interest payments (DINTCH), government debt exclusive debt interest payments (DEBT) and squared debt excluding interest payments ($DEBT^2$) are divided by trend GDP. DEBT and $DEBT^2$are lagged 12 months, thus excluding the government budget for the current year. To avoid simultaneity between the sovereign credit spread and debt interest payments, DINTCH is instrumented by its previous month's values[12].

In order to test the hypothesis that the level of a country's credit spread is a¤ected by the way in which the borrowed funds are spent, we shall in our empirical analysis split total government expenditure into its four main components: government investment, government consumption, social security expenditure and subsidies and other expenditures. To avoid perfect collinearity, one of the expenditure components should be excluded from the regression. However, this may a¤ect the estimated coe¢cients of the other expenditure components (see Kneller et al. 1999). The estimated coe¢cients will give the e¤ect of a unit change in the relevant variable minus the e¤ect of a unit change in the omitted variable. Choosing another expenditure component to be omitted from the regression will alter the estimated coe¢cients. In order to minimize the error, the model should exclude an expenditure component from which the theory suggests a zero coe¢cient. In accordance with the theoretical and empirical results of the endogenous growth models, the other expenditures component is assumed to have zero impact on sovereign credit spreads and is therefore excluded from the regressions. Government investment (GINV), government consumption (GCONS) and cyclically adjusted social security expenditure and subsidies (GSOC) are divided by cyclically adjusted government expenditures excluding interest payments. Government tax receipts, cyclically adjusted (TAX) and the current account balance (CA) are both divided by trend GDP. The analysis includes monthly changes of the logarithm of the (real) industrial production (GROW) to take account of cyclical in‡uences. In‡ation is measured as the change of the logarithm of the consumer price index (INFL).

[11] See appendix B for more details. All data not available on a monthly basis are obtained via intrapolation. The model is estimated using the intrapolated data. In a next step, the model is reestimated assuming that the data are constant during 12 months.

[12] The …rst lag is prior year's value [x(-12), x(-13),...]. The optimal number of lags is determined by the Akaike Information criterium.

Before running the regressions, it is important that the model balances with respect to the order of integration, which means that the dependent variable has the same order of integration as the explanatory variables (individually or collectively). Hence, each variable is tested for the presence of a unit root according to the Panel Augmented Dicky Fuller test proposed by Im, Peseran and Shin (1996)[13].

Table 2: Panel data unit root tests according to Im, Peseran and Shin (1996)

	Stand. t-bar statistic			Stand. t-bar statistic	
	(1)	(2)		(1)	(2)
$CRED^{ger}$	-2.63***		GSOC	-0.06	-2.19**
$CRED^{fra}$	-2.156*		TAX	-0.69	-2.81***
DEBT	0.47	-2.05**	GROW	-10.70***	
DINTCH	-2.17**		INFL	-2.04**	
GINV	1.90	-2.59**	CA	-2.90***	
GCONS	0.99	-2.44**			

Note: The means and the variances used to calculate the standardized t-bar statistic are computed via stochastic simulations with 50 000 replications (see Im, Peseran and Shin (1996) for more details). * rejection of unit root at 10% level. ** rejection of unit root at 5% level. *** rejection of unit root at 1% level.

The first column of table 2 shows that during the sample period (1987-1999), the null hypothesis of a unit root can be rejected at the 5% level in the case of $CRED^{ger}$, $CRED^{fra}$, DINTCH, GROW and INFL. For the other variables, the null hypothesis cannot be rejected. Since this may be caused by a small sample problem, the second column reports the Panel Augmented Dicky Fuller test for these variables over the period 1978-1999. In that case, the null hypothesis of a unit root can also be rejected at the 5% level or better for DEBT, GINV, GCONS, GSOC and TAX. As a result, the analysis includes the variables without first differencing.

