PUBLIC CONFIDENCE AND DEBT MANAGEMENT: A MODEL AND A CASE STUDY OF ITALY

Alberto Alesina

Alessandro Prati

Guido Tabellini

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ABSTRACT

    High debt countries may face the risk of self-fulfilling debt crises.   If
the public expects that in the future the government will be unable to roll
over the maturing debt, they may refuse to buy debt today and choose to hold
foreign assets.   This lack of confidence may then be self-fulfilling.   This
paper argues that under certain conditions, the occurrence of a confidence
crisis is more likely if the average maturity of the debt is short.   On the
contrary, a long and evenly distributed maturity structure may reduce such a
risk.   We consider the recent Italian experience from this perspective.   In
particular we ask whether recent developments in the market for government debt
show signs of unstable public confidence, and of a risk premium.

Alberto Alesina   Alessandro Prati   Guido Tabellini
Harvard University,   Bank of Italy, and   CEPR, NBER, and
CEPR, and NBER   Department of Economics   Department of Economics
1050 Massachusetts Ave   University of California   University of California
Cambridge, MA 02138   405 Hilgard Avenue   405 Hilgard Avenue
                           Los Angeles, CA 90024   Los Angeles, CA 90024

I.   Introduction

With a public debt projected to remain close to 100% of GNP for several years in the future, the Italian authorities face two goals: first, to keep the cost of debt service as low as possible; second, to guarantee monetary and financial stability while carrying out the financial liberalization required by the EEC accords. This paper investigates the role of public debt management in the achievement of these two goals.

Section II of the paper briefly summarizes the debt management policies followed in Italy during the 1980s. Even though in the first half of the decade these policies were quite successful, they may have planted the seeds for the difficulties of the Summer of 1987, which marked a turning point. Unlike in the pre-87 period, the government has been unable to issue long-term debt at low cost. A difficult dilemma has arisen: Should the government pay a premium in order to prevent a shortening of the maturity of its debt? And what kind of debt instruments should be issued?

The answers to these questions depend on the nature of the risk premium currently paid on long-term debt. Section III asks whether the return on the Italian public debt currently incorporates a premium against the risk of a confidence crisis, or more generally of a government default. This is a difficult question, and any attempt to answer it must be regarded as tentative and not conclusive. However, we do find some evidence that such a premium may exist and may have been rising in recent years.

Section IV analyzes a simple model that begins to address some of the questions relating to debt management and confidence crises. The central result is that the maturity structure of public debt may influence the

likelihood of a confidence crisis on the debt: The shorter and more concentrated is the maturity, the more likely is a confidence crisis.

Finally, Section V concludes the paper with a discussion of some implications of our model about debt management policies.
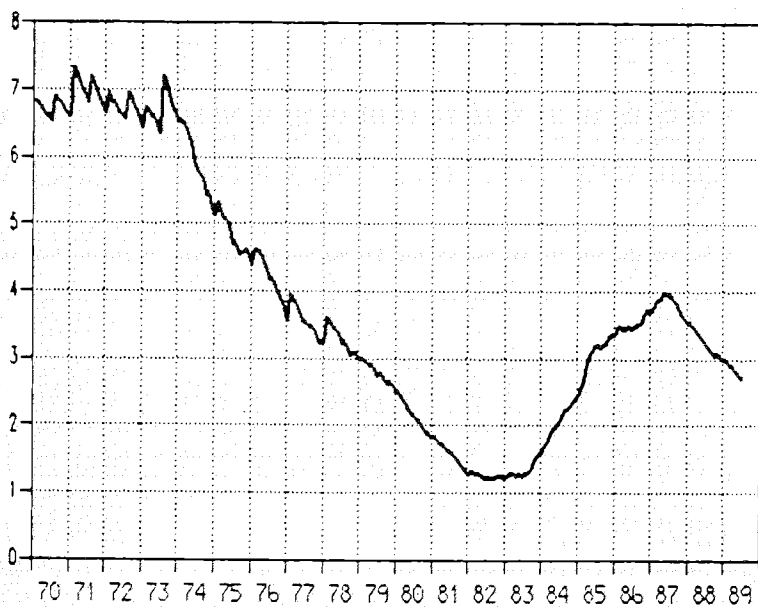
II. Debt Management in Italy During the 1980s

As shown in Figure 1, Italy approached the 1980s with a short and rapidly declining maturity of public debt: In 1981, about 60% of the debt had a maturity of less than a year; the average maturity of the whole debt outstanding was less than one and a half years. Virtually all of it was nominal domestic debt. Investors had suffered capital losses during the late 1970s, due to rising inflation and high nominal interest rates. Afraid of repeating the same mistakes, they were reluctant to hold long-term fixed interest nominal debt (see Pagano (1988)).

In order to lengthen the maturity of public debt, the authorities could choose between three instruments: foreign currency debt, debt indexed to the price level, or debt indexed to some short-term nominal interest rate. The fourth option, fixed nominal interest debt, would have demanded an excessively high premium against the inflation risk. The authorities opted heavily for the third alternative. As indicated in Table 1, between 1982 and 1987 they increased considerably the net issues of CCT (Treasury Credit Certificates), medium-term notes whose coupons are indexed to the returns on 6-months or 1-year Treasury Bills (TB). As shown in Figure 1, they succeeded in lengthening the average maturity of government debt from a minimum of 14 months in 1982 to a maximum of almost 4 years in the summer of 1987.

Figure 1

Average maturity of government debt
(Jan. 1970 - Apr. 1989)

Table 1

Gross and Net Issues of Public Debt

	Total (% of GDP)	BOT	CCT	BTP (% of total Issues)	Foreign Currency	Others
			Gross			
1980	35.97	90.78	9.21	0.01	0.00	0.00
1981	46.70	91.39	4.25	2.54	0.00	1.83
1982	59.71	83.95	14.51	0.94	0.44	0.16
1983	56.46	74.89	20.99	3.66	0.18	0.28
1984	47.34	66.51	27.82	5.18	0.49	0.00
1985	47.62	66.64	25.28	4.50	0.88	2.71
1986	44.96	66.39	19.79	13.30	0.52	0.00
1987	41.45	78.25	13.73	4.68	0.72	2.62
1988	42.27	77.01	5.14	14.19	3.23	0.43
			Net			
1980	6.24	104.64	11.04	-6.96	0.00	-8.72
1981	8.90	79.80	6.65	9.23	0.00	4.32
1982	10.32	56.80	47.70	-2.84	2.49	-4.15
1983	12.79	13.80	83.10	4.66	0.79	-2.35
1984	10.04	12.83	78.29	11.64	2.33	-5.09
1985	13.20	12.42	74.05	3.74	3.17	6.61
1986	10.87	9.98	55.10	36.05	2.14	-3.27
1987	8.57	30.17	42.28	16.07	3.48	8.00
1988	9.50	35.36	-7.65	58.31	15.21	-1.23

Note: For. Curr. = BTE + CTE

Source: Bank of Italy

The authorities preferred financial indexation to price level indexation on the grounds that the latter would have reduced the Treasury's incentives to fiscal adjustment and it would have affected the credibility of their anti-inflationary policy (an essential part of which was a reduction of wage indexation). These concerns are clearly indicated in the 1981 "concluding remarks" of the Governor of the Bank of Italy (see Banca d'Italia 1981).

