Scand. J. of Economics 104(3), 443–469, 2002

How is the Debt Managed? Learning from Fiscal Stabilizations*

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Abstract

This paper examines public debt management during episodes of fiscal stabilization when long-term interest rates are generally higher than governments' expectations of future rates. We find that governments increase the share of fixed-rate long-term debt denominated in the domestic currency, the higher is the conditional volatility of short-term interest rates, the lower are long-term interest rates, and the stronger is the fall in long-term rates that follows the announcement of the stabilization program. This evidence suggests that governments tend to prefer long to short maturity debt because they are concerned about refinancing risk. However, when long-term rates are high relative to their expectations, they issue short maturity debt to minimize borrowing costs.

Keywords: Credibility; debt maturity; public debt management; stabilization

JEL classification: *E*63; *H*63

I. Introduction

The positive issue of how policymakers choose debt instruments remains largely unexplored in the literature on debt management.[1] Although officials

*We thank all the people in Treasuries and Central Banks who helped us build a database on the composition and maturity of public debt. We thank Pierpaolo Battigalli, Rudi Dornbusch and Prescott Miller for insightful discussions. We are particularly indebted to two anonymous referees whose suggestions have considerably improved the quality of the paper. The paper benefited from the comments of Olivier Blanchard, Francesco Daveri, Carlo Favero, Ilan Goldfajn, Mervyn King, Gustavo Piga and Paul Tucker.

[1]The possibility of a strategic use of debt characteristics is suggested by Milesi-Ferretti (1995), Drudi and Prati (1995), Uhlig (1997) and Pecchi and Piga (1999). There are very few empirical studies of the choice of debt denomination and debt maturity: Calvo, Guidotti and Leiderman

often state that minimization of the costs and risks of servicing the public debt are the main goals of debt management, very little is known about how these goals are pursued in practice. For instance, cost minimization can be attained either by creating liquid markets for benchmark bonds and following a predictable issuing strategy, or by supplying bonds with characteristics which satisfy investors' demand, or by an active trading strategy based on views about future interest rates. This paper addresses this issue by empirically investigating how debt managers behave on a particular occasion, that is at the start of a fiscal stabilization.

We focus on debt management during episodes of fiscal stabilization because such episodes tend to share a common feature. When a stabilization plan is announced, it typically does not enjoy full credibility among investors; long-term interest rates are thus higher than governments' expectations of future rates. This feature of a stabilization thus allows us to overcome the problem that governments' expectations of future interest rates are generally not observable—a necessary step in the analysis of how debt instruments are chosen.

Our sample contains 72 episodes of fiscal stabilization in OECD countries between 1975 and 1998. In each case we analyze the government issuing strategy during the first two years of the stabilization. We find evidence that governments, at the start of a stabilization, increase the share of fixed-rate long-term debt denominated in the domestic currency, the higher is the conditional volatility of short-term interest rates, the lower is the level of long-term interest rates, and the stronger is the fall in long-term rates that follows the announcement of the stabilization program. By contrast, conventional measures of the relative cost of issuing long-term debt, such as the long–short interest-rate spread, are not significant.

This evidence suggests that governments tend to prefer long to short maturity debt because they are concerned about the risk of refinancing at higher than expected interest rates. However, when long-term rates are high relative to their expectations, governments issue short maturity debt to minimize borrowing costs.

This observation is consistent with the view in Campbell (1995) that a committed government can reduce the cost of debt servicing by issuing short-term debt. High interest rates on long-term bonds may reflect credibility problems, rather than term premia: since the government's resolution to carry out a stabilization is not known to the private sector, long rates may remain high until the time when the uncertainty is resolved. Moreoever, issuing short-term debt can yield additional benefits to the extent that it

(1991), Missale and Blanchard (1994), De Broeck (1997) and Miller (1997a). The normative literature is surveyed in Missale (1997).

signals the governement's intentions. By shortening debt maturity, committed governments may distinguish themselves from those that are less determined.

We provide a simple formalization of signaling effects by exploring a reputation game between two governments which differ in their ability to cut spending and thus in the interest rates that they expect to face after the program is carried out. Under symmetric information, long-term interest rates correctly reflect the prospects of the stabilization attempt and the expected cost of debt service is independent of debt maturity. In this case, long-term bonds minimize the probability that the stabilization fails as a result of an exogenous interest rate shock. However, if the government's ability to cut spending is not known to the public, and spending cuts require time to be implemented, then a low-spending government faces "too high" interest rates on long-term bonds. It may thus want to issue short-term debt to reduce borrowing costs and signal its ability to cut spending. We show that a separating equilibrium exists where the "tough" government shortens debt maturity to signal its determination. The separating maturity is decreasing with the level of the long-term interest rate, and increasing with the variability of interest rates.

The paper is organized as follows. We set up a simple model of a fiscal stabilization in Section II. In subsections, we then describe the choice of debt maturity when the authorities and the private sector share the same information, introduce asymmetric information and examine separating equilibria, and study pooling equilibria. The empirical evidence is reported in Section III. Section IV concludes.

II. A Simple Model of Fiscal Stabilization

In our simple model of fiscal stabilization, the government's objective is to reach a target surplus, S^*, that can be thought of as the announced budget for the current year, within a multi-year stabilization program, or as the surplus needed to stabilize the debt-to-GDP ratio.

The government chooses taxes, T, weighting the expected cost of missing the announced target against the costs of distortionary taxation. Approximating the deadweight loss from taxation by a quadratic term in the tax rate, the expected loss is given by

$$L = p\Pi + \tfrac{1}{2}T^2, \tag{1}$$

where p denotes the probability that the stabilization fails and Π is the fixed cost of failure relative to the cost of taxation.

This loss function has been used by Dornbusch (1991) and Drazen and

Masson (1994) in the context of exchange rate stabilization. The cost of taxation is standard, while the cost of a failed stabilization reflects either the reputational and political costs of missing the announced budget target, as in Dornbusch (1991), or the higher inflation which may result if the stabilization fails (here described by the fixed term Π), as in Drazen and Masson (1994).[2]

The sequence of events is as follows. At the beginning of period 0 the government rolls over the public debt and decides the relative amounts of one- and two-period bonds to be issued. The current short-term interest rate, r_0, is known. After the government has decided the composition of the debt, private investors form expectations on the period-1 interest rate, r_1: this determines the interest payments on two-period bonds. At the beginning of period 1 investors observe government spending and all the exogenous uncertainty about the period-1 interest rate is resolved. This determines the interest rate, r_1, at which one-period bonds are rolled over. At the end of period 1 the government chooses taxes to meet the announced budget target. However, whether or not the target will be met remains uncertain, since it depends on a shock, X, which hits the budget after taxes have been set.

The success of the stabilization depends on the realization of X. Setting, without any loss of generality, S^* equal to zero, the probability that the stabilization fails, i.e., the probability of a budget deficit, is equal to

$$p = \text{prob}[X > T - G - I], \tag{2}$$

where G denotes government spending and I the cost of debt service which depends on the level of interest rates and on the maturity composition of the debt.

To model debt service it is sufficient to consider r_1, the interest rate which prevails in period 1, because the interest rate in period 0, r_0, is known at the time of debt issuance. (Since we are interested in the relative cost of short- vs. long-term debt, the exact leve of r_0 is irrelevant: we thus set it equal to zero to simplify the notation.) Assuming that private investors are risk neutral and denoting by E_0 the expectation conditional on the information available at period 0, interest payments are equal to

[2]This loss function may appear to excessively penalize the government for small deviations from S^*. However, as can easily be shown, adding a linear term that makes the cost of a failed stabilization increase with the size of the budget deficit, does not qualitatively affect the result regarding maturity. It is also worth noting that all results regarding maturity still hold if we were to replace equation (1) with a quadratic loss function in the deviation of the budget from target, that is $L = \Pi E(S^* - S)^2 + kE(S^* - S) + \frac{1}{2}T^2$. We prefer the specification in the text not only because it captures the fixed costs of a failed stabilization but also because it shows that the analysis does not depend on the assumption that the government is risk averse.

$$I = (1 - m)r_1 + mE_0 r_1, \tag{3}$$

where m is the share of two-period bonds issued in period 0 and where the initial level of debt has been normalized to one. (In what follows we refer to m as debt maturity.)

r_1 plays a key role in the choice of debt maturity. Having set r_0 equal to zero, the cost of two-period bonds is equal to the expectation, at period 0, of the interest rate, r_1, which prevails in period 1, i.e., to the forward rate $E_0 r_1$. The cost of two-period bonds is thus predetermined. But the cost of one-period bonds is uncertain, since it depends on the interest rate, r_1, at which such debt will be refinanced in period 1.

