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World Public Debt and Real Interest Rates

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Abstract

Real interest rates appear to have risen in virtually all industrialized countries relative to levels that prevailed in the 1960s and 1970s. There is increasing concern that this may reflect higher public debt, which is crowding out private sector activity. Over the last two decades, there has also been increasing international capital market integration. This suggests that interest rates in any country may be sensitive to global fiscal developments. This paper estimates the effects of aggregate fiscal developments in the industrialized world on real interest rates in nine industrial countries. The results imply that the increase in OECD-wide government debt since the late 1970s was a major factor explaining the rise in real interest rates.

JEL Classification Numbers:

E43, F21, F32, F36

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Contents

Summary

Aside from perhaps unemployment or inflation, no other recent macroeconomic policy issue has attracted as much attention as government deficits. Robert Barro and others have demonstrated that the long-term effects of government debt on real interest rates will depend on the extent to which consumers view government debt as wealth. If consumers are connected to all future generations and can borrow against their future income streams, changes in government debt will not crowd out private consumption and investment because consumers adjust their savings to offset the effects of government deficits on their future tax liabilities. This invariance proposition is referred to as Ricardian equivalence, although David Ricardo himself did not believe that the economic consequences of deficits were unimportant. Although there exists considerable empirical evidence that rejects the notion that consumers offset completely the effects of government deficits, there is a paucity of direct empirical evidence that higher levels of government debt will result in higher real interest rates. Indeed, a significant body of empirical research, for example, that by Robert Barro and Paul Evans, has concluded that government deficits and government debt have not had any significant effects on interest rates.

This paper estimates the effects of aggregate fiscal developments in the industrial world on real interest rates in nine industrial countries with liberalized capital markets. The results imply that the increase in OECD-wide government debt since the late 1970s was responsible for the rise in real interest rates in all of these countries. The fact that increases in government debt in any one country will increase real interest rates in other countries suggests that some countries with high levels of government debt may be imposing significant negative externalities on other countries. The results of this paper have two implications for policy. First, they suggest that policymakers should care as much about debt targets as they do about deficit targets. Second, since debt reduction in one country provides long-term benefits for the world economy, there may be an important role for coordination of fiscal policies across countries.

I. Introduction

Concern should not focus on what deficits do to interest rates, capital accumulation, or economic growth, for there is precious little evidence that deficits affect these variables."

Evans (1985, p. 86)

There is increasing concern among policy makers that persistent government budget deficits and the resulting run-up in public debt in most industrialized countries will adversely affect economic performance by crowding out private sector investment. This view contrasts sharply with the academic literature on Ricardian equivalence. According to the Ricardian-equivalence-hypothesis, consumers realize that higher deficits imply higher future taxes and therefore raise their own savings to exactly offset higher public deficits. The implication of pure Ricardian equivalence is that total savings, and hence interest rates are not affected by government deficits. These two views obviously have very different implications for the conduct of fiscal policy.

A key link in the crowding out mechanism is the increase in real interest rates in response to rising debt. The empirical evidence supporting this link is, however, weak. Indeed, empirical studies that have focussed on long historical time series have found that fiscal variables have either no significant positive effects on real interest rates or may even have perverse negative effects; see Evans (1987) and Barro and Sali-i-Martin (1990). This paper provides a new perspective on this issue by assuming that the capital markets of selected industrial countries are effectively integrated. In this case, an increase in the level of world government debt would raise the world real interest rate and, all else equal, the interest rates in individual countries. To examine this possibility, we regress the OECD-wide net public debt-GDP ratio (as well as other OECD-wide variables) on real interest rates in nine OECD countries, and find that the effect of debt on interest rates has been economically and statistically significant.

Several regression exercises are carried out. Separate OLS regressions on each of the nine real interest rates yield coefficients on the debt-GDP ratio that are always positive and generally statistically significant. Moreover, the point estimates are quite large--the lowest implies that a 1 percentage point increase in the world debt-GDP ratio increases real interest rates by 14 basis points. Because the underlying model of worldwide interest arbitrage suggests that the effect of world fiscal policy should be the same in each country, we also pool the data and constrain the coefficients to be the same across all nine countries. The pooled coefficient estimate implies that a 1 percentage point increase in the world debt-GDP ratio raises the real interest rate by about 25 basis points. We also consider the possibility that the true regression residuals are correlated across countries by using Zellner's seemingly unrelated regressions (SUR) technique. Unfortunately, with annual data there are not

enough observations to estimate the system for all nine countries, so we divide them into two groups. Again, the effects of world debt are economically and statistically significant, although the point estimates vary substantially between the two groups. To check the robustness of the results we also add several variables that might influence real interest rates, but none have much effect on the debt-GDP coefficients.

We conclude that the rise in government debt since the late 1970s has had a substantial effect on real interest rates in these industrial countries, contrary to the Ricardian hypothesis. Between 1978 and 1993 the OECD-wide net debt-GDP ratio rose from 21.2 percent to 39.7 percent, an increase of 18.5 percentage points. Based on our parameter estimates, this has boosted real interest rates by 250 to 450 basis points.

The next section briefly surveys the relevant empirical literature on crowding out and international capital market integration and presents the economic model underlying the regressions. Section III presents the main econometric results, Section IV examines the robustness of these results to changes in specification, and Section V concludes.

II. Crowding Out and International Capital Mobility

For the purposes of this paper, crowding out refers to the familiar proposition that an increase in public debt will require higher equilibrium interest rates to induce the public to hold it, which will in turn lower interest-sensitive components of private-sector activity, particularly investment. 1/ For the past two decades, the academic debate on crowding out has been dominated by the Ricardian equivalence proposition--see Barro (1989), Bernheim (1989), and Eisner (1989) for a lively discussion of its relevance. Building on the fact that debt financing today means higher taxes tomorrow, this proposition states that private sector economic agents will anticipate the higher future tax burden by raising their savings today to exactly offset the higher deficit, leaving the real interest rate and other aspects of private sector activity unaffected. That is, deficit and tax financing of government outlays are in this sense equivalent.

Strong assumptions are required for full Ricardian equivalence. In particular, all private sector agents must have access to capital markets on the same terms as the government--this is necessary to ensure that it is

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1/ There are at least three other types of crowding out. First, taxes and transfers drive a wedge between private and social costs, causing deadweight output losses. Second, government consumption, as distinct from transfers, directly diverts resources from the private sector, even if financed by nondistorting taxes. Third, the path of public debt may be unsustainable, in that it violates the government's intertemporal budget constraint, which would presumably result eventually in debt monetization or outright default, either of which would be economically disruptive.

feasible for them to offset government financial policy--and agents must take their heirs' taxes into account--this is required to ensure that they do not try to pass the burden of the public debt on to future generations. Although many have found such assumptions to be unrealistic, the significance of Ricardian equivalence for economic policy should stand or fall on the empirical evidence.

The evidence can be divided into two broad categories which tend to point to different conclusions. In the first category is the behavior of consumption and saving. It is now well established that consumption behavior does not accord with the strict permanent income hypothesis, as would be expected in a Ricardian world of forward-looking agents facing efficient capital markets--see Flavin (1985, 1993). Research has also shown that a plausible explanation for deviations from the permanent income hypothesis is that some agents are liquidity constrained--see Japelli and Pagano (1989), and Zeldes (1989). Thus, it would appear that at least some agents cannot necessarily borrow and lend to offset the effects of fiscal deficits, even if they wanted to. More direct econometric studies of the effect of public debt on consumption find that households only partially offset changes in government deficits--see Bernheim (1987) and Nicoletti (1988). In sum, the empirical evidence on consumption suggests that public debt should crowd out private sector activity, although there may be a partial Ricardian offset.

The second category of evidence is the relationship between real interest rates and public debt. As crowding out occurs through interest rate increases, government debt (and, perhaps, deficits) should be positively related to real interest rates. Yet, such a relationship has proved to be elusive in the data. It can be argued that this reflects practical difficulties, such as defining the correct (ex ante) real interest rate or separating transitory from permanent changes in deficits and debt. Nevertheless, the bulk of the evidence points to the conclusion that interest rates have not been very responsive to public debt, and to that extent supports the Ricardian view--see, for example, Evans (1988).

