NORTH-HOLLAND

In Search of an Independent Province for the Treasuries: How Should Public Debt Be Managed?

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We provide a rationale for the growing phenomena of calendars for issues of government bonds and of independent agencies of debt management. In our analysis, both phenomena emerge as a solution to a time-inconsistency bias to issue illiquid bonds. Because debt managers wish to take views on the market to reduce the cost of financing, they must sacrifice some liquidity in the secondary market, as liquidity creation is slow to achieve. Markets expect that behavior and reduce the liquidity premium. We provide some stylized facts on how the United States, France and Italy have tackled this problem.

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I. Introduction

It is frequently noted in the economic literature that debt management is theoretically a powerful instrument to achieve monetary policy objectives.[1] However, this view runs into two problems. First, the empirical evidence on the effects of debt management on interest rates is inconclusive [for example, see Agell and Persson (1992)]. Second, the movement to grant independence to the Central Banks to implement monetary policy could make (according to the above-mentioned literature) authorities in charge of debt management

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[1] Tobin (1963, p. 148) affirmed in a famous article: "There is no neat way to distinguish monetary policy from debt-management, the province of the Federal Reserve from that of the Treasury." For recent examples, see Blanchard and Missale (1994) or Giavazzi and Pagano (1990) for different uses of debt to affect actual or/and expected inflation.

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(treasuries) either dependent on Central Banks or seemingly devoid of any policy objective. In reality, a closer look into debt-management practices would tell us that this is not the case and that economic theory has lagged behind in identifying the rationale for and the consequences of a debt manager's behavior. Objectives like liquidity, transparency and regularity are becoming more frequently words credited to debt officials, who avoid any reference to monetary policy; and agencies for debt management, granted independence so as to achieve specific goals—like maximizing net worth given risk—are being created in several countries.

This paper investigates a possible rationale for these new attitudes toward debt management and what its consequences might be in terms of welfare and in terms of the political economy of debt management. Many issues that this paper raises represent a first try at bridging the widening gap between monetary theories of debt management and debt management itself. In this paper, we abandon the traditional macroeconomic perspective on debt management and concentrate on the daily activities of a debt manager, and his/her motives. Although it is generally in the primary market that the debt manager learns the cost of its debt, he/she understands that secondary market conditions are important for at least two reasons. The first is that in the absence of an efficient and transparent secondary market, the primary market results (notably through auctions) are negatively affected. Liquidity of bonds (i.e., the degree of substitutability with cash or, more appropriately, the capacity to be traded immediately in large amounts without affecting prices) provides a good example. If a bond is not liquid, it will be hard to sell and it is likely that the seller will have to receive a lower price than if that same bond had been issued in a bigger quantity and was easier to exchange. Those who are in the market will ask for a higher yield to hold it.[2] It has also been argued that markets with no liquidity are deserted by potential entrants, [see Pagano (1989a)] and if the market becomes thinner, it will be hard to distinguish what drives the price movements, increasing further the required yield to hold debt instruments. All this will be reflected in the yields requested at the auctions of new bonds.[3] We assume critically that liquidity can be affected by debt-management decisions, and therefore is not simply an endogenous variable determined by the equilibrium behavior of traders. To assume this, one must note that what can be controlled by debt managers is really the size and fungibility of the bond. However, to use the terminology of Lippman and McCall (1986, p. 47), the more fungible a bond, the less idiosyncratic it is, the thicker the market. There is theoretical evidence that thickness of markets increases liquidity.[4] Also, there is theoretical evidence that issuers reduce their opportunity cost through "liquidity increasing financial policies" [Amihud and Mendelson

[2] From now on, we define the higher price of a more liquid bond compared to otherwise equivalent instruments as the "liquidity premium." Liquidity is generally priced in government bonds [see, for example, Warga (1992)], and this pricing can be theoretically justified [see, for example, Boudoukh and Whitelaw (1993) and Amihud and Mendelson (1980)]. Note that liquidity effects, even if not directly priced through lower interest expenses (higher liquidity premium), can generally be viewed as a welfare-improving choice through the internalization of an externality to society. It is evident that an ill person who holds a bond, and will need to sell it to finance his/her hospitalization, will benefit from liquid markets.

[3] Boudoukh and Whitelaw (1993) argued that, in Japan, authorities have an incentive to discriminate bond issuance into liquid and illiquid bonds so as to reap consumers' surplus. For their theory to hold, they must assume collusion between authorities and market-makers, which fits Japanese institutions but is hard to apply to those of other countries. As is the case with their model, we believe that liquidity may be welfare-enhancing for the debt manager, but we differ in the institutional set-up that backs such a result.

[4] By liquidity, one may mean the marketability of a bond (its capacity to be sold at short notice without loss) or the riskiness of its final value. However, both aspects of liquidity can be positively affected by market depth. See Pagano (1989b), in particular footnote 5.

(1980, p. 46)] in the presence of trading costs and frictions, i.e., by increasing the size of the amount outstanding and standardizing securities so as to make them more fungible.

Available empirical evidence indicates that liquidity costs increase as the size of the bond decreases [for example see Garbade and Silber (1976); Sarig and Warga (1989)], while theoretical models with search costs [Garbade and Silber (1976)] or trading externalities [Pagano (1989a, b)] can justify government intervention which increases the nominal amount of fungible bonds outstanding and thereby raises liquidity.

Beside liquidity, the regularity of bond issues and information regarding their size are important for individuals who need to plan their investments and have no full knowledge of the financing needs of treasuries. It may well be that this additional information and the regularity of issues increase the attractiveness of the bonds issued.

