Default risk on government debt in OECD countries

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1. Introduction

Do high debt countries pay a premium on their public debt? And if so, why? Two kinds of risk may be priced by the market. The first is a devaluation risk: high debt countries may be induced to 'inflate away' part of their debts denominated in domestic currency by a devaluation. Monetary integration in Europe, culminating in a complete monetary union, will make devaluations either impossible or extremely costly politically if the country will have to leave the union. Thus, a credible monetary union eliminates devaluation risk. The second risk is outright default. Even when the option of devaluation is abandoned, governments still retain the option of reducing by fiat the value of their debt. In this paper we use 'default' as a general term which includes not only repudiation of debt obligations, but also new taxes with a retroactive effect on debt repayments, or to some extent 'consolidation' of debts, such as those that occurred in the 1920s in Italy and Belgium.

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If one believes that devaluation risk will become a default risk (McKinnon, 1992), then high debt countries will not see their nominal interest rates reduced by joining the Monetary Union. If instead default, retroactive forms of taxation, or consolidation are viewed as very unlikely, then the credibility gain on nominal interest rates could be substantial.

This paper focuses on default risk. To distinguish it from the risk of devaluation, we measure the price of default risk as the difference between the return from holding government debt and the return from holding 'safe' private debt of corresponding maturity, denominated in the same currency. On average, in our sample of 12 countries in the period 1974–89, the return on government debt is smaller than that on private assets, indicating that private assets are generally considered more risky than government debt. However, we find statistical evidence that high stocks or rapid accelerations of government debt are associated with an increase of the return on government debt relative to the private return. The evidence on the effects of the maturity structure is instead uncertain: only in a few countries does a longer maturity tend to reduce the interest differential. These results are consistent with those obtained by Goldstein and Woglom (1992) who studied, from a similar perspective, debt issued by American States.

Naturally, pure 'default' risk premia are more likely to be observed after the completion of monetary unification than in the process leading to it. In the current monetary regime countries still have the option of 'repudiating' their debts through a devaluation. That there is some evidence of a default risk even before monetary unification strongly suggests that such perceived risks will increase after full integration.

This question has important implications for the criteria of fiscal convergence as preconditions for joining the union. Two different views have been put forward on this point. One view holds that convergence of inflation rates cannot be maintained without a certain amount of convergence of fiscal indicators, such as public debts and budget deficits. Before proceeding any further with monetary integration, high debt countries have to achieve some fiscal targets. The alternative view is that the 'market' will resolve automatically the problem of fiscal convergence. Once the process of monetary integration makes it impossible for different countries to follow independent inflation policies, highly indebted governments will be forced to pay higher real interest rates if they keep borrowing, in order to compensate for the risk of a fiscal collapse or of an explicit default. Fiscal discipline will then be imposed by high market rates of interest.

Our findings that the markets seem to perceive a default risk on the high debt countries does not quite provide evidence in favour of the

second view, however. The magnitude of the perceived default risk, though statistically significant, is quantitatively very small. This conclusion is further reinforced by the fact that our measures incorporate both the expected default and a potential premium against the default risk. Since the latter is non-negative and probably positive, the expected default can be even smaller than indicated by our results.

The paper is organized as follows: Section 2 reviews some theoretical issues concerning defaults, maturity structure and risk premia. Section 3 describes our data, while Section 4 describes some of their properties. Sections 5 and 6 discuss the specification of our tests and present the results. The last section concludes.

2. Default risk on government debt: theoretical issues

Indebted governments can reduce the value of their liabilities in two ways: (i) by increasing inflation beyond the level which was expected by the public and 'incorporated' in nominal interest rates; and (ii) by means of outright default, which can take the form of a simple cancellation by law of government debt obligations, or some retroactive tax on government debt holdings. When investors perceive the possibility of partial (or complete) default, they require compensation for such risk, which raises the cost of government finances.

The risk of default by means of inflation can be drastically reduced or even completely eliminated in several ways: (i) by issuing debt denominated in foreign currency (Giavazzi and Pagano, 1990); (ii) by issuing government debt denominated in domestic currency but indexed to domestic inflation;[1] and (iii) by shortening the maturity of government debt (Missale and Blanchard, 1990). In other words, default by inflation is effective only on long-term non-indexed debt, denominated in domestic currency (Alesina *et al.*, 1990, documents how the Italian government had much difficulty in issuing such debt in the 1980s after the high inflation period; see also Cottarelli and Mecagni, 1990).

The European Monetary Union implies that each country will lose the ability to set its inflation rate independently. The choice of outright default will be the only possible form of debt devaluation. Hence, monetary union with a European Central Bank formally committed to low inflation eliminates inflation risk on government debts,

[1] A different form of indexation, widely used in Italy, is 'financial indexation'. The rate on long-term debt is indexed to the rate on short-term debt, usually one-year Treasury bills.

but may increase the risk of solvency crises for highly indebted governments.[2]

2.1. Costs and benefits of default

Why would a 'benevolent' government ever consider defaulting on the debt held by its citizens? The reason is that default is a non-distortionary lump-sum tax, which substitutes for the various distortionary taxes levied to service the debt (Fischer, 1980). The incentive to default is far from being just a theoretical curiosum. In Italy, in the late 1980s, the yearly interest payments on the public debt were approximately absorbing all the personal income tax revenue (Spaventa, 1988). The Italian government could have stopped paying interest on its debt and abolished the personal income tax, in a revenue-neutral fiscal manoeuvre! With top marginal tax rates above 50% in Italy, even conservative estimates suggest that such a default policy might have led to substantial gains in the form of increased labour supply and productivity.

Needless to say, default also has very high costs, which can be summarized in three points: (i) a defaulting government loses reputation and will have difficulty borrowing in the future when necessary (Grossman and van Huyck, 1988; Chari and Kehoe, 1990; for an empirical estimation see Ozler, 1990, and the references therein); (ii) default leads to income redistribution. Governments concerned with their popularity may not want to hurt the constituencies of debt-holders which would bear a disproportionate share of the costs of default (Alesina, 1988; Eichengreen, 1990; Tabellini, 1991); and (iii) if financial institutions hold a significant amount of government debt in their portfolios, default may lead to bankruptcies in the financial sector, leading to financial instability and, possibly, to 'bank panics' (Spaventa, 1988; Alesina, 1988).

These three arguments are sufficiently strong to make outright default a very remote and unlikely possibility in OECD economies. In 'normal' circumstances, even for highly indebted governments, the costs of default are likely to greatly outweigh its benefits. By 'normal' circumstances, we refer to a situation in which the government can roll over its debt at a 'reasonable' interest rate. However, an indebted government

[2] Governments with fiscal difficulties may pressure the European Central Bank to 'ease' on monetary policy. However, given the very high degree of political independence that the draft statute guarantees to the Bank, this possibility is fairly remote. See Alesina and Grilli (1991) on the degree of independence of the European Central Bank.

may be forced to default in situations in which rolling over the debt becomes impossible because of 'confidence crises'.

2.2. Confidence crises, maturity structure and default

In Alesina *et al.* (1990) it is shown how confidence crises may erupt.[3] They consider the case of a country with a significant amount of outstanding public debt. To roll over the principal and service it, the government must raise a substantial amount of distortionary taxes. In a monetary union, there is no inflation tax. If the debt has a maturity of, say, one year, every year the entire stock of debt has to be rolled over. For a given interest rate, which for a small open economy is exogenous, investors are willing to roll over the debt if they think that the government will not default next year. If the costs of default are high enough, the government will not default as long as the investors are willing to roll over the debt every year. Thus, it is possible to envision an equilibrium situation with no default, no risk premium and where the debt is rolled over every year.

However, there may exist another, ominous, equilibrium. For whatever reason, investors today may come to believe that investors next year will not want to roll over the debt. The government will then have to pay the interest and the principal, which sharply raises distortionary taxes. If the distortions become too costly, default may well be the most attractive (if not the only available) option. Thus, today's investors' beliefs, even if initially completely unsubstantiated, may be vindicated next year, and are therefore rational today. In that case, investors will not want to roll over the debt today, a confidence crises erupts and the government defaults today. This is another possible equilibrium, one that cannot be ruled out.[4]

A rational confidence crisis of this kind could never occur if the costs of default were sufficiently high relative to the costs of taxation, so that the government would not default even if the debt were not rolled over. This is likely to be the case when the outstanding public debt is small, for then the costs of repaying the principal in full, if a confidence

[3] Parcu (1986), Calvo (1988), and Giavazzi and Pagano (1990) present related models of confidence crises on government debt, with a structure similar to models of 'bank runs' as in Diamond and Dybvig (1983). Alesina *et al.* (1990) do not explicitly derive a formulation for the risk premium, since theirs is a model with certainty and two equilibria: one with default, one with no default. As discussed in that paper, the introduction of some form of uncertainty and of asymmetric information between investors and government would lead to a more explicit derivation of a risk premium.

[4] In Diamond and Dybvig (1983) there is a coordination problem among bank depositors making simultaneous investment decisions. Here the coordination problem is between investors making sequential decisions.

crisis occurs, are relatively small. On the other hand, high levels of debt push the economy towards the 'two equilibrium' range. Thus, the analysis suggests an interesting 'non-linearity', which will be tested: 'low debt' countries may be in the range of values for which only one equilibrium exists, with no default and no risk premium. However, once debt crosses a certain threshold, a second equilibrium with default emerges and a risk premium appears.