Most of this evidence, however, is based on U.S. data, under the assumption that domestic fiscal policy is the dominant factor affecting domestic interest rates. 1/ In this paper, we address the issue of the link between debt and interest rates in the context of globally integrated capital markets. This approach is motivated by the accumulating evidence that financial liberalization has increased the integration of international capital markets. Although strict real interest rate parity is empirically rejected, it now seems reasonable to suppose that capital markets are to a substantial extent integrated across several countries, and that international arbitrage between instruments of different currencies is

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1/ The search for a robust statistical relationship between U.S. fiscal deficits and interest rates has been an elusive one--see, for example, Evans (1985), Tanzi(1985; 1987), Spiro (1987), and Bovenberg (1988).

effective in reducing deviations between country-specific interest rates. In the limit, one could speak of a world real interest rate. 1/

Cavaglia (1992) examines cross-country differentials in one month Euromarket rates for five countries. He finds that these differentials substantially vanish after about 12 months. This suggests that arbitrage effectively eliminates differentials in a relatively short period of time, lending credence to the proposition of capital market integration and to the notion of a world real interest rate.

Brunner and Kaminski (1994) also find evidence of international capital market integration. They conclude that German, Japanese, and U.S. three-month real interest rates are cointegrated over the period 1960 to 1993, implying that there is a common stochastic trend toward which the country-specific interest rates converge in the long run. This trend can be interpreted as an estimate of the world real interest rate. They also examine the role of fiscal policy, as measured by the budget deficit-GDP ratio in each of the three countries, and estimate that innovations in U.S. fiscal policy account for a substantial fraction of the variation in the world real interest rate.

Most recently, Gagnon and Unferth (forthcoming) estimate the persistence of deviations of three-month Euromarket real interest rates from the average real interest rate for nine OECD countries. At an annual frequency, they conclude that these deviations are essentially white noise, except for the United States, implying convergence of interest rates within about a year. They interpret the average real interest rate as the world rate. These results are consistent with those of Cavaglia, although the methodology and, therefore, the implied world interest rate are different.

From the perspective of crowding out, the key implication of globally integrated capital markets is that, in the absence of full Ricardian equivalence, an important determinant of country-specific real interest rates is world public debt, as distinct from country-specific debt. We have in mind a transmission mechanism through which additional public debt in any one country effectively increases world public debt, which results in higher real interest rates in all countries. It is natural to suppose that changes in world debt will not generally affect the equilibrium spreads between country-specific interest rates, and that therefore a change in the world interest rate will result in an equal change in each country's rate, all

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1/ In this sense, we use the term "world real interest rate" much like macroeconomists use the notion of a real interest rate for a particular country. Obviously, country- or currency-specific factors--such as taxes, or the risk of default or of exchange rate movements--could cause systematic deviations between the world rate and each country's rate, just as variations in characteristics generate relatively stable interest rate spreads across assets within a country. These factors do not directly affect the arguments presented here.

else equal. But our model does not rule out the possibility that country-specific variables may affect spreads. However, we focus on the transmission from world fiscal variables to real interest rates. In this context, a dollar of public debt has the same effect on the world real interest rate regardless of which country issues it. This implies that the increase in the debt-GDP ratio in the United States of 18 percentage points between 1978 and 1993 had a more important effect on real interest rates than the increase of 74 percentage points that occurred in Belgium over the same period.

To examine the role of world public debt, we regress aggregate OECD-wide fiscal variables on real interest rates in each of the nine countries examined by Gagnon and Unferth. These countries were identified by the OECD (1990) as having liberalized capital markets over the 1978 to 1993 period. This approach avoids the need to specify a world real interest rate, although it has the drawback of conflating the transmission from debt to the world rate with the transmission from the world rate to each country's rate. We do examine two ad hoc measures of the world rate; however: the simple average and the first principal component of the nine real interest rates.

One interpretation of the estimated coefficients is simply the effect of the fiscal variables on real interest rates in each country. Another interpretation is that the estimated model is a filter which is extracting movements in the world real interest rate that are due to world fiscal policy. The predicted value from the estimated regression would then be a measure of the world real interest rate. We hesitate to push either of these interpretations too far, however. Because we do not specify a full model of interest rate determination for each country, the coefficient estimates may be biased and we cannot exclude the possibility that the omitted factors may affect the world real interest rate.

This paper differs in focus from Cavaglia, Gagnon and Unferth, and Brunner and Kaminski, who are interested principally in the existence of a world real interest rate. As regards fiscal policy, our approach differs substantially from that of Brunner and Kaminski. We consider more countries and examine directly the influence of world fiscal policy on country-specific interest rates. A key technical difference is that they assume that real interest rates and the relevant fiscal policy variables are

integrated, whereas we assume they are not. 1/ Therefore, we do not use cointegration techniques. Despite these differences, we also find that fiscal policy has a substantial effect on real interest rates under the assumption of international capital market integration.

III. The Data

The data on real interest rates are those used by Gagnon and Unferth. As described by them, these are rates on 12-month Euromarket certificates of deposit, compiled by the Bank of International Settlements, deflated by national consumer price indices. The data begin in September 1977 and end in December 1993. The discussion will focus on the nine countries with liberalized capital markets: Belgium, Canada, Denmark, Germany, the Netherlands, Japan, Switzerland, the United Kingdom, and the United States. We use annual data because the influence of fiscal variables on real rates is most likely to emerge at relatively low frequencies, the evidence on interest rate convergence, although still fragmentary, suggests that it occurs over the span of a year, and the annual frequency avoids overlapping data, which would complicate the estimation. 2/ However, this means there are only 16 observations, which imposes important constraints on estimation methods and on statistical interpretation. Extending the series back would not appear to be appropriate in this context, since capital market liberalization was less widespread in the 1960s and early 1970s.

The real interest rates for each country and their unweighted average are plotted in Chart 1. In most countries, the real interest rate was quite low in the 1970s, although the sample used in this paper captures only the end of this period, and then increased substantially in the early 1980s. During the past decade, real interest rates varied substantially, although in most countries there is little clear trend. As documented by Gagnon and Unferth, interest rates in most countries appear to gravitate towards the

