BUYBACKS OF DOMESTIC DEBT IN PUBLIC DEBT MANAGEMENT

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Abstract

In the model a …scal stabilisation is announced under asymmetry of information between the government and the private investors. The government could be of two types: a dry type and a wet type, according to the amount of spending cuts it decides to make. Private investors may thus lack con…dence in the stabilisation program and interest rates would be too high, re‡ecting this lack of credibility. A dry type which has to …nance new spending may want to signal its resolution (type) in order to lower its interest costs and one way to do that would be to repurchase a fraction of the outstanding debt. The wet type could also decide to buyback some of its debt in order to pretend to be a dry type and to (possibly) lower its interest payments. It is showed that a critical amount of buyback exists such that the two types could be separated.

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1. Introduction

From 1990 onwards, some OECD countries have begun to acquire experience in the use of debt repurchase instruments and some of them have established regular bond repurchasing programmes (from Tables 1 to Table 4, in the Appendix, more detailed information is presented). As far as we know, the literature on public debt management has not dealt with buybacks of public (domestic) debt, while they have been analysed quite deeply in the international debt framework.

Missale (1999) points out how policy-makers' approach to debt management implies a trade-off between cost and risk minimisation. A strategy of cost minimisation would suggest issuing securities with the lowest risk premium (which would then pay high returns when labour and capital income are lower than expected), while, to minimise risk, the correlation between debt returns and income should be positive. Missale argues that policy-makers have so far been mainly concerned with the minimisation of borrowing costs ("without taking too much risk") while, according to him, the correct approach should be the opposite, provided that risk premia on government securities are "fair", that is they reflect only their risk-return characteristics. In sum, the objective of reducing interest costs should be pursued only when interest rates on debt are "unfair", i.e. they incorporate a risk premium which may result from market imperfections and from the government's credibility problems.

The main idea of this paper is that buybacks could be used to eliminate unfair risk premium since they can help resolve a government's credibility problems. (Debt repurchases could actually be used also to reduce market imperfections as they might help improving liquidity and efficiency in the secondary market.)

More specifically, a theoretical model is developed to examine whether buybacks of public debt may signal a government type. In the model it is assumed that the government could be of two types: a dry type and a wet type, according to their willingness to implement a …scal stabilisation (in this model this basically means reducing …scal spending). Asymmetry of information between the government and private investors is assumed. In particular interest rates are assumed to incorporate a risk premium which re‡ect the expectation that the inability to implement a stabilisation programme may result in more in‡ation and/or taxation, or debt default.

In particular, during a …scal stabilisation, private investors would lack con…dence in the stabilisation programme and interest rates would be too high, re‡ecting this lack of credibility. (This argument is to some extent similar to Missale et al., 1997). Thus, a dry type which has to …nance new spending may want to signal its resolution in order to lower its interest costs and one way to do that would be to repurchase a fraction of the outstanding debt. The wet type could also decide to buy-back some of its debt in order to pretend to be dry and to (possibly) lower its interest payments. It is showed that a critical amount of buyback exists such that the two types could be separated.

In Section 4 we examine the series of prices of long term Italian bonds in order to test the main implication of the theoretical model and the results seem consistent with the theory.

The rest of the paper is organised as follows: in Section 2 we brie‡y review the literature. In Section 3 the theoretical model is presented and Section 4 contains some empirical evidence about the repurchases of public debt and the results of the structural break test which was carried out in order to test for the implications of the theoretical model. Finally, Section 5 concludes.

2. Related Literature

One of the most debated aspects of voluntary international debt reduction has been whether debtor countries bene…t from repurchases of their outstanding debt on the secondary market, at low prices. Many countries have been keen to do so, as they considered the reduction in the price of their liabilities an attractive opportunity. In principle, contracts between a debtor and its creditors forbid debtor governments to engage in these market buybacks without receiving special permission (Rotemberg, 1991), but in practise these transactions have been common.[1]

Bulow and Rogoff (1988, 1991) provide a formal statement of the critique to buybacks. They argue that buybacks, even at existing secondary prices ("average value," as in their paper) are a costly mistake for the debtor, and that the country should be prepared to pay no more than the "marginal" value of its debt, which the authors argue is much lower.[2] Other authors, instead, see buybacks with favour: a different set of motives for buybacks is given, among the others, by Krugman (1989), Froot (1989), Rotemberg (1991), Acharya and Diwan (1993), Cohen and Verdier (1995), Thomas (1996), Marchesi and Thomas (1999).

In public (domestic) debt management, buybacks could be used both to eliminate "unfair" risk premium, that is only due to asymmetry of information between the government and the private sector and to reduce market imperfections as they can help improving liquidity and efficiency in the secondary market. As Missale (1999) points out how policy-makers approach to debt management implies a trade-off between cost and risk minimisation, he argues that policy-makers have so far been mainly concerned with the minimisation of borrowing costs ("without taking too much risk") while the correct approach should be the opposite, provided that risk premia on government securities are "fair", that is they reflect only their risk-return characteristics. In sum, the objective of reducing interest costs should

[1] For example, Brazilian state firms eliminated nearly $7 billion of external debt in 1988 alone through discounted buybacks. Bolivia, in 1988, offered an example of a buyback of commercial bank debt at the secondary market prices (it took four years to complete). More recently also Niger bought back all of its commercial bank debt and Chile used the secondary market to reduce its debt through buybacks, too.

[2] Since the marginal value is defined as the probability of repayment while the average value is given by the ratio of the total market value of the country's debt (which includes what creditors receive when the country pays back only in part) over the outstanding debt, the average value is bigger than the marginal value.

be pursued only when interest rates on debt are "unfair", that is they incorporate a risk premium which may result from market imperfections and a government's credibility problems.[3]

2.1. Market Imperfections

As far as market imperfections are concerned, interest costs should be reduced by enhancing the transparency and predictability of the issuing policy, by increasing the liquidity and e¢ciency of secondary markets (which would lead to thick markets and to a greater "standardisation" of the securities that are o¤ered) and by introducing borrowing and risk-hedging facilities (futures and option contracts in government bonds have been introduced in most countries so as to provide hedges against the interest rate risk of securities holdings).[4] "A regular issuing policy which relies on the same set of instruments, irrespective of market conditions, and increases the issue size of government securities, allows saving on risk premia which would otherwise be required for the uncertainty of sales and for the illiquidity of government." (Missale, 1999).

In this contest, debt buybacks have been used to improve the liquidity and the e¢ciency in the secondary market. Among the most frequent objectives of the repurchases there have actually been: smoothing of the maturity pro…le (some countries used an early redemption programme to eliminate heavy infra-year concentration of debt redemption; this permitted better management of cash ‡ow demand and reduced the interest rate impact on the burden of the public debt); the reduction of debt servicing costs (after misalignements along the yield curve are identi…ed, securities with yields not in line with the benchmark curve are repurchased) and

[3] More precisely, di¤erences in the expected returns of debt instruments are "fair" if they re‡ect properly called risk premia, asked by risk-averse investors who do not make systematic mistakes, are fully informed about the likelihood of future events, and con…dent that …scal and monetary policy actions will be carried out as announced.

[4] More recently, "repurchase agreement" (repos) markets have been established in many countries allowing dealers to cover open positions which they have to take in the process of market making (Missale, 1999).

elimination of securities with poor liquidity (to maintain high liquidity in the secondary market, some countries decided either to repurchase small amounts of illiquid bonds and eliminated them or to switch from illiquid to liquid ones). In the long run, all of these choices lead to a reduction of the cost of financing. A market with a smoother redemption profile, more liquid instruments and an informative yield curve provide a government with lower cost and better opportunities to fund its debt. Table 2, in the Appendix contains the analytic answers of the interviewed countries.

2.2. Asymmetric information

According to Missale (1999), the other circumstance in which an objective of interest cost minimisation should prevail over the budgetary risk minimisation (namely discretion in public debt management should be used) is when interest rates incorporate a risk premium which derives from credibility problems. In this paper we focus on the credibility problems that might derive from the uncertainty about a government's announcement because of the asymmetry of information between the government and the private sector.

More specifically, private investors may not be able to tell how serious the government really is about the reform process. Imperfect information of this sort is likely to be particularly present in developing countries or in countries where governments rotate quite frequently (as in Italy). The resolution of this kind of credibility problem will require the government to signal its true type (Rodrik, 1989).

In assessing the effect of observed policy choices on credibility the role of external circumstances may be especially important when policies have persistent effect on the economic environment. As in Drazen and Masson (1994): "if tough policies constrain the room to maneuver in the future then following a tough policy may actually harm rather than enhance credibility." They actually present a model in which a policymaker maintains a fixed parity in good times but devalues in if the unemployment rate gets too high. The idea is that, in case of persistence of unemployment, oberving a tough policy in a given period may actually lower rather than raise the credibility of a no-devaluation in subsequent periods.

Extending Drazen and Masson, Benigno and Missale (1997) examines how public debt, policy-makers' credibility and external circumstances a¤ect the probability of exchange rate devaluation. Public debt creates the link between current and future policy actions. In fact, if the debt level is low (or in absence of it) there is a strong incentive to resist the temptation of a devaluation and its only e¤ect would be to reveal a weak government, thus increasing the likelihood of future devaluations (the so called "signalling e¤ect" dominates). On the contrary, if the level of debt is high, a devaluation would reduce the debt burden and thus the need to resort to further ones in the future (the so called "debt burden e¤ect" prevails).[5]

There is another paper that actually links the timing of an intervention by policy-makers (in this case a …scal corrections) to the level of public debt (Drudi and Prati, 1998). In their framework, a …scal stabilisation can be delayed if debt levels (and risk premia) are below a certain level so that no government has the incentive to tighten …scal policy and to run a surplus (i.e., pooling equilibria prevail). Only if risk premia or debt levels are beyond a critical threshold, do interest payments become so large that good type (dry) government prefer to run primary surpluses, thus signalling the sustainability of the …scal regime. That is separating equilibria do exist where good type government achieve primary surplus and bad type ones default.

Finally, Missale et al. (1997) provides theory and evidence on the behaviour of public debt managers at the start of …scal stabilisations. In such episodes interest rates on long-term debt could be high because of lack of con…dence in the stabil-

[5] Debt accumulation is actually shown to reduce the credibility of an exchange rate regime but only in the short run as there are no e¤ects on the credibility in the long-run. Reputational incentives reduce the short term interest rates but there is no impact on the forward rate since it depends only on fundamentals.

isation programme by private investors. In this case the informational advantage of the authorities makes it possible to minimise the cost of debt service by issuing short maturity debt.