There are two sources of uncertainty affecting r_1. First, this interest rate is subject to independent exogenous shocks. Second, it depends on government spending—for instance because higher G might lead investors to expect higher inflation or exchange rate depreciation. This is not known to the private sector at the time of debt issuance since the government's ability to cut spending is private information. Assuming that government spending only affects the mean of the interest rate, we have

$$r_1 = r(G) + u, \tag{4}$$

where $r(G) \geqslant 0$ denotes the mean of r_1 as a positive function of government spending, and u is an independent shock, distributed on the compact support $[u^l, u^h]$, with mean $E_0 u = 0$ and variance $E_0 u^2 = \sigma^2$.

Lengthening Debt Maturity to Minimize Refinancing Risk

We first examine the choice of debt maturity, m, when government spending in period 1, and hence $r(G)$, are publicly known. We solve the government's problem backward, first deriving the choice of taxes, given debt maturity and interest rates, then the choice of debt maturity.

In period 1 the government minimizes the loss function (1): p, the probability of missing the announced budget target, is obtained by assuming that the distribution of the shock X is triangular with mean zero, $E_1 X = 0$, and a support ranging between $-a$ and a. (With this assumption we capture the fact that shocks of larger size are less likely to occur.)[3] We consider the RHS of the distribution of X, since we focus on a government which expects to succeed, in the sense that it chooses a level of taxes, T^*, for which the

[3] The result for the optimal share, m, holds as a linear approximation for probability density functions decreasing in X over the relevant region.

expected budget is larger than the announced target, $S^* = 0$; i.e., it chooses $T^* - G - I > 0$.[4]

Substituting $G + I - T$ into the value of p, and replacing p in equation (1), we obtain the loss that the government expects after observing I, but before knowing the realization of X:

$$L = \frac{\Pi}{2a^2}(a + G + I - T)^2 + \tfrac{1}{2}T^2. \tag{5}$$

Then, the optimal value of taxes is equal to $T^* = \delta(a + G + I)$ where $\delta = \Pi/(a^2 + \Pi)$.

We now turn to the choice of m. Substituting T^* into equation (5), and taking expectations conditional on the information at time 0, yields the value of the expected loss when the government decides the maturity of the debt

$$E_0 L^* = E_0 \frac{\delta}{2}[a + G + I]^2 = E_0 \frac{\delta}{2}[a + G + (1 - m)r_1 B + mE_0 r_1]^2. \tag{6}$$

The loss (6) is minimized choosing $m = 1$. By issuing only two-period bonds, the government insulates the budget from interest rate shocks and thus eliminates all the uncertainty regarding the cost of debt service. This policy is optimal because it rules out that the stabilization may fail as a result of a negative shock to the interest rate.[5] Intuitively, a government which expects to succeed will not take bets on interest rates: a negative interest-rate shock increases the probability of failure by a larger amount than a positive shock of the same size reduces it.[6]

Various arguments for issuing long-term debt have been made in the public debt literature. In Barro (1997, 1998) long-term debt insulates the budget from fluctuations in interest rates and thus allows for smoothing of tax rates. A long and balanced maturity structure may also prevent the

[4]This government can be regarded as characterized by a high cost of failure, Π, relative to the level of government spending and the variance of X. Formally, the expected surplus is positive if and only if $\Pi > a(G + I)$. It follows that the support of the distribution of r_1 must also be bounded from above to rule out the possibility that the surplus turns out to be negative because of a large realization of I.

[5]Note that the expected cost of debt service in period 0 is independent of debt composition because of the assumption of risk-neutral investors. With a term premium on two-period bonds, the optimal maturity would be lower than one. This would affect our results numerically, though not qualitatively.

[6]This is because the probability of a bad shock, $X > 0$, to the budget decreases with the size of the shock. Note that the tax-smoothing motivation implied by the quadratic term T^2 in the loss function is not sufficient to conclude that long maturity debt is optimal: if X were uniformly distributed, the maturity of the debt would be irrelevant.

emergence of self-fulfilling crises, or speculative attacks, as in Calvo (1988), Alesina, Prati and Tabellini (1990), Giavazzi and Pagano (1990), Obstfeld (1994) and Sachs, Tornell and Velasco (1996), among others. In this model a preference for long-term debt arises for a different reason: for any given expected cost of debt service, long-term debt increases the probability that the stabilization will succeed. Our result is closer in spirit to a simple idea in the corporate finance literature; Morris (1976) describes how a debt maturity matching the life of a firm's asset minimizes the variance of cash flows and thus reduces the bankruptcy risk.

In our model, a government will issue short maturity debt only if the cost of long-term debt is too high relative to its expectation of the interest rate in period 1. This is the case if investors lack confidence in the government's ability to cut spending. Credibility problems are considered below.

Shortening Debt Maturity to Signal Resolution

We introduce asymmetric information by assuming that the amount of spending cuts and thus the level of spending in period 1 are not known to private investors. The government can be of two types—tough or weak—depending on the level of spending in period 1. A tough government (carries out larger cuts and) has a level of spending, G^L, lower than the level of spending, G^H, of a weak government.

Therefore, from equation (4), the interest rate a tough government faces, $r_1^T = r(G^L) + u$, is expected to be lower than the interest rate faced by a weak government, $r_1^W = r(G^H) + u$. The distributions of the two interest rates are assumed to be identical except for their mean, so that the difference between the expected interest rates faced by the two governments is a positive constant: $s \equiv r(G^H) - r(G^L)$.

As above, we limit our analysis to the case where both governments are expected to succeed—but the size of the shocks for which they fail differs. Both governments are thus better off, the smaller is the variance of interest payments—under perfect information they would issue long maturity debt. Investors, however, are uncertain about the type of government they face: a tough government may therefore want to issue short-term debt to avoid paying a premium on long maturities. This is because short-term debt will be refinanced in period 1, after spending cuts are observed and thus, if the government is tough, at a lower interest rate.

The idea that short-term debt helps to reduce the financing costs of better borrowers (if their quality is not known) due to the arrival of new information is well known in corporate finance.[7] As first shown by Flannery (1986),

[7] See Ravid (1996) for a survey of the literature.

short-term debt might signal the quality of the borrower. In what follows we extend this idea to the choice of the maturity of public debt, showing that short-term debt allows a tough government to distinguish itself from a weak type.[8]

Consider a class of separating equilibria where beliefs have the following form: for maturities shorter than or equal to m^S, the separating maturity, investors expect the government to be tough; for maturities longer than m^S they expect the government to be weak.

The weak government reveals itself if and only if the expected loss when it issues only two-period bonds, and is therefore identified as weak, is smaller than the expected loss when it chooses a maturity equal to (or shorter than) m^S:

$$E_0 L^W(W,\ m = 1) \leqslant E_0 L^W(T,\ m \leqslant m^S), \tag{7}$$

where the first term in parentheses denotes investors' beliefs. This inequality holds for

$$m \leqslant m^S \equiv \frac{\sigma^2 + sx - \sqrt{s^2x^2 + \sigma^2 s(2x - s)}}{\sigma^2 + s^2}, \tag{8}$$

where $x \equiv a + G^H + r(G^H)$ is the square root of the expected loss of the weak government under full information (divided by $\delta/2$). The incentive compatibility constraint of the weak government is satisfied for maturities lower than or equal to m^S which can be shown to lie in the interval [0; 1] for any choice of parameter values.