5.3 Specification and Estimation Results

The sovereign credit risk model is estimated for an unbalanced panel data set of 7 countries using a one-way (country dummies) and a two-way (country and time dummies) fixed or random effects model. Assuming that the benchmark (German or French government bond yield) is default free, the credit spread in country i at time t can be written as follows

$$cr_{it} = \alpha + x_{it}'\beta + u_{it} \qquad \text{with} \quad \begin{array}{l} u_{it} = \mu_i + \lambda_t + \nu_{it} \\ i = 1, \ldots, N \\ t = 1, \ldots, T \end{array} \tag{14}$$

[13] See appendix A for more details.

i represents the cross-section dimension and t the time-series dimension. x_i refers to the determinants of the default probability of government bonds in country i. μ_i denotes the unobserved individual effect, which is time-invariant and controls for country-specific omitted variables. If $\mu_i^{\prime}$s are assumed to be fixed unknown parameters, the model is referred to as a fixed effects model, which has the advantage that it does not impose any restrictions on the relation between explanatory variables and the fixed effects. If $\mu_i^{\prime}$s are assumed to be random, i.e. drawn from a distribution with mean zero and a variance σ_1^2, the model is referred to as a random effects model. In that case, the $\mu_i^{\prime}$s should be uncorrelated with the explanatory variables. λ_t denotes the unobservable time effect, which is county-invariant and accounts for any time-specific effect. In this paper, the $\lambda_t^{\prime}$s are assumed to be fixed parameters. Further, it is assumed that the explanatory variables influence the sovereign credit spreads in a similar way, i.e. the reaction coefficients are the same for all countries.

The estimation results in which German bunds are treated as the benchmark are reported in panel A of table 3. Since the residuals of the regressions show evidence of heteroskedasticity, all standard errors and associated t-statistics are computed using White's method. The Hausman test, which is reported at the bottom of table 3, compares the β_{Fixed} (fixed effect estimates) and the β_{GLS} (random effects estimates[14]). Both estimators are consistent under $H_0 : E\{u_{it}|x_{it}\} = 0$. If however, the individual effects are correlated with one or more explanatory variables, the fixed effects model is the only consistent one. Since the Hausman test statistic is asymptotically distributed as χ^2 with degrees of freedom equal to the number of estimated slope coefficients, the null hypothesis is rejected in regressions (1) to (4) at the one percent level. As a result, panel A of table 3 only reports the fixed effect estimates. In these regressions, the F-test on the absence of fixed effects[15] is rejected. The fixed effects reflect unquantified factors such as differences in taxation system between EMU-countries, the technical component of the total yield spread (see equation (10)), the composition of debt, a range of political economy considerations, factors that determine the recovery rate in the case of default and others that affect the credit spread and which are assumed to be constant through time.

The results in table 3 indicate that the coefficients of the components of the expenditure side of the government budget have the expected sign and are significant at the one percent level. More government investment and less government consumption significantly reduce sovereign credit spreads. The coefficient of -0.09 for government investment and 0.12 for government consumption suggest

[14] In this paper the random effects model is estimated according to the method proposed by Baltagi (1995), which corrects for heteroskedasticity through the μ_i:

[15] This is a simple Chow test with the restricted residual sums of squares (RRSS) being that of OLS on the pooled model and the unrestricted residual sums of suared (URSS) being that of the fixed effects estimation. In regression (6), the RRSS is that of the time dummy variables model and the URSS is the within-residual sum of squares.