Other less compelling reasons have been suggested to explain this choice in favor of CCT. It has been argued that financial indexation is preferred by the investor to price level indexation or to foreign currency debt, and hence demands a lower premium, because it protects against inflation risk as well as against changes in the short-term real interest rate. However, this cannot be an argument for issuing only financially indexed long-term debt. An additional explanation is the fear that issuing real or foreign currency debt makes it impossible to reduce the burden of the debt by means of inflation or of devaluation in case of an emergency. However, the government still retains other escape clauses, such as wealth taxation, forced consolidation, or outright repudiation. We discuss this issue in Section V.

The almost exclusive reliance on financial indexation had two negative effects. First, it magnified the repercussions of monetary policy on the government budget. Any change in the short-term interest rate automatically affected the interest payments on a large fraction of the government debt. Thus, one of the purposes of lengthening the maturity was defeated.

Second, the choice of the indexation parameter (the rate on Treasury Bills) gave rise to a time-inconsistency problem. The value of this parameter is under the control of the authorities. Thus they have a temptation to keep it high at first, when the debt is issued, and to reduce it

once the private sector is locked into an irreversible investment decision, thereby inflicting a capital loss on the debt holders. After 1985, perhaps the authorities were succumbing to this temptation. As indicated in Figure 2, after 1985 the rate of return on the 1-year TBs (to which much of the debt was indexed) remained systematically below that on the shorter-term TBs, right up to the crisis of 1987. At the same time, as shown in Figure 3, the return on the 1-year TBs was also generally below that on medium term government bonds. The positive differential between the 3-month (or 6-month) and the 1-year TBs is particularly striking in the first half of 1987, just prior to the crisis. Presumably, at that time the market was expecting higher nominal rates in the future; and yet the authorities were not allowing the 1-year rate to bulge.
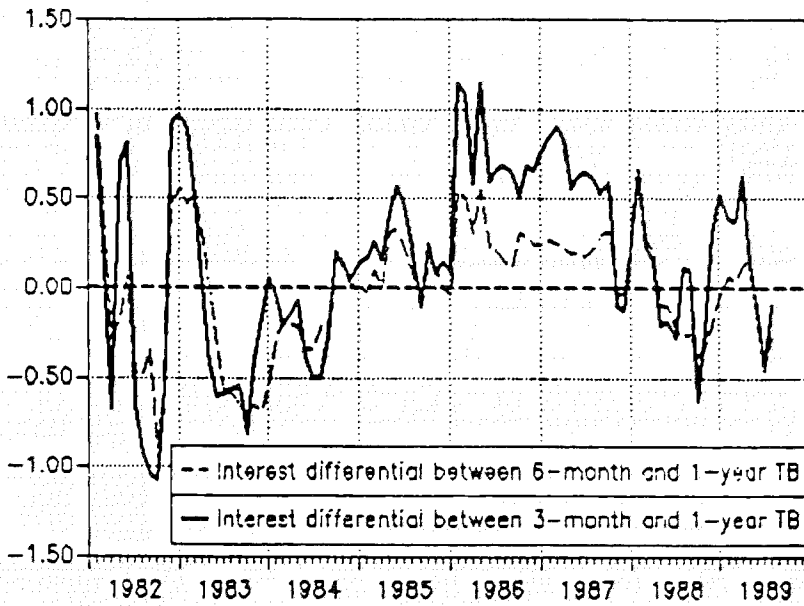
As pointed out by Bencini-Tabellini (1987) and Ministero del Tesoro (1989), the perception of this time-inconsistency was probably one of the causes of the crisis in the Summer of 1987, even though other factors have played an important role.[1] In the few months after July 1987, the secondary market price of CCT plummeted by more than 3 percentage points. Since then, the market of this debt instrument has not recovered, and the authorities have been unable to replace all of the CCT as they became due. Since the summer of 1987, the sales of CCT to the public have never been fully subscribed. At times the market bought even less than 50% of the amount offered.

This crisis marked a turning point. The previous strategy of financing the deficit by issuing CCT had to be discontinued. Perhaps, a new debt management strategy has not yet emerged. As indicated in Table 1, in 1988 the government had to resume the old policy of issuing large amounts of short-term Treasury Bills, implying a fall of the average maturity of the debt. The government also issued large amounts of medium-term fixed-nominal-interest
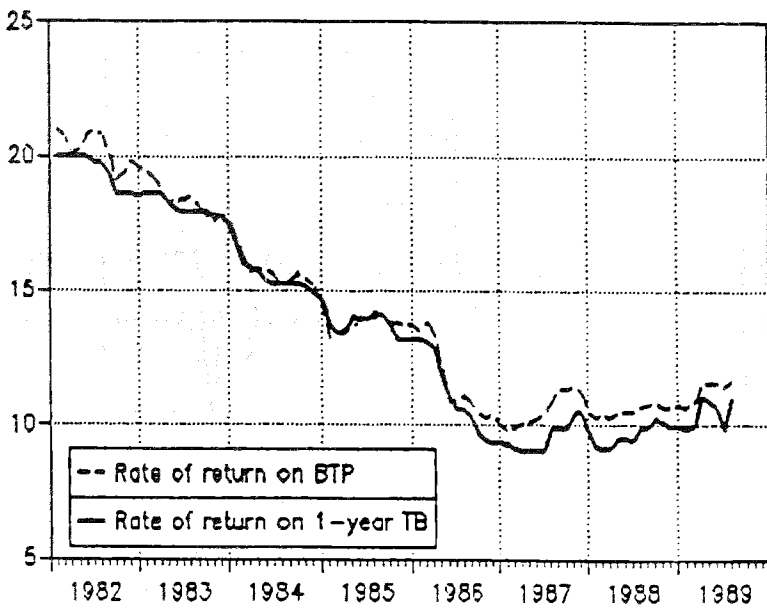
Figure 2

Interest differential on Treasury Bills (TB)

Source: Bank of Italy.

Figure 3

Rate of return on medium-term government
bonds (BTP) and 1 year Treasury Bills
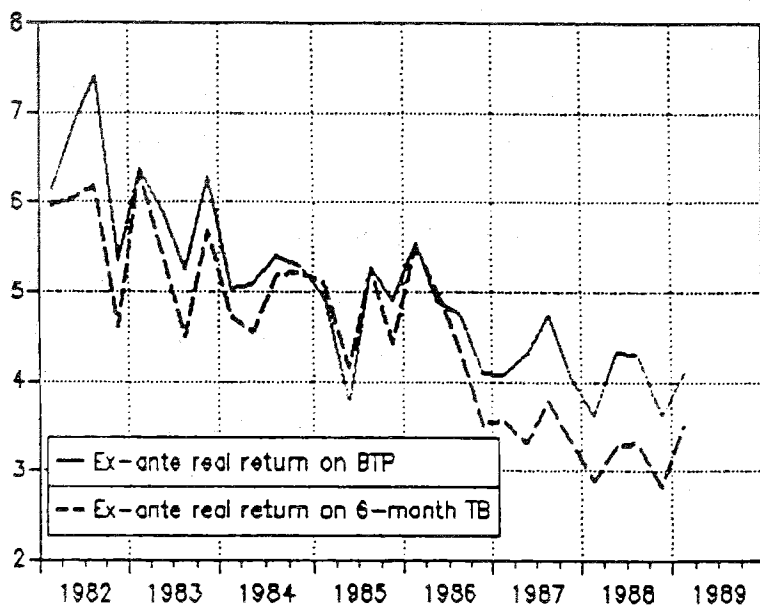

Source: Bank of Italy.

debt of a high interest rate. Figure 4 compares the *ex ante* real rates of
return net of taxes on fixed-interest government bonds (BTP) and on 6-months
Treasury Bills. Both rates display a common declining trend that reflects a
decrease in real interest rates throughout the world. But since the summer of
1987, the BTP have paid almost 1 percentage point in real terms more than
Treasury Bills. A similar pattern emerges if one compares the real yield on
the CCT and on the 6-months Treasury Bills.[2] Clearly, the market is unwilling
to hold medium-long-term debt without a compensation.

