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The Effects of the European Economic and Monetary  
Union (EMU) on National Fiscal Sustainability

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Abstract

This paper presents a methodology to analyze the responsiveness of fiscal sustainability to the "endogenous fiscal discipline" that will be strengthened by the EMU. This discipline arises in response to the harmonization of tax systems, the loss of control of current and prospective money financing, and the deepening of financial market-based discipline. The model used in this paper is a generalization of Blanchard's 1984 model, in which the interest rate is determined endogenously. This provides the framework to analyze more features of the linkage between sustainability and endogenous fiscal discipline. This paper also presents a new intratemporal fiscal sustainability index.

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Summary

This paper presents a methodology to analyze some of the possible fiscal effects of the EMU. It uses a theoretical tool, the "fiscal sustainability frontiers," and a new fiscal sustainability index. The paper argues that in the EMU the fiscal autonomy will be tightened by the "endogenous fiscal discipline" stemming from the harmonization of tax systems, the loss of current and prospective money financing, and the deepening of financial market-based discipline.

This paper extends Blanchard's 1984 analysis in three ways. First, it sets the interest rate endogenously as a positive function of the debt. (In Blanchard's model, the interest rate is maintained constant.) Second, this innovation provides a more detailed framework to examine the implications of the three factors strengthening the endogenous fiscal discipline. Third, the fiscal sustainability frontiers permit the definition of the regions where combinations of deficit and debt are fiscally sustainable.

These extensions of Blanchard's model are used to illustrate how the sustainable debt is affected by the reputation of the government. If this reputation is low and the financial market commands a significant country-specific risk premium, the fiscal sustainability frontier will shift adversely.

The new intratemporal fiscal sustainability index allows a comparison of the fiscal positions of the EU members. The index is based on the gap between an indicative sustainable level of debt and the current debt. The EU members are classified in three groups according to their fiscal performance. The Group 1 countries--France, Germany, Luxembourg, and the United Kingdom--do not have a fiscal sustainability problem. The Group 2 countries--Denmark, Ireland, the Netherlands, Portugal, and Spain--do not have an immediate fiscal sustainability problem. However, Group 3 countries--Belgium, Greece, and Italy--may need a fiscal adjustment. The paper argues that the EMU might provide all Groups 2 and 3 countries with an opportunity to improve their fiscal sustainability if certain conditions are satisfied.

## I. Introduction

The current members of the European Union (EU) are becoming more economically and financially integrated as they get closer to joining the European Monetary Union (EMU) and adopting a single currency. 1/ The objective of this paper is to present a methodology to analyze the responsiveness of fiscal sustainability to the changes that will be entailed by the EMU. The main argument of the paper is that the fiscal autonomy of EMU members will be tightened by the "endogenous fiscal discipline" that stems from: 2/

- (1) the harmonization of tax systems across the EU. An empirical section analyzes the development of selected fiscal variables to better understand this process;
- (2) the loss of control of current and prospective money financing once the single currency is adopted; and
- (3) the strengthening of financial market-based discipline that compels financial markets to differentiate among borrowers.

The model used in this paper to analyze the responsiveness of fiscal sustainability to the changes entailed by the EMU is a generalization of Blanchard (1984). The objective of Blanchard's model was to clarify the notion of fiscal sustainability and to examine its main determinants while holding the interest rate constant. This paper assumes that lenders may not be willing to supply funds at unchanged interest rate and instead may demand an increasing premium that hinges on the level of indebtedness and the confidence in the government. This modified model provides a more general basis for the finding of Blanchard that targeted increases in the primary surplus raise the sustainable level of debt. In particular, this paper demonstrates that this result holds also when the interest rate is set endogenously and is a positive function of the stock of debt. A new intra-temporal index of fiscal sustainability, that measures the gap between an estimate of the sustainable debt and the current debt, summarizes the main findings of the modified model. A small, or even negative, value of this index indicates that the government has a small margin of manoeuvre left. Therefore a shift in fiscal policy is necessary to secure fiscal sustainability.

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1/ The Maastricht Treaty lays out the convergence criteria--for inflation, long-term interest rates, exchange rate stability within the exchange rate mechanism (ERM), and the government budget deficit and debt--which countries must satisfy in order to qualify for the final stage of the EMU. The fiscal admission criteria require that deficits must not exceed 3 percent of GDP, and that public debts must not exceed 60 percent of GDP at the start of the EMU. The deficit may be allowed to temporarily exceed this threshold in exceptional cases. An EMU candidate with both deficit and debt in excess of the respective admission threshold may still be admitted if both have been progressively reduced and at a satisfactory pace. This paper does not concern itself with the potential for meeting the fiscal admission criteria in the near future.

2/ This type of discipline is distinct from the effective implementation of the Maastricht admission criteria or the endorsement of any new EU budgetary restriction.

The paper illustrates its main findings by means of "fiscal sustainability frontiers". These frontiers define the loci of budget deficit and debt that are fiscally sustainable. Finally, this paper shows that the fiscal sustainability of the countries participating in the EMU is likely to improve provided that certain conditions discussed below are satisfied.

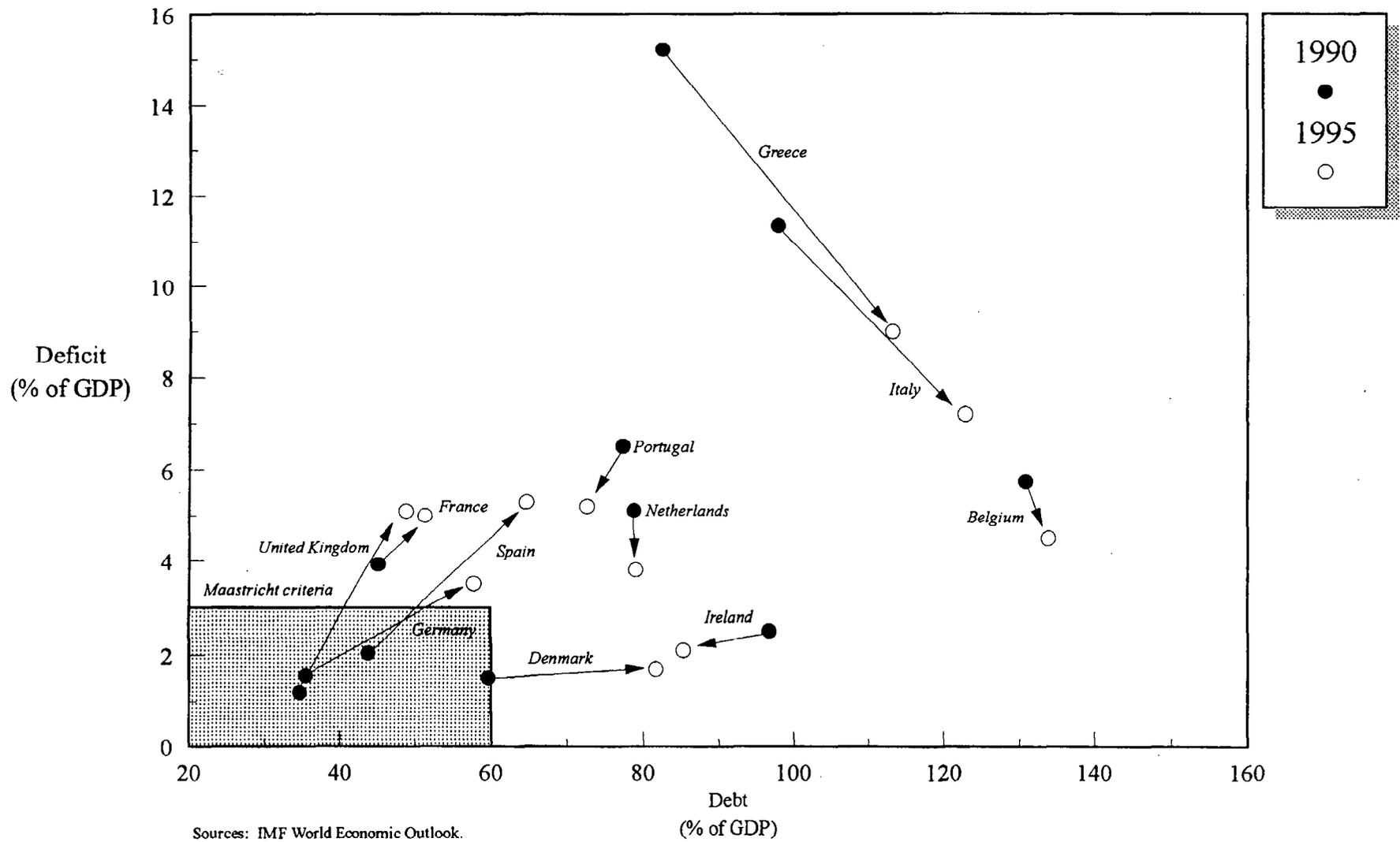
In this paper, a sustainable fiscal plan is defined as one which could be maintained for an extended period while excluding any exceptional financing, such as an outright default, a partial repudiation through some surprise inflation, or retroactive taxation. Such a plan would compel national governments to rely solely on normal and sustained sources of revenue and financing. The concept of fiscal sustainability is at times arbitrary and somewhat elusive. Several authors--such as Buiter and Patel (1992), Wilcox (1989), Hamilton and Flavin (1986), and the references therein--focus instead on a solvency condition that should prevent some actualized value of the public debt from exploding in the future. Solvency is secured when a country meets its intertemporal budget constraint by satisfying a transversality condition that prevents the debt from growing without bound. This paper adds the solvency condition to Blanchard's (1984) model and shows that, when the debt is on an insolvent path, a shift in fiscal policy is necessary to satisfy the solvency condition and secure fiscal sustainability.

Securing fiscal sustainability in the EMU is important for its success because: (1) as economic and financial integration deepen, the effects of fiscal imbalances in any single country are more likely to spill over to the others; (2) high debt-to-GDP ratios reduce policy flexibility and restrict the ability of national governments to pursue counter-cyclical fiscal policies; and (3) the increasing burden of public debt will reduce the provision of public goods, divert resources from domestic investment, and, eventually, cause an emigration of the tax base.

All EU members at the end of 1994 are discussed as if they could take part in the last stage of the EMU. However, the dispersion of budget deficits and debt-to-GDP ratios (Figure 1) is such that not all these countries may join at the same time. The paper is organized as follows. Section II inquires whether all the principal fiscal variables are diverging or some limited convergence is taking place for any variable. The endogenous fiscal discipline is discussed here. Section III presents the model of fiscal sustainability. Section IV presents some empirical findings, and an index of fiscal sustainability. Section V concludes.

The ranking of the EU members in the paper should be interpreted as indicative because the variables and the assumptions underlying the index contain a certain degree of uncertainty and subjectivity. Furthermore, fiscal sustainability across the EU cannot be assessed on the basis of this index alone, but should rely on a variety of fiscal indicators also looking at the inter-temporal evolution of the main fiscal variables. The distinction between various types of gross and net debt, which may change somewhat the results, is briefly considered at the end of Section IV.

Figure 1. Public Sector Deficit and Debt, and the Attainment of the Maastricht Criteria in the EU, 1990-95 <sup>1/</sup>



Sources: IMF World Economic Outlook.

<sup>1/</sup> In 1995, Luxembourg had a 0.4 percent of GDP deficit and a 6.3 percent of GDP gross debt.

## II. Fiscal Divergence, and the Endogenous Fiscal Discipline

### 1. Are all the principal fiscal variables diverging?

Despite the deepening of economic and financial integration, in recent years the fiscal performances of EU members have varied widely (Table 1). <sup>1/</sup> Table 2 recapitulates the relative fiscal positions of EU members at the end of 1995. A set of statistical indicators now investigates some developments crucial for the paper. The data from 1970 to 1994 show that, as a share of GDP, government expenditure and the public debt have diverged the most. Conversely, in more recent years, tax revenue (and partly, total government revenue), and budget deficits have tended to converge. These developments are particularly evident with respect to the six founding EU members (the EU6): Belgium, France, Germany, Italy, Luxembourg, and the Netherlands, as they have integrated their economies earlier than the others. Figure 2.a shows that between 1970 and 1994, the standard deviation of tax revenue was consistently less than that of total government expenditure and total revenue. Since the late 1970s the standard deviation of tax revenue has been declining sharply in the EU6 (Figure 2.b). In the case of budget deficits, their standard deviation has followed a downward trend since the early 1980s in the EU6, and the late 1980s in the EU as a whole. However, this finding may be biased by the size of the deficits.

To overcome the size problem, the coefficient of variations of the principal fiscal variables is calculated. It consists of the absolute value of the ratio between the standard deviation of each variable and its mean, and is illustrated in Figures 2.c and 2.d. In both figures, the coefficient of variations of tax revenue is consistently less than that of the other variables, while that of the budget deficits is initially high but drops in the mid 1970s, and remains almost constant. Therefore, the picture is somewhat mixed with respect to total government expenditure and revenue, and only the EU6 figure shows that the latter variable is slightly smaller. To obtain some additional information about the evolution of the main fiscal variables, the statistical correlation of each country's time series is computed for the 1980-94 period. Only for tax revenue the sample ranges from 1970 to 1992 because more recent data were not yet available. These statistical indicators are reported in Appendix I, and show that:

- (1) correlations are consistently positive only in the case of tax revenue;
- (2) correlations between total government revenue are generally higher than those between government expenditure; and
- (3) correlations between budget deficits are generally positive.

These findings suggest that debt-to-GDP ratios have diverged across countries due largely to different expenditure policies. Furthermore, some fiscal convergence is currently taking place across the EU on the revenue side, particularly concerning tax revenues.

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<sup>1/</sup> Tanzi and Fanizza (1995) provides a detailed analysis of the principal fiscal developments across the EU. Hereafter, convergence refers to a reduction in the dispersion of fiscal variables over time.

