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Tax Competition

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PUBLIC DEBT ASYMMETRIES AND TAX COMPETITION

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Abstract The paper investigates the effect of asymmetric debt and debt servicing obligations on taxes and primary spending in a standard tax competition model, assuming public debts are pre-determined and in their steady state. The impact of increasing financial market integration and capital mobility on tax and spending asymmetries is then investigated, and the results are tested empirically for EU countries. The model predicts that cross country asymmetries in debt servicing obligations lead to cross-country asymmetries in taxes and spending, and these predictions are supported by the data, with high-debt EU countries having lower expenditures and higher taxes than low-debt countries. Moreover, as the impact of increasing capital mobility on tax asymmetries is theoretically ambiguous and empirically insignificant, increasing capital mobility is found to amplify debt-induced tax distortion asymmetries. Finally, higher capital mobility is found to amplify public spending asymmetries theoretically as well as empirically across EU member countries.

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Abstract The paper investigates the effect of asymmetric debt and debt servicing obligations on taxes and primary spending in a standard tax competition model, assuming public debts are pre-determined and in their steady state. The impact of increasing financial market integration and capital mobility on tax and spending asymmetries is then investigated, and the results are tested empirically for EU countries. The model predicts that cross country asymmetries in debt servicing obligations lead to cross-country asymmetries in taxes and spending, and these predictions are supported by the data, with high-debt EU countries having lower expenditures and higher taxes than low-debt countries. Moreover, as the impact of increasing capital mobility on tax asymmetries is theoretically ambiguous and empirically insignificant, increasing capital mobility is found to amplify debt-induced tax distortion asymmetries. Finally, higher capital mobility is found to amplify public spending asymmetries theoretically as well as empirically across EU member countries.

Introduction

The standard model of tax competition predicts that increasing mobility of capital will result in not only a downward pressure on taxes and sub-optimally low levels of public spending, but also a convergence in tax rates and public spending levels¹. These concerns have been particularly voiced in a European Union context, where financial integration is, perhaps, farther reaching than in any other regionally integrating constellation of sovereign states. This downward convergence of tax rates and public spending is partly based on the assumption that regions engaging in tax competition are identical. The assumption of symmetry allows tractability, and in some cases solvability, of the model, but is hard to justify empirically. A small number of investigations of asymmetric tax competition have shown that tax asymmetries may persist to some degree in a perfect capital mobility regime². But such asymmetric tax competition models are few and have been limited to asymmetries in economic size or factor endowments of the countries engaged in tax competition. Other types of asymmetries – while abundant empirically – have yet to be modeled. This paper provides a new step into the territory of cross country asymmetries and tax competition.

The high and differing levels of public debt of European Union countries is one case of obvious asymmetry which is not accounted for in the tax competition literature. While exceptional public sector growth took place in virtually all European countries in the last century, its financing differed widely, leaving the levels of public debt ranging from 46 percent of GDP in Finland to

¹ See Wilson (1999) for a recent review of the literature on tax competition.

² The seminal contributions on asymmetry and tax competition are Bucovetsky (1991) and Wilson (1991). Moreover, recent studies have looked at the effects of the existence of agglomeration economies on the tax competition outcome. See for example Baldwin et.al. (2003).

116 percent of GDP in Belgium by the end of the 1990s. These public debt asymmetries within the EU are reflected in considerable asymmetries in debt servicing obligations. For example, Italy, Belgium and Greece spent 16 to 18 percent of tax revenues on interest payments on the public debt on average between 1970 and 1999, compared to a 4 percent average for Finland during the same period³.

The asymmetric levels of public debt in the European Union provide for cross country differences in the constraints facing a policymaker in choosing a tax rate. A high level of public debt and debt servicing obligations reduces fiscal policy flexibility, and evidently, asymmetries in debt servicing obligations must be associated with either higher taxes or lower spending in high debt countries relative to low debt countries, all else equal. Public debt asymmetries can therefore be expected to explain some of the cross-country variation in other fiscal variables.

But does tax competition lead to a reduction in these debt-induced asymmetries in line with the standards tax competition results of downward convergence, or conversely, might tax competition amplify debt-induced fiscal asymmetries? If the latter is the case, and if increasing tax competition amplifies the level of distortions associated with a given level of taxes, then high-debt countries will suffer increasingly higher distortions to their economies as financial integration proceeds. If the former is the case and taxes converge between high and low debt countries, this would leave primary expenditures to adjust to high debt levels and in turn increase spending asymmetries as tax competition increases. This paper investigates these issues more formally by introducing public debt asymmetries in a model of capital tax competition a la

³ Source: Own calculations based on OECD Economic Outlook data.

Zodrow and Mierzkowski (1986). Two overall questions are addressed. First, prior to engaging in tax competition – i.e. in financial autarky - how is the burden of public debt servicing split between taxes and public spending? Second, since tax competition is expected to add a downward pressure on taxes and, in turn, public spending, the question is raised as to how increasing tax competition changes the transmission of public debt asymmetries to asymmetries in spending and tax revenues.

The structure of the paper is as follows. Section 1 presents the theoretical model and derives four testable hypotheses concerning the effects of debt service and capital mobility on taxes and primary spending. These hypotheses are tested empirically for a panel of European Union countries in Section 2. The final section concludes.

1. The Model

The model is based on Zodrow and Mierzkowski (1986). Capital is initially assumed immobile, but will later be assumed perfectly mobile internationally, and it is assumed that no country is large enough to affect the international after-tax return to capital under perfect capital mobility. The latter assumption allows for a focus on the consequences of debt service obligations for the indebted country, without getting into a spiral of strategic reactions of the competing countries. Each country has three sectors: production, households (the representative citizen) and the government. There are two inputs in production: capital and labor. The representative citizen owns the production process and supplies a fixed amount of labor. Capital enters with decreasing marginal productivity:

$$f(k), \quad f_k > 0, \quad f_{kk} < 0 \quad (1)$$

where k is the amount of capital invested in domestic production. The representative citizen's budget constraint is:

$$x = f(k) - f_k \cdot k + \rho \cdot \bar{k} \quad (2)$$

where \bar{k} is the representative citizen's savings of capital and ρ is the international after-tax return to capital. The representative citizen's utility function is given by⁴:

$$u(g, x), \quad u_g, u_x > 0, \quad u_{gg}, u_{xx} < 0, \quad u_{gx}, u_{xg} = 0 \quad (3)$$

Till this point, the structure of the model follows that of Zodrow and Mierskowski (1986) closely.

Now introduce public debt. National public debt levels are assumed to have reached a steady state, and the competing countries have entered into an economic union after accumulating the public debt, which, in addition to providing for perfect capital mobility, stipulates a balanced budget. The effect of changes in debt service on budget items is hence such that spending and taxation will change in order to ensure a primary balance equal to the debt servicing obligations. Formally, the government has D amount of debt, which is held by overseas creditors⁵. The government has borrowed at the world rate of interest and has ρD in debt service obligations, pays ΔD off the debt and provides public goods g , all of which are financed with a specific source tax t on capital invested domestically. Obviously, in equilibrium, the government will choose not to pay off any debt, since there is no incentive to do so in a model where tomorrow does not matter. Hence, ΔD is equal to zero. The government budget constraint becomes:

$$t \cdot k = g + \rho D \quad (4)$$

⁴ The assumption that the utility function is separable in its two arguments substantially simplifies the analysis and makes the model tractable. The same conclusions would be arrived at without this assumption, but would necessitate several assumptions concerning the size of the cross derivatives and would obscure the intuition of the model.