The critical question is: what is the nature of this risk premium? If
the premium represents the expectation of forthcoming inflation and our
measures of the *ex ante* real rates are wrong, then the course of action for
the government is clear. Foreign currency and real (i.e., indexed) debt
should be issued in much larger amounts. This policy has been advocated by a
committee of Italian economists, established by the Treasury ministry in 1988
-- see Ministero del Tesoro (1989). There is however a second possibility.
The high real interest rates currently paid on the Italian long-term debt may
represent also a premium against a more general and vague risk of a financial
crisis. In this second case, changing the nature of the debt instrument would
not reduce the risk premium.

By financial crisis we do not mean that the government deliberately and
unexpectedly chooses to default on its debt. This possibility seems very
remote. In the current Italian situation it would probably have very high
political costs, by disrupting the system of financial intermediation and
causing arbitrary wealth redistributions. What we have in mind instead is the
possibility of a crisis initiated by a reluctance of investors to roll over
the public debt. In such an event, default or consolidation may be the only

Figure 4

Ex ante real returns on medium-term government bonds (BTP)
and 6 month Treasury Bills

Source: Bank of Italy and Isco-Mondo Economico (see the text).

way out. But the realization that, in the event of a confidence crisis, the government would be forced to a default, may be enough to trigger a crisis. A run on government debt could be self fulfilling, just like a bank run (see also Bencini-Tabellini (1988)). Figure 5 suggests that even disregarding the primary deficits, in the next few years the government is called to roll over a large fraction of its outstanding debt. The authorities may be able to withstand a temporary crisis, as they did in 1982, when a large part of the maturing debt was bought by the Bank of Italy, who then resold it to the financial markets in the form of repurchase agreements. But would the system be able to survive a more prolonged confidence crisis? And even if the answer is positive, would the public believe that the system can survive? We now turn to some evidence suggesting that private investors may already fear a negative answer to these questions.
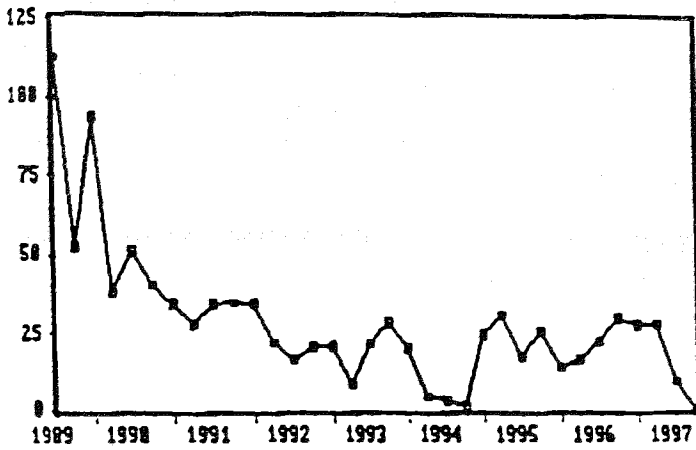
III. Rates of Return on the Italian Public Debt

This section asks what is the nature of the risk premium on the Italian public debt. We attempt to discriminate between to alternative sources of risk. a) Inflation risk, due to the fact that most of the outstanding debt is nominal. b) Risk of a financial crisis leading up to public debt consolidation or default. To do so, we compare the returns on public debt to those on equivalent private financial instruments. We always find that the public debt pays a higher interest rate. This suggests that it is the identity of the debtor, and not the nature of the instrument, that is feared by the market.

III.1 Interest Rate Differentials on Short-Term Debt

Figure 5

Maturing government debt, as of April 1989
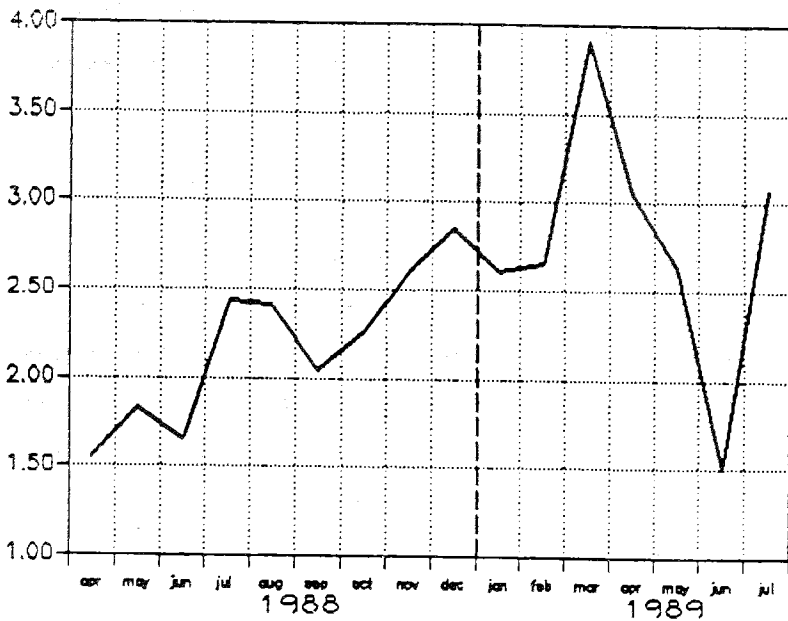(in thousand of billions of lires; quarterly data at par value)

The only financial instrument similar to the Treasury Bills (TB) are the Certificates of Deposit (CD) of corresponding maturity issued by banks. The differentials between the interest rates net of taxes paid on three- and twelve-month TBs and the interest rates on CDs of corresponding maturity are shown in Figures 6 and 7.[3]

These figures are striking. The TBs pay interest rates which are between two and four points above the interest rates paid on CDs. The differentials relative to 12-month TBs indicate again an increasing trend starting in 1987. It is also worth noting the peaks of March and April 1989, which reflect the issue difficulties of those months accompanied by a one point increase of the official discount rate. A very similar pattern is followed by the differential between 6-month TBs and 6-month CDs.

This differential between TBs and CDs is high by international standards, as shown in Table 2. The high debt countries are those in which the Treasury Bills pay a higher rate, while in the low debt countries the relationship is reversed. We should note however that the size of the Italian differential could also be attributed to the illiquidity of the secondary market for TBs and to the possible existence of informal repurchase agreements for CDs between banks and depositors, which would make the CDs more liquid than the TBs. Since the Italian market for the CDs developed only recently, it is impossible to compute a differential before mid-1984. In that period the closer substitute of TBs was the saving deposit. Figure 8 shows the interest differential between TBs and saving deposits for the period 1978-1988.[4] The differential is negatively correlated with the average maturity of government debt. This negative correlation is consistent with the predictions of our theoretical model of debt runs.[5]