The intuition for this result is as follows. A short maturity carries no benefit for a weak government, except for allowing it to disguise itself as tough. Since by mimicking a tough government, interest payments are saved only on long-term debt, such a gain disappears as the maturity shortens. By contrast, the refinancing risk increases with the amount of short-term debt issued. It follows that there is always a short enough, but positive, maturity, $0 < m^S < 1$, which makes the weak government reveal itself. Importantly, m^S increases with the variance of interest rates, σ^2, and decreases with the difference, $s \equiv r(G^H) - r(G^L)$, between the interest rate that the weak

[8]In our model, signaling is costly because it affects the probability of success of the stabilization and not because of exogenous underwriting costs, as in Flannery (1986), or because of removal of the borrower from control of the firm, as in Diamond (1991, 1993). The problem also differs from that in Drudi and Prati (1995) where the maturity of public debt signals inflationary preferences: a government that never inflates may issue long-term debt to separate itself from a high-inflation government in the intermediate period.

government expects in period 1 (after the implementation of budget cuts) and the interest rate expected by a tough government.

A separating equilibrium thus exists if and only if the tough government is willing to shorten the maturity down to m^S, thus signaling its type. This happens if

$$E_0 L^T(T, m^S) \leqslant E_0 L^T(W, m^S < \overline{m} \leqslant 1), \tag{9}$$

where $\overline{m}$ is the maturity which minimizes the expected loss when the tough government is believed to be weak, that is, for maturities in the interval $[m^S; 1]$.[9]

The incentive compatibility constraint of the tough government is satisfied if

$$(1 - m^S)^2\sigma^2 \leqslant (1 - \overline{m})^2\sigma^2 + \overline{m}^2 s^2 + 2\overline{m}sz, \tag{10}$$

where $z \equiv a + G^L + r(G^L)$ is the square root of the expected loss of the tough government under full information (divided by $\delta/2$). This condition shows that the tough government will shorten the maturity of the debt only if the cost of being perceived as weak, which depends on the difference between the interest rates faced by the two governments, s, is high relative to the refinancing risk, σ^2.

A sufficient condition for a separating equilibrium is[10]

$$\sigma^2 \leqslant s(a + G^L + r(G^L))\left[1 + \frac{a + G^L + r(G^L) + s}{2(a + G^H + r(G^L)) + s}\right], \tag{11}$$

where the RHS is increasing in $s \equiv r(G^H) - r(G^L)$.

Necessary conditions on the values of σ^2 and s for the existence of a separating equilibrium can be found with the help of numerical simulations (not reported here). Results of such simulations confirm that σ^2 cannot be too large relative to s—otherwise the tough government would prefer not to reveal itself, and limit the roll-over risk by issuing a larger amount of long-term debt.

[9]Note that if the tough government chooses a maturity longer than m^S, it opts for the maturity which minimizes its loss. Since it is believed to be weak, it chooses $\overline{m} \leqslant 1$ to reduce interest payments.

[10]The math is a follows. Since for any given maturity the expected loss is lower when the government is believed tough than when it is believed weak, condition (10) is satisfied for $\overline{m} = m^S$. Then, a sufficient condition for (10) to hold is that the loss from being believed weak increases with m for maturities greater than m^S: i.e., that $m^2(\sigma^2 + s^2) - 2m(\sigma^2 - sz) + z^2 + \sigma^2$ increases over the interval $[m^S; 1]$ which gives condition (11).

When a separating equilibrium does not exist, pooling equilibria may exist, where both governments choose the same maturity.

High Risk and Low Cost: Pooling Equilibria

In a pooling equilibrium both governments choose the same maturity, and the interest rate on two-period bonds, i.e., the forward rate, is equal to

$$E_0 r_1^P = E_0[q r_1^T + (1-q) r_1^W = r(G^L) + (1-q)s, \tag{12}$$

where q, the probability that the government is tough, depends on the prior beliefs of investors. The forward rate decreases with a government's reputation, q, and increases with the difference between the interest rates faced by the two governments, $s \equiv r(G^H) - r(G^L)$.

Let us denote by m^P the maturity which minimizes the loss of the tough government, given "pooling" expectations and thus an interest rate on two-period bonds equal to $E_0 r_1^P$. Then, a class of pooling equilibria may exist and is supported by the following beliefs: for maturities shorter than or equal to m^P—the pooling maturity—investors do not distinguish the government type and ask for an interest rate on two-period bonds equal to $E_0 r_1^P$; for maturities longer than m^P they expect the government to be weak.[11]

Since the tough government chooses m^P, the maturity which minimizes its expected loss, a pooling equilibrium exists if and only if m^P satisfies the incentive compatibility constraint of the weak government, $E_0 L^W(Pool, m^P) \leqslant E_0 L^W(W, m=1)$. This requires[12]

$$m^P = \frac{\sigma^2 - (1-q)sz}{\sigma^2 + (1-q)^2 s^2} \geqslant m^W \equiv \frac{\sigma^2 + sqx - \sqrt{s^2 q^2 x^2 + \sigma^2 sq(2x - sq)}}{\sigma^2 + s^2 q^2}. \tag{13}$$

Condition (13) shows that for a pooling equilibrium to exist the initial reputation, q, must be sufficiently high. Intuitively, a better reputation implies a lower interest rate, $E_0 r_1^P$, thus making the tough government willing to choose a longer maturity, m^P. A lower interest rate also increases the incentive of a weak government not to reveal itself and face a higher

[11] See Missale, Giavazzi and Benigno (1997) for the proof.

[12] Other pooling equilibria may exist when $m^P > m^W$. In particular, it can be shown that any maturity m^{WP}, such that $m^P > m^{WP} \geqslant m^W$ can also be sustained as a pooling equilibrium by the expectation that the government is weak when a maturity longer than m^{WP} is chosen, provided that m^{WP} satisfies the incentive compatibility constraint of the tough government; see Missale *et al.* (1997).

refinancing risk. This lowers the cut-off maturity m^W that makes the weak government indifferent between pooling and revealing itself.

Although the parameter values for which condition (13) holds cannot be derived analytically, the important points for the empirical analysis that follows can be made without numerical simulations. First, if a pooling equilibrium exists, the corresponding maturity, m^P, is longer than the separating maturity, m^S, which induces a weak government to reveal itself, since $m^W > m^S$. (This is because m^W decreases with sq and is equal to m^S for $q = 1$.) Second, the maturities m^W and m^P increase with the variance of period 1 interest rates, σ^2, and decrease with the difference, s, between the interest rates faced by the two governments.

To summarize, the analysis of the reputation game shows that the variance of short-term rates, σ^2, is low relative to the interest-rate differential, s, a separating equilibrium exists; the separating maturity, m^S, increases with σ^2 and decreases with s. Instead, for higher values of σ^2 relative to s only pooling equilibria may exist. In a pooling equilibrium, debt maturity is always longer than in a separating equilibrium. Moreover, the pooling maturity increases with σ^2 and decreases with s, more precisely, with $(1 - q)s$.[13]

III. Debt Maturity and Fiscal Stabilizations: The Evidence

The model above suggests that the share of long-term debt issued by a government truly committed to carrying out a stabilization will depend on the extent to which its announcements are believed by private investors. Lack of credibility will result in shorter maturities.

Measuring credibility is obviously difficult. Ideally, one would like to know how credible a program is at the time it is announced, before the maturity of the debt is chosen. The variable which could convey such information is the change in long-term interest rates immediately following the announcement. However, recovering such information from case studies of individual stabilizations is an almost impossible task—in particular, what is difficult is identifying the time of the first announcement of a stabilization plan. Realistically, we have to rely on an *ex-post* measure of credibility. We thus proxy credibility with the change in the long-term interest rate that occurs during the first year of the stabilization. We expect that a fall in such rates leads governments to issue long-term debt.

