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Interest Rates and Government Debt: Are the Linkages Global Rather than National? *

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Abstract

Given the increasing integration of financial markets, a better understanding of the effects of fiscal deficits and debt on real interest rates might be obtained by taking a global, rather than a national, perspective. The paper constructs aggregate flow and stock data (including GDP, fiscal deficits, government debt, and saving rates) and examines the empirical evidence of the global effect of fiscal policies on interest rates. The sensitivity of the results to the choice of deficit (central or general government), public debt (gross or net), and saving (gross or net), as well as the level and method of aggregation, is also examined.

JEL Classification Numbers:
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Contents

Summary

In recent years, the growth of public debt in most industrial countries has raised questions about its effect on their economies. In particular, the possibility that an enlarged public debt could raise interest rates has been recognized by many economists and rejected by some. This paper addresses the question whether such a relationship exists within a global, rather than a national, context. The reason for considering this question in a global context is that wide capital movements make it far easier now than it was in the past to finance a country's fiscal deficit with other countries' savings.

Section II discusses the growth of public debt in industrial countries and the relationship between that growth and the growth of the economy and the level of the real interest rate. By using U.S. data, it also shows that the burden of a given ratio of public debt to gross domestic product (GDP) can vary over time and across countries, since it depends, to a large extent, on the real interest rate. Section III summarizes the basic statistics for Organization for Economic Cooperation and Development (OECD) countries. These statistics are aggregated for the G-3, G-7, and G-13 countries in the empirical part of the paper. It is also argued that the growth of public debt in OECD countries has also eventually raised the tax level and reduced government capital spending.

Section IV provides the empirical results obtained by regressing real interest rates against several variables, including the ratio of public debt to GDP. A large number of regressions were run to test the preferable functional form, the choice of variables, and the robustness of the results. Most of these equations supported the hypothesis that high debt ratios do, indeed, lead to high real interest rates. This section concludes with a comparison of these results with those obtained in a recent paper by Professors Barro and Sala i Martin in which the authors argue that the size of the public debt has no effect on real interest rates.

I. Introduction

This paper has several objectives. First, it presents comparable statistics on the growth of public debt in the post-1970 period for OECD countries. Thus, data on the share of public debt in gross domestic product (GDP) for each country are given as well as data on the growth of interest payments and other relevant statistics. Second, these data are aggregated for progressively larger groups of countries, to show the extent of the growth of public debt in the global economy. The reason for doing this is that in the recent world, with large capital movements, the debt of a country can easily be financed by the financial savings of other countries. 1/ Therefore, if there are linkages between, say, debt and real interest rates, these linkages are likely to show more at the global, than at the national level. However, the economies of the three biggest countries--the United States, Germany, and Japan--are so large that what happens to them determines, to a large extent, what happens to the global economy. 2/ In other words, in analyzing the relation between public debt and interest rates, little is gained by going beyond those three countries. The third objective of this paper is to attempt to determine empirically whether a relationship exists between the growth in public debt and the level of real interest rates.

The paper is made up of three main sections. Section II provides some general background. Section III presents the relevant statistics on the growth of public debt and discusses some of the effects of this growth on tax revenue and on noninterest spending. Section IV presents the empirical results on the relationship between real interest rates and public debt.

II. General Background

In a much-cited address delivered in August 1984 at the 40th Congress of the International Institute of Public Finance, Jacques de Larosière, then Managing Director of the Fund, expressed his concern for the "explosion in public debt" that was affecting both developing and developed countries alike (de Larosière (1986)). He outlined various

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1/ For example in 1988, 41 percent of the borrowing by the U.S. Federal Government was from foreigners (US$67.2 billion out of US$162.1 billion). See Special Analysis: Budget of the United States Government, Fiscal Year 1990 (Washington: Government Printing Office, 1990), p. E-19. Countries such as Denmark, Greece, and Ireland have financed a large share of their total public debt from external sources.

2/ Over the period 1970-87, the combined GDP of the United States, Germany, and Japan, using purchasing power parity exchange rates, accounted for 66.7 percent of the combined GDP and 61.8 percent, on average, of the gross general government debt of the 13 countries examined on this paper.

consequences of excessive indebtedness and called on governments to pursue structural reforms in their public finances in order to contain such an "explosion" and to put their fiscal houses in order. A century earlier, another Frenchman had written that

> "Le phenomène des dettes nationales a pris depuis cinquante ans dans le monde entier un développement si prodigieux que l'esprit en est étonné et presque effrayé." (Leroy-Beaulieu, 1888, p. 584).

Leroy-Beaulieu was concerned enough about this "phenomenon" to have dedicated to it 16 chapters (or about 500 pages) of his influential two-volume Treatise. Is such a preoccupation with the growth of public debt a peculiarity of the French, or are there reasons for concern when public debts are high and, especially, when they are high and growing? Given the focus on medium-term fiscal consolidation which is currently under way in most G-7 countries, it appears that such concerns are present.

Debt financing substitutes for taxation. It, thus, allows governments to maintain or increase, at least temporarily, public spending without the need to legislate tax increases. In other words it has the political advantage of generating an immediate benefit (the public expenditure) without an immediate cost (the raising of tax rates). Given that governments are likely to have short horizons and, thus, to discount future costs at high rates, especially when there is a high probability that these costs will be faced by another set of policymakers, or even by another party, the temptation to finance spending through debt is naturally strong. One could theorize that governments that expect to remain in power for a long time will be more reluctant to finance additional spending through debt accumulation than those with a more precarious hold on the electorate. 1/

If the additional spending is temporary, an argument can be made that debt financing will help smooth the required changes in tax rates over time. Since sudden changes in tax rates generate distortions and, thus, welfare losses, the use of debt finance will increase the efficiency of the economy. 2/ This would be the case especially when the increase in spending is caused by wars, depressions, or large public investments concentrated in a relatively short time. In the latter case, if the investment is productive, the debt would pay for itself by increasing the tax base of the economy. This is similar to what happens

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1/ See Roubini and Sachs (1988) and Alesina (1990) and the articles cited therein for a survey of current work in this area.

2/ See Barro (1979), Persson and Svensson (1984), and Flemming (1988). Some work on the United States by Barro and others has tried to explain the change in debt/GNP ratio as a way of maintaining effective tax rates constant over time. Trehan and Walsh (1988) reject this explanation, however.

in successful private enterprises: they borrow to make investments which, by increasing future earnings, generate the resources to service the higher debt.

How high and how fast the share of public debt into GDP can rise can be shown by the experience of a few countries such as Belgium, Denmark, Ireland, Italy, Greece, and Japan. Between 1975 and 1987, the share of general government debt into GDP rose: from 61.1 percent to 132.4 percent in Belgium; from 11.9 percent to 57.2 percent in Denmark; from 64.3 percent to 123.7 percent in Ireland; from 60.4 to 92.7 percent in Italy; and in Japan from 22.4 percent to 76.0 percent. In Greece, between 1981 and 1987 the share of public debt in GDP rose from 47.2 percent to 100.5 percent.

If the increase in public spending is not temporary and is financed by debt, the share of public debt in national income may grow depending on considerations explained below. As a consequence, the cost of servicing the debt will also grow, especially if interest rates are high. Thus, ironically, the debt that may have been used to keep tax rates down may eventually force them up since the country will in time need to generate a primary surplus to service the debt and, in cases where public spending is rigid downward, that primary surplus can be generated mostly through higher taxes. 1/ For example, over the 1975-87 period, in spite of the debt accumulation shown above, the share of total taxes in GDP grew: from 41.1 percent to 46.1 percent in Belgium; from 41.4 percent to 52 percent in Denmark; from 31.5 percent to 39.9 percent in Ireland; and from 26.2 percent to 36.2 percent in Italy; and from 20.9 percent to 30.2 percent in Japan. In Greece, between 1981 and 1987 the tax share rose from 29.6 percent to 37.4 percent. The tax increases went largely to finance higher government interest payments over the period. These increases in interest payments, also shown as percentages of GDP, were 6.9 in Belgium, 7.1 in Denmark, 5.3 in Ireland, 5.2 in Italy, and 3.2 in Japan.

The growth of the debt to GDP ratio is influenced by the rate of growth of the economy, the effective interest rate on the debt and the size of the primary surplus which can be used to pay the interest on the debt. If D_1 and D_0 are the ratios of debt to GDP in years one and zero; if PD is the ratio of the primary deficit in GDP in year one; if g and i are respectively the nominal growth rate of the economy and the nominal effective interest rate on the debt in year one, then the growth in the debt ratio will be given by the following relationship:

1/ When tax rates are already high, the welfare costs associated with increasing them at the margin will be especially high. Recent work has shown that the marginal cost of raising an extra dollar is much higher than the average cost. Therefore, the benefits associated with the additional spending must be very high to be economically justified. For further discussion of this issue, see Economic Report of the President (1985), pp. 71-3.

$$D_1 - D_0 = PD - [(g-i)/(1+g)]\, D_0 \qquad (1)$$

Thus a high growth rate and a low rate of interest will be major contributors to restraining the growth of public debt in GDP. Furthermore, the current fiscal stance, as assessed through the primary surplus or deficit outcome, is also an important contributor. 1/ In fact, since countries generally cannot control the rates of interest and the growth of the economy, the policy variable in equation (1) is the primary surplus. If noninterest spending cannot be reduced, the tax ratio becomes the basic policy instrument.

Equation (1) implies that in the absence of comparable real effective interest rates on the debt, comparisons of debt ratios through time or through space are not as meaningful as some economists think they are. For example, much has been made of the fact that the debt/GNP ratio for the United States was much higher in the 1940s and 1950s than in the 1980s. Some economists have concluded from this and from other considerations that the current share of public debt into GNP in the United States should not be a matter for concern. 2/ However, the debt in the 1940s and 1950s was largely the result of World War II, while that in the 1980s could not be attributed to any special circumstances. In fact, the growth of the debt/GDP ratio in the 1980s accompanied one of the longest booms in U.S. economic history. Furthermore, interest rates in the 1940s and 1950s were extraordinarily low, due in part to explicit efforts by the Federal Reserve until the "accord" with the Treasury in March 1951, and in part because the deflationary psychology that prevailed in the pre-war period generated, after the war, inflationary expectations, especially over the medium and longer run, that resulted in consistently negative real rates. In other words, the holders of public bonds kept expecting rates of inflation lower than the actual rate. By accepting very low interest rates they paid a large implicit wealth tax on the portion of their wealth held in government securities. 3/

Table 1 provides data for two significant periods for the United States--1946-55 and 1980-89. Column (1) shows the ratio of gross federal debt (end of period) to gross national product. Column (2) shows the ratio of net Federal interest payments to GNP. The debt/GNP

1/ Given the large share of entitlements in government budgets, the change in primary deficit must mostly come from a change in the level of taxation. It is thus no surprise that in recent years fiscal consolidation has come mostly from tax increases.