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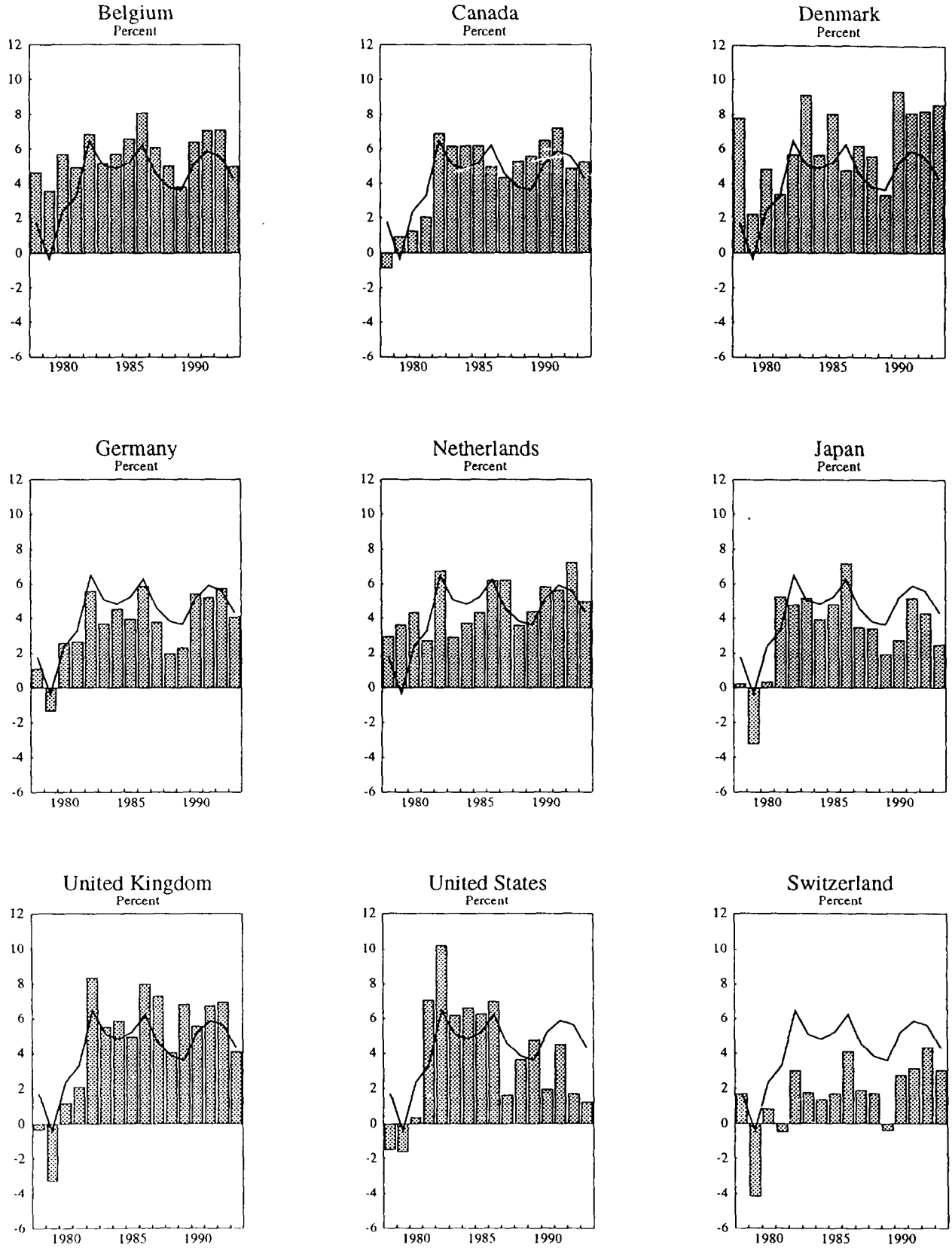
1/ We do not criticize Brunner and Kaminsky for their choice, which they verified with the standard augmented Dickey-Fuller tests. Experience has shown, however, that it can be difficult to distinguish integrated from stationary series. The most thoroughly examined time series in this context is U.S. real GDP. Although standard statistical tests indicate integration, there has been substantial work casting doubt on this conclusion and, by implication, on the power to reject integration. See, for example, Cochrane (1988) and Stock (1992). Skepticism about the relevant statistical tests leads us to put more weight on the following ex ante presumptions. The fiscal variables, defined as a ratio to GDP, are bounded (except perhaps for debt) and therefore cannot truly be integrated, although they may appear to be so in actual samples. If the real interest rate is ultimately tied down by the marginal product of capital and fiscal policy, then it too should be stationary, according to standard growth theory.

2/ Under rational expectations, overlapping data--for example, using monthly observations of 12-month returns--yield moving average errors.

Chart 1: Ex Post Real Interest Rates -- 12-Month Euromarket

Bar: Real Interest Rate ___ Average Real Interest Rate



average, especially if constant differences over the sample are removed (notably in the cases of Belgium and Switzerland). Nevertheless, as shown in Table 1, the raw correlations among real interest rates in the nine countries are not always very high, and in some cases are even negative.

In the basic specification, the country-specific interest rates are explained by three OECD-wide fiscal variables. That is, the regressors are the same in each equation (country). The fiscal variable of most interest is government net debt. An alternative would be gross debt, but it includes intra-government holdings, such as public pension funds invested in government paper, and so in some countries deviates substantially from the amount of debt held by the public. Although of lesser interest, it seems likely that direct public consumption of resources, which competes with the private sector, may also result in crowding out through higher interest rates. Since an increase in government consumption may have both permanent and temporary effects, we include both the level and the first difference of real public consumption as a ratio to real GDP. Each of these series is a weighted average across OECD countries, where the weights are GDPs in common currency calculated using purchasing power parities (rather than actualexchange rates), as published by the OECD. The three key fiscal variables, are plotted in Chart 2 against the average real interest rate.

To check the robustness of the results, we add several other variables to the basic specification. These variables are the income share of capital in the business sector, the inflation rate as measured by the consumer price index and by the GDP deflator, the growth of real GDP, the growth of labor productivity, labor force and employment growth, the unemployment rate, and finally, the change in the net public debt-GDP ratio. The last variable is basically the government deficit and therefore specifications that include this variable permit different long-run and short-run effects of government debt. The other variables are included as proxies to pick up shifts in the marginal product of capital that are unrelated to changes in government debt. All these data were drawn from the OECD, and are plotted in Chart 3.

IV. Estimation Results

1. OLS estimates

The most straightforward model for estimating the effects of global fiscal policy on real interest rates is:

$$RR_i = a_i + b_i*X + e_i \qquad (1)$$

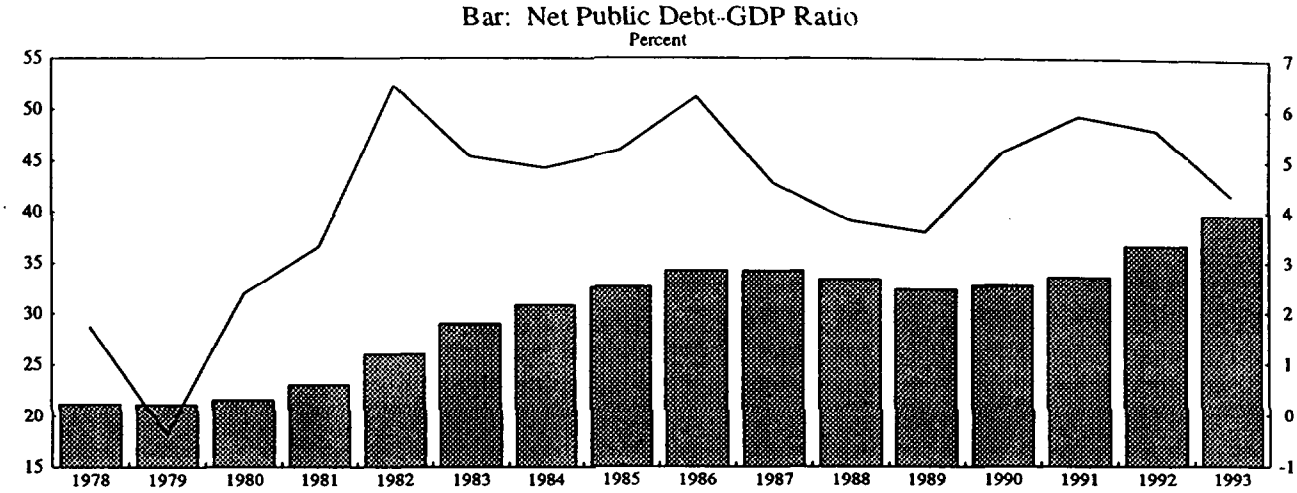
where the subscript i refers to the country (the time subscript has been suppressed), RR is the real interest rate, and X is the vector of the three OECD-wide fiscal variables. All other influences on the real interest rate are buried in the error term, which must be uncorrelated with X if the coefficient estimates are to be unbiased. Since equations (1) have few degrees of freedom, it is difficult to model these other influences

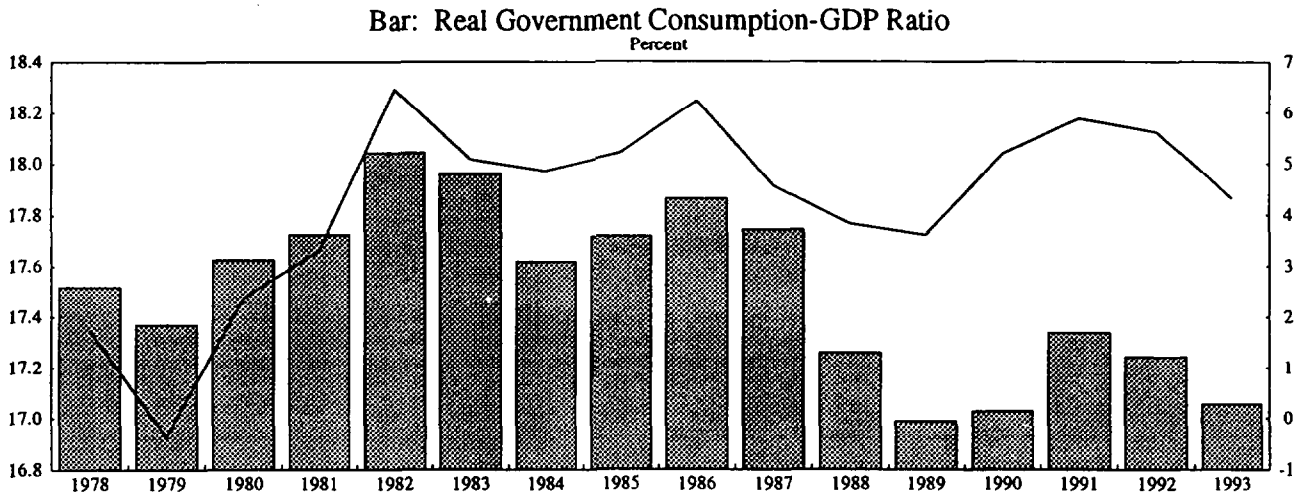
Table 1. Correlations of Ex-Post Real Interest Rates