If, instead, the announced budget cuts are not fully credible—which

[13]It is worth noting, however, that for certain values of σ^2 and s the equilibrium could be pooling or separating, implying that different maturities might be observed for the same parameter values. In this case the use of refinements is necessary to eliminate pooling equilibria and fully prove our claim.

happens if investors ignore the type of government they face, and thus its determination in carrying out the program—a committed government will face long-term rates which are too high relative to its expectations of future rates, and will shorten the maturity of the debt. The maturity it chooses will be shorter, the greater is s, the difference between the interest rates that a weak and a tough government face after the implementation of budget cuts (the greater is $(1 - q)s$ in a pooling equilibrium) and the lower the conditional volatility of short-term interest rates, σ^2.

Though not directly observable, s and q are reflected in the forward rate—i.e., in the expectation of future interest rates implied by the term structure. If the private sector ignores the type of government it faces, the forward rate is $E_{t-1} r_t = r(G^L) + (1 - q_{t-1})s$, as in a pooling equilibrium. $(1 - q_{t-1})s$ can be measured by the difference between the forward rate and the rate that would prevail if the government were known to be fully committed, $r(G^L)$. This difference reflects the probability that future interest rates could be higher because the government turns out to be weak: we call it the *informational spread*. To obtain a measure of $(1 - q_{t-1})s$ we proceed in two steps. First, we restrict our attention to stabilizations characterized by sizable fiscal corrections so as to select truly committed governments. Second, we approximate $(1 - q_{t-1})s$ with the long-term rate at the start of each episode, R_{t-1}, implicitly assuming that the expectations of debt managers on the level of future interest rates, $r(G^L)$, are constant across episodes of fiscal stabilization. This would be be case if debt managers shared a common view as to what the interest rate will be after a successful stabilization.

Debt maturity should increase with σ^2 (which we measure using an estimate of the conditional volatility of short-term interests rates), and decrease with our measure of the informational spread. In what follows we test these predictions using cross-section data on the composition of public debt and on interest rates in 72 episodes of fiscal stabilization which occurred in the OECD countries between 1975 and 1998.

We have identified these episodes using the OECD estimates of the general government's primary structural budget surplus—that is, the cyclically adjusted budget surplus net of interest payments (see the Appendix for further details). An episode of fiscal stabilization is defined as a period, lasting one or more years, during which the structural primary surplus improves by at least 1 percent of GDP. This definition is intended to capture important changes in the discretionary component of the budget. By excluding small corrections—those between 0 and 1 percent of GDP—we avoid the risk of including improvements in the primary budget which occurred by chance, or simply because of the exhaustion of temporary expansionary measures. More importantly, we want to capture relatively large fiscal corrections, since the predictions of our model concern the issuing strategy of governments confident in their ability to implement the announced program.

The regression we ran is of the form

$$m_{t+1} - m_{t-1} = \beta_0 + \beta_1(\sigma_r/\mu_r)_{t-1} + \beta_2 R_{t-1} + \beta_3 \Delta R_t + \beta_4 m_{t-1} + \beta_5 (B/GDP)_{t-1} + \varepsilon, \quad (14)$$

where $m_{t+1} - m_{t-1}$ is the two-year change in the share of fixed-rate long-term debt; $(\sigma_r/\mu_r)_{t-1}$ is the conditional standard error (divided by the mean) of short-term interest rates; R_{t-1} is the long-term interest rate the year before the stabilization; ΔR_t is the change in the long-term interest rate in the first year of the stabilization; m_{t-1} is the initial share of long-term debt and $(B/GDP)_{t-1}$ is the initial debt-to-GDP ratio.

The two-year change in the share of fixed-rate long-term debt is computed as the difference between the share of such debt at the end of the second year of the stabilization and the share at the end of the year preceding the stabilization.[14] The share of fixed-rate long-term debt is defined as the percentage of fixed-rate government bonds and loans denominated in the domestic currency with an initial maturity longer than one year (see the Appendix for further details). Consistent with our model, floating-rate bonds are defined as short maturity debt since their coupons reflect (with a lag) changes in market interest rates. The classification of bonds and loans denominated in foreign currency, and of inflation-indexed bonds, is less clear-cut. If high long-term interest rates reflect expected inflation and exchange-rate depreciation, then indexed and foreign-currency debt play the same role as short-term debt, since they reduce the cost of borrowing and signal commitment.[15] Including such instruments in short maturity debt would instead be wrong if high interest rates reflected a premium arising from default risk. Although such a case seems unlikely for the sample of industrialized OECD countries and for the period considered in our estimation, we also report the results obtained when such instruments are included among long-term debt.

The variance of short-term interest rates, conditional on the information available to the government, measures the *roll-over risk*. We proxy the conditional variance, $(\sigma_r/\mu_r)_{t-1}$, by the standard error (divided by the mean) of short-term interest rates in the seven-year period preceding the

[14] For most countries in our sample this information is available only once-a-year, at the end of the fiscal year, usually December 31st. For countries where the fiscal year ends on March 31st, the data have been assigned to December of the previous year.

[15] Although such instruments reduce the roll-over risk, they expose the government budget to other costs and risks. For instance, foreign currency debt introduces exchange-rate risk stemming from foreign monetary disturbances, as in Bohn (1990) and Miller (1997b), while issuing indexed debt is costly because of the absence or illiquidity of the secondary market, as in Persson (1997).

stabilization. The standard error is estimated from an auxiliary regression (on quarterly data) of the short-term rate on its first lag and the first lag of the long-term rate.

The level of the long-term interest rate in the year preceding the stabilization, R_{t-1}, is used to approximate the *informational spread*, that is, the difference between the forward rate implicit in the long-term interest rate and the forward rate as expected by the government. Since the latter is unobservable we treat it as a constant.[16] This does not affect the estimation results to the extent that the governments' expectations about the level of future interest rates are constant across stabilization episodes. It is worth noting that conventional measures of credibility, such as the spread between long- and short-term interest rates, i.e., the slope of the yield curve, are not appropriate for the problem considered here. What matters is not the current level of the short-term rate, but rather the future level of such a rate, as expected by the government, compared with the market's expectations implicit in the current long-term rate. In fact, the issuing strategy of a government facing a flat yield curve can be quite different depending on whether the level of the interest rate is 5 or 15 percent.

The change in the long-term interest rate that occurs during the first year of the stabilization, ΔR_t, is used as an *ex-post* measure of the credibility of the program. Consistent with the argument developed above, the share of long-term debt should decrease with ΔR_t.

Finally, we add two control variables to the set of regressors: the initial share of long-term debt and the debt-to-GDP ratio at the start of the stabilization episode. We include the initial share of long-term debt since our model does not claim to provide a complete account of the steady-state composition of the debt. For instance, we expect a correction towards a higher share of long debt (a negative coefficient on the initial share) in countries which start from a very low level of long-term debt, say, because of a greater concern for refinancing risk.

The initial level of debt relative to GDP may also affect the choice of debt maturity in the sense that the minimization of cost and risk should be relatively more important in highly indebted countries.

[16]Note that since we use yield-to-maturity on 10-year bonds, the longer-term interest rate is a good approximation of the forward rate.

Empirical Results

The 72 episodes of fiscal corrections we consider are listed in Table 1.[17] The composition of the public debt in each country was obtained from national sources and is reported in Missale (1999). Data on debt, short- and long-term interest rates are from OECD *Economic Outlook*. Long-term interest rates are the yields-to-maturity of benchmark long-term government bonds on the domestic market. Short-term interest rates refer to three-month interbank rates.[18] Quarterly data on short-term interest rates used to estimate σ_r/μ_r are from OECD *Main Economic Indicators* (see the Appendix).

No clear pattern in the choice of debt maturity emerges from Table 1. While on average, during a fiscal stabilization, the share of long-term debt increases slightly, the number of episodes where the opposite happens appear to be equally important.