2/ See, for example, Eisner (1989), and Heilbroner and Bernstein (1989). For a critical review of some of these arguments, see Congressional Budget Office (March 1990).

3/ At the time this led some economists, such as Milton Friedman, to deplore the unfairness of this implicit form of taxation. Interest rates on 91-day Treasury bills averaged only 2 percent in the 1950s.

Table 1. United States: Federal Debt and Interest on the Debt

(In percent)

	Debt/GNP 1/	Interest/GNP	Average Interest
1946	127	2.2	1.7
1947	115	2.2	1.9
1948	102	2.1	2.1
1949	96	2.0	2.1
1950	96	2.1	2.2
1951	81	1.8	2.2
1952	76	1.7	2.3
1953	72	1.8	2.4
1954	73	1.6	2.4
1955	71	1.6	2.3
1980	34	2.8	8.2
1981	33	3.2	9.7
1982	36	3.7	10.3
1983	41	3.9	9.5
1984	42	4.2	10.0
1985	46	4.5	9.8
1986	51	4.6	9.0
1987	53	4.4	8.3
1988	54	4.5	8.3
1989	56	4.7	8.4

Source: Economic Report of the President (Washington: Government Printing Office, various years).

1/ Includes debt held by Federal Government accounts such as the social security trust funds.

ratio was very high in the 1940s and 1950s and fell continuously to 33 by 1981. It, then, started rising again and reached 56 percent in 1989. In 1989 it was still much lower than in any year in the 1946-55 period. However, the behavior of the interest/GNP ratio was different. It was very low during the high debt years of the 1940s and 1950s and much higher and generally rising in the 1980s. Thus, the lower debt ratios in the 1980s were more of a fiscal burden than the high ratios in the 1940s. For sure the ratios in the 1980s would require higher tax ratios to service.

The American example raises the question of comparison of debt burdens, over time for one country and across countries. Comparisons of debt burdens will be meaningful if real interest rates are the same. But, over time, real interest rates are clearly not the same. However, in recent years, because of large capital movements, interest rates have tended to converge across countries and to move in the same direction. This implies that global factors, as distinguished from purely domestic factors, have played a growing role. If real world interest rates tend to be influenced by the size of the global debt, and if countries with higher than average debt may tend to pay some differential or penalty over the international interest rates, then even cross-sectional comparisons need to be qualified. 1/

On the other hand, some debt may reflect subsidized credit. This issue is particularly significant in developing countries for which a large part of the public debt is often owed to foreigners and where a significant part of this foreign debt may have been obtained through concessional sources. For this reason the debt/GDP comparison of say India and Brazil is not very informative since much of India's foreign debt is concessional, and thus carries very low interest rates, while Brazil's debt is owed mostly to commercial banks, and thus carries a market-determined rate. Difficulties in comparing debt burdens also arise when governments have access to captive sources of domestic financing, as has been the case in both industrial and developing countries.

Before going to the more empirical part of this paper, it may be useful to present in Section III some basic information regarding the growth of public debt in the 1970-87 period for OECD countries and for subgroups of these countries. In the process of presenting these data a few relevant questions will also be discussed.

1/ There is empirical evidence that indicates that in fact while interest rates may be largely globally-determined, the countries' own policies may create a differential over the global rate. This means that in empirical analyses of individual countries, only the differential over the "world rate" should be correlated with indices of the country's own fiscal policy. See, for example, Cottarelli and Mecagni (1990).

III. The Growth of Public Debt in OECD Countries

The main objective of this section is to provide comparable data on public debt and other relevant statistics for the OECD countries. This information is given in a set of charts and tables. A statistical appendix provides additional data. In our empirical analysis we shall use general government data. This choice is motivated by availability of data and the desire to minimize differences due purely to classification.

Table 2 summarizes, for the 1970-87 period, statistics for the gross debt of general government expressed as a share of GDP. The growth of that share gives substance to the concern about a "debt explosion" expressed by de Larosière in 1984. With very few exceptions the ratio of gross debt to GDP has been on an upward trend. By 1987 it had reached very high levels in many countries.

To pursue our thesis that, because of wide capital movements among countries, especially in recent years, some of the relationships between interest rates and debt are better analyzed in a context wider than a single country, Table 2 shows the behavior of gross debt as a share of GDP also for the United States, Japan, and Germany combined (G-3), as well as for the G-3 plus France, Italy, the United Kingdom, and Canada (G-7). In addition, thirteen OECD countries for which the statistical information was available were aggregated to provide the G-13 group. In each of these groups the weight of a country reflected its gross domestic product. The conversion into dollars was done using alternatively average official exchange rates and purchasing power parities. 1/

The significant growth of debt as a share of GDP is experienced by all of these groups. Especially in the 1980-85 period the growth rate of public debt was particularly high. Between 1980 and 1987 the debt ratio rose by close to 20 percentage points for the G-3 and a little less in the other groups. Chart 1 provides a visual presentation of the aggregated public debt data.

Chart 2 shows the behavior of the real long-term government bond rate which also reflects the average for the same groups of countries. 2/ The comparison of Chart 1 with Chart 2 shows that some common trends are shared by both charts. Until 1974 the share of debt

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1/ Purchasing power parity exchange rates are provided by the OECD.

2/ This rate was constructed as the ex post rate on long-term government debt, as reported in International Financial Statistics, and contemporaneous changes in the consumer price indices, using relative GDP shares as weights.

Table 2
General Government Gross Debt
(Percent of GDP)

	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987
United States	46.0	43.1	38.5	37.8	41.9	44.8	45.8	48.8	51.6	52.2
Japan	12.1	22.4	52.0	56.9	61.1	66.9	68.5	69.3	73.1	76.0
Germany	18.4	25.1	32.6	36.4	39.4	41.0	41.8	42.5	42.7	43.9
France	53.1	41.1	37.3	36.4	40.1	41.4	43.8	45.5	45.5	47.6
Italy	41.6	60.4	58.9	61.0	66.3	71.9	77.1	84.0	88.5	92.7
United Kingdom	85.1	65.2	54.7	54.7	53.4	53.6	55.0	53.6	52.4	50.1
Canada	52.3	43.6	45.5	45.5	50.5	56.6	59.2	65.0	68.9	69.4
Netherlands	52.2	41.4	45.9	50.3	55.6	61.9	66.1	69.6	71.1	74.9
Australia	36.9	23.8	22.7	20.6	22.1	24.0	25.1	26.4	26.6	23.4
Switzerland	...	...	...	...	...	...	...	...	...	...
Sweden	30.5	29.5	44.8	52.9	62.6	66.1	67.6	68.1	68.3	62.0
Belguim	67.5	61.1	79.9	93.4	102.4	113.4	118.7	123.0	127.2	132.4
Austria	19.4	23.9	37.2	39.3	41.6	46.0	47.9	49.6	53.8	57.3
Denmark	11.3	11.9	33.5	43.6	53.0	62.6	67.0	65.7	59.5	57.2
Finland	15.2	8.6	13.8	14.6	17.1	18.7	19.0	18.9	18.8	19.9
Norway	47.0	44.7	52.2	47.4	42.1	38.8	38.7	40.7	51.0	43.3
Ireland	--	64.3	75.0	79.8	85.9	96.2	101.6	104.9	120.2	123.7
Spain	--	--	18.7	23.2	29.0	35.0	41.9	47.2	48.1	48.4
G3 1/	37.4	36.0	40.6	42.2	45.9	49.4	50.5	52.8	56.5	58.1
G3 2/	35.7	36.4	40.7	41.9	46.1	49.5	50.5	52.8	55.5	56.8
G7 1/	42.7	40.3	42.9	43.9	47.4	50.8	52.2	54.6	57.9	59.6
G7 2/	42.5	41.3	43.1	44.0	47.9	51.2	52.7	55.2	57.6	58.8
G13 1/3/	42.2	39.3	42.5	43.6	47.1	50.5	52.0	54.4	57.7	59.2
G13 2/3/	42.0	40.4	42.7	43.7	47.7	51.0	52.6	55.0	57.3	58.3

Source: OECD

1/ Using period average exchange rates for aggregation.
2/ Using PPP exchange rates for aggregation.
3/ Total of above countries except Switzerland, Belguim, Finland, Ireland, and Spain.

CHART 1.

GENERAL GOVERNMENT GROSS DEBT, 1970-1987

(SHARE OF GROSS DOMESTIC PRODUCT)