The second reason for which secondary markets are important for a debt official is that he/she may want to take advantage of arbitrage opportunities which the market is incapable of closing because the market is less informed than the debt official, or simply because the debt official has a view on future macroeconomic fundamentals which will affect future interest rate behavior and, therefore, interest expenses, like budget news or monetary news. Frequent instruments in the hands of the official are exchange offers, early redemptions, hedging techniques and sudden interruptions in the process of financing the debt through one specific instrument or switching from one issue to the other. Campbell (1995), for example, described how the failure of the pure expectation hypothesis may lead a debt manager to consider the sudden shortening of the maturity of public debt, (as achieved for example by the Clinton administration through the sudden interruption of long-term bonds reopening), as beneficial in terms of average cost of debt.

We argue that there is a potential trade-off for the debt manager between these two reasons. On the one hand, he/she is tempted to follow a market-oriented approach; on the other hand, he/she is tempted to adopt a beat-the-market strategy.[5] Tobin (1963) summarized the trade-off in the following way[6]:

> The government does not, of course, borrow in a perfect market. As the government makes security transactions, it turns the market against itself . . . . The rate differential that made the switch advantageous will tend to vanish as authorities exploit it. This does not mean that it is fruitless to take advantage of favorable opportunities. They should be exploited until they are exhausted, and no farther . . . . Even so the minimization objective is not to be regarded as something to be precisely and continuously achieved . . . . The authorities may well wish to sacrifice some apparent economy of interest cost in order to avoid too frequent and drastic interventions in the market. [Tobin (1963, pp. 191–192)]

We believe that this trade-off may explain several features of the way in which debt managers and market investors interact. Notably, the existence of calendars of issues (described in the citation below) and of agencies of debt management, or the absence of either one or both of these things. The IMF report on International Capital Markets [World Economic and Financial Surveys (1994)] confirms the existence of a trade-off and describes one relevant way in which countries differ in its evaluation:

> In response to calls from market participants, many countries have adopted a firm, preannounced issue calendar. Increased certainty about issue dates and about amounts of government securities to be issued is said to help market participants to place the issue. It allows institutional investors to structure the maturity of their investment portfolios in line with the issuing calendar. It is often maintained that greater predictability lowers the cost of issues. Some countries, such as France, have become strong believers in such a firm issue calendar [. . .] Some others (the United Kingdom for one) are more skeptical; they

[5] See Pecchi and Piga (1995) for more details on these two approaches.
[6] What Tobin (1963) defined as “favorable opportunities,” we will call “views”.

> emphasize the wisdom of having enough leeway in timing to take advantage of opportunities for obtaining the best price, as well as the need to prevent the market from changing the environment in their favor just before an auction. [World Economic and Financial Surveys (1994, p. 22)]

In the parts that follow, we argue that liquidity or information-enhancing policies may sometimes clash with the fruitful use of information available to the debt official. For a medium and long-term bond[7] to be liquid, debt officials all over the world have engineered the re-opening over time of tranches of the same bond, that is a bond which carries the same coupon, the same maturity, the same issue date and the same fiscal treatment so as to make the issues at different times fully fungible. However, to become liquid, a long-term bond needs to reach a certain size, at which stage it may be called a benchmark, *and that takes time*. The commitment of debt officials to issue benchmarks may be questioned if benefits from interrupting the reopening of an issue arise due to new information. On the one hand, the government wishes it could issue the first tranche of a bond already securing a higher liquidity premium by convincing the market that it will keep that bond open until the right level of liquidity is reached. In this case, demand may increase due to the higher attractiveness of the bond, as market participants will be able to go short on the belief that they will find more of those bonds available in the future. On the other hand, once the market has paid more for those bonds, the debt official may have an incentive to renege on his/her promise. That is, if the market asks for a high liquidity premium, believing the debt official, he/she will have an incentive not to make the bond liquid, thereby also extracting the gains which derive from switching from one maturity to the other. Obviously, this is not an equilibrium, as the market will expect this inconsistent behavior and will pay a low liquidity premium. At that point, the debt official will find it optimal not to issue a liquid bond but will not reap the benefits of switching away from an issue.

How relevant is this type of problem? We will argue that this is a serious problem the more a country uses debt management for monetary policy reasons or more generally to express a view on future interest rates, taking advantage of the information available on monetary and budget news. One situation when this occurs is when debt managers are dependent on Central Banks. In this case a rigid commitment to liquidity and regularity may obscure potential signals or views that the Central Bank would like to express.[8] How do those debt managers then cope with this problem? Our opinion is that they cope by finding binding rules like calendars of issues, where amounts and dates of issue are specified. In this case, they will not be tempted to issue illiquid bonds, by gaining independence from Central Banks. However, we will also argue that issuing calendars may be sub-optimal in light of the complete lack of flexibility which it may bring about. Indeed, we show that the optimal institutional design to achieve the first-best outcome is an independent agency for debt management, like the one in Ireland, where debt-official remuneration is linked to the performance in achieving the goals set by the government.

In Section II, we quickly review the diverse stylized facts on calendars of issue in three OECD countries characterized by different degrees of liquidity of secondary markets in government securities. To prove our point, in Section III, we model the choice of the quantity of a specific bond to be issued by a debt manager in a symmetric information

[7] Such a strategy is not relevant for short-term bonds,which are either inherently liquid [see Warga (1992)] or are ear-marked to finance unexpected cash-needs of the sovereign borrower. Indeed, calendars with quantities are not published for short-term bonds.