The evidence shows that governments, at the start of a stabilisation, tend to issue a larger share of short maturity debt the less credible is the programme and the lower is the roll-over risk. The theoretical model demonstrates that the debt issuing strategy which is observed in reality can be consistent with optimal debt management assuming asymmetry of information between the government and private agents.

In a similar context we will show how a debt repurchase could help to reduce an "unfair" risk premium, that is only due to asymmetry of information between the government and the private sector.

3. The model

To introduce the concept of a buyback in a public debt framework we start with a very simple model. The model extends over two periods, period zero and period one. We assume that, at $t = 0$, the government has inherited an amount D of public debt at the fixed gross 2-period interest rate $\bar{\imath}$; so $D\bar{\imath}$ is due at $t = 1$ (where D is normalised to one). Thus, interest rate repayments on the outstanding debt are set before the "game" starts.

We also assume that the government could be of two types: a dry type and a wet type, according to the amount of spending cuts it decides to make. A dry government carries out larger cuts and has a level of spending G^L (at the end of period zero) which is lower than the level of spending G^H of a wet government. However, the two levels of spending G^L and G^H will not actually enter the analysis, except as signals that invariably identify the two types i: The fundamental characteristic that differentiates the two types is a risk premium on period one interest payments p, which can either be p^W or p^D, depending whether it corresponds to the wet or the dry type risk premium, respectively.

Asymmetry of information is assumed: the amount of spending cuts made by the government (and thus the level of spending) is not known ex ante to private investors and it will be observed only at the end of period zero. Private investors are assumed to be risk neutral.

If some new borrowing takes place at the beginning of period zero, to be rolled over in period one, the costs of that borrowing will depend on the interest rates both in period zero and in period one. In particular, at $t = 1$, interest rates will be determined after the uncertainty about the government's type is resolved. Interest costs will be lower if the level of spending is low, or higher if spending is high. More speci…cally, in both periods interest rates contain a risk premium which re‡ects the expectations that the inability to stabilise the economy may result in debt default (or higher in‡ation and/or taxation) and which is greater for the wet type government.

In this Section we are going to assume that both risk premia are exogenous; in the next Section the risk premium in period one will be endogenous.

After the dry government, at $t = 0$, implements a stabilisation programme (which here basically consists in cutting public spending), which is going to a¤ect the level of spending (and thus the interest rate in period one), she might …nd it bene…cial to buy-back a fraction of her outstanding debt, issuing at the same time short-term debt to be rolled over at the beginning of period one. In this way she could bene…t from a "reputation e¤ect" of her policy in terms of reduced interest rate in both periods. In period one, because after public spending is actually observed, the government type is distinguished and the risk premium on interest payments can decrease (if the type is dry). In period zero, however, because the buyback could be the signal that a government is dry (assuming only the dry type can actually bene…t from reduced rates in period one, if there is a separating equilibrium), it could in‡uence the risk premium of period zero, as well. Timing is described in

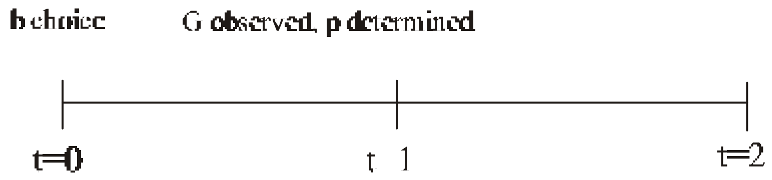

Figure 3.1:

Figure 4.1

Issuing short term debt and rolling it over is preferred here by the dry type (to issuing 2-period debt) because, in this way, she can bene…ts from the consequences of her implementation of the stabilisation programme, in terms of reduced interest costs. Missale et. al (1997) also develop a model in which short-term debt maturity is actually used as a signalling device by the government which is really committed to carrying out the …scal stabilisation.

We examine …rst the very simple model, with neither additional …nancing nor period zero risk. We will see that without assuming both some new borrowing and some default risk in period zero as well as in period one, the buyback leaves the dry type indi¤erent and the wet type worse o¤. So while it separates the two types, there is no advantage to the authority in undertaking the buyback.

We start by making the following assumptions: (A1) There are no resources for repaying at the end of period zero, therefore all debt has to be carried forward to the end of period one; (A2) There is no additional spending, nor stabilisation risk during period zero. (Assumptions one and two make sense if the period zero is "very short term.") (A3) Information of wet/dry is revealed before debt can be rolled over.

Let's de…ne i* as the gross safe (world) interest rate (= 1 + r), where i* is assumed constant over the two periods. Suppose there is a separating equilibrium in which the (critical) size of the repurchase of debt at the outset of period zero signals the type, then the following “arbitrage” condition should hold:

$$\bar{i}(1 - p) = qi_0(1 - p)i_1; \qquad (3.1)$$

where p can either be p^W or p^D (see above). Notice that we allow the wet type to repurchase some debt, i.e. we consider a separating equilibrium in which the wet type does a positive repurchase, but at a different level. Q is the price of the repurchase of one unit (£1 face value) of the inherited debt; i_1 is the interest rate in period one and can take the two values i_1^W or i_1^D and i_0, which is the interest rate in period one, is equal to i^* (there is no risk in period zero). The left hand side of (3.1) represents the expected returns to a bondholder from one unit of inherited debt over the two periods, while the right hand side contains the returns from selling one unit of debt at the start of period zero at the price q; earning i_0 in period zero and $(1 - p)i_1$, in period one. Notice that the probability of default, in period one, is the same either holding long-term or short-term debt. Below, we take into account the possibility that holding short term debt can introduce some default probability in period zero as well, that's being more consistent with the literature on debt default according to which shortening the maturity of government's debt can increase the possibility of a crisis equilibrium (see for example, Alesina et al., 1990).

The arbitrage condition in period one is:

$$i^* = (1 - p)i_1; \qquad (3.2)$$

and substituting (3.2) in (3.1), the price of one unit of debt becomes:

$$q = \frac{\bar{i}(1 - p)}{(i^*)^2}:$$

If the wet type does the repurchase, he will be believed to be dry and therefore the price per unit of debt repurchased will be:

$$q^D = \frac{\bar{i}(1 - p^D)}{(i^*)^2};$$

rather than:

$$q^W = \frac{\bar{i}(1 - p^W)}{(i^*)^2};$$

where q^D is higher than q^W as the dry type is safer. Correspondingly, the interest rate the wet type has to pay in period 1 is greater since it is a riskier type. That is:

$$i_1^W = \frac{i^*}{(1 - p^W)};$$

while

$$i_1^D = \frac{i}{(1 - p^D)}.$$

We assume that the government is interested only in minimise the amount it has to repay at the end of period one, assuming it does not default. Thus, the cost of the repurchase of one unit of debt, at the end of $t = 1$, for the wet government (assuming it does not default) is:

$$C = q^D i_0 i_1^W;$$

that is:

$$C = \frac{\bar{i}(1 - p^D)}{(i^*)^2} i^* \frac{i^*}{(1 - p^W)} = \bar{i}\frac{(1 - p^D)}{(1 - p^W)} > \bar{i}. \quad (3.3)$$

As we can see, for the wet type, the buyback (no matter what its size) is bad if it signals the dry type, since his interest costs are higher than in the case without it, while the dry type has the same interest payment and so she will be indifferent. Likewise, the wet type is indifferent about doing a buyback if this signals it is wet, and in this case the dry type would strictly prefer to mimic the wet type (just replace p^W by p^D in (3.3) and you would get a fraction that is smaller than $\bar{i}$) so there cannot be a separating equilibrium in which the wet type makes a positive repurchase. More specifically, if there was a separating equilibrium, it would be of the form: if any repurchase is made, then the probability of the dry type would be one. There cannot be a positive threshold value for the buyback, since the dry type would like to undertake a smaller buyback to signal it is wet. In this model there is no reason to have a buyback as this does not affect the ultimate allocation in terms of interests payments made by either type.

This conclusion will not change if we modify assumption (A2) introducing some risk in period zero as well. (Notice that period zero risk does not affect the risk on long-term debt). Condition (3.1) becomes:

$$\bar{i}(1 - p) = q i_0 (1 - s) i_1 (1 - p) \tag{3.4}$$

where i_0 can either be i_0^W or i_0^D. Let's assume that the wet type has a period zero default risk equal s, so $i^* = (1 - s) i_0^W$ and the cost of one unit repurchase for the wet type is:

$$C = q^D i_0^D i_1^W$$

which is the same as before (see (3.3)). Again, interest costs are not diminished and so there is no reason to have a buyback.

In this model, in addition to period 0 risk, some new borrowing F, to be financed at the beginning of period zero, can make the repurchase worthwhile. The dry type will gain for sure from the buyback because she is normally indifferent about that, but assuming additional spending to be financed in period zero and a small risk premium that could be reduced by the repurchase, it will be surely better off. (Note that, without any uncertainty, interest costs with and without buybacks would be the same, that is (3.5) and (3.6) are the same when $s = 0$. Thus, as above, there would be no reason to have a buyback).

The reason why she did not benefit from the reduced risk premium obtained by signalling its type before was that the current holders of debt simply valued their debt more highly once they believed they were facing the dry type, and so the buyback took place at a high price which just reflected this reduced risk.

The wet type is normally worse off with the buyback, since this takes place at a high price, corresponding to the dry type's risk premium. But with the financing of new expenditure, he could find it advantageous to pretend to be dry in order to benefit from better conditions on the new borrowing. We argue there will be a critical amount of the repurchase such that the two types will be separated.

Let's define b as the amount of debt which is repurchased by the dry type at $t = 0$. Then, at time zero, the dry type should decide whether to do the buyback or not. Thus, she should compare the interest costs of the outstanding debt and of the new borrowing in the two circumstances of with and without buyback. If she opts for the buyback strategy, the timing of the model will be the following: at $t = 0$ the government repurchases an amount b of its outstanding debt, to be rolled over in period one, and simultaneously finances the new borrowing with short term debt, to be rolled over at the beginning of period one as well. At the end of period zero, the level of public spending G is observed and the risk premium of period one interest rate is determined.