⁵ If part or all of the public debt is held by the representative citizen, the conclusions do not change for the perfect capital mobility case if the interest rate on the public debt are assumed the same as those on savings, and as long as the debt held domestically is part of the savings, such that the domestic representative citizen does not have more savings to invest than the representative citizen of the competing countries. The conclusions would change,

The government is benevolent and chooses the tax rate that maximizes the representative citizen's utility (3), subject to the relevant resource and behavioral constraints of the economy. (4) shows that debt servicing obligations constitute a wedge between tax revenues and primary expenditures in the budget constraint. Notice that the debt servicing component could represent any other lump sum transfer to or from the budget constraint, which is independent of the tax rate and does not provide utility to the representative citizen. It could for example represent the degree of inefficiency of the public administration of the country in question, income from oil possessions, or some windfall gain, and the results of the subsequent analysis can therefore also be interpreted in this light.

The Case of Zero Capital Mobility

Consider initially a country in financial autarky. Capital mobility is zero, but assume that the balanced budget rule still applies. The representative citizen can only invest in domestic production, irrespective of the domestic after-tax return to capital relative to that of other countries. Private net income reduces to:

$$x = f(k) - t \cdot \bar{k} \quad (5)$$

In this case, the capital source tax does not have an effect on the investment decision of capital owners, and the elasticity of capital to the tax rate is zero. This implies that the marginal cost of public funds is unity (i.e. increasing overall tax revenues of the government by increasing the tax rate will result in a one to one decrease in private net income). Domestic source taxation of

however, if there were no access to international capital markets, in which case domestic production would suffer the loss of capital tied up in government bonds.

capital is non-distortionary in this case, and the first order condition for the government's problem, found by maximizing (3) subject to (2) and (5) , becomes ⁶:

$$\frac{u_g(g, x)}{u_x(g, x)} = 1 \quad (6)$$

Totally differentiating the first order condition with respect to debt servicing obligations yields the partial derivatives of the equilibrium capital tax rate and equilibrium government spending:

$$\frac{\partial t^n}{\partial \rho D} = \frac{\varepsilon_g^n}{k \cdot (\varepsilon_g^n + \varepsilon_x^n)} > 0 \quad (7)$$

$$\frac{\partial g^n}{\partial \rho D} = \frac{\varepsilon_g^n}{(\varepsilon_g^n + \varepsilon_x^n)} - 1 < 0 \quad (8)$$

$$\varepsilon_x^n = \frac{\partial u_x}{\partial t} \cdot \frac{t^n}{u_x} = -\frac{u_{xx}}{u_x} \cdot k^n \cdot t^n > 0 \quad (9)$$

$$\varepsilon_g^n = -\frac{\partial u_g}{\partial t} \cdot \frac{t^n}{u_g} = -\frac{u_{gg}}{u_g} \cdot k^n \cdot t^n > 0 \quad (10)$$

The superscript n indicates the financial autarky regime equilibrium values. This simple model of fiscal policy confirms the general intuition about how debt servicing obligations affect the two sides of the budget: one should expect to see a combination of a lower level of government spending and a higher level of taxes in countries with higher debt service obligations compared to countries with lower debt servicing obligations, all else equal. Partitioning the cost of debt service between taxes and primary expenditures minimizes the utility loss associated with debt service payments, due to the assumption of diminishing marginal utility of private net income and public spending. The effect on taxes relative to the effect on primary expenditures of debt servicing obligations is determined by the parameters of the model as follows. The greater

⁶ The second order condition is $u_{gg} \cdot k^2 + u_{xx} \cdot (-k)^2 < 0$. Since the second derivatives of the utility function are

(smaller) in absolute value the elasticity of the marginal utility of public goods provision (private net income) to the tax rate, the less primary expenditures will adjust and the more taxes will increase due to higher debt service.

Allowing for Perfect Capital Mobility

When capital is perfectly mobile, the representative citizen can invest her capital abroad and attain the world after-tax return to capital if the after-tax return to capital is lower domestically.

The financial market equilibrium condition therefore becomes:

$$f_k - t = \rho \quad (11)$$

where $f_k - t$ is the domestic after-tax return to capital. The tax rate consequently has an impact on the investment decision of investors in domestic production, i.e. taxes are distortionary. The marginal cost of public funds is therefore greater than one. Maximizing (3) subject to (2), (4) and (10) gives the first order condition for the government's problem under perfect capital mobility⁷:

$$\frac{u_g(g, x)}{u_x(g, x)} = MCPF > 1 \quad (12)$$

where $MCPF = \frac{1}{1 - \varepsilon_k}$ is the marginal cost of public funds, and ε_k is the elasticity of

domestically invested capital to the tax rate. Under perfect capital mobility, the equilibrium marginal utility of public spending is higher than the marginal utility of private consumption since the relative cost of public good provision is higher. The government therefore sets a tax rate

negative, the soc is always fulfilled.

⁷ The second order condition is $\varepsilon_{u_g} + \varepsilon_{u_x} + \varepsilon_{mcpf} > 0$. Assuming that the third derivative of the production function is zero is a sufficient condition for satisfying the second order condition, but the second order condition also allows for the third derivative to take some positive values.

that is lower than the optimal tax rate under zero capital mobility, and equilibrium public spending is suboptimally low relative to private spending from a social welfare perspective.

The analysis below takes as starting point the symmetric no-debt tax competition model, and looks at how the equilibrium values of the central variables for one country change when the debt increases marginally from zero to positive in that country. Let one and only one country go from having zero debt to having a positive level of public debt, while staying solvent. Totally differentiating the first order condition with respect to debt service yields the derivative of the equilibrium tax rate with respect to debt service under perfect capital mobility:

$$\frac{\partial t^p}{\partial \rho D} = \frac{\varepsilon^p_g}{k \cdot (1 - \varepsilon^p_k) \cdot (\varepsilon^p_g + \varepsilon^p_x + \varepsilon^p_m)} > 0 \quad (13)$$

where

$$\varepsilon^p_x = \frac{\partial u_x}{\partial t} \cdot \frac{t}{u_x} = -\frac{u_{xx}}{u_x} \cdot k \cdot t > 0 \quad (14)$$

$$\varepsilon^p_g = -\frac{\partial u_g}{\partial t} \cdot \frac{t}{u_g} = -\frac{u_{gg}}{u_g} \cdot k \cdot t \cdot (1 - \varepsilon^p_k) > 0 \quad (15)$$

$$\varepsilon^p_m = \frac{\partial mcpf}{\partial t} \cdot \frac{t}{mcpf} = \frac{\varepsilon^p_k}{1 - \varepsilon^p_k} \left[1 + \varepsilon^p_k + \varepsilon^p_k \cdot k \cdot \frac{f_{kkk}}{f_{kk}} \right] > 0 \quad (16)$$

The superscript p denotes equilibrium values in the perfect capital mobility regime. While (14) and (15) are always positive, (16) can take on both positive and negative values, but the denominator of (13) is positive when the second order condition is fulfilled (see footnote 7). (13) shows that an increase in the debt level will lead to an increases in the tax rate. The mechanism is

straightforward: Given the no debt equilibrium tax rate, an increase in debt service obligations will initially (i.e. before a policy reaction) result in lower primary public spending without changing the tax rate and tax revenues. u_g is therefore initially higher than in no-debt countries, while u_x and the $MCPF$ are the same as in the no debt situation. Increasing the tax rate above its no debt equilibrium level - hence redirecting resources from private to public spending - will therefore increase utility until the first order condition for optimum is again fulfilled.