	Average	Belgium	Canada	Denmark	Germany	Japan	Netherlands	Switzerland	United Kingdom
Canada	.83	.49							
Denmark	.50	.40	.40						
Germany	.95	.86	.73	.53					
Japan	.89	.71	.65	-.32	.80				
Netherlands	.62	.73	-.46	-.24	.70	-.33			
Switzerland	.84	.80	-.52	.69	.87	.70	.63		
United Kingdom	.93	.67	.83	-.33	.87	.80	.66	.73	
United States	.69	.42	.64	-.06	.55	.79	-.13	.30	.65

Chart 2: Net Public Debt and Government Consumption Ratios in the OECD: 1978-93

___ Average Ex Post Real Interest Rate in 9 Countries





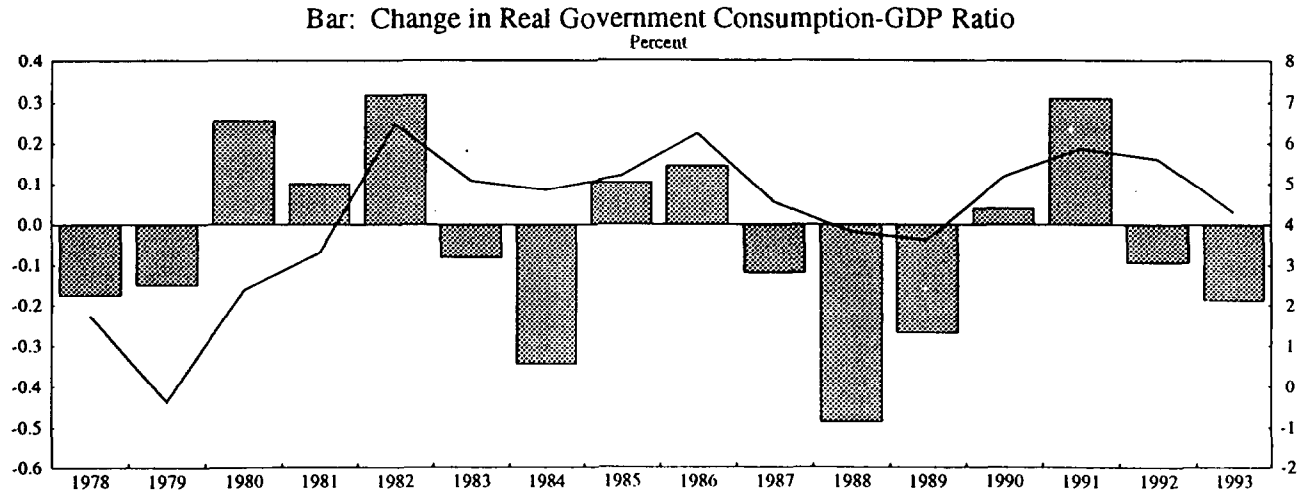
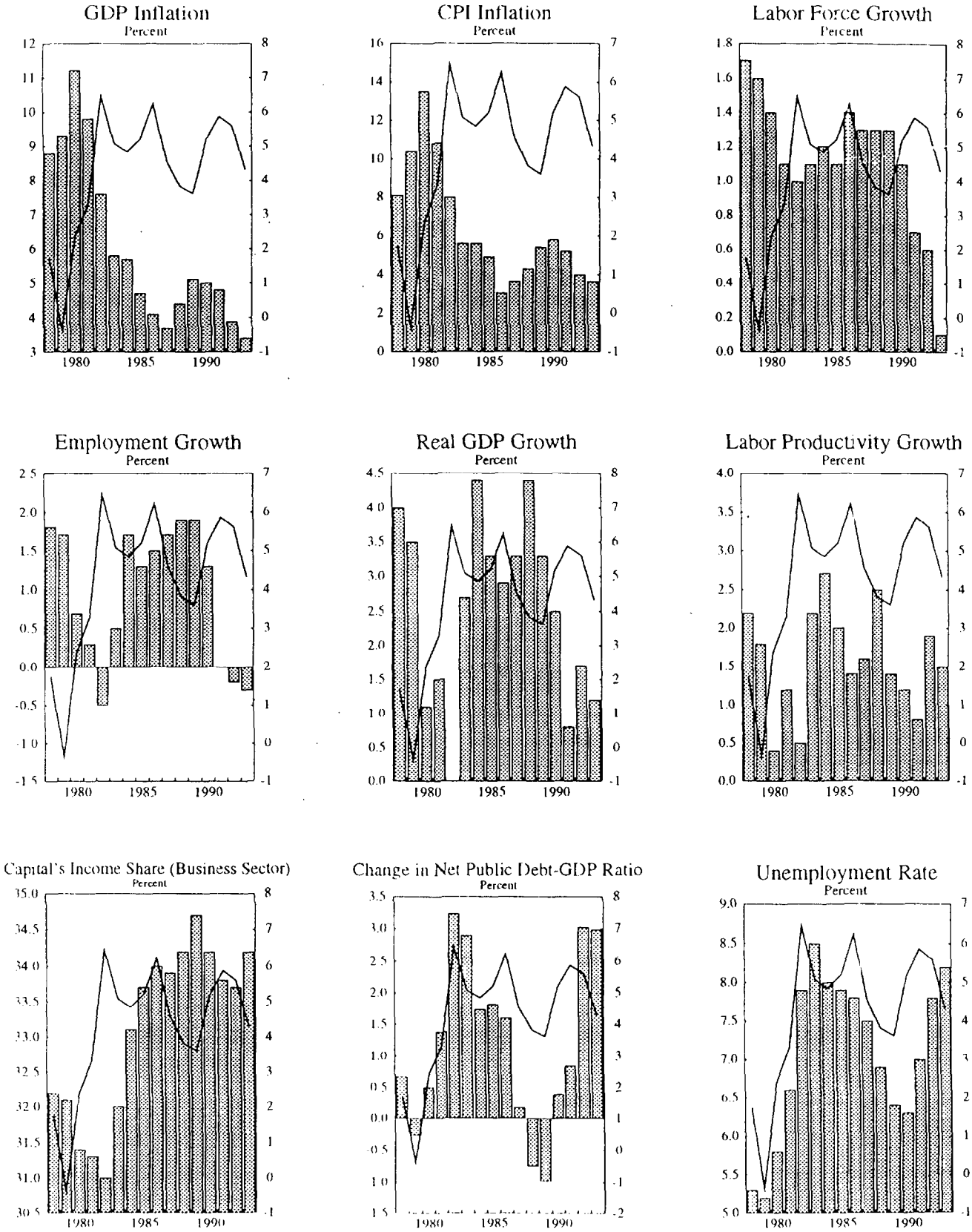


Chart 3: Other Potential Explanatory Variables (measured as OECD aggregates)

___ Average Ex Post Real Interest Rate in 9 Countries



explicitly. However, in Section V, we add several candidates to the specification and find that they do not substantially affect the coefficient on debt.

The OLS results are shown in Table 2. For all countries except Denmark and the United States the estimated coefficient on the net public debt variable is significant (with 13 degrees of freedom and at the standard 5 percent level of significance, the critical T-value is 2.16). There is considerable variability in the coefficient estimates, which range from .14 in Belgium--implying that a 1 percentage point increase in the OECD-wide debt-GDP ratio raises the Belgian interest rate by 14 basis points--to .49 for the United Kingdom. The public consumption-GDP ratio is positive for all countries except the Netherlands, but is significant only for Japan, the United Kingdom, and the United States. The change in the ratio is positive for all countries, but significant only for Belgium, Germany, and the Netherlands. Despite the aggregate nature of the regressors, the explanatory power of the regressions, as judged by the R-squared, is quite good. For most countries, the Durbin-Watson statistics and the residuals, which are plotted in Chart 4, suggests little residual serial correlation, although this conclusion is based on a very limited number of observations.