Therefore, assuming again a separating equilibrium and that there is some default risk in period zero as well as in period one (as above), if the dry government does the buyback, her interest costs would be:

$$\begin{aligned} R_b^D &= bq^D i_0^D i_1^D + (1 - b)\bar{i} + F i_0^D i_1^D \\ &= \bar{i} + F \frac{(i^*)^2}{(1 - p^D)}; \end{aligned} \tag{3.5}$$

while, without any buyback, they would be:

$$R^D = \bar{i} + F i_0^W i_1^D = \bar{i} + F \frac{(i^*)^2}{(1 - s)(1 - p^D)} \tag{3.6}$$

where, although after observing no buyback beliefs put probability one on the wet type, this reverts to probability one on the dry type once spending is observed. As we can see, $R_b^D < R^D$ and the repurchase is always advantageous.

On the other hand, the wet type's interest costs with the buyback are:

$$\begin{aligned} R_b^W &= bq^D i_0^D i_1^W + (1 - b)\bar{i} + F i_0^D i_1^W \\ &= b\bar{i} \frac{(1 - p^D)}{(1 - p^W)} + (1 - b)\bar{i} + F \frac{(i^*)^2}{1 - p^W} \end{aligned} \tag{3.7}$$

and, without it, they are:

$$\begin{aligned} R^W &= \bar{i} + F i_0^W i_1^W \\ &= \bar{i} + F \frac{i^*}{(1 - s)} \frac{i^*}{(1 - p^W)} \end{aligned} \tag{3.8}$$

In order to obtain the critical value of b such that the two types are separated, we need to find that b $(= b^S)$ such that the interest costs the wet type has to pay with the repurchase (R^W_b) are equal to the interest costs it should pay without it (R^W): then any $b > b^S$ will be separating. That is:

$$b^S\bar{i}\frac{(1-p^D)}{(1-p^W)} + (1-b^S)\bar{i} + F\frac{(i^*)^2}{(1-p^W)} = \bar{i} + F\frac{(i^*)^2}{(1-s)(1-p^W)} \qquad (3.9)$$

which reduces to:

$$b^S = F\frac{(i^*)^2}{(p^W - p^D)\bar{i}}\frac{s}{(1-s)} \qquad (3.10)$$

where b^S is increasing in the quantity of new borrowing F and in the risk premium s (these two factors make the buyback more advantageous for both types) and decreasing in the difference between p^W and p^D and in $\bar{i}$ (both of them increase the costs of doing the repurchase). If this difference tends to zero (i.e., $p^W = p^D$) b^S tends to infinity as good type bonds tend to cost the same as bad type ones (i.e., they become cheaper). On the other hand, if $s = 0$; $b^S = 0$; as the advantage of carrying out a repurchase vanishes. The reason why the separating equilibrium can actually work is that the dry type is more willing to convert its debt to short term debt because she is not afraid of adverse information becoming available during the course of longer maturities, whereas the wet type would have to roll over at a higher interest rate (at the end of period zero).

As for the dry type interest rates, we need to check whether its interest costs in the buyback case are always lower than the ones it pays with no buyback. The dry type might find it more advantageous to repurchase only a fraction $\bar{b} < b^S$ (I am assuming here that beliefs are such that $Prob[W \mid b < b^S = 1]$) in order to pay a lower buyback price in period zero and still be able to reduce her interest costs in period one, after the asymmetry of information is cleared. Obviously, b^S will be preferable if the corresponding interest payments R^D_b are lower. Let's define $R^D_{\bar{b}}$ as the interest costs that correspond to $\bar{b}$:

$$R^D_{\bar{b}} = \bar{b}q^W i^W_0 i^D_1 + (1-\bar{b})\bar{i} + F i^W_0 i^D_1 \qquad (3.11)$$

$$= \bar{b}\frac{\bar{i}(1-p^W)}{(i^*)^2}\frac{i^*}{(1-s)}\frac{i^*}{(1-p^D)} + (1-\bar{b})\bar{i} + F\frac{i^*}{(1-s)}\frac{i^*}{(1-p^D)}$$
$$= \bar{b}\frac{\bar{i}}{(1-s)}\frac{(1-p^W)}{(1-p^D)} + (1-\bar{b})\bar{i} + F\frac{(i^*)^2}{(1-p^D)(1-s)}$$

$R^D_{\bar{b}} > R^D_{b^S}$ if:

$$\bar{b}\frac{\bar{i}}{(1-s)}\frac{(1-p^W)}{(1-p^D)} + (1-\bar{b})\bar{i} + F\frac{(i^*)^2}{(1-p^D)(1-s)} > \bar{i} + F\frac{(i^*)^2}{(1-p^D)} \tag{3.12}$$

that simplifies to:

$$\bar{b}\bar{i}\left[\frac{(1-p^W)}{(1-s)(1-p^D)} - 1\right] > -\frac{F(i^*)^2 s}{(1-p^D)(1-s)}$$

that means:

$$\bar{b} \leq \frac{F(i^*)^2 s}{(1-p^D)(1-s)\bar{i}}\left(\frac{(1-p^D)(1-s)}{(1-p^D)(1-s)-(1-p^W)}\right) \tag{3.13}$$
$$= \frac{F(i^*)^2 s}{[(1-p^D)(1-s)-(1-p^W)]\bar{i}}$$

under the assumption that $(1-p^D)(1-s) > (1-p^W)$ (for instance when $(1-s)$ is very close to one).

Thus, if s is low, if the dry type does the buyback she basically benefits by borrowing F at the true (low) risk premium. If she does not undertake a buyback she has to borrow F at the wet risk premium in period zero, which is obviously worse. The issue is what happens if she was to buy-back $\bar{b}$, $0 < \bar{b} < b^S$? If we assume that any for any $b < b^S$; the government is assumed to be wet, then he benefits by the fact that the buyback price reflects the risk premium for the wet government over the two periods. Clearly the larger $\bar{b}$ is the more tempting this is (and if s is lower, $\bar{b}$ does not have to be so big for the temptation to succeed). (3.13) says just this: if $\bar{b} \leq RHS(3.13)$ then it does not pay to pretend to be wet, while it does if $\bar{b} > RHS(3.13)$. But since it is easily checked that $RHS(3.13) > b^S$ (and $\bar{b}$ cannot obviously be bigger than b^S) then for the dry type it never pays to be believed wet.

In sum, if b^S is the critical value for beliefs, then the separating equilibrium works (assuming $(1-p^D)(1-s) > (1-p^W)$), and indeed any value $\tilde{b}$ in between b^S

and (3.13) works (i.e. if beliefs are: $Prob.[dry] = 1$ if $b > b^S$ and zero otherwise). But if b^S was above this range, then it is not a separating equilibrium as dry type would do a lower buyback.

3.1. Endogenous risk premium

We now assume that the government wants to minimise the following loss function:[6]

$$L = \frac{1}{2}T^2 + pK$$

in which T is the level of taxes, K is the fixed cost of failure relative to the cost of tax distortions and p is the probability that the stabilisation fails. The loss function has been used by Dornbush (1991) and Drazen and Masson (1994) in the context of exchange rate stabilisation. The cost of taxation is standard, while the cost of a failed stabilisation reflects either the reputational and political costs of missing the announced budget target, as in Dornbush, or the higher inflation which may result if the stabilsation fails, as in Drazen and Masson.

The level of taxes T is set at the beginning of period one (once the period one interest rate has been determined) and, after that, the only remaining source of uncertainty arises from an exogenous shock X, which hits the government budget at the end of period one. As we said in the previous Section we now assume that p, and T are endogenous. Raising taxes is costly, because they are distortionary. Their level is chosen so to minimise the loss function where:

$$L = \frac{1}{2}T^2 \qquad \text{if stabilisation succeeds}$$
$$L = \frac{1}{2}T^2 + K \qquad \text{if stabilisation fails}$$

The probability that the stabilisation fails, i.e., that debt D increases ($\Delta D = X + G + R - T > 0$) is the probability that an adverse shock to the budget exceeds the planned surplus:

$$p = Prob[X > T - G - R]$$

[6] The same loss function is used, for example, in Dornbusch (1991) and in Missale et al. (1997).

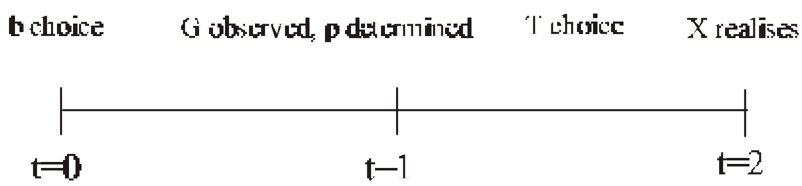

Figure 3.2:

where, as we saw above, R could take four different values (from 3.5) to (3.8) and shock X has a triangular distribution with mean zero and a support ranging between $-a$ and a.

At $t = 0$ there is still uncertainty about the government type and the buyback of public debt could be the signal that a government is dry (as above) and so private investors will apply the dry type risk premium p_b^D to short term rates. In period one, after the uncertainty about the government's type is resolved and assuming no buyback, the risk premium will be determined according to the level of spending which has been observed: it will be p^D if the level of spending has been low, or p^W if spending has been high. Notice that there is a slight change of notation respect to the previous Section as p_b^D and p^D are not equal anymore. As for the wet type p_b^W now represents the risk premium that applies off the equilibrium actions (that is when the wet type tries to cheat) and p^W indicates the risk premium corresponding to the wet type when no buyback is made.

Consider the choice of taxes and debt maturity by a government whose programme is expected to succeed (likely stabiliser) in the sense that for $X = E_0(X) = 0$ (and for its choice of taxes T^*) the overall budget shows a surplus: $\beta = T^* - G^L - I > 0$ and it could fail only if hit by a very large realisation of X.[7] We actually limit our analysis to the case in which both governments are on average successful but the size of the shock which could cause them to fail, β^W and β^D differ as they differ only in their spending G. Timing is now described in Figure 4.2.

[7] The support of the distribution of i must also be bounded from above to rule out the possibility that the surplus turns out to be negative because of a large realisation of i.