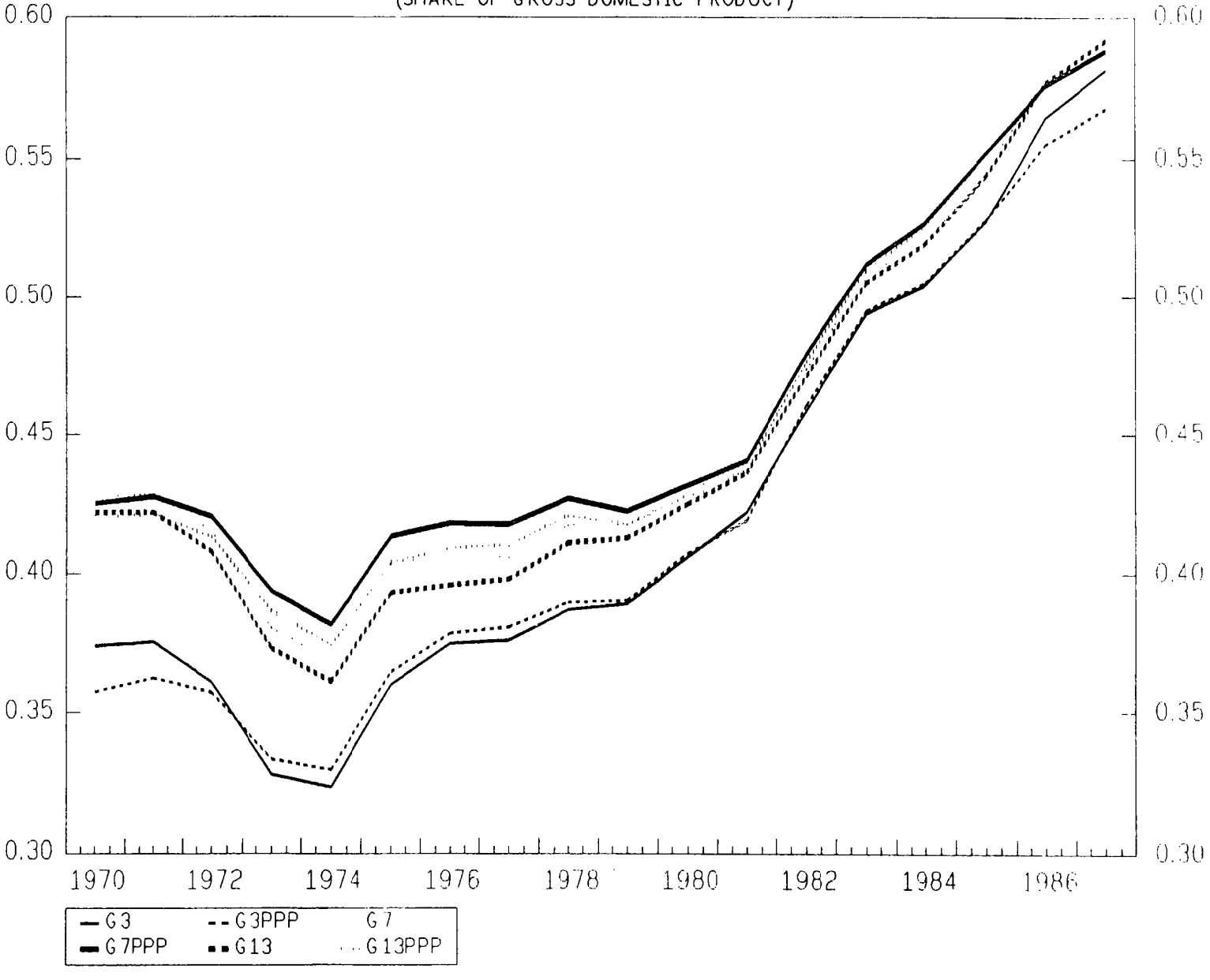
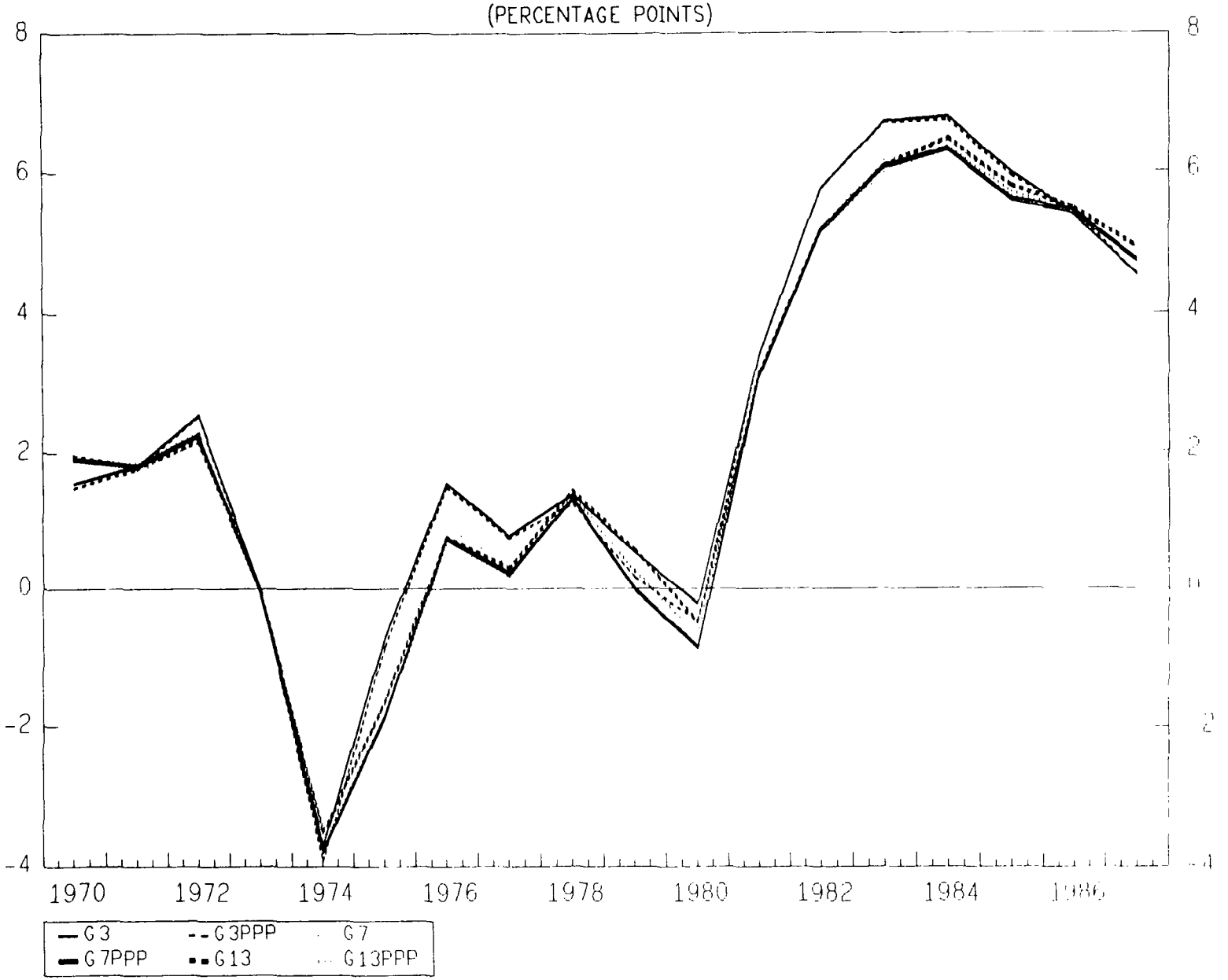


Chart 2.

REAL LONG-TERM GOVERNMENT BOND RATE, 1970-1987

(PERCENTAGE POINTS)



to GDP was falling and so was the real bond rate. 1/ Between 1975 and 1980 there was some increase in the debt share as well as in the real bond rate. From 1980 to 1985 the share of debt in GDP rose very fast and so did the real bond rate. After 1985, however, the trends seem to diverge with the debt ratio continuing its upward trend, though at a slower pace, while the real rate fell somewhat. We shall come back more formally to an analysis of this possible relationship. In the rest of this section we consider other issues.

Table 3 shows the behavior of general government interest payments as a percent of GDP for each of the OECD countries and for the three groups. A significant growth of this share is observed for most countries and for all groups. However, that growth hides the increased real burden in view of the fall in the average rate of inflation between the decade of the 1970s and that of the 1980s. This fall implies that a much larger proportion of the interest payments made in the 1980s was "real" as compared to the 1970s.

An increase in interest payments on the public debt must result in (a) a higher fiscal deficit, (b) a higher level of taxation, or (c) a crowding out of other public expenditure. A formal analysis of all of these alternatives is not carried out here but, at the same time, this is an issue that cannot be completely ignored. Of course, the increase in interest payments, as a share of GDP, in the absence of changes in real interest rates must be preceded by an increase in public debt. For industrial countries there has been far more discussion among economists of debt financing than of debt servicing. 2/ In fact, while those writing on developing countries have often focused on the difficulties of servicing these countries' debt, those writing on industrial countries have focused far more on the process of debt accumulation.

As mentioned in the first section, the growth of public debt has been defended by some economists when it is associated with wars and major public investments since it prevents the increase in tax levels that would be required to finance through taxation the temporary increase in public spending. How do these reasons apply to the growth of debt in our sample countries?

1/ Significantly negative real interest rates were experienced by most countries in our sample in 1974. The degree of the fall in these rates varied greatly among countries; by far the largest decline was experienced by Japan, whose real rate was -11.3 percent in 1974, compared to -3.9 percent in 1973, largely due to an increase in its CPI of 23.2 percent.

2/ See, inter alia, Buiter (1985) and Spaventa (1987). Debt management seems to have largely disappeared as a field of interest for economists. It used to be a major field in the 1950s and 1960s. However, see the recent work by Alesina, Prati, and Tabellini (1989) and by Ciavazzi and Pagano (1989).

Table 3
General Government Interest Payments
(Percent of GDP)

	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987
United States	2.2	2.4	3.2	3.7	4.2	4.4	4.8	5.0	5.0	4.9
Japan	0.6	1.2	3.1	3.6	3.8	4.2	4.4	4.5	4.5	4.4
Germany	0.8	1.3	1.9	2.2	2.7	2.9	2.9	3.0	2.9	2.8
France	1.1	1.2	1.5	2.0	2.0	2.6	2.7	2.9	2.9	2.8
Italy	1.3	2.9	4.9	6.2	7.1	7.5	8.0	8.0	8.6	8.1
United Kingdom	3.9	3.9	4.7	5.0	5.0	4.7	4.9	4.9	4.5	4.3
Canada	3.7	3.8	5.5	6.3	7.3	7.3	7.9	8.5	8.5	8.3
Netherlands	3.4	3.8	4.7	5.5	6.3	7.0	7.5	7.7	7.6	7.2
Australia	2.3	1.4	2.1	2.2	2.5	2.9	3.3	3.7	3.9	3.7
Switzerland	1.5	2.0	1.8	1.8	1.8	1.8	1.7	1.6	1.5	1.5
Sweden	1.9	2.2	4.1	5.4	6.9	7.2	7.7	8.4	7.5	6.6
Belguim	3.4	3.6	6.0	7.8	9.1	9.3	9.8	10.6	11.1	10.5
Austria	1.1	1.3	2.5	2.8	3.1	3.0	3.4	3.5	3.6	4.0
Denmark	1.1	1.2	3.9	5.3	6.0	8.1	9.6	9.9	8.8	8.3
Finland	1.0	0.6	1.0	1.1	1.3	1.5	1.6	1.8	1.7	1.6
Norway	1.8	1.7	3.4	3.3	3.2	3.3	3.3	3.5	4.3	4.3
Ireland	3.7	4.2	6.3	7.2	8.8	9.1	9.1	10.0	9.5	--
Spain	0.6	0.5	0.7	0.8	1.0	1.3	2.0	3.2	3.8	--
G3 1/	1.8	2.0	2.9	3.5	3.9	4.2	4.5	4.7	4.6	4.5
G3 2/	1.7	2.0	3.0	3.5	3.9	4.2	4.5	4.6	4.6	4.6
G7 1/	2.0	2.2	3.2	3.7	4.2	4.4	4.7	4.9	4.9	4.7
G7 2/	1.9	2.2	3.2	3.8	4.2	4.5	4.8	4.9	5.0	4.8
G13 1/3/	2.0	2.2	3.2	3.8	4.2	4.5	4.8	5.0	5.0	4.8
G13 2/3/	1.9	2.2	3.3	3.8	4.3	4.5	4.8	5.0	5.0	4.9

Source: OECD

1/ Using period average exchange rates for aggregation.
2/ Using PPP exchange rates for aggregation.
3/ Total of above countries except Switzerland, Belguim, Finland, Ireland, and Spain.

Fortunately for these countries, the 1970-87 period was not one characterized by war. Thus, war financing cannot be an explanation for the growth in public debt in this period as it had been for the growth in American debt in the 1940s, or for British debt during the past century. The explanation must be found somewhere else.

What about a bulge in public investment? Is there any evidence of it? Our data indicate that, on the contrary, the share of general government investment spending in GDP fell in practically all countries over the period (see Table 4). Therefore, the argument that debt financing would be self-liquidating, if associated with major (and productive) capital projects, is irrelevant for these countries.