Table 3: Fixed e¤ects estimates on a panel data set of 7 EMU-countries

	Regressions					
	Panel A				Panel B	
	(1)	(2)	(3)	(4)	(5)	(6)
DEBT	0.02***		0.04***	0.04***	-0.04***	-0.02**
	(0.004)		(0.008)	(0.005)	(0.007)	(0.007)
$DEBT^2$	-0.0002***		-0.0002***	-0.0002***	0.00008*	0.00001
	(0.00003)		(0.00005)	(0.00003)	(0.00004)	(0.00004)
DINTCH			0.05***			
			(0.02)			
GCONS	0.12***	0.18***	0.12***	0.16***	0.04***	0.14***
	(0.02)	(0.01)	(0.03)	(0.02)	(0.01)	(0.02)
GINV	-0.09***	-0.08***	-0.10*	-0.06*	-0.09***	-0.14***
	(0.03)	(0.02)	(0.06)	(0.04)	(0.03)	(0.04)
GSOC	0.09***	0.13***	0.06***	0.08***	0.10***	0.09***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
TAX	-0.05***	-0.06***	-0.05***	-0.05***	-0.07***	-0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GROW	-0.006	-0.007	-0.01	-0.001	-0.003	0.003
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CA	-0.13*	-0.16**	-0.09	-0.01	-0.54***	-0.12*
	(0.07)	(0.06)	(0.07)	(0.01)	(0.07)	(0.06)
INFL	0.37**	0.35**	0.23	0.42**	0.40**	0.30*
	(0.18)	(0.18)	(0.18)	(0.17)	(0.2)	(0.17)
Time e¤ect						
’91				-0.11***		0.19***
’92				-0.09***		0.13***
’93				-0.09***		0.11**
’94				-0.20***		-0.32***
’95				-0.07***		-0.13***
’96				-0.21***		-0.25***
’97				-0.27***		-0.23***
’98				-0.09***		-0.18***
’99				-0.06***		-0.11***
SSR	19.87	21.40	17.77	16.93	28.26	17.61
$\overline{R}^2$	0.75	0.73	0.70	0.79	0.45	0.80
N	597	597	597	597	597	597
F-test for FE	131.04	137.56	37.45	137.76	-	170.23
(p-value)	(0.00)	(0.00)	(0.00)	(0.00)	-	(0.00)
Hausman test	88.349	72.78	40.78	399.06	4.79	18.48
(p-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.18)	(0.00)

Note: Dependent variable: sovereign credit spreads compared to German bunds [Panel A], sovereign credit spreads compared to French government bonds [Panel B]. Explanatory variables: DEBT (debt, excluding interest payments), DINTCH (debt interest payments), TAX (government receipts), CA (current account), GCONS (government consumption), GINV (government investment) and GSOC (social security expenditure and subsidies), INFL (change of the logarithm of CPI) and GDP (change of the logarithm of industrial production). Regressions are estimated using a …xed or random e¤ects model with White standard errors and associated t-statistics. * signi…cant at a 10 % level. ** signi…cant at a 5 % level. *** signi…cant at a 1 % level.

that if governments were to increase the share of investment and reduce the share of consumption in total (cyclically adjusted) government expenditure excluding interest payments with 100 basis points, sovereign credit spreads would decrease with 21 basis points. While social security expenditure and subsidies are expected to have a relatively small effect on long-term economic growth, they do appear to significantly increase sovereign credit spreads. Since the government debt ratio is highly correlated with government investment (ρ = -0.59) and social security expenditure and subsidies (ρ = -0.91), regression (2) excludes DEBT and DEBT^2. Although, the coefficients of GCONS and GSOC slightly increase, they still have the expected sign and are significant at the one percent level. The coefficient of government investment remains more or less the same. The negative sign of TAX is in accordance with the view that countries with a high tax share in GDP are less likely to have liquidity problems because they have more funds to pay their interest charges and/or principal amount. Altering the specification of the model (see equation (1) to (4)) has only a minor impact on the coefficient of TAX.

In accordance with the results of Goldstein and Woglom (1991), Alesina et al. (1992), Capeci (1994), Bayoumi et al. (1995) and Lemmen and Goodhart (1999), the government debt ratio significantly increases sovereign credit spreads. Contrary to the predictions of the market-based fiscal discipline hypothesis, the squared debt ratio is negatively correlated with sovereign credit spreads. Goldstein and Woglom (1991) and Lemmen and Goodhart (1999), however, also find a negative coefficient for the squared debt term. More debt interest payments, which are instrumented by the prior year's debt interest payments, significantly increase sovereign credit spreads (see equation (3)). The results suggest that sovereign credit spreads decrease during periods of high economic growth. The coefficient of GROW is, however, not significant at the 10 percent level in regressions (1) to (4). A possible explanation may be that the effect of economic growth is already captured by the budgetary policy variables included in the regressions. A surplus on the current account reduces sovereign credit spreads. The magnitude and the significance of the coefficient is, however, highly sensitive to the model specification. Including DINTCH as an explanatory variable renders the effect of the current account balance insignificant. Higher inflation significantly increases sovereign credit spreads (except when debt interest payments are included). This finding supports the assumption of Cantor and Packer (1996) that a high rate of inflation points to structural problems.