The risk of confidence crises may be reduced by lenghthening and 'smoothing' the maturity structure of the debt because it avoids the concentration of high levels of debt maturing at any particular point of time. Thus, the lower is the risk of confidence crises with default, the lower is the risk premium on government debt. This result holds when inflation is ruled out so that the only risk is repudiation. When the government can use inflation, but not outright default, the result may be reversed. Missale and Blanchard (1990) show that the shorter is the maturity of the debt, the lower is the incentive to inflate, and hence the lower is the expected inflation incorporated in the nominal interest rate. The two results viewed together suggest that to minimize the risk premium on public debt the government should issue long-term indexed debt, or long-term debt denominated in foreign currency. Such a strategy reduces both the inflation risk and the outright default risk.

Finally, we expect the interest differential to vary over business cycles. During periods of slow-down, private debt becomes riskier and the private interest rate is expected to rise relatively to the public debt rate, hence a negative effect on the differential.

2.3. Summary

The arguments of this section, to be tested in the next section, can be summarized as follows:

(1) Indebted governments in OECD economies are unlikely to default on their debts, if they have the opportunity of rolling over the principal at 'reasonable' interest rates.
(2) High levels of debt make confidence crises more likely. If a confidence crisis is self-fulfilling, in the sense that the government has to default in response to it, debt holders will require compensation.
(3) This premium against the possibility of default triggered by a confidence crisis is increasing with the size of the debt and decreasing in its average maturity.
(4) In the downswing of the business cycle it is the private risk premium which increases most.

3. Data description and sources

The sample includes 12 OECD countries over the period 1974–89: Australia, Belgium, Canada, Denmark, France, Ireland, Italy, Japan, the Netherlands, Spain, the UK and the US. The choice of these countries is dictated by data availability. Appendix A provides a full description of the data and methods.

The default risk on government debt is measured by either the *ratio* on the public interest rate over the private interest rate (*RATIO*) or by the *differential* (*DIF*) between the two of them. The interest rate ratio is not affected by changes in the unit of measurement. In addition, an identical change of the tax rate on both bonds would not change the ratio, while it would change the differential. In 1988, from the point of view of households, the tax treatment of public and private bonds was indeed identical in most countries, since they were both subject to the income tax (Japan is an exception, see Banca d'Italia, 1989, and OECD, 1991; the special case of Belgium is further discussed). On the other hand, the interest ratio, but not the differential, is affected by changes in expected inflation. As shown below, the results are very similar for both measures of default risk.

The ratio of market debt to GDP (*DEBTPR*) is computed by subtracting the debt held by the central bank from the total stock of debt (end of period data) and dividing the result by the seasonally adjusted GDP for the corresponding quarter. For some countries (Ireland, Belgium, Denmark and Spain) quarterly GDP data were not available and were obtained from a linear interpolation of annual data. The variation of government debt (*DELTAD*) is measured by the 12-month change of *DEBTR*. The business cycle is measured by the 12-month growth rate of the industrial production index (*CYCLE*). The average maturity of government debt is measured in years by the variable (*MATURITY*) for the countries where it is available, or by the fraction of short-term debt over total privately held debt for all countries (*SHORT*). These two variables imperfectly approximate what we really need to measure the smoothness of the debt structure, namely the amount of debt maturing every period.

4. A preliminary look at the data

Figure 1 plots the interest rate ratio against the debt-GDP ratio. Each point in the plot represents the sample average for one country. The interest rate ratio is smaller than one for all countries, implying that on average private debts are perceived as riskier than government bonds. As predicted by the analysis, the figure reveals a (perhaps weak) positive relationship between the two variables.

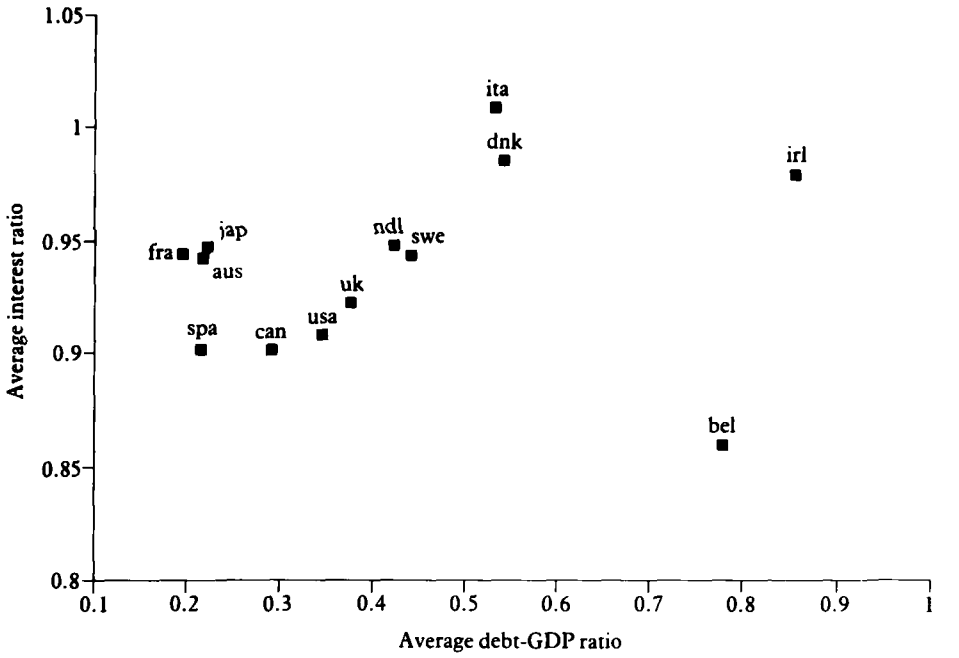

Figure 1. Average interest ratio and debt-GDP ratio, 1979–89

Source: See Appendix A.

The range of variation of the average interest rate ratios is relatively small, from about 0.89 to about 0.98. On the contrary, the range of variation of the debt to GDP ratios is quite large, from about 0.2 to almost 0.9. This immediately suggests that if indeed a relationship between debt ratios and interest ratios is found, the impact of debt on the interest differential must be very small.

Belgium stands apart, with an interest ratio rather low given the very high debt to GDP ratio. Tax considerations provide a possible explanation. The corporate bond market has almost entirely shifted from Belgium to Luxembourg. Because bonds in Luxembourg are tax-exempt while the Belgian public debt is subjected to a 25% withholding tax, we have grossed up the private bond rate in Luxembourg by 25%. However, the withholding tax is often avoided by cashing in the interest in banks in Luxembourg. Hence we may have overestimated the adjustment needed to make the private and public rate equivalent from the point of view of the tax regime. If so, we are underestimating the actual value of the variable *RATIO* (or *DIF*) in Belgium.

In Figure 2 the horizontal axis represents the average maturity of the debt. This measure is available for only 10 countries. If one were to ignore Belgium and Spain, the predicted negative relationship would appear very obviously. However, the observations for Belgium and

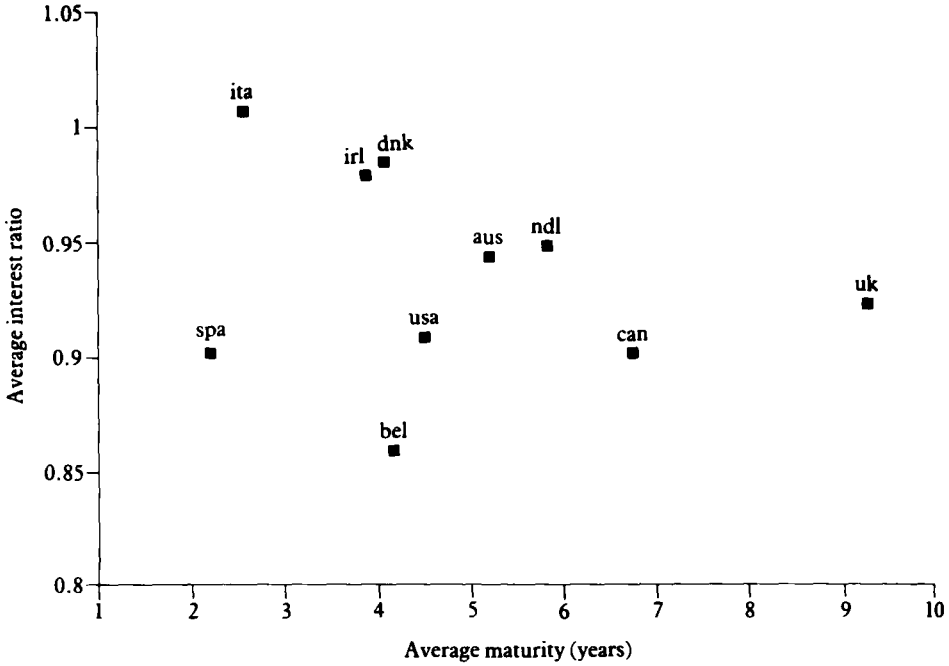

Figure 2. Average interest ratio and maturity

Source: See Appendix A.

Spain make this correlation doubtful, even if a systematic bias may explain the observation for Belgium.

These two figures alert us to the fact that the interest rate ratio is certainly affected by many institutional features that are specific to each country and unrelated to default risk. In other words, not only is default risk measured with great error by the interest rate ratio, but more importantly this error is likely to vary across countries. For this reason, the rest of the paper proposes a systematic analysis of the correlation between the interest rate ratio and alternative indicators of fiscal sustainability and debt management policies. This is done either by removing the country mean from each variable, or by studying each country in isolation.