Since the planned surplus β is positive, the probability of failure is lower than 1/2 and it is derived using the right hand side of the triangular distribution of X, that is:

$$p = \mathrm{Prob}[X > T - G - R] = \frac{1}{2a^2}(a + G + R - T)^2$$

Replacing p in the government function yields the loss that the government expects before knowing the realisation of X, but after having observed the period one interest rate, and thus R:

$$L = \frac{K}{2a^2}(a + G + R - T)^2 + \frac{1}{2}T^2$$

Differentiating L with respect to T we obtain the value of taxes:

$$T^* = \delta(a + G + R) \text{ where } 0 < \delta \equiv \frac{K}{a^2 + K} < 1$$

which is increasing in public spending and thus in the cost of debt service.

Substituting T^* back into p we obtain:

$$p = \gamma(a + G + R)^2 \text{ where } 0 < \gamma \equiv \frac{a^2}{2(a^2 + K)^2} < 1$$

where p now could take four different values depending on:

$$p_b^D = \gamma(a + G^L + R_b^D)^2 = \gamma\left[a + G^L + \bar{i} + F\frac{(i^*)^2}{(1 - p_b^D)}\right]^2 \tag{3.14}$$

$$p^D = \gamma(a + G^L + R^D)^2 = \gamma\left[a + G^L + \bar{i} + F\frac{(i^*)^2}{(1 - s)(1 - p^D)}\right]^2 \tag{3.15}$$

$$p^W = \gamma(a + G^H + R^W)^2 = \gamma\left[a + G^H + \bar{i} + F\frac{(i^*)^2}{(1 - s)(1 - p^W)}\right]^2 \tag{3.16}$$

and:

$$p_b^W = \gamma(a + G^H + R_b^W)^2 = \gamma\left[a + G^H + b\bar{i}\frac{(1 - p_b^D)}{(1 - p_b^W)} + (1 - b)\bar{i} + F\frac{(i^*)^2}{(1 - p_b^W)}\right]^2 \tag{3.17}$$

Substituting T^* in the loss function, yields the value of the loss function L^*, as of the beginning of period zero:

$$L^* = \frac{1}{2}T^2 + pK$$
$$= \frac{1}{2}\delta^2(a + G + R)^2 + \gamma(a + G + R)^2 K$$

which simplifies to:

$$L^* = \frac{\delta}{2}(a + G + R)^2$$

The wet type will now reveal itself if the losses, when he chooses not to do the buyback and he is identified as being wet, are smaller than the losses when he chooses to do the buyback and he is believed to be dry. That is:

$$L^W[W; b = 0] \leq L^W\left[D; b \geq b^S\right]$$

which means:

$$\frac{\delta}{2}\left[a + G^H + R^W\right]^2 < \frac{\delta}{2}[a + G^H + R_b^W]^2 \qquad (3.18)$$

that is:

$$\frac{\delta}{2}\left[a + G^H + b\bar{i}\frac{(1 - p_b^D)}{(1 - p_b^W)} + (1 - b)\bar{i} + F\frac{(i^*)^2}{1 - p_b^W}\right]^2 - \frac{\delta}{2}\left[a + G^H + \bar{i} + F\frac{(i^*)^2}{(1 - s)(1 - p^W)}\right]^2 \geq 0 \qquad (3.19)$$

(3.19) as an equality is the equation of a parabola with two roots:

$$b_1 = \frac{F i^2(p^W(-1 + p_b^W) - p_b^W + s)}{(p_b^W - p_b^D)(1 - s)\bar{i}}$$

$$b_2 = \frac{1}{(p_b^D - p_b^W)(-1 + s)\bar{i}}(-2F(i^*)^2 + F(i^*)^2 p_b^W + F(i^*)^2 p^W - F(i^*)^2 p_b^W p^W + F(i^*)^2 s + 2a(-1 + p^W + s - p^W s) + 2G^H(-1 + p^W + s - p^W s) - 2\bar{i} + 2p^W\bar{i} + 2s\bar{i} - 2p^W s\bar{i})$$

where b_2 simplifies to:

$$b_2 = \frac{-[F i^2(1 - s + (1 - p_b^W)(1 - p^W)) + 2(a + G^H + \bar{i})(1 - s)(1 - p^W)]}{(p_b^W - p_b^D)(1 - s)\bar{i}}$$

which is always negative. Thus, the extra-losses from being believed dry are positive only for $b > b_1$. That implies that the separating condition (3.18) is satisfied for:

$$b \geq b^S \equiv b_1 = \frac{F(i^*)^2(p^W(-1+p_b^W) - p_b^W + s)}{(p_b^W - p_b^D)(1-s)\bar{i}} \qquad (3.20)$$

We can see that the candidate separating amount of buyback b^S is positive only if:

$$s > p_b^W + p^W - p^W p_b^W$$

and it is increasing in F and in s and decreasing in $\bar{i}$ (as we saw above, in (3.10)). If b^S is negative, then any positive critical value for beliefs will work (thinking of b^S as being the minimum value for the critical belief).

Finally, after substituting (3.16), (3.17) and (3.14) (whose value was for simplicity put equal to zero) into (3.20) and with the help of numerical simulations, we have found positive values of b and p_b^W and p^W and lying between zero and one (Table 4.1).

Table 4.1: Some simulation results

$\bar{i}$	1.0518	1.0518	1.0518	1.1000	1.1500
i^*	1.0480	1.0480	1.0480	1.0500	1.0700
a	0.10	0.10	0.10	0.10	0.10
K	0.50	0.50	0.50	0.50	0.50
γ	0.0005	0.0005	0.0005	0.0005	0.0005
G^H	0.30	0.30	0.30	0.30	0.30
F	0.10	0.10	0.10	0.10	0.10
p_b^D	0.00	0.00	0.00	0.00	0.00
s	0.0025	0.0050	0.0100	0.0050	0.0050
b^S	0.00973	0.22912	0.67075	0.19478	0.16835
p_b^W	0.001195177738	0.00119560062	0.00119645301	0.00127117554	0.001358241842
p^W	0.001195177739	0.00119560063	0.00119645302	0.00127117557	0.001358241847

Note that $\bar{i}$ is the gross 2-period return and its value is set equal to the Euro-11 two years gov. bond (as in the Economist of the 9th September); i^* is the gross safe world interest rate and its value is set equal to the average of 3-months money market of 8 OECD countries (i.e., Australia, Britain, Canada, Denmark, Japan, Sweden, Switzerland, United States, as in the Economist of the 9th September); $\gamma \equiv \frac{a^2}{2(a^2+K)^2}$.

From the first three columns of Table 4.1 we can observe that as s increases (ceteris paribus), b^S increases as well. That is because buybacks become more advantageous for both types and so the separating critical quantity must increase, too. As both $\bar{i}$ and i^* increase (and also their difference) (again ceteris paribus) instead the critical size of b^S diminishes.

As we did in the previous Section, we now need to check whether the dry type interest costs in the buyback case are always lower than the ones it pays with no buyback. The dry type might find it more advantageous to repurchase only a fraction $\bar{b} < b^S$ (again assuming that beliefs are such that $Prob[W \mid b < b^S = 1]$) in order to pay a lower buyback price in period zero and still be able to reduce her interest costs in period one, after the asymmetry of information is cleared. Obviously, b^S will be preferable if the corresponding losses are lower, That is:

$$L^D\left[W; b = \bar{b}\right] > L^D\left[D; b \geq b^S\right]$$

which means:

$$\frac{\delta}{2}\left[a + G^L + R^D_{\bar{b}}\right]^2 > \frac{\delta}{2}[a + G^L + R^W_{b^S}]^2 \tag{3.21}$$

that is:

$$\frac{\delta}{2}\left\{a + G^L + \bar{b}\frac{\bar{i}}{(1-s)}\frac{(1-p^D)}{(1-p^W)} + (1-\bar{b})\bar{i} + F\frac{(i^*)^2}{(1-s)(1-p^D}\right\}^2 - \frac{\delta}{2}\left\{a + G^L + \bar{i} + F\frac{(i^*)^2}{(1-p^D_b)}\right\}^2 \tag{3.22}$$

(3.22) as an equality is the equation of a parabola with two roots:

$$\bar{b}_1 = \frac{F(i^*)^2(1-p^D)(-p^D(1-p^D_b) - p^D_b + s)}{(1-p^D_b)(p^W - p^D)(1-s) - s)\bar{i}}$$

and

$$\bar{b}_2 = \frac{(1-p^D)[F(i^*)^2(2-p^D-p^D_b+p^Dp^D_b-s) + 2(a+G^L+\bar{i})(1-s)(1-p^D_b)]}{(1-p^D_b)(p^W-p^D(1-s)-s)\bar{i}}$$

which are both negative, assuming $s > p_b^W + p^W - p^W p_b^W$.[8]

Thus, for every positive b, the extra-losses from being believed dry are positive, the dry type does not have any incentive to choose to appear wet and the separating condition (3.18) is satisfied.

In sum, if b^S is the critical value for beliefs, then the separating equilibrium works (assuming $s > p_b^W + p^W - p^W p_b^W$; and indeed any value $\hat{b}$ in between b^S and 1 works (i.e. if beliefs are: $Prob[dry] = 1$ if $b \geq b^S$ and zero otherwise). But if $\hat{b}$ was above this range, then it is not a separating equilibrium as dry type would do a lower buyback.

4. Empirical Evidence

A programme of repurchase in advance of maturity of outstanding securities (RAMS) has actually included both bonds repurchase and bonds conversions. Either programme may be carried out using various techniques. According to a questionnaire (carried out by the Bank of Italy in November 1996), before 1990 RAMS operations were a rarity: only Sweden and the United Kingdom carried out them before that year. From 1990 onwards, countries began to acquire experience in the use of debt repurchases instruments and some of them have established regular bond repurchasing programmes. Table 1, in the Appendix, reports the analytic answers of 19 OECD countries (out of the 24 countries which have been interviewed by the Bank of Italy).