Table 1. Selected Budgetary Indicators and Tax Rates for 1993–1995

|                       | General Government, 1995 1/ |              |                 |                    |                |               | Selected tax ratios and tax rates, 1993 |                          |                         |                                |               |  |
|-----------------------|-----------------------------|--------------|-----------------|--------------------|----------------|---------------|---|--------------------------|-------------------------|--------------------------------|---------------|--|
|                       | Total Revenue               | Total Expend | Overall Balance | Structural Balance | Primar Balance | Gross Debt 2/ | Total Tax Revenue 3/                    | Taxes on Income and Prof | Social Sec. Contrib. 4/ | Taxes on goods and Services 5/ | Other Taxes 6 | Corpor. and Capital Gains Tax Rates 7/ |
|                       | (In percent of GDP)         |              |                 |                    |                |               | (In percent of Total Tax Revenue)       |                          |                         |                                |               | (Tax rates)                            |
| Belgium               | 47.9                        | 52.4         | -4.5            | -3.9               | 4.7            | 133.8         | 45.5                                    | 35.6                     | 35.6                    | 26.3                           | 2.5           | 39.0                                   |
| Denmark               | 60.6                        | 62.3         | -1.7            | -0.8               | 1.7            | 81.6          | 48.9                                    | 59.5                     | 3.2                     | 31.7                           | 5.6           | 34.0                                   |
| France                | 49.6                        | 54.6         | -5.0            | -3.1               | -2.0           | 52.3          | 43.7                                    | 17.4                     | 44.6                    | 26.7                           | 11.3          | 33.3                                   |
| Germany               | 47.0                        | 50.6         | -3.5            | -2.1               | -0.3           | 57.7          | 40.0                                    | 30.7                     | 38.7                    | 27.8                           | 2.8           | 50.0                                   |
| Greece                | 45.0                        | 54.0         | -9.0            | -7.4               | 2.9            | 113.2         | 38.3                                    | 18.2                     | 33.8                    | 43.9                           | 4.1           | 35.0                                   |
| Ireland               | 43.0                        | 45.1         | -2.1            | -2.1               | 2.3            | 85.3          | 38.0                                    | 40.2                     | 15.4                    | 38.3                           | 6.1           | 40.0                                   |
| Italy                 | 45.4                        | 52.6         | -7.2            | -6.0               | 3.3            | 122.9         | 42.4                                    | 34.0                     | 37.1                    | 23.7                           | 5.2           | 52.2                                   |
| Luxembourg 8/         | 37.6                        | 37.2         | 0.4             | ...                | ...            | 6.3           | 43.1                                    | 36.8                     | 28.6                    | 26.9                           | 7.7           | 42.1                                   |
| Netherlands           | 58.0                        | 61.8         | -3.8            | -3.0               | 0.8            | 79.0          | 46.7                                    | 32.4                     | 38.2                    | 25.3                           | 4.1           | 35.0                                   |
| Portugal              | 42.1                        | 47.3         | -5.2            | -3.7               | 0.2            | 72.6          | 37.8                                    | 27.5                     | 26.8                    | 42.6                           | 3.1           | 36.0                                   |
| Spain                 | 41.0                        | 47.0         | -5.9            | -4.3               | -0.5           | 64.7          | 35.9                                    | 29.9                     | 38.1                    | 26.8                           | 5.2           | 35.0                                   |
| United Kingdom        | 37.9                        | 43.1         | -5.1            | -3.2               | -2.5           | 48.8          | 35.8                                    | 35.0                     | 17.8                    | 35.3                           | 11.9          | 33.0                                   |
| EU arithm. average    | 46.3                        | 50.7         | -4.4            | -3.3               | 0.9            | 76.5          | 41.3                                    | 33.1                     | 29.8                    | 31.3                           | 5.8           | 38.7                                   |
| EU weighed average 9/ | 45.3                        | 52.4         | -5.1            | -3.6               | -0.0           | 73.2          | 40.9                                    | 29.9                     | 35.0                    | 28.2                           | 6.8           | 41.1                                   |

Sources: National sources; IMF World Economic Outlook, OECD Economic Outlook; and Ernst and Young.

1/ IMF World Economic Outlook, May 1996. Balances are deficit if (-) and surplus if (+).

2/ The gross debt is not consistent with the definition agreed at Maastricht. It includes all financial liabilities as defined by the System of National Accounts.

3/ Total tax revenue comprise: (1) taxes on income, profits and capital gains levied on individuals and corporations; (2) social security contributions; (3) taxes on property; (4) domestic taxes on goods and services; and (5) taxes on international trade and transactions.

4/ Social security contributions paid by employees and employers as a percent of GDP. For Denmark they are included in taxes on income and profits.

5/ General sales tax, value-added tax, excises, and other taxes as a percent of GDP in 1991.

6/ Includes taxes on capital gains and on property, and taxes on payroll.

7/ Represents only indicative tax rates in effect at the beginning of 1993. May include state and local corporate income tax (minus some deductions). Some reduced or increased rates, and certain exemptions are not reflected. Distributed profits may be taxed less in some countries. Other rates may apply to specified entities.

8/ 1994 data for Columns (1) through (6).

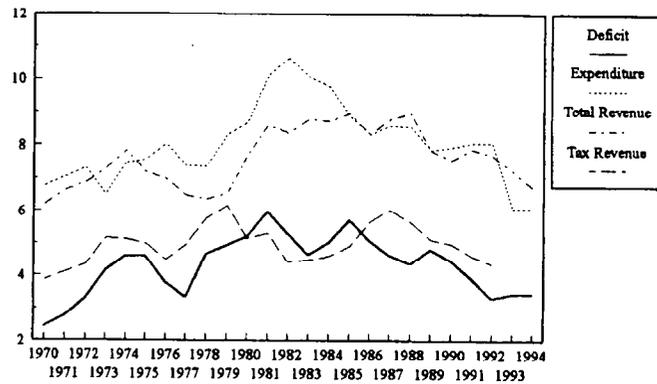
9/ Weighted by relative GDP.

Table 2. European Union: The Relative Fiscal Position of the EU Members in 1995

|        | Government Expenditure                               | Total Revenue                                | Budget Deficit   | Public Debt                                       |
|--------|--|--|--|---|
| High   | Belgium<br>Denmark<br>France<br>Italy<br>Netherlands | Belgium<br>Denmark<br>France<br>Netherlands  | Greece<br>Italy<br>Spain                                       | Belgium<br>Greece<br>Ireland<br>Italy<br>Denmark  |
| Medium | Germany<br>Greece<br>Portugal                        | Germany<br>Italy<br>Luxembourg<br>Portugal   | Belgium<br>France<br>Netherlands<br>Portugal<br>United Kingdom | Netherlands<br>Portugal<br>Spain                  |
| Low    | Ireland<br>Luxembourg<br>Spain<br>United Kingdom     | Greece<br>Ireland<br>Spain<br>United Kingdom | Denmark<br>Germany<br>Ireland<br>Luxembourg                    | France<br>Germany<br>Luxembourg<br>United Kingdom |

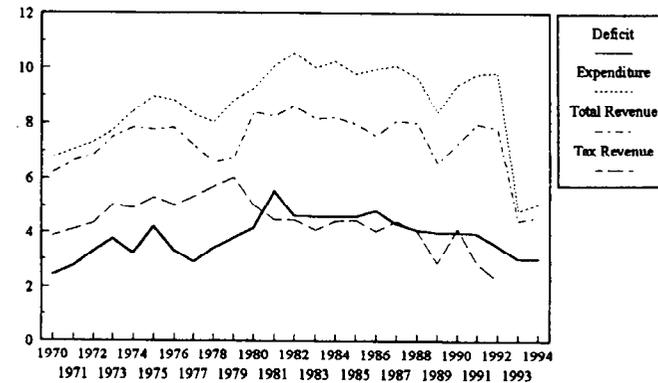
Sources: National Sources; IMF May 1996 World Economic Outlook

**Figure 2 (a)**  
**Standard Deviations of the**  
**Principal Fiscal Variables in the EU 1/**



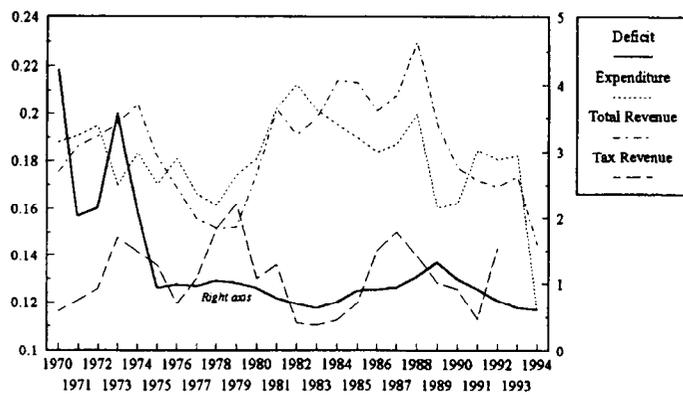
Source: IMF World Economic Outlook (WEO).  
 1/ Each year, it includes only the current members.

**Figure 2 (b)**  
**Standard Deviations of the**  
**Principal Fiscal Variables in the EU 6 1/**



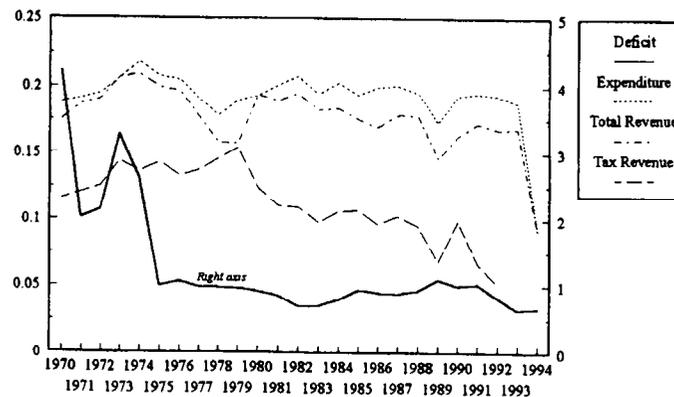
Source: IMF World Economic Outlook (WEO).  
 1/ Restricted to only the founding members of the European Union: Belgium, Germany, France, Italy, Luxembourg, and the Netherlands.

**Figure 2 (c)**  
**Coefficients of Variation of the**  
**Principal Fiscal Variables in the EU 1/**



Source: IMF World Economic Outlook (WEO).  
 1/ Coefficient of variation is the ratio between the standard deviation and the mean. Each year, it includes only the current members.

**Figure 2 (d)**  
**European Union 6: Coefficients of Variation of the**  
**Principal Fiscal Variables in the EU 6 1/**



Source: IMF World Economic Outlook (WEO).  
 1/ Coefficient of variation is the ratio between the standard deviation and the mean. This chart is restricted to only the founding members of the European Union: Belgium, France, Germany, Italy, Luxembourg, and the Netherlands.

## 2. Endogenous fiscal discipline

The endogenous fiscal discipline is prompted by three main factors.

a. **The harmonization of tax systems across the EU.** This process of harmonization is bolstered by a spontaneous convergence of tax structures in response to competitive pressures, and by institutional factors. Concerning the first factor, the deepening of economic integration is rendering goods, some services, and factors of production increasingly mobile across the EU. Increased mobility, in turn, is blurring the separation between national tax jurisdictions and compelling most members of the EU to bring their tax rates closer to those of their partners. The tax harmonization is also prompted by the following institutional factors: (1) the acceptance of common EU external tariffs with respect to the rest of the world; (2) the elimination of internal tariffs, border controls, and restrictions across the EU; (3) the harmonization of several tax bases; and (4) the adoption of several EU directives concerning the operation of the members' tax systems and the acceptance of common regulatory standards for conducting business. <sup>1/</sup> The statistical findings of the previous subsection provide some grounds for the hypothesis that some harmonization is already taking place across tax systems. In the EMU the harmonization of the tax systems, whether spontaneous or mandated by institutional factors, will increasingly reduce the ability of each country to raise its effective tax rates relative to those of the trading partners.

b. **The loss of control of monetary policy and money financing.** The effects of losing control of current and prospective money financing are far reaching in the EMU. Each participating country will lose control of two sources of money financing: seigniorage and surprise inflation. The importance of seigniorage has varied widely among EU members, but has steadily declined since the inception of the European Monetary System (EMS). Mongelli (1996a) shows that average seigniorage across the EU is now about 0.3 percent of GDP and falling. Hence, from the standpoint of seigniorage the EMU should not significantly worsen fiscal sustainability. By joining the EMU, national governments will also lose control of surprise inflation, the second source of inflation financing. In some EU members surprise inflation has been a significant source of financing in the 1960s, 1970s, and early 1980s (Mongelli (1996a)). However, since the mid-1980s, the surprise inflation effect had largely faded. Furthermore, there is

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<sup>1/</sup> Kopits (1992), that provides a comprehensive examination of these issues, finds that tax harmonization is more significant for indirect taxation and in corporate and capital income taxation. In these areas, tax harmonization is aimed at: enhancing economic efficiency through the removal of tax distortions and the promotion of international tax neutrality; preventing tax competition and the migration of the tax base; and raising welfare by improving fiscal equity. Tax harmonization is, however, less urgent for the personal income tax, due to low labor mobility, and for taxation of land and all other immobile production factors.

increasing empirical evidence that the EU members with a higher inflation rate have been increasingly penalized by means of significant devaluation risk premium. <sup>1/</sup> Hence, by establishing a low and stable inflation, the EMU will reduce interest rates in the previously "high inflation" countries, and improve fiscal sustainability.

c. **The strengthening of financial market-based discipline.** The EMU will render information on each borrower, as well as alternative investment opportunities, more easily available and less costly to pursue. As a result, investors are more likely to shy away from a high debt-to-GDP government out of fear that it would resort to some partial repudiation such as adopting a retroactive tax on interest payments. Investors will then command a country-specific default risk premium by holding the liabilities of that government only until the risk-adjusted rates of return are equalized. To the extent that a country with a relatively high debt-to-GDP ratio responds to these "signals" and refrains from further borrowing, its country-specific default risk premium will fall, and interest rate differential across the EU will also fall. This constitutes the core of the financial market-based discipline which is strengthened by the EMU. Conversely, the EMU could increase the country-specific risk premium and worsen fiscal sustainability in any member country that did not pursue cautious fiscal policies.