5. Panel estimation

In this section we ask whether the variables *RATIO* and *DIF* are related to the stock of debt and to its average maturity by regression analysis on panel data. The explanatory variables always include: *DEBTPR*, *DELTAD* and *CYCLE*. All three variables are expected to have positive

estimated coefficients.[5] We also always include a measure of maturity, *SHORT*, lagged one quarter. The expected sign of its coefficient is negative. We use yearly data, to minimize the possibility of spurious correlation due to seasonality or other special features of the data. (Quarterly data give very similar results.) Because the definition of the private rate of return and many institutional features of financial markets vary across countries, all variables are measured as deviations from country means.

5.1. Some simple regressions

When the error term is independently distributed across countries and time, OLS estimates are correct. The results are displayed in Table 1, columns (1) and (2) for *DIF* and *RATIO* respectively. The variables *DEBTPR* and *DELTAD* have positive coefficients, generally significantly different from zero. Thus, as expected, a higher outstanding debt and/or a more rapid growth of debt tends to raise the rate of return on public debt relative to private debt. Debt maturity, on the other hand, has the wrong sign: the estimated coefficient on the variable *SHORT* is negative, but not significantly different from zero. Similar results (not reported in the table) are obtained if we replace *SHORT* with the average maturity of public debt, which is available only for a smaller number of countries. Finally, the variable *CYCLE* is significantly different from zero with the expected (positive) sign.

Columns (1) and (2) impose the restriction that all countries have the same coefficients on all variables (except the intercept). Section 2, however, suggests that there may be a non-linearity involved. When public debt is small and expected to remain so, there is only one equilibrium, with no default risk. Once debt has passed some threshold, however, multiple equilibria appear and a risk premium related to the size and path of debt, as well as its maturity, can emerge. This suggests that the coefficients on the variables *DEBTPR*, *DELTAD* and *SHORT* should be positive only for countries with a high or rapidly growing debt. For the other countries they are expected to be zero. The variable *CYCLE*, which is meant to capture the risk on private debt, should have an effect independent of whether there is a high or low public debt.

To check this possibility, the countries are partitioned into two groups. The first group (labelled *U*) includes the countries with a high and/or unsustainable public debt: Ireland, Belgium, Italy, Denmark, the Netherlands and Spain. The remaining group of countries, labelled *S*,

[5] To limit the problem of reverse causation, both *DEBTPR* and *DELTAD* are lagged one quarter.

Table 1. Panel data

Dependent Variable	(1) *DIF*	(2) *RATIO*	(3) *DIF*	(4) *RATIO*	(5) *DIF*	(6)* *ΔDIF*
CYCLE	0.028	0.002	0.030	0.002	0.029	0.027
	(2.340)	(1.929)	(2.456)	(2.056)	(2.358)	(2.775)
DEBTPR	1.510	0.094	—	—	—	—
	(3.516)	(2.754)				
DELTAD	3.334	0.301	—	—	—	—
	(1.793)	(2.030)				
SHORT	−0.191	−0.070	—	—	—	—
	(−2.256)	(−1.182)				
DEBTPRU	—	—	1.602	0.104	—	2.928
			(3.558)	(2.898)		(1.450)
DEBTPRS	—	—	0.627	−0.022	0.640	3.118
			(0.421)	(−0.183)	(0.429)	(0.649)
DEBTPRUD	—	—	—	—	1.716	—
					(3.067)	
DEBTPRUG	—	—	—	—	1.522	—
					(1.962)	
DELTADU	—	—	4.340	0.362	—	—
			(2.099)	(2.205)		
DELTADS	—	—	−0.927	0.080	−0.915	—
			(−0.209)	(0.228)	(−0.206)	
DELTADUD	—	—	—	—	1.912	—
					(0.656)	
DELTADUG	—	—	—	—	6.728	—
					(2.259)	
SHORTU	—	—	−0.176	−0.099	−0.244)	5.135
			(−0.209)	(−1.489)	(−0.288)	(2.553)
SHORTS	—	—	−0.209	0.054	−0.212	−1.601
			(−0.125)	(0.404)	(−0.127)	(−0.391)
N. OBS	150	150	150	150	150	147
R^2	0.334	0.328	0.328	0.326	0.325	0.071
SE	0.766	0.059	0.740	0.059	0.742	0.876

Notes: *t*-statistics in parenthesis. The number of countries is 12. The time period is 1977–89 for all countries, except France (1978–89) and Spain (1981–89). Data are in deviations from country means.

* All variables are in first differences, including the right-hand-side variables.

consists of Australia, Canada, France, Japan, the UK and the US. This country grouping is supported by the analysis of Grilli *et al.* (1991), who perform some stationarity tests of the public debt to GNP ratio in a number of OECD countries. For all countries in group *U*, with the possible exceptions of Denmark and Spain, the hypothesis of instability (unit root) of the debt to GDP ratio could not be rejected.[6] Despite the

[6] Grilli *et al.* (1991) argue that countries with proportional electoral systems and large coalition governments have had difficulties in implementing fiscal stabilizations because of conflicts of interest within the ruling coalitions. On the same point see also Roubini and Sachs (1989).

ambiguity of the tests for Denmark and Spain, we decided to include them among the unstable countries. In the case of Denmark, the early 1980s was a period of very rapid growth of debt relative to GNP, accompanied by explicit uncertainty in the financial markets about the country's ability to repay (in 1982 S&P added a 'credit watch' to the rating of Danish foreign debt). Spain still has a relatively low debt, but its rate of growth in the mid-1980s is one of the largest in the sample (particularly for privately held public debt).

Columns (3) and (4) report the new estimates, with the coefficients on *DEBTPR*, *DELTAD* and *SHORT* – now distinguished by a *U* (*S*) suffix at the end – allowed to differ across the two country groups. The results on *DEBTPR* and *DELTAD* are even more suggestive of a risk premium on government debt: their coefficients are positive and highly significant only for the countries in the *U* group. The coefficient on *SHORT*, on the other hand, remains insignificantly different from zero and with the wrong sign. Again, similar results are obtained for average maturity. Finally, the results are very similar for both measures of the dependent variable. As this is true also for all the results described below, from now on we only report the regressions where default risk is measured by *DIF*.

Column (5) reports a finer grouping of countries. Group *UD* consists of Belgium, Ireland and Italy, namely the three unstable countries with a high stock or debt. Group *UG* consists of the Netherlands, Denmark and Spain, namely the unstable countries with rapid debt accumulation but where the stock of debt is relatively low. Finally, group *S* is as defined above. We expect the stock of debt (*DEBTPR*) to be positive and significant mainly in group *UD*, while we expect the accumulation of debt (*DELTAD*) to matter mainly in group *UG*. These predictions are largely confirmed. The other results do not change. (The results are similar if the Netherlands is shifted from group *UG* to group *UD*.)

That the estimated coefficients of *DEBTPR* and *DELTAD* differ between the stable and unstable countries is very important, because it enables us to discriminate between two alternative interpretations of the positive effect of debt or debt growth on the interest rate. One interpretation is the risk of a confidence crisis. An alternative interpretation is the presence of portfolio effects due to a larger supply of government bonds, in a world where public and private instruments are imperfect substitutes. But according to this explanation, the coefficients of *DEBTPR* and *DELTAD* should be significantly positive for both groups of countries.

Finally, the last column of Table 1 presents estimates in first differences, again distinguishing between stable and unstable countries. Now, unlike in the previous regressions, the fraction of short-term debt

(*SHORT*) has a positive and significant estimated coefficient, but only in the sample of unstable countries, as predicted by the theory.

Summarizing, three main conclusions emerge. First, there is a positive and significant correlation between the interest rate differential and the stock and/or the accumulation of public debt, but it is present only in countries with an unstable debt to GDP ratio. This is evidence of a premium for a default risk on government debt. Second, although the evidence is much weaker, this premium is larger the shorter is the maturity of the debt. Third, there is strong and very robust evidence that the interest rate differential is positively correlated with the level of economic activity.[7]

5.2. Dynamic specification

To cope with the possibility that, for some countries, the residuals may be serially correlated, Table 2 presents a new dynamic specification. Now included are first the lagged endogenous variable, and next the lagged endogenous and exogenous variables.[8]

As before, the coefficients on the variables *DEBTPR*, *DELTAD* and *SHORT* are allowed to differ between the two groups of countries, those with stable and unstable debt paths. Columns (1) and (2) of Table 2 report the estimates based on partitioning countries into stable and unstable groups. Columns (3) and (4) report the finer partition into three groups of countries. The results are very similar for all columns and basically confirm those of Table 1. Furthermore, when in columns (5) and (6) we estimate the model in first differences, the results confirm again those of Table 1. In particular, the debt maturity variable (*SHORT*) is now positive and significant only in the unstable countries. The similarity of the results in Tables 1 and 2 and across specifications and estimation methods is reassuring.

The effect of the debt on the interest rate differential is not only statistically significant. It is also quantitatively important in relation to the other explanatory variables. Using columns (1) and (2) we find that a one standard deviation change in the debt to GNP ratio in the high

[7] Even though this third finding is not directly related to the questions addressed in this paper, it is of considerable independent interest. It is consistent with the predictions of the literature on business cycles and on the transmission mechanism of monetary policy. Already detected by others for the US, it is remarkable that this effect is also strongly supported for all the OECD countries.

[8] With this dynamic specification and fixed effects the OLS estimates would be biased (see Nickell, 1981). Hence we estimate the model with instrumental variables. The instruments for the lagged endogenous variable are the lagged exogenous variables (with two lags in some cases) and the endogenous variable lagged twice. As above, all the independent variables except *CYCLE* are lagged one quarter.