Figure 6

Interest differential between 3-month Treasury Bills
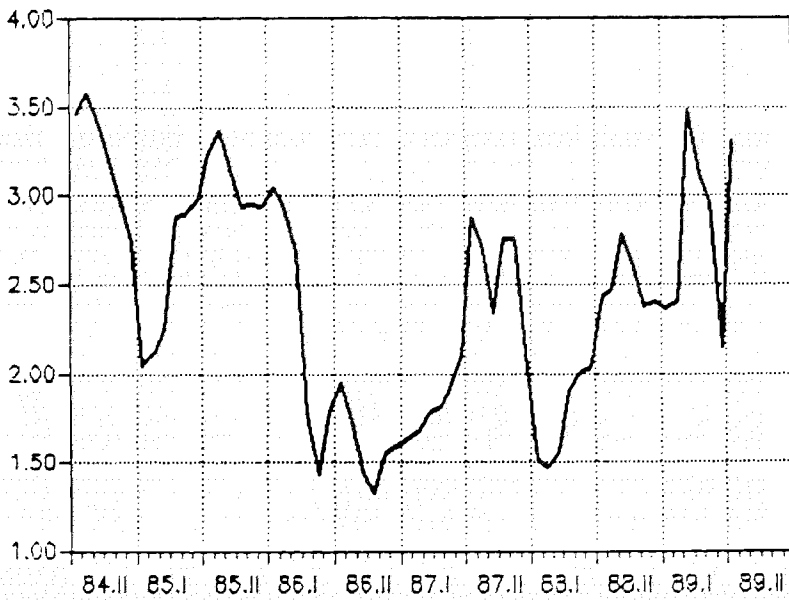and 3-month Certificate of Deposits (CD)
(Apr. 1988 - July 1989)

Source: Bank of Italy.

Figure 7

Interest differential between 12-month Treasury Bills
and 12-month Certificates of Deposits (CD)

Source: Bank of Italy.

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Table 2

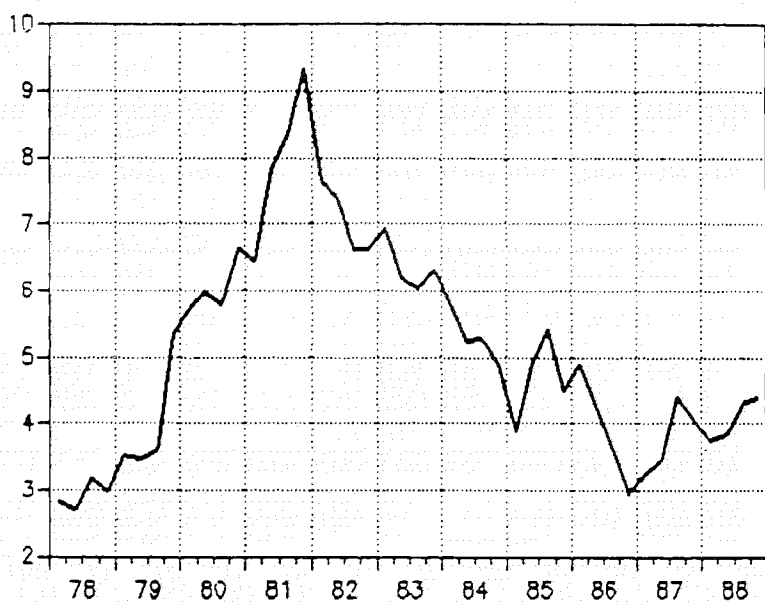Short-term interest differential and Debt/GNP ratios:
selected countries

Year 1988		
Countries	Debt/GDP (%)	TB3-CD3 Differential
Belgium	126	2.2
Italy	95	1.0 (2.7)*
Netherlands	80	0.9
Canada	69	-0.1
Japan	68	-2.1
United States	52	-1.1
Great Britain	45	-0.4
Germany	45	-0.1

*All differentials are gross of taxes (the net of taxes Italian differential is reported in parenthesis and it is the 1988 average of the differential in Fig. 6). For Belgium, Canada, Germany and the Netherlands, the interest rate on 3-month CDs corresponds to the interest rate on 3-month time deposits.

Source: Bank of International Settlements Databank.

Figure 8

Interest differential between 1-year Treasury Bills
and Saving Deposits

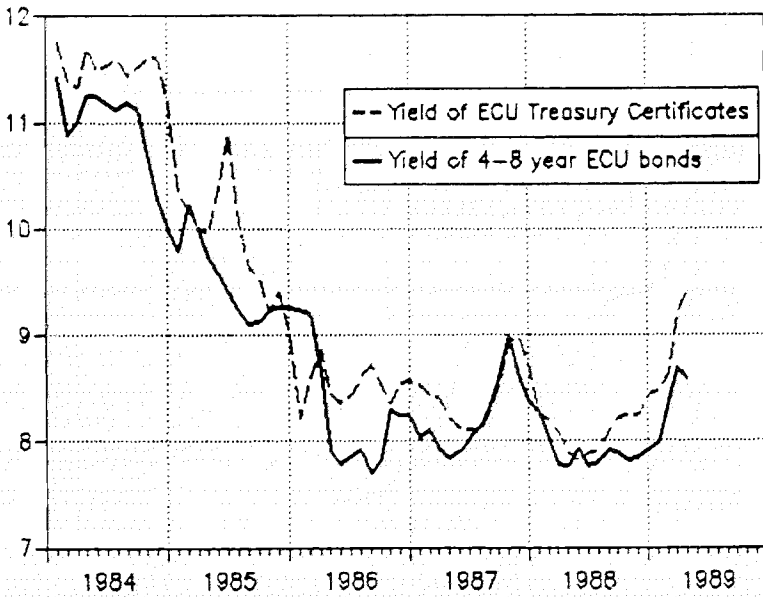III.2 Interest Differentials on Medium/Long-Term Debt

The possibility of a risk premium on the Italian government debt can also be investigated by comparing the yield on ECU denominated government bonds (CTE) with the average yield of ECU bonds of corresponding maturity (4-8 years). Figure 9 indicates that the yield net of taxes on the Italian bonds was higher on average than the yield on ECU bonds. The differential diminished and almost disappeared in 1987; since 1988, however, we can note again a premium on CTE. This evidence is again consistent with the view that the risk premium varies inversely with the average maturity of the debt. Note that the yield on CTE is net of taxes while that on ECU bonds is gross of taxes, so that the after-tax differential should be even more favorable to CTE.

Figure 10 shows the interest differential at issue between 2-3 years BTP and 18-24 month certificates of deposit issued by special credit institutions. The differential is always favorable to the BTPs with peaks in 1987 and in the first months of 1989. The differential is even more remarkable if one considers that 1988 was a boom year for the certificates of deposit of the special credit institutions: in spite of the differential, this kind of CDs increased by 41% with respect to 1987.

Summarizing, this evidence suggests that private investors may fear a confidence crisis on the Italian public debt. We now turn to a theoretical model that analyzes how such a crisis might take place.

Figure 9

Secondary market yields of ECU bonds

Legend (in chart):
-- Yield of ECU Treasury Certificates
— Yield of 4–8 year ECU bonds
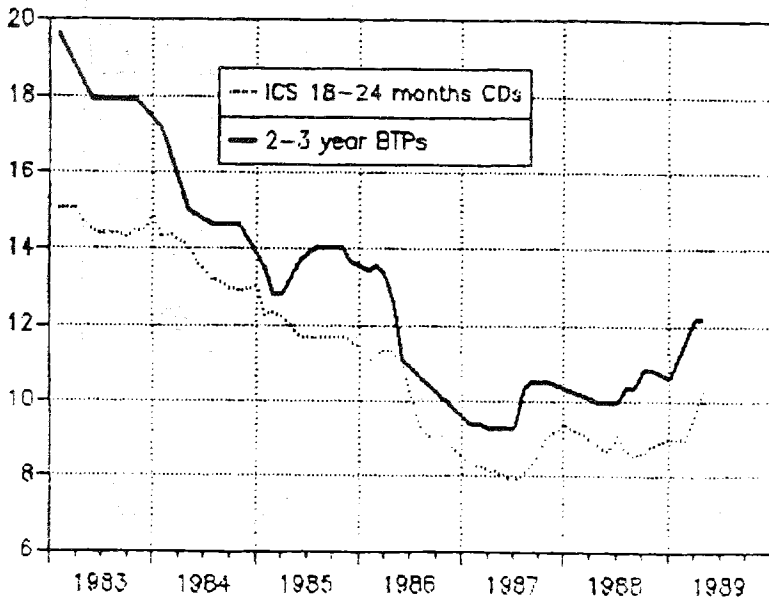
Source: Bank of Italy.