In Table 2 we report the results of the OLS estimation of equation (14). The estimates for the full sample of stabilization episodes are shown in column 1. The coefficient on the standard error of the short-term interest rate is positive and significant at the 10 percent level, suggesting that an increase in the volatility of short rates leads governments to lengthen debt maturity in order to limit the refinancing risk. The coefficients on the long-term interest rate and its change are negative as expected, and significant at the 5 percent level. These results strongly support the predictions of the model. A rise in the long-term rate during the first year of a program—an indication that the program lacks credibility—significantly reduces the share of long-term debt. A high long-term rate at the start of a stabilization—a measure of the informational spread—leads the government to issue short-term debt (or variable rate or foreign-currency debt). The effect of the initial share of long-term debt is negative and significant: if such a share is low to start with, the government tends to raise it. The debt-ratio appears to positively affect the share of long-term debt, but its coefficient is unprecisely estimated.

In the second column of Table 2 we ask whether the effects detected so far are equally present in the subsample of episodes characterized by a relatively larger fiscal adjustment. Column 2 reports evidence for episodes of fiscal adjustments greater than or equal to 2 percent of GDP (Corr $\geqslant$ 2). We have no good excuse for choosing the 2 percent cut-off point, except that any such

[17]According to our definition, there are 79 episodes of fiscal correction from 1975 to 1998 for the 19 countries for which the OECD Economic Department estimates structural balances; see OECD *Economic Outlook*, Annex Table 31. Our sample reduces to 72 episodes due to the lack of information on the debt composition of Greece and Norway and because data on interest rates for the Spanish episode of 1975 are not available.

[18]Interest rates on three-month Treasury bills are not available for all countries. For long-term rates, the OECD *Economic Outlook* reports the yield-to-maturity on 10-year bonds when available, otherwise it considers shorter maturity bonds.

Table 1. *The stabilization episodes*

Episode	Corr	$m_{t+1} - m_{t-1}$	m_{t-1}	B/GDP	σ_t/μ_r	R_{t-1}	$R_{t-1} - r_{t-1}$	ΔR_t	$\Delta(R_t - r_t)$
Australia 77	2.7	−12.6	70.1	24.5	11.0	10.2	0.9	0.1	−0.9
Australia 80–82	3.2	1.7	56.1	25.4	7.0	9.8	−0.1	1.9	−0.4
Australia 85–88	3.7	−5.9	64.5	25.4	6.7	13.6	1.3	0.4	−3.6
Australia 95–98	3.1	−1.8	76.3	35.8	7.7	9.0	3.3	0.1	−1.9
Austria 77–78	2.0	2.6	53.9	27.4	2.1	8.8	4.1	0.0	−2.8
Austria 80–81	2.3	−14.3	60.6	36.0	1.6	8.0	2.4	1.4	−3.3
Austria 84	2.2	−1.0	41.9	46.5	1.9	8.2	2.8	−0.2	−1.3
Austria 92	1.4	2.5	48.7	58.6	6.2	8.6	−0.5	−0.3	−0.6
Austria 96–97	3.3	6.4	54.6	69.2	4.2	7.1	2.6	−0.8	0.4
Belgium 77	1.3	−1.2	80.2	59.4	21.8	9.1	−0.8	−0.3	2.5
Belgium 82–87	10.0	−6.6	55.1	92.9	20.0	13.4	−1.8	0.0	1.3
Belgium 92–94	3.5	2.7	59.4	130.3	9.2	9.3	−0.1	−0.7	−0.6
Belgium 96–98	1.3	2.2	60.3	134.6	13.7	7.4	2.6	−1.1	0.5
Canada 79–81	3.3	9.3	39.8	46.4	12.3	9.3	0.4	0.9	−2.3
Canada 86–90	3.2	1.0	40.2	64.7	17.4	11.1	1.5	−1.6	−1.2
Canada 93–98	7.6	4.0	46.1	88.0	11.9	8.8	2.1	−0.9	0.8
Denmark 83–86	12.2	8.2	59.3	67.0	17.9	21.4	4.6	−6.3	−2.2
Denmark 96–98	1.7	11.0	60.8	80.9	17.1	8.3	2.3	−1.2	1.0
Finland 75–76	3.7	−10.0	57.0	8.5	3.5	8.8	−1.6	0.8	−0.5
Finland 81	1.3	−4.6	42.2	14.1	12.4	10.4	−1.9	0.6	1.3
Finland 84	2.4	−1.9	43.0	18.5	9.4	10.8	−3.8	0.4	−1.6
Finland 88–89	2.4	10.6	45.8	20.5	7.6	7.9	−2.1	2.4	2.5
Finland 93–94	1.8	3.5	30.9	46.2	11.5	12.1	−1.2	−3.8	1.6
Finland 96–97	2.3	12.0	43.4	69.0	14.7	7.9	2.2	−1.9	0.2
France 76	1.2	−2.0	16.3	30.4	14.7	10.3	2.4	0.2	−0.6
France 79–80	2.5	12.9	15.2	31.0	12.9	10.6	2.5	0.2	−1.1
France 83–87	3.4	1.4	30.1	34.2	11.0	16.0	1.4	−1.6	0.5
France 95–97	2.8	−1.1	71.9	54.7	9.9	7.5	1.7	0.1	−0.6
Germany 76–77	1.7	1.5	83.4	25.1	18.7	8.7	3.7	−0.6	0.1
Germany 80–85	5.4	5.4	87.2	30.8	21.5	7.6	0.9	0.9	−2.0
Germany 89	1.7	−2.3	93.9	44.4	9.6	6.5	2.2	0.5	−2.2
Germany 92–98	4.8	−3.6	92.4	41.2	8.6	8.5	−0.7	−0.6	−0.9
Ireland 82–84	6.5	−5.8	44.7	76.4	15.7	17.3	2.1	−0.2	−1.3
Ireland 86–89	8.7	6.9	40.9	103.5	8.5	12.6	0.7	−1.6	−2.2
Ireland 91–93	2.7	1.5	40.7	97.4	15.2	10.1	−1.2	−0.9	0.0
Ireland 96–98	2.6	4.5	44.9	87.9	25.1	8.3	2.0	−0.8	0.0
Italy 76–77	4.2	0.6	36.8	57.6	21.3	10.0	−0.6	2.6	−2.4
Italy 80	1.7	−9.0	30.4	60.7	19.4	13.0	1.2	2.2	−3.1
Italy 82–83	3.7	−9.2	21.4	60.3	14.5	19.4	0.1	0.9	0.3
Italy 86	1.2	3.0	11.0	82.3	5.4	13.7	−1.5	−2.2	−0.4
Italy 88–89	1.1	5.5	14.0	90.6	6.8	10.6	−0.7	0.3	0.8
Italy 91	1.5	4.7	18.5	106.5	9.2	13.5	1.6	−0.4	−0.4
Italy 93	3.8	6.8	23.2	116.8	11.1	13.7	−0.6	−2.4	1.3
Italy 95–97	5.3	7.4	30.9	123.9	13.6	10.5	2.0	1.7	−0.3
Japan 79–87	7.8	4.6	82.9	39.7	13.2	6.4	1.3	2.0	1.1
Netherlands 77	1.0	−1.0	89.7	41.4	33.5	9.0	2.1	−0.9	1.5
Netherlands 81–83	2.7	4.9	92.8	46.9	31.0	10.2	−0.5	1.3	0.4
Netherlands 85	1.2	−0.3	98.8	66.8	19.1	8.1	2.0	−0.8	−1.0
Netherlands 87–88	1.6	0.1	98.5	73.5	13.5	6.3	0.6	0.1	0.4
Netherlands 91	2.8	0.7	98.7	78.8	11.3	8.9	0.2	−0.2	−0.8
Netherlands 93	2.0	−2.7	99.5	79.6	8.2	8.1	−1.3	−1.7	0.8

Table 1. (*Continued*)