Table 2. Dynamic specification
Dependent variable: Interest rate differential (*DIF*)

	(1)	(2)	(3)	(4)	(5)*	(6)*
CYCLE	0.023	0.020	0.020	0.019	0.022	0.022
	(1.797)	(1.460)	(1.540)	(1.341)	(2.370)	(2.358)
$CYCLE_{-1}$	—	0.014	—	0.012	—	—
		(1.024)		(0.818)		
DEBTPRU	1.830	—	—	—	3.058	—
	(2.683)				(1.578)	
$DEBTPRU_{-1}$	—	1.416	—	—	—	—
		(1.947)				
DEBTPRS	0.848	—	0.905	—	1.919	1.921
	(0.567)		(0.599)		(0.416)	(0.415)
$DEBTPRS_{-1}$	—	0.521	—	0.503	—	—
		(0.348)		(0.332)		
DEBTPRUD	—	—	2.248	—	—	3.110
			(2.855)			(1.286)
$DEBTPRUD_{-1}$	—	—	—	1.364	—	—
				(1.236)		
DEBTPRUG	—	—	1.369	—	—	2.984
			(1.506)			(1.062)
$DEBTPRUG_{-1}$	—	—	—	1.262	—	—
				(1.320)		
DELTADU	4.424	2.940	—	—	—	—
	(2.128)	(1.031)				
$DELTADU_{-1}$	—	5.972	—	—	—	—
		(2.096)				
DELTADS	−1.061	−1.548	−1.163	−1.697	—	—
	(−0.237)	(−0.295)	(−0.258)	(−0.321)		
$DELTADS_{-1}$	—	7.575	—	7.822	—	—
		(1.361)		(1.391)		
DELTADUD	—	—	1.783	2.001	—	—
			(0.583)	(0.510)		
$DELTADUD_{-1}$	—	—	—	6.405	—	—
				(1.346)		
DELTADUG	—	—	6.552	3.726	—	—
			(2.158)	(0.894)		
$DELTADUG_{-1}$	—	—	—	5.194	—	—
				(1.291)		
SHORTU	−1.080	1.390	−1.284	1.283	5.150	5.164
	(−0.913)	(0.495)	(−1.059)	(0.389)	(2.657)	(2.598)
$SHORTU_{-1}$	—	−2.369	—	−2.296	—	—
		(−0.961)		(−0.803)		
SHORTS	−0.455	0.484	−0.434	0.399	−1.963	−1.963
	(−0.261)	(0.117)	(−0.247)	(0.095)	(−0.500)	(−0.499)
$SHORTS_{-1}$	—	−1.611	—	−1.552	—	—
		(−0.368)		(−0.352)		
DIF_{-1}	−0.066	0.031	−0.102	0.060	−0.219	−0.219
	(−0.308)	(0.144)	(−0.498)	(0.227)	(−2.662)	(−2.650)
N. OBS	146	143	146	143	146	146
R^2	0.307	0.339	0.302	0.326	0.118	0.112
S.E.	0.736	0.713	0.743	0.718	0.839	0.842

Notes: *t*-statistics in parenthesis. The number of countries and time periods are as in Table 1. For columns (1)–(4), the estimation method is instrumental variables, with data in deviations from country means.

* All variables, dependent and independent, are expressed in first differences.

public debt countries (*DEBTPRU*) brings about a change of between 73% and 54% of the standard deviation of the interest rate differential. However, the standard deviation of the interest rate differential is fairly small (it is 0.9), so that the final effect of the debt on the risk premium is also small in absolute value.

5.3. Sensitivity analysis

A number of checks have been carried out to assess the sensitivity of these results. First, replacing the variable *SHORT* with the average maturity of public debt (available for a subset of countries only) yields similar results. Only when the regression is carried out in first differences is the estimated effect negative, and then it is less significant than for the variable *SHORT*.

Second, a government facing a large risk premium on long-term debt may be forced to shorten its maturity. In that case the maturity itself cannot be considered as exogenous. Hence we reestimated the model with instrumental variables (*SHORT* lagged one year, *DEBTPR* lagged one year, and the lags of the dependent variable). The results were very similar to those reported above – probably suggesting that these are not very good instruments.

Third, we looked whether some variables had not been omitted. None of the variables that we tried (the return on equity which would also control for the riskiness of private debt, the rate of inflation, the stock of debt held by the central bank, and the stock of foreign currency debt) was significant and none of the results of interest was affected. We also tried adding yearly dummy variables, one for each year in the panel, with no effect. This suggests that the results are also robust to the dynamic specification.

Fourth, to recognize that the fiscal efforts differ across countries, we added a measure of tax pressure as a percentage of GDP. (This variable was available on a comparable basis only for the EC countries and for the period 1981–89.) The results of interest were not affected and the estimated coefficient of this new variable was always insignificantly different from zero.

Fifth, regressions were also run on quarterly data, for slightly shorter time periods, and for slightly different definitions of the interest rate data. The results were generally weaker but confirmed the present findings.

6. Country by country analysis

In this section, we focus on those countries which are characterized by either large or rapidly accelerating debt to GDP ratios (Ireland, Italy,

Table 3. Ireland (1st quarter 1978–4th quarter 1989) Dependent variable: *RATIO*

CONSTANT	$RATIO_{-1}$	$DELTAD_{-1}$	$CYCLE_{-1}$	$DELMAT_{-1}$	*YIELD*	R^2	*AUTOCOR* (%)
0.302**	0.320**	0.229**	0.368**	−0.056**	0.296**	0.651	65.524
(2.545)	(2.430)	(2.181)	(3.249)	(−2.763)	(5.984)		

Notes: White (1980) *t*-statistics corrected for heteroscedasticity in parentheses. * indicates that the coefficient is significant at the 10% level. ** indicates that the coefficient is significant at the 5% level.
RATIO: ratio of public and private interest rates on long-term bonds, computed as quarterly averages of monthly rates.
$RATIO_{-1}$: *RATIO* lagged one quarter.
$DELTAD_{-1}$: 12-month change of *DEBTPR* (ratio of market-held debt to GDP) lagged one quarter.
$CYCLE_{-1}$: 12-month growth rate of industrial production lagged one quarter.
$DELMAT_{-1}$: first-difference of *MATURITY* (average maturity of government debt) lagged one quarter.
YIELD: yield curve, measured by the ratio of long-term to short-term interest rates on public bonds.
AUTOCOR: Lagrange multiplier test modified for small samples of first-order residual autocorrelation. The percentage in the column is the probability of observing at least the *F*-value of the test under the null of no residual autocorrelation.

Belgium, the Netherlands, Denmark and Spain). The graphical evidence and the statistical analysis confirm the expected positive effect of the public debt on the interest differential (here the ratio of public to private rates) as well as the predicted negative impact of the debt maturity.

Looking at one country over time raises a number of difficulties. They are discussed, and the procedure adopted is presented, in Appendix B. In addition to the previous explanatory variables, two additional ones are used. First, the slope of the yield curve – the variable *YIELD* – may affect the interest rate differential if the maturity of the public and the private bonds is not the same. Indeed, this variable is significant in most specifications, though its exclusion from the regressions does not affect the results crucially. Second, the 12-month inflation rate – the variable *INFL* – can be relevant, since the ratio of interest rates is affected by changes in expected inflation. This variable plays a role only in the case of Denmark.

The results confirm the existence of a long-run positive relationship between the debt to GNP ratio and the interest rate ratio in Italy, the Netherlands and Denmark, while debt changes have only a positive short-run impact in Ireland, Belgium and Spain. In all countries, the negative effect of debt maturity is only present in the short run.

6.1. Ireland

Table 3 shows that, after controlling for the strong association with the business cycle, the changes of government debt (*DELTAD*) affect positively *RATIO* and the variation of the average maturity (*DELMAT*) has the predicted negative effect. There is no evidence of a long-term relationship (except the one between *YIELD* and *RATIO*).

Table 4. Belgium (1st quarter 1975–4th quarter 1989)
Dependent variable: *DELRATIO*

CONSTANT	*DELRATIO*$_{-1}$	*DELTAD*$_{-1}$	*CYCLE*$_{-1}$	*DELTAMAT*$_{-1}$	*DELYIELD*	R^2	*AUTOCOR* (%)
−0.015*	0.215*	0.133	0.131**	−0.024*	0.099**	0.355	35.086
(−1.742)	(1.898)	(1.238)	(2.046)	(−1.798)	(3.985)		

Notes: As in Table 3: also
DELRATIO: first-difference of *RATIO* (the ratio of public and private interest rates on long-term bonds, computed as quarterly averages of monthly rates).
DELTAMAT$_{-1}$: 12-month change of *MATURITY* (average maturity of government debt), lagged one quarter.
DELYIELD: first difference of *YIELD* (yield curve, measured by the ratio of long-term to short-term interest rates on public bonds).

Table 5. Italy (1st quarter 1975–4th quarter 1989)
Dependent variable: *DELRATIO*

CONSTANT	*RATIO*$_{-1}$	*DEBTPR*$_{-1}$	*CYCLE*$_{-1}$	*DELTAMAT*$_{-1}$	*DELYIELD*	*YIELD*$_{-1}$	R^2	*AUTOCOR* (%)
0.799**	−0.644**	0.378**	0.060	−0.030*	−0.229**	−0.217**	0.561	15.983
(4.396)	(−4.629)	(3.338)	(1.192)	(−1.763)	(−5.543)	(−4.622)		

Long-Term equilibrium:
RATIO = 1.241 + 0.587 *DEBTPR* − 0.337 *YIELD*

Notes: As Table 3: also
DELRATIO: first-difference of *RATIO*.
DEBTPR$_{-1}$: ratio of market-held debt to GDP, lagged one quarter.
DELTAMAT$_{-1}$: 12-month change of *MATURITY* (average maturity of government debt lagged one quarter).
DELYIELD: first difference of *YIELD*.