[8] To be sure, those signals could be given through the use of other financial instruments. Why this is not always the case remains unclear.

environment, while in Section IV, we extend the model to the case of asymmetric information. Conclusions follow.

II. Three Countries

In order of increasing liquidity of the secondary market for government bonds,[9] we have singled out three countries, with different institutional arrangements on debt management, to see how they interact with and provide information to markets. We will begin by looking at Italy, a country whose debt management is often considered to be jointly handled by the Treasury and the Central Bank; we will then look at France, where the Central Bank has just acquired independence through the Maastricht requirements and has not a tradition of control over debt managers (the latter working for a branch of the *Ministère de l'Economie*); and the United States where the Federal Reserve and the Treasury have a long tradition of mutual independence. None of these countries has established an agency for debt management.

Italy

Even though an important secondary market reform has been implemented recently, the Italian market is young (created in 1988) and, in comparison to other markets, is still not sufficiently efficient nor transparent.[10] Italy has recently published the first of a series of quarterly calendars for medium- and long-term bonds. The calendar indicates the characteristics of the bond which will be issued (coupon, maturity, reimbursement date), whether the bond is a floating or fixed-rate security, and the minimum amount which will be issued in the quarter for each type of bond. The experience so far with the minimum quantity shows that the Italian Treasury tends to communicate amounts which are close to the necessary amount for a benchmark (i.e., that ensure a commitment to liquidity), but not to raise them above that level. It is interesting to note that before the calendar was established, the issuance policy of Italy had been characterized by a frequent switch from one issue to another at the expense of liquidity, as benchmarks were practically nonexistent. The reason for this has been synthesized by the most famous official report on Italian government securities and debt management policies:

> Up to now it seems that the orientation is one where it is not convenient for the Treasury to plan and announce its issues . . . following the belief that it is convenient for the Treasury to keep the maximum number of degrees of freedom, so as to issue each time that which is more desired by the market because that will enable it to minimize interest rate expenses [Ministero del Tesoro (1989, p. 50)]

Figure 1 shows the size in Italian liras of the bonds issued between 1991 and 1994. The horizontal solid line is drawn at the level generally considered by market makers as the minimum amount required for a benchmark: 10,000 billion liras. The vertical solid line describes the moment in which the quarterly calendar is put into place. From the graph, it is clear that, excluding a few exceptions in 1992, the issuance strategy had not guaranteed the creation of a pure benchmark until the institution of a calendar.

[9] The classification of liquidity is from IMF, [World Economic and Financial Surveys (1994, p. 24)].

[10] A recent reform of the secondary market was implemented to prevent the widespread practice of primary dealers to achieve the required amount of transactions through fake deals.

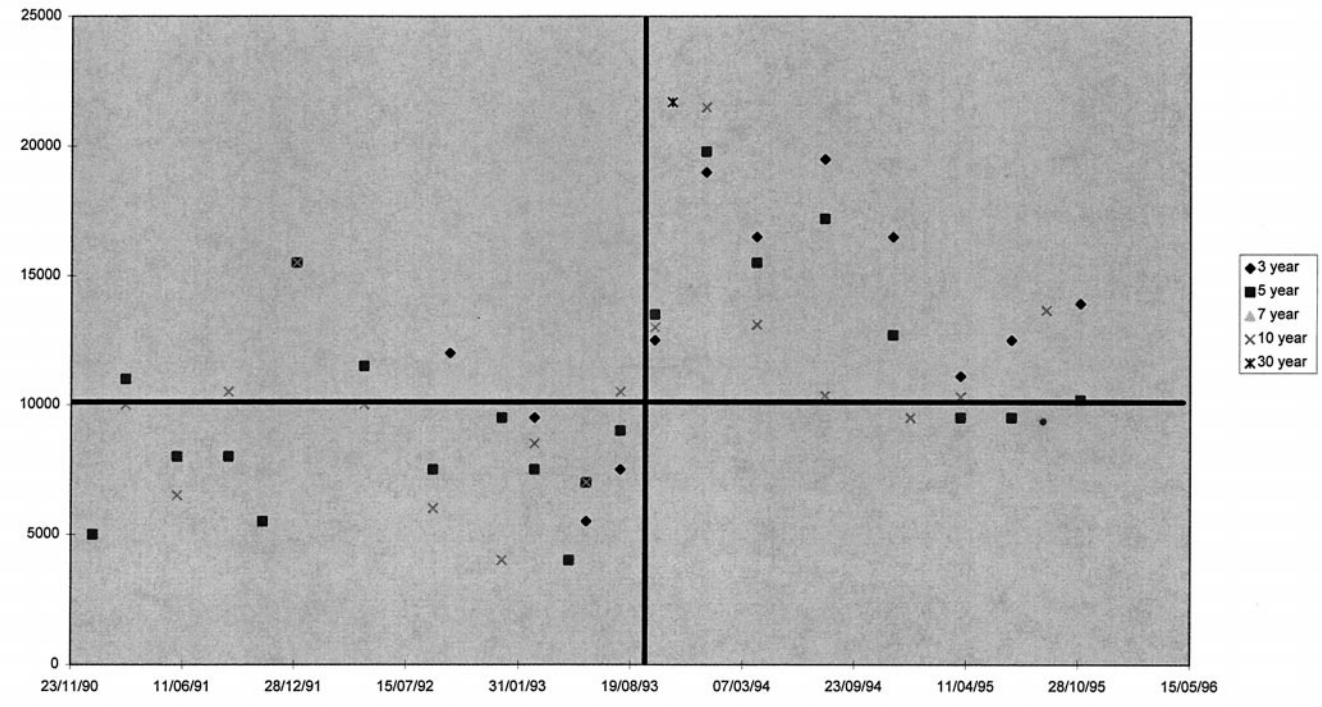

Figure 1. Outstanding amount of fixed-rate Italian government securities according to their maturity at issuance: 1991–1995 (billion lira).