When the countries' public finances are under pressure, because of large fiscal deficits, governments may try to limit the deficits by raising taxes and by reducing noninterest expenditures. In other words, they try to raise the primary surplus since, as we have seen earlier, this is the policy variable available to them. The expenditures that they would try to reduce are (a) those which do not have strong constituencies to protect them, and (b) those whose benefits occur only in the future so that the present (especially political) value of these benefits is low. Public investment clearly meets both of these criteria. There are no entitlements for public investments and generally no legislation or public interest groups that protect them from budgetary cuts. 1/ Some other types of "exhaustive" expenditures, such as those for wages and salaries and operation and maintenance, are also likely to be squeezed. In general, transfers (especially pensions) are protected more than "exhaustive" expenditures. 2/

Debt accumulation must necessarily have reduced the need to raise taxes while net borrowing exceeded interest payments. However, the higher is the debt share in GDP, and the higher are interest rates, the less likely it will be that net borrowing will keep exceeding interest payments. Eventually, interest payments will exceed net borrowing. Thus, the early attempt at maintaining low tax levels will in time lead to higher tax levels. The experience of the OECD countries shows that the growth of public debt will eventually contribute to the rise of tax levels. The pressure to increase taxes becomes stronger as interest rates become significantly greater than the growth rates of the economies, as has occurred in the 1980s. In practically all countries the ratio of tax revenue to GDP rose over the period. Furthermore, that ratio seems to have risen the most especially in those countries which experienced the largest increase in debt and, consequently, in interest payments (see Table 5). The increases in tax ratios were particularly

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1/ In developing countries where public investment is often financed by external and subsidized sources different considerations may exist.

2/ Over the long run much of the growth in public expenditure has been associated with the growth of cash transfers and not real or "exhaustive" expenditures. See Tanzi (1986).

Table 4
General Government Investment
(Percent of GDP)

	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987
United States	2.4	2.2	1.8	1.7	1.6	1.6	1.4	1.6	1.5	1.6
Japan	4.5	5.3	6.1	6.1	5.8	5.5	5.1	4.8	4.9	5.1
Germany	4.4	3.7	3.4	3.1	2.7	2.4	2.3	2.2	2.3	2.3
France	3.7	3.8	3.2	3.2	3.3	3.2	3.0	3.2	3.2	3.3
Italy	3.0	3.2	3.2	3.6	3.7	3.7	3.6	3.7	3.6	3.5
United Kingdom	4.7	4.7	2.4	1.8	1.6	2.0	2.0	2.0	2.0	1.7
Canada	3.6	3.7	2.7	2.6	2.8	2.6	2.6	2.7	2.5	2.3
Netherlands	4.7	3.9	3.3	3.1	2.9	2.7	2.8	2.6	2.4	2.3
Australia	3.7	4.2	2.6	2.6	2.8	2.9	3.0	3.1	3.1	2.7
Switzerland	...	...	...	...	...	...	...	...	...	...
Sweden	6.5	4.3	4.4	4.2	3.9	3.7	3.3	3.1	2.9	2.9
Belguim	3.5	3.3	3.5	3.4	3.2	2.8	2.5	2.1	1.8	1.7
Austria	4.7	5.2	4.2	4.2	3.7	3.4	3.2	3.1	3.2	3.0
Denmark	5.4	3.9	3.5	3.0	2.8	2.4	2.1	2.4	2.0	2.3
Finland	3.5	4.1	3.6	3.4	3.7	3.8	3.4	3.4	3.4	3.5
Norway	4.5	4.8	4.0	3.5	3.2	3.1	2.8	2.7	3.2	3.5
Ireland	3.7	4.3	4.4	4.5	4.5	4.3	3.9	4.0	3.7	--
Spain	2.5	2.6	1.1	1.4	1.5	1.6	1.2	1.2	1.1	...
G3 1/	3.0	3.0	3.1	2.9	2.7	2.6	2.3	2.4	2.6	2.7
G3 2/	3.1	3.0	3.0	2.9	2.7	2.6	2.4	2.4	2.4	2.5
G7 1/	3.2	3.3	3.0	2.9	2.7	2.7	2.5	2.5	2.6	2.8
G7 2/	3.3	3.3	3.0	2.8	2.8	2.7	2.5	2.6	2.5	2.6
G13 1/3/	...	3.4	3.1	2.9	2.8	2.7	2.5	2.5	2.6	2.8
G13 2/3/	...	3.4	3.0	2.9	2.8	2.7	2.5	2.6	2.5	2.6

Source: OECD

1/ Using period average exchange rates for aggregation.
2/ Using PPP exchange rates for aggregation.
3/ Total of above countries except Switzerland, Belguim, Finland, Ireland, and Spain.

Table 5. Changes in General Government Interest Payments, Debt Ratios, Tax Levels, and Capital Spending, 1980-87

(In percent of GDP)

	Change in Interest Payments	Change in Debt Ratios	Change in Tax Ratio	Change in Capital Spending
United States	1.7	13.7	0.5	-0.2
Japan	1.3	24.0	4.7	-1.0
Germany	0.9	11.3	-0.4	-1.1
France	1.3	10.3	3.1	0.1
Italy	3.2	33.8	6.0	0.3
United Kingdom	-0.4	-4.6	2.2	-0.7
Canada	2.8	23.9	2.9	-0.4
Netherlands	2.5	29.0	2.2	-1.0
Australia	1.6	0.7	2.3	-0.9
Switzerland	-0.3	...	1.2	...
Sweden	2.5	17.2	7.3	-1.5
Belgium	4.5	52.5	2.6	-1.8
Austria	1.5	20.1	1.1	-1.2
Denmark	4.4	23.7	6.5	-1.2
Finland	0.6	6.1	2.9	-0.1
Norway	0.9	-1.2	1.2	-0.5
Ireland	3.2	48.7	5.9	-0.7
Spain	3.1	29.7	8.9	--

Source: OECD.

large in Belgium, Canada, Denmark, Ireland, Italy, Japan, and Spain, all countries that experienced large rises in debt to GDP ratios and in interest payments to GDP ratios.

Charts 3 and 4 give a visual presentation of the (negative) relationship between capital spending and interest payments, both expressed as percentages of GDP, and of the (positive) relationship between changes in average tax ratios and changes in interest payments, again both expressed as percentages of GDP. Regressing the change in capital spending against the change in interest payments gave a negative correlation coefficient of 0.32. Regressing the change in tax ratios against the change in interest payments gave a positive correlation coefficient of 0.57.

Although this analysis may be seen as too simple, it does provide results that are consistent with what one would expect from general public choice considerations. Thus, the growth in public debt will in time lead to increases in tax ratios as well as to changes in the structure of public expenditure with government investment being progressively squeezed out by rising interest payments. On both counts the impact of the growth of public debt on the growth of the economy cannot be positive.

IV. Debt and Interest Rates: Empirical Results

The impact of government debt on real interest rates has been a controversial issue in recent years and it has been analyzed in several studies especially in the United States. 1/ An early study by Feldstein and Eckstein (1970) found that government debt had a statistically significant but small effect on interest rates. This study was supported or rejected by several subsequent studies. A more recent study, by de Leeuw and Holloway (1985), using a cyclically-adjusted measure of federal debt, found the coefficients of the debt variable to be statistically significant--an increase in this ratio by one percentage point was associated with an increase of about 0.4 percentage points in interest rates. A study by one of the authors of the present paper found that the ratio to GNP of public debt was statistically significant in various tests attempting to measure the impact of fiscal policy on interest rates (Tanzi, 1985a). A recent book by Spiro (1989) has reconfirmed those results leading Spiro to conclude that: "The empirical evidence shows that the size of the public debt outstanding (as a percent of GNP) does have a significant impact on all interest rates" (Spiro, p. 63). These and other studies establish a presumption that public debt would be a potentially important determinant of interest rates.

1/ Many of these studies have been surveyed in a recent paper by Barth, Iden, Russek, and Wohar (1989).