6.2. Belgium

The regression estimates in Table 4 confirm a strong positive impact of *CYCLE* and the negative effect of changes of the average maturity (*DELTAMAT*); the debt variation (*DELTAD*), has the right sign but is only weakly significant. There is no evidence of a long-term relationship.

6.3. Italy

Table 5 confirms the predicted effects of maturity changes (*DELTAMAT*, negative and significant) and of *CYCLE* (positive, but not significant), together with a long-run relationship among *RATIO*, *DEBTPR* and *YIELD*. (The long-run equilibrium between *RATIO* and *DEBTPR* would still be present if we dropped *YIELD* from the equation.) In the long run, a 100% increase of *DEBTPR* increases *RATIO* by almost 0.64.

Table 6. The Netherlands (4th quarter 1979–4th quarter 1989)
Dependent variable: *DELRATIO*

CONSTANT	$RATIO_{-1}$	$DEBTPR_{-1}$	$CYCLE_{-1}$	$DELMAT_{-1}$	$YIELD_{-1}$	R^2	*AUTOCOR* (%)
0.697**	−0.728**	0.245**	0.057	−0.026	−0.059**	0.397	84.054
(6.304)	(−6.323)	(4.963)	(0.656)	(−0.802)	(−3.426)		

Long-Term equilibrium:
$RATIO = 0.957 + 0.337\ DEBTPR - 0.082\ YIELD$

Notes: As Table 3: also
$DEBTPR_{-1}$: ratio of market-held debt to GDP, lagged one quarter.
DELYIELD: first difference of *YIELD*.

6.4. The Netherlands

In the Netherlands, the interest ratio presents a structural break at the beginning of the 1980s, which is likely to correspond to the rapid acceleration of government debt. In Table 6, *CYCLE* and the changes of *MATURITY* have the right sign but they are not significant; a long-run relationship among *RATIO*, *DEBTPR* and *YIELD* is clearly identified. In the long run, the coefficient of *DEBTPR* is smaller than in Italy, but still relatively large (almost 0.35).

6.5. Denmark

In Table 7, the effects of *CYCLE* and changes of *MATURITY* are weak, but a long-term relationship is identified among *RATIO*, *DEBTPR* and *INFL*. The long-term coefficient of *DEBTPR* is about 0.21. In Denmark, the long-term relation between the government debt and the interest ratio is slightly weaker than in Italy and the Netherlands.

6.6. Spain

The regression results (Table 8) show a positive significant coefficient for the annual variation of government debt (*DELTAD*), while the maturity variations (*DELTAMAT*) are not significant and *CYCLE* presents the wrong sign.

6.7. Other countries

Figure 3 shows a surprisingly strong correlation between the interest ratio and the variation of the debt GDP ratio in the UK and Japan. No such correlation appears in the other countries.

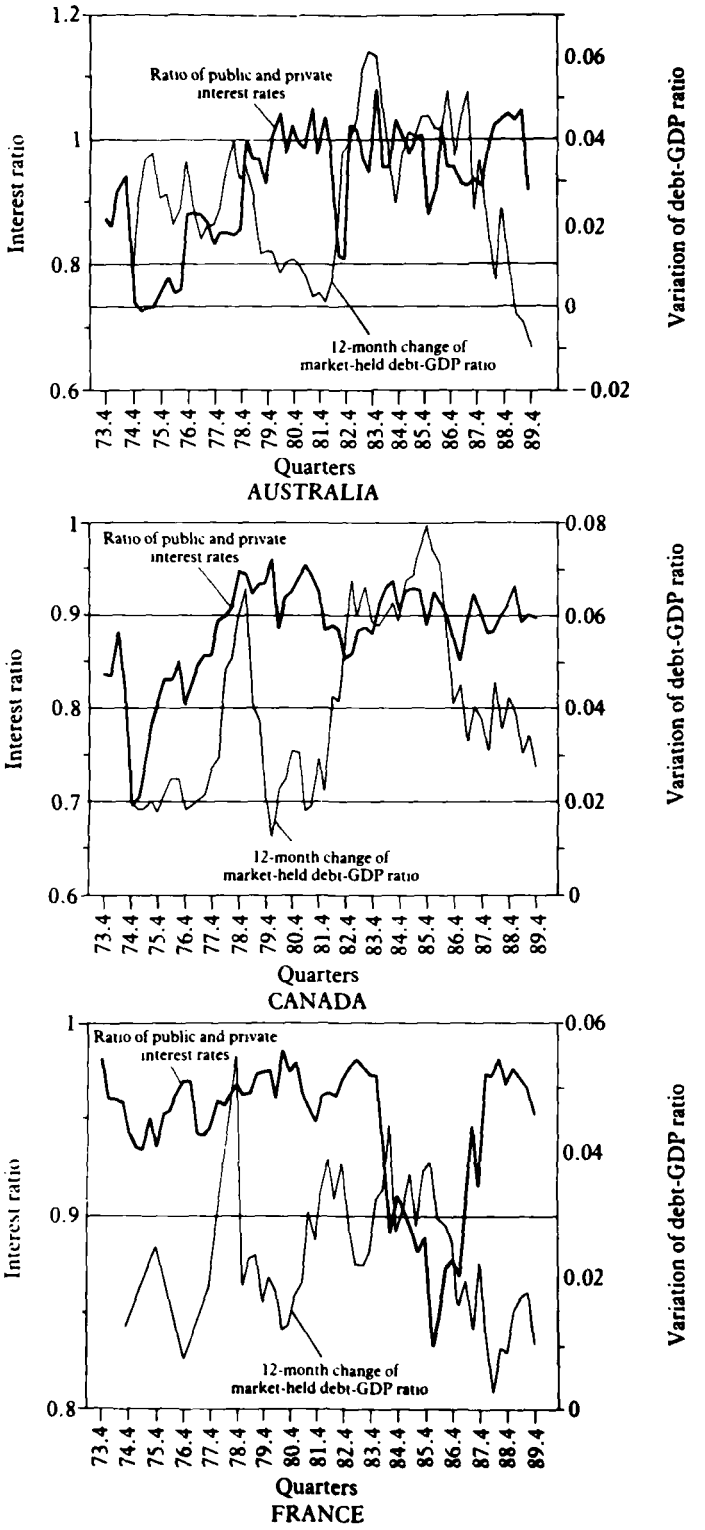

Figure 5. Interest rate ratio and variation of debt held by the market

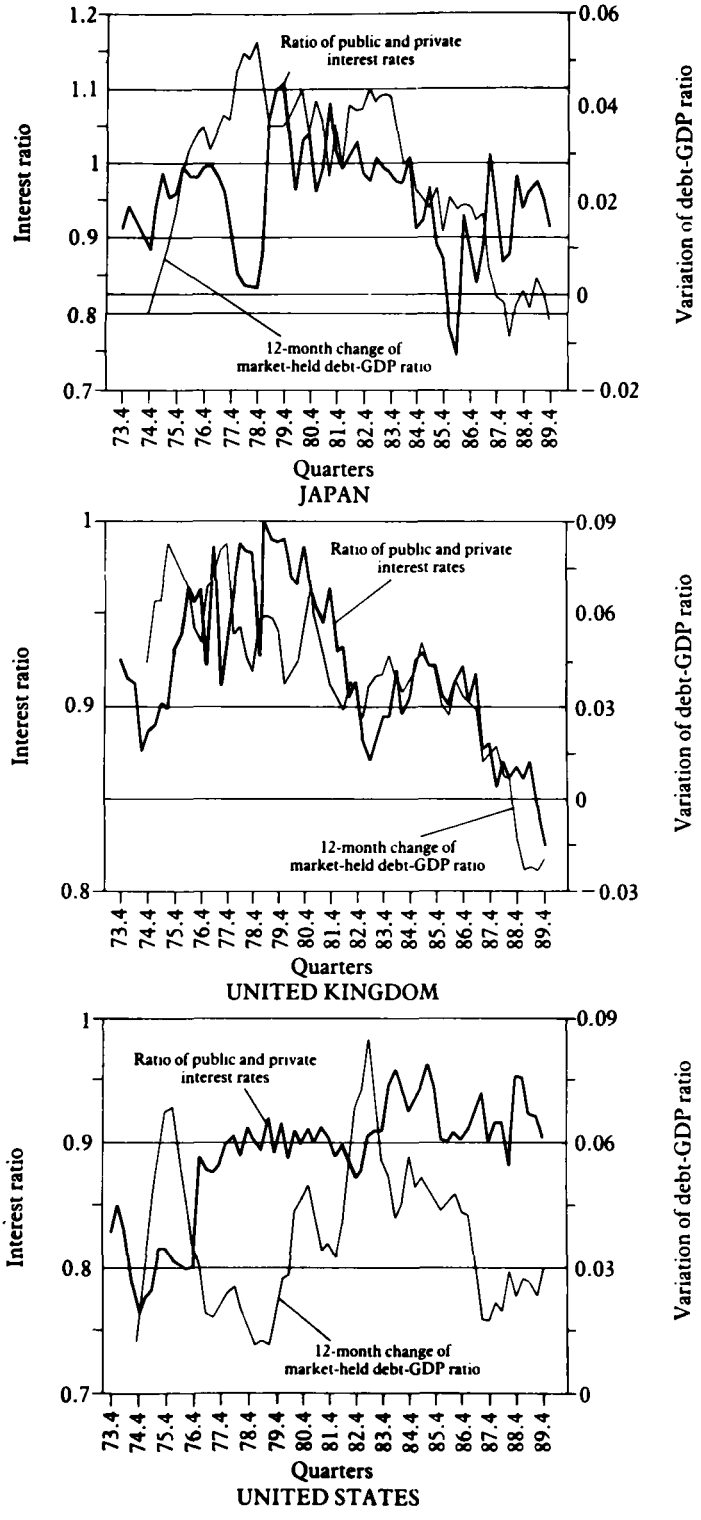

Figure 3—continued

Table 7. Denmark (2nd quarter 1976–4th quarter 1989) Dependent variable: *DELRATIO*