These results are generally supportive of the hypothesis that world debt is an important determinant of country-specific real interest rates. However, the precision of the estimates is limited by the few degrees of freedom. Moreover, the underlying logic of interest rate determination in integrated capital markets suggests that world debt and deficits may affect each country's interest rate equally. Although our model does not rule out the possibility that country-specific debt variables are also important, we find little evidence that they add much to the basic model once the aggregate debt variable is included in the regression. Table 3 reports the estimated parameter estimates and t-statistics when we augment the simple OLS regressions reported in Table 2 with measures of own-country debt ratios. 1/ In no case do we find a significant positive coefficient on these own-country debt variables. However, in some cases we do find significant negative effects--for the United Kingdom and the United States--confirming some earlier findings in the literature that it is possible to generate perverse effects by focussing on own-country fiscal variables.

Another way of potentially extracting more information out of our limited sample, is to impose cross equation restrictions. Indeed, constraining coefficients across equations (countries) can be thought of as a way of extracting a common trend from the nine individual interest rates. We therefore consider systems estimates.

1/ The results for Switzerland are not available because we could not obtain data on net public debt.

Table 2. OLS Estimation Results 1/

	Country Constant	OECD Net Public Debt 2/	OECD Public Consumption 3/ Change	OECD Public Consumption 3/ Level	Std. Error	R^2	DW
Belgium	-21.65	0.14	3.05	1.32	0.72	.74	2.89
	(1.84)	(4.23)	(3.48)	(2.03)			
Canada	-31.59	0.34	1.89	1.48	1.70	.60	1.03
	(1.13)	(4.20)	(0.91)	(0.96)			
Denmark	-0.84	0.20	1.86	0.06	2.14	.27	2.17
	(0.02)	(1.98)	(0.71)	(0.03)			
Germany	-32.49	0.27	4.01	1.59	1.09	.75	2.62
	(1.82)	(5.32)	(3.01)	(1.61)			
Japan	-88.12	0.33	2.15	4.64	1.54	.70	2.24
	(3.48)	(4.55)	(1.14)	(3.32)			
Netherlands	3.66	0.16	3.36	-0.21	1.05	.57	3.02
	(0.21)	(3.14)	(2.63)	(0.22)			
United Kingdom	-77.45	0.49	2.83	3.84	1.93	.71	1.68
	(2.45)	(5.31)	(1.20)	(2.20)			
United States	-116.41	0.24	1.78	6.44	2.83	.44	1.47
	(2.51)	(1.81)	(0.52)	(2.52)			
Switzerland	-34.12	0.28	2.76	1.56	1.46	.60	2.87
	(1.43)	(4.04)	(1.55)	(1.18)			

1/ T-statistics are reported in parentheses under the estimated coefficients.
2/ Measured as a ratio of nominal GDP.
3/ Measured as real government consumption expenditures in the OECD countries divided by real GDP.

Chart 4: Fitted Values and Residuals From OLS Regressions

___ Real Interest Rate --- Fitted Values bar - residuals

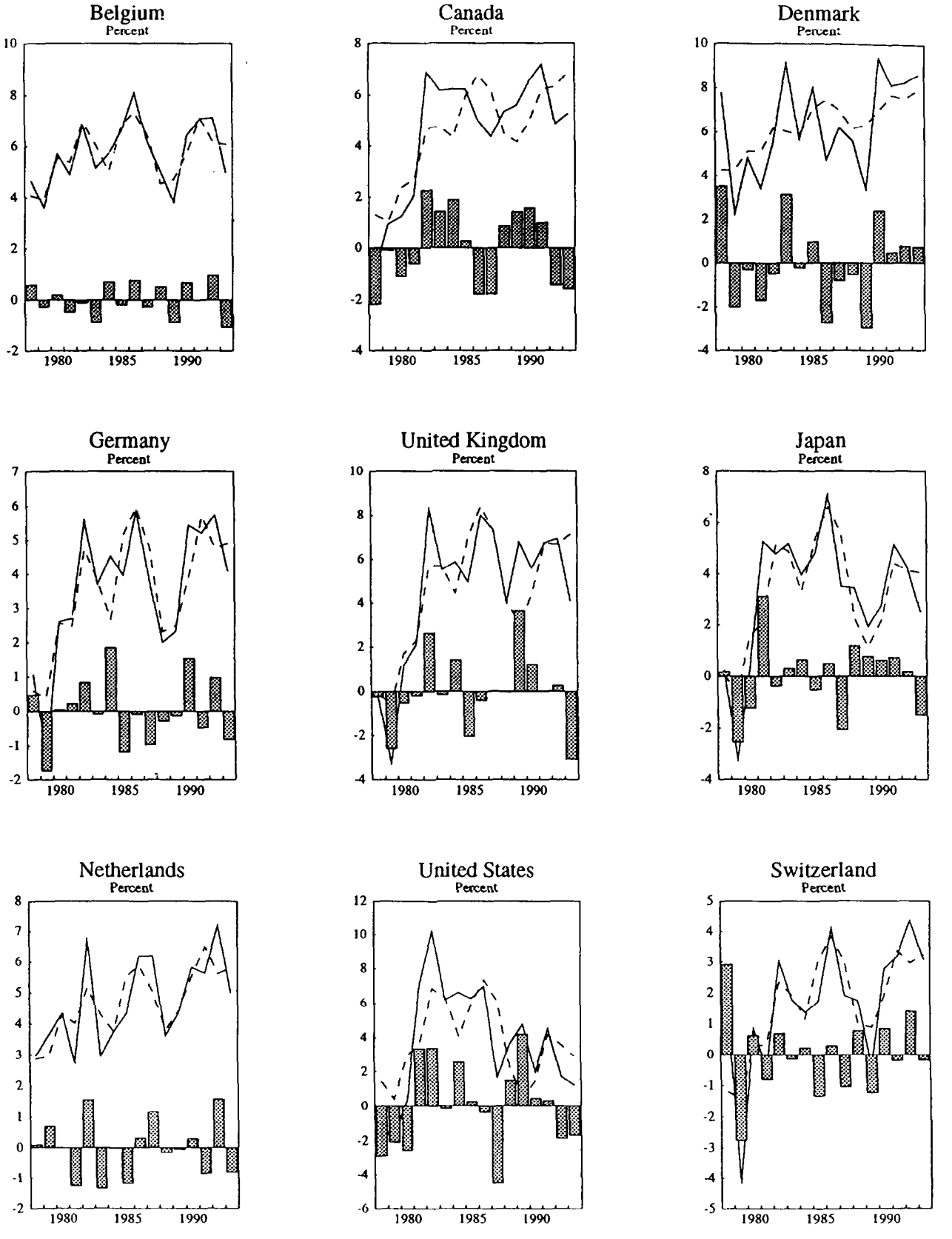
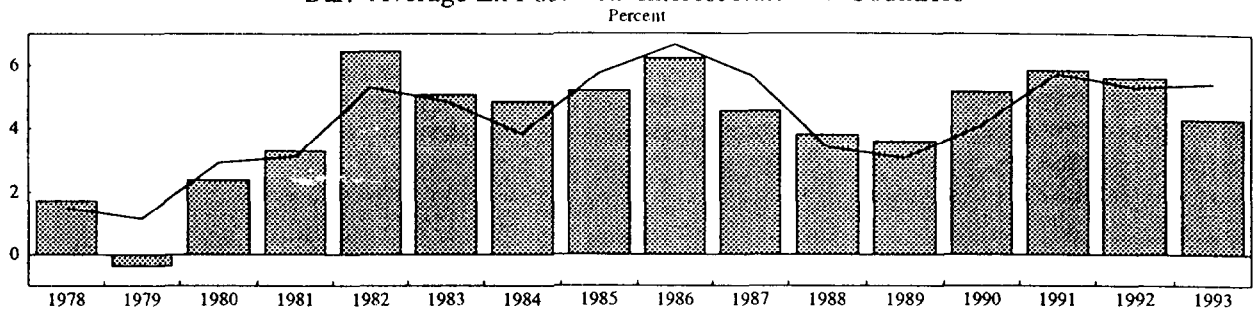