In order to evaluate the effect of an increase in the debt level on primary public spending, the government budget constraint is totally differentiated with respect to debt service, and (12) and (13) are used to obtain:

$$\frac{\partial g^p}{\partial \rho D} = \frac{\varepsilon_g^p}{\varepsilon_g^p + \varepsilon_x^p + \varepsilon_m^p} - 1 < 0 \quad (17)$$

The assumption that the elasticity of the marginal cost of public funds is positive is a sufficient condition for ensuring that the sign of the derivative of public spending with respect to debt service is negative⁸.

Now compare the effect of debt service on the tax rate under zero capital mobility with the effect of debt service on the tax rate under perfect capital mobility. A priori, one would think that a higher marginal cost of public funds would imply that debt servicing obligations would affect taxes less and primary spending more. However, the model also allows for the opposite to be the case, since the elasticity of the LHS of the first order condition also changes when capital becomes mobile. It can be shown that:

$$\frac{\partial t^p}{\partial \rho D} < \frac{\partial t^n}{\partial \rho D} \quad \text{if} \quad \begin{aligned} &\varepsilon_g^p + \varepsilon_x^p + \varepsilon_m^p > \Phi \cdot (\varepsilon_g^n + \varepsilon_x^n) \\ &\Phi = \frac{u_{gg}^p}{u_{gg}^n} \cdot \frac{u_g^n}{u_g^p} \cdot \frac{t^p}{t^n} > 1 \end{aligned} \quad (18)$$

Condition (18) is best understood in terms of the first order conditions under zero and perfect capital mobility respectively. The sum of the tax elasticities of the tree components making up the first order condition indicate the size of the adjustment to equilibrium: the greater is any of the three elasticities, the less of a tax rate increase is needed to get back to equilibrium after an increase in debt servicing obligations. Moving from zero to perfect capital mobility increases the elasticity of the marginal cost of public funds from zero to positive, but also changes ε_g and ε_x . If either ε_g or ε_x is sufficiently lower under perfect than under zero capital mobility, it may allow for the odd case where the increase in debt service results in a greater increase in taxes in the perfect capital mobility regime compared to the zero capital mobility case. To see why, consider a change in debt from zero to positive. Under zero capital mobility, the increase in debt leads to higher taxes and lower spending, and the relative impact on the two sides of the budget depends on the parameters of the model. Under perfect capital mobility, there are two additional effects of an increase in debt service, both emanating from the distortionary effect of taxation. First, there is the marginal effect. When the marginal cost of public funds, and hence the distortionary effect of taxation, increases, the effect of debt will shift from the tax side to the public spending side of the budget, leaving the effect of debt on taxes lower and the negative effect of debt on primary spending higher. The second effect is the infra-marginal effect. Taxes are higher in a high-debt country compared to a low-debt country irrespective of the degree of capital mobility, as shown by (7) and (13). Therefore, the high-debt economy reaches a higher

⁸ This assumption is sufficient but not necessary, and imposes a slightly tighter upper limit on the third derivative of

level of distortions, a lower level of invested capital, and hence a lower level of overall domestic production. There are therefore less resources in the economy to divide between public spending and private spending. The isolate infra-marginal effect is therefore that debt will have a greater impact on both taxes and spending when capital mobility increases, due to the distortion of overall production.

Both the marginal effect and the infra-marginal effect will increase the downward pressure of debt servicing obligations on primary public spending. But only the first effect will decrease the effect of debt servicing obligations on taxes, while the second effect will increase the effect of debt servicing obligations on taxes. Hence, whether the effect of debt on taxes increases or decreases when moving from zero to perfect capital mobility depends on the relative importance of the marginal and infra-marginal effects, while the effect of debt servicing obligations on public spending always becomes stronger when moving from zero to perfect capital mobility:

$$\frac{\partial g^p}{\partial \rho D} < \frac{\partial g^n}{\partial \rho D} \quad (19)$$

Tax competition can therefore be seen as decreasing the cross-country asymmetries of the tax burden on capital induced by asymmetric levels of public debt only when condition (18) is satisfied. On the other hand, intensifying tax competition will always increase cross-country asymmetries in primary spending due to debt asymmetries.

Conclusions of the Theoretical Model

Allowing for asymmetric levels of debt and debt servicing obligations in an otherwise symmetric model of capital tax competition shows that these asymmetries lead to cross country asymmetries

the production function than already imposed by the second order condition (see footnote 7).

in equilibrium taxes and primary spending. Moreover, holding public debt levels and asymmetries constant shows that the impact of capital mobility on capital tax asymmetries is ambiguous and depends on the parameters of the model. However, the asymmetries on the public spending side unambiguously intensify with increasing capital mobility. Finally, if capital mobility does not actually reduce the impact of debt service on capital taxes, then capital mobility will increase cross country debt induced distortion asymmetries, simply because higher debt means higher taxes and higher capital mobility leads to a higher level of distortions associated with a given level of taxes.

A caveat is in place regarding these findings. The model assumes that the government only has one tax base, and extending the model to include taxation of a less mobile labor supply would greatly increase its relevance. Increasing capital tax competition could thus be expected to lead to a shift of the tax burden from capital toward labor, and hence, to increasing labor tax asymmetries rather than increasing public spending asymmetries. These speculations are left for future modeling. Meanwhile, capital income taxation should be seen in the present case as a proxy for overall taxation of a country, assuming that the mobility of all tax bases is at least correlated with that of capital income, or that tax revenues from other sources are constant, for example at their maximum. The four predictions derived from this model are therefore formulated for both overall taxation and capital taxation for the purposes of empirical testing:

1. The higher the debt service obligations, the higher is the level of taxes, and in particular, the higher is the capital tax rate
2. The higher the debt service obligations, the lower are primary expenditures

3. The higher the capital mobility, the smaller is the effect of debt service on the level of taxes, and in particular on capital taxes, given condition (18).
4. The higher the capital mobility, the greater is the downward pressure of debt service on primary expenditures

These four predictions are tested empirically for a panel of EU countries in the remainder of this paper.

2. Empirical Methodology

According to the model, the asymmetries levels of public debt and debt servicing obligations among EU member countries should lead to detectable asymmetries in the levels of tax revenues or the level of primary expenditures in EU countries, given that deficit financing of the budget is constrained by long term sustainability considerations and – if not to the letter – by the Growth and Stability Pact. Moreover, according to the model, European integration and tax competition may have had the additional effect of increasing asymmetries in public spending and taxation within the European Union. Whether public debt asymmetries have had such effects no taxation and spending in the European Union is tested below. A basic specification for estimating the direct effects of debt service on the budget is presented below, and in turn, augmented with an interaction term of capital mobility and debt service to allow for capital mobility effects.