Almost all countries which have introduced a RAMS programme have achieved

[8] $\bar{b}_1$ is positive either if $s > p_b^D + p^D - p^D p_b^D$ and $s < \frac{p^W - p^D}{1 - p^D}$ or if $s < p_b^D + p^D - p^D p_b^D$ and $s > \frac{p^W - p^D}{1 - p^D}$; while $\bar{b}_2$ is positive if $s < \frac{p^W - p^D}{1 - p^D}$.
If $s > p_b^W + p^W - p^W p_b^W$ (as above, p.21) then it follows that $s > p_b^D + p^D - p^D p_b^D$ and $s > \frac{p^W - p^D}{1 - p^D}$. Therefore $\bar{b}_1$ and $\bar{b}_2$ are both negative.

their original aims. The percentage of debt that was repurchased in di¤erent countries ranges from 0.3% (for Italy) to signi…cant amounts (such as 12% performed by Ireland).[9] Among the most frequent objectives of the repurchase there are: the reduction of the outstanding debt (which implies a reduction of the interest expenditure as well); a greater smoothing of the maturity pro…le (some countries used an early redemption programme to eliminate heavy infra-year concentration of debt redemption; this permitted better management of cash ‡ow demand and reduced the interest rate impact on the burden of the public debt); the reduction of debt servicing costs (DSC) (after misalignements along the yield curve are identi…ed, securities with yields not in line with the benchmark curve are repurchased) and elimination of securities with poor liquidity (to maintain high liquidity in the secondary market, some countries decided either to repurchase small amounts of illiquid bonds and eliminated them or to switch from illiquid to liquid ones).

In the long run, all of these choices lead to a reduction of the cost of …nancing. A market with a smoother redemption pro…le, more liquid instruments and an informative yield curve provide a government with lower cost and better opportunities to fund its debt. Table 2, in the Appendix contains the analytic answers of the interviewed countries.

Bonds repurchase and bonds conversions are the instruments that have been mainly used (see Table 3, in the Appendix for more details). Debt exchange operations have been mostly used since they are self-…nancing: exchange o¤ers always take place on the issue of new bonds. In fact, they are not meant to reduce the stock of debt but to increase the market activity through an improvement of the characteristics of liquidity and maturity of outstanding bonds. Buyback operations

[9] Actually, in order to make comparisons, also absolute values must be considered. In fact, due to the di¤erent sizes of the outstanding debt, a percentage that appears trascurable might correspond to a major operation in the pro…le of the debt.

can be made either through a reverse auctions or in the secondary market. In countries with greater experience of this instrument, auctions usually take place on a competitive basis where an advance announcement is given concerning the bonds to be repurchased.[10] In general, both debt exchange or reverse auction are held in a more standardised procedure and, thus, they are less ‡exible instruments. For this reason, several countries decided to choose a combination of the two.[11]

With the only exceptions of the Netherlands and New Zealand (where these operations are open to all kind of investors), repurchase programmes usually take place through intermediaries. Most of them are “market makers”, like primary dealers or specialists in Government bonds (where they exist). In some other cases, these operations take place through the Central Bank while the Treasury usually coordinates them. Market information is given through professional channels in an appropriate way. Every operator should be able to know about the opportunity that the Treasury is giving the market.[12]

Finally, four kind of …nancial resources have been mainly used (as in Table 4, in the Appendix). The majority of OECD countries use funds generated mainly by the issue of new debt. Then there are the credit facilities with the central Bank (as the access to funds of the Treasury, at the Central Bank, which are used to …nance Government expenditure). Budget surplus are used as well and, …nally, there are also special Fund (“Sinking Funds”) created, in Italy and in France for example,

[10] The bids submitted by operators are generally met with cut-o¤ prices determined either by the Treasury or by the Central Bank. UK has a di¤erent procedure with a more active role of the Central Bank.

[11] For example, in France, large operations were carried out with both reverse auction and debt exchange o¤ers, while small adjustments were made through “standard repurchase”. In Italy a composite set of instruments was used: reimbursement of bonds at maturity, buyback both with reverse auction and on the secondary market.

[12] A few countries do not give any informations: Australia (where the operations are conducted only by the Central Bank) and Iceland (where a press release is issued only after the operation is closed).

with the outcome of the privatisation.[13]

More recently, also in the United States (as in the Financial Times, August 1999 and March 2000), the Clinton administration has announced it has planned to spend the forecast (over the next decade) budget surplus (worth around $3,000bn) to buy-back 1,700 billions of dollars of public debt within the next 10 years (and to eliminate it entirely by the 2015).[14] Last January Larry Summers announced that the government planned to buy-back up to $30 billion of the $5.7 trillion national debt this year (of this total $3.6 trillion is held by the public) and last March the Treasury Department actually paid $1.345 billion to repurchase $1 billion of the national debt. Buybacks took the form of a reverse auction, in which the Treasury selects o¤ers on a competitive basis based on the lowest prices and the buyback was limited to 30-years bonds. It was the Treasury's …rst debt repurchase in 70 years. In fact, the Treasury currently pays debt by replacing maturing debt with a smaller amount of new debt, while the new proposal would allow it to repurchase outstanding debt (particularly older, higher-yielding securities). Buybacks took the form of a reverse auction, in which the Treasury selects o¤ers on a competitive basis based on the lowest prices and the buyback was limited to 30-years bonds.

In sum, the main advantages of this plan would be: to use budget surpluses to reduce the debt level and interest payments (rather than to …nance tax cuts); to push more capital into private investments; to have more short-term, lower interest rate debt and to make the benchmark 30-year Treasury bond more liquid. Following news of the buyback plan, Treasury bonds prices have actually increased.

[13] While in France there are also other options, in Italy, a law (27/10/'93, No. 432) establishes that all funds arising from privatisation must be used exclusively for the purpose of reducing public debt.

[14] The Democrats have presented this plan as an alternative to the proposal of huge tax cuts, over the next ten years, presented by the Republican. In fact, they claim that the gains due to lowered interest costs (consequence of a smaller debt) will be equivalent to those of the announced tax cut.

4.1. The Data

The data we used were provided by the Banca d'Italia. They consist of 20 series of bond prices for Italian medium/long-term bonds (i.e., "Buoni Poliennali del Tesoro", BTP and "Certi…cati del Tesoro a Tasso Variabile", CCT) observed almost daily over the period 3/10/1995 to 31/12/1997, for a total of 586 observations. Each series is constructed considering approximately two months observations before and after the repurchase date. We chose a quite short interval of time in order to be able to investigate the impact of the buyback on the pattern of bonds'prices. Given the relatively small amount of debt that is repurchased on average (approximately 10% of the total outstanding amount of a every type of bond), if we considered a too long period of time, the e¤ect of the buyback would be probably blurred.

Most of these repurchases were carried out during November and December 1995; October and December 1996 and November and December 1997. Overall we obtained 22 series for the BTP bonds and 13 series for the CCT bond prices, with an average of about 100 observations.[15] One graph for each repurchase date is presented in the Appendix. As we can see, in correspondence of the break point t_B; it is generally associated a small jump in prices, while after that, most of the series decline.

Initially, we test the hypothesis of the presence of a structural break due to the buyback, assuming that the break occurrs on the day of the repurchase, since we can only know the day in which the repurchase occurrs, but not when it was announced (if it was). Since most of our series are likely to be non-stationary we implemented the testing procedure suggested by Perron (1989) which allows one simultaneously to control for the presence of unit roots and break-points. Perron proposes three

[15] The total number of the series we considered is greater than the original one since some bond has been repurchased more than once.

different variants of the traditional Dickey Fuller (1979) test, assuming that under the alternative hypothesis the series is stationary around a segmented trend, rather than a linear one. Under the alternative, the segmented trend can show a change in the intercept (Model A), in the slope (Model B) or in both (Model C):

$$H_0 : y_t = a_0 + y_{t-1} + \mu_2 D(TB)_t + \varepsilon_t \qquad \text{(Model (A))}$$

$$H_1 : y_t = a_0 + a_1 y_{t-1} + a_2 t + \mu_1 DU_t + \varepsilon_t$$

$$H_0 : y_t = a_0 + y_{t-1} + \mu_1 DU_t + \varepsilon_t \qquad \text{(Model (B))}$$

$$H_1 : y_t = a_0 + a_1 y_{t-1} + a_2 t + \mu_3 DT^*_t + \varepsilon_t$$

$$H_0 : y_t = a_0 + y_{t-1} + \mu_2 D(TB)_t + \mu_1 DU_t + \varepsilon_t \qquad \text{(Model (C))}$$

$$H_1 : y_t = a_0 + a_1 y_{t-1} + a_2 t + \mu_1 DU_t + \mu_4 DT_t + \varepsilon_t$$

where t_B is the break-point and:

$$DU = 1 \quad \text{if} \quad t > t_B; \ 0 \quad \text{otherwise}$$

$$D(TB) = 1 \quad \text{if} \quad t = t_B + 1; \ 0 \quad \text{otherwise}$$

$$DT^* = t - t_B \quad \text{if} \quad t > t_B; \ 0 \quad \text{otherwise}$$

$$DT = t \quad \text{if} \quad t > t_B; \ 0 \quad \text{otherwise}$$

The three tests are carried out following the procedure in Perron, which requires the regression of the dependent variable on a constant, a time trend, the lagged dependent variable, DU and augmented differences lag in order to remove autocorrelation (according to Model A); on a constant, a time trend, the lagged dependent variable, DT^* and augmented lagged differences (according to Model B); on a constant, a time trend, the lagged dependent variable, DU, DT and augmented lagged differences (according to Model C).[16]

[16] For more details see Perron (1989), p. 1373 and Enders (1995), p. 247.

We took logs of each series and estimated it under the three specifications and the testing equation that performed best was Model C, which allows for both a change in the intercept (DU) and for a change in the slope (DT) of the trend, under alternative. In fact, analysing the pattern of the series, as in the graphs in the Appendix, it seems appropriate to have a model that captures both a very short-term break (associated to the date of the repurchase/breakpoint t_B) and a longer-term behaviour (after the repurchase the series generally decreases).

The detailed results are presented in Tables 5 and 6 and in Tables 5a and 6a in the Appendix. Most of the series are non-stationary at 5% and 10% level of significance (see Table 5 and 6). The coefficient of DU is generally significant and positive, while the coefficient of DT is generally significant and negative, which is consistent with the behaviour observed in the graphs. For the series on BTP this result holds in most cases (see Table 5). There are only few cases in which the coefficients do not have the expected signs (as for I12675, I12678, I12686 and I36675 in Table 5) or they are not significant (as for I12686, I12675, I36674 and I36675 in Table 5a). For the series on CCT similar conclusions hold: in two cases coefficients do not have the expected signs (I13097, I13204) and in other few cases they are not significant (I13097, I13204, I36612, I36690 and I36726).