CONSTANT	$RATIO_{-1}$	$DEBTPR_{-1}$	$CYCLE_{-1}$	$DELTAMAT_{-1}$	$DELINFL_{-1}$	$INFL_{-1}$	$DELRATIO_{-1}$	$DELRATIO_{-2}$	R^2	*AUTOCOR* (%)
0.584**	−0.780**	0.165*	0.080	−0.011	−0.458*	1.127**	0.277	0.494**	0.348	81.936
(3.041)	(−2.715)	(1.793)	(1.277)	(−0.972)	(−1.783)	(2.077)	(1.200)	(2.802)		

Long-Term equilibrium:
$RATIO = 0.749 + 0.212\ DEBTPR + 1.445\ INFL$

Notes: As Table 3: also
DELRATIO: first-difference of *RATIO*.
$DEBTPR_{-1}$: ratio of market-held debt to GDP, lagged one quarter.
$DELTAMAT_{-1}$: 12-month change of *MATURITY* (average maturity of government debt lagged one quarter).
INFL: 12-month inflation rate.
$DELINFL_{-1}$: 12-month change of *INFL*, lagged one quarter.

Table 8. Spain (1st quarter 1978–4th quarter 1989) Dependent variable: *RATIO*

CONSTANT	$RATIO_{-1}$	$DELTAD_{-1}$	$CYCLE_{-1}$	$DELTAMAT_{-1}$	*DUMMY*83	R^2	*AUTOCOR* (%)
0.670**	0.248**	0.592**	−0.674**	−0.026	0.007	0.307	38.527
(6.640)	(2.389)	(2.015)	(−2.090)	(−0.411)	(0.266)		

Notes: As Table 3: also
$DELTAMAT_{-1}$: 12-month change of *MATURITY* (average maturity of government debt) lagged one quarter.
*DUMMY*83: dummy variable equal to 1 in the period 1983.1–1989.4 and zero before.

7. Conclusions

We have looked for evidence that the markets fear a fiscal crisis in the highly indebted OECD countries, and asked whether this fear is related to the average maturity or to other features of debt management policies. The answer is mixed. On the one hand, in the highly indebted OECD countries, the differential between public and private rates of return is positively related to the debt outstanding and to debt growth. This is not the case, however, in the countries with a stable and sustainable debt to GDP ratio. Thus, indeed, the markets do not seem to rule out the possibility of a fiscal crisis in some of these countries. On the other hand, the strength of this correlation and the size of the corresponding interest rate differential is small. This finding is reminiscent of developing country debt: in the period before the outbreak of the 1982 external debt crisis, many researchers (for instance Edwards, 1984) found positive but extremely small premia on loans to highly indebted developing countries.

The fact that the perceived default risk is small can be explained in several ways. First, one may argue that markets are 'right' and that, in fact, the risk of debt panics and defaults is very small. This is quite possible, although for some of the high debt countries a crisis may not be so remote in the absence of 'tough' fiscal adjustment programs. Second, it could be that data and measurement problems are so large as to make it simply too difficult to measure with enough precision the effects we are searching for. Third, one may argue that if a government debt panic occurs, it may lead to general financial difficulties (particularly in countries where commercial banks hold government debt), which may be reflected in high interest rates for both private and public borrowers. If indeed a government debt crisis may bring about a generalized credit crunch, our measure of risk premia underestimates this generalized risk. Fourth, as of today, the markets may only perceive a devaluation risk; a default risk will appear only after monetary union has taken place. Fifth, the markets may be 'overoptimistic' and not show enough concern about high and rapidly growing debts.

In our opinion, the third and fourth explanation are the most convincing. A public fiscal crisis would certainly also affect private financial assets. Moreover in the current regime a fiscal crisis would equally certainly lead to an exchange rate crisis. Hence our measure biases the results against finding any default risk.

One way of looking at the issue of 'country risk' would be to consider the Moody's bond rating for debts issued in different countries. The problem is that in constructing these ratings, in addition to the level of debt, Moody looks at various additional indicators of different countries'

Table 9. Evidence from the Eurobond market

Country	Differential	Currency	Coupon	Date
Australia	0.502097	$	11.000	1995
Belgium	0.166900	$	8.125	2001
Denmark	0.388988	$	7.250	1996
Finland	0.290241	GBP	10.375	1998
Ireland	0.146122	ECU	8.875	1995
Italy	0.064609	$	9.625	1999
Spain	0.235824	FF	10.500	1998
Sweden	0.314038	DM	7.250	1995

Source: Reuter Finance Link.
Notes: Reference day: March 4 1992. Excess of secondary market redemption yields on Eurobonds issued by national governments over the yields on Eurobonds issued by either the World Bank or the European Investment Bank (choice of Eurobonds in the same currency and most closely corresponding in coupon and maturity) (in percentages–to be multiplied by 100 for basis points).

economic performance which may have little to do with the debt, such as recent growth, current account balance, inflation, etc. Furthermore these ratings are revised relatively infrequently, thus they are not easy to use in econometric work.

A second way is to look at debts issued by different countries in the same currency in international markets, for example in the Eurodollar or ECU markets. Table 9 reports the differentials between the secondary market redemption yields on Eurobonds issued by national governments over those issued by either the World Bank or the European Investment Bank. The differentials are very small, and certainly there is no evidence that the high public debt countries pay higher rates. The reason, we believe, is that the high public debt countries have issued only very small amounts in thse markets. Hence a fiscal crisis is unlikely to spill over and affect these instruments. By 'defaulting' on its Eurodollar bonds, the Republic of Italy would gain very little, but it would severely damage its reputation as a sovereign borrower. The historical evidence on defaults of sovereign states certainly supports this view (see Calomiris, 1992). This is why Table 9 does not present any evidence against the view that domestic bond markets price the risk of default.

The evidence concerning the effect of debt management policies on the default premium is mixed. In Section 5 the effect of maturity on the interest rate differential is at best very weak. In Section 6, country by country analysis detects a stronger association. It is very likely that the ambiguity of the results is related to the fact that debt maturity and risk premia influence each other. A government would presumably

choose its debt management policies so as to exploit differences in long versus short-term interest rates or in domestic versus foreign currencies rates, and this in turn could affect the riskiness of the public debt instrument. More work on this issue is clearly needed.

Finally, a surprisingly strong result is the effect of business cycles on the interest rate differential between public and private debt. This effect is evident both in the panel data and within each country. Even though it is not directly related to the main question addressed in this paper, this finding is of independent interest for the issue of the transmission mechanism of monetary policy.

In summary, what do our results suggest concerning the possibility of an appearance of significant default risk premia when devaluation risks completely disappear? The answer to this question is difficult and rather speculative. What we can say is that the results of this paper do not rule out at all the possibility of observing more substantial default risk premia in the future, failing significant fiscal adjustments in high debt countries.

Discussion

Maurice Obstfeld
University of California at Berkeley, CEPR and NBER

Alesina, De Broeck, Prati and Tabellini (ADPT) have analysed a painstakingly assembled data set on the debt of OECD governments and the borrowing rates they face. They reach two central conclusions concerning the link between official policies and the terms of public-sector borrowing. First, they find a detectable default premium, distinct from the expected-inflation premium, in the nominal interest rate on government debt. This premium is an increasing convex function of the public debt-GDP ratio. Second, they find that the maturity structure of public debt has no clear-cut influence on the default premium.

The ADPT conclusions on debt levels parallel those reached by Morris Goldstein and Geoffrey Woglom (1992) in their recent panel study of the general-obligation debt of American state governments. Although American states have no currency-devaluation option, yield differentials between comparable obligations of different states have reached 150 basis points and more over the 1973–90 period that Goldstein and Woglom study. Like ADPT, Goldstein and Woglom find that default premia exist and increase non-linearly with higher debt levels, as well as with the growth rate of debt. Significantly, they also find that state constitutional provisions limiting debt issue have a detectable impact on default premia that varies with the stringency of the

commitment to budgetary balance. The ability to detect default premia seems remarkable when one observes that among US states, only Vermont lacks some legal mechanism aimed at tying the hands of fiscal policy-makers.

The Goldstein–Woglom study has the advantage that a 'clean' independent variable is available, namely the yield differential relative to a fixed reference state. As there is no currency risk between US states, this variable accurately captures differential repayment risk. ADPT, however, use as their preferred dependent variable the ratio of yields on public- and private-sector debt; and while this choice eliminates currency premia, it introduces a variety of factors other than government default that may well interact with fiscal variables. For example, a higher proportion of government debt in the market portfolio may allow a fall in the risk premium on private debt, a development that would widen the public-private yield spread even when the probability of government default is zero. As another case, imagine a monetary authority that expands liquidity through domestic open-market purchases whenever private default premia rise and does the reverse when they fall. Since the ADPT public-debt measure (correctly) nets out central-bank holdings, we will see a positive correlation between the public–private spread and the government debt stock in private hands.