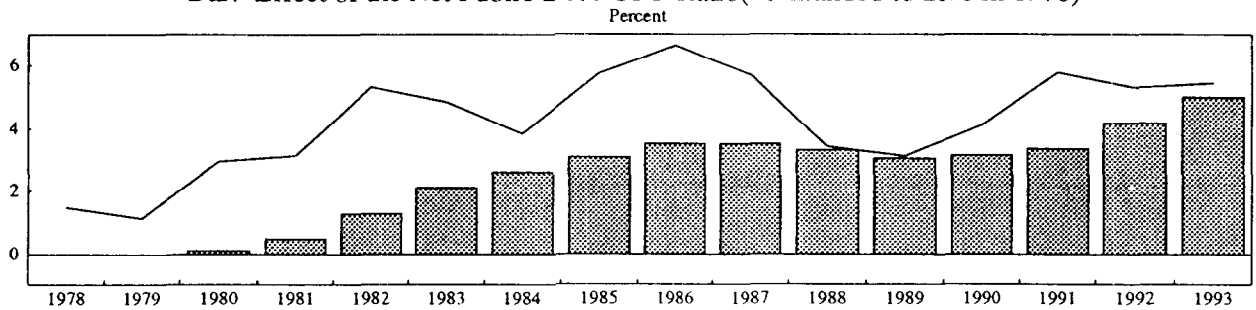
Chart 5: Effects of Fiscal Variables on the 9-Country Average Real Interest Rate

___ Fitted values from the Average Real Interest Rate Model

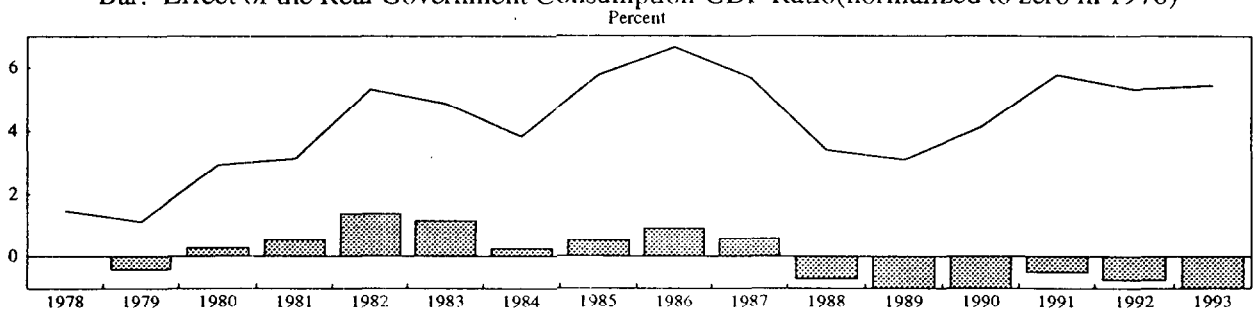
Bar: Average Ex Post Real Interest Rate in 9 Countries



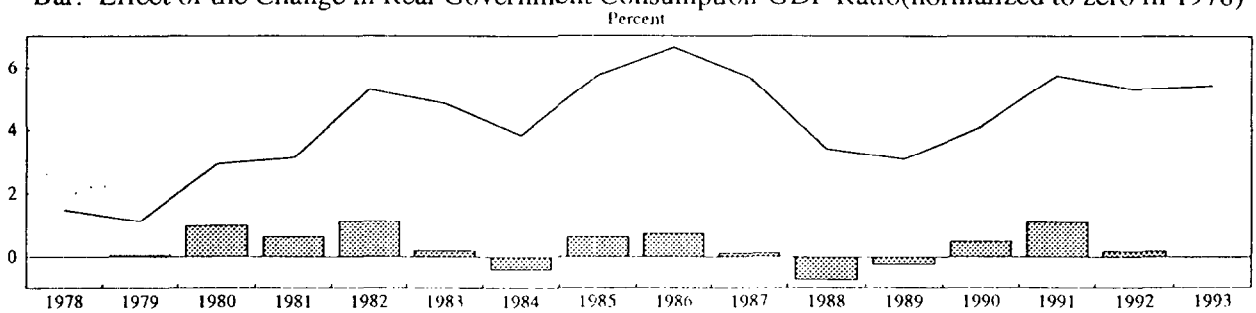
Bar: Effect of the Net Public Debt-GDP Ratio(normalized to zero in 1978)



Bar: Effect of the Real Government Consumption-GDP Ratio(normalized to zero in 1978)



Bar: Effect of the Change in Real Government Consumption-GDP Ratio(normalized to zero in 1978)



Note: The effect of each variable is computed by expressing each variable as a deviation from its 1978 value and then multiplying the resulting series by its estimated parameter.

Table 3. Tests For Own-Country Debt Effects 1/

	Own-Country Debt Variable 2/
Belgium	-0.01 (0.36)
Canada	-0.33 (1.92)
Denmark	0.01 (0.06)
Germany	0.10 (0.51)
Japan	0.06 (0.57)
Netherlands	0.03 (0.32)
United Kingdom	-1.15 (2.52)
United States	-0.29 (3.22)

1/ T-statistics are reported in parentheses under the estimated coefficients.
2/ Measured as a ratio of nominal GDP.

2. System estimates

We first consider a simple pooling of the observations, where the slope terms, but not the constants, are assumed to be equal across countries. In terms of parameter estimates, this amounts to regressing the three aggregate fiscal variables against the unweighted sample mean of the nine real interest rates. The model is:

$$RR_i = a_i + b*X + e_i \qquad (2)$$

The results of this estimate are shown in Table 4. The coefficients of all three explanatory variables are positive and statistically significant and for most countries the explanatory power remains good. The coefficient on debt implies that a 1 percentage point increase in world public debt raises each country's interest rate by 27 basis points. There is a deterioration in the residual pattern, relative to the OLS results, although examination of the Durbin-Watson statistics suggests that serial correlation is a problem only in Canada and the United States. The top panel of Chart 5 shows the fit of the pooled regression and the average real interest rate. The other panels show the contribution of each variable (the variable times its coefficient, normalized to zero in 1978) to the fitted average real interest rate. The role of debt can be most clearly seen at the beginning of the sample, when both debt and the real interest rate trend up, and at the end of the sample, when the (fitted and actual) interest rate remains high, even though the government consumption variables are not adding any pressure. The effect of the change in government consumption is most apparent in the 1980s and early 1990s, when it is closely correlated with interest rate movements.

Although pooling increases efficiency, especially in view of the few available degrees of freedom, it may introduce bias if the restrictions are incorrect. The tests we performed give somewhat different answers, but we conclude that pooling is likely rejected by the data. 1/ This may suggest that the transmission from the world real interest rates to country-specific rates varies by country, or that there are omitted variables that are more important for some countries than others, and that bias the (unrestricted) coefficient estimates.

The pooling estimator assumes that the residuals are uncorrelated across equations (countries). It seems more natural, however, to assume instead that they are correlated, because it is likely that there are factors, other than world fiscal policy, that affect all country-specific interest rates, especially on the assumption that capital markets are integrated. Zellner's seemingly unrelated regression (SUR) technique allows

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1/ The standard F-test for 24 linear restrictions cannot reject pooling at the 5 percent level. This test assumes equality of variances across equations, however, and in the absence of this assumption, a Wald test may be more appropriate. This test rejects pooling decisively.