Episode	Corr	$m_{t+1} - m_{t-1}$	m_{t-1}	B/GDP	σ_t/μ_r	R_{t-1}	$R_{t-1} - r_{t-1}$	ΔR_t	$\Delta(R_t - r_t)$
Netherlands 95–97	2.0	−3.5	96.7	79.1	6.2	6.9	1.7	0.0	0.8
Portugal 84–86	8.5	−2.9	7.1	49.7	13.8	26.6	3.8	3.2	1.0
Portugal 92	2.8	8.0	7.9	70.2	7.6	21.3	3.5	−3.6	1.0
Portugal 94–97	2.0	5.0	15.9	67.5	7.3	17.7	5.3	−0.9	0.0
Spain 79	1.0	6.0	15.3	14.4	42.9	11.9	−5.7	1.4	3.5
Spain 83–84	1.3	−13.0	24.5	30.4	17.9	16.0	−0.3	0.9	−2.8
Spain 86–87	2.0	11.6	13.4	50.8	10.6	13.4	1.1	−2.0	−1.4
Spain 91–94	3.5	9.0	30.3	50.3	10.2	14.6	−0.6	−1.8	0.2
Spain 96–97	4.0	7.9	54.0	70.8	5.5	11.3	1.9	−2.5	−0.7
Sweden 75–76	2.7	−1.0	90.7	30.4	20.7	8.0	0.7	1.0	0.5
Sweden 83–84	2.2	−4.4	59.2	61.7	12.1	13.3	0.0	−0.7	1.1
Sweden 86–87	5.6	3.2	49.8	66.7	10.4	13.2	−0.9	−2.7	1.6
Sweden 89	1.1	−6.3	51.6	53.1	11.5	11.4	1.3	−0.2	−1.6
Sweden 94–98	14.3	8.1	43.9	75.8	11.9	8.5	0.2	1.0	1.9
UK 77	1.6	2.5	73.4	60.0	15.6	13.6	2.0	−1.6	2.0
UK 79–82	5.8	3.5	76.0	57.3	18.0	12.1	2.8	0.9	−3.6
UK 88–90	2.4	−10.6	68.6	55.6	10.6	9.6	−0.1	0.1	−0.5
UK 94–98	7.2	−1.4	61.0	56.9	10.7	7.5	1.5	0.7	0.2
USA 76–79	2.4	6.0	35.1	39.7	14.6	8.0	2.2	−0.4	0.4
USA 87–89	1.1	−0.2	53.6	50.5	15.6	7.7	1.7	0.7	0.9
USA 93–98	4.5	0.8	49.9	60.1	7.9	7.0	3.6	−1.1	−0.7

Notes: All variables are in percent. t refers to the first year of the stabilization.
Legend: Corr = cumulative change in structural budget; $m_{t+1} - m_{t-1}$ = change in the share of fixed-rate long-term debt; m_{t-1} = share of fixed-rate long-term debt; B/GDP = debt-to-GDP ratio in the year preceding the stabilization; σ_r/μ_r = standard error (divided by mean) of short-term rates from auxiliary regression for the seven years preceding the stabilization; R_{t-1} = long-term intrest rate; $R_{t-1} - r_{t-1}$ = spread between long- and short-term interest rates; ΔR_t = change in long-term interest rate; $\Delta(R_t - r_t)$ = change in spread between long- and short-term interest rates.

choice would be arbitrary, and the consideration of larger corrections would leave us with too few observations. In the restricted sample of 51 episodes, both the level and the change in the long-term rate continue to be highly significant, as well as the initial share of long-term debt. The result for the standard error of short-term rates is stronger in the new sample: its coefficient is now significant at the 5 percent level. The fit of the regression also improves.[19]

We next focus on the 44 episodes where the initial level of debt is greater than 50 percent of GDP, in order to examine how the level of debt affects

[19]We also examined the implications of further restricting the sample to episodes which last two or more years. The experiment leads to similar results as those shown in column 2 and are available from the authors on request. This outcome is not surprising given that the sample is reduced by only seven episodes: most episodes of large fiscal corrections last two or more years.

Table 2. *The choice of debt maturity in fiscal stabilizations (cross sections of stabilization episodes)*

Dep. variable $m_{t+1} - m_{t-1}$	Change in fixed-rate long debt denominated in domestic currency			Change in fixed-rate long debt including foreign denominated		
Sample	Full sample	$Corr \geqslant 2$	$B/GDP \geqslant 0.5$	Full sample	$Corr \geqslant 2$	$B/GDP \geqslant 0.5$
Constant	8.97**	12.9**	12.8**	7.30*	9.66**	5.56
	(2.32)	(2.83)	(2.55)	(1.83)	(2.30)	(1.06)
m_{t-1}	−0.10**	−0.15**	−0.12**	−0.07**	−0.11**	−0.07**
	(3.47)	(3.87)	(3.60)	(2.70)	(3.34)	(2.05)
$(B/GDP)_{t-1}$	3.05	0.44	2.11	2.35	0.84	4.86
	(1.25)	(0.14)	(0.67)	(0.96)	(0.30)	(1.41)
$(\sigma_r/\mu_r)_{t-1}$	0.17*	0.33**	0.06	0.02	0.12	−0.16
	(1.89)	(2.39)	(0.43)	(0.20)	(0.99)	(0.96)
R_{t-1}	−0.62**	−0.69**	−0.77**	−0.31	−0.28	−0.16
	(2.98)	(3.00)	(3.15)	(1.61)	(1.42)	(0.63)
ΔR_t	−1.47**	−1.42**	−2.38**	−1.15**	−1.05**	−1.41**
	(3.26)	(2.73)	(4.69)	(2.55)	(2.22)	(2.40)
Observations	72	51	44	72	51	44
Mean of dep.	1.14	1.55	2.03	0.95	1.58	1.87
Adjusted R^2	0.24	0.29	0.40	0.15	0.22	0.23
Jargue–Bera p-value	0.27	2.36	0.34	5.72	1.78	1.20
	(0.87)	(0.31)	(0.84)	(0.06)	(0.41)	(0.55)

Notes: OLS esimation of equation (14). See Table 1 for variable definitions. Variables are in percent. The coefficient of $(B/GDP)_{t-1}$ is multiplied by 100. t-Statistics are in parentheses. *Significant at the 10% level. **Significant at the 5% level.

debt management. The evidence reported in column 3 shows that at high levels of debt, the choice of debt instruments becomes more sensitive to long-term interest rates, while the conditional variance of short-term rates no longer affects the issuing policy. Although this result is difficult to interpret within our model, it suggests that, at high levels of debt, cost considerations and credibility effects become more important than interest-rate volatility for the success of a stabilization program.

So far we have classified foreign currency debt and inflation-indexed debt as short-term debt. This is appropriate if high interest rates mainly reflect a lack of confidence in the government's ability to keep inflation and the exchange rate under control. But if high interest rates reflected default-risk premia, then foreign currency debt and indexed debt should be classified according to their maturity. In columns 4–6 of Table 2 we provide evidence on a definition of long-term debt which includes debt denominated in foreign currencies. Interestingly, the new definition of long-term debt appears to be uncorrelated with the standard error of short-term rates. The relation with the level of the long-term rate is also not significant in all samples considered. We take such evidence as a clear indication that, in most episodes, foreign currency debt played the same role as short maturity debt.[20]

In Table 3 we examine whether the spread between long- and short-term interest rates, $(R_{t-1} - r_{t-1})$, and its change, $\Delta(R_t - r_t)$, do a better job at explaining the choice of debt maturity during a stabilization, than the variables suggested by our model. Controlling for the spread between long and short rates serves two purposes. First, it helps to distinguish our credibility interpretation from other hypotheses about government's behavior. In particular, we want to explore the possibility that the reaction of debt managers to long rates merely follows from a "naïve" strategy of borrowing short when long rates are high relative to short rates, and vice versa. This strategy might be suggested by a failure of the expectations hypothesis regarding the term structure of interest rates of the kind shown by Campbell (1995) for the US.[21] Second, the long–short spread is a commonly used measure of credibility: this is because the slope of the yield curve not only conveys useful information about the path of future interest rates, but also captures "unjustified" inflation expectations or risk premia to which debt managers may want to react.