In view of these ambiguities, it would have been useful to see some alternative measures of yield spread that might better reflect the risk of government default.

In general a more systematic discussion of specification would have been enlightening. The alternative specifications tried by ADPT do materially affect the results, although the criteria for settling on the 'best' results are not clearly spelled out. It is not evident why short-term yields, which may be more accurately measured than the long-term ADPT seek to capture, do not contain useful information on default probabilities. Theory suggests that the size of government may affect default probabilities, but no variables on government spending enter the equations.

A main contribution of this paper is its empirical analysis of the maturity structure of public debt. ADPT motivate their study with a non-monetary model in which a sufficiently high public-debt level can lead to two possible equilibria, one of which involves a government funding crisis. Not only does the debt's level matter for generating multiple equilibria; so does the debt's maturity profile. A debt structure with payments heavily skewed toward the present leaves the government vulnerable to a rise in the borrowing rate it faces in the market – essentially an adverse movement in the government's intertemporal

terms of trade. In a crisis equilibrium, the government finds it worthwhile to ratify a higher borrowing rate by a partial or total default on its obligations. Thus, ADPT expect that the data will reveal shorter maturities resulting in higher default premia.

Reliance on a model with multiple equilibria is problematic, however, when one turns to interpreting some of the empirical results. Presumably ADPT view the interest-rate data for high-debt economies as generated by a process under which a debt-crisis equilibrium may, with some probability, occur in the future. In other words, the interest rate is indeterminate and interest-rate data emerge from a 'sunspot' equilibrium that attaches an arbitrary probability to the crisis state. Since each country can have its own sunspot with a country-specific crisis probability, cross-sectional analysis of the type ADPT conduct becomes uninformative.

But the authors need not rely on a multiple-equilibrium story to generate their results. Even though default costs are probably enormous for governments, there is some sufficiently high debt level at which the conditional probability of some type of default begins to rise from zero, even when there is a unique equilibrium. (Italy may not be too far from that level.)

One could still rationalize a maturity effect on default premia by invoking a sticky general price level and arguing that short-term debt cannot be devalued as effectively as long-term debt through an increase in nominal interest rates. This factor might raise the likelihood of outright default. Even with sticky prices, however, a simple open-market purchase of short-term debt by the monetary authority is equivalent to inflating that debt away. In the end, given the analytical complexity of the optimal maturity question and the countervailing incentives at work, it is not too surprising that maturity plays no consistent role in the empirical equations.

Despite some reservations, I found the results of ADPT's work to be fascinating and suggestive. The authors hesitate, however, to draw strong conclusions for policy. They offer the tentative suggestion that bond markets are myopic – although no compelling evidence in support of this hypothesis is present in the estimates. Should readers conclude that market default premia will be ineffective in curbing expansive fiscal propensities under a European Monetary Union? Or that a removal of the inflation option will raise the risk of a non-repayment crisis? Perhaps it is unfair to ask the authors to stick their necks out beyond the limits warranted by the interesting and important findings presented here. I hope that their next paper frames and tests additional hypotheses that throw light on the debate over fiscal independence in a one-currency Europe.

Sergio Rebelo
Bank of Portugal

This paper tries to uncover the determinants of the risk premia associated with government debt. This is an important subject that is currently poorly understood. The wide disagreement among the debt ratings produced by different evaluators (e.g. *Euromoney* and *Institutional Investor*) is a clear sign of the difficulties in assessing the risk of government debt.

The point of departure for the empirical analysis in this paper is two theoretical predictions: the risk premium associated with default increases with the size of public debt and decreases with the average maturity. These predictions follow from the fact that (i) the benefits from defaulting increase with the size of the public debt; and (ii) when the maturity of the debt is short it is more likely that the government will face difficulties in 'rolling over' the debt.

The main difficulty in this empirical investigation is the measurement of the risk premium. The authors employ the following two measures:

(1) *RATIO* = Yield on Public Debt / Yield on Private Debt
(2) *DIF* = Yield on Public Debt – Yield on Private Debt

Both of these measures are problematic. The variable *RATIO* is affected by changes in expected inflation and in inflation variability, two factors that are likely to have changed during the time period analysed. The variable *DIF* nets out the impact of inflation but is more likely to be affected by changes in taxation. One potential problem with both measures is that they are just as likely to capture movements in the riskiness of private debt as they are to represent changes in the government debt risk premium.

In order to think about what these two measures are likely to capture it is important to distinguish between two components of the government debt premium: the premium associated with outright default and the inflation risk premium. The risk of outright default is likely to be extremely small for the bonds studied in this paper, which are not indexed and are denominated in local currency. The government can always issue local currency to service the debt associated with this type of bond. For this reason most of the government debt premium must be associated with inflation risk. From this standpoint the empirical results that show an association between *DIF* (which incorporates no inflation premium) and the level of public debt are surprising.

It is difficult to think of viable alternatives to *DIF* and *RATIO* as measures of the risk premium. One possibility is to use covered interest parity to obtain dollar-denominated yields that can be compared with those of US government bonds. The main problem with this strategy

is that it relies on the forward exchange market. This market tends to operate only for horizons up to one year, which makes it impossible to compute yields on long-term bonds such as those used by the authors.

A second alternative to *DIF* and *RATIO* is to use the return on dollar-denominated bonds issued by the various countries and compare these with the yield on US government securities. The authors discuss this strategy in the concluding section of the paper and argue that the default risk associated with these bonds is extremely small. Bonds issued in dollars or other foreign currencies represent a negligible part of government debt in each country and hence the benefit of default is very small.

The empirical analysis carried out in this paper suggests a clear relation between the risk premium proxies and the level of government debt in three countries: Italy, the Netherlands and Denmark. In the other three countries studied in detail, Ireland, Belgium and Spain, there seems to be no relation between the risk premium and the level of the debt. Explaining the different behaviour exhibited by these two groups of countries is the main challenge that needs to be addressed in future research.

The prediction that shorter debt maturities should be associated with higher risk premia receives little support from the data.

Since it is difficult to improve on the two risk measures used by the authors it would be useful to learn more about the institutional details associated with the securities used in the analysis. The case of Belgium, in which the surprisingly low value of the *RATIO* measure can be explained by tax features, is a good example of the value of institutional information. Rules concerning tax withholding, provisions against default, transaction costs, the possibility of using certain types of bonds to fulfil reserve requirements, and the liquidity of the various securities, are examples of important factors that are likely to affect the government bond risk premium. Factors such as these might help explain the puzzling absence of a relation between the level of the debt and the risk premium in Belgium, Ireland and Spain.

I view this paper as a promising first step on a difficult problem. The sheer effort involved in gathering the data set used in this paper has paid off since it allowed the authors to document an interesting set of empirical regularities and to open new research avenues on the study of the determinants of the government debt risk premium.

General discussion

Martin Hellwig was concerned about the legal possibility of default and more generally the status of domestic debts in the courts. Guido

Tabelini acknowledged these questions and indicated that in the empirical part of the paper, default is simply associated with the interest differential between public and private debt, so that implicitly partial default is taken into account. He saw differential taxes and consolidation as the most likely instruments of partial default.

Hans-Werner Sinn insisted that the authors' empirical work did not actually establish the existence of a risk premium; rather the results indicate that the return on public debt is lower than that on safe private debt. The actual remuneration which is required by financial markets to support the risk of default cannot be inferred from this.

Jacques Drèze expressed little surprise at the observation that risk premia on government debt are small; he argued that taxation of nominal assets was by far the most convenient (and equitable) alternative to default. Realizing this, financial markets anticipate that differential treatment of public debt is unlikely and accordingly a very small premium is deemed appropriate. Tabellini replied that a differential treatment of public debt was actually more attractive from a political point of view; indeed, at least in the case of Italy, public debt is concentrated among 22% of the population. When it comes to votes, default on public debt is thus rather more attractive than taxation of nominal assets. Pierre Pestieau wondered whether cross-country differences in the risk premia could not be associated with institutional variables. Tabellini indicated that an enquiry into the institutional factors which increase agents' assessment of default probabilities would indeed be interesting; yet such an analysis would be difficult given that the correlation between interest differentials and the level of debt is only observed for the rather small set of 'unstable' countries.

Paul Seabright returned to the theoretical framework used by the authors, in which actual default is basically determined by the relative cost of raising taxes and defaulting. He wondered whether the specification of both types of costs could not be improved upon; on the one hand, it is not clear that the cost of taxation is convex. The recent UK experience has indeed shown that a small increase in a moderate lump-sum tax could be particularly costly. On the other hand, the cost of default could be convex, to the extent that a large default would presumably affect the stability of the banking system.

Appendix A. Data appendix

A1. Debt

This data set on government debt was collected in De Broeck (1991). The reader is referred to the Appendix of De Broeck (1991) for details about the original sources.

The data on the public debt, amount at face value and maturity composition, are constructed from the statistical publications of the Central Bank and/or of the Treasury of each country. The data on government debt are published quarterly for every country in the sample. Debt is always scaled to nominal GDP.