The Basic Specification

The basic estimating equation is inspired by the rather sparse empirical literature on the correlations between capital tax rates and measures of capital mobility (see for example Garrett and Mitchell, 2001) with slight modifications. In line with how debt and debt service are included

in estimating equations for fiscal variables in Roubini and Sachs (1989) and Kontopoulos and Perotti (1998), the following basic specification of the set of equations for estimation is put forward:

$$\Delta BUDGET_{it} = \alpha + \beta \cdot \begin{bmatrix} \Delta RB_{i,t-1} \\ \Delta BY_{i,t-1} \end{bmatrix} + \gamma \Delta \Omega_t + \nu_i + \varepsilon_{it} \quad (20)$$

where

$$\Delta \Omega_t = \left[GR_{i,t-1}, INFL_{i,t-1}, \Delta OPEN_{i,t-1}, \Delta PART_{i,t-1}, \Delta UN_{i,t-1}, MAAS_{i,t-1} \right]^{-1} \quad (21)$$

BUDGET is the overall tax revenues in percent of GDP (*TOTALTAX*), the implicit capital tax rate (*IMPLCAP*), and primary spending to GDP (*EXPGDP*) depending on which hypothesis is tested. *BY* is the ratio of public debt to GDP and *RB* is debt service obligations. The lagged gross debt to GDP ratio is included to control for efforts made to stabilize the budget. The overall tax rate and the capital tax should therefore be positive functions of the lagged debt to GDP ratio while expenditures should depend negatively on the debt to GDP ratio. Ω contains control variables included in the regression. The inclusion of real growth (*GR*) controls for real changes in nominally fixed budgets expenditure when nominal budgets are sticky, and is hence expected to affect overall taxes, capital taxes and spending negatively. Inflation (*INFL*) controls for the changes in tax revenues due to changes in distribution of income between nominal tax brackets. Inflation also proxies for money growth and, in turn, monetary financing of the budget. There is hence no clear expectation of the sign of the effect of inflation on taxes while the effect of inflation on spending is expected to be positive. Openness of the economy, *OPEN*, is included to control for the often hypothesized effect of the degree of openness on the optimal size of the public sector (see Rodrik, 1999). *OPEN* has been cleaned of country-size effects as explained in Appendix 1, and is expected to affect taxes and expenditures positively. Demographic changes

are controlled for by including the participation ratio, *PART*. *PART* is defined as the labor force in percent of total population between 15 and 65 years of age, and should affect taxes and expenditures to GDP negatively as higher participation is associated with a lower need for social insurance payments. The unemployment rate, *UN*, is included to account for direct effects of unemployment on tax receipts and is therefore expected to affect the overall and capital taxes negatively and spending positively. Finally, a dummy taking the value one in the Maastricht years (*MAAS*) is included to control for the effect of the Maastricht criteria regarding fiscal variables. Further explanatory and control variables could be included – notably political variables such as ideology of incumbent government and election cycles – but are left out for parsimony and data availability reasons. The robustness of the results to the inclusion of such variables is checked however. The model is estimated in first differences to reduce suspicions that results are spurious (apart from growth and inflation, all variables exhibit unit roots), as well as to avoid the bias introduced in fixed effects regressions when the lagged dependent variable is included as explanatory variable⁹.

A few comments on the obvious sources of endogeneity of the above specification are in place. First, growth and inflation may be explained by budget variables rather than the other way around. This is taken into account by lagging the explanatory variables by one period. But more importantly in the present context of debt and debt service effects on the budget, higher tax revenues (lower spending) may lead to a decrease of the public debt, in turn reducing debt service the following year. This latter source of endogeneity could turn out to bias the estimates of the debt servicing variables directly if the contemporaneous debt service component were used in

⁹ Growth and inflation could be included in first differences in line with the rest of the variables. However, including

(20). Now, the lag, and not the contemporaneous, value of the change in debt service is used as explanatory variable. Using the lag of debt service changes the nature of the simultaneity, but does not completely eliminate it. Changes in tax revenues or spending may potentially be correlated with the lagged changes (i.e. there may be persistence in the changes of taxes and spending), which in turn would be correlated with the lagged change in debt as described above. If changes in taxes or expenditures are auto-correlated *and* the first difference of taxes or expenditures are correlated with the contemporaneous change in debt service, then this may be a problem. If, however, the first differences of taxes or expenditures are not persistent, or if the first difference of taxes or expenditures is not correlated with the contemporaneous change in debt service, there should not be a problem of endogeneity. When calculating the latter correlation, it in fact turns out to be insignificant, and the latter source of endogeneity is hence not expected to result in important biases of the parameter estimates. Moreover, since the presence of endogeneity would bias the parameter estimates toward zero, the true parameter estimates would have the same sign but be larger in absolute value than the biased estimate. The presence of endogeneity would therefore still allow for drawing qualitative conclusions, although the parameter estimates would only indicate a lower limit to what the true estimate would be¹⁰.

Allowing for Capital Mobility

Increasing capital mobility affects the budget in two ways according to the tax competition model: it has a direct effect on the equilibrium tax rate and level of primary expenditures - the traditional tax competition hypothesis - and it affects the reaction to changes in government debt

these variables in levels or first differences does not change the conclusions, but using levels gives more plausible results, and they have therefore been kept in levels.

service. To account for this, an index of capital mobility is included in the estimating equation in addition to an interaction term between this capital mobility index and the measure of debt service.

$$\Delta BUDGET_{it} = \alpha + \beta \cdot \begin{bmatrix} \Delta RB_{i,t-1} \\ Icap_{i,t-1} \cdot \Delta RB_{i,t-1} \\ \Delta Icap_{i,t-1} \\ \Delta BY_{i,t-1} \end{bmatrix} + \gamma \Delta \Omega_t + \nu_i + \varepsilon_{it} \quad (22)$$

The included variables and subscripts are as outlined for equation (20) except for the variable *Icap*, which is an index of the degree of capital mobility and computed as described below. The parameter estimate for the pure debt service term in (20) therefore measures the effect of debt service on the dependent variable under perfect capital mobility, while the interaction term measures the change in the effect of debt service when capital mobility increases (i.e. the change in the effect of debt service per unit of *Icap*). Support for hypotheses 3 and 4 would therefore require that the interaction term have the opposite sign of the debt service term for taxes and the same sign as the debt service term for expenditures, given that hypotheses 1 and 2 are accepted.

The Data

The sample consists of yearly data for 14 EU member countries (EU15 less Luxembourg) from 1980 to 2000, with some variation in the length of the individual country series. Definitions and precise sources of the data are given in Appendix 1. Some data issues deserve further comments. First, the exercise of measuring capital mobility empirically is not straightforward. Suggested proxies for capital mobility are plenty, most with more drawbacks than advantages and none of them perfect (see Edison *et al.* (2002) for a recent survey). For the purposes of the present study,

¹⁰ Due to the contemporaneous simultaneity, lagging the explanatory variables does lead to a situation where the dependent variable may be correlated with the lagged error terms. However, this should not bias or render the

capital mobility is measured by the absolute value of covered interest parity differentials on three-month interbank deposits, with the advantage of using a measure which takes into account the actual intensity of capital controls, but with the drawback of measuring the mobility of a very small segment of capital, namely that of short term financial capital flows. Assuming that the mobility of longer term and real capital is correlated with that of short term financial capital, this drawback is considered acceptable, or at least more acceptable than the drawbacks associated with other capital mobility measures used in the literature. *Icap* is set equal to minus the absolute deviation from covered interest parity in order to ensure that an increase in the measure indicates an increase in capital mobility. The highest value, indicating perfect capital mobility, is thus zero. Second, measuring the tax burden on capital is equally subject to pitfalls. Basing the measure on capital or corporate tax revenues in percent of GDP would not take into account changes in the tax base (corporate profits) which is generally considered to have increased significantly since the 1990s. To account for this problem, an implicit tax rate is used, based on capital tax revenues and divided by an estimate of the capital tax base calculated according to the method of Carey and Rabesona (2002), which is a modified version of the Mendoza, Razin and Tesar (1994) methodology. The drawbacks of using this measure consists mainly in the lack of accuracy of the estimate of the tax base as well as the fact that it is ex post and as such does not take into account the effect of behavioral responses to changes in taxes on the tax base. These drawbacks should be kept in mind when interpreting the results. One more variable needed for the empirical analysis deserves attention: how to measure debt servicing obligations. In a world similar to that of the tax competition model outlined in Section 1, with no tomorrow and hence no growth, the measure is the pure nominal interest payments on the public debt:

estimates inconsistent.