### III. The Sustainable Level of Government Expenditure in the EMU

#### 1. Debt sustainability and fiscal adjustment

The original question posed by Blanchard (1984), "what does it mean to say that a given combination of debt and deficits is unsustainable?", seems even more relevant today in the light of the divergence of the level of indebtedness across the EU. This fiscal divergence stands in sharp contrast to the commitment undertaken by each EU member in signing the Maastricht Treaty. This section presents a methodology to analyze the responsiveness of fiscal sustainability to the changes that may be entailed by the EMU. <sup>2/</sup> Appendix II gives the list of notation.

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<sup>1/</sup> From an empirical standpoint, Masson and Symansky (1995), the IMF World Economic Outlook (1995), and the references therein, maintain that default risk premia, as gauged from the interest rates prevailing on the countries' foreign currency debt, are in the range of 50 basis points, or less. Therefore, the largest share of the interest rate differential across the EU must be due to each country's devaluation risk premium.

<sup>2/</sup> It is assumed that the EMU will be guided by the European Central Bank (ECB) that will issue the union's single currency. The ECB will establish a clear monetary discipline by means of tight legal regulations and the appointment of "conservative" central bankers committed to maintaining low inflation and to not bailing out any member in financial distress.

The present section extends Blanchard's (1984) analysis in three ways. First, it assumes that the interest rate is set endogenously and is a positive function of the stock of debt. This assumption allows an analysis of the link between fiscal sustainability and the endogenous fiscal discipline. In this sense this modified model of fiscal sustainability is a generalization of Blanchard (1984). Second, the implications of the endogenous fiscal discipline are extensively discussed. Specifically, this section illustrates how the endogenous fiscal discipline could alter the level of sustainable public debt. Third, the main findings are illustrated by means of the "fiscal sustainability frontiers" that are similar to the stable arm in Blanchard (1994). This modified model, while simple, is powerful in its ability to yield intuition-building treatments of issues linked to fiscal sustainability.

## 2. The model of fiscal sustainability

The basis of the model is the following temporal government budget constraint,

$$(1) \quad \frac{dB_t}{dt} = G_t - T_t + i(b_t, \pi_t) B_t,$$

where  $G_t$  are nominal non-interest government expenditure on goods and services,  $T_t$  are nominal government revenue from taxes and other receipts (and net of government transfers).  $B_t$  are net nominal liabilities of the government in the form of perpetual bonds. Equation (1) states that a government finances its fiscal deficit by issuing new debt ( $DB_t/dt$ ). The fiscal deficit is constituted by a primary deficit ( $G_t - T_t$ ) plus the interest payments on the outstanding public debt ( $i(b_t, \pi_t)B_t$ ). The nominal interest rate has a real and a nominal component, i.e.,  $i(b_t, \pi_t) = r(b_t) + \pi_t$ , and  $b_t$  is the level of indebtedness normalized by output (i.e.,  $b_t = B_t/Y_t$ ). For simplicity, the revenue from seignorage are omitted (they are currently negligible across the EU and can be thought of as part of  $T_t$ ), prices grow at a constant level of inflation ( $\pi_t$ ), and real income grows at some non-zero rate  $\mu$ . Revenue from money financing have been omitted for simplicity and because currently very modest (Section II.2, point b).

To allow comparisons across time and countries, all terms in (1) are normalized with respect to the nominal level of output,

$$(1') \quad \frac{db_t}{dt} = g_t - \tau_t + (r(b_t) - \mu) b_t = -ps_t + (r(b_t) - \mu) b_t$$

$ps_t$  is the real primary balance (i.e., a primary surplus if positive, and a primary deficit if negative). Taking the time derivative of the normalized stock of debt, and simplifying, cancels out the inflation component of the nominal interest rate and yields the growth adjusted real interest rate ( $r(b) - \mu$ ). To prevent the government from indefinitely borrowing to service the outstanding debt the condition ( $r(b) > \mu$ ) must be stipulated.

Given the constant rate of growth of real GDP ( $\mu$ ), the evolution of public indebtedness ( $b_t$ ) hinges on the fear of some default by the financial markets and the evolution of the real primary balance ( $ps_t$ ). The term  $r(b_t)$  captures a government-specific risk premium which is commanded by bondholders because government bonds bear a perceived probability of complete default  $\phi$ , where  $0 \leq \phi < 1$ . The higher the perceived probability of a default, the higher is  $\phi$ . This implies that the supply curve of funds to the national government is upward sloping, and that its steepness increases with the level of indebtedness. It is this new specification of the interest rate that will provide the new insight with respect to Blanchard (1984), who assumed a constant real interest rate. These bonds are issued at a rate  $r(b_t)$ , which must equalize the interest rate with similar assets that bear a risk free rate  $r^f$  (Figure 3(a)). 1/ It is assumed that the risk of default is a function of the debt-to-GDP ratio  $\phi = \phi(b_t)$ , that it is zero when there is no debt and that the first derivative is always positive when there is some debt outstanding  $\phi(0) = 0$ ,  $\phi_b(0) = 0$ , and  $\phi_b(b_t) > 0$  when  $b_t > 0$ . Furthermore,  $\lim_{b_t \rightarrow \infty} \phi(b_t) = 1$  but  $\phi \neq 1$ , must be stipulated as well.

Consequently,  $(1+r(b_t))(1-\phi) = 1+r^f$ , must hold which in turn

yields  $r(b_t) = \frac{r^f + \phi(b_t)}{1 - \phi(b_t)}$ . Totally differentiating this expression of the real interest rate yields,

$$\frac{dr(b_t)}{db_t} = \frac{\phi_b + \phi_b r^f}{(1 - \phi(b_t))^2} \geq 0.$$

For example, if the reputation of the government is low or the uncertainty associated with a complete repayment of the outstanding public debt is high, the financial market may immediately demand a higher risk premium. 2/ In this case,  $\phi_b$  is high and  $r(b_t)$  becomes steep at lower levels of the debt as in curve I in Figure 3(a).

Figure 3(b) illustrates the points that satisfy the  $\frac{db_t}{dt} = 0$  schedule. Given a rate of growth of output  $\mu$ , a lower reputation of the government, entails higher risk premiums, increases the growth adjusted real interest

1/ The "risk-free" rate  $r^f$  is that theoretical real interest rate which may prevail if the financial market was perfectly transparent and lending and borrowing could take place without any restrictions or fear of any form of repudiation. Therefore,  $r^f$  would reflect only the relative supply and demand of saving, and other economic factors (such as the productivity of investment).  $r^f$  is a device to simplify the discussion, and may be interpreted as a base or "reference" interest rate that borrowers aspire to reach through savvy policies and fiscal prudence. This paper also conjectures that the German interest rate is among the closest to  $r^f$ .

2/ The following second derivative is also positive as each element in bracket is positive,

$$\frac{d^2 r(b_t)}{db_t^2} = \frac{\phi_{bb}(1+r^f)(1-\phi(b_t)) + 2\phi_b(1-\phi(b_t))^2}{(1-\phi(b_t))^4} \geq 0.$$



rate and renders the  $\frac{dB_t}{dt} = 0$  schedule steeper. If instead the confidence in the country's fiscal and monetary management is high, the response of the financial markets to high debt-to-GDP ratios may be almost negligible. In this second case,  $\phi_b$  would be lower,  $r(b_t) - \mu$  less steep, and, consequently, the risk premium function may be flatter as in curve II in Figures 3(a) and 3(b). Instead, the lack of a feedback between the debt-to-GDP ratio and the interest rate, as in Blanchard (1984), is illustrated by curve III in Figures 3(a) and 3(b).

The discussion now turns to the freedom of the primary balance  $ps_t$  in the EMU. It is now assumed that there are upper and lower bounds for government revenue net of transfers, respectively,  $\bar{\tau}$  and  $\underline{\tau}$ . There are also upper and lower bounds for non-interest government expenditure on goods and services,  $\bar{g}$  and  $\underline{g}$ , respectively. Two of these variables will play an important role in the ensuing analysis.

The first variable is  $\bar{\tau}$ , the maximum amount of government revenues net of transfers that can be collected. This variable is determined, inter alia, by the state of the tax system and several other characteristics of the economy, such as its degree of openness and the exposure to international competition. A deepening of integration and the endogenous fiscal discipline, which increases tax competition, is likely to lower  $\bar{\tau}$  in high tax countries. Conversely,  $\bar{\tau}$  may still be able to raise in low tax countries but this case is not discussed in the rest of the paper.

The second important variable is  $\underline{g}$ , the minimum amount of socially acceptable government outlays. It could be interpreted as that level of provision of public goods below which there could be a decline in output. For example, the reduced provision of some indispensable public services may hinder production and/or lead to an emigration of the tax base. The deepening of economic integration, which will be expedited by the EMU, works toward increasing  $\underline{g}$  in those countries with a relatively low provision of some public services (e.g., the high speed railway currently under construction across Europe, or some waste treatment plants built to improve environmental standards). On the other hand, the deepening of economic integration could decrease  $\underline{g}$  in those countries with a relatively high provision of some public services, but this latter case is not discussed here.

Correspondingly,  $\bar{ps} = \bar{\tau} - \underline{g}$  is postulated to be the maximum primary surplus the country can manage without great difficulty. At the inception of the EMU, the deepening of integration and the endogenous fiscal discipline are likely to reduce the maximum primary surplus ( $\bar{ps}$ ) that is attainable in a country with a relatively high level of taxation. In Figure 3(b) this is illustrated by a decline from  $\bar{ps}$  to  $\bar{ps}'$ , which would in turn shift the points A, B, and C to A', B', and C' along the new horizontal schedule  $\bar{ps}'$ . A steepening of the growth adjusted real interest rate

$r(b_t) - \mu$ , that could be the result of a loss of confidence, would also reduce the fiscal autonomy of a national government.

The combined effect of the decline in  $\bar{p}s$  and the loss of confidence is illustrated by the contraction of the feasible fiscal area from the rectangle (0 1 B 2) to the smaller one (0 1' A' 2').

Another important feature of fiscal policy considered in this model, is that budgetary policy changes cannot take place all at once. Both the increases in the tax burden (toward  $\bar{r}$ ) and the decrease in public expenditure (toward  $\bar{g}$ ) can occur only gradually. In fact, these measures may require extensive reforms of the tax administration--for example, to improve taxpayers compliance--or the central and local expenditure centers. These reforms can be slow to implement, and may be politically unpopular or even unfeasible in some economic sectors or regions. Hence, the adjustment of the gap between the current primary surplus  $ps_t$  toward  $\bar{p}s_t$  will require time. It is assumed here that the gap between the current primary balance and the maximum primary surplus follows an adaptive process limited by an inequality as in (2). The model of fiscal sustainability is represented by,

$$(1'') \quad \frac{db_t}{dt} = -ps_t + \left[ \frac{r^f + \phi(b_t)}{1 - \phi(b_t)} - \mu \right] b_t$$

$$(2) \quad \frac{dps_t}{dt} \leq \gamma (\bar{p}s_t - ps_t),$$

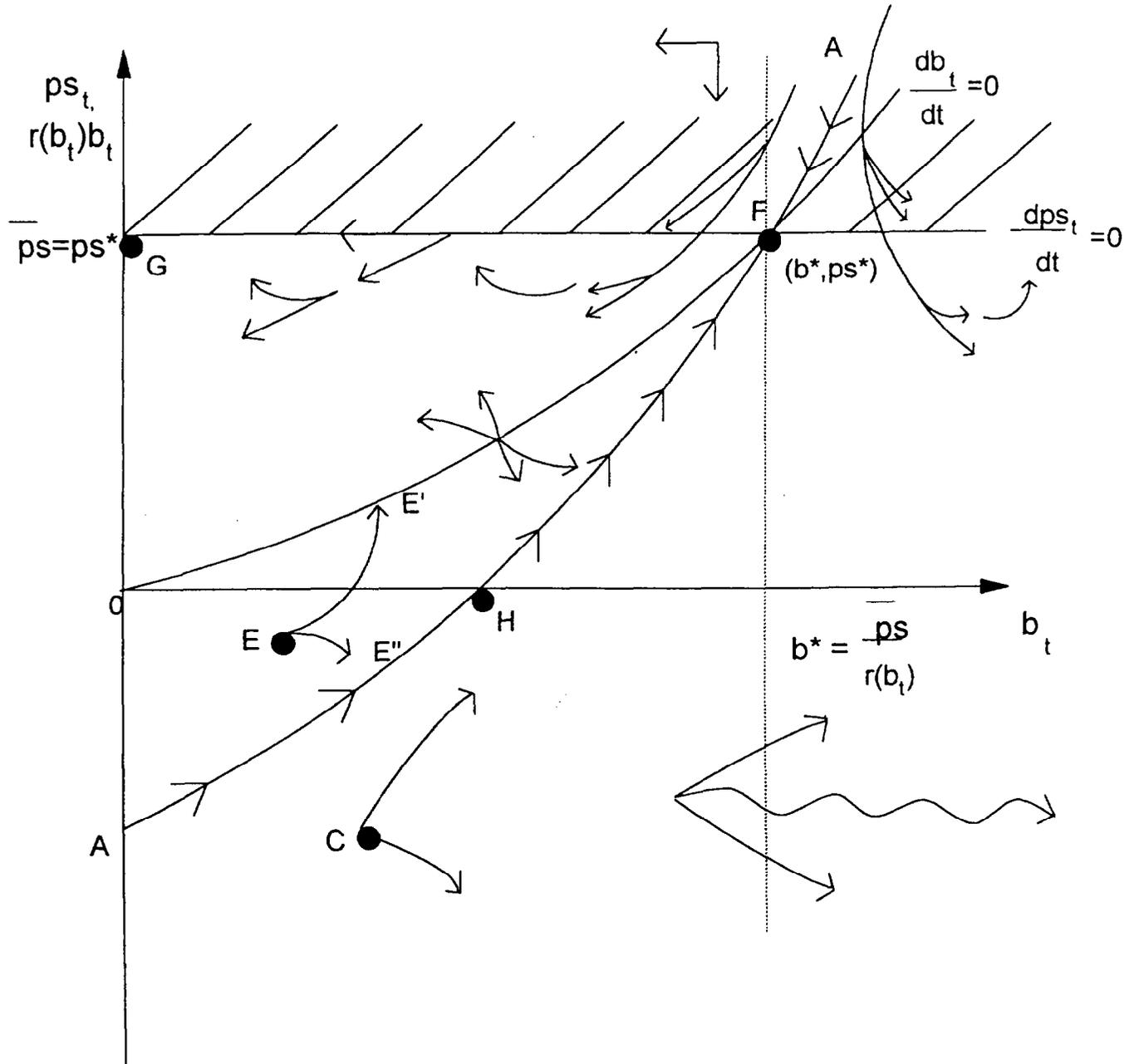
where  $\gamma$  is the speed of adjustment and may be interpreted as an indicator of the maximum fiscal effort which a national government is willing to undertake during a particular period to improve its primary balance. Two difficulties arise at this point, due to the specification of the model. The first difficulty is that the system presents an inequality in (2). However, this inequality represents a restriction of an economic nature. Therefore, the system can be studied by imposing an equality, keeping in mind that there are more solutions if (2) is an inequality than if it is an equality. The inequality will be reintroduced later. This will expand the admissible space of the solutions. The second difficulty pertains to the non-linearity of the system. This difficulty can be overcome by studying the properties of the linearized system near its saddle point equilibrium