France

Although the French secondary market reform is recent (1986), it has been impressive in its market-oriented stance, greater than the Italian one, as the reform has led the French market to become widely recognized by many investors as the rival in terms of efficiency (including liquidity) and transparency to its American counterpart. In France, the announcing strategy is different from the Italian one. At the beginning of the year, the Ministry of the Economy and Finance releases the yearly Treasury borrowing program in medium- and long-term bonds. Among other things, it provides the general features of the issues for the following year. A minimum quantity to be issued at each time that is non-binding (very small; equivalent to 200 million dollars) is communicated through the calendar. In addition, every quarter, the Treasury releases a more detailed calendar which carries not only the specific medium- and long-term bond to be issued, but also the short-term auction dates. No quantity is pre-announced in these calendars.

United States

The United States is traditionally considered the most sophisticated market for government securities. In the United States, there is a yearly calendar of more than 150 issues which is "well-known to market participants" [Department of the Treasury (1992, p. A-4)]. Even if the schedule for offering securities is "regular [and] predictable", it is not published; changes in this calendar are announced as soon as possible so as to allow the market to digest the information and prepare for the offers [Department of the Treasury (1992, p. A-4)]. This calendar provides the frequency and timing of the issues of different bonds. Although the U.S. Treasury has been generally coherent in the past years with respect to its implicit calendar, in 1993 it underwent a major change by canceling the issues of the 7-year bond, reducing the 30-year bonds and increasing the reliance on short-term debt. This change was initiated by the Clinton Administration in order, officials said, to take advantage of the positive steepness of the curve.

Why do countries decide on such different institutional settings to issue, publicize and manage their debt? The following sections will attempt to clarify their motives.

III. The Case of Symmetric Information

We will analyze the optimal choice of the final outstanding quantity of a single bond i to be issued over time in several tranches (n). The analysis is a partial equilibrium one in that it assumes that whatever the final nominal value of this bond, the debt manager can fund the budget deficit and roll over the debt. It is therefore meant to capture the problems faced by countries where rolling over debt is not a substantial concern.

Throughout the paper, we will assume the following three conditions hold:

1. Liquidity premia exist and they are positively correlated with the final quantity the bond is expected to reach.[11] Let $(n + 1)$ be the number of tranches for a given issue i, opened at time t and reopened at times $t + 1$, $t + 2 \ldots t + n$. Call $L^{i}_{(t-1+j)}$ the

[11] The assumption that quantities and liquidity premia are positively correlated is realistic. Garbade and Silber (1976), using a model with search costs in the presence of competing primary dealers and analyzing the U.S. government securities market, showed that price dispersion decreases with the volume of the issue, and that the perception of price dispersion increases liquidity costs. See also Amihud and Mendelson (1980).

liquidity premium charged at the auction of the jth tranche of issue i, for $j = 1, 2 \ldots, n+1$, and $Q^i_{(t-1+j)}$ the amount auctioned per tranche. The final amount, Q^i, to be issued of the bond is therefore $Q^i_t = \sum_{j=1}^{j=n+1} Q^i_{(t-1+j)}$. We further conjecture that the expectation of a shortage decreases liquidity premia from the first tranche. Calling the expectation of the amount to be issued of issue i as Q^{ie}_t, we are therefore assuming that the savings, S^i_t, derived from liquidity premia are: $S^i_t = \sum_{j=1}^{j=n+1} Q^{ie}_{(t-1+j)} \cdot L^i_{t-1+j}$;

2. Building up a liquid bond takes time. This time could be used by debt managers to take views or take advantage of information available or to send signals through the interruption of the issuance of the specific bond;[12]
3. If there were no liquidity effects nor advantageous information, the debt manager would care only about issuing a given fixed quantity of the bond, $F \cdot F$ may vary depending on the structure of the public and private institutions which supply and demand bonds.

As we said, we will examine the problem related to one single issue of bonds, therefore $Q^i_t = Q_t$ and $S^i_t = S_t$. Consider the following loss function for the official in the debt-management office:

$$\mathcal{L}_t = (u_t \cdot Q_t) - S_t + a(Q_t - F)^2 \qquad u_t,\ a \geq 0. \tag{1}$$

Following assumption (1), and calling the expectation by the markets on the total quantity of the bond that will be issued Q^e_t, let for simplicity the liquidity premium be a constant α, so that $S_t = \alpha Q^e_t$, with $\alpha > 0$. Then the objective function can be rewritten as:

$$\mathcal{L}_t = u_t \cdot Q_t - \alpha \cdot Q^e_t + a(Q_t - F)^2 \qquad u_t,\ \alpha,\ a \geq 0. \tag{2}$$

Q_t is the quantity of the bond chosen to be issued in any length of time starting at time t[13] of a particular bond for which liquidity is slow to build up (i.e., a medium- and long-term maturity bond), and F is a quantity-threshold that society considers ideal in terms of its needs.[14]

Looking at the first two terms of equation (2): as u_t and α are positive, we are saying that losses are increasing in the amount issued (assumption (2)) and decreasing in the amount expected to be issued (assumption (1)). These two terms represent the conflicting goals for the debt manager explained in Section I. We assume that Q^e_t is directly related to the liquidity premium paid by investors: the higher the quantity the market expects to be issued over period t, the higher the liquidity premium paid in terms of price, the lower the losses thanks to reduced amount of interest expenses.[15] This liquidity premium is paid by investors on all tranches of the issue, even if the bond has still not reached its final expected size, Q^e_t. However, the higher the quantity Q_t that the debt manager has to issue,

[12] See, for example, Campbell (1995) for an account of the recent debt-management policy in the United States, which tried to decrease the average cost of debt by shortening the maturity of debt and thereby betting against the pure expectation hypothesis.