However, invoking the null hypothesis for the series that are unambiguously non stationary alters very much the results. Table 5a and 6a present the results we obtain when the null is actually imposed (for both BTP and CCT) and they look quite different respect those in Table 5 and 6 as the coefficient of DU is now rarely significant and the one of DP is almost never significant. This big difference between the two sets of results actually questions the validity of the non-stationarity test. The test seems to have low power, that is to be biased towards accepting the null hypothesis. This can also be accentuated because of both the short span (two years) and the high frequency of the data (daily data incorporate lot of noise)[17].

Our interpretation of these results is that the initial impact of the repurchase is to make the prices of the remaining bonds rise, since the coefficient of DU is positive and significant, as in Tables 5a and 6a. This result is actually consistent with our theory as we can interpret an increase in bonds price (and correspondingly a decrease in their rates of returns) as a signal that the buyback operation has (somehow) positively affected the credibility of a government. From the same Tables it emerges that the coefficient of DT is negative in most cases, that is, after a short period of time, the bonds' prices generally decrease. Both results are consistent with the behaviour observed in the graphs.

However, to explain the pattern of bonds' prices as the period of time becomes longer, we need a better model of all the factors that might affect bonds' prices, not only taking into account their break-points. In this respect it could be very useful to have access to the same kind of data for some other countries, since Italy is generally considered as a "special case" as it suffers from political instability and so from serious credibility problems. It would also be useful to increase the sample to check the robustness of our results.

5. Conclusions

In this paper a model was developed in which public debt repurchases was a signal of a government's type. Asymmetry of information between the government and private investors was assumed where a government could be of two types: a dry type and a wet type, according to its willingness to implement a fiscal stabilisation. In particular interest rates were assumed to incorporate a risk premium which re-

[17] For this reason using the whole sample (rather than two months before and ahead the break) does not make these results change at all.

‡ected the expectation that the inability to implement a stabilisation programme may have resulted in more in‡ation and/or taxation, or debt default. More specifically, during a …scal stabilisation, private investors would lack con…dence in the stabilisation programme and interest rates would be too high, re‡ecting this lack of credibility. (This argument was somehow similar to an argument found in Missale et al., 1997). Thus, a dry type which had to …nance new spending might want to signal its resolution (type) in order to lower its interest costs and one way to do that would be to repurchase a fraction of the outstanding debt. Actually, also the wet type could decide to buyback some of its debt in order to pretend to be a dry type and to (possibly) lower its interest payments. It was showed that a critical amount of buyback exists such that the two types could be separated.

Finally, evidence is provided in favour of the hypothesis that the repurchase of public debt is actually perceived as a good signal by private investors, consistently with our theoretical model. In order to do that we analysed series of prices of long term Italian bonds, in order to detect the presence of a structural break, in correspondence to the day of the buyback. The data were provided by the Banca d'Italia and they consisted of 20 series of bond prices for Italian medium/long-term bonds (BTP and CCT) observed over the period 3/10/1995 to 31/12/1997, for a total of 586 observations. Each series was constructed considering approximately two months observations before and after the repurchase date. We implemented the testing procedure suggested by Perron (1989) which allows to simultaneously control for the presence of unit roots and break-points.

According to our results, the initial impact of the repurchase was to make the prices of the remaining bonds rise, while, after a short period of time, these prices generally decrease. This was consistent with our theory as we can interpret an increase in bonds price (and correspondingly a decrease in their rates of returns) as a signal that the buyback operation has positively a¤ected the credibility of a government. However, to explain the pattern of bonds' prices as the period of time increases, we should probably model better all the factors that might a¤ect bonds' prices, not only taking into account their break-points. In this respect it could be very useful to have access to the same kind of data for some other countries, since Italy is generally considered as a "special case" as it su¤ers from political instability and so from serious credibility problems.

References

[1] Acharya S. and Diwan I. (1993) "Debt Buybacks Signal Sovereign Countries' Creditworthiness: Theory and Tests". International Economic Review, Vol. 34, pp. 795-817.

[2] Bulow J. and Rogo¤ K. (1988) "The Buyback Boondoggle." Brookings Papers on Economic Activity, pp. 675-99.

[3] Bulow J. and Rogo¤ K. (1991) "Sovereign Debt Repurchases: no cure for overhang". Quarterly Journal of Economics, Vol. 106, pp. 1219-1235.

[4] Cohen D. and Verdier T. (1995) "Secret Buybacks of LDC Debt." Journal of International Economics, Vol. 39, pp. 317-334.

[5] Dicky D. and W.A. Fuller (1979) "Distribution of the Estimates for Autoregressive Time Series with a Unit Root." Journal of the American Statistical Association, Vol. 74, pp. 427-431.

[6] Dornbusch R. (1991) "Credibility and Stabilisations." Quarterly Journal of Economics, Vol. 106, pp. 836-850.

[7] Drazen, A. (2000) "Political Economy in Macroeconomics." Princeton University Press, Princeton, New Jersey.

[8] Drazen A. and P.R. Masson (1994) "Credibility of policies versus credibility of policymakers." Quarterly Journal of Economics, Vol. 109, No. 3, pp. 735-754.

[9] Drudi F. and A. Prati (1998) "Signaling Fiscal Regime Sustainability." Banca d'Italia: Temi di Discussione del Servizio Studi No. 335.

[10] Enders W. (1995) "Applied Econometric Time Series." Wiley Series in probability and statistics. John Wiley & Sons, Inc.

[11] Froot K.A. (1989) "Buybacks, Exit Bonds, and the Optimality of Debt and Liquidity Relief." International Economic Review, Vol. 30, pp. 49-70.

[12] Krugman P. (1989) "Market-Based Debt Reduction Schemes." In Frenkel J.A., Dooley M.P. e Wickham P. (eds), "Analytical Issues in Debt", Washington D.C.: International Monetary Fund.

[13] Marchesi S. and J.P. Thomas (1999) "IMF Conditionality as a screening device." Economic Journal, Vol. 109, pp. 111-125.

[14] Missale A. (1999) “Public Debt Management.” Oxford University Press.

[15] Missale A., Giavazzi F. and P. Benigno (1997) “Managing the Public Debt in Fiscal Stabilisation: the Evidence.” NBER No. 6311.

[16] Financial Times, 5th August 1999.

[17] Perron P. (1989) “The great crash, the oil price shock, and the unit root hypothesis.” Econometrica, Vol. 57, pp. 461-471.

[18] Persson T. and G. Tabellini (1997) “Political Economics and Macroeconomic Policy.” CEPR Discussion Paper No. 1759.

[19] Rodrik D. (1989) “Promises, promises: credible policy reform via signalling.” The Economic Journal, Vol. 99, pp. 756-772.

[20] Rotemberg J.J. (1991) “Sovereign debt buybacks can lower bargaining costs.” Journal of International Money and Finance, Vol. 10, pp. 330-348.

[21] Thomas J.P. (1996) “Sovereign Debt Buybacks revisited.” Global Economic Institutions (GEI) Working Paper, No. 20.

[22] Zivot E. and D.W.K. Andrews (1992) “Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit Root Hypothesis.” Journal of Business & Economic Statistics, Vol. 10, pp. 251-270.

Appendix

Table 1: 19 OECD countries interviewed by the Bank of Italy

Countries	Y/N	Description
Australia	Y	Bond conversion. '90-'91. RAMS since '93
Austria	Y	No information
Belgium	Y	RAMS '91-'92. Bond Conversion since '91
Canada	N	
Denmark	Y	RAMS since '90
Finland	Y	RAMS since '94
France	Y	RAMS since '91
Greece	N	Only some issues between '91-'95 were repurchased
Iceland	Y	RAMS planned to start in 1997
Ireland	Y	RAMS since '90
Italy	Y	RAMS since '95
Netherlands	Y	RAMS only at the end '94
New Zealand	Y	RAMS since '90
Norway	Y	2 RAMS. The …rst since '95
Spain	Y	RAMS since '95
Sweden	Y	RAMS since '89
Switzerland	N	
United Kingdom	Y	RAMS since '88
United States	N	

Table 2: Reasons for the repurchase programme

Countries	Description (*)
Australia	(4) Poor liquidity (2) Smoothing
Austria	(3) DSC (2) Smoothing (1) Debt reduction
Belgium	(2) Smoothing (4) Poor liquidity (5) Old certi...cates
Denmark	(2) Smoothing (6) FT (4) Poor liquidity (3) DSC
Finland	(2) Smoothing (7) Short liquidity (5) Old certi...cates
France	(2) Smoothing (4) Poor liquidity (3) DSC
Greece	(1) Debt reduction (2) Smoothing (3) DSC (4)Poor liquidity
Iceland	(2) Smoothing
Ireland	(4) Poor liquidity (3) DSC (2) Smoothing
Italy	(1) Debt reduction (2) Smoothing (4) Poor liquidity (3)DSC
Netherlands	(4) Poor liquidity (8) Extend debt maturity (3) DSC
New Zealand	(2) Smoothing (4) Poor liquidity
Norway	(2) Smoothing (3) DSC (4) Poor liquidity
Spain	(4) Poor liquidity (2) Smoothing
Sweden	(4) Poor liquidity (2) Smoothing
United Kingdom	(9) Money market management (2) Smoothing

(*) (1) Reduction of outstanding debt; (2) Smoothing of the maturity pro...le; (3) Reduction of debt servicing costs (DSC); (4) Elimination of securities with poor liquidity; (5) Elimination of old physical certi...cates; (6) Fine Tuning of the government borrowing in accordance with the borrowing requirement (FT); (7) Elimination of securities with short liquidity; (8) Extend the debt maturity; (9) Money market management.

Table 3: Techniques adopted in the repurchase

Countries	Description
Australia	Buyback operations for stock nearing maturity (CB holding)
Austria	Unannounced buyback operations
Belgium	Bond Conversion (into longer maturity bonds)
Denmark	Continuous buyback operations
Finland	Debt exchange techniques
France	OTC. Larger amounts: reverse auctions or public exchange
Greece	Buyback of extraordinary issues (at interest payments)
Iceland	Buyback operations and bond conversions
Ireland	Switching programme and direct buybacks (rarely)
Italy	Reverse auctions (illiquid assets) and buybacks
Netherlands	Bond conversion and buyback operations
New Zealand	Buyback and bond exchange (greater volume in a new bond)
Norway	Buybacks (on the stock exchange), fixed-price offers
Spain	Debt exchange auctions and buybacks
Sweden	Bond conversion
United Kingdom	Purchases of “next maturities”, “small”/“index-linked” stocks (*)
	Reverse auction and bond conversion

(*) “Next maturities”: Bank of England bids daily a price for bonds maturing within the next three months; “small stocks”: Bank of England repurchases issue with extremely low outstanding amount; “index-linked” stocks: sometimes the Bank of England is asked by primary dealers to do so in order not to reduce the volume of such bonds in the market.