$$DS1 \equiv r_t \cdot b_t \quad (23)$$

where b is the debt to GDP and r is the average nominal interest rate on government debt. But the government budget constraint is affected by growth, and allowing for GDP growth makes the choice of how to measure debt service less clear. An alternative measure of debt service, which is similar to the measure proposed by Roubini and Sachs (1989) and used in several studies after that, is given by the intertemporal budget constraint:

$$DS2 \equiv (r_t - \sigma_t) \cdot b_t \quad (24)$$

where σ is the nominal growth rate. Using the $DS2$ measure of debt service implicitly assumes that policy responds to the level of the primary balance, $t_t - g_t$, needed to keep the debt to GDP ratio unchanged. If growth increases, it gives the same leeway in the budget as if the interest rate on the public debt decreases, so a change in the interest rate on public debt only matters budget wise if the growth rate does not change in the same way as well. $DS1$, on the other hand, assumes that the policy response to changes in growth and interest payments are not the same, although the two effects provide the same air in the overall budget. One reason for such a behavior of policy makers could be that pure interest payments directly and visibly affect the budget and are predictable, while the effects of growth, all else equal, is to reduce the debt to GDP ratio indirectly, and this effect is observed with a lag compared to the interest payments effect, as accounts and statistics become available. Hence, in short, the cash effect of pure interest payments in the budget has a different timing than the growth effect, and this could potentially affect the response of the policy maker.

If $DS2$ is the measure that policy makers respond to, and $\sigma_t \cdot b_t$ and $r_t \cdot b_t$ are not correlated, the parameter estimates of $DS2$ and $DS1$ should be the same. However, since $\sigma_t \cdot b_t$ and $r_t \cdot b_t$ are found to be positively correlated empirically¹¹, using $DS1$ will bias the parameter estimate toward zero if $DS2$ is the correct measure. If, on the other hand, $DS1$ is the correct measure and $\sigma_t \cdot b_t$ does not have significant explanatory power, using $DS2$ in the regression will imply a higher standard error of the parameter estimate. A regression including the interest part and the growth part separately can be used to test whether $DS2$ is the right measure of debt service impacting on the budget, by testing whether the parameter estimate of the interest rate term is equal to minus the estimate of the growth term. Carrying out this test, $DS2$ does turn out to have higher standard errors of the parameter estimate while parameter estimates for $DS1$ are greater in size, and robust to the inclusion of $\sigma_t \cdot b_t$. Moreover, the parameter estimates of the growth and the interest components cannot be accepted as being equal statistically (see the Wald test statistics in Table 1). Only $DS1$ has therefore been used in the following analysis. $DS1$ and $DS2$ are defined and calculated as implicit rates as laid out in Appendix 1.

The Estimation Results

The Basic Specification

Table 1 shows the results of the regressions of the basic specification given by (21) for the tax revenues to GDP ratio, the implicit capital tax rate and primary expenditures to GDP ratio. The regressions are carried out for an unbalanced panel with fixed effects¹² using feasible GLS, thus accounting for contemporaneous correlation as well as cross sectional heteroscedasticity. The signs of the parameter estimates are for the most part either as expected and in line with the

¹¹ With a correlation coefficient of 0.74 in the EU14 panel from 1973 to 1999.

previous literature on the determinants of fiscal policy, or insignificant, with a few exceptions. The participation ratio is significant but with the wrong sign in the two tax regressions, and the unemployment rate is significant with the wrong sign in the capital tax regression and the expenditure regression. Interestingly, the dummy for the Maastricht years takes the predicted signs is is significant on the 10 percent level in the expenditures regression, implying that the entry into force of the Maastricht convergence criteria was associated with a reduction in spending to of GDP of 0.37 percentage points.

(Table 1 IN HERE)

How Does Debt Servicing Affect Taxes and Spending (H1 and H2)?

The regression results confirm hypothesis one, by showing that a one percentage point increase in the debt service to GDP ratio results in a 0.37 percentage point increase in the tax revenue to GDP ratio, a 0.26 percentage point increase in the implicit capital tax rate and 0.35 percentage point fall in the primary expenditures to GDP ratio the following year. Since the sum of the two parameter estimates of the total tax regression commented on above, and the parameter estimate of the expenditures regression is below one, the change in debt service is not fully adjusted to in the budget the following year. The significantly positive effect on overall taxes is robust to the inclusion of a dummy for political ideology (the construction of which is discussed in Appendix 1), the current and the first lead of a dummy for election year to capture election cycle effects on

¹² The results of the Hausman test indicated fixed effects. The estimated fixed effects are not shown but can be obtained from the author.

the budget, and overall interest rate changes (see Table 4)¹³. In order to test whether the effect of debt service changed due to the fiscal provisions of the Maastricht treaty and their continuation in the shape of the Stability and Growth Pact, the regressions are also estimated including an interaction term between debt servicing and the Maastricht dummy as a robustness test. The results, presented in Table 6, show that the parameter estimates of the debt servicing terms are robust to this inclusion in all three regressions, and moreover, the interaction terms are insignificant.

Table 2 shows the percentage change in the tax to GDP ratio and the primary expenditures to GDP ratio due to debt service in 1999 implied by the parameter estimate of the basic regression. According to the calculations, Greece was the country most affected by debt service obligations in 1999, with an estimated 9.05 percent increase in the tax to GDP ratio and an estimated 8.37 percent fall in primary expenditures to GDP due to debt service obligations. In comparison, France was estimated to have had 2.7 percent higher taxes and 2.41 percent lower expenditures to GDP due to debt service during that year. Cross country differences in the level of debt may therefore be a non-negligible source of asymmetry in the overall tax burden across EU countries.

(Table 2 IN HERE)

In order to single out the types of expenditures which are reduced as a consequence of debt service obligations, regressions are carried out using as dependent variables four major items of primary spending. The parameter estimates of debt service obtained from these regressions are

¹³ The correlation could be suspected of being the result of “common shocks” in that taxes, spending and debt

given in Table 3. Government expenditures on non-wage consumption and social security payments are not significantly affected by changes in debt servicing obligations. Government expenditures on wage consumption is significantly affected by debt service, but rather modestly. In contrast, government investment expenditures are found to respond significantly with a reduction of 0.69 percentage points to an increase in debt servicing obligations of one percentage point.

(Table 3 IN HERE)

The conclusion of the test of hypotheses one and two is that higher debt and hence debt servicing obligations lead to higher taxes, higher capital taxes and lower overall spending. Moreover, the data indicates that public investments constitute the main part of spending reduced when debt servicing increases. If public investments in fact increase productivity and growth, the results indicate that high debt and debt servicing levels may have implications for high-debt countries' ability to grow themselves out of their public debt in the future.

Does Tax Competition Increase Debt Induced Asymmetries (H3 and H4)?

Hypotheses three and four concerning the change of the effect of debt service on taxes and expenditures of increasing capital mobility are tested by estimating equation (22) for overall taxes, the implicit capital tax rate and primary expenditures. The estimation procedure is the same as above. Greece and Finland have been excluded from the sample due to the few available

servicing could all three in principle be correlated with interest rates, and in turn with each other without any causal link.

observations of the capital mobility variable for these countries¹⁴. Additionally, the inclusion of *Icap* in the regression lowers the number of observations used in the regression substantially, which should be kept in mind in interpreting the results. The regression results are shown in Table 4. In general, the parameter estimates have slightly higher standard errors, which may be due both to the shorter sample or the slight increase in multicollinearity introduced by the inclusion of the capital mobility terms.