[13] The length of the period is exactly equal to the time it takes for the bond to reach its final outstanding amount.

[14] Note that if a security is not issued, then $Q_t = Q^e_t = 0$. In this case, however, there will be a positive loss, aF^2, arising from the fact that society needs a bond of that specific maturity.

[15] Interest expense minimization is not necessarily meant to be the goal of a debt manager, even if taxation is distortionary, as pointed out by the relatively recent literature on tax-smoothing. By assuming convex costs of taxation collection, however, the level of interest expense matters, especially in this case where savings are equal across states of nature.

the longer, ceteris paribus, the time horizon that will have to be devoted to issuing only that bond, and the lower the opportunities to reduce interest expenses through other instruments. Issuing a benchmark reduces flexibility.[16] What matters for our results is that time taken to achieve liquidity is harmful to flexibility in expressing views on future market trends or in sending signals to the markets and that, given liquidity premia advantages obtained from the market through expectations on the issuance policy, the debt manager's task of building up a liquid bond is costly and increasingly so as more quantities of the same bond are issued.

Note that this term is proportional to u, the marginal loss from increasing the size of the issue, given market expectations. The greater u, the greater the advantage of using more time (by issuing less of the bond i) to try to take advantages from the issuance of securities different from Q_t.[17] u_t may increase the more the Central Bank has authority in debt management and, in this case, the more the Central Bank has a preference for giving signals or views of monetary policy which surprise the markets through different government bonds operations. u_t may also increase the greater the instruments and possibilities for independent debt managers to intervene in the secondary market.

The second part of equation (2) may be thought of as the costs of issuing a quantity different from a given amount, F, not already priced through the liquidity premium. These costs could, for example, refer to the distortions caused by illiquidity and the possible illegal or speculative behavior it motivates,[18] pricing difficulties in other national financial markets,[19] etc. The lower the volume issued compared to the ideal size, F, the higher the cost for the country in terms of welfare. We assume also that any shift from that quantity

[16] Implicit in the trade-off is the assumption that once less than a certain issue has been auctioned to take advantage of an opportunity, the debt official will not reopen the old outstanding bond to make it finally a liquid benchmark, but will rather prefer to open a new one. This may happen for several reasons. First, so much time has passed that the issue itself is old and already allocated in the portfolio of final investors; second, investors like specific, conventional maturities and the passage of time may prevent the reopening of an issue which has become of an unconventional maturity; third, reopening an old bond may require debt officials to issue securities at coupon rates very different from market rates, and this may not be appreciated by authorities if the change of coupon carries a market signal or if investors for fiscal reasons tend to prefer bonds selling at discount to bonds selling at a premium or vice versa.

[17] A possible example of this occurred when the Clinton Administration decided to reduce the issue of 30-year bonds because their interest rate was too high compared to short-term notes. The move to short-term notes was viewed (by the Administration, not by the market) as favorable to interest expense reduction and, in that sense, the sooner it would have been exploited, the better. Interestingly, to confirm our view of the existence of a trade-off between flexibility and liquidity, such a move also involved the cancellation of the 7-year bond and similar problems of liquidity on the 30-year segment of the curve.

[18] See the Joint Report on Government Securities Market [Department of the Treasury (1992)] for the impact of illiquidity due to the Salomon Brother illegal behavior in auction. Although those distortions were caused by market participants, they could in other cases be caused by negligence on the part of the government to issue liquid bonds. The fact that a squeeze is more likely to occur the lower the amount outstanding is confirmed by the policies adopted by the U.S. Treasury after the scandal, of "selling more securities if an acute shortage materializes" [Jordan and Jordan (1996, p. 26)]. Also, when recently recommending the issue of real-indexed bonds, the U.S. Committee on Government Operations (1992, p. 17) suggested that the U.S. Treasury should be required by law to announce its yearly plans of issuance, should abstain from minimizing coupon yield, as this would encourage small and infrequent issues (1992, p. 15), and should be regular in its issuance of indexed bonds to avoid speculation based on supply uncertainties (1992, p. 26).

[19] It is, in fact, frequently noted that liquid foreign currency issues by sovereign borrowers act as a catalyst for private local issues in foreign currencies, as it becomes easier to determine the country-risk and other components of the required yield than in the absence of such a sovereign program.

will be costly for the debt manager; issues in excess of F are more costly than issues of F.[20]

Given a subjective rate of time preference, δ, for the debt official, his/her objective at time t is to minimize the following expression:

$$L_t = E[\mathcal{L}_t + \delta_{t+1}\mathcal{L}_{t+1} + \cdots]. \tag{3}$$

The policymaker controls Q and its composition, and chooses Q_t, treating Q_t^e and Q_{t+i}^e with $i > 0$ as given. Also, future expectations of Q are invariant with respect to current issues of Q.