For all the countries in the sample we were able to net out the public debt held by various government agencies. The remaining debt stock is decomposed into six categories classified according to a combination of ownership, maturity and currency denomination: (1) debt held by the Central Bank; (2) short-term debt held by financial institutions; (3) long-term debt held by financial institutions; (4) short-term debt held by the private sector not classified as financial institutions; (5) long-term debt held by the private sector not classified as financial institutions; and (6) debt denominated in foreign currency.

A2. Maturity

A summary measure of the maturity structure of the public debt is the ratio of short-term debt to the total (excluding debt held by the Central Bank and other government agencies). For a subset of countries we have information on the average maturity of the public debt. Seven of them publish these data quarterly: Belgium, Canada, Ireland, Italy, Spain, the UK and the US. The remaining two (Denmark and the Netherlands) publish them annually and the quarterly maturity data are derived by linear interpolation.

The interest rate data for most of the countries are obtained from national sources or from the OECD *Monthly Financial Statistics*. This publication provides on a comparable basis interest rates on publicly and privately issued medium-term debt instruments. In some instances, we used data published by the Bank for International Settlements.

A3. Long-term interest rate data

AUSTRALIA

Public: Secondary market yield on two-year Treasury bonds.

Source: Reserve Bank of Australia *Bulletin.*
J. Financial Markets.
J. 2. Interest rates and yields: capital market.

Private: Interest rates on first ranking debentures of companies associated with major trading banks, two-year.

Source: Reserve Bank of Australia *Bulletin.*
J. Financial markets.
J. 4. Interest rates and yields: other financial institutions.

BELGIUM

Public: Rate of return on government bonds with maturity of more than five years.

Source: *Paribas.*
Wekelijske lijst van waarden met vaste rente Bruto redementen op staatsfondsen en daarmee gelijkgestelde fondsen.

Private: Rate of return on bonds issued by Companies until 1980 (bonds issued in Belgium).

Source: *Banque Nationale de Belgique, Bulletin.*
XIX. Taux d'Escompte, d'Intérêt et de Rendement.
XIX. 7. Taux de rendement de titres à revenu fixe.
Cotes à la Bourse de Bruxelles, Echéance à plus de 5 ans, Sociétés privées.
From 1980 on (bonds issued in Luxembourg) Kredietbank Luxembourgeoise, *Bulletin Financier.*
Taux de rendement de la Bourse de Luxembourg.
Emprunts flux M.T.

CANADA

Public: Average bond yields on government securities.

Source: *Bank of Canada Review.*
F. Financial markets.
F1. Selected Canadian and international interest rates, including bond yields and interest arbitrage.
Government of Canada securities, average bond yields.

Private: Average bond yields corporate weighted; mid-term only from 1980 onwards.

Source: *Bank of Canada Review*
F. Financial markets.
F. 1. Selected Canadian and international interest rates, including bond yields and interest arbitrage.
Other corporate bond yield averages (Scotia McLeod).

DENMARK

Public: Secondary market yield on government bonds (20-year maturity).

Source: Danmarks Nationalbank, *Monetary Review.*
Yields on selected bonds quoted on the Stock Exchange, and minimum nominal yield on government bonds.

Private: Secondary market yield on mortgage credit bonds (20-year maturity).

Source: Danmarks Nationalbank, *Monetary Review.*
Yields on selected bonds quoted on the Stock Exchange, and minimum nominal yield on mortgage credit bonds.

FRANCE

Public: Secondary market yield on government bonds (public sector until 1984.3).

Source: Banque de France, *Bulletin Trimestriel.*
Taux d'intérêt à long terme obligations.
Taux de rendement en bourse, Etat long terme.

Private: Secondary market yield on private sector bonds.

Source: Banque de France, *Bulletin Trimestriel.*
Taux d'intérêt à long terme obligations.
Taux de rendement en bourse, Secteur privé.

IRELAND

Public: Representative yields of government securities (average of three years and five years maturity).

Source: Central Bank of Ireland, *Quarterly Bulletin.*
B. Interest rates and exchange rates.
B. 2. Ireland: deposit and other selected interest rates.
VI Government Securities Market,
Representative yields on government securities.

Private: Lending rates of Associated Banks (AAA, three to five years).

Source: Central Bank of Ireland, *Quarterly Bulletin.*
B. Interest rates and exchange rates.
B. 1. Ireland: selected lending rates.
II Licensed Banks.
1. Associated Banks.

ITALY

Public: Net of tax yield of BTP on the secondary market.

Source: Bank of Italy.

Private: Net of tax yield of industrial bonds on the secondary market.

Source: Bank of Italy.

Note: The Italian market for Industrial bonds is very thin, but industrial bonds are the only proper alternative private asset whose rate of return is available for a long enough time series. A differential

between BTP and bonds issued by Special Credit Institutions (Istituti Mobiliari) would display a similar upward trend. Since October 1987, it is possible to compute a differential between BTP and bonds issued in lire by International Institutions (BEI) subject to the same tax treatment: the differential is almost always positive and has an average of about half a percentage point.

JAPAN

Public: Yield on the secondary market on interest-bearing 10-year government bonds.

Source: The Bank of Japan, Research and Statistics Department, *Economic Statistics Monthly.* Market Rates.
Over-the-counter sale yields of public and corporate bonds (Tokyo).
Interest-bearing government bonds.

Private: Secondary market yield on 12-year industrial bonds.

Source: The Bank of Japan, Research and Statistics Department, *Economic Statistics Monthly.*
Market rates.
Over-the-counter sale yields of public and corporate bonds (Tokyo).
Industrial bonds.

THE NETHERLANDS

Public: Secondary market yield on central government medium-term, five to eight year bonds.

Source: De Nederlandsche Bank, *Quarterly Bulletin.*
9.2. Market Interest Rates.
Capital Market Rates.
4. Bonds.
4.1. Central government loans.
4.2. Medium-term bonds.

Private: Yield on Bank bonds; until 1981 Industrial bonds; 1981–86 Mortgage bonds.

Source: De Nederlandsche Bank, *Quarterly Bulletin.*
9.2. Market Interest Rates.
Capital Market Rates.
4. Bonds.
4.3. Bank loans.

SPAIN

Public: Secondary market yield on government bonds over two years.

Source: Banco de España, *Boletín Económico.*
Indicadores Económicos.

4. Tipos de interés: mercados de valores a large plazo.
Dueda pública del Estado (bonos y obligaciones).
Rendiemento interno en los mercados secundarios.
Dueda anotada, a más de 2 años.

Private: Secondary market yields on private sector bonds, over two years (electric utilities).

Source: Banco de España, *Boletín Económico.*
Indicadores Económicos.
4. Tipos de interés: mercados de valores a largo plazo.
Obligaciones privadas (eléctricas), Rendiemento interno mercado bursátil, Sin Bonificación a más de 2 años.

UNITED KINGDOM

Public: Redemption yields on 20-year government securities.

Source: Central Statistical Office, *Financial Statistics.*
Foreign exchange rates, interest rates and security prices.
13.5. British government securities. Calculated long-dated gross redemption yield.

Private: Redemption yields on company debentures and 20-year loan stocks.

Source: Central Statistical Office, *Financial Statistics.*
Foreign exchange rates, interest rates and security prices.
13.7. Company security prices and yields.
Fixed interest securities.
Debenture and loan stocks, redemption yields.

UNITED STATES

Public: Secondary market yield on long-term government bonds (over 10 years).

Source: Board of Governors of The Federal Reserve System, *Federal Reserve Bulletin.*
Domestic Financial Statistics.
Interest Rates, Capital Market Rates.
US Treasury notes and composite bonds.

Private: Secondary market yield on AAA corporate bonds, seasoned issues.

Source: Board of Governors of The Federal Reserve System, *Federal Reserve Bulletin.*
Domestic Financial Statistics.
Interest Rates, Capital Market Rates.
Corporate bonds, seasoned issues.

Appendix B. Procedures adopted for the time-series analysis

The particular difficulties encountered in carrying out a regression analysis on a country-by-country basis are the following. First, some time series are stationary and others are non-stationary. Second, in some countries the variables of interest have a long-run relationship, while in others only short-term effects are present. Third, there is a possibility of reverse causation from the interest ratio to the debt-GDP ratio, the business cycle or the average maturity. In order to cope with these problems, we follow the following steps:

(1) stationarity tests determine the degree of integration of each time series (the stationarity and cointegration tests – available from the authors – should be interpreted with caution, given the limited length of most time series);
(2) if the variable *RATIO* is stationary (this is the case for Ireland and Spain), the regression is carried in level for the variable *RATIO*, and all non-stationary explanatory variables are differenced;
(3) if the variable *RATIO* is non-stationary but is not cointegrated with any of the other non-stationary variables (this is the case for Belgium), the regression is estimated in first differences for all variables;
(4) if the variable *RATIO* is non-stationary and is cointegrated with some of the non-stationary explanatory variables (this is the case for Italy, the Netherlands and Denmark), there is a long-term relationship among these variables. The regression is specified to allow for the identification of both the short-run and the long-run dynamics of the model (the short-run dynamics is identified by differentiating *RATIO* and all explanatory variables, while the long-run dynamics is identified by introducing among the explanatory variables the levels of the cointegrated variables);
(5) in order to avoid the problem of reverse causation, all explanatory variables are lagged one quarter;
(6) the specification is conducted by estimating first a general form with four unrestricted lags of the differenced variables and one lag of the level of the variables for which a long-run relationship is expected; the non-significant variables are then dropped and four significant lags of a differenced variable are substituted with a four-period difference of the same variable (this restriction is of no consequence for the results and is imposed only for presentation purposes).

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