$(b^*, ps^*)$  that is found by setting  $\frac{db_t}{dt} = \frac{dps_t}{dt} = 0$ . Specifically,  $ps^* = \bar{p}s$  and

$$b^* = \frac{1}{r(b^*) - \mu} \bar{p}s = \frac{1 - \phi(b^*)}{r^f + (1 + \mu)\phi(b^*) - \mu} \bar{p}s.$$

The  $\frac{db_t}{dt} = 0$  schedule, drawn in Figure 4, crosses the origin and is upward sloping. Assuming that (2) holds with equality, the  $\frac{dps_t}{dt} = 0$  schedule is horizontal at the value  $ps_t = \bar{p}s$ . Both  $ps^*$  and  $b^*$  are positive because the interest rate function is monotonically nondecreasing in  $b_t$ , and crosses the  $\frac{dps_t}{dt} = 0$  schedule only once. It can be shown that given some

Figure 4. Sustainable Deficit and Debt Pairs



plausible values of the parameters and the variables this system has a saddle point equilibrium  $(b^*, ps^*)$ , to which it might converge along the stable arm AA in Figure 4.

To obtain an indication of the dynamic of the points in the  $(ps_t, b_t)$  space, the following two partial differentials are obtained from (1'') and (2) when it is an equality,

$$(a) \quad \frac{db_t/dt}{db_t} = \frac{(1-\phi)(r^f + \phi + b^*\phi_b) + \phi_b(r^f + \phi)b^*}{(1-\phi)} - \mu > 0$$

$$(b) \quad \frac{dps_t/dt}{dps_t} = -\gamma < 0.$$

The sign of (a), indicates that on the left of the  $\frac{db_t}{dt} = 0$  schedule,  $b_t$  is decreasing, while to the right, it is increasing. The sign of (b), indicates that above the  $\frac{dps_t}{dt} = 0$  schedule,  $ps_t$  will decrease, while below it will increase. 1/ However, when (2) is taken with the inequality sign,

below the  $\frac{dps_t}{dt} = 0$  schedule,  $ps_t$  can increase or decrease as shown in

Figure 4. The following condition is the stable arm AA of the system (1'') (2), that needs to be satisfied by each initial pair  $(ps_0, b_0)$  to secure fiscal sustainability,

$$(3) \quad \left( \frac{(1-\phi)(r^f + \phi + b^*\phi_b) + \phi_b(r^f + \phi)b^*}{(1-\phi)^2} - \mu + \gamma \right) (b_t - b^*) - (ps_t - ps^*) \leq 0.$$

If the economy finds itself at the initial point C in Figure 4, which lies below the stable arm AA, the deficit will be so high that it will not be reduced fast enough to prevent the public debt from growing along one of the unsustainable paths. If instead the economy starts at the initial point E,

which lies above the stable arm AA, it might reach the  $\frac{db_t}{dt} = 0$  schedule by moving along the path EE', and crossing it. Alternatively, it can move toward the path EE'' and reach the stable arm AA.

Therefore, just as in Blanchard (1984), it is the area below the stable arm AA that may lead to debt repudiation, and not the area to the right of the steady state level of the public debt  $(b^*)$ . An increase in the fiscal effort to increase the primary surplus improves fiscal sustainability. This improvement is reflected in an increase in the speed of adjustment  $\gamma$ , which increases the slope of the stable arm, tilting it

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1/ The system (1'') (2) has two eigen-values of opposite signs to which two eigenvectors are associated. The first one pulls the economy away from the steady state along the  $\frac{dps_t}{dt} = 0$  schedule, the second is the stable arm.

from AA to A'A' in Figure 5 and lowers its intercept with the vertical axis of the primary balance in Figure 5. This will reduce the area in which the debt is unsustainable. In the same figure, this will now render point C sustainable. If the adjustment could be realized instantaneously (i.e.,  $\gamma \Rightarrow \infty$  in the absence of any constraint in the adjustment of  $ps_t$  to the maximum primary surplus), the key condition for sustainability would be that the debt never exceeds the critical threshold (i.e.,  $b_t < b^*$ ). If instead  $\gamma \Rightarrow 0$ , no debt is sustainable.

The "fiscal sustainability frontiers" can assist in illustrating the main findings of the model. They define the regions where combinations of deficit and debt are fiscally sustainable. These frontiers--which are obtained from (3)--are samples of the stable arms AA and A'A' in Figure 4. Each EU member will have its own fiscal sustainability frontier given its country-specific maximum amount of net government revenue ( $\bar{r}$ ) which can be collected, the minimum amount of socially acceptable non-interest government expenditure ( $g$ ), the fiscal effort  $\gamma$  that a national government is willing to undertake to improve the primary surplus, the risk free real interest rate ( $r^f$ ), its specific borrowing conditions, and its real income growth  $\mu$ . Therefore, each EMU member's fiscal sustainability frontier has a different slope and positions because each country's constraints are different (this point will be investigated further in the next section). These frontiers will also continuously move over time as the economic and budgetary conditions of the country evolve.

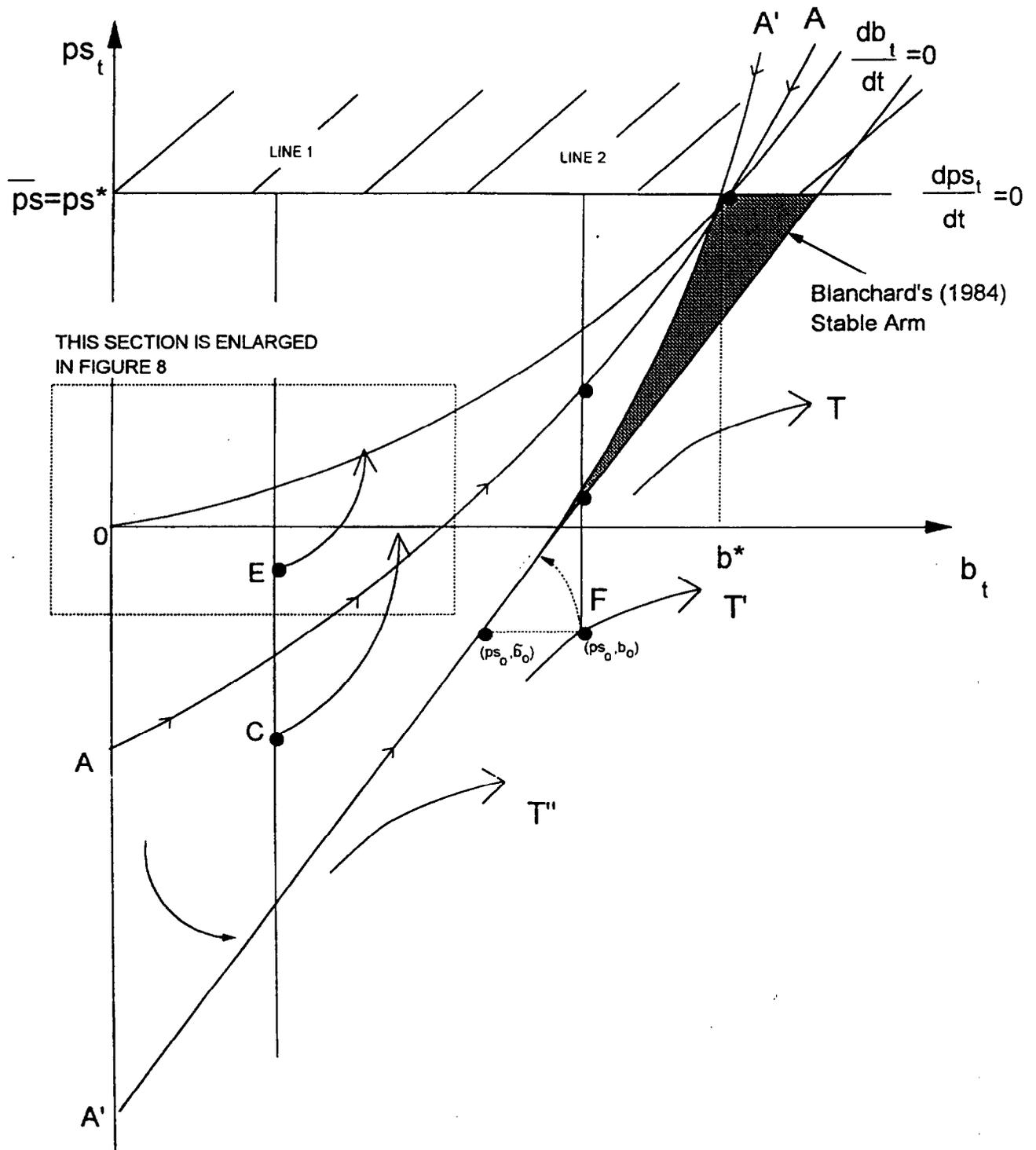
Three conclusions can now be advanced. The first conclusion is that  $b^*$  is positively related to  $ps^*$ , and inversely related to the growth adjusted real interest rate which increases when the confidence in the government by the financial markets declines. Specifically, the higher  $\phi_b$  and the steeper  $(r(b^*) - \mu)$ , the lower  $b^*$  (i.e.,  $b^* = \bar{ps} / [r(b^*) - \mu]$ ) will be. In Blanchard (1984), instead, this critical threshold of the debt-to-GDP ratio (that is equal to  $b^* = \bar{ps} / (r - \mu)$ , ) is constant given  $\bar{ps}$ , and a constant  $r$  and  $\mu$ . 1/

The second conclusion is that as in Blanchard (1984), the sustainability condition cannot be approximated by any critical threshold, but is rather more complex. The principal difference between the solutions

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1/ For example, in Figure 3b, point C with its coordinates  $(b_c^*, \bar{ps})$  illustrates the maximum debt that is attainable given a constant interest rate  $r$ , a maximum primary surplus  $\bar{ps}$ , and some other initial assumptions.

Figure 5. Sustainable Deficit and Debt Pairs:  
the Effect of an Increase in the Speed of Adjustment



in Blanchard (1984) and the solutions in this paper is represented by the grey shaded area in Figure 5. In Blanchard (1984), the debt could become unsustainable on the right of the straight line (i.e., the fiscal sustainability frontier is straight). Instead, when the government faces an upward sloping supply of funds, as in this paper, the fiscally sustainable region is reduced. Furthermore, the lower the reputation of the government--and the higher the risk premium commanded by the financial market for each increment of the debt--the smaller the fiscally sustainable region becomes. Only if the uncertainty associated with a complete repayment of the outstanding public debt vanishes, will the two solutions converge.

The third conclusion concerns an aspect not discussed in Blanchard (1984). A high budget deficit can also imply a loss of fiscal sustainability even at low levels of debt. Lines 1 and 2 which cross Figure 5, show that relatively high debt-to-GDP ratios could be fiscally sustainable if associated with primary surpluses high enough to produce a fall in debt over time. Conversely, relatively low debt-to-GDP ratios, could be fiscally unsustainable if associated with relatively high budget deficits. This problem could worsen if the improvements in the primary balances are delayed because efforts to improve the primary balance (i.e.,  $\gamma$ ) are minimal. Furthermore, the upward sloping supply of funds schedule could provide a significant impediment to redress a significant budget deficit. Specifically, when the reputation of the government is low, each increment of the debt (that occurs while the government increases its primary balances) will bring about a higher risk premium. This higher risk premium will in turn increase the sizes of the primary surpluses necessary to secure fiscal sustainability.

The analysis conducted so far has two main caveats. First, what would happen if it was not absolutely clear and credible that national public debts are the exclusive obligation of each national government? So far it has been assumed that monetary discipline will be clearly established, and that the no bailout principle stated in the Maastricht Treaty will be fully implemented. What if monetary discipline is lax and the financial market expects a bailout? Paradoxically, if a country was admitted in the EMU and started running continuous and excessive budget deficits the country's specific interest rate may not rise as fast. Financial solidarity, which could take the form of an implicit or explicit bailout, would reduce the incentive of the financial market to raise the risk premium and/or restrict lending to "high debt" governments. That is, the fiscal sustainability frontier of such a high debt country would shift to the right, easing this country's debt servicing.

The reverse side of the financial solidarity is that the burden of the fiscal undiscipline by one, or more, countries falls on all other EMU members. One of the channels--the previously "risk-free" real interest rate  $r^f$  of the EMU would not be risk free any longer but would include a premium

(due to the possibility of a bailout of an "undisciplined" member). Correspondingly, the fiscal sustainability frontiers of these partner countries would shift to the left, worsening their fiscal sustainability.