Chart 3

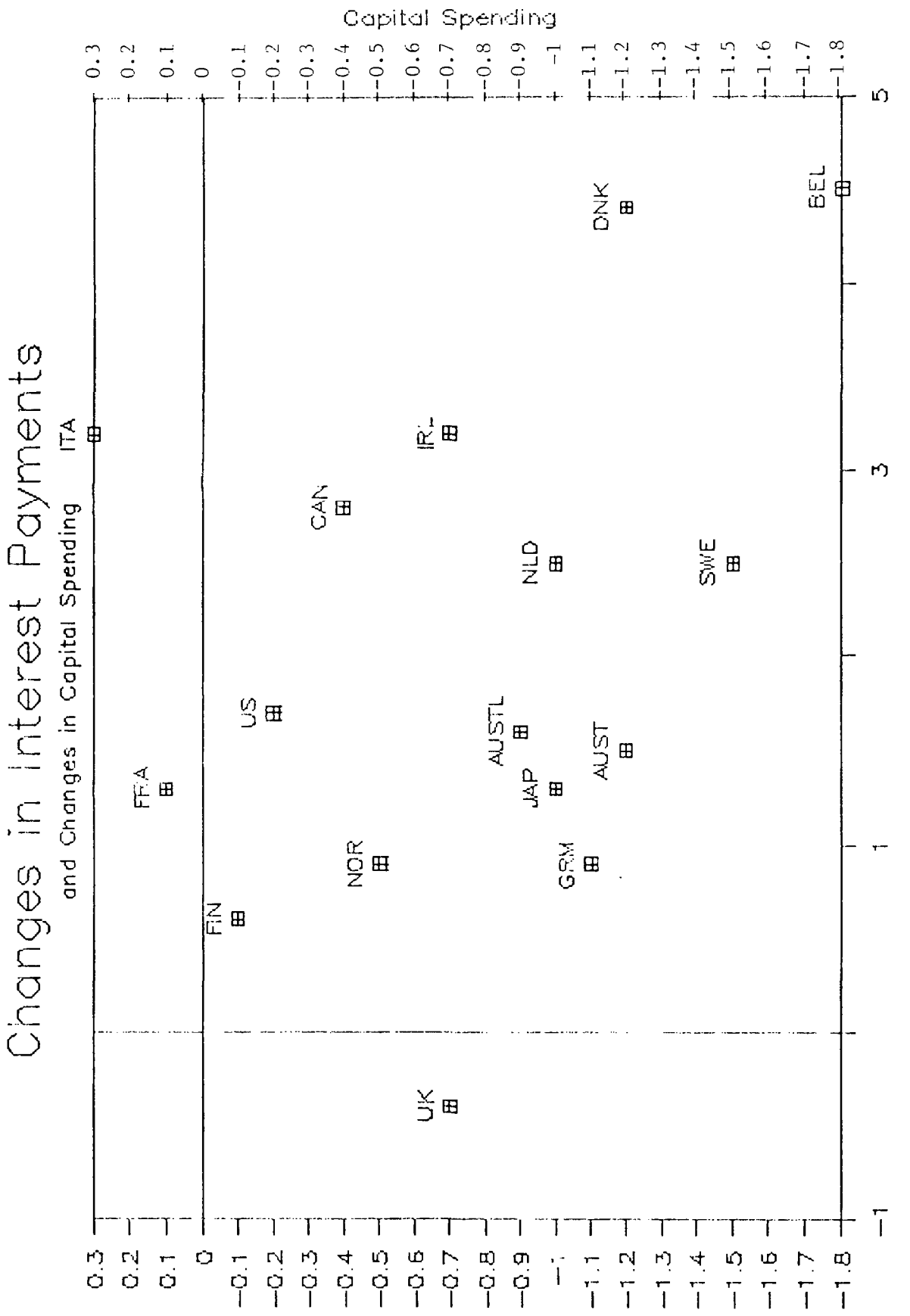
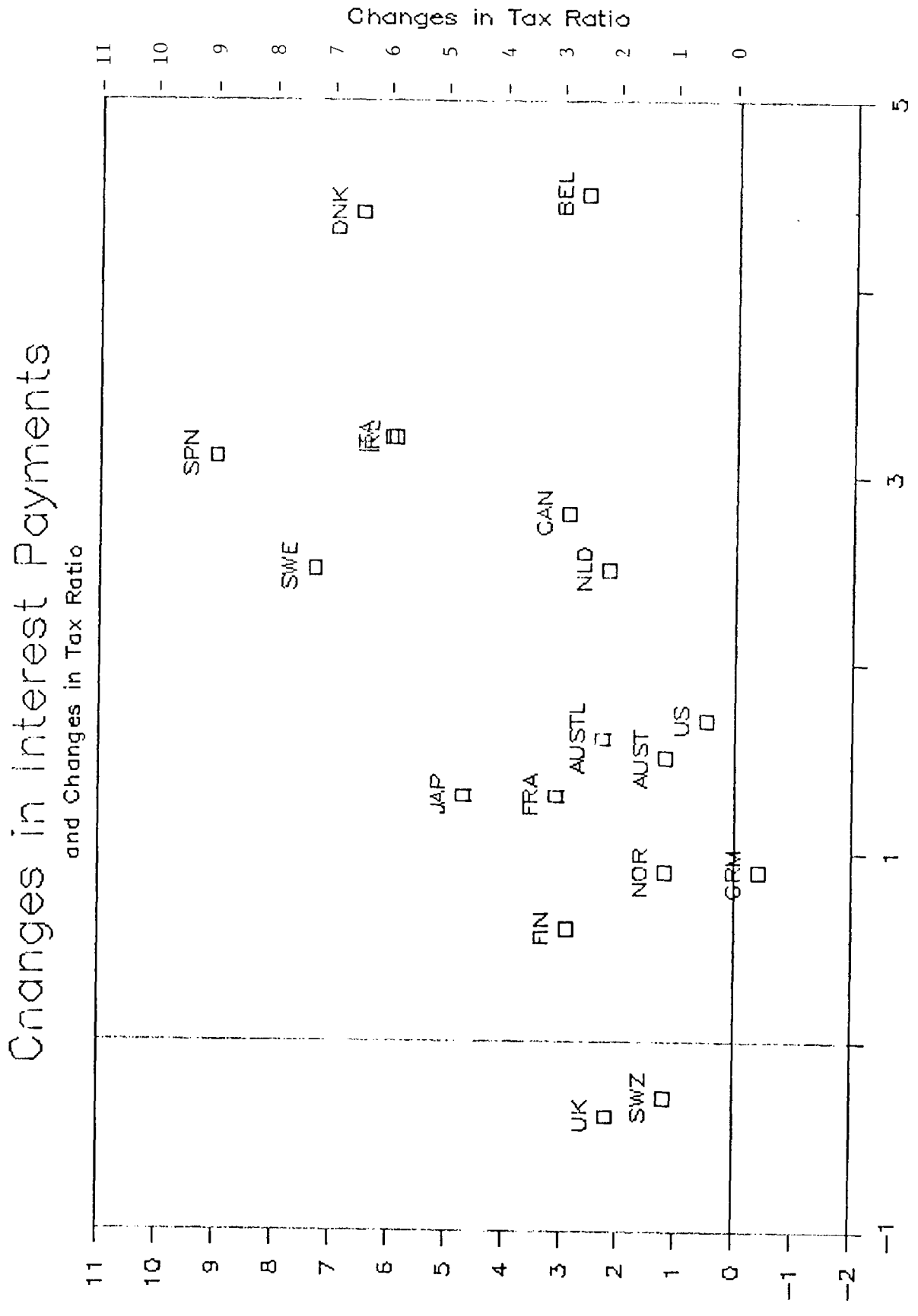

Changes in Interest Payments
and Changes in Capital Spending
Capital Spending
Interest Payments
ITA
FRA
US
FIN
CAN
NOR
IRL
UK
AUSTL
JAP
GRM
NLD
AUST
DNK
SWE
BEL
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
-1.4
-1.5
-1.6
-1.7
-1.8
-1
1
3
5

Chart 4


Changes in Interest Payments
and Changes in Tax Ratio
Changes in Tax Ratio
Changes in Interest Payments
SPN
DNK
BEL
IRA
SWE
CAN
NLD
JAP
FRA
AUSTL
AUST
US
FIN
NOR
GRM
UK
SWZ

While all these studies have been conducted within the context of single countries, some authors have argued that, in view of the growing importance of capital movements in the world, one cannot assume that the fiscal deficits of one country need necessarily be financed by the financial resources of that country. 1/ This issue is closely linked with the controversy initiated by Feldstein and Horioka (1980), who showed that, for the 1960-74 period, there was an almost one-to-one correspondence between changes in a country's domestic saving and its domestic investment. This implied that an increase in saving in one country would contribute little to the increased investment in another country and would, thus, not prevent the likely increase in interest rates in the latter country. By the same token, an increase in the fiscal deficit in one country would not be financed by an inflow of resources from other countries and, in the absence of an induced increase in domestic saving à la Barro, would result in an increase in interest rates.

A recent article has confirmed that the results achieved by Feldstein and Horioka are no longer relevant, especially in the 1980s. The correlation between national saving and investment has been much less close in the 1980s (see Dean, Durand, Fallon, and Hoeller, 1990). From this it would follow that the correlation between the total domestic demand for saving (including investment and fiscal deficits) and the total domestic supply must also have become much less close.

However, for the world as a whole, the demand for financial savings and the supply of financial savings must equate and the interest rate must play a major role in bringing about this equilibrium. This means that if fiscal policy (measured either through the fiscal deficit or through its effect on the debt to GDP ratio), affects interest rates, it must be especially in a world context and not in a country-by-country context. This of course does not mean that the fiscal policy of a specific country will not have any effect on the real interest rate of that country. However, such an effect will be in moving the country's interest rate above or below the world rate. Regardless of its fiscal policy, a country cannot insulate its interest rate from the world influences.

We have not developed a theoretical model that determines the independent variables that influence the world rate. But we have simply experimented with variables for which there is a presumption that they might affect real interest rates and that have been used in other studies. Nevertheless, one could justify the equations from the perspective of a simple IS-LM sticky-price type framework, augmented with wealth effects.

1/ On this point, see particularly Blanchard and Summers (1984) and Tanzi (1985b).

The global real interest rate can be modeled as being determined through the equalization of saving, both public and private, and investment.

$$I(r,X) = S^{pr}(r,Z) + S^{pub} \qquad (1)$$

where X and Z are vectors of factors influencing investment and saving, respectively. This equilibrium condition can be inverted to solve for the interest rate as a function of public saving and the vectors X and Z.

$$r = f(X,Z,S^{pub}). \qquad (2)$$

For simplicity, X is limited to a variable proxying for the business cycle. Implicit in this choice is the empirical regularity that investment expenditures are strongly pro-cyclical. Private saving behavior is influenced by a number of factors. Among them are wealth, current income, and the interest rate. Recognizing that current income is endogenously determined, and that our "world" economy can be thought of as a closed economy, we include government consumption as an exogenous variable which, at least in the short run, influences the level of economic activity and the demand for currently produced output. Monetary policy, measured by the ratio of reserve money to trend GDP, also influences the level of economic activity in the short run, and therefore the amount of saving and the level of interest rates. 1/ Finally, government debt may be perceived by households as wealth if, for example, they use a higher effective interest rate than does the government in discounting future implied tax increases. In this case, an increase in the debt/GDP ratio reduces current saving and raises the interest rate. Additionally, if households perceive government bonds to be imperfect substitutes for alternate forms of wealth, an increase in the debt/GDP ratio will, ceteris paribus, increase the required return on government bonds.

A large number of regressions were run in order to test the preferable functional form, the choice of variables, and the robustness of the results. Three general types of equations were specified: in levels of the relevant variables, using both ordinary least squares (OLS) and instrumental variables (IV), and in first differences. When instrumental variables were used, the instruments were the first lag of the variables specified below, a time trend, and the current and first two lags of real petroleum prices. The data were annual and the sample period available for the OLS equations was 1970-87, while 1971-87 and

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1/ Given the real balance effect, an increase in the money supply may also decrease desired saving for a given level of current output and place upward pressure on interest rates, but we assume that this impact is of a second-order importance.

1972-87 were the relevant periods for the differenced and IV equations, respectively.

Three levels of aggregation were examined: the G-3, the G-7, and the G-13, the latter being the largest group of countries for which data over the entire sample period were available. 1/ Aggregation was obtained by either using actual period average exchange rates to express all national values in dollars, or using purchasing power exchange rates to obtain PPP dollar aggregates. The real interest rate on long-term government bonds 2/ was regressed on a constant, and all or some of the following: the level of government debt, the government deficit, government consumption, private saving, and reserve money, all expressed as ratios to trend nominal GDP, as well as the residuals of an equation regressing the log of real GDP on time, which is used as a proxy for the business cycle. 3/ Equations were run using the general or central government as the relevant concept, either gross or net debt, 4/ either the overall financial balance (referred to as net lending) or the current balance (referred to as net saving) as the relevant deficit measure, and either gross or net private saving, for both the PPP and actual exchange rate aggregates at all three levels of aggregation.

The data are obtained from two main sources. All government sector and national income data are from the OECD's National Income Accounts annual data tape, with the exception of debt data. Purchasing power parity exchange rate data were also obtained from this source. Data on government debt, while provided by the OECD, are unpublished. Data on

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1/ The G-13 comprises the G-7 as well as the Netherlands, Australia, Sweden, Austria, Denmark, and Norway.

2/ The real long-term interest rate was calculated as [(1 + nominal rate)/(1 + inflation) - 1]*100, where the inflation rate is the percentage change in the current over previous year's consumer price index (CPI). These calculations result in, for example, an interest rate of 4.5 percent expressed as 4.5. As all right-hand side variables are expressed as either ratios to GDP (e.g., 0.45) or as the log deviation (which is an approximation to a percentage deviation), all estimated coefficients are therefore measured in basis points.