Figure 10

Interest differential at issue between 2-3 years BTP
and 18-26 months CD issued by special credit institutions

Source: Bank of Italy.

IV.   A Model of Debt Runs

The basic result of this section is that a crisis of confidence in the public debt can be self-fulfilling, like a bank run; but it is less likely to occur if the public debt has a long and balanced maturity structure.

IV.1   Introduction and Review of the Literature

The idea that there may be an analogy between a bank run and a run on government debt has a long tradition, but the most recent treatment is in Calvo (1988). This author studies a two period model of a small open economy: If the government repudiates its debt, it bears a cost proportional to the amount repudiated. Calvo shows that two equilibria exist: a "good" equilibrium in which the government honors its debt, and a "bad" equilibrium, in which investors expect the government to partially repudiate and demand a higher interest rate, and the government fulfills these expectations. Calvo's "bad" equilibrium is similar to the banking panic studied by Diamond and Dybvig (1983); it reflects a coordination problem among investors making simultaneous portfolio decisions. If an investor expects all the other investors to demand a risk premium, he realizes that the government will be forced to partially repudiate in the future; thus, his optimal response is also to demand a risk premium.

The confidence crisis that we study in this paper, instead, reflects a coordination problem among individuals making investment decisions at different dates. We study an infinite horizon model in which the optimal government policy is to roll over its debt for ever. There are two equilibria. In one this optimal policy is expected by investors and carried out by the government. In the other current investors refuse to buy any

public debt, in the anticipation that future investors will do likewise, and the government is forced to repudiate. A second difference between Calvo's model and ours is in the specification of the costs of default. These differences imply that in our model, unlike in Calvo's, the larger is the stock of debt maturing in a given period, the greater is the range of parameter values for which a crisis can occur. This feature of our model provides a role for debt management.

Giavazzi and Pagano (this volume) derive results related to ours. However, in their paper, unlike in ours, the policy that gives rise to the debt run is not derived from the government optimization problem but is postulated exogenously. In addition, they focus on repudiation by means of exchange rate devaluation; whereas, we consider outright repudiation. Prati (1989) models a confidence crisis along lines similar to this paper, but focuses on nominal debt and disregards debt management.

V.2 The Model

A small open economy is inhabited by an infinitely lived representative consumer, maximizing:

$$(1) \qquad U = \sum_{t=0}^{\infty} \beta^t u(c_t) \qquad\qquad 1 > \beta > 0$$

where c_t denotes consumption and $u(\cdot)$ is a well behaved concave utility function. In each period he receives one unit of non-storable output and pays a distorting tax τ_t to the government. This tax is distorting: in addition to paying the tax, the consumer loses an amount $f(\tau_t)$ every time the tax is

collected, where $f(0) = 0$, $f'(\cdot) > 0$, $f''(\cdot) > 0$. Thus, the consumer disposable income in each period is

(2) $\qquad F(\tau_t) = 1 - \tau_t - f(\tau_t)$.

This specification and, in particular, the convexity of $f(\cdot)$ captures in a very simple way the well-known idea that "tax smoothing" is desirable. Alternatively, one could introduce a labor supply decision with a distortionary income tax. Such a model, however, introduces subtle time-consistency problems which we want to abstract from (see Lucas and Stokey (1983) and Persson and Tabellini (1989) on this point).

Consumers have access to perfect international capital markets in which they can borrow or lend at a risk free gross real interest rate equal to their discount factor, $1/\beta$. External tax-free assets held by the consumers at the beginning of period t are denoted e_t. The government only issues one period discount debt and there is no domestic government debt held abroad. With no loss of generality, there is no government spending. In each period the government decides how much tax revenue to raise and whether or not to honor its outstanding debt obligations; thus, policy commitments are ruled out. Debt repudiation is costly: the first time some debt is repudiated, the economy bears a cost proportional to output (which is normalized to 1); that is, output is reduced by a fraction $\alpha > 0$ in the period in which repudiation occurs for the first time. This cost represents the economic disruptions that may be brought about by a default on government debt, such as bankruptcies in financial markets, uncertainty, and disruption in the allocation of resources.

With no change in the results, we could assume that this cost affects government utility rather than its budget constraint.

Based on these assumptions, we can write the private sector and the government intertemporal budget constraints respectively as:

$$(3) \qquad q_t b_{t+1} + \beta e_{t+1} + c_t \leq F(\tau_t) + e_t + b_t(1-\theta_t) - D(\theta_t)$$

$$(4) \qquad b_t(1-\theta_t) \leq \tau_t + q_t b_{t+1}$$

where b_t denotes the stock of domestic government debt at the beginning of period t, q_t is the market price at which new debt is issued, θ_t is the fraction of debt repudiated at time t, and $D(\theta_t)$ denotes the cost of repudiation. Our assumption about the costs of default is summarized by

$$(5) \qquad D(\theta_t) = 0 \quad \text{if} \quad \theta_t = 0 \quad \text{or} \quad \theta_{t-i} = 1, \quad i > 0$$

$$D(\theta_t) = \alpha \quad \text{otherwise}.$$

Within each period, the timing of events is as follows. First, the government announces a price q_t at which it stands ready to sell the debt, and the maximum amount for sale. Then, on the basis of that price, the private sector chooses how much debt to buy. Finally, the government chooses the combination of τ_t and θ_t that satisfies the government budget constraint, given the amount of debt outstanding, b_t, and the debt just sold, b_{t+1}.

Alternatively, the timing of events could be as follows. First, the government announces the maximum amount of debt for sale. Then, the private sector chooses the price at which it is ready to buy the debt offered (β or zero, corresponding to $\theta^e_{t+1} = 0$ or $\theta^e_{t+1} = 1$). Finally the government chooses the combination of r_t and θ_t that satisfies the government budget constraint. The two timings correspond to different auction techniques. The technique used to auction TBs in Italy until March 1989 is very similar to the first timing of events, since the government announced a minimum price and an amount offered before the public made its bids. Since March 1989, the technique used to auction TBs corresponds to the second timing of events, since the government announces <u>only</u> the amount offered. Both timing assumptions guarantee the separation between the time at which the debt is offered and the time at which the public makes its bids, that is crucial for our results. Section IV.5 discusses alternative timing assumptions.

All private agents have the same (perfect) information as the government. Thus, a no-arbitrage condition between the returns on domestic and foreign assets implies (e superscript denotes private expectations):

(6) $q_t = \beta(1-\theta^e_{t+1})$

At time 0 a positive stock of debt outstanding b_0 is held by the consumer. For a discussion of this point see Section IV.5. Finally, the government maximizes the utility of the consumer.