(Table 4 IN HERE)

The inclusion of the capital mobility terms increases the size of the parameter estimates of the debt service terms in all three regressions. Moreover, interestingly, the capital mobility term alone is insignificant in all three regressions implying that tax competition has not affected taxes – neither capital taxes nor other taxes – or spending as of yet¹⁵.

Turning to the question of interest here, the parameter estimates for the interaction terms between debt service and capital mobility show that the hypothesis that increased capital mobility should result in a smaller effect of debt servicing obligations on overall and capital taxes is not supported by the data. In turn, the tax induced level of distortions to high-debt countries must be higher relative to low-debt countries, the more mobile capital becomes. Hence, asymmetries in tax induced distortions increase with financial integration and capital mobility.

¹⁴ The exclusion of these two countries does not considerably change the parameter estimate of DS1 in the regression given in Table 1.

¹⁵ Finding an insignificant parameter estimate for the capital mobility term is in line with the general results (or lack thereof) of the empirical literature testing basic tax competition hypotheses. See Garret and Mitchell (2001) for a recent example.

Capital mobility is found to increase the downward pressure of debt service on primary expenditures, and the parameter estimates of debt servicing and the interaction between debt servicing and capital mobility are robust to the inclusion of political variables and changes in the interest rate. The effect of a one percentage point increase in the *DSI* under perfect capital mobility (i.e. when $I_{cap}=0$) is to reduce the primary expenditures ratio with 0.46 percentage points, and this impact is 0.22 percentage points smaller in absolute value for every percentage point decrease of the *Icap* below zero. The fact that the average value of *Icap* for European Union countries increased from about -2 percentage points in the early 1990s to zero for the countries joining the Euro in 1999 gives an impression of the quantitative importance of these estimates. Hence, according to the data, the speeding up of financial integration in the 1990s lead to an average increase in the impact of debt servicing obligations on primary spending ratios of about 0.44 percentage points, or almost the entire amount of the debt induced asymmetries.

The case of no support for hypothesis 3 while some support for hypotheses four is found conforms to the special case in the model where the infra-marginal effect of increasing capital mobility outweighs the marginal effect of higher marginal cost of public funds (i.e. the case in which condition (18) is not fulfilled).

3. Conclusion

Allowing for asymmetric levels of public debt in an otherwise symmetric tax competition model shows how debt service obligations lead to higher taxes and lower spending in high-debt countries relative to low-debt countries. Moreover, while the impact of increasing capital mobility on tax asymmetries is theoretically ambiguous and depends on the parameters of the model, going from zero to positive capital mobility results in debt-induced tax distortion

asymmetries due to the simple fact that high-debt countries have higher taxes irrespective of the degree of capital mobility. Furthermore, higher capital mobility is found to amplify public spending asymmetries theoretically.

The predictions of the model are largely supported by the data for a panel of European Union countries. Debt servicing obligations significantly increase total tax revenues in percent of GDP and implicit capital tax rates in EU member countries. Moreover, primary expenditures are significantly lower the higher are debt servicing obligations. In particular, debt servicing seems to reduce public investments more than any other category of public spending. The impact of capital mobility on the effect of debt servicing obligations on taxes is insignificant, implying that the level of debt induced distortions to high-debt economies *relative* to their low-debt counterparts increases with the degree of capital mobility. Capital mobility is found to significantly amplify the effect of debt service on primary spending.

The findings indicate that the highly asymmetric levels of public debt across EU member countries explain some of the cross country asymmetries in national tax and spending levels within the EU. In addition, rather than inducing convergence, the process of financial integration within the Single Market may have been magnifying public debt induced primary spending asymmetries, as well as asymmetries in the level of tax induced distortions to the economies of the European Union.

These results have several implications. If a higher level of tax induced distortions hampers growth relative to less distorted economies, and if public investments increase future productivity

and growth, then the results indicate two mechanisms by which public debt may adversely affect growth. Public debt asymmetries may therefore induce growth asymmetries among EU countries. Moreover, a high level of debt and debt servicing obligations may hamper high-debt countries' efforts to grow out of their public debts. Finally, if these negative links between debt and growth have intensified due to increasing financial market integration in the European Union, then all else equal, integration itself could be placed under suspicion of having hampered the convergence of public debt and deficit to GDP ratios in the EU.

Appendix 1: Data Sources and Definitions

The data used in the empirical analysis are described in Table 5. The overall sample size is 1972 to 2000. Some series start later or end earlier and the panel is hence unbalanced. The countries included in the sample are the EU15 less Luxembourg due to poor data availability. In line with the empirical literature on the effects of ideology on fiscal policy, data provided by Woldendorp et al. (2000) on ideology of the government in power is used in the construction of the index of ideology. They provide a classification of the ideology of government by breaking it down to five cases. 1. Right wing parties dominate both government and parliament. 2. Right wing or center parties make up between 33.3% and 66.6% of government. 3. Center parties make up more than 50% of government. 4. Left wing or center parties make up between 33.3% and 66.6% of government. 5. Left wing parties dominate government. Woldendorp et al. (2000) describes how the distinction has been made between right wing, center and left wing parties. On the basis of this data series, the left wing dummy (LEFT) takes the value one in case 4 and 5.

(Table 5 IN HERE)

Appendix 2: Robustness tests

(Table 6 IN HERE)

(Table 7 IN HERE)

(Table 8 IN HERE)

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Tables

Table 1. Results for the basic specification. Sample: 1980-2000

| | <i>ΔTOTALTAX</i> | | | <i>ΔIMPLCAP</i> | | | <i>ΔEXPGDP</i> | | |
|-------------------------|------------------------|--------|----------|------------------------|--------|----------|------------------------|--------|----------|
| | Para- meter Est. | t-stat | p-value | Para- meter Est. | t-stat | p-value | Para- meter Est. | t-stat | p-value |
| $\Delta DS1_{-1}$ | 0.37 | 5.47 | 0.00 | 0.26 | 2.28 | 0.02 | -0.35 | -3.92 | 0.00 |
| ΔBY_{-1} | 0.003 | 0.79 | 0.43 | 0.01 | 1.43 | 0.15 | -0.04 | -6.89 | 0.00 |
| GR_{-1} | -0.05 | -2.47 | 0.01 | -0.08 | -2.72 | 0.01 | -0.17 | -7.14 | 0.00 |
| $INFL_{-1}$ | 0.02 | 0.93 | 0.35 | 0.02 | 0.38 | 0.70 | 0.13 | 4.22 | 0.00 |
| $\Delta OPEN_{-1}$ | -0.001 | -0.16 | 0.87 | 0.02 | 2.94 | 0.00 | -0.01 | -1.74 | 0.08 |
| $\Delta PART_{-1}$ | 0.20 | 3.08 | 0.00 | 0.36 | 4.24 | 0.00 | 0.01 | 0.16 | 0.87 |
| ΔUN_{-1} | -0.01 | -0.12 | 0.90 | -0.36 | -5.70 | 0.00 | -0.11 | -2.66 | 0.00 |
| $MAAS_{-1}$ | 0.11 | 0.94 | 0.35 | 0.10 | 0.54 | 0.59 | -0.37 | -1.66 | 0.09 |
| Observations | | 258 | | | 241 | | | 255 | |
| F-test (all slopes=0) | | 6.66 | (p=0.00) | | 16.1 | (p=0.00) | | 10.2 | (p=0.00) |
| DW | | 2.02 | | | 1.87 | | | 2.18 | |
| R ² | | 0.10 | | | 0.23 | | | 0.20 | |
| Wald-test ^{/a} | | 10.8 | (p=0.00) | | 0.18 | (p=0.67) | | 4.03 | P=(0.04) |

/a: In a regression using *DS2* but splitting up *DS2* into the interest rate term and the growth term, the Wald test is for the restriction that the parameter estimate of the interest rate term is equal to minus the parameter estimate of the growth-debt interaction term, which would support the use of *DS2*.