Table 4. System Estimation Results 1/

	Country Constant	OECD Debt 2/	OECD Public Consumption 3/ Change	Level	Std. Error	R^2	DW
Belgium	-42.84	0.27	2.63	2.30	0.93	.65	1.40
	(3.07)	(6.36)	(3.13)	(3.01)			
Denmark	-42.26	0.27	2.63	2.30	2.00	.21	1.81
	(3.01)	(6.36)	(3.13)	(3.01)			
Germany	-45.01	0.27	2.63	2.30	0.99	.73	2.32
	(3.21)	(6.36)	(3.13)	(3.01)			
Netherlands	-43.86	0.27	2.63	2.30	1.21	.44	1.74
	(3.13)	(6.36)	(3.13)	(3.01)			
Switzerland	-46.92	0.27	2.63	2.30	1.29	.59	2.69
	(3.34)	(6.36)	(3.13)	(3.01)			
Canada	-44.01	0.27	2.63	2.30	1.59	.53	0.97
	(3.14)	(6.36)	(3.13)	(3.01)			
Japan	-45.32	0.27	2.63	2.30	1.49	.65	1.80
	(3.22)	(6.36)	(3.13)	(3.01)			
United Kingdom	-43.96	0.27	2.63	2.30	2.02	.69	1.18
	(3.10)	(6.36)	(3.13)	(3.01)			
United States	-44.83	0.27	2.63	2.30	2.79	.27	1.00
	(3.24)	(6.36)	(3.13)	(3.01)			

1/ T-statistics are reported in parentheses under the estimated coefficients.
2/ Measured as a ratio of nominal GDP.
3/ Measured as real government consumption expenditures in the OECD countries divided by real GDP.

estimation of covariances of the equation errors, but there are not enough observations in our sample to estimate the system with all nine countries. 1/ We, therefore, divide the countries into two groups and estimate two separate systems, and impose the same coefficients within each system.

One intuitively appealing group is Germany and the four smaller European countries, all of which have close economic ties to Germany. Another is the four largest countries, all of which have important world currencies and large capital markets, plus Canada, which is linked closely to the United States. This yields two groups of five countries each, with Germany being in both groups. Examination of the covariance matrix of the residuals from the OLS regressions, shown on Table 5, lends support to this partition. For example, the U.S. residual is not highly correlated with those of the smaller European countries, but is with those of all the large countries except perhaps Germany. The German residual is highly correlated with many of large countries, and also with those of some small countries, such as Belgium and Switzerland. The U.K. residual is correlated with those of the large countries, but much less so with those of the small European countries.

Subject to the choice of these two five-country systems, the SUR estimates are shown in Table 6. The coefficient on the OECD-wide debt variable is significant in both systems. For the large country group, its coefficient is the same as in the pooled regression. For the Germany-small country group, it is at the bottom of the range of the OLS estimates. In contrast to the pooled results, the level of public consumption is no longer significant for either group. 2/

3. Proxies for the world real interest rate

All the regressions confirm the influence of world fiscal variables--especially the debt-GDP ratio--on real interest rates in several industrial countries. As described, the logic underlying these regressions assumes the existence of a world capital market and even a world interest rate. Another test of the hypothesis of crowding out at the world level would be to regress world fiscal variables directly against the world interest rate. This approach has the drawback of requiring a definition of the world real interest rate. Many proposals in the literature tend to be ad hoc, and therefore may introduce specification error.

1/ For the same reason, we cannot test the pooling restrictions in the SUR estimates.

2/ Although the results are not shown, the constraint that its coefficient is zero cannot be rejected in either system, and imposing this constraint has no effect on the debt coefficients.

Table 5. Residual Correlations of OLS Residuals

	Belgium	Canada	Denmark	Germany	Japan	Netherlands	Switzerland	United Kingdom
Canada	-0.12							
Denmark	0.13	0.02						
Germany	0.56	0.32	0.28					
Japan	0.19	0.28	-0.01	0.50				
Netherlands	0.46	-0.12	-0.21	0.24	-0.39			
Switzerland	0.60	-0.18	0.57	0.66	0.30	0.20		
United Kingdom	0.16	0.55	-0.16	0.62	0.44	0.33	0.24	
United States	-0.13	0.73	-0.32	0.37	0.68	-0.24	-0.12	0.60

Table 6. System Estimation Results with SURE 1/

	Country Constant	OECD Debt 2/	OECD Public Consumption 3/ Change	OECD Public Consumption 3/ Level	Std. Error	R^2	DW
Five European Countries: LLF = -111.380							
Belgium	-11.57	0.14	3.17	0.75	0.64	0.72	2.76
	(1.32)	(5.50)	(4.85)	(1.55)			
Denmark	-11.00	0.14	3.17	0.75	1.96	0.18	1.94
	(1.25)	(5.50)	(4.85)	(1.55)			
Germany	-13.74	0.14	3.17	0.75	1.19	0.72	1.65
	(1.56)	(5.50)	(4.85)	(1.55)			
Netherlands	-12.59	0.14	3.17	0.75	0.97	0.51	2.59
	(1.43)	(5.50)	(4.85)	(1.55)			
Switzerland	-15.64	0.14	3.17	0.75	1.47	0.51	2.28
	(1.78)	(5.50)	(4.85)	(1.55)			
Five Large Countries: LLF = -138.340							
Canada	-26.07	0.32	2.97	1.19	1.49	0.59	1.03
	(2.11)	(9.11)	(3.23)	(1.74)			
Germany	-27.07	0.32	2.97	1.19	1.06	0.70	2.06
	(2.19)	(9.11)	(3.23)	(1.74)			
Japan	-27.38	0.32	2.97	1.19	1.69	0.52	1.49
	(2.22)	(9.11)	(3.23)	(1.74)			
United Kingdom	-26.02	0.32	2.97	1.19	1.94	0.68	1.34
	(2.11)	(9.11)	(3.23)	(1.74)			
United States	-26.89	0.32	2.97	1.19	3.06	0.15	0.84
	(2.18)	(9.11)	(3.23)	(1.74)			

1/ T-statistics are reported in parentheses under the estimated coefficients.
2/ Measured as a ratio of nominal GDP.
3/ Measured as real government consumption expenditures in the OECD countries divided by real GDP.

To explore this issue further, the two definitions of the world real interest rate proposed by Gagnon and Unferth--the simple average and the first principal component of the interest rates of the nine countries--are regressed against the same fiscal variables. These two proxies are plausible in that they are fairly highly correlated with each of the country-specific interest rates--see Table 1 for the unweighted sample average and Table 7 for the factor loadings of the first principal component (which as shown are equal to the correlations of the principal components with each interest rate). Also shown in Table 7 are the transformed factor loadings used as weights to compute a world real interest rate that is comparable to the raw real interest rate series. 1/ The weight is very low for the United States, which seems counterintuitive in view of the size of the U.S. financial market. This may reflect important idiosyncratic shocks in U.S. financial markets, such as the large increase and subsequent decline in the exchange rate in the mid-1970s, which would be consistent with Gagnon and Unferth's finding that the U.S. interest rate has not converged very rapidly to the world rate. This result is also consistent with the pooled regression (Table 4), which in the case of the United States has relatively low explanatory power and a poor Durbin-Watson statistic.

The regression results are summarized in Table 7. For the unweighted average these are identical to the pooled regression, and are repeated here for convenience. For the first principal component, the coefficient on public debt is almost the same as for the unweighted average and as the larger of the SUR estimates (that is, for the large-country group). Although not shown, the second and third principal components are not closely related to either the individual interest rates or the fiscal variables.

4. Quarterly data

The use of quarterly data increases the degrees of freedom, allowing SUR estimation for the system of all nine countries. On the other hand, it also introduces considerable noise, since the fiscal variables under examination are unlikely to affect quarter-to-quarter movements in real interest rates. 2/ Nevertheless, the quarterly results largely confirm

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1/ The loading factors are computed from normalized (zero mean and unit standard deviation) interest rate series, rather than from the raw series. For the regression, these factors were rescaled so their sum of squares equalled one, and the raw interest rate series were averaged using the squares of the rescaled factors.

2/ High frequency movements are likely to be dominated by market news, inflation surprises, and perhaps short-term monetary policy intervention.