Regression (4) in table 3 includes time dummies. This should prevent us from picking up a spurious correlation between sovereign credit spreads and the composition of the government budget. The formation of EMU may cause a correlation between the composition of the government budget and sovereign credit spreads which has nothing to do with a direct effect of the composition on the spreads. In an attempt to overcome this problem, the model is estimated using a two-way fixed effects model, which includes country and time dummies.

The time dummies should capture unobservable time speci…c e¤ects. Equation (4) shows that each time dummy is signi…cantly negative at the one percent level. A possible explanation may be that the formation of the EMU had a direct impact on governments' credibility and sovereign credit spreads apart from the e¤ect on governments' budgetary policy. The conclusions concerning the correlation between the composition of the government budget and sovereign credit spreads remain the same. In panel A, this two-way …xed e¤ects model has the highest R^2.

6 Robustness

Until now, the model treats the yield on German bunds as the benchmark, assuming that these bonds are default-free. However, as can be seen in table 1, the credit spread of French government bonds relative to German bunds is negative on average over the sample period (-5 basis points). This is due to the fact that, in a number of subperiods, investors appear to have treated the French bonds as the default-free benchmark. Therefore, the model is reestimated using credit spreads relative to the French government bonds as the dependent variable. The results, which are presented in column (5) and (6) of table 3, are qualitatively similar. In regression (5), the Hausman test statistic could not reject the null hypothesis that the individual e¤ects are uncorrelated with one or more explanatory variables. Although the …xed and random e¤ects estimator are consistent under the null hypothesis, the random e¤ects estimator is the most e¢cient one. Therefore, column (5) reports the random e¤ects model estimated according to the method proposed by Baltagi (1995), which corrects for heteroskedasticity through the $^1{}_i$:

The magnitude of the coe¢cients on the government expenditure components and the tax receipts are similar to the estimations for credit spreads relative to German bunds. As a result, the conclusion remains that increased government investment, less government consumption, less social security expenditure and subsidies and more tax receipts reduce sovereign credit spreads. Contrary to regressions (1) to (4), the coe¢cients of DEBT are negative and signi…cant. This is in line with the results of LÁnning (2000), who …nds a negative correlation between the total yield spread and the gross government debt ratio in a sample of 10 European countries. Regression (5) and (6) show evidence of a non-linear relationship between sovereign credit spreads and the government debt ratio. The results indicate that an increase of the government debt ratio reduces the sovereign credit spread if the debt ratio stays below a certain "trigger" value. Once the government debt ratio reaches that "trigger" value, the sovereign credit spread increases. This non-linear relationship is, however, fragile. Including time dummies, renders the e¤ect of $DEBT^2$ insigni…cant.

A surplus on the current account and lower in‡ation signi…cantly reduces sovereign credit spreads. The e¤ect of the business cycle is again not signi…cant at the 10 percent level. Regression (6) shows that the time dummies are significantly negative from 1994 onwards. Contrary to the results in regressions (1) to (4), the time dummies are significantly positive from 1991 till 1993. During that period, the yield on 10-year French government bonds decreased much faster than the yield on German bunds. Moreover, the yield on French swap contracts was between 50 and 150 basis points higher than the yield on German swap contracts. Again, this two-way error component model has the highest explanatory power, the adjusted R^2 is 0.8.

The results are also robust with respect to alternative measures of the business cycle. Replacing GROW by the unemployment rate as in Bayoumi et al. (1995) yields similar results. Dividing government investment, government consumption, social security expenditures and subsidies by trend GDP instead of cyclically adjusted government expenditure excluding interest payments also gives similar results. In the case of GCONS, GINV, GSOC, TAX, monthly observation are obtained via interpolation of yearly data. Assuming that the data are constant for a year does not alter the results.

In sum, the robustness tests seem to imply that there is a robust relation between the composition of the government budget and sovereign credit spreads.