The second caveat is that this chapter has only briefly addressed the political or institutional factors behind fiscal unsustainability. 1/ These factors significantly affect the "true" commitment, or the ability, to improve tax compliance, stem public expenditure, and pursue a fiscal restraint when it is needed. To the extent that significant political or institutional biases toward budget deficits are present, the issue of fiscal sustainability will have to be examined on grounds not considered here. However, in terms of the framework developed in this chapter such political

biases correspond to: (1) lower  $\bar{r}$ , the maximum government revenue that is sought by the government; (2) higher  $g$ , the minimum amount of socially acceptable non-interest expenditure that the government can afford from a political standpoint; and (3) lower  $\gamma$ , the speed of adjustment of the budget that the government is willing to pursue. All these factors shift the fiscal sustainability frontier to the left and lower the maximum primary surplus that can be sought by the government (i.e., the  $\frac{dps_t}{dt} = 0$  schedule shifts downward). In summary, the fiscally sustainable region would be greatly reduced.

3. How likely is it that the public debt will become irreversibly unsustainable, leading to a sovereign default?

For illustrative purposes the discussion thus far has allowed the debt to grow along some outward bound trajectories (such as T, T', and T'' in Figure 5), if the initial pair  $(b_0, ps_0)$  is on the right of AA. Clearly, this condition is not realistic; although some sovereign defaults have occurred across Europe in the past, they are not very common among these countries. Therefore, an additional requirement, which has not yet been discussed, will reduce the likelihood of a sovereign default by a national government. 2/ This requirement is the solvency condition that preclude any national government from indefinitely borrowing to service the outstanding debt. Hence, the question that is now asked is: what would happen if the solvency condition needed to be satisfied at each point in time? Adding the solvency condition to the elements discussed thus far could give rise to a contradiction if a country finds itself on the right of

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1/ Alesina and Perotti (1994) and Asilis and Milesi-Ferretti (1994) provide a clear and comprehensive survey of this literature.

2/ The author is grateful to Nouriel Roubini for having raised this issue on an earlier draft of the paper. The response to this point led to the following discussion.

the fiscal sustainability frontier: specifically, it is impossible for a national government to contemporaneously satisfy the following four conditions:

- the following simplified temporal government budget constraint for a specific country  $i$  (that is obtained from (1''),

$$(1''') \quad \frac{db_t^i}{dt} = ps_t^i + (r^i - \mu^i) b_t^i \quad i = 1, 2, \dots, 12,$$

where the superscript  $i$  identifies the 12 EU members, and the real interest rate  $r^i$  is now given for each country  $i$  and is assumed to remain constant (in Table 3 below it is the 1995 real interest rate). 1/ In each country, output grows at a constant rate  $\mu^i$ , and  $r^i - \mu^i$  is the constant growth-adjusted real interest rate;

- the solvency condition  $\lim_{t \rightarrow \infty} b_t^i e^{-(r^i - \mu^i)t} = 0$  which requires public debt to grow asymptotically at a rate lower than the real interest rate at which it is discounted;
- a steady adjustment of the current primary balance (i.e., a budget deficit if negative) toward the maximum primary surplus. This adjustment is akin to equation (2) above; and
- a country finding itself at point F below the fiscal sustainability frontier CC on Figure 5 (i.e., at the initial fiscal position  $(b_0^i, ps_0^i)$ ).

**Proof of the contradiction.** First, (1''') is forward integrated between time 0 (that is the initial time period of this exercise) and infinity, and is discounted by  $e^{-(r-\mu)t}$ . Second, the outcome is integrated

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1/ It must be noted at the onset that the downside of the approach adopted below is that the real interest rate is no longer a function of the debt-to-GDP ratio, as this would give rise to a non-linearity. Hence,  $r^i$  must be thought of as that real interest rate which prevails in a EU member at a given point in time. This simplification restricts any intertemporal investigation while allowing some intra-temporal comparisons of fiscal sustainability across EU members. In other terms the framework below allows to examine and compare the proximity of each country to its specific fiscal sustainability frontier (as in Table 3 below) given some current values of  $r$ ,  $\mu$ ,  $b$ ,  $ps$ , and the maximum primary surplus.

by parts and solved. Third, one of the remaining terms is eliminated by applying the solvency condition. After some further simplifications the following intertemporal budget constraint is obtained, 1/

$$\bar{b}_0^i = \int_0^\infty ps_s^i e^{-(r^i - \mu^i)s} ds$$

Fourth, solving (2) with the equality sign yields  $ps_t^i = (ps_0^i - \bar{ps}^i) e^{-\gamma t} + \bar{ps}^i$ , where  $ps_0^i$  is an initial value of the primary surplus (or deficit if negative) and  $\bar{ps}^i$  is the maximum primary surplus that a country can achieve. Fifth, substituting this solution into the intertemporal budget constraint, yields the following discounted stream of future primary surpluses:

$$(4) \quad \bar{b}_0^i = \int_0^\infty \left[ (ps_0^i - \bar{ps}^i) e^{-\gamma t} + \bar{ps}^i \right] e^{-(r^i - \mu^i)t} dt.$$

Sixth, given some initial assumptions concerning the values of  $\bar{ps}^i$ ,  $ps_0^i$ ,  $\gamma$ , and  $r^i - \mu^i$ , (4) can be further simplified as follows:

$$(4') \quad \bar{b}_0^i = \frac{\gamma}{(r^i - \mu^i)(r^i + \gamma - \mu^i)} \bar{ps}^i + \frac{1}{(r^i + \gamma - \mu^i)} ps_0^i.$$

This new expression describes Blanchard's (1984) stable arm in Figure 5, given the four conditions above. It divides the  $(ps_t, b_t)$  space into two regions. If (2) is now taken with the inequality sign, the region to the right of (4') is the fiscally unsustainable region.

Therefore, to secure fiscal sustainability, any country should always be on the Blanchard's stable arm (4') or to its left. Hence,

given  $\bar{ps}^i$ ,  $ps_0^i$ ,  $\gamma$ , and  $r^i - \mu^i$ , the current level of indebtedness  $b_0^i$  must not exceed  $\bar{b}_0^i$ , and the following inequality should be satisfied for the debt to remain sustainable:

$$(4'') \quad b_0^i \leq \bar{b}_0^i = \frac{\gamma}{(r^i - \mu^i)(r^i + \gamma - \mu^i)} \bar{ps}^i + \frac{1}{(r^i + \gamma - \mu^i)} ps_0^i.$$

However, when a national government finds itself at a point such as point F on Figure 5, the level  $b_0^i$  of the debt will be greater than the level  $\bar{b}_0^i$  which satisfies (4''). But,  $b_0^i$  cannot at the same time exceed  $\bar{b}_0^i$  (from the fourth condition listed above) and be smaller than  $\bar{b}_0^i$  in order to satisfy (4''). Similarly, (4'') cannot be satisfied by all the combinations

1/ The following intertemporal budget constraint states that if at the initial time period ( $t=0$ ) there is an outstanding stock of debt  $b_0$ , the government will have to run some primary surpluses in the future to repay it.

of deficit and debt in the area to the right of the Blanchard's (1984) stable arm in Figure 5. Therefore, one of the four conditions above has been violated and the most likely culprit is the solvency condition.

Therefore, if the economy is at a point such as point F in Figure 5 or any other point to the right of the Blanchard's stable arm, at some point in time the economy will need to undertake a shift in fiscal policy, toward the Blanchard's stable arm and prevent the public debt from growing without bound. For example, it could adjust along the dotted path starting at point F, which would entail a decline in both the deficit and the debt.

#### IV. What Index of Fiscal Sustainability can be obtained from the Analysis Conducted thus Far?

##### 1. Some empirical findings and the index of fiscal sustainability

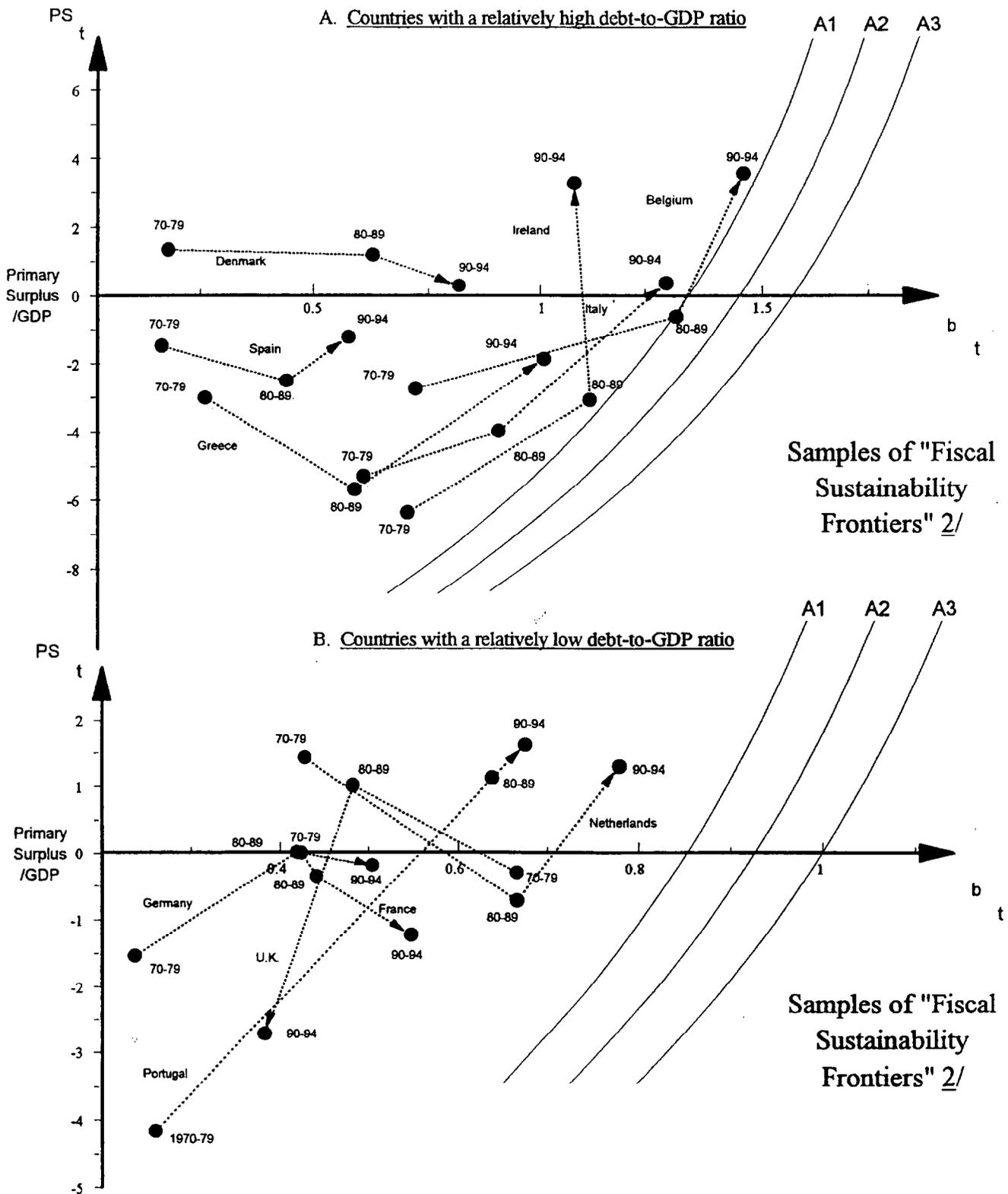
When the time path of primary surpluses and the debt-to-GDP ratios are plotted together from 1970 to 1994 (as shown in Figure 6) it is apparent that most EU members have increased their primary surpluses over time. <sup>1/</sup> For simplicity and ease of comparison, the data are grouped for the periods 1970-79, 1980-89, and 1990-94 whenever available. In the upper chart, the fiscal efforts to raise primary surpluses by Ireland, Belgium, Denmark, and Italy are clearly discernible. Also, Greece, Spain, Portugal, and the Netherlands, shown in the lower chart, display a marked improvement of their primary surpluses. In all these countries these fiscal efforts succeeded in slowing down the growth of debt.

How close to its "indicative" country specific fiscal sustainability frontier is each EU member at present time? Equation (4') yields an estimate of the indicative stock of public debt  $\delta_0^i$ . The gap between  $\delta_0^i$  and the current public debt  $b_0^i$ , provides a measure of the proximity of each EU member to its country specific fiscal sustainability frontier. This indicator of fiscal sustainability is based on two main elements. The first element is the effort of each national government to increase the primary surplus. This effort represents the speed of adjustment of the current primary balance, and is measured by the coefficient  $\gamma$  in column (4) in Table 3. The method of estimation of the EU members'  $\gamma$  coefficients between

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<sup>1/</sup> Three features of Figure 6 are worthy of consideration. First, this figure enlarges the dotted section of Figure 5. Second, the set of upward sloping schedules,  $A_1$ ,  $A_2$ , and  $A_3$  are only samples of "fiscal sustainability frontiers." They have an illustrative purpose and do not intend to depict any actual frontier for any particular country. The relative fiscal sustainability across the EU is measured in Table 3. Third, the paths in the figure can be seen as a crude approximation of the paths that EU members may follow in Figure 5. Last, the scale in the two charts is different.

Figure 6. European Union: The Time Path of Primary Surplus and Debt 1/



1/ Observations indicate average values for 1970-79, 1980-89 and 1990-94 respectively, whenever data is available.

2/ The schedules A1, A2, and A3 are illustrative samples of "fiscal sustainability frontiers". A more accurate measurement of the relative fiscal sustainability across the E.U. is in Table 3.