An equilibrium is defined as a situation in which, in each period and for all sequences of previous aggregate histories: (i) The price q_t is optimal

for the government, given the private sector reaction to the announced price.
(ii) The private sector portfolio decision is optimal, given the price q_t
announced by the government and the expected future equilibrium outcomes.
(iii) The choice of taxes τ_t and θ_t is optimal for the government, given the
private current investment decision and the effect of the current policy on
the expected future equilibrium outcomes.[6]

IV.3 Multiple Equilibria with One Period Debt

Any equilibrium must have the following properties: a) Either $\theta_t = 0$
or $\theta_t = 1$. This is due to the lump sum nature of the costs of defaulting.[7]
Equation (6) then implies that the price at which investors are willing to buy
of government debt is either $q_t = \beta$ (if no default is expected) or $q_t = 0$
(otherwise). b) If the government defaults, it always does it in period 0.
Delaying the default does not reduce its cost, but it brings about more tax
distortions while the debt is serviced.

We now characterize the "good" equilibrium: by Property (b) we only need
to consider period 0. If at time 0 the government defaults, then the
consumer's consolidated budget constraint from time 0 onward is:

$$(7) \qquad e_0 + \frac{1}{1-\beta} - \alpha \geq \sum_{t=0}^{\infty} \beta^t c_t$$

Standard results of consumption theory imply that the optimal consumption path
is constant, and by (7) it is:

(8) $\qquad c_t = (1-\beta)e_0 + 1 - \alpha(1-\beta) = c^d \qquad t: 0,1,\ldots$

Suppose instead that $\theta_t = \theta^e_{t+1} = 0$ for every t. The optimal policy is to raise taxes to pay interest on the debt and roll over the principal:

(9) $\qquad r_t = (1-\beta)b_0 = r^\star \qquad t = 0,1,\ldots$

Equation (9) captures the basic result of "optimal tax smoothing." The consumer now maximizes (1) subject to (2), where $D(\theta_t) = 0$, and chooses:

(10) $\qquad c_t = (1-\beta)e_0 + 1 - f[(1-\beta)b_0] = c^\star \qquad t = 0,1,\ldots$

That is, in every period consumption is equal to disposable income plus the interest payments on the initial foreign assets.

In period 0, the government will choose _not_ to repudiate if and only if:

(11) $\qquad c^\star > c^d$

(without loss of generality we assume that an indifferent government chooses _not_ to repudiate). Using (8) and (10), condition (11) implies that repudiation occurs if and only if it costs less than the present value of the tax distortions needed to service the debt:

(12) $\qquad \alpha \geq \dfrac{1}{1-\beta}\, f[(1-\beta)b_0] = \underline{\alpha}$

A confidence crisis is triggered by the investor's beliefs that in the next period the government will not be able to roll over the debt and will be forced to default. Thus, if a crisis occurs in period t, $\theta^e_{t+1} = 1$; investors require immediate full repayment of the principal and invest in foreign assets. For the moment we take these expectations as exogenous; we show below under what conditions they are rational and self-fulfilling. Faced by a confidence crisis, the government has two choices:[8] 1) to raise taxes and repay the debt; 2) to default immediately. If the government chooses to default, from then onward consumption is c^d as defined in (8). If the government chooses to raise taxes, income falls by the amount of the tax distortions, $f(b_0)$. Clearly, raising taxes in response to a confidence crisis is superior to defaulting if and only if

(13) $\alpha \geq f(b_0) = \bar{\alpha}$

Lemma 1: $\bar{\alpha} > \underline{\alpha}$

Proof: $\bar{\alpha} > \underline{\alpha}$ is equivalent to $(1-\beta)f(b_0) > f((1-\beta)b_0)$. This inequality follows immediately from the strict convexity of $f(\cdot)$ and from $f(0) = 0$.

Q.E.D.

Proposition 1: (i) If $\alpha < \underline{\alpha}$ there is a unique equilibrium in which default occurs in the first period: $\theta_0 = 1$, (θ^e_t, θ_t are indeterminate for $t > 0$). (ii) If $\alpha \geq \bar{\alpha}$ there is a unique equilibrium in which default never occurs,

and $\theta_{t+1}^e = \theta_t = 0$ $\forall t$. (iii) If $\underline{\alpha} \geq \alpha < \bar{\alpha}$ there are two Pareto-ranked equilibria. In the good equilibrium, default never occurs, i.e., $\theta_{t+1}^e = \theta_t = 0$ $\forall t$. In the bad equilibrium default occurs in the first period, i.e., $\theta_0 = \theta_1^e = 1$.

<u>Proof</u>: (i) Follows immediately from (12). (ii) From (13) $\theta_t = \theta_{t+1}^e = 0$ is an equilibrium. To prove uniqueness, consider the event of a crisis: from (13), if $b_{t+1} = 0$, then $\theta_t = 0$ and taxes are raised to repay the debt. By (5) it then follows that $\theta_{t+1} = 0$. Hence $\theta_{t+1}^e = 1$ cannot be an equilibrium, since it violates rational expectations. (iii) By (12), $\theta_t = 0$ if $q_t = \beta$ and all the debt is rolled over. Hence, $\theta_t = 0$ is the government best response to $\theta_{t+1}^e = 0$. And $\theta_{t+1}^e = 0$ is the private sector best response to $\theta_{t+2}^e = 0$. But by (13), $\theta_t = 1$ if $\theta_{t+1}^e = 1$ and no debt is sold. Hence $\theta_t = 1$ is the government best response to $\theta_{t+1}^e = 1$. By repeating the same argument for period $t+1$, $\theta_{t+1} = 1$ is the government best response to $\theta_{t+1}^e = 1$, irrespective of the value of θ_t — see also (5). As a consequence $\theta_{t+1}^e = 1$ is the private sector best response to $\theta_{t+1}^e = 1$. Q.E.D.

The crucial point is that if $\underline{\alpha} \leq \alpha < \bar{\alpha}$ there are two equilibria, with and without default, depending upon the occurrence of a confidence crisis.[9]

The proof relies on the lump-sum nature of these repudiation costs, which rules out partial default. Suppose that the repudiation costs were linear in the amount defaulted, and consisted of both a fixed and a variable component. The good equilibrium with no default would still be described as in Proposition 1. However, a confidence crisis could now take other forms in addition to those described in that Proposition. In particular, confidence

crisis similar to those of Calvo (1988) would also be possible, in which a partial default occurs because investors fear a fall in the demand for public debt in the current period.

IV.4 Multiple Equilibria with Multi-Period Debt

Let us assume that there exist "short-term" debt (i.e., of one period) and "long-term" debt (i.e., two periods). The consumer maximizes the same objective function as above, subject to the following new budget constraint, where $_i b_j$ (i<j) indicates debt issued in period i which matures in period j and $_i q_j$ is its market price:

$$(14) \qquad c_t + \beta e_{t+1} + {}_t q_{t+1}\ {}_t b_{t+1} + {}_t q_{t+2}\ {}_t b_{t+2} \leq$$

$$F(\tau_t) + e_t - D(\theta_t) + {}_{t-1} b_t (1-\theta_t) + {}_{t-2} b_t (1-\theta_t)$$

In (14) we assume that the default parameter (θ_t) is the same for both types of debt maturing at time t. The budget constraint of the government is:

$$(15) \qquad {}_{t-1} b_t (1-\theta_t) + {}_{t-2} b_t (1-\theta_t) \leq \tau_t + {}_t b_{t+1}\ {}_t q_{t+1} + {}_t b_{t+2}\ {}_t q_{t+2}$$

The no arbitrage conditions require:

$$(16) \qquad {}_t q_{t+1} = \beta(1-\theta^e_{t+1}); \qquad {}_t q_{t+2} = \beta^2 (1-\theta^e_{t+2})$$

Let us consider first under what conditions the government does not default in the absence of a crisis. The discounted present value of the debt outstanding at the beginning of period 0 is:

(17) $b = {}_{-1}b_0 + {}_{-2}b_0 + \beta \, {}_{-1}b_1$

Hence the optimal tax rate is:

(18) $\tau_t = (1-\beta)b = \tau^*, \quad t = 0,1,\ldots$

Repeating the same argument illustrated in the previous subsection, we can conclude that the government will not repudiate in the absence of a crisis if the previous condition $\alpha \geq \underline{\alpha}$ holds, where $\underline{\alpha}$ is defined as in (12), except that now b replaces b_0.[10]

Consider now a confidence crisis in period t. Suppose first that the private sector followed on open-loop strategy, in the sense that the private expectations θ^e_{t+i}, $i>0$, do not depend on the aggregate history of the game in previous periods. If $\theta^e_{t+i} = 1$, $i > 0$, then in period t the government can either default, in which case consumption from then onward is c^d as in (8), or it can repay the debt. In the latter case, since by hypothesis private expectations are given and equal to 1, taxes have to be as follows:

(19) $\tau_t = {}_{t-1}b_t + {}_{t-2}b_t$

(20) $\tau_{t+1} = {}_{t-1}b_{t+1}$

(21) $\tau_s = 0, \qquad s > t+1$

If the government chooses to repay, consumption from t onwards (c^R) is:

(22) $c_s^R = 1 + e_t(1-\beta) - (1-\beta)[f({}_{t-1}b_t + {}_{t-2}b) + \beta f({}_{t-1}b_{t+1})] \qquad s \geq t$

From (8) and (22) it follows that in the event of a crisis the government chooses to repay if and only if:

(23) $\alpha \geq [f({}_{t-1}b_t + {}_{t-2}b_t) + \beta f({}_{t-1}b_{t+1})] = \bar{\alpha}_t.$

As in the previous subsection, it can be shown that, since no debt is repaid between periods 0 and t, $\bar{\alpha}_t > \underline{\alpha}$ for all t. Hence, if $\bar{\alpha}_t > \alpha \geq \underline{\alpha}$, there exists an (open-loop) equilibrium in which a confidence crisis occurs in period t or earlier.[11]

Clearly, by (23), $\bar{\alpha}_t$ depends on the maturity structure of public debt.

Proposition 2: If the private sector plays an open-loop strategy, the equilibrium with a confidence crisis is least likely to exist if only long-term debt is issued, and if the same amount of debt matures in each period.

<u>Proof</u>: By definition, α only depends on the present value of the total debt outstanding, and not on its maturity composition. Consider the sequence $\{\bar{\alpha}_t\}$, $t = 0, 1, \ldots$, and define $\bar{\alpha}*$ as the maximal element of that sequence. We want to find the maturity structure that minimizes $\bar{\alpha}*$, for a given net-present value of the total debt outstanding. A constant net present value of debt implies:

(24)
$$_{t-1}b_t + _{t-2}b_t + \beta\, _{t-1}b_{t+1} = b, \quad t = 0, 1, \ldots \tag{23}$$

Consider the problem of minimizing $\bar{\alpha}_t$ as defined in (23), by choice of $_{t-2}b_t$, $_{t-1}b_t$ and $_{t-1}b_{t+1}$, subject to (24). The first order conditions of this problem imply:

(25)
$$_{t-1}b_t + _{t-2}b_t = _{t-1}b_{t+1}$$

The maximal element $\bar{\alpha}*$ is minimized when all the elements of the sequence $\{\bar{\alpha}_t\}$ are minimized, which happens when (25) holds for all t. Combining (24) and (25) we then obtain that $_{t-1}b_t = 0$ and $_{t-2}b_t = _{t-1}b_{t+1}$ for all t. Only two-period debt must be issued, in equal amounts in each period. Q.E.D.

This result is due to the convexity of the tax collection costs. When a large amount of debt falls due in a given period, the cost of repaying it in the event of a confidence crisis is high. Hence, the crisis is more likely to result in a default. By holding a long and balanced maturity structure, the government reduces the cost of responding to a crisis by raising taxes, since the tax burden is distributed over several periods.

Proposition 2 can easily be generalized to a debt of more than two-periods. In the limit, if all debt is consols, a confidence crisis is ruled out and $\bar{\alpha} = \underline{\alpha}$. In this limiting case, there is no need to roll over the principal, and taxes are raised just to pay interest in the debt.

Next, consider the case in which the private sector plays a feedback strategy. Thus, now θ^e_{t+1} is allowed to depend on the aggregate history up to period $t+i-1$. In particular, in a sequentially rational Nash equilibrium, θ^e_{t+i} is a function of the stock of debt outstanding in the previous period, b_{t+i-1}. Suppose that $\theta^e_{t+1} = 1$. If the government chooses not to repudiate the debt, in period t it has to raise taxes in the amount:

$$(20)' \qquad \tau_t = {}_{t-1}b_t + {}_{t-2}b_t$$

But now, the total stock of debt outstanding next period is ${}_{t-1}b_{t+1}$. Servicing this debt or even repaying it all at once entails smaller tax distortions. Hence, the continuation of the confidence crisis beyond period t is now less likely. If ${}_{t-1}b_{t+1}$ is sufficiently small (so that $\underline{\alpha} > ({}_{t-1}b_{t+1})$), the continuation of the crisis past period t is ruled out altogether. Thus, when the private sector plays a feedback strategy, long—term public debt has an additional advantage besides that discussed with reference to Proposition 2. Namely, it enables the government to regain the confidence of investors by partially repaying some of the debt outstanding. This point is developed by Lars Svensson, in his comments to this paper.

IV.5   Extensions and Discussion

IV.5.1   Government spending, or where does the initial debt come from?

An alternative interpretation of our results is as follows. Suppose that there is no initial debt, but the government needs to issue debt to finance a temporarily high level of spending in period 0. The optimal policy is to issue debt in period 0 and roll it over forever, so as to smooth tax distortions over time. If α is sufficiently high (higher than $\bar{\alpha}$) debt can be issued regardless of "confidence"; if $\alpha < \underline{\alpha}$ debt cannot be issued and no tax smoothing can be achieved. In the intermediate case, $\underline{\alpha} \leq \alpha < \bar{\alpha}$, debt can be issued only as long as confidence crises do not occur. Thus, the possibility of confidence crises restricts the range of parameter values for which optimal tax smoothing can be achieved by issuing debt.

IV.5.2   Debt Auctions

The timing of events postulated in the previous pages corresponds to a particular method for selling government debt. Namely, the government fixes a base price and lets the market determine the amount bought. The nature of the equilibrium, and in particular the possibility of a confidence crisis, depends critically on the features of this auction. Suppose for instance that government debt is sold through the following more sophisticated auction method: the government fixes a base price for short-term debt; if any short-term debt remains unsold, then the government sells the remaining debt as a consol, at whatever interest rate the market will require to absorb it. As remarked above, if all debt was a consol, a confidence crisis would never occur in this simple model. Hence, in the event of a confidence crisis, the government would always be able to sell the consol with no risk premium.

Knowing that the government can rely on this option rules out the bad equilibrium with the confidence crisis, for any maturity of the debt outstanding: the maturity of the outstanding debt is completely irrelevant! What matters is only that the government retains the possibility of selling long-term debt.

However, in a more realistic environment, where long- and short-term instruments are not perfect substitutes from the point of view of the investors, this alternative auction method may not rule out completely the bad equilibria. But this example suggests that a careful selection of auction methods may contribute to ensure financial stability in a high debt economy. A more careful study of this issue is an important task for future research.