7 Conclusion

This paper provides some support to the hypothesis that governments can influence the credit spread on their long-term debt by changing the composition of the budget balance. The empirical analysis uses a panel data set of 7 EMU-countries during the 1990s to estimate the relationship between sovereign credit spreads (compared to German and French government bonds) and the components of the budget balance, debt, growth, inflation and the current account.

The results suggest that increasing the share of government investment and decreasing the share of government consumption significantly reduce sovereign credit spreads. These governments are perceived by the market as being more credible. This finding is in accordance with the endogenous growth theory which predicts a positive impact of government investment and a negative impact of government consumption on the long-term growth rate. While social security expenditure and subsidies are expected to have a relatively small effect on long-term economic growth, they do appear to significantly increase sovereign credit spreads. Governments with higher tax receipts are perceived by the market as having a lower default probability. A possible explanation may be that countries with high tax revenues are less likely to have liquidity problems because they have more funds to pay their interest charges and/or principal amount. The results do not provide evidence of a non-linear relationship between sovereign credit spreads and the government debt ratio.

Using a sample of 7 EMU-countries, the strong correlation between the composition of the government budget and sovereign credit spreads may be spurious because of the influence of EMU. The formation of EMU may cause a correlation between budgetary policy variables and sovereign credit spreads which has nothing to do with a direct effect of the budgetary policy variables on the spreads. In an attempt to overcome this problem, the model is estimated using a two-way fixed and random effects model, which include country and time dummies. From 1994 onwards, the time dummies are negative and significant. This supports the assumption that the formation of the EMU has a direct impact on sovereign credit spreads. The conclusions concerning the correlation between the composition of the government budget and the sovereign credit spreads, however, remain the same.

The strong evidence concerning the effect of the composition of the government budget on sovereign credit spreads should be a warning and guideline for policy makers. When adjusting the budget, governments should incorporate the effect on sovereign credit spreads. Changing the composition of the budget as such that credit spreads decrease, can cause a virtuous cycle of lower credit spreads, a lower government debt burden and more budgetary policy room for manoeuvre.

Appendix A

1. Unbalanced Panel: Time Series Dimension

Table 4: Sample Period

	Period		Period
Belgium	1991:01 - 1999:02	Italy	1991:10 - 1999:02
Finland	1991:10 - 1999:02	Netherlands	1988:09 - 1999:02
France	1988:09 - 1999:02	Spain	1991:10 - 1999:02
Germany	1988:09 - 1999:02		

2. Panel Augmented Dicky Fuller test proposed by Im, Peseran and Shin (1996)

In a first step, the following Panel Augmented Dicky Fuller model is estimated for each country

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \sum_{j=1}^{p_i} \rho_{ij} \Delta y_{i,t-j} + e_{it} \qquad \begin{array}{l} i = 1,\ldots,N \\ t = 1,\ldots,T \end{array} \tag{15}$$

α_i is the fixed effect for country i and e_{it} the error term generated independently across time and countries. The null hypothesis is defined as

$$H_0 : \beta_i = 0 \quad \text{for all } i \tag{16}$$

against the alternative of stationarity

$$H_1 : \beta_i < 0 \quad \text{for all } i \tag{17}$$

The authors propose a testing procedure based on averaging individual unit root test statistics for panels.

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1} t_{iT_i}(p_i) \tag{18}$$

This method produces a single t-statistic for each variable included in the analysis which is called the t-bar statistic $\left(\bar{t}_{NT}\right)$. Im et al. (1996) show that under the null hypothesis and assuming that e_{it}'s are iid with zero means and finite (heterogenous) variances, as $T \to \infty$; $N \to \infty$; $\sqrt{N}/T \to 0$; the t-bar statistic weakly converge to standard normal variates.