In this section, we assume symmetric information; as in Barro and Gordon (1983), we assume that the debt official does not observe the benefit parameter u_t nor does the public. u_t moves around with a stationary process over time with expected value, $\bar{u}$, and variance, σ_u^2: serial correlation is therefore excluded. If the debt official was able to pre-commit to issue a given quantity, for example with a calendar like the one used in Italy, we would reach a cooperative outcome that implies the issuance of the ideal quantity for the market. In this case, we would have the cooperative (c stands for cooperative) equilibrium defined as follows:

$$Q_t^c = Q_t^e = F + \frac{\alpha - \bar{u}}{2a} \quad \text{with} \quad \mathcal{L}_t^c = (\bar{u} - \alpha)F - \frac{(\bar{u} - \alpha)^2}{4a}. \tag{4}$$

The ideal quantity in this environment for the debt manager turns out to increase with the level of the liquidity premium, α, and to decrease the higher the expected costs of the lack of flexibility linked to issuing a liquid bond.

In many situations, however, the debt official may not be able to pre-commit. In this case, in period t, the debt manager chooses the quantity to be issued so as to maximize $\mathcal{L}$ in period t:

$$\frac{dE(\mathcal{L}_t)}{dQ_t} = \bar{u} + 2a(Q_t - F) = 0 \tag{5}$$

which gives the amount that is going to be issued, given the expectation of the market (d stands for discretionary):

$$Q_t^d = F - \frac{\bar{u}}{2a}. \tag{6}$$

The amount issued is lower than the optimal one in equation (4), the more so the higher the liquidity premium. Notice that in this case, the amount issued is independent of Q_t^e; however, the market knows that the debt official will minimize its loss by choosing Q as in equation (5) and, therefore, will expect that amount to be issued. Thus:

$$Q_t^d = Q_t^e = F - \frac{\bar{u}}{2a} \quad \text{with} \quad \mathcal{L}_t^d = (\bar{u} - \alpha)F - \frac{\bar{u}^2}{4a} + \frac{\alpha\bar{u}}{2a}. \tag{7}$$

[20] This is not unrealistic. Markets also like variety. For example, new coupons and new maturities are needed because they provide bonds with different durations and convexity which could be helpful for immunization strategies. Opening the same issue for too long decreases available variety. Also, as far as any single issue is reimbursed at the same maturity date, the Treasury may have difficulties financing that reimbursement if that amount is too large. This aspect also indicates the possibility of decreasing marginal returns from liquidity.

One may notice what is occurring: because the debt official is aware that to stop an issue and/or switch to another one may be beneficial, the market knows that he/she won't be able to keep his/her promise of making this issue a sufficiently liquid one. The increased welfare loss is due to the lower liquidity premium received on the bonds.[21]

One can see the reasons why the market does not believe the debt official in the absence of a way for pre-committing to issue the quantity F. Once the market has granted its trust to the debt official by maximizing the liquidity premium, he/she has an incentive not to stick to the agreement. For example, he/she could renege on the agreement by switching to issue other bonds where the yield-curve outlook provides opportunities, and leaving the issue illiquid. The market, however, understands the incentives of the official and will discount them in the price bids in the primary market in terms of what we call a liquidity premium. Clearly in this case a beat-the market strategy backfires. How to remedy to it?

A possible answer may be found in the evidence that markets and debt officials repeatedly interact over time. Many times this interaction is not interrupted even by a change in government, even though it may be true that new governments will order debt officials to adopt different strategies. We are clearly analyzing a problem which pertains to the repeated game literature. The market may therefore find it attractive to create a scheme of threats which is applied only in the case in which the debt official decides to renege on a cooperative but non-binding agreement meant to achieve the issuance of Q^c. Depending on the scheme of the threats, the market may succeed in convincing the Treasury to issue the cooperative quantity. If this is the case, the debt official, by not cheating, builds up a reputation which enables society to be better off (in terms of lower costs from equation (2)), with respect to the discretionary case. However, he/she will do so only if the advantages of reputation overcome the advantages of fooling the market by reneging on the tacit agreement. We can prove that threat mechanisms are available to investors that force debt managers to issue optimally more than the discretionary quantity, even though, for some schemes, equilibria are multiple.[22] However it is difficult to justify the coordination of markets on such punishment schemes.

When information is symmetric, there is clearly no advantage to using a beat-the-market strategy. In the case of symmetric information, therefore, the benefits that a calendar like the Italian one could bring are clear. By tying the debt official's hands, it minimizes the losses for debt managers. Note that if the time-inconsistency arose because of the Central Bank's advantages in using debt management to obtain gains from the first part of equation (1), then a calendar may well be the way for Treasury officials to become independent from the Central Bank's use of debt management for monetary policy purposes.

If information is symmetric, we could also find justifications for the U.S. case where there is no calendar and issues are nevertheless very liquid.[23] The absence of a calendar

[21] Even though the loss is greater by being noncooperative rather than cooperative, it is not the case that the debt official is irrational. In the absence of a rule that binds him/her to issue the cooperative quantity, he/she will still find it optimal to issue Q^d. If the debt official was to convince the market that he/she would issue $F + ((\alpha - \bar{u})/(2a))$ and the market believed him/her (which it will not in equilibrium), then the debt official maximizes equation (2) by taking Q_t^e as given and equal to F. In this case (i, for inconsistent) we will have:

$$Q_t^i = F - \frac{\bar{u}}{2a} Q_t^e = F + \frac{\alpha - \bar{u}}{2a} \quad \text{with} \quad \mathscr{L}_t^i \leq \mathscr{L}_t^c.$$

[22] Calculations are available upon request.