3/ When net private saving was included, it was expressed as a ratio to trend nominal net domestic product. In all cases the trend nominal denominator was obtained as follows. A regression of the log of the real variable (either real GDP or the difference between nominal GDP and nominal consumption of fixed capital, deflated by the GDP deflator) was run on a time trend. The predicted values were transformed back to levels and multiplied by the GDP deflator to obtain the trend nominal concept. It should be noted, therefore, that the actual inflation over the period is included, while only the deviation from trend real growth is removed. This latter residual is used as the business cycle variable.

4/ Central government net debt figures were available over the entire time period for only the United States, Japan, France, and Canada, and therefore these aggregate regressions were not run.

reserve money, long-term government bond interest rates, consumer price indices, and annual average exchange rates were obtained from the International Financial Statistics database.

It is useful at this stage to provide a general characterization of the results from OLS estimation on the levels of the real interest rate on the ratios discussed above before looking more closely at their robustness. It can be said with a great deal of certainty that over the sample period both real interest rates on long-term government bonds and the ratio of government debt to GDP exhibited upward trends and show significant positive correlations. These results are robust to using either OLS, IV or OLS on differenced data as estimation methods. 1/ Using OLS, the fits for equations including the debt variables are generally quite good, with adjusted R^2s of .70 - .90. Given the paucity of observations, the indeterminant range on in the Durbin-Watson test statistics is quite large; however, the equations do not appear to have seriously autocorrelated errors.

Table 6 contains a representative sample of the results obtained in the regressions. These include as right hand side variables general government gross debt and deficits (the latter measured by the broader net lending, or overall financial balance, concept), and net private saving (defined as private sector income less current consumption). The regressions were run in levels and the estimation method used was ordinary least squares. It can be seen that the magnitude of the coefficient estimates are, with the exception of those for government consumption, fairly reasonable and have the appropriate signs. An increase in the debt/GDP ratio by one percentage point increases real interest rates by about 20 basis points, while an increase in the deficit by a similar magnitude has an effect which is eight to ten times as strong. 2/ Higher stocks of reserve money lower real interest rates, at least in the first year, while higher levels of economic activity have the opposite effect. The coefficients on net private saving are in general negative, as predicted; when the deficit variable is excluded, they have the wrong sign but are insignificant.

In equations in which the debt variable is included, the significance of the coefficients on the other variables, excluding

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1/ The lack of observations, however, does not allow us to reject that the two series are not cointegrated. One can visually see upward trends in these series, and the null hypothesis of nonstationarity can not be rejected for them. However, when a regression of real interest rates on the debt/trend GDP ratio is estimated, one can not reject the null of nonstationarity of the residual, a necessary condition for cointegration. Nor, if this residual is used in an error correction equation, is its t-statistic significant. This difficulty is surely due to the short sample period.

2/ A deficit implies negative net lending. Therefore, if deficits are thought to raise interest rates, a negative coefficient is expected.

Table 6
Sample Regression Results
(Sample Period 1970-87)

Interest Rate	Gross Debt	Net Lending	Reserve Money	Business Cycle	Gov't Cons.	Net Pr. Saving	R^^2	S.E.E.	D.W.
G3RLBOND	23.632	-66.862	106.223	29.603	-554.845	-21.668	.873	1.043	2.065
	(3.051)	(1.370)	(0.781)	(1.345)	(2.972)	(0.336)			
G3RLBOND	30.776		-43.139	8.632	-350.932	34.667	.864	1.081	1.903
	(4.940)		(0.514)	(0.527)	(3.007)	(0.674)			
G3RLBOND		-157.774	278.785	87.594	-852.544	-202.247	.733	1.514	1.956
		(2.560)	(1.501)	(1.501)	(3.471)	(3.221)			
G7RLBOND	11.688	-164.491	-87.727	114.016	-745.257	-124.111	.876	1.028	1.933
	(1.118)	(1.773)	(1.194)	(1.951)	(2.382)	(1.192)			
G7RLBOND	26.217		-182.347	18.430	-220.214	37.846	.853	1.116	1.646
	(3.718)		(3.326)	(0.752)	(2.012)	(0.699)			
G7RLBOND		-245.767	-51.059	170.675	-1030.15	-226.322	.873	1.038	2.299
		(4.221)	(0.769)	(5.804)	(5.621)	(4.507)			
G13RLBOND	8.631	-185.365	-161.997	128.103	-746.309	-110.664	.901	0.913	1.965
	(0.905)	(2.170)	(2.576)	(2.370)	(2.770)	(1.243)			
G13RLBOND	24.965		-225.844	20.585	-193.850	54.253	.871	1.045	1.622
	(3.727)		(3.551)	(0.833)	(1.918)	(1.023)			
G13RLBOND		-246.394	-151.543	171.089	-949.729	-181.476	.903	0.906	2.275
		(4.734)	(2.470)	(6.680)	(6.436)	(4.307)			

Notes - General Government Gross Debt and Net Lending, Reserve Money and General Government Consumption are all expressed as shares of trend nominal GDP. Net Private Saving is expressed as a share of trend nominal NDP. The business cycle variable is the residual from a regression of the log of real GDP on a time trend.
- The estimation method for the results in this table was OLS. The regressions contained constants, which are not reported.
- Aggregate variables were obtained for the results in this table using actual exchange rates.
- Values in parentheses are t-statistics.

government consumption, is often quite low and many times they have the "wrong" sign. When the debt variable is dropped, the coefficients on the deficit variables have the correct (negative) sign, and are generally significant. The sign on the monetary coefficient does not appear to be influenced by the presence or absence of the debt variable but, as is discussed below, by the level of aggregation, which may reflect institutional or policy differences.

The coefficient on government consumption may strike some as something of an oddity. While, among all of the regressions run, its sign varies with the level of aggregation (with positive coefficients resulting in some G-3 regressions), there is a preponderance of significant negative coefficients with quite large magnitudes, especially at the general government level. This is of course inconsistent with the prevalent view in the literature that interest rates should be positively correlated with government consumption. The explanation that we can offer is consistent with the discussion in the earlier part of this paper. As the 1980s progressed and increasing debt stocks, coupled with high interest rates, raised governments' debt servicing expenditures, it became necessary to cut spending elsewhere. Given the "entitlement" aspect of transfer payments and the inability to cover the additional spending fully by tax increases, the only remaining area with significant room for adjustment was government consumption.

Included below is an examination of the robustness of the results in more detail.

1. Are the results sensitive to the method of aggregation used?

In general, the overall fit of the equations including debt variables does not seem to be sensitive to the method of aggregation used (either PPP or actual exchange rates). In equations which exclude the debt variables, however (referred to hereafter as deficit equations) the fit using actual exchange rates is much better (e.g., adjusted R^2s of about 0.70 compared to 0.50) and the indication of autocorrelated errors is eliminated. A number of coefficient estimates appear to vary according to the method of aggregation used. When PPP exchange rates are used for aggregation and debt variables are included, the deficit coefficients are incorrectly signed and sometimes significant. When using actual exchange rates, in contrast, while the sign is still often wrong, the coefficients are no longer significant. In the PPP debt equations, the coefficients on the business cycle variables are often incorrectly signed and sometimes significant. The coefficients on the business cycle variable are more likely to have the correct sign and be significant when actual exchange rates are used for aggregation. There is no discernible sensitivity of the sign or significance of the coefficients for government consumption, private saving or monetary variables to the method of aggregation.

2. Are the results sensitive to the level of aggregation?

When debt variables are included, there is little difference in the overall fits of the equations for the G-3, the G-7 or the G-13, regardless of the method of aggregation. For the general government deficit equations, however, the G-13 equations fit far better than the G-7 regressions, which in turn are better than the deficit equations for the G-3. This does not appear to be attributed to any one variable; increased precision in all coefficient estimates, as shown in the t-statistics, is obtained.

A number of the variables' coefficient signs and significance are sensitive to the level of aggregation, suggesting that, as an area of future research, one could attempt to isolate the reasons for the implied different behavioral relations among the component countries and examine what, if any, economic rationale exists for these differences. The coefficients for reserve money are insignificant at the G-3 level, while significant and correctly signed in the G-13 countries. In the deficit equations, the significance of the deficit variable (either net lending or saving) rises in general with the number of countries aggregated.

3. Are the results sensitive to the use of gross or net debt?

There is very little difference in the overall fit of equations using gross or net debt. The coefficient on the net debt is higher than on the gross debt by 15 to 50 percent, which is explained by the smaller variation of the former. However, the correlation between the two debt ratios over the sample period is generally over .95, leading one to expect very similar results.

4. Are the results sensitive to the use of general or central government?

The overall fits of equations including debt ratios are higher for the general government than for the central government. The only variable whose coefficient value appears to be clearly dependent upon the level of government is consumption. At the general government levels, the coefficient is much more likely to be negative and significant, while at the central government it is usually positive and often significant.

5. Are the results sensitive to using net or gross private saving?

While the differences are small, the standard errors of equations using gross private saving are smaller than those from equations using net private saving. The signs and significance of other coefficient estimates are not largely affected by the choice of private saving variables.

6. Are the regression results sensitive to estimating in levels or in first differences?

In a word, yes. The overall fits and adjusted R^2s are greatly reduced in equations estimated in differences. In fact, the F statistic in the central government regressions are rarely significant in the latter regressions. This leads one to the view that the coefficient estimates from the equations estimated in levels may be spurious and not robust. 1/ This does not appear to be the case as regards the debt variables, however. The gross debt variables are significant and have the correct sign in both levels and differences equations, and their values are similar and "reasonable."

The business cycle variable has the correct sign and is generally significant only in equations estimated in levels that exclude debt variables. It is insignificant in differenced equations and often has the wrong sign.

The private saving rates present conflicting evidence. In differenced equations the estimates are generally insignificant and often have the wrong sign. In equations in levels, they are also often insignificant, although in those excluding debt variables they are significant and have the correct sign, while for those including debt variables they sometimes have significant but wrong signs. It must be noted that this variable is surely endogenous and must be compared with estimates from IV equations. Finally, the monetary variable generally has the correct sign and is significant in levels, while insignificant in differenced equations.

7. Are the results sensitive to OLS or IV estimation?

In general, the results are not as sensitive to the decision to use OLS or IV estimation as they are to the question of differencing the data. This may imply either that the right hand side variables are not as susceptible to simultaneity bias as was thought (though still possibly exhibiting spurious correlations), that the instruments chosen were themselves not sufficiently exogenous, or that the lack of degrees of freedom does not allow the advantages of IV estimation to be exploited. Nevertheless, the overall fits of the equations appear to be improved, although exact comparisons cannot be made, given the shorter estimation period. The debt variables all have positive and significant coefficients. The deficit variables often have incorrect, but insignificant signs when the debt variables are included; when excluded, they have correctly signed and significant coefficients. The business cycle coefficient often has the wrong sign (which is sometimes significant) when the debt variables are included; when they are excluded, however, the sign is correct and sometimes significant.