3. Summary Statistics

Table 5: Mean and Standard Deviation of all variables included in the analysis

	Belgium	Finland	France	Germany	Italy	Netherl.	Spain
$CRED^{ger}$	21	14	-4	-	83	3	12
	(17)	(20)	(16)	-	(53)	(11)	(16)
$CRED^{fra}$	23	13	-	4	82	6	9
	(8)	(27)	-	(16)	(53)	(20)	(11)
DEBT	129	54.6	54.7	54.8	124.8	74.1	72.0
	(6.2)	(6.5)	(9.5)	(6.9)	(3.3)	(3.9)	(5.2)
TAX	50.7	53.3	49.42	45.3	47.1	44.1	37.8
	(1.0)	(2.7)	(1.24)	(1.6)	(0.9)	(0.9)	(0.3)
GINV	3.3	5.4	6.4	5.28	4.7	5.4	8.2
	(0.1)	(0.3)	(0.6)	(0.4)	(0.5)	(0.2)	(0.6)
GCONS	40.0	42.4	45.1	41.16	36.1	50.5	43.5
	(1.2)	(1.3)	(0.1)	(0.6)	(0.8)	(1.1)	(0.3)
DINTCH	15.9	1.9	5.6	5.6	18.6	9.2	9.9
	(1.3)	(1.9)	(0.6)	(0.7)	(1.9)	(0.6)	(1.1)
GSOC	40.1	29.4	34.7	35.8	35.4	31.6	33.2
	(1.0)	(1.0)	(0.4)	(1.3)	(0.3)	(1.0)	(0.1)
GROW	0.03	0.1	0.02	0.02	0.01	0.03	0.05
	(0.9)	(0.6)	(0.4)	(0.6)	(0.5)	(0.6)	(0.9)
INFL	0.03	0.02	0.03	0.04	0.04	0.04	0.06
	(0.04)	(0.05)	(0.03)	(0.05)	(0.03)	(0.04)	(0.06)
CA	0.4	0.2	0.07	0.02	0.15	0.4	–0.04
	(0.1)	(0.3)	(0.1)	(0.2)	(0.17)	(0.1)	(0.1)

Note: Mean and standard deviation (between brackets) of every variable are given. $CRED^{ger}$ (credit spread relative to the yield on German bunds) and $CRED^{fra}$ (credit spread relative to the yield on French government bonds) are expressed in basis points. DEBT (debt, excluding interest payments), TAX (government receipts), GCONS (government consumption), GINV (government investment), DINTCH (debt interest payments) and GSOC (social security expenditure) and CA (current account) are expressed as a percentage. INFL is the change of the logarithm of CPI. GROW is the change of the logarithm of industrial production.

Appendix B

Data description and sources

- Yields and swap rates: Redemption yields on 1, 2, 3, 5, 7 and 10-year government bonds are downloaded from Datastream on a daily basis to obtain spot rates on 10-year government bonds. Rates on 1-year to 10-year swap contracts are downloaded from Datastream on a daily basis to obtain spot rates on 10-year swap contracts. Monthly averages of daily spot rates are calculated.

- Government debt: The data on government debt and the debt interest payments are downloaded from Datastream on a monthly basis, except for the Netherlands which are only available on a yearly basis. Government debt, excluding debt interest payments (DEBT) and debt interest payments (DINTCH) are divided by trend GDP.

- Government budget balance: The data on total government receipts (cyclically adjusted), total government expenditure, excluding interest payments (cyclically adjusted), government consumption, government investment and social security expenditure and subsidies are obtained from OECD on a yearly basis. The OECD data set covers the operations of the general government. According to the OECD method, the cyclically adjusted or structural component is derived by calculating the revenues that would pertain if output were at its potential level. Total government receipts are divided by trend GDP (TAX). Government consumption (GCONS), government investment (GINV) and social security expenditure and subsidies (GSOC) are divided by total government expenditure, excluding interest payments (cyclically adjusted).

- Real growth rates: Data on industrial production are downloaded from Datastream on a monthly basis. The regression includes monthly changes of the logarithm of the volume of industrial production (GROW).

- Inflation: Data on the CPI were downloaded from Datastream on a monthly basis. The regression includes monthly changes of the logarithm of the CPI (INFL).

- Current account: Data on current account are downloaded from Datastream on a monthly basis. The data are divided by trend GDP of the corresponding period (CA).

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