Table 3. Estimates of the Proximity to the Fiscal Sustainability Frontier, 1995 <sup>1/</sup>

|                                 | Maximum<br>Primary<br>Balance<br>(1) | Real<br>Interest<br>Rate<br>(2) | Rate of<br>Growth<br>of GDP<br>(3) | Estimates<br>of<br>Gamma<br>(4) | Latest<br>Primary<br>Balance<br>(5) | Current<br>Public<br>Debt <sup>2/</sup><br>(6) | Sustainable<br>Public<br>Debt<br>(7) | Fiscal<br>Gap<br>(7)-(6)<br>(8) | Outcome <sup>3/</sup><br>(9) |
|---------------------------------|--------------------------------------|---------------------------------|------------------------------------|---------------------------------|-------------------------------------|--|--------------------------------------|---------------------------------|------------------------------|
| Belgium                         | 0.060                                | 0.050                           | 0.019                              | 0.093                           | 0.047                               | 1.34   | 1.87                                 | 0.53                            | --                           |
| Denmark                         | 0.040                                | 0.054                           | 0.029                              | 0.303                           | 0.017                               | 0.82   | 1.53                                 | 0.72                            | +/-                          |
| France                          | 0.040                                | 0.047                           | 0.024                              | 0.533                           | -0.020                              | 0.52   | 1.70                                 | 1.18                            | ++                           |
| Germany                         | 0.040                                | 0.039                           | 0.019                              | 0.498                           | -0.003                              | 0.58   | 1.92                                 | 1.34                            | ++                           |
| Greece                          | 0.045                                | 0.051                           | 0.020                              | 0.369                           | 0.029                               | 1.13   | 1.45                                 | 0.31                            | --                           |
| Ireland <sup>4/</sup>           | 0.040                                | 0.062                           | 0.042                              | 0.145                           | 0.015                               | 0.85   | 1.74                                 | 0.88                            | +/-                          |
| Italy                           | 0.040                                | 0.055                           | 0.032                              | 0.163                           | 0.033                               | 1.23   | 1.74                                 | 0.51                            | --                           |
| Netherlands                     | 0.040                                | 0.048                           | 0.024                              | 0.429                           | 0.008                               | 0.79   | 1.69                                 | 0.91                            | +                            |
| Portugal                        | 0.040                                | 0.058                           | 0.024                              | 0.235                           | 0.020                               | 0.73   | 1.15                                 | 0.43                            | -                            |
| Spain                           | 0.040                                | 0.054                           | 0.030                              | 0.309                           | 0.020                               | 0.65   | 1.54                                 | 0.89                            | +                            |
| United<br>Kingdom <sup>5/</sup> | 0.040                                | 0.051                           | 0.024                              | 0.390                           | -0.025                              | 0.49   | 1.40                                 | 0.92                            | ++                           |

Source: National Sources, IMF's IFS and WEO.

<sup>1/</sup> Col. (1) based upon recent values of the primary surpluses of each country. Col. (2) real interest rate is the average of the short-term and the long-term rates weighed by their share in 1995. Col. (3), (5), and (6) 1995 IMF WEO estimates. Col. (4) estimates of gamma are described in Append. III. Col. (7) debt values are computed on the basis of Eq. (4') in the text. Some data for Luxembourg are unavailable. Col. (8) is the difference between the values in Col. (7) and Col. (6). In Col. (9) ++ means satisfactory, + means adequate, - means inadequate, and -- means unsatisfactory.

<sup>2/</sup> May not be consistent with the definition agreed at Maastricht. It includes all financial liabilities as defined by the System of National Accounts.

<sup>3/</sup> Outcome based upon the latest primary balance in Col. (5), the level of public indebtedness in Col. (6), and the fiscal gap in Col. (8).

<sup>4/</sup> In 1995 economic growth was exceptionally high. Therefore 1991-1995 averages have been used in Columns (2), (3), (5), and (6). despite the very low fiscal gap in Col. (8) and the poor outcome in Col. (9), the fiscal situation has rapidly improved in recent years due to a decline in budget deficit and debt.

<sup>5/</sup> Despite the worsening of the budget deficit in recent years, the debt-to-GDP ratio is still among the lowest in the EU. Therefore, the U.K. doesn't face an immediate fiscal sustainability problem.

1970 and 1994 are detailed in Appendix III. The second element is the magnitude of the maximum primary surpluses  $\bar{p}s$  in column (1). These values of  $\bar{p}s$  are based upon the recent trends of EU primary surpluses. 1/

The rest of the assumptions in Table 3 are as follows. Column (2) contains the 1995 real interest rates. 2/ Column (3) contains the latest IMF World Economic Outlook estimates of the 1995 real rate of growth of the economy. The current primary balance  $ps_t$  is in Column (5). Column (6) contains the latest IMF World Economic Outlook estimates of the gross public debt stock at end 1995 (OECD estimates of net indebtedness are used in Table IV.1 in the appendix). The debt values in Column (7) are the "sustainable public debts." These debt values are computed on the basis of Equation (4'). Column (8) calculates the gap between the sustainable debt in Column (7) and the current debt in Column (6). It is this gap which provides the estimate of the proximity to the fiscal sustainability frontier. A sustainability problem, and the consequent need for a "policy shift," would be revealed by a negative or a small value in this column.

Given the relative fiscal positions in Tables 1 and 2, the recent fiscal performance and the efforts to improve the primary balance in Figures 1 and 6, and the estimates of the proximity to the fiscal sustainability frontier in Table 3, the EU members can be classified in three groups. Table 4 summarizes these preliminary findings, while Figure 7 illustrates them. 3/

- Group 1, comprises Germany, France, Luxembourg, and the United Kingdom. Luxembourg is not shown in Figure 7 because its debt-to-GDP falls outside the chart. 4/ Group 1 countries do not currently exhibit a problem of fiscal sustainability. Only France and the

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1/ For example, in some countries the maximum primary surplus  $\bar{p}s^i$ , has achieved higher values in past years than those envisaged in Table 3. Denmark has had a primary surplus of 8.5 percent of GDP in 1986, and 6.9 percent in 1987. Ireland has had a primary surplus of 5.1 percent in 1989, and 4.7 percent of GDP in 1990. The United Kingdom has had a primary surplus of 5.1 percent of GDP in 1970. Therefore, in such countries the index may be downward biased. On the other side, these high primary surpluses were not maintained for many periods.

2/ These interest rates are the averages of the short-term and long-term real interest rates. The weighing factor is the respective shares in circulation as reported in Masson and Symansky (1995).

3/ The latter figure divides the deficit- and debt-to-GDP space in three areas by using two curves that are akin to the fiscal sustainability frontier.

4/ Luxembourg is currently running a budget surplus and its debt-to-GDP ratio, the lowest in the EU, is significantly below the Maastricht fiscal criteria.

United Kingdom should reduce their budget deficits over the medium term and improve primary balances (see Columns (1) and (3) in Table 4).

- **Group 2**, comprises Denmark, Ireland, the Netherlands, Portugal, and Spain. These countries do not have an immediate fiscal sustainability problem. However, Denmark, Ireland, and the Netherlands need to continue their fiscal correction and consolidate the significant fiscal improvements of recent years. Portugal and Spain may need to improve their primary balances more decisively.
- **Group 3**, comprises Belgium, Greece, and Italy. These countries are relatively closer to their respective fiscal sustainability frontier. This implies that they must persevere in their efforts to reduce budget deficits and increase primary balances (see Column (3) in Table 4). This will initially improve the "grades" in Column (1), and then the "grades" in Columns (2) and (4) over time.

The fiscal sustainability gaps in Column (8) are meant to provide a preliminary evaluation of the relative fiscal positions of each EMU candidate. They are not meant to estimate the precise size of the fiscal adjustment that may be needed by any EU member. Therefore, the ranking of the EU members should be interpreted as indicative because some of the variables and assumptions underlying the index of fiscal sustainability contain a certain degree of uncertainty and subjectivity. The next subsection illustrates the effects of even limited changes in the underlying variables and assumptions.

## 2. A sensitivity analysis

This subsection conducts a sensitivity analysis to test the possible effects of a deepening of the endogenous fiscal discipline. First, what could be the effect of a decline in the maximum primary surplus resulting from the process of tax harmonization? Row (a) in Table IV.1 of Appendix IV estimates the effects of a 1 percent of GDP decline in the maximum primary surplus  $\bar{p}s^i$  that can be pursued by each national government. All other variables and assumptions are unchanged with respect to those in Table 3.

In all countries the decline in  $\bar{p}s^i$  reduces the sustainable debt-to-GDP ratio in Column (7). Correspondingly, the fiscal gap estimated in Column (8) of Table 3, worsens as well. For example in Belgium the fiscal gap would worsen by about 25 percent of GDP (a 46.4 percent worsening with respect to the fiscal gap in Table 3), in Denmark by 37 percent of GDP, in Greece by 30 percent of GDP, in Ireland by 41 percent of GDP, in Italy by 39 percent of GDP, and in the Netherlands by 42 percent. This highlights the critical role of pursuing higher maximum primary surpluses in securing fiscal sustainability.

Table 4. The Main Findings of the Paper 1/

|   | Deficit<br>/GDP | Debt<br>/GDP | Effort to<br>Improve primary<br>balance in<br>recent years <u>2/</u> | Proximity to<br>Fiscal Sustain.<br>Frontier <u>3/</u> |
|---|-----------------|--------------|--|---|
| Group 1: Countries that do not have a fiscal sustainability problem                       |                 |              |  |   |
| France  | -               | ++           | -  | ++  |
| Germany   | ++              | +            | +/-  | ++  |
| Luxembourg  | ++              | ++           | ++   | ++  |
| United Kingdom  | -               | ++           | +/-  | ++  |
| Group 2: Countries that do not have an immediate fiscal sustainability problem, <u>4/</u> |                 |              |  |   |
| Denmark   | ++              | -            | +/-  | -   |
| Ireland   | ++              | -            | ++   | +/-   |
| Netherlands   | +/-             | -            | ++   | +   |
| Portugal  | -               | +/-          | ++   | -   |
| Spain   | --              | +/-          | +/-  | +   |
| Group 3: Countries that need a fiscal adjustment  |                 |              |  |   |
| Belgium   | -               | --           | ++   | --  |
| Greece  | --              | --           | +/-  | --  |
| Italy   | --              | --           | +  | --  |

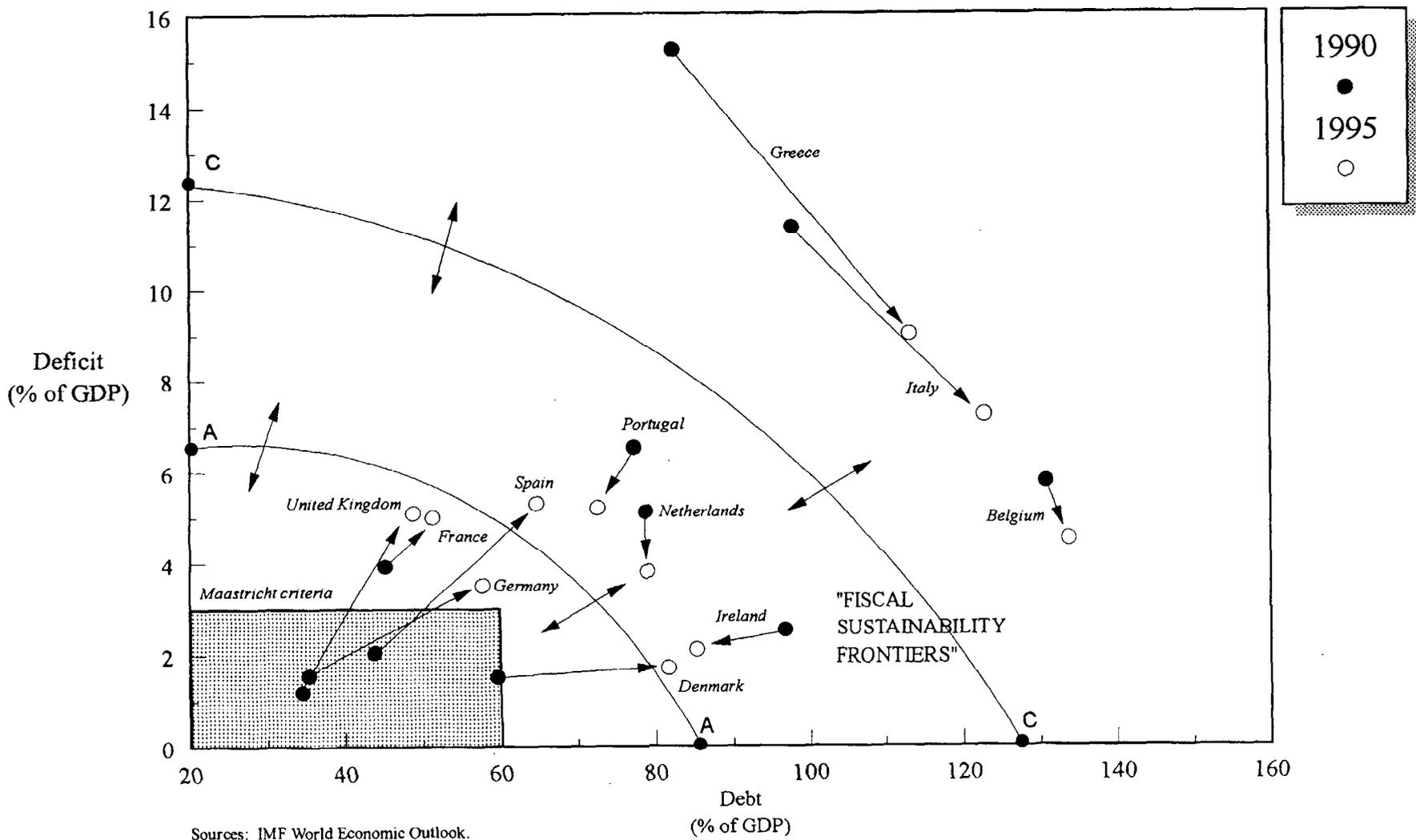
1/ ++ means very adequate, + means adequate, - means slightly inadequate, -- means very inadequate. This ranking of the EU members reflects: (1) the data on budget deficit and public debt in Table 1; (2) the relative fiscal position of the EU members in 1995 in Table 2; (3) the ranking of EU members according to the findings summarized in Table 3; and (4) the evolution of primary balances shown in Figure 6.

2/ Indicates whether an effort is under way to reduce the budget deficit and improve the primary balance in order to stem the growth of the debt-to-GDP ratio.