1/ The other feature which leads one to suspect spurious coefficient estimates, low Durbin-Watson statistics, is not present, however.

Before concluding, it is important to say a few words about a recent paper by Professors Barro and Sala i Martin (1990). Although their approach is rather similar, they reached opposite conclusions concerning the influence of fiscal variables on real interest rates. They model the determination of expected world short-term real interest rates through the interaction of desired world real investment and saving ratios. The former is posited to depend upon lagged real stock market returns, the lagged real investment ratio and revisions in expected real interest rates. The desired real saving ratio is argued to be a function of its lagged value, the expected real interest rate, and expected real transitory income (proxied by the level of real oil prices, and possibly nominal monetary and real fiscal variables). Their reduced form equation for the expected real interest rate indicates significantly positive influences from the (lagged) stock market, oil, investment ratio and real interest rate variables, and a significantly negative influence from the monetary variable. Neither the lagged ratio of real government debt nor the real deficit to real GDP explained a significant amount of variation in expected real interest rates.

While the different measures of interest rates, time periods, number of countries, and method of aggregation make direct comparisons of our results difficult, 1/ we attempted to examine the robustness of their results. 2/ We ran their reduced form interest rate equations for the period 1973-87 for the G-3, G-7 and G-13, using both actual and PPP exchange rates, regressing the ex-post real long-term government bond rate on its first lag, on the first lags of real petroleum prices, the ratio of (nominal) investment to GDP, the percentage changes in reserve money and the real stock market. Like Barro and Sala i Martin, we obtained significant positive coefficients on the interest rate and petroleum variables; however, the coefficient estimates for the monetary and stock market variables were insignificant. Furthermore, the

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1/ Among other differences, they used simple averages of expected real 3-month treasury bill interest rates, based upon forecasts of inflation from autoregressive processes, while we used ex-post real interest rates on long-term government debt. Their "world" aggregated over 9 or 10 countries (the G7, plus Belgium, Sweden, the Netherlands and sometimes Italy), using the Summers/Heston PPP exchange rates, and estimated over 1959-88. Their ratios are constructed using actual real GDP, while we employed nominal trend GDP. Moreover, they used gross central government debt (deflated by the CPI), as recorded in IFS, and its first difference for the deficit, while our data were provided by the OECD, as discussed above. Finally, their monetary variable was the first difference in M1, while we used the ratio of reserve money to GDP.

2/ Barro and Sala i Martin tested for coefficient stability by splitting their sample period, with the latter half covering 1973-88. They were unable to reject stability and the estimates in the latter period had the same signs and roughly similar magnitudes to their entire sample estimates. No fiscal variables were included in the equation tested for coefficient stability, however.

estimate for the lagged investment ratio was consistently negative and generally significant. This difference may be due to our use of the nominal, rather than real, ratio. However, given well known difficulties in constructing appropriate investment price deflators for computing equipment (which is an increasingly large component of overall investment--see Evans (1989)), one should be cautious in attaching too much weight to either estimate. A more troubling feature of our estimated equations is the presence of serially correlated errors, which were significant at the 5 percent level for one equation and at the 10 percent level in two other equations, casting some doubt on inferences made about coefficient signs and significance. 1/

When Barro and Sala i Martin tested for the significance of fiscal variables in explaining expected real interest rates, they always included both the debt and deficit ratios. If these two variables are correlated then neither may have a significant coefficient estimate, although jointly they may help explain interest rate behavior. 2/ We included either the deficit or debt ratio, as well as both variables simultaneously, in the equations described above. While the debt variable always had the correct sign, as did the deficit variable when included alone, in no case were the estimates significant.

The same argument applies, however, not only to the debt and deficit variables, but also to other explanatory variables. As shown in Table 6, there is strong positive correlation between the debt ratio and the contemporaneous ex-post real interest rate, and a negative relationship between interest rates and the deficit ratio. Furthermore, the 1980s have been a period of rising deficit and debt ratios and strong stock markets. A number of observers (e.g., Summers (1981), Blanchard and Summers (1984), and Lutz (1986)) suggested that reductions in business taxes may have a positive impact on the stock market and interest rates and a simultaneously negative impact on fiscal balances. Therefore, the insignificant coefficient estimates for the fiscal variables could be due to the fact that the stock market and interest rate regressors are also included.

We therefore estimated interest rate equations which sequentially replaced the lagged stock market and interest rate variables with the fiscal variables. When the stock market variable was dropped, the fiscal variables continued to have insignificant, but generally correctly signed, coefficient estimates. This was not too surprising, given that our initial equations did not have significant coefficient estimates for the stock market variable. In sharp contrast, however, dropping the lagged real interest rate variable resulted in a

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1/ Barro and Sala i Martin report only Durbin-Watson statistics, which are not applicable in equations containing lagged dependent variables, so one cannot determine whether their regression residuals are significantly autocorrelated.

2/ They did test for and reject the joint significance of the fiscal variables over the entire 1959-88 sample, but did not do so for the 1973-88 subsample.

preponderance of significant and correctly signed coefficient estimates for the debt ratio, although the deficit ratio remained insignificant and often had the "wrong" sign. During the period 1973-87, the simple correlation coefficient between the debt ratio and the real interest rate variable was, depending upon the country and exchange rate aggregation chosen, between 0.85 and 0.88, while for the deficit ratio and the interest rate, between 0.26 and 0.61. From this we can conclude that, given currently available data, it is difficult to separate the influences of lagged government debt and real interest rates in the determination of the current real interest rates. 1/

V. Concluding Remarks

This paper has surveyed various issues associated with the growth of public debt in OECD countries. It has also attempted to provide a set of statistics for individual countries and for groups of countries aggregated using their GDPs as weights. This aggregation was done on the assumption that these countries are progressively becoming more integrated economically so that relationships such as those between interest rates and debt have more meaning on a global than on an individual basis.

Some consequences of a growing debt to GDP ratio are outlined. First, such a growth is likely to bring about growing tax levels with the inevitable inefficiencies that accompany higher tax rates. Second, the growth in debt servicing puts downward pressure on expenditures which do not have strong constituencies. Capital spending is likely to suffer the most. Higher taxes combined with lower government capital expenditure are likely to have negative effects on the countries' growth potential. Third, the growth in debt to GDP ratios will raise interest rates thus also reducing private sector investment. This will be an additional element working toward a reduction in growth rates.

1/ Finally, Barro and Sala i Martin expressed their saving, investment, and fiscal variables as ratios to actual GDP. Given the cyclical nature of real interest rates (see Tanzi (1980)), this may result in estimates for the variables that are biased toward zero. To test for the significance of this bias, we ran all of the above equations using trend GDP as the denominator. While it sometimes resulted in significantly positive coefficient estimates for the debt ratio in equations in which the stock market variable was dropped, the rest of the comments above continue to apply.

Appendix Table 1
General Government Net Lending
(Percent of GDP)

	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987
United States	-1.4	-4.3	-1.5	-1.1	-4.0	-4.9	-3.8	-4.2	-4.4	-3.5
Japan	1.6	-2.8	-4.4	-3.8	-3.6	-3.7	-2.1	-0.8	-1.0	0.6
Germany	0.2	-5.6	-2.9	-3.7	-3.3	-2.5	-1.9	-1.1	-1.3	-1.8
France	0.9	-2.4	-0.0	-1.9	-2.8	-3.2	-2.8	-2.8	-2.9	-2.4
Italy	-3.3	-10.6	-8.6	-11.4	-11.3	-10.6	-11.6	-12.5	-11.7	-11.1
United Kingdom	2.5	-4.8	-3.5	-3.9	-2.8	-3.4	-3.8	-2.9	-3.1	-1.5
Canada	0.8	-2.5	-2.8	-1.5	-6.0	-7.0	-6.5	-7.1	-5.5	-4.6
Netherlands	-1.2	-2.9	-4.0	-5.5	-7.1	-6.4	-6.3	-4.8	-5.9	-6.2
Australia	1.7	-2.1	-0.8	-0.4	-2.4	-3.8	-3.3	-2.8	-1.5	0.3
Switzerland	...	...	...	...	...	...	...	...	...	...
Sweden	4.4	2.8	-3.7	-4.9	-6.3	-5.0	-2.6	-3.8	-0.6	4.1
Belguim	...	...	...	...	...	...	...	...	...	...
Austria	1.2	-2.5	-1.7	-1.8	-3.4	-4.0	-2.6	-2.5	-3.7	-4.1
Denmark	2.0	-1.4	-3.3	-6.9	-9.1	-7.2	-4.1	-2.0	3.5	2.0
Finland	4.3	2.7	0.3	1.2	-0.6	-1.7	0.4	0.1	0.8	-1.1
Norway	3.2	3.3	5.7	4.7	4.4	4.2	7.4	10.2	5.5	3.5
Ireland	-3.7	-11.1	-11.1	-12.2	-13.1	-11.4	-9.3	-10.6	-10.5	--
Spain	0.7	0.0	-2.6	-3.9	-5.6	-4.8	-5.5	-7.0	-6.1	--
G3 1/	-0.7	-4.2	-2.4	-2.1	-3.8	-4.3	-3.2	-3.1	-3.0	-2.1
G3 2/	-0.6	-4.2	-2.3	-2.1	-3.8	-4.3	-3.2	-3.0	-3.2	-2.4
G7 1/	-0.5	-4.4	-2.7	-2.8	-4.2	-4.7	-3.9	-3.8	-3.7	-2.8
G7 2/	-0.4	-4.5	-2.7	-2.9	-4.3	-4.7	-4.0	-3.9	-3.9	-3.1
G13 1/3/	-0.3	-4.0	-2.6	-2.8	-4.2	-4.6	-3.8	-3.6	-3.5	-2.6
G13 2/3/	-0.2	-4.2	-2.7	-2.9	-4.3	-4.7	-3.9	-3.8	-3.7	-2.9

Source: OECD

1/ Using period average exchange rates for aggregation.
2/ Using PPP exchange rates for aggregation.
3/ Total of above countries except Switzerland, Belguim, Finland, Ireland, and Spain.