Table 2. The percentage change in overall tax and expenditures ratios due to debt service in 1999 according to parameter estimates, percent.

| | Overall Taxes in percent of GDP | Primary Expenditures in percent of GDP |
|-------------|---------------------------------|--|
| Greece | 9.05 | -8.37 |
| Italy | 5.89 | -6.06 |
| Belgium | 5.75 | -5.78 |
| Netherlands | 4.08 | -4.07 |
| Spain | 3.83 | -3.67 |
| Sweden | 3.77 | -3.66 |
| Germany | 3.45 | -3.44 |
| Denmark | 3.34 | -3.22 |
| Portugal | 3.33 | -2.92 |
| Austria | 3.26 | -2.92 |
| Ireland | 3.19 | -2.73 |
| UK | 2.84 | -2.70 |
| France | 2.70 | -2.41 |

b) The number for Greece is calculated for 1997 due to lack of availability of later data.

Table 3: The estimated effect of debt service on four major items of government primary expenditures

| | Average EU percentage of total primary expenditures in 1999 | Parameter estimate ^a |
|---|---|---------------------------------|
| Government non-wage consumption expenditure in percent of GDP | 21.5 % | -0.073 |
| Government wage expenditure in percent of GDP | 30.5 % | - |
| Government investments expenditures in percent of GDP | 6.7 % | -0.691 |
| Social security benefits paid in percent of GDP | 39.5 % | - |

/a: Estimates are significantly different from zero on the 1% significance level, except for social security and non-wage consumption, which are insignificant.

Table 4. Results for the specification including *Icap*. Sample: 1980-2000.

| | <i>ΔTOTALTAX</i> | | | <i>ΔIMPLCAP</i> | | | <i>ΔEXPGDP</i> | | |
|-------------------------------|------------------|--------|---------|-----------------|--------|---------|----------------|--------|---------|
| | Para- meter | | | Para- meter | | | Para- meter | | |
| | Est. | t-stat | p-value | Est. | t-stat | p-value | Est. | t-stat | p-value |
| $\Delta DS1_{-1}$ | 0.72 | 3.40 | 0.00 | 0.32 | 1.02 | 0.31 | -0.46 | -2.05 | 0.04 |
| $-CIP_{-1} * \Delta DS1_{-1}$ | 0.01 | 0.09 | 0.92 | -0.20 | -1.23 | 0.22 | -0.22 | -1.94 | 0.04 |
| $-\Delta CIP_{-1}$ | -0.08 | -0.84 | 0.39 | -0.10 | -0.54 | 0.59 | -0.18 | -1.42 | 0.16 |
| ΔBY_{-1} | 0.02 | 2.49 | 0.01 | 0.02 | 2.05 | 0.04 | -0.01 | -1.77 | 0.07 |
| GR_{-1} | 0.01 | 0.14 | 0.88 | 0.05 | 0.71 | 0.48 | -0.15 | -3.54 | 0.00 |
| $INFL_{-1}$ | 0.06 | 1.74 | 0.08 | 0.02 | 0.43 | 0.66 | 0.03 | 0.86 | 0.38 |
| $\Delta OPEN_{-1}$ | 0.002 | 0.26 | 0.79 | 0.01 | 1.69 | 0.09 | -0.002 | -0.51 | 0.61 |
| $\Delta PART_{-1}$ | 0.30 | 2.98 | 0.00 | 0.32 | 1.91 | 0.06 | 0.43 | 4.32 | 0.00 |
| ΔUN_{-1} | -0.18 | -2.74 | 0.01 | -0.28 | -2.73 | 0.01 | -0.07 | -0.88 | 0.38 |
| $MAAS_{-1}$ | 0.07 | 0.45 | 0.65 | 0.23 | 0.89 | 0.37 | -0.37 | -1.59 | 0.11 |
| Observations | 131 | | | 164 | | | 161 | | |
| DW | 2.07 | | | 1.89 | | | 1.83 | | |
| R ² | 0.18 | | | 0.30 | | | 0.28 | | |

Table 5: Definitions and sources of data used in the panel regression analysis

| Variable | Definition and Sources |
|---|--|
| EXPGDP | Primary expenditures in percent of GDP. Source: OECD Economic Outlook |
| IMPLCAP | Implicit tax rate on capital calculated according to Carey and Rabesona (2002) on the basis of OECD revenue statistics. Source: Personal communication from David Carey. |
| TOTALTAX | Total tax revenues in percent of GDP. Source: OECD Economic Outlook |
| Icap | Calculated as one minus the yearly average of monthly observations of absolute deviation from covered interest parity on 3 month interbank deposit interest rates vis-à-vis the German ditto. The underlying assumption is hence that German capital mobility was near perfect during the period studied. Data on forward and spot exchange rates for calculating the forward premium is from Datastream. Interest rate data is from OECD Main Economic Indicators |
| BY | First difference of the debt to GDP ratio (Nominal gross debt and nominal gross domestic product). Source: OECD Economic Outlook |
| DS1 | Gross interest payments on public debt in percent of GDP |
| DS2 | The average nominal interest on government debt less the nominal growth rate times the debt to GDP ratio. The average interest on government debt is approximated by the gross interest payment on public debt divided by the gross debt. Source: OECD Economic Outlook |
| GR | Real growth rate, calculated using data on nominal GDP and the GDP deflator. Source: OECD Economic Outlook |
| INFL | The yearly percentage change in the consumer price index. Source: OECD Economic Outlook |
| OPEN | Residuals of a regression of the sum of exports and imports divided by 1.000.000*GDP (all in current local currency) on the relative size of the country (size is measured as real GDP in percent of sum of real GDP of the panel countries). Source: OECD Economic Outlook |
| UN | Unemployment rate, percent. Source: OECD Economic Outlook |
| PART | The participation rate, constructed as the labor force in percent of the population between the age of 15 and 65. Data for Portugal are from the Ameco database. Otherwise, the source is OECD Economic Outlook. |
| MAAS | Dummy for the Maastricht years, taking the value 1 from 1993 onwards. |
| LEFT | Dummy for the ideology of the government in power. Construction as explained above. Source: Woldendorp, Keman and Budge (2000) |
| IR | Long term interest rate, percent. Source: OECD Economic Outlook |
| EYEAR | Dummy taking the value 1 in years of parliamentary elections of the given country, and zero otherwise. Source: Parties and Elections in Europe: http://www.parties-and-elections.de/ |
| Government non-wage consumption expenditure in percent of GDP | Source: OECD Economic Outlook |
| Government wage expenditure in percent of GDP | Source: OECD Economic Outlook |
| Government investments and other capital transactions in percent of GDP | Source: OECD Economic Outlook |
| Social security benefits paid in percent of GDP | Source: OECD Economic Outlook |