3/ A lower "rating" indicates that a "policy shift" is more urgent to continue to secure fiscal sustainability.

4/ Ireland is in this group due to its recent progress in reducing its budget deficit and the level of indebtedness. Portugal is in this group due to its relatively low level of indebtedness and its significant effort to reduce the budget deficit.

Figure 7. European Union: Public Sector Deficit and Debt, and the Fiscal Sustainability Frontiers



The second sensitivity test involves a fall in the speed of the fiscal adjustment  $\gamma$ . Specifically, rows (b) estimates the effects of a 5 percent across the board increase in  $\gamma$ . In all countries this raises the sustainable debt-to-GDP ratio by at most 5 percent of GDP.

The third sensitivity test involves a fall in the real interest rate along the following lines. First, it is assumed that monetary discipline will be clearly established in the EMU and that any bail out of a member in financial distress is precluded. Therefore, the EMU's inflation/devaluation risk premium will be minimum. Correspondingly, the high inflation countries could benefit from a very significant fall in interest rates if they were admitted. Following Masson and Symansky (1995), such a fall could even exceed 1 percent in Italy, Portugal, and Spain. Second, all EMU members will benefit from a fall in several transaction costs that were associated with the independent national currencies. "One Market One Money," a report by the EU Commission (Emerson, et al, 1992) estimates that these savings fall between 0.5 and 1 percent of GDP. The latter figure applies to the small open European economies with a limited national currency circulation. Third, the EMU will also strengthen financial market-based discipline, and the conduct of each national government will be scrutinized more closely by bondholders. To the extent that each national government complies with some form of fiscal discipline and avoids free-riding the others fiscal prudence, the outright default risk premiums may even fall in the countries with a relatively higher debt such as Belgium, Greece, and Italy. Rows (c) estimates the effects a 50 percent fall in all interest rate differentials with Germany. 1/ Specifically, the fiscal gap in column (8) could improve by 43 percent of GDP in Belgium, 71 percent in Denmark, 34 percent in Greece, 155 percent in Ireland, 94 percent in Italy, and 47 percent in Portugal. Hence, the countries with a relatively high debt-to-GDP ratio could significantly benefit from a fall in interest rates. Eventually, high debt countries could gain the most from the EMU if they were admitted.

### 3. Net versus gross public debt

The distinction between various types of gross and net debt is now briefly considered. Corsetti and Roubini (1994), and Buitert, Corsetti, and Roubini (1992) and other references therein contain a more meticulous discussion of these aspects. First, gross non-monetary liabilities of the government are relatively lower in countries with a relatively larger monetary base (i.e., the southern-belt countries). Second, under the Maastricht Treaty privatization receipts can reduce the public debt, but should be counted as financing. Therefore countries with lower privatization receipts are discriminated against. Third, the holding of

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1/ This does not constitute a projection of the expected convergence of real interest rates across the EMU. Such a reduction in interest rates could be too conservative in the light of the recent empirical findings concerning the magnitude of the inflation/devaluation risk premium. Conversely, it could be too loose if the outright default risk premium increased due to a slow and unconvincing fiscal consolidation.

gross financial assets may significantly reduce the net debt and different funding practices for public pensions obligations also play a role.

Row (d) in Table IV.1 in Appendix IV adopts net public debt figures from the IMF WEO and the OECD. <sup>1/</sup> All other assumptions are unchanged with respect to those in Table 3. It must be noted that the return on the government's assets is not necessarily comparable with the burden of servicing the gross public debt. Therefore, the new fiscal gap in Column (8) must be treated with great circumspection and should be considered as an upper bound "optimistic" estimate of the fiscal gap. With this in mind, the fiscal gap improves substantially in Denmark (by 37.8 percent with respect to Table 3), France (14.6 percent), Italy (26.5 percent), the Netherlands (19.9 percent), and Spain (16.1 percent). The improvement is more modest in Belgium (11.1 percent), Germany (6.4 percent), and the United Kingdom (8.4 percent).

#### V. Concluding Remarks

1. Economic and financial integration vs. fiscal divergence. Despite progress toward economic and financial integration, fiscal developments have diverged widely across the EU. However, this paper has found that some limited convergence is already taking place on the revenue side, particularly with respect to tax revenue. This finding provides some ground for the hypothesis that a limited harmonization of tax systems is already taking place across the EU.

2. The contributions of this paper. This paper has presented a methodology to analyze the responsiveness of fiscal sustainability to the changes that will be entailed by the EMU. An extension of Blanchard's (1984) model illustrates how the sustainable level of debt is affected by the reputation of the government. If this reputation is weak, and the financial market commands a significant risk premium, the fiscal sustainability frontier will shift to the left. The higher the risk premium, the more this paper's solution will diverge from Blanchard's (1984). In addition, this paper has shown that a high budget deficit can also imply a loss of sustainability even at low levels of debt, and vice versa. Therefore, the implementation of the Maastricht Treaty criteria for the budget deficit and public debt are both crucial to securing fiscal sustainability.

3. The fiscal challenges versus the fiscal rewards of the EMU. This paper has presented an index of fiscal sustainability that is based on the

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<sup>1/</sup> These estimates of net public debt, when available, include all financial liabilities and exclude all financial assets as defined by the System of National Accounts. Estimates cover the general government sector, which consolidates the central, state, and local governments and the social security sector. It must be noted that the difference between gross and net debt is significant in Denmark, France, Italy, the Netherlands, and Spain. It is less significant in Belgium, Germany, and the United Kingdom.

proximity of each country to an estimated fiscal sustainability frontier. The EU members have been classified in three groups according to their current relative fiscal position. The EMU might provide any Group 2 or Group 3 countries with a unique opportunity to improve its fiscal sustainability if it is admitted and if:

- the interest rate structure of the EMU falls after the adoption of the single currency on account of a fall in various transaction costs and the establishment of an anti-inflationary discipline by the ECB; and
- country-specific interest rates fall even further if fiscal discipline is pursued by each member, and no country in financial distress can be bailed out.

Figure 6 and Tables 1 and 4 leave no doubt that most EU members, particularly those with relatively high debt-to-GDP and deficit-to-GDP ratios, have recently managed to improve their primary balances. However, fiscal sustainability across the EU cannot be assessed on the basis of this index alone, but should rely on a variety of fiscal indicators also looking at the inter-temporal evolution of the main fiscal variables and other related aspects. For example, Corsetti and Roubini (1994) calculate "one period" and an "infinite periods" primary gaps across the EU. <sup>1/</sup> Masson and Symansky (1995), Mongelli (1996a), the IMF May 1996 World Economic Outlook, the OECD recent Economic Outlook provide other useful insights.

4. Future extensions of the paper. First, the calculation of the relative fiscal positions in this paper is based largely on the current gross debt. Therefore, to the extent that governments have different strategies for the distribution of net debt between liabilities and assets, the relative ranking of EU members is distorted. A future extension of this methodology will investigate this matter in greater detail and attempt to estimate the returns on government assets. The second extension is of an empirical nature. The period chosen for the estimation of the parameter capturing the fiscal effort is rather arbitrary. The parameter estimates are not stable, but swing over time, and as a result the relative ranking of countries changes as well. However, using fewer recent observations may not have been an adequate solution. What needs to be done in an extension of this methodology is to calculate a dynamic fiscal gap that reflects the observed annual fluctuations in budget deficits, primary surpluses, real interest rates, current public debts, and fiscal efforts of each country. This entails calculating the fiscal gaps in Table 3 for every year from 1970 to 1995 (on an ex-post basis).

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<sup>1/</sup> Corsetti and Roubini's (1994) approach is based on the current fiscal stance, some implicit "computed" interest rates, and significant projected declines in interest rate differentials. This approach penalizes less high debt-to-GDP countries, and relatively more the countries with relatively high budget deficits.

APPENDIX I

Table I. Correlation of the Principal Fiscal Variables across the EU.

Table Ia. Correlations of Government Expenditure (horizontal), and Budget Deficits Across the EU (1980-1994) 1/

|    | B     | D     | F     | G     | GR    | IR    | I     | L     | N     | P     | S     | UK    |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| B  | 1.00  | 0.04  | -0.04 | 0.33  | -0.61 | 0.78  | -0.57 | 0.14  | 0.26  | -0.26 | -0.59 | 0.70  |
| D  | 0.53  | 1.00  | 0.59  | 0.54  | 0.51  | -0.13 | 0.46  | 0.25  | 0.38  | 0.70  | 0.45  | 0.42  |
| F  | -0.05 | 0.30  | 1.00  | 0.35  | 0.67  | 0.00  | 0.80  | -0.41 | 0.23  | 0.84  | 0.80  | 0.35  |
| G  | 0.40  | 0.64  | 0.22  | 1.00  | 0.36  | 0.21  | 0.02  | 0.04  | 0.34  | 0.26  | 0.13  | 0.36  |
| GR | -0.76 | -0.51 | 0.10  | -0.65 | 1.00  | -0.58 | 0.88  | -0.27 | 0.11  | 0.79  | 0.92  | -0.03 |
| IR | 0.93  | 0.47  | -0.07 | 0.32  | -0.78 | 1.00  | -0.51 | -0.12 | 0.34  | -0.34 | -0.51 | 0.42  |
| I  | 0.13  | -0.20 | 0.20  | -0.30 | 0.41  | 0.14  | 1.00  | -0.40 | 0.08  | 0.89  | 0.97  | -0.15 |
| L  | 0.76  | 0.76  | 0.22  | 0.39  | -0.71 | 0.69  | -0.20 | 1.00  | -0.01 | -0.22 | -0.35 | 0.18  |
| N  | 0.64  | 0.19  | 0.08  | -0.12 | -0.28 | 0.59  | 0.45  | 0.60  | 1.00  | 0.27  | -0.01 | 0.25  |
| P  | 0.85  | 0.71  | 0.19  | 0.46  | -0.65 | 0.82  | 0.06  | 0.83  | 0.51  | 1.00  | 0.84  | 0.10  |
| S  | 0.02  | 0.25  | 0.82  | 0.13  | 0.06  | 0.14  | 0.40  | 0.10  | 0.05  | 0.23  | 1.00  | -0.10 |
| UK | 0.12  | 0.48  | 0.68  | 0.55  | -0.37 | 0.23  | -0.28 | 0.34  | -0.15 | 0.41  | 0.64  | 1.00  |

Table Ib. Correlations of Tax Revenue (horizontal) and Total Government Revenue (vertical) Across the EU (1980-1994) 1/ 2/

|    | B     | D     | F     | G     | GR    | IR    | I     | L     | N     | P     | S     | UK   |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| B  | 1.00  | 0.73  | 0.95  | 0.71  | 0.87  | 0.83  | 0.76  | 0.79  | 0.88  | 0.86  | 0.81  | 0.57 |
| D  | 0.15  | 1.00  | 0.83  | 0.43  | 0.86  | 0.80  | 0.88  | 0.62  | 0.78  | 0.83  | 0.91  | 0.52 |
| F  | 0.67  | 0.68  | 1.00  | 0.60  | 0.95  | 0.90  | 0.90  | 0.76  | 0.88  | 0.96  | 0.92  | 0.67 |
| G  | 0.36  | -0.02 | 0.00  | 1.00  | 0.49  | 0.48  | 0.35  | 0.68  | 0.69  | 0.52  | 0.47  | 0.15 |
| GR | 0.16  | 0.30  | 0.11  | 0.42  | 1.00  | 0.87  | 0.94  | 0.68  | 0.85  | 0.94  | 0.94  | 0.65 |
| IR | 0.33  | 0.66  | 0.58  | 0.06  | 0.25  | 1.00  | 0.86  | 0.54  | 0.77  | 0.89  | 0.81  | 0.78 |
| I  | 0.22  | 0.65  | 0.47  | 0.14  | 0.82  | 0.42  | 1.00  | 0.63  | 0.79  | 0.96  | 0.96  | 0.70 |
| L  | -0.38 | 0.32  | -0.19 | -0.36 | 0.18  | -0.11 | -0.25 | 1.00  | 0.81  | 0.76  | 0.76  | 0.23 |
| N  | -0.02 | 0.14  | -0.02 | 0.21  | 0.78  | 0.40  | 0.52  | 0.18  | 1.00  | 0.86  | 0.85  | 0.44 |
| P  | 0.23  | 0.64  | 0.51  | 0.15  | 0.73  | 0.43  | 0.92  | 0.20  | 0.42  | 1.00  | 0.96  | 0.68 |
| S  | 0.13  | 0.78  | 0.49  | 0.04  | 0.73  | 0.46  | 0.96  | 0.45  | 0.48  | 0.91  | 1.00  | 0.56 |
| UK | 0.11  | -0.56 | -0.07 | -0.15 | -0.85 | -0.30 | -0.84 | -0.53 | -0.66 | -0.67 | -0.85 | 1.00 |

Sources: IMF World Economic Outlook, and OECD.

1/ Labels: B=Belgium, D=Denmark, F=France, G=Germany, GR=Greece, IR=Ireland, I=Italy, L=Luxembourg, N=Netherlands, P=Portugal, S=Spain, UK= United Kingdom.

2/ For tax revenue. Correlations between 1970 and 1992.