In columns 1–3 of Table 3 the long–short spread $(R_{t-1} - r_{t-1})$ in the year preceding the stabilization attempt, and its change, $\Delta(R_t - r_t)$, during the first year of the stabilization have been added to the set of regressors. The results are striking: the coefficient on the basic explanatory variables are unaffected. Not only the long rate and its change outperform the long–short interest-rate spread and its change, but the coefficient on the spread is positive and significant. Contrary to what might be expected, once we control for the level and the change in long-term rates, a steep yield curve is associated with an increase in the share of long-term debt. A change in the spread also has a positive impact on the share of long-term debt. In the full sample, such effects are significant at the 5 and 10 percent level, respectively; they are not significant, however, in the case of large fiscal adjustments. This evidence provides a strong rejection of the "naïve" hypothesis about governments' behavior.

The results in Table 3 suggest that what matters for the choice of debt maturity is the level of the long-term interest rate (relative to government's expectations), while the position of short rates is not that important. For

[20] Applying different definitions of long-term debt denominated in domestic currency, in particular excluding fixed-rate loans or limiting attention to the debt held by the private sector, where possible, does not significantly affect the results.

[21] Campbell (1995) shows that in the US borrowing short at times when the slope of the yield curve is steeper than normal (and vice versa) would allow substantial savings in debt servicing costs. This is likely to happen because term premia on long-term bonds increase with the slope of the yield curve.

Table 3. *The choice of debt maturity in fiscal stabilizations (adding the yield slope and the German interest rate)*

Dep. variable $m_{t+1} - m_{t-1}$	Change in fixed-rate long debt denominated in domestic currency					
Sample	Full sample	*Corr* ⩾ *2*	B/GDP ⩾ 0.5	Full sample	Corr ⩾ 2	*B/GDP* ⩾ 0.5
Constant	9.85**	12.7**	12.0**	15.4**	20.2**	14.0**
	(2.61)	(2.79)	(2.44)	(2.76)	(3.30)	(2.28)
m_{t-1}	−0.11**	−0.14**	−0.12**	−0.09**	−0.14**	−0.12**
	(3.64)	(3.65)	(3.71)	(2.98)	(3.82)	(3.33)
$(B/GDP)_{t-1}$	2.15	−0.20	2.64	2.93	0.59	3.25
	(0.90)	(0.06)	(0.84)	(1.28)	(0.22)	(1.02)
$(\sigma_r/\mu_r)_{t-1}$	0.16*	0.35**	0.05	0.16*	0.31**	0.11
	(1.67)	(2.51)	(0.37)	(1.86)	(2.49)	(0.80)
R_{t-1}	−0.65**	−0.74**	−0.79**	−0.42**	−0.50**	−0.71**
	(3.15)	(3.19)	(3.26)	(2.00)	(2.30)	(2.22)
ΔR_t	−1.27**	−1.34**	−2.17**	−1.90**	−1.87**	−2.73**
	(2.86)	(2.56)	(4.19)	(4.01)	(3.75)	(4.12)
$R_{t-1} - r_{t-1}$	0.73**	0.69	0.82*			
	(2.03)	(1.49)	(1.91)			
$\Delta(R_t - r_t)$	0.85*	0.63	0.12			
	(1.86)	(1.06)	(0.24)			
R^*_{t-1}				−1.17	−1.24	−0.40
				(1.66)	(1.48)	(0.42)
ΔR^*_t				1.54	2.04*	1.59
				(1.66)	(1.82)	(1.06)
Observations	72	51	44	72	51	44
Mean of dep.	1.14	1.55	2.03	1.14	1.55	2.03
Adjusted R^2	0.28	0.30	0.43	0.36	0.47	0.43
Jarque–Bera p-value	0.52	1.69	0.32	3.76	8.26**	0.93
	(0.77)	(0.43)	(0.85)	(0.15)	(0.02)	(0.63)

Notes: Columns 1–3: OLS estimation of equation (14) with added regressors: $R_{t-1} - r_{t-1}$ = difference between long-term and short-term interest rate; $\Delta(R_t - r_t)$ = change in $R_{t-1} - r_{t-1}$. Columns 4–6: OLS estimation of equation (12) with added regressors: R^*_{t-1} = German long-term interest rate; ΔR^*_t = change in R^*_{t-1}. Variables are in percent. The coefficient of $(B/GDP)_{t-1}$ is multiplied by 100. t-Statistics are in parentheses. *Significant at the 10% level. *Significant at the 5% level.

example, a debt manager facing high short and long interest rates, with short rates higher than long rates, may well prefer to borrow short if she is confident that long rates are temporarily high, and will fall as the program is carried out and credibility builds up. In fact, a rationale could be found even for the positive relation between the share of long-term debt and the slope of the yield curve. Stabilization episodes are often accompanied by a tightening of monetary policy which raises short rates above long rates. In such instances, the yield slope becomes negative, and the credibility of the stabilization attempt can solely be inferred from the behavior of the long rate.[22] Only the fall in such a rate below its pre-stabilization level, rather than the twist in the yield curve, is an indication that the stabilization is credible.

In order to examine the effect of international factors on the choice of debt maturity, we included among the explanatory variables the German long-term interest rate, R^*_{t-1} (the year before the stabilization), and its change, ΔR^*_t (in the first year of the stabilization). We use German rates since most of the episodes in our sample happened in Europe. Results are shown in the last three columns of Table 3. The change in the German long-term rate is an important control variable: if domestic long-term interest rates fell along with international rates, such a fall is likely to reflect a change in international conditions more than a gain in credibility. The effect of the level of the long-term German rate is in principle uncertain. If we believe that German authorities have always been credible, then a high German rate may suggest (an alternative explanation for high domestic rates and thus) that confidence in the announced budget cuts is higher for any given domestic long-term rate. The maturity of the debt should thus increase with the German rate. On the other hand, high German rates may capture common trends in long-term rates on international bond markets to which governments may react by shortening debt maturity. Neither of these interpretations is supported by the data. The coefficient on the level of the German interest rate is negative but not significant in all samples considered. The coefficient on the change in the German rate is positive in all regressions but is significant at the 10 percent level only in the restricted sample of stronger fiscal corrections. This provides some support to the idea that credibility effects are better measured by a change in domestic interest rates relative to foreign rates. The important result from these regressions is that both the level and the change in long-term domestic rates remain significant at the 5 percent level. The fact that the domestic rate statistically outperforms the German rate is strong evidence that the choice of debt maturity depends on the government's expectations of future rates rather than being determined by international movements in interest rates.

Although the specification (14) appears robust to the inclusion of yield spreads and international interest rates, in Table 4 we added time dummies to further check whether the results are affected by common trends in the relevant variables. Specifically, we consider three time dummies for the periods 1981–1985, 1986–1990 and 1991–1996, so as to divide the sample of stabilization episodes into four subperiods of approximately the same duration (no stabilization started in 1997 and 1998). The first two columns

[22] This is particularly evident for the stabilization episodes that refer to the European countries which were members of the Exchange Rate Mechanism of the EMS, as defenses of the fixed parity were often accompanied by fiscal adjustments.