[23] Suppose that the debt official has access only to the latest update of, for example, budget forecasts. Suppose also that he/she releases the forecast immediately to the public and that after reading the press release, the public would know as much as he/she does. That is an example of symmetric information.

may be justified by a strong punishment function which leads to liquid issues. However, as we have said, it is hard to see how agents, especially in financial markets, can easily coordinate to enforce punishments. But the answer may lie in a feature not captured by this model, which is the fact that the U.S. authorities may have built up a sufficient reputation to make the absence of punishment mechanisms and the presence of liquid bonds compatible independently from the level of the benefit parameter. This is because information is symmetric. Assume that u_t can be decomposed in a Treasury forecast and a white noise, and that the market can observe for a few periods the behavior of the Treasury, as information is symmetric. The market will be able to judge if the Treasury is implementing the optimal policy, and it may well be that even in the absence of rules or threats, the optimal outcome results.[24] This would explain why an unofficial calendar has emerged in United States.

IV. The Case of Asymmetric Information

Rules vs. Discretion, Again

It is clear that benefits from flexibility may arise only in cases in which the debt official is consistently able to fool the market. Let us examine the case in which the parameter u_t is known only by debt officials, while market participants only know its distribution. u_t is still following a stationary process. In countries where verifiable information on budget forecasts is not released, or in countries where Central Banks have a say in debt management, and verifiable information on monetary forecasts is not released, this may well be a realistic case. Looking over two periods, the discretionary outcome is therefore changed in the following way:

$$Q_t^d = F - \frac{u_t}{2a} \quad Q_t^e = F - \frac{\bar{u}}{2a} \quad \text{with} \quad \mathcal{L}_t = (u_t - \alpha)F + \left(\frac{\bar{u}\alpha}{2a}\right) - \frac{u_t^2}{4a}; \tag{8}$$

$$Q_{t+1}^d = F - \frac{u_{t+1}}{2a} \quad Q^e = F - \frac{\bar{u}}{2a} \quad \text{with} \quad E_t(\mathcal{L}_{t+1}) = -\frac{(\sigma_u^2 + \bar{u}^2)}{4a} + \frac{\alpha\bar{u}}{2a} + (\bar{u} - \alpha)F. \tag{9}$$

Comparing equations (7), (8) and (9), one can immediately see what is happening. If the advantage of decreasing the quantity issued is greater than what the market expects ($u > \bar{u}$), then private information today enables the debt official to improve on the discretionary outcome when information is symmetric. Also, private information increases the expected gains in the second period: in this case, with the variance of u, σ_u^2, which tells us the deviation from market expectations and, therefore, can be here thought of as the return on a beat-the-market strategy. It is interesting to compare equations (8) and (9) with the optimal case of the previous paragraph, in which the debt official commits him/herself to issue (through a calendar, for example) the quantity $F + ((\alpha - \bar{u})/(2a))$:

[24] See Canzoneri (1985, p. 1061) for the possibility of this outcome to be an equilibrium one.

$$Q^c = Q^e = F + \frac{\alpha - \bar{u}}{2a} \quad \text{with} \quad \mathcal{L}_t^c = \mathcal{L}_t^d + \left(\frac{u_t - \bar{u}}{2a}\right)^2 + \frac{\alpha}{2a}\left(u_t - \bar{u} - \frac{\alpha}{2}\right)$$

$$E\mathcal{L}_{t+1}^c = E\mathcal{L}_t^d + \frac{-\alpha^2 + \sigma_u^2}{4a}. \tag{10}$$

The commitment to issue Q^c this time is not necessarily welfare superior to the issuance of the discretionary quantity. In fact, if the returns from private information are high enough, maximization of welfare will be achieved through a discretionary policy which does not commit itself to the Q^c rule. More precisely, in the first period, a sufficient condition is that u_t would have to be sufficiently higher than the expected value of the market, and in the second period, we would need to have:

$$E_t\mathcal{L}_{t+1}(Q^c) \geq E_t\mathcal{L}_{t+1}(Q^d) \Leftrightarrow \sigma_u^2 \geq \alpha^2. \tag{11}$$

This result seems to indicate that the publication of a calendar with exogenous quantities may not be welfare-optimizing if the returns on private information are high.

However, we know that this does not imply that discretion is better than rules; in fact, we can actually enforce a state-contingent rule which succeeds in minimizing costs under asymmetric information. Consider the following rule:

$$Q^r = F + \frac{\alpha - \bar{u}}{2a} - \frac{u_t - \bar{u}}{2a} = F + \frac{\alpha - u_t}{2a}. \tag{12}$$

If the Treasury announces this rule, and the market believes the Treasury, then the outcome is the following:

$$Q_t^r = F + \frac{\alpha - u_t}{2a} \quad Q_t^e = F + \frac{\alpha - \bar{u}}{2a} \quad \mathcal{L}_t^r = \mathcal{L}_t^d - \frac{\alpha^2}{4a} = \mathcal{L}^c - \left(\frac{u_t - \bar{u}}{2a}\right)^2 - \frac{\alpha}{2a}(u_t - \bar{u}); \tag{13}$$

$$Q_{t+1}^r = F + \frac{\alpha - u_{t+1}}{2a} \quad Q_{t+1}^e = F + \frac{\alpha - \bar{u}}{2a} \quad E\mathcal{L}_{t+1}^r$$

$$= E\mathcal{L}_{t+1}^d - \frac{\alpha^2}{4a} = E\mathcal{L}_{t+1}^c - \frac{\sigma_u^2}{2a}. \tag{14}$$

In fact, this state-contingent rule manages to reduce the cost of debt more than any discretionary outcome even in the presence of asymmetric information. The rule requires the Treasury to issue less than the expected necessary amount for liquidity purposes when the value of asymmetric information is high, and to exceed in liquid offers when the returns on asymmetric information are low. On average, the size of the issue is still compatible with the creation of the optimal benchmark. In fact, with those rules, welfare from debt management with private information at the disposal of the debt official is higher than welfare in a society with symmetric information. The additional role of the rule in this case is the one of permitting the smoothing of surprises which cannot be controlled by the public.