The notation

|                    |   |   |
|--------------------|---|---|
| $G_t$              | = | nominal non-interest government expenditure on goods and services,  |
| $T_t$              | = | nominal government revenue from taxes and other receipts net of government transfers,   |
| $B_t$              | = | net nominal liabilities of the government in the form of perpetual bonds,   |
| $Y_t$              | = | nominal gross domestic product (GDP),   |
| $P_t$              | = | price level,  |
| $y_t$              | = | real gross domestic product,  |
| $\mu$              | = | rate of growth of real GDP,   |
| $i_t$              | = | nominal interest rate,  |
| $r$                | = | real interest rate,   |
| $\pi_t$            | = | level of inflation,   |
| $r^f$              | = | risk free real interest rate,   |
| $r^i$              | = | real interest rate prevailing in a specific EU member (where $i=1,2,\dots,12$ are the 12 EU members),   |
| $g_t$              | = | ratio of non-interest government expenditure on goods and services to nominal GDP ( $G_t/Y_t$ ),  |
| $\tau_t$           | = | ratio of government revenue from taxes and other receipts net of transfers to nominal GDP ( $T_t/Y_t$ ),  |
| $b_t$              | = | public debt to nominal GDP ratio ( $B_t/Y_t$ ),   |
| $ps_t$             | = | primary balance as a ratio to GDP ( $\tau_t - g_t$ ); it is a surplus when positive and a deficit when negative,  |
| $\bar{\tau}$       | = | maximum amount of net government revenue which can be collected. It is an upper bound value of $\tau_t$ ,   |
| $\underline{\tau}$ | = | minimum amount of net government revenue that can be collected. It is a lower bound value of $\tau_t$ ,   |
| $\bar{g}$          | = | maximum amount of non-interest government expenditure on goods and services,  |
| $g$                | = | minimum amount of socially acceptable non-interest government expenditure on goods and services,  |
| $\bar{ps}$         | = | maximum attainable primary surplus,   |
| $\gamma$           | = | speed of adjustment of the primary surplus. It is an indicator of the fiscal effort that a national government is willing to undertake during a particular period to improve the primary balance, |
| $\phi$             | = | risk of default of a national government. $0 \leq \phi < 1$ and the first derivative $\phi_b$ is positive when the debt $b_t$ is positive,  |
| *                  | = | starred variables indicate the steady state level of the respective variables.  |

Estimates of the fiscal effort to raise the primary surplus.

This appendix describes the methodology that is used to estimate  $\gamma$ , the speed of adjustment of the current primary balance  $ps_t$  to the maximum primary surplus  $\bar{ps}$ . To overcome the problem of the economic cycle the current primary balance  $ps_t$  is the structural primary balance. For simplicity it is assumed that  $\bar{ps}$  is constant. Three different values of  $\bar{ps}$  --that are based upon recent values of the structural primary surpluses in each country--will then be utilized to calculate Index 1 in Table 3. However, in some countries  $ps_t$  has achieved higher values in past years.

Equation (2') in Section III.1 is now rewritten in discrete time,

$$(III.1) \quad (ps_t - ps_{t-1}) = \gamma (\bar{ps} - ps_t).$$

Rewriting (III.1) and assuming a normally distributed errors term ( $\mu_t$ ) yields the following equation that can be empirically estimated,

$$(III.2) \quad ps_t = a_1 \bar{ps} + a_2 ps_{t-1} + \mu_t$$

where  $a_1 = \gamma/(1+\gamma)$ , and  $a_2 = 1/(1+\gamma)$ . The coefficient  $a_2$  provides the values of  $\gamma$  in Table III.1 below. These values are also used in Table 3 in the text for the calculation of Index 1.

Table III.1. Estimates of  $\gamma$ , which measures the effort to improve the primary balance, 1971-1994. 1/

|                | Estimate of $\gamma$ | T-Statistic. 2/ | R-Square | D.W. |
|----------------|----------------------|-----------------|----------|------|
| Belgium        | 0.093                | 6.64            | 0.75     | 1.70 |
| Denmark        | 0.303                | 5.92            | 0.61     | 1.04 |
| France         | 0.533                | 2.84            | 0.30     | 1.99 |
| Germany        | 0.498                | 2.71            | 0.25     | 1.89 |
| Greece         | 0.369                | 2.04            | 0.18     | 1.76 |
| Ireland 3/     | 0.145                | 0.63 *          | 0.09     | 1.83 |
| Italy          | 0.163                | 6.32            | 0.65     | 2.29 |
| Netherlands    | 0.429                | 2.07            | 0.18     | 1.84 |
| Portugal       | 0.235                | 4.44            | 0.62     | 1.28 |
| Spain          | 0.309                | 1.65 *          | 0.17     | 1.44 |
| United Kingdom | 0.39                 | 2.93            | 0.31     | 1.28 |

1/ For Belgium 1975-1991. For France, Greece, the Netherlands, and the United Kingdom 1971-1991. For Portugal 1977-1990. For Spain 1980-1994.

2/ \* indicates not significant at 5 percent level.

3/ Ireland has undertaken a fiscal consolidation in recent years. 1985-1991 data are used (and later data were not available), but the estimate of  $\gamma$  is likely to be undervalued.

Table IV.1. A Sensitivity Analysis: Estimates of the Possible Effects of the Endogenous Fiscal Discipline on the Fiscal Gap Estimated in Table 3. 1/

|                       | Maximum<br>Primary<br>Balance<br>(1) | Real<br>Interest<br>Rate<br>(2) | Rate of<br>Growth<br>of GDP<br>(3) | Estimates<br>of<br>Gamma<br>(4) | Latest<br>Primary<br>Balance<br>(5) | Current<br>Public<br>Debt<br>(6) | Sustainable<br>Public<br>Debt<br>(7) | New Fiscal<br>Gap<br>(7)-(6)<br>(8) | % Change wr<br>Fiscal Gap<br>in Table 3<br>(9) |
|-----------------------|--------------------------------------|---------------------------------|------------------------------------|---------------------------------|-------------------------------------|----------------------------------|--------------------------------------|-------------------------------------|--|
| <b>Belgium</b>        |                                      |                                 |                                    |                                 |                                     |                                  |                                      |                                     |  |
| (a)                   | 0.050                                | 0.050                           | 0.019                              | 0.093                           | 0.047                               | 1.34                             | 1.62                                 | 0.28                                | -46.4  |
| (b)                   | 0.060                                | 0.050                           | 0.019                              | 0.143                           | 0.047                               | 1.34                             | 1.90                                 | 0.56                                | 5.9  |
| (c)                   | 0.060                                | 0.045                           | 0.019                              | 0.093                           | 0.047                               | 1.34                             | 2.30                                 | 0.96                                | 80.8   |
| (d)                   | 0.060                                | 0.050                           | 0.019                              | 0.093                           | 0.047                               | 1.28                             | 1.87                                 | 0.59                                | 11.1   |
| <b>Denmark</b>        |                                      |                                 |                                    |                                 |                                     |                                  |                                      |                                     |  |
| (a)                   | 0.030                                | 0.054                           | 0.029                              | 0.303                           | 0.017                               | 0.82                             | 1.16                                 | 0.35                                | -51.6  |
| (b)                   | 0.040                                | 0.054                           | 0.029                              | 0.353                           | 0.017                               | 0.82                             | 1.54                                 | 0.73                                | 1.3  |
| (c)                   | 0.040                                | 0.047                           | 0.029                              | 0.303                           | 0.017                               | 0.82                             | 2.25                                 | 1.43                                | 100.1  |
| (d)                   | 0.040                                | 0.054                           | 0.029                              | 0.303                           | 0.017                               | 0.55                             | 1.53                                 | 0.99                                | 37.8   |
| <b>France</b>         |                                      |                                 |                                    |                                 |                                     |                                  |                                      |                                     |  |
| (a)                   | 0.030                                | 0.047                           | 0.024                              | 0.533                           | -0.020                              | 0.52                             | 1.27                                 | 0.74                                | -36.9  |
| (b)                   | 0.040                                | 0.047                           | 0.024                              | 0.583                           | -0.020                              | 0.52                             | 1.71                                 | 1.19                                | 0.8  |
| (c)                   | 0.040                                | 0.043                           | 0.024                              | 0.533                           | -0.020                              | 0.52                             | 2.07                                 | 1.55                                | 31.3   |
| (d)                   | 0.040                                | 0.047                           | 0.024                              | 0.533                           | -0.020                              | 0.35                             | 1.70                                 | 1.35                                | 14.6   |
| <b>Germany</b>        |                                      |                                 |                                    |                                 |                                     |                                  |                                      |                                     |  |
| (a)                   | 0.030                                | 0.039                           | 0.019                              | 0.498                           | -0.003                              | 0.58                             | 1.44                                 | 0.86                                | -35.9  |
| (b)                   | 0.040                                | 0.039                           | 0.019                              | 0.548                           | -0.003                              | 0.58                             | 1.92                                 | 1.35                                | 0.5  |
| (c)                   | 0.040                                | 0.039                           | 0.019                              | 0.498                           | -0.003                              | 0.58                             | 1.92                                 | 1.34                                | 0.0  |
| (d)                   | 0.040                                | 0.039                           | 0.019                              | 0.498                           | -0.003                              | 0.49                             | 1.92                                 | 1.43                                | 6.4  |
| <b>Greece</b>         |                                      |                                 |                                    |                                 |                                     |                                  |                                      |                                     |  |
| (a)                   | 0.035                                | 0.051                           | 0.020                              | 0.369                           | 0.029                               | 1.13                             | 1.14                                 | 0.01                                | -97.4  |
| (b)                   | 0.045                                | 0.051                           | 0.020                              | 0.419                           | 0.029                               | 1.13                             | 1.45                                 | 0.32                                | 1.4  |
| (c)                   | 0.045                                | 0.045                           | 0.020                              | 0.369                           | 0.029                               | 1.13                             | 1.80                                 | 0.67                                | 113.3  |
| <b>Ireland</b>        |                                      |                                 |                                    |                                 |                                     |                                  |                                      |                                     |  |
| (a)                   | 0.030                                | 0.062                           | 0.042                              | 0.145                           | 0.015                               | 0.85                             | 1.32                                 | 0.47                                | -47.1  |
| (b)                   | 0.040                                | 0.062                           | 0.042                              | 0.195                           | 0.015                               | 0.85                             | 1.77                                 | 0.92                                | 3.7  |
| (c)                   | 0.040                                | 0.053                           | 0.042                              | 0.145                           | 0.015                               | 0.85                             | 3.28                                 | 2.43                                | 175.0  |
| <b>Italy</b>          |                                      |                                 |                                    |                                 |                                     |                                  |                                      |                                     |  |
| (a)                   | 0.030                                | 0.055                           | 0.032                              | 0.163                           | 0.033                               | 1.23                             | 1.35                                 | 0.12                                | -75.9  |
| (b)                   | 0.040                                | 0.055                           | 0.032                              | 0.213                           | 0.033                               | 1.23                             | 1.75                                 | 0.52                                | 1.6  |
| (c)                   | 0.040                                | 0.047                           | 0.032                              | 0.163                           | 0.033                               | 1.23                             | 2.67                                 | 1.45                                | 181.3  |
| (d)                   | 0.040                                | 0.055                           | 0.032                              | 0.163                           | 0.033                               | 1.09                             | 1.74                                 | 0.65                                | 26.5   |
| <b>Netherlands</b>    |                                      |                                 |                                    |                                 |                                     |                                  |                                      |                                     |  |
| (a)                   | 0.030                                | 0.048                           | 0.024                              | 0.429                           | 0.008                               | 0.79                             | 1.28                                 | 0.49                                | -45.6  |
| (b)                   | 0.040                                | 0.048                           | 0.024                              | 0.479                           | 0.008                               | 0.79                             | 1.70                                 | 0.91                                | 0.8  |
| (c)                   | 0.040                                | 0.043                           | 0.024                              | 0.429                           | 0.008                               | 0.79                             | 2.09                                 | 1.30                                | 44.0   |
| (d)                   | 0.040                                | 0.048                           | 0.024                              | 0.429                           | 0.008                               | 0.61                             | 1.69                                 | 1.09                                | 19.9   |
| <b>Portugal</b>       |                                      |                                 |                                    |                                 |                                     |                                  |                                      |                                     |  |
| (a)                   | 0.030                                | 0.058                           | 0.024                              | 0.235                           | 0.020                               | 0.73                             | 0.89                                 | 0.16                                | -62.2  |
| (b)                   | 0.040                                | 0.058                           | 0.024                              | 0.285                           | 0.020                               | 0.73                             | 1.16                                 | 0.44                                | 2.7  |
| (c)                   | 0.040                                | 0.048                           | 0.024                              | 0.235                           | 0.020                               | 0.73                             | 1.63                                 | 0.90                                | 111.1  |
| <b>Spain</b>          |                                      |                                 |                                    |                                 |                                     |                                  |                                      |                                     |  |
| (a)                   | 0.030                                | 0.054                           | 0.030                              | 0.309                           | 0.020                               | 0.65                             | 1.17                                 | 0.52                                | -41.9  |
| (b)                   | 0.040                                | 0.054                           | 0.030                              | 0.359                           | 0.020                               | 0.65                             | 1.55                                 | 0.90                                | 0.9  |
| (c)                   | 0.040                                | 0.047                           | 0.030                              | 0.309                           | 0.020                               | 0.65                             | 2.27                                 | 1.62                                | 81.6   |
| (d)                   | 0.040                                | 0.054                           | 0.030                              | 0.309                           | 0.020                               | 0.50                             | 1.54                                 | 1.04                                | 16.1   |
| <b>United Kingdom</b> |                                      |                                 |                                    |                                 |                                     |                                  |                                      |                                     |  |
| (a)                   | 0.030                                | 0.051                           | 0.024                              | 0.390                           | -0.025                              | 0.49                             | 1.04                                 | 0.56                                | -39.4  |
| (b)                   | 0.040                                | 0.051                           | 0.024                              | 0.440                           | -0.025                              | 0.49                             | 1.42                                 | 0.93                                | 1.8  |
| (c)                   | 0.040                                | 0.045                           | 0.024                              | 0.390                           | -0.025                              | 0.49                             | 1.84                                 | 1.36                                | 48.0   |
| (d)                   | 0.040                                | 0.051                           | 0.024                              | 0.390                           | -0.025                              | 0.41                             | 1.40                                 | 0.99                                | 8.4  |

Source: National Sources, IMF's IFS and WEO, OECD.

1/ All fundamental assumptions are identical to those in Table 3, but for the following changes: in row (a) the maximum primary surplus is reduced by 1 percent of GDP; in row (b) the parameter gamma (i.e., the fiscal effort) is increased by 5 percent; and in row (c) the interest rate differential with Germany is reduced by 50 percent. In row (d) net public debt-to-GDP ratio is from IMF WEO database or OECD Economic Outlook, where available. This measure of Government net worth takes into account holding of financial assets, notably across social security systems.

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