Table 4: Source of financing used

Countries	Description
Australia	(2) credit facilities (1) new issues
Austria	(3) budget surplus
Belgium	(1) new issues
Denmark	(1) new issues
Finland	(1) new issues
France	(1) new issues (4) special Fund
Greece	
Iceland	(1) new issues
Ireland	(1) new issues
Italy	(4) special Fund(a*)
Netherlands	(1) new issues
New Zealand	(1) new issues (initially short term)
Norway	(1) new issues (2) credit facilities
Spain	(2) credit facilities
Sweden	(1) new issues
United Kingdom	Since '93 GOOA (Gilt Edged Official Operations Account))(b*)

(a*) In October 1993, the Italian government has instituted a Fund (with the outcome of the privatisations) which could be used only to repurchase public debt. It could constitute a "signal" of credibility both because it helps reducing internal debt and for an "accounting" reason as well, since the outcome of the privatisations (a long term quantity) is imputed to reduce debt (a stock quantity) and not current expenditure.

(b*) It is an account through which all official transactions in Gilts passe (sales and purchase). It is managed by the National Debt Commissioners under the authority of the Treasury.

Table 5: Results of the structural break test

BTP	Buyback date	Model (C): y_{t-1}	const.	trend	DU	DT	lags		λ
I2675b	31/10/1996	-0.121	0.565	2.39E-05	0.004	-5.29E-05	0	NS	.532
(B1)		(-2.957)	(2.956)	(2.854)	(3.479)	(-3.698)			
I36606	31/10/1996	-0.148	0.683	-2.61E-06	0.002	-2.88E-05	0	NS	.532
(C1)		(-3.402)	(3.402)	(-1.0001)	(3.426)	(-3.727)			
I36622	31/10/1996	-0.122	0.568	2.15E-05	0.004	-4.86E-05	0	NS	.532
(D1)		(-3.119)	(3.118)	(3.261)	(3.547)	(-3.884)			
I36631	31/10/1996	-0.101	0.468	2.41E-05	0.003	-4.48E-05	0	NS	.532
(E1)		(-2.744)	(2.744)	(2.968)	(3.300)	(-3.608)			
I36635	31/10/1996	-0.125	0.581	3.96E-05	0.004	-6.08E-05	1	NS	.532
(F1)		(-3.066)	(3.065)	(3.464)	(3.613)	(-3.983)			
I36641	31/10/1996	-0.113	0.527	3.66E-05	0.004	-5.84E-05	0	NS	.532
(G1)		(-3.010)	(3.010)	(3.135)	(3.737)	(-3.934)			
I36650	31/10/1996	-0.093	0.429	4.00E-05	0.004	-5.41E-05	0	NS	.532
(H1)		(-2.673)	(2.673)	(3.016)	(3.334)	(-3.669)			
I36676	31/10/1996	-0.108	0.494	0.0001	0.010	-0.0001	0	NS	.532
(I1)		(-2.974)	(2.977)	(2.922)	(3.055)	(-2.891)			
I36682	31/10/1996	-0.172	0.793	1.60E-05	0.002	-2.65E-05	4	S	.532
(J1)		(-4.196)**	(4.195)	(4.424)	(4.298)	(-4.642)			
I36691	31/10/1996	-0.181	0.832	2.84E-05	0.003	-4.02E-05	4	S	.532
(K1)		(-4.499)*	(4.498)	(5.051)	(4.963)	(-5.346)			
I36707	31/10/1996	-0.180	0.275	9.63E-06	0.001	-1.44E-05	4	S	.532
(L1)		(-4.552)*	(4.551)	(5.070)	(5.141)	(-5.479)			
I36715	31/10/1996	-0.182	0.842	6.12E-05	0.006	-8.28E-05	4	S	.532
(M1)		(-4.216)**	(4.215)	(4.672)	(4.798)	(-5.116)			
I36727	31/10/1996	-0.121	0.564	4.47E-05	0.005	-6.06E-05	0	NS	.532
(N1)		(-3.025)	(3.025)	(3.242)	(3.486)	(-3.761)			
I36740	31/10/1996	-0.110	0.512	5.07E-05	0.005	-6.61E-05	0	NS	.532
(O1)		(-2.883)	(2.883)	(3.133)	(3.452)	(-3.732)			
I36747	31/10/1996	-0.121	0.562	6.65E-05	0.006	-7.57E-05	0	NS	.532
(P1)		(-2.996)	(2.997)	(3.207)	(3.456)	(-3.709)			

t statistics are reported in parenthesis. NS refers to the non stationarity of the series.

λ is the proportion of observations occurring before the structural change.

The critical value for Model C and for $\lambda = 0.05$ is -4.24 at 5% (*)

and -3.96 at 10% (**).

The asympotic distribution of the other coefficients' t statistic is standardized

normal. Data are expressed in logs.

Table 5 contd.: Results of the structural break test

BTP	Buyback date	Model (C): y_{t-1}	const.	trend	DU	DT	lags		λ
I12686	31/10/1996	-0.099	0.457	-1.16E-05	0.0001	-4.51E-06	1	NS	.568
(B1)		(-1.605)	(1.605)	(-1.673)	(0.788)	(-1.321)			
I36674	31/10/1996	-0.136	0.627	1.24E-07	0.0001	-3.62E-06	1	NS	.568
(C1)		(-2.416)	(2.416)	(0.058)	(0.890)	(-1.305)			
I12675	30/11/1995	-0.160	0.739	3.25E-05	-0.002	4.36E-05	0	NS	.524
(B1)		(-2.548)	(2.547)	(1.484)	(-0.846)	(1.020)			
I12678	30/11/1995	-0.249	1.152	2.69E-05	-0.005	0.0001	0	NS	.524
(C1)		(-3.318)	(3.318)	(1.858)	(-2.694)	(2.817)			
I12686	30/11/1995	-0.260	1.199	2.33E-05	-0.002	4.39E-05	2	S	.524
(D1)		(-4.250)*	(4.249)	(2.134)	(-2.548)	(2.333)			
I36675	3/11/1997	-0.145	0.671	-1.09E-05	-0.001	2.54E-05	2	NS	.565
(B1)		(-2.440)	(2.442)	(-1.114)	(-1.356)	(1.600)			
I36607	12/12/1995	-0.133	0.614	5.86E-05	0.007	-6.76E-05	1	NS	.553
(B1)		(-3.074)	(3.074)	(2.030)	(2.294)	(-1.675)			

t statistics are reported in parenthesis. NS refers to the non stationarity of the series.

λ is the proportion of observations occurring before the structural change.

The critical value for Model C and for both λ=0.06 and λ=0.05 is -4.24 at 5% (*).

For λ=0.06 it is -3.95 and for λ=0.05 it is -3.96, at 10% level of significance (**).

The asympotic distribution of the other coefficients' t statistic is standardized normal.

Data are expressed in logs.

Table 6: Results of the structural break test

CCT	Repurchase date	Model (C): y_{t-1}	const.	trend	DU	DT	lags		λ
I13096	31/10/96	-0.230	1.060	-8.74E-06	0.0004	-5.49E-06	1	S	.371
(B1)		(-4.311)*	(4.311)	(-0.898)	(2.010)	(-0.653)			
I13097	31/10/96	-0.042	0.196	2.93E-06	-0.0003	5.18E-06	1	NS	.371
(C1)		(-0.771)	(0.771)	(0.241)	(-1.378)	(0.461)			
I13204	31/10/96	-0.037	0.173	1.08E-05	-0.0001	-5.16E-06	2	NS	.371
(D1)		(-0.573)	(0.572)	(1.006)	(-0.543)	(-0.510)			
I36612	31/10/96	-0.140	0.647	-1.14E-06	0.0003	-5.61E-06	1	NS	.371
(E1)		(-2.010)	(2.010)	(-0.081)	(0.997)	(-0.461)			
I36690	31/10/96	-0.062	0.285	1.33E-05	0.0002	-1.42E-05	0	NS	.371
(F1)		(-1.084)	(1.084)	(0.911)	(0.414)	(-0.972)			
I36685	3/11/97	-0.109	0.502	4.95E-06	0.0005	-6.86E-06	1	NS	.528
(B1)		(-2.608)	(2.608)	(1.654)	(1.974)	(-1.953)			
I36690	3/11/97	-0.0006	0.060	3.39E-06	0.0005	-6.31E-06	0	NS	.528
(C1)		(-1.576)	(1.576)	(1.290)	(1.837)	(-1.885)			
I36694	3/11/97	-0.110	0.506	5.61E-06	0.0006	-7.39E-06	1	NS	.528
(D1)		(-2.704)	(2.705)	(1.833)	(2.084)	(-2.057)			
I13207	31/12/96	-0.001	0.138	-8.19E-07	0.002	-2.71E-05	1	NS	.5
(B1)		(-2.909)	(2.908)	(-0.280)	(2.336)	(-2.751)			
I36611	31/12/96	-0.160	0.742	3.27E-07	0.002	-2.87E-05	1	NS	.5
(C1)		(-3.857)	(3.857)	(0.103)	(3.282)	(-3.395)			
I36629	31/12/96	-0.150	0.739	.1.51E-07	0.002	-3.18E-05	0	NS	.5
(D1)		(-3.392)	(3.392)	(0.043)	(2.890)	(-3.006)			
I36726	19/12/1997	-0.221	1.018	1.07E-05	0.0008	-1.53E-05	2	NS	.695
(B1)		(-2.575)	(2.575)	(2.555)	(1.085)	(-1.366)			
I36746	19/12/1997	-0.271	1.253	1.21E-05	0.001	-2.11E-05	1	NS	.695
(C1)		(-3.444)	(3.444)	(3.011)	(1.645)	(-1.900)			

t statistics are reported in parenthesis. NS refers to the non stationarity of the series.

λ is the proportion of observations occurring before the structural change.

The critical value for Model C and for λ=0.07 is –4.18 at 5% (*)

and -3.86 at 10% (**).

For λ=0.05, it is -4.24 at 5% (*) and –3.96 at 10% (**).