Table 7. Estimation Results with Averages and Principal Components 1/

	Constant	OECD Debt 2/	OECD Public Consumption 3/ Change	Level	Std. Error	R^2	DW
First Principal Component	-24.61 (3.21)	0.15 (6.88)	1.69 (2.96)	1.14 (2.70)	0.47	0.83	2.16
Average Real Interest Rate	-44.33 (3.00)	0.27 (6.38)	2.63 (2.39)	2.30 (2.82)	0.90	0.80	1.61
Weighted-Average Real Interest Rate	-46.15 (3.03)	0.29 (6.57)	2.78 (2.45)	2.37 (2.82)	0.93	0.81	1.80

Load factors and corresponding weights for the first principal component:

	Load Factors	Weights
Belgium	0.85632	.126
Canada	0.79694	.110
Denmark	0.51771	.046
Germany	0.97162	.163
Japan	0.86070	.128
Netherlands	0.69055	.082
Switzerland	0.87177	.131
United Kingdom	0.92270	.147
United States	0.62436	.067

1/ T-statistics are reported in parentheses under the estimated coefficients.
2/ Measured as a ratio of nominal GDP.
3/ Measured as real government consumption expenditures in the OECD countries divided by real GDP.
4/ Weights are derived by squaring the load factors and dividing by their corresponding sum.

those presented above. 1/ For the individual country regressions, there is a spread of coefficient estimates, although all are positive. The t-statistics and R-squares are generally lower with quarterly data, owing to the extra variation in real interest rates that cannot be explained by fiscal policy. However, the move to quarterly data allowed us to estimate a nine-equation model with SURE that imposed identical coefficients across equations. In this case, the coefficient estimate for debt variable is highly significant, and has a point estimate of 0.24, which is close to the annual pooled estimate and to the higher of the annual SUR estimates.

V. Extensions to the Basic Model

As a test of the robustness of the results, several OECD-wide regressors were added one at a time to the basic specification, using annual data. The results for the average world interest rate (corresponding to the pooled system estimate), the first principal component, and the two SUR systems are shown Table 8. In the interest of brevity, only the coefficients on the added variable and on OECD-wide debt are shown, along with significance statistics.

The additional variables can be thought of as being divided into two types. Theory suggests variables that should affect the real interest rate. In standard growth models, higher labor force or productivity growth (both of which affect real output growth) lowers the steady state capital-output ratio and so raises the interest rate. The change in public debt--the public sector borrowing requirement--may crowd out activity in addition to its effect on subsequent levels of debt, as in Brunner and Kaminsky. The other variables--inflation, the unemployment rate, and the capital income share--may capture cyclical factors that have temporary effects on real interest rates.

In general, the coefficients on the additional variables are themselves statistically insignificant and do not affect the sign of the public debt variable and, especially in the cases of changes in the labor force, employment, real GDP, and net public debt, typically do not much affect its size or significance either. Except for capital's share, the cyclical variables tend to reduce both the point estimates and the significance levels of the coefficient on public debt.

1/ The results with quarterly data are so similar that we do not report all of the results in tables. However, they can be obtained by contacting one of the authors.

Table 8. Robustness Tests: Adding Other Variables

Model	Added Variable Estimated Parameter	Debt Variable Estimated Parameter
GDP Inflation in the OECD		
Average Real Interest Rate	-0.15 (t = 0.37)	0.21 (t = 1.22)
Weighted Average Real Interest Rate	-0.11 (t = 0.27)	0.24 (t = 1.35)
System #1: 5 European Countries	-0.33 (χ^2 = 1.76)	-0.01 (χ^2 = 0.01)
System #2: 5 Large Countries	-0.20 (χ^2 = 0.28)	0.26 (χ^2 = 2.90)
CPI Inflation in the OECD		
Average Real Interest Rate	-0.13 (t = 0.56)	0.21 (t = 1.68)
Weighted Average Real Interest Rate	-0.12 (t = 0.51)	0.23 (t = 1.86)
System #1: 5 European Countries	-0.14 (χ^2 = 1.05)	0.07 (χ^2 = 0.70)
System #2: 5 Large Countries	-0.08 (χ^2 = 0.18)	0.30 (χ^2 = 7.29)
Growth Rate of the Labor Force in the OECD		
Average Real Interest Rate	-0.01 (t = 0.01)	0.27 (t = 4.49)
Weighted Average Real Interest Rate	0.19 (t = 0.20)	0.30 (t = 4.77)
System #1: 5 European Countries	0.88 (χ^2 = 2.15)	0.16 (χ^2 = 12.62)
System #2: 5 Large Countries	-0.13 (χ^2 = 0.03)	0.32 (χ^2 = 9.33)
Growth Rate of Employment in the OECD		
Average Real Interest Rate	-0.14 (t = 0.39)	0.27 (t = 5.75)
Weighted Average Real Interest Rate	-0.09 (t = 0.24)	0.28 (t = 5.94)
System #1: 5 European Countries	0.25 (χ^2 = 1.02)	0.13 (χ^2 = 10.63)
System #2: 5 Large Countries	-0.13 (χ^2 = 0.20)	0.31 (χ^2 = 14.40)
Growth Rate of the Labor Force in the OECD		
Average Real Interest Rate	-0.08 (t = 0.26)	0.27 (t = 5.98)
Weighted Average Real Interest Rate	-0.07 (t = 0.21)	0.29 (t = 6.15)
System #1: 5 European Countries	0.43 (χ^2 = 3.82)	0.12 (χ^2 = 9.36)
System #2: 5 Large Countries	0.06 (χ^2 = 0.26)	0.33 (χ^2 = 16.91)
Growth Rate of Labor Productivity in the OECD		
Average Real Interest Rate	-0.14 (t = 0.19)	0.27 (t = 5.96)
Weighted Average Real Interest Rate	-0.01 (t = 0.01)	0.29 (t = 6.16)
System #1: 5 European Countries	1.70 (χ^2 = 8.69)	0.08 (χ^2 = 5.31)
System #2: 5 Large Countries	1.24 (χ^2 = 3.14)	0.29 (χ^2 = 16.04)

Table 8 (concluded). Robustness Tests: Adding Other Variables

Model	Added Variable Estimated Parameter	Debt Variable Estimated Parameter
Capital's Share of Income in the Business Sector		
Average Real Interest Rate	-0.24 (t = 0.50)	0.31 (t = 3.79)
Weighted Average Real Interest Rate	-0.18 (t = 0.37)	0.31 (t = 3.75)
System #1: 5 European Countries	0.16 (χ^2 = 0.22)	0.11 (χ^2 = 2.12)
System #2: 5 Large Countries	-0.34 (χ^2 = 0.61)	0.36 (χ^2 = 16.04)
Change in Net Public Debt in the OECD		
Average Real Interest Rate	0.12 (t = 0.54)	0.26 (t = 2.28)
Weighted Average Real Interest Rate	0.08 (t = 0.35)	0.28 (t = 5.43)
System #1: 5 European Countries	0.05 (χ^2 = 0.11)	0.14 (χ^2 = 10.40)
System #2: 5 Large Countries	0.24 (χ^2 = 0.94)	0.26 (χ^2 = 7.37)
Unemployment Rate in the OECD		
Average Real Interest Rate	0.63 (t = 1.13)	0.17 (t = 1.70)
Weighted Average Real Interest Rate	0.51 (t = 0.86)	0.21 (t = 1.97)
System #1: 5 European Countries	-0.58 (χ^2 = 1.39)	0.21 (χ^2 = 7.30)
System #2: 5 Large Countries	0.94 (χ^2 = 2.24)	0.13 (χ^2 = 0.84)

VI. Policy Implications

This paper has presented evidence that the ratio of OECD public debt to world GDP has had a substantial effect on real interest rates in nine industrial countries that have had liberalized financial markets since the late 1970s. These findings provide support for the hypothesis that there is significant international integration of capital markets.

From a methodological perspective, tests of the influence of fiscal policy on the real economy that include only domestic fiscal variables are likely to be misspecified and biased towards finding little effect on real interest rates. This point is also made by Beck (1993), who finds that fiscal policy affects exchange markets, as one would expect under global capital market integration. Indeed, exchange markets may be one explanation of why the pooling restrictions are rejected in our data--changes in world debt do not seem to be translated equally to all country-specific interest rates, perhaps because they also generate expectations of exchange rate changes. In any case, further examination of the transmission from global debt variables, or from the world interest rate, to country-specific interest rates would appear warranted.

From a policy perspective, capital market integration expands the opportunities for public debt management for all countries, just as free trade in goods and services expands each country's consumption set. If the public debt policies of each country were optimal (in some sense), then integration would raise world welfare, just as free trade does. On the other hand, integration raises the problem of spillovers, or external effects, of public debt. Any country that issues a significant amount of debt will tend to raise interest rates, and induce crowding out, worldwide. The incentives faced by each government are thereby tilted towards more debt issue. This observation provides a building block for increased international concern about the fiscal policies of each country, which would no longer have only, or even predominately, domestic effects.

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