Table 6. Hypothesis 1 and 2: Results for the primary expenditures regression including the Maastricht dummy interacted with debt service. Sample: 1980-2000

| Dependent Variable | $\Delta TOTALTAX$ | | | $\Delta IMPLCAP$ | | | $\Delta EXPGDP$ | | |
|-------------------------|--------------------|--------|---------|--------------------|--------|---------|--------------------|--------|---------|
| Explanatory Variable | Parameter Estimate | | | Parameter Estimate | | | Parameter Estimate | | |
| | Estimate | t-stat | p-value | Estimate | t-stat | p-value | Estimate | t-stat | p-value |
| $\Delta DS1_{-1}$ | 0.34 | 3.66 | 0.00 | 0.42 | 2.56 | 0.01 | -0.42 | -3.85 | 0.00 |
| MAAS* $\Delta DS1_{-1}$ | 0.130 | 0.87 | 0.38 | -0.31 | -1.37 | 0.17 | 0.24 | 1.14 | 0.26 |
| ΔBY_{-1} | 0.003 | 0.79 | 0.42 | 0.01 | 1.63 | 0.10 | -0.04 | -6.97 | 0.00 |
| GR_{-1} | -0.05 | -2.42 | 0.02 | -0.08 | -2.60 | 0.01 | -0.16 | -7.06 | 0.00 |
| $INFL_{-1}$ | 0.02 | 1.02 | 0.30 | 0.02 | 0.36 | 0.71 | 0.12 | 4.11 | 0.00 |
| $\Delta OPEN_{-1}$ | -0.001 | -0.18 | 0.85 | 0.02 | 2.98 | 0.00 | -0.01 | -1.74 | 0.08 |
| $\Delta PART_{-1}$ | 0.19 | 3.12 | 0.00 | 0.35 | 4.16 | 0.00 | 0.02 | 0.25 | 0.80 |
| ΔUN_{-1} | -0.01 | -0.19 | 0.84 | -0.34 | -5.39 | 0.00 | -0.11 | -2.82 | 0.01 |
| MAAS $_{-1}$ | 0.11 | 0.92 | 0.35 | 0.08 | 0.45 | 0.64 | -0.36 | -1.60 | 0.11 |

Table 7. Hypothesis 1 and 2: Robustness of parameter estimates to the inclusion of other explanatory variables. Sample: 1980-1996^a

| | <i>ΔTOTALTAX</i> | | | <i>ΔIMPLCAP</i> | | | <i>ΔEXPGDP</i> | | |
|--------------------|--------------------|--------|---------|--------------------|--------|---------|--------------------|--------|---------|
| | Parameter Estimate | t-stat | p-value | Parameter Estimate | t-stat | p-value | Parameter Estimate | t-stat | p-value |
| $\Delta DS1_{-1}$ | 0.31 | 3.41 | 0.00 | 0.35 | 2.41 | 0.02 | -0.58 | -10.04 | 0.00 |
| ΔBY_{-1} | 0.01 | 1.41 | 0.16 | 0.01 | 1.63 | 0.10 | -0.04 | -9.32 | 0.00 |
| GR_{-1} | -0.07 | -3.05 | 0.00 | -0.12 | -3.54 | 0.00 | -0.27 | -18.12 | 0.00 |
| $INFL_{-1}$ | -0.04 | -1.71 | 0.09 | -0.02 | -0.41 | 0.68 | 0.25 | 10.43 | 0.00 |
| $\Delta OPEN_{-1}$ | -0.01 | -0.81 | 0.42 | 0.026 | 3.20 | 0.00 | -0.01 | -2.39 | 0.02 |
| $\Delta PART_{-1}$ | 0.14 | 2.09 | 0.04 | 0.50 | 4.69 | 0.00 | -0.14 | -2.41 | 0.01 |
| ΔUN_{-1} | 0.03 | 0.60 | 0.55 | -0.32 | -3.83 | 0.00 | -0.13 | -5.02 | 0.00 |
| $MAAS_{-1}$ | 0.11 | 0.77 | 0.44 | 0.38 | 1.38 | 0.17 | -0.27 | -0.96 | 0.34 |
| ΔIR_{-1} | 0.11 | 3.11 | 0.00 | 0.095 | 1.49 | 0.14 | 0.30 | 8.68 | 0.00 |
| LEFT | -0.22 | -2.58 | 0.01 | -0.45 | -3.62 | 0.00 | -0.17 | -2.68 | 0.01 |
| EYEAR ₊ | -0.22 | -2.45 | 0.02 | -0.11 | -0.83 | 0.41 | -0.35 | -4.77 | 0.00 |
| $\frac{1}{EYEAR}$ | -0.71 | -7.64 | 0.00 | -0.79 | -5.98 | 0.00 | -0.25 | -3.52 | 0.00 |
| DW | 2.029 | | | 1.876 | | | 2.25 | | |

a: The time dimension of the sample is limited by the times series on ideology, which end in 1996.

Table 8. Hypothesis 3 and 4: Robustness of parameter estimates to the inclusion of other explanatory variables. Sample: 1980-1999^a

| | $\Delta TOTALTAX$ | | | $\Delta IMPLCAP$ | | | $\Delta EXPGDP$ | | |
|-------------------------------|--------------------|--------|---------|--------------------|--------|---------|--------------------|--------|---------|
| | Parameter Estimate | t-stat | p-value | Parameter Estimate | t-stat | p-value | Parameter Estimate | t-stat | p-value |
| $\Delta DS1_{-1}$ | 0.82 | 3.81 | 0.00 | 0.07 | 0.26 | 0.79 | -0.49 | -2.18 | 0.03 |
| $-CIP_{-1} * \Delta DS1_{-1}$ | 0.04 | 0.36 | 0.71 | -0.34 | -2.22 | 0.03 | -0.20 | -1.72 | 0.08 |
| $-\Delta CIP_{-1}$ | -0.13 | -1.50 | 0.13 | -0.18 | -1.04 | 0.29 | -0.12 | -0.90 | 0.37 |
| ΔBY_{-1} | 0.01 | 2.48 | 0.01 | 0.02 | 2.34 | 0.02 | -0.015 | -1.88 | 0.06 |
| GR_{-1} | 0.004 | 0.11 | 0.91 | 0.06 | 0.87 | 0.38 | -0.21 | -4.55 | 0.00 |
| $INFL_{-1}$ | 0.04 | 1.60 | 0.11 | 0.03 | 0.71 | 0.47 | 0.02 | 0.54 | 0.59 |
| $\Delta OPEN_{-1}$ | 0.005 | 0.52 | 0.59 | 0.01 | 1.83 | 0.07 | -0.001 | -0.39 | 0.69 |
| $\Delta PART_{-1}$ | 0.33 | 3.32 | 0.00 | 0.31 | 1.93 | 0.05 | 0.47 | 4.49 | 0.00 |
| ΔUN_{-1} | -0.14 | -2.27 | 0.02 | -0.27 | -3.27 | 0.00 | -0.049 | -0.56 | 0.57 |
| $MAAS_{-1}$ | 0.09 | 0.59 | 0.55 | 0.12 | 0.53 | 0.59 | -0.28 | -1.21 | 0.23 |
| ΔIR_{-1} | -0.04 | -1.11 | 0.26 | -0.16 | -2.42 | 0.01 | 0.13 | 2.15 | 0.03 |
| $EYEAR_{+1}$ | -0.001 | -0.02 | 0.99 | 0.13 | 0.86 | 0.38 | -0.23 | -1.88 | 0.06 |
| $EYEAR$ | -0.50 | -7.25 | 0.00 | -0.71 | -4.63 | 0.00 | -0.27 | -2.23 | 0.03 |
| DW | 2,13 | | | 2.29 | | | 1.71 | | |

a: 1980-1997 when the implicit tax rate is used. Controlling for the ideology dummy is left out as this reduces the number of observations to a degree that renders results uninteresting in the present regression.

a: The time dimension of the sample is limited by the times series on ideology, which end in 1996.