For λ=0.04, it is -4.22 at 5% (*) and -3.95 at 10% (**).

The asympotic distribution of the other coefficients' t statistic is standardized normal.

Data are expressed in logs.

Table 5a: Results of the structural break test (under H_0)

BTP	Buyback date	Model (C): const.	DU	DP	lags	%	Euro (mill.)
I2675b (B1)	31/10/1996	0.0001 (0.949)	-0.0002 (-1.446)	0.0001 (0.142)	0		41
I36606 (C1)	31/10/1996	-4.17E-05 (-0.960)	-0.0001 (-2.191)	0.0003 (0.785)	0		10
I36622 (D1)	31/10/1996	8.69E-05 (0.983)	-0.0002 (-1.835)	0.0004 (0.602)	0		31
I36631 (E1)	31/10/1996	0.0001 (1.725)	-0.0003 (-2.060)	0.0009 (1.210)	0		41
I36635 (F1)	31/10/1996	0.0002 (1.925)	-0.0003 (-1.847)	0.001 (1.437)	1		2
I36641 (G1)	31/10/1996	0.0002 (1.931)	-0.0003 (-1.849)	0.002 (2.613)	0		46
I36650 (H1)	31/10/1996	0.0002 (1.436)	-0.0002 (-1.303)	0.002 (2.081)	4		16
I36676 (I1)	31/10/1996	0.001 (2.275)	-0.0002 (-0.415)	0.006 (1.877)	0	.5%	13
I36682 (J1)	31/10/1996					9%	67
I36691 (K1)	31/10/1996					10%	77
I36707 (L1)	31/10/1996						57
I36715 (M1)	31/10/1996						62
I36727 (N1)	31/10/1996	0.0002 (2.047)	-0.0003 (-1.604)	0.001 (1.230)	0	10%	88
I36740 (O1)	31/10/1996	0.0002 (1.560)	-0.0003 (-1.282)	0.002 (1.653)	4	2.7%	28
I36747 (P1)	31/10/1996	0.0004 (2.548)	-0.0004 (-1.533)	0.002 (1.297)	0	1.1%	15

The asympotic distribution of the coe¢cients' t statistic is standardized normal.

t statistics are reported in parenthesis.

The last two columns contain the amount of debt repurchased (in million euro): the percentage (%) and the total amount respectively.

Data are expressed in logs.

Table 5a contd.: Results of the structural break test (under H_0)

BTP	Buyback date	Model (C): const.	DU	DP	lags	Euro (mill.)
I12686 (B1)	31/10/1996	-0.0001 (-3.951)	-0.0001 (-2.603)	7.50E-05 (0.413)	1	26
I36674 (C1)	31/10/1996	3.06E-05 (1.222)	-6.25E-05 (-1.659)	-3.93E-05 (-0.236)	1	21
I12675 (B1)	30/11/1995	4.63E-05 (0.174)	0.0003 (0.859)	0.0006 (0.340)	0	277
I12678 (C1)	30/11/1995	9.47E-05 (0.544)	0.0004 (1.614)	-0.0005 (-0.440)	0	204
I12686 (D1)	30/11/1995					1077
I36675 (B1)	3/11/1997	8.04E-05 (0.638)	-3.78E-06 (-0.020)	-0.0003 (-0.384)	2	1067
I36607 (B1)	12/12/1995	0.0003 (0.793)	-4.07E-05 (-0.068)	0.001 (0.324)	1	191

The asympotic distribution of the coe¢cients' t statistic is standardized normal.

t statistics are reported in parenthesis.

The last column contains the total amount of debt repurchased (in million euro).

Data are expressed in logs.

Table 6a: Results of the structural break test (under H_0)

CCT	Repurchase date	Model (C): const.	DU	DP	lags	%	Euro (mill.)
I13096 (B1)	31/10/96					.28%	10
I13097 (C1)	31/10/96	2.31E-05 (0.266)	-1.58E-05 (-0.148)	3.21E-05 (0.081)	1	.4%	10
I13204 (D1)	31/10/96	-8.21E-06 (-0.110)	1.51E-05 (0.166)	-3.43E-05 (-0.104)	2	.18%	5
I36612 (E1)	31/10/96	2.16E-06 (0.023)	-4.86E-07 (-0.004)	-2.36E-05 (-0.055)	1	4%	31
I36690 (F1)	31/10/96	0.0002 (2.162)	-0.0002 (-1.743)	1.87E-20 (4.01E-17)	0	3.5%	36
I36685 (B1)	3/11/97	4.58E-05 (1.227)	-6.08E-05 (-1.125)	9.44E-05 (0.319)	1	98%	759
I36690 (C1)	3/11/97	4.04E-05 (1.031)	-6.23E-05 (-1.096)	3.76E-05 (0.121)	1	13.2%	418
I36694 (D1)	3/11/97	4.81E-05 (1.268)	-5.92E-05 (-1.077)	8.96E-05 (0.297)	1	51%	1164
I13207 (B1)	31/12/96	1.13E-05 (0.236)	-0.0002 (-2.957)	-0.0008 (-2.117)	0		
I36611 (C1)	31/12/96	7.55E-06 (0.133)	-0.0001 (-1.675)	0.0001 (0.358)	2	10%	155
I36629 (D1)	31/12/96	3.38E-05 (0.538)	-0.0002 (-2.311)	0.0002 (0.347)	0	13.2%	170
I36726 (B1)	19/12/1997	4.94E-05 (1.256)	-7.73E-05 (-1.095)	7.27E-05 (0.250)	2	40%	413
I36746 (C1)	19/12/1997	5.46E-05 (1.385)	-8.96E-05 (-1.265)	-5.14E-05 (-0.178)	2	26%	1033

The asympotic distribution of the coe¢cients' t statistic is standardized normal.

t statistics are reported in parenthesis.

The last two columns contain the amount of debt repurchased (in million euro): the percentage (%) and the total amount respectively.

Data are expressed in logs.

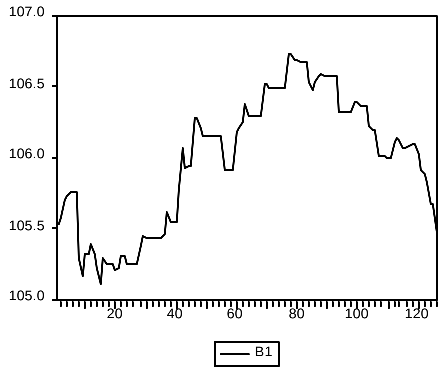

Figure 5.1: BTP, OCT (t_B = 67)

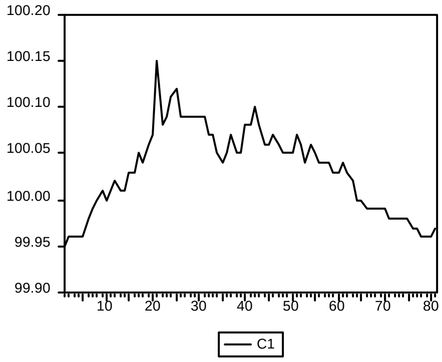

Figure 5.2: BTP, OCT bis (t_B = 46)

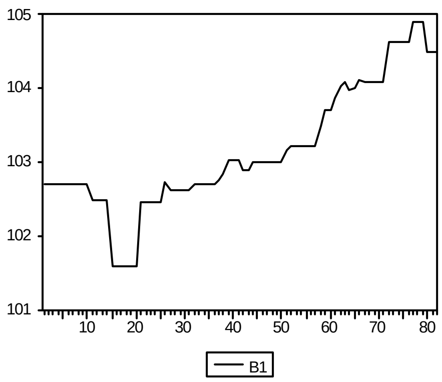

Figure 5.3: BTP, NOV (t_B = 43)

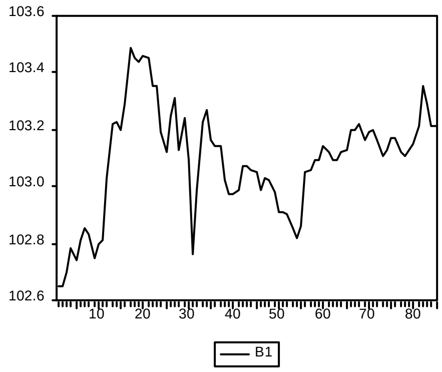

Figure 5.4: BTP, NOV bis (t_B = 48)

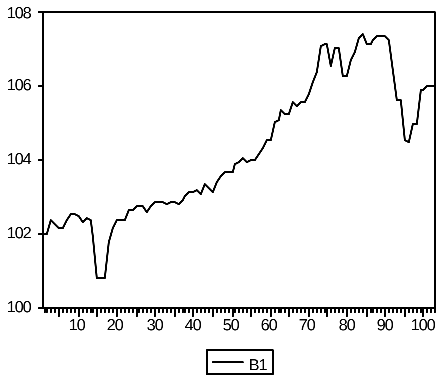

Figure 5.5: BTP, DEC (t_B = 57)

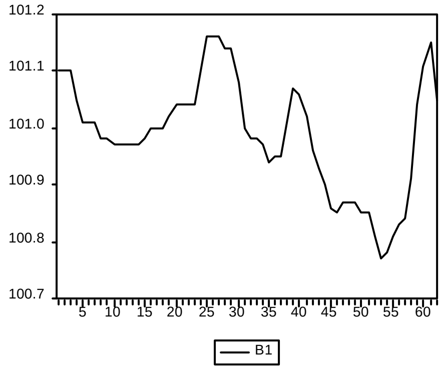

Figure 5.6: CCT, OCT (t_B = 23)

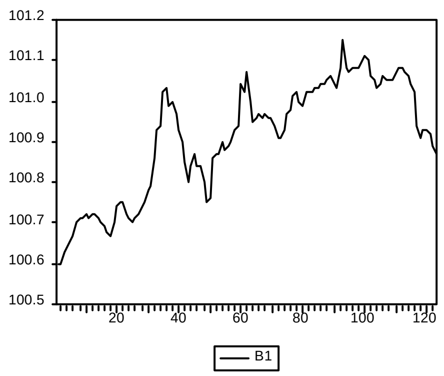

Figure 5.7: CCT, NOV (t_B = 65)

Figure 5.8: CCT, DEC (t_B = 62)

Figure 5.9: CCT, DEC bis (t_B = 57)