IV.5.3 Risk premium

Our model is deterministic, thus it is impossible to address the issue of the risk premium in a precise way. More generally, in a model with some uncertainty a risk premium on government debt might be requested by the investors. Giavazzi and Pagano (this volume) have analyzed this issue. We conjecture that the nature of their results would carry over to our optimizing framework.

Suppose that a confidence crisis occurs in every period with probability Q_t, exogenously given. That is, in every period t, $\theta^e_{t+1} > 0$ with probability Q_t and $\theta^e_{t+1} = 0$ with probability $1-Q_t$.[12] Assume that the true value of α is unknown to the consumer, who only assigns a probability distribution to α, $\phi(\alpha)$. If $\theta^e_{t+1} = 0$ no default occurs with certainty, but if $\theta^e_{t+1} = 1$ the probability of a default is equal to $\text{Prob}(\alpha < \bar{\alpha}) = \phi(\bar{\alpha})$ where $\bar{\alpha}$ has the same interpretation as above. Thus, in every period t, the

probability of default is $\phi(\bar{\alpha})Q_t$. If a confidence crisis occurs and $\alpha \geq \bar{\alpha}$ the government repays the debt; if $\alpha < \bar{\alpha}$ the government defaults. In either case there is no debt left after the crisis. Until a confidence crisis occurs, the government has to pay a risk premium on its liability to compensate for the default risk. As shown above, $\bar{\alpha}$ is lowest the "more balanced" and the longest is the maturity structure of the debt. Thus, the risk premium can be reduced by lengthening and balancing the maturity structure of government debt.

IV.5.4 Consolidation

A third option, in addition to repudiating or raising taxes, is available to the government in the event of a confidence crisis: to consolidate the debt. "Consolidation" is defined as a compulsory transformation of short-term debt due for maturity into long-term debt. If the secondary market for public debt is perfectly efficient, a consolidation would cause only a minor capital loss on the current holders of the debt. Thus, if private investors could be sure that the government would respond to the crisis by consolidating the debt rather than by repudiating it, they would not "fear" the crisis. But this in turn would seem to make the occurrence of a crisis less likely. Indeed, it can be shown that if the secondary market is perfectly efficient, allowing the government to consolidate its debt in the event of a crisis eliminates the bad equilibrium in which a crisis occurs. This is similar to a suspension of payments during a banking panic, as in Diamond-Dybvig (1983).

There are however two counterarguments, at least in the Italian situation. First, even though the market is much more efficient now than it used to be, it is interesting to recall what happened during the Italian

forced consolidation of 1926. At that time, the secondary market price of government debt plummeted by about 30% (even though it later recovered, and debt holders who did not liquidate the consolidated debt did not suffer high losses — see Alesina (1988) and Confalonieri–Gatti (1986)). This suggests that consolidation is still likely to be very fearsome for private investors. Second, to the extent that the political and economic costs of consolidation are smaller than those of outright repudiation, the panic equilibrium may be made more (rather than less) likely by the option of consolidating the debt. In terms of the model, the parameter α would drop, which in turn makes the crisis more likely.

V. Conclusions

Our theoretical and empirical findings suggest a tentative explanation of the recent difficulties in rolling over the Italian public debt: the fear of a confidence crisis on the debt. If correct, this explanation has some novel policy implications. All of them enhance the chance of surviving a confidence crisis without defaulting on the debt.

First of all, the quantity of debt coming due at each date is more important than the composition of the debt by category of debt instrument. Minimizing the stock of debt coming due at each date would diminish the perceived likelihood of a confidence crisis. This could be achieved by issuing debt of long maturity and evenly concentrated at all future dates. Such a policy may reduce the cost of servicing the debt because it would reduce the default risk premium required by the investors, since a confidence crisis would be less likely to occur.

Second, like in the case of banking panics, there is a role for a lender of last resort. Here this role could be fulfilled by foreign governments or international organizations, through the promise of a credit line to the country hit by the debt panic. Gaining access to such a credit line would increase the chances of surviving a crisis without defaulting, thereby making the occurrence of the crisis less likely. A similar point is raised by Grilli-Alesina (1990) with reference to speculative attacks against the exchange rate.

There is a third option, often used in the past: to rely on financial controls and monetary policy in order to artifically increase the demand for public debt. However, the European accords will severely constrain the use of both instruments. This constraint is more likely to be a blessing than a drawback. It is true that imposing financial controls and monetizing part of the debt would make it easier to withstand a debt run. But on the other hand, resorting to these instruments too frequently distorts the incentives of the government, by hiding the costs of deficit finance and creating a confusion of responsibilities between budgetary policies and monetary policy. As often argued in the Italian policy debate, these incentive effects could slow down the process of debt stabilization and thus further undermine the credibility of the government.

Footnotes

1. First, the lags in the indexation mechanism of CCT determined capital gains as long as inflation and interest rates were falling, but, when they started to increase, the same lags determined capital losses and heavy disinvestments of banks and mutual funds. Second, technical innovations in the newly issued CCT and a change in taxation contributed to the fall of the market price of CCT in the secondary market. Finally, the unusually large redemptions that the mutual funds were facing forced them to liquidate part of their assets.

2. The *ex ante* real returns have been computed by using a survey of inflation expectations published by Isco-Mondo Economico, which provides quarterly expected inflation data for the current and following quarter. Naturally, the real return differential in Figure 5 should be interpreted with caution, since we are using the same deflator for short- and long-term government debt (we simply analyze the six months expected inflation from the survey).

3. The time series of the differential relative to the 3-month CD starts only in April 1988, since this kind of financial instrument was first introduced at that date.

4. Note that the definition of saving deposits includes the CDs. The interest rate on saving deposits used to compute the differential in Fig. 8 is a weighted average of the interest rate on CDs and on other kind of saving deposits (the CD component will evidently be relevant only since 1984).

5. However, the movements of the differential between TBs and saving deposits correspond quite closely to those of the nominal interest rate. As a consequence, part of the differential can also be attributed to the tax levied

on banks by means of the reserve requirement. This tax, in fact, varies together with the nominal interest rate; as long as the banks transfer part of the tax on depositors, the differential with the TBs widens when the nominal interest rates increase and it shrinks when they decline.

6. An equilibrium satisfying these two conditions is a sequentially rational Nash Equilibrium, as defined in Persson and Tabellini (1989).

7. Suppose that the government chooses $0 < \theta_{t+1} < 1$. Then it incurs the costs of default as if $\theta_{t+1} = 1$ and some remaining debt has to be serviced with distortionary taxation.

8. In principle a third option would be available: consolidation. We will discuss this option below, in Section IV.5. For the moment we rule it out by assuming that the cost α applies to both default and consolidation. More fundamentally, this simple model with one period debt and no uncertainty is not well equipped to handle the issue of consolidation.

9. In this deterministic model a multiplicity of equilibria cannot occur in any period other than the first without violating a rationality condition. In fact if a confidence crisis had to occur at time $t > 0$, nobody would hold debt of time $(t-1)$, $(t-2)$ and so on. Thus, the crisis would ravel backward at time zero. Thus, the critical assumption is that b_0 exists before the planning horizon begins.

10. By (5), the cost of repudiation is borne only once. Thus, if $\theta_0 = 1$, then $\theta_1 = 1$ also.

11. If $\bar{\alpha}_s > \underline{\alpha}$, $s < t$, the confidence crisis unravels to the period immediately preceding that for which $\bar{\alpha}_s > \underline{\alpha}$ for the first time.

12. Remember that given our specification of the costs of default, no value of $\theta \in (0,1)$ can be a rational expectation equilibrium.

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