Appendix Table 2
General Government Consumption
(Percent of GDP)

	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987
United States	18.8	18.6	17.6	17.5	18.4	18.4	18.0	18.3	18.6	18.6
Japan	7.4	10.0	9.8	9.9	9.9	10.0	9.9	9.7	9.8	9.6
Germany	15.8	20.5	20.1	20.6	20.4	20.1	19.9	20.0	19.8	19.8
France	14.7	16.6	18.1	18.8	19.3	19.5	19.6	19.4	19.2	19.1
Italy	12.9	14.1	14.7	16.0	16.0	16.4	16.2	16.4	16.2	16.9
United Kingdom	17.5	22.0	21.3	21.9	21.8	21.8	21.6	21.0	21.1	20.8
Canada	18.5	19.5	19.2	19.4	21.1	21.0	20.1	20.1	19.9	19.5
Netherlands	15.4	17.4	17.9	17.8	17.7	17.5	16.6	16.2	15.9	16.1
Australia	13.6	16.5	17.3	17.7	19.7	20.0	19.6	19.6	19.5	18.9
Switzerland	10.5	12.6	12.7	12.7	13.0	13.4	13.4	13.3	13.1	12.8
Sweden	21.4	23.8	28.8	29.2	29.1	28.4	27.6	27.4	27.2	26.7
Belguim	13.7	16.8	18.3	19.1	18.6	18.1	17.6	17.6	17.3	16.7
Austria	14.7	17.2	18.0	18.5	18.9	18.9	18.6	18.9	19.0	19.0
Denmark	20.0	24.6	26.7	27.8	28.2	27.4	25.9	25.3	24.2	25.5
Finland	14.5	17.1	18.1	18.7	19.0	19.4	19.3	20.3	20.5	20.7
Norway	16.9	19.3	18.8	19.1	19.4	19.4	18.6	18.5	19.8	20.9
Ireland	14.6	18.6	19.9	19.9	19.6	19.2	18.5	18.3	18.5	18.0
Spain	9.1	10.1	12.7	13.2	13.4	13.9	13.7	14.0	14.0	14.4
G3 1/	16.7	17.2	16.3	16.1	16.8	16.7	16.4	16.6	16.3	16.1
G3 2/	16.2	17.1	16.2	16.2	16.7	16.7	16.4	16.5	16.7	16.6
G7 1/	16.5	17.4	16.9	16.9	17.5	17.4	17.1	17.2	17.0	16.8
G7 2/	16.1	17.3	16.8	17.0	17.4	17.5	17.2	17.2	17.3	17.3
G13 1/3/	16.5	17.6	17.2	17.3	17.8	17.7	17.4	17.4	17.2	17.1
G13 2/3/	16.1	17.4	17.1	17.2	17.7	17.7	17.4	17.5	17.6	17.5

Source: OECD

1/ Using period average exchange rates for aggregation.
2/ Using PPP exchange rates for aggregation.
3/ Total of above countries except Switzerland, Belguim, Finland, Ireland, and Spain.

Appendix Table 3
General Government Net Lending
(Percent of Gross Private Saving)

	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987
United States	7.8	20.9	7.6	5.7	20.3	25.0	19.3	22.3	24.1	21.1
Japan	-5.0	9.7	15.8	14.0	13.4	13.7	7.8	3.1	3.5	-2.3
Germany	-0.9	26.7	15.0	19.3	17.1	12.9	9.7	5.8	6.1	8.1
France	-4.1	11.5	0.1	10.8	16.2	18.5	16.5	16.9	16.4	14.5
Italy	11.9	35.3	29.3	38.8	39.0	36.9	39.3	44.0	41.8	41.5
United Kingdom	-18.9	34.0	19.2	22.4	15.9	18.6	20.8	15.6	18.0	8.7
Canada	-4.8	12.1	12.3	7.0	27.4	31.6	28.1	30.6	26.6	22.3
Netherlands	5.4	13.9	21.7	27.1	31.0	27.8	25.8	20.2	24.5	27.1
Australia	-8.4	10.5	4.5	2.3	14.7	19.4	17.8	15.9	8.7	-1.7
Switzerland	...	...	...	...	...	...	...	...	...	...
Sweden	-31.7	-16.4	22.5	31.3	41.3	30.4	15.5	21.3	4.3	-32.1
Belguim	...	...	...	...	...	...	...	...	...	...
Austria	-5.2	11.8	8.0	8.9	15.6	19.3	12.6	12.4	16.9	17.9
Denmark	-14.4	8.4	23.2	45.5	52.3	41.4	24.8	14.4	-33.2	-18.4
Finland	-21.7	-14.0	-1.5	-5.8	3.0	7.9	-1.8	-0.7	-4.2	5.8
Norway	-15.8	-17.8	-28.8	-22.4	-21.9	-19.9	-36.0	-60.8	-38.3	-21.2
Ireland	19.6	40.2	52.1	60.0	52.8	48.7	41.4	46.0	47.5	--
Spain	-2.9	-0.2	12.9	21.0	29.2	25.9	26.3	32.1	27.6	--
G3 1/	3.6	18.9	11.3	10.0	17.9	20.3	15.1	15.1	14.4	10.2
G3 2/	2.8	18.6	10.9	9.7	17.9	20.3	14.9	14.7	15.6	12.1
G7 1/	2.3	19.9	12.6	13.1	19.9	22.0	18.0	18.2	17.5	13.8
G7 2/	1.7	20.3	12.7	13.5	20.3	22.3	18.6	18.6	18.9	15.5
G13 1/3/	1.5	18.6	12.5	13.2	20.1	22.0	17.8	17.7	16.9	13.1
G13 2/3/	1.0	19.2	12.6	13.6	20.5	22.2	18.3	18.2	18.3	14.8

Source: OECD

1/ Using period average exchange rates for aggregation.
2/ Using PPP exchange rates for aggregation.
3/ Total of above countries except Switzerland, Belguim, Finland, Ireland, and Spain.

Appendix Table 4
General Government Net Lending
(Percent of Net Private Saving)

	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987
United States	16.2	43.2	19.4	14.6	58.1	67.8	46.3	57.4	63.4	62.4
Japan	-8.1	17.0	28.1	25.9	25.4	26.6	15.2	6.0	6.9	-4.8
Germany	-1.6	54.8	35.3	49.0	45.2	32.7	24.5	15.0	13.4	17.3
France	-6.6	21.7	0.2	28.0	44.6	52.4	47.9	48.8	42.3	40.8
Italy	17.8	57.0	45.3	61.0	62.8	59.1	61.7	70.2	67.5	68.6
United Kingdom	-47.9	110.5	46.7	61.4	41.1	45.5	50.4	37.4	49.0	27.6
Canada	-11.5	22.2	22.1	13.3	52.3	58.4	49.4	55.0	53.3	43.7
Netherlands	8.4	23.5	41.8	50.4	53.6	48.1	42.9	34.0	40.6	47.2
Australia	-18.5	24.9	14.6	10.7	128.6	73.1	72.8	79.2	54.8	-7.9
Switzerland	...	...	...	...	...	...	...	...	...	...
Sweden	-80.1	-35.2	56.5	90.9	130.9	86.0	40.2	51.0	13.3	-168.1
Belguim	...	...	...	...	...	...	...	...	...	...
Austria	-9.9	25.1	16.3	20.9	33.6	44.1	29.4	29.6	36.1	36.2
Denmark	-25.7	15.9	55.7	103.8	100.4	79.7	48.6	33.9	-139.8	-72.5
Finland	-50.6	-47.4	-4.2	-18.7	9.3	22.5	-5.2	-2.1	-16.6	17.9
Norway	-43.3	-64.2	-92.9	-65.0	-76.6	-60.0	-97.7	-243.5	-518.3	-132.2
Ireland	33.2	54.4	99.1	113.1	85.5	82.8	69.4	75.3	79.3	--
Spain	-5.0	-0.3	25.6	50.0	67.8	66.3	58.2	67.3	54.1	--
G3 1/	6.8	37.4	25.2	22.7	44.5	49.1	34.2	35.5	33.0	24.8
G3 2/	5.2	36.8	24.4	22.2	44.1	48.9	33.7	34.5	36.3	30.4
G7 1/	4.4	39.0	27.1	29.1	47.0	50.9	39.4	41.2	39.1	32.6
G7 2/	3.1	39.7	27.2	29.8	47.3	50.9	40.2	41.7	42.5	37.2
G13 1/3/	2.9	36.7	27.0	29.8	47.9	50.9	39.1	40.4	38.2	31.2
G13 2/3/	1.9	37.8	27.1	30.3	48.1	51.0	39.9	40.9	41.5	35.7

Source: OECD

1/ Using period average exchange rates for aggregation.
2/ Using PPP exchange rates for aggregation.
3/ Total of above countries except Switzerland, Belguim, Finland, Ireland, and Spain.

Appendix Table 5
General Government Expenditures
(Percent of GDP)

	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987
United States	32.1	34.9	34.2	34.6	36.8	37.2	36.0	36.9	37.2	36.9
Japan	18.5	26.2	31.1	32.1	32.5	33.0	32.3	31.7	32.2	32.4
Germany	36.9	47.0	46.3	47.5	47.7	46.7	46.2	45.9	45.4	45.5
France	38.0	42.8	45.6	48.2	50.0	51.1	51.7	52.0	51.6	51.6
Italy	31.3	37.9	41.1	44.9	46.9	48.5	48.4	48.9	49.6	49.4
United Kingdom	37.5	45.5	44.1	45.7	46.0	46.0	46.4	45.8	44.8	41.7
Canada	34.9	39.9	40.2	41.1	45.8	46.1	45.9	46.3	45.7	45.2
Netherlands	42.9	51.3	55.3	57.1	59.1	59.9	58.5	57.4	56.6	57.2
Australia	26.4	32.1	32.8	33.6	38.3	39.9	39.8	39.9	39.8	37.9
Switzerland	...	...	...	...	...	...	...	...	...	...
Sweden	43.3	49.0	61.2	63.7	65.3	64.9	63.0	63.9	63.0	61.6
Belguim	36.5	44.5	50.7	55.3	55.5	55.4	54.4	54.1	53.5	52.3
Austria	37.7	43.8	47.0	48.2	49.0	48.6	48.3	49.2	49.9	50.3
Denmark	32.4	47.4	55.7	58.6	60.2	60.8	59.7	58.8	55.8	58.0
Finland	30.1	35.4	36.1	37.0	38.5	39.8	39.4	41.0	41.6	41.7
Norway	41.0	46.2	48.3	47.9	48.3	48.4	46.3	45.6	49.9	51.6
Ireland	37.9	45.6	49.4	51.4	54.3	54.6	52.9	54.2	54.1	--
Spain	21.0	23.8	30.8	33.0	33.9	35.5	35.8	37.6	37.2	...
G3 1/	30.7	35.2	35.6	35.8	37.3	37.5	36.3	36.6	36.8	36.7
G3 2/	30.1	34.7	35.1	35.7	37.2	37.4	36.4	36.7	37.0	36.9
G7 1/	32.0	37.0	37.9	38.4	40.0	40.1	39.1	39.4	39.6	39.5
G7 2/	31.7	36.7	37.3	38.4	40.1	40.4	39.7	39.9	40.0	39.6
G13 1/3/	32.3	37.7	39.0	39.4	41.0	41.1	40.0	40.2	40.5	40.5
G13 2/3/	32.1	37.3	38.1	39.2	41.0	41.4	40.6	40.8	40.8	40.5

Source: OECD

1/ Using period average exchange rates for aggregation.
2/ Using PPP exchange rates for aggregation.
3/ Total of above countries except Switzerland, Belguim, Finland, Ireland, and Spain.

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