Table 4. *The choice of debt maturity in fiscal stabilizations (adding time dummies and instrumental variables estimation)*

	OLS estimation		IV estimation		
Dep. variable $m_{t+1} - m_{t-1}$	Change in fixed-rate long debt denominated in domestic currency				
Sample	Full sample	$Corr \geqslant 2$	Full sample	$Corr \geqslant 2$	$B/GDP \geqslant 0.5$
Constant	5.81	9.30*	1.11**	14.7**	15.7**
	(1.37)	(1.92)	(2.58)	(2.98)	(2.69)
m_{t-1}	−0.09**	−0.14**	−0.11**	−0.16**	−0.14**
	(2.83)	(3.47)	(3.55)	(3.87)	(3.59)
$(B/GDP)_{t-1}$	0.95	−2.66	1.26	−1.47	1.12
	(0.32)	(0.69)	(0.44)	(0.41)	(0.32)
$(\sigma_r/\mu_r)_{t-1}$	0.20**	0.41**	0.21**	0.38**	0.16
	(2.07)	(2.84)	(2.09)	(2.56)	(0.94)
R_{t-1}	−0.34	−0.38	−0.75**	−0.81**	−1.05**
	(1.38)	(1.36)	(3.16)	(3.14)	(3.06)
ΔR_t	−1.25**	−1.21**	−2.50**	−2.31**	−3.58**
	(2.66)	(2.25)	(2.78)	(2.52)	(3.29)
DU 81–85	−3.01	−3.65			
	(1.41)	(1.36)			
DU 86–90	0.50	0.82			
	(0.22)	(0.28)			
DU 91–96	1.89	2.26			
	(0.86)	(0.86)			
Observations	72	51	72	51	44
Mean of dep.	1.14	1.55	1.14	1.55	2.03
Adjusted R^2	0.26	0.32	0.18	0.25	0.31
Jarque–Bera *p*-value	0.35	2.41	0.90	0.90	6.73**
	(0.84)	(0.30)	(0.64)	(0.64)	(0.03)

Notes: Columns 1–2: OLS estimation of equation (14) with added time dummies $DU_j = 1$ for period j. Columns 3–5: IV estimation of equation (14). Instrument for ΔR_t: change in long-term interest rate over the six months preceding the stabilization. Variables are in percent. The coefficient of $(B/GDP)_{t-1}$ is multiplied by 100. *t*-Statistics are in parentheses. *Significant at the 10% level. *Significant at the 5% level.

Hausman test:

Full sample:	t-statistic = 1.14	p-value = 0.16
Corr ⩾ 2%:	t-statistic = 1.24	p-value = 0.22
Sample $B/GDP \geqslant 0.5$:	t-statistic = 1.38	p-value = 0.18

of Table 4 show that the coefficients on the dummies are individually not significant, suggesting that particular events or factors which might have occurred in those periods, and that were omitted from our regressions, have not significantly affected the choice of debt maturity. However, while the inclusion of time dummies does not generally alter the other coefficients, it reduces the impact of the long-term interest rate, which is no longer significant in either regression. This is likely to depend on the correlation between the long-term interest rate and the 1981–1985 dummy. Long-term interest rates were unusually high in the early 1980s, which might have led governments to issue short-term debt in anticipation of a return to normal conditions. This evidence, however, also leaves open the interpretation that uncertainty about the governments' intentions was particularly important during the early 1980s.

Finally, we ask whether our estimates might suffer from an endogeneity problem. As we measure the credibility of a stabilization by the fall in the interest rate during the first year of the program, there is a potential for this variable to be affected by the type of debt that the government issues at the outset of the stabilization. The choice of debt instruments may convey private information about the prospects of the stabilization, and may thus affect the private sector's expectations and interest rates. To deal with this potential source of endogeneity in the change in the long-term interest rate, we use, as an instrument, the change in such a variable that occurred during the six months preceding the first year of the stabilization attempt.

Instrumental variable estimates are shown in columns 3–5 of Table 4. These regressions generally confirm the OLS results. The coefficient on the long-term interest rate is unaffected. The impact of the standard error of short-term rates is instead stronger in all samples considered, and is significant at the 5 percent level both for the full sample and for adjustments larger than 2 percent of GDP. Finally, the coefficient on the change of long-term debt remains significant at the 5 percent level in all the regressions considered. Although this coefficient is greater (in absolute value) than the corresponding OLS coefficient, a formal Hausman test does not reject the hypothesis that such a variable is exogenous to the choice of debt maturity at the 10 percent significant level for all samples.

The overall impression is that our theory provides a consistent explanation of governments' behavior in OECD economies over the last three decades. Our basic regression accounts for more than one-fourth of the observed change in the share of long-term debt, a result which is even more comforting if we consider that it has been obtained from data covering a long time spell and different institutional arrangements, monetary and exchange-rate regimes. This result should also be contrasted with the lack of a systematic relation between changes in the debt composition and interest rates over time within single countries; see e.g. Missale (1999).

IV. Concluding Remarks

When a stabilization plan is announced, it typically does not enjoy full credibility among investors: long-term interest rates are thus higher than governments' expectations of future rates. This feature of a stabilization allows us to overcome a common problem in the analysis of debt management—namely that governments' expectations of interest rates are not observable.

Studying fiscal stabilizations in OECD countries, we find evidence that governments do issue a larger share of short-term debt, the higher is the interest rate on long-term bonds and the lower is the variance of short-term interest rates. We fail, instead, to find evidence in favor of the common view that the choice of debt maturity is affected by the spread between long- and short-term interest rates. Divergences of government's views from market expectations seem to provide a better explanation of government behavior. In other words, debt managers appear to be driven more by their expectations about the future evolution of interest rates than by the attempt to exploit failures in the expectations hypothesis of the term structure, in particular, systematic variations in term premia. This behaviour is consistent with evidence that the expectations hypothesis of the term structure performs reasonably well in European countries, which represent the main group in our sample; see e.g. Hardouvelis (1994) and Gerlach and Smets (1998). It is also consistent with evidence for the UK that strategies based on the minimization of term premia yield negligible savings in interest costs; see Coe, Pesaran and Vahey (2000).

Finally, our findings cast doubts on the relevance of debt management theories which stress the strategic use of debt instruments; see e.g. Milesi-Ferretti (1995), Uhlig (1997) and Pecchi and Piga (1999). In particular, governments do not appear to issue long maturity debt in order to increase bondholders' political support for anti-inflationary policy and fiscal restraint. The evidence in this paper points instead to a conventional trade-off between the cost and risk of debt service, as usually stated in the reports of debt agencies. Such a trade-off appears to be a key element of how debt is actually managed and should provide the starting point for a positive theory of debt management.

Appendix: Data Sources and Definitions

Data on primary structural surpluses as a percentage of actual GDP were computed by normalizing structural balances (defined in terms of potential GDP) and subtracting interest payments as a percentage of actual GDP. (The latter were obtained as the difference between overall financial surpluses and the corresponding primary surpluses). For the most recent period, these data are published in the OECD *Economic Outlook*. Revised series of the above variables starting in the 1970s have been kindly provided by Alexandra Bibbe of the OECD Economics Department, Public Economics Division.

Data on the composition, by instrument, of public debts are from national sources and are reported in Missale (1999). In most instances they refer to the central government debt, but the rule is amended in a few cases when data are available only for the general government. Since the composition of debt holdings of the monetary authorities is not available for some countries, we use a definition of debt which includes central bank holdings, net of credit lines.

Long-term debt is defined as the sum of fixed-rate bonds and loans denominated in the domestic currency with an initial term to maturity longer than one year. This rule is amended for Spanish and Italian Treasury Bills with an 18-month maturity that have been considered as short maturity debt.

Hence, bonds and loans denominated in foreign currency, and bonds bearing coupons indexed to market interest rates, to the price level, or to the ECU exchange rate, have been regarded as short-term debt.

Long-term Spanish loans in the 1970s have been considered a short debt, since they were placed with the local banks at below-market interest rates.

Extendible bonds and bonds with an option for early redemption (such as those issued in Belgium, France and Italy) have been regarded as long-term debt if the period preceding the earliest possible maturity is longer than one year. Fixed-rate bonds with an option for converting coupons into variable-rate coupons (such as those issued in France in the early 1980s) have been considered as fixed-rate debt since the holders do not exercise the option if the interest rate falls.

The definition of long-term debt that encompasses debt denominated in foreign currencies used in the estimations reported in columns 4–6 of Table 2 includes foreign-currency debt with maturities shorter than one year. This is because the maturity composition of the debt denominated in foreign currencies is available only for a few countries. However, for countries where the information is available, short maturities appear to be a minor component of foreign debt.

Long-term interest rates refer to the yields-to-maturity of benchmark long-term government bonds on the domestic market. Short-term interest rates refer to three-month interbank rates, since interest rates on Treasury Bills are not always available.

Yearly data on short- and long-term interest rates are from OECD *Economic Outlook*. Quarterly data on short- and long-term interest rates are from OECD *Main Economic Indicators* and, when the OECD series is not available, from IMF *International Financial Statistics*.

The ratio of public debt to GDP is from OECD *Economic Outlook* and refers to gross general government debt.

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