As before, the rule in equation (12) is time-inconsistent if there is no way for the debt official to pre-commit. In their model, Barro and Gordon (1983) proved that a series of contingent rules based on reputation can be enacted, which will not, however, reach the

optimal contingent rule in terms of welfare. Even though we believe that those equilibria can also be found in our case (and with all likelihood they would not reach the results of the optimal contingent rule in equation (12)), doubts may arise on the equilibrium content of those contingent rules based on reputation in the presence of private information. As Canzoneri (1985) clearly pointed out, the mechanism in equation (12) would not necessarily be incentive compatible. Suppose u_t is not known with certainty, even by the debt official; however, he/she has a forecast of it, e_t, which has expected value (for the market) of $\bar{u}$. Think of e_t, for example, as budget forecasts. That is:

$$u_t = e_t + \epsilon_t \quad \text{with} \quad e_t \sim (\bar{u};\ \sigma_e^2) \quad \text{with} \quad \epsilon_t \sim (0;\ \sigma_\epsilon^2)$$

where ϵ_t is the i.i.d. forecast error at time t, known in advance by a debt official who makes forecasts rationally. The market is not able to decompose e_t from ϵ_t, which are mutually uncorrelated, even though ex-post the market will be able to determine the realization of u_t. The forecast is the Treasury's private information. In this case, as e_t and ϵ_t are distributed independently, the discretionary outcome is:

$$Q_t^d = F - \frac{e_t}{2a} \quad Q_t^e = F - \frac{\bar{u}}{2a} \quad \mathcal{L}_t = F(e_t - \alpha) - \frac{e_t^2}{4a} + \frac{\alpha\bar{u}}{2a}; \tag{15}$$

$$Q_{t+1}^d = F - \frac{e_{t+1}}{2a} \quad Q_{t+1}^e = F - \frac{\bar{u}}{2a} \quad E_t\mathcal{L}_{t+1} = F(\bar{u} - \alpha) + \frac{\alpha\bar{u}}{2a} - \frac{(\sigma_e^2 + \overline{u^2})}{4a}. \tag{16}$$

The rule (equation (11)) would then become:

$$Q_t^r = F + \frac{\alpha - e_t}{2a} \quad Q_t^e = F + \frac{\alpha - \bar{u}}{2a} \quad \mathcal{L}_t^r = F(e_t - \alpha) - \frac{(e_t^2 + \alpha^2)}{4a} + \frac{\alpha\bar{u}}{2a}; \tag{17}$$

$$Q_{t+1}^r = F + \frac{\alpha - e_{t+1}}{2a} \quad Q_{t+1}^e = F + \frac{\alpha - \bar{u}}{2a} \quad E\mathcal{L}_{t+1}^r = F(\bar{u} - \alpha) - \frac{(\overline{u^2} + \sigma_e^2 + \alpha^2)}{4a} + \frac{\alpha\bar{u}}{2a}. \tag{18}$$

As Canzoneri (1985) has proved, even though equations (17) and (18) are welfare-superior to the discretionary solution, they may not be incentive incompatible. The threat mechanism is obviously enforceable as long as the market is capable of obtaining (ex-post) the private information, which was in the hands of the debt official. But this is not the case, as the market will only know u_t but not e_t, unless the debt official is forced to release his/her forecast. But even in that case, the official is not required to release the true forecast. That is, if you oblige the debt official to communicate the budget forecast (or the monetary forecast), he/she may well distort the value released to the public and do so optimally by communicating a (fake) forecast which may even achieve the cheating solution. In fact by announcing a forecast, e_t^f, equal to the true forecast (which will never be known by the public) plus an appropriate number, the debt official will be able to duplicate the cheating solution. The results (available upon request), show that, as expected, the debt official will have a tendency to overestimate the necessity to issue fewer bonds than what is really required for liquidity purposes, as $e_t^f > e_t$.

Investors, therefore, will never know if the Treasury has reneged on its promises or not. To overcome this problem, Canzoneri (1985) suggested that incentive-compatible rules may be found which will not need a punishment scheme. To make rules incentive-compatible, the market must surrender some flexibility to the debt official. To do so, one can think of rules which have to be abided by only over a certain period of time. Whether one looks at a two-period averaging solution or at a longer multi-period one, in these kinds of problems it has, however, been shown [Garfinkel and Oh (1993, p. 112)] that "the full discretionary solution dominates any finite targeting procedure for a large part of the parameter space". Also, in the cases in which a rule has proven to be effective, most of the time this is a one-period form of targeting. As far as these averaging rules require, in the words of Canzoneri (1985), a "legislative approach" to debt-management, we are in a world in which a calendar is still preferable to none only if returns from private information are low. Still, we are far from the welfare levels of the cooperative outcome in equations (13) and (14).

The fact that Italy has surrendered its scope for flexibility while France has not[25] may indicate that French officials did not need to find ways to become independent from the Central Bank and possibly that they have been more able than Italian officials to appropriate the potential returns of private information. This may be due to a higher ability to access monetary news (if the French Treasury has greater access to Central Bank information than the Italian Treasury) or budgetary news (if the transmission mechanism between the Budget Office and the Debt Management Office of the forecasts is more efficient). In fact, secondary market interventions by the Treasury in France are common, while it is something very rare in Italy.

A New Approach

Targeting procedures, while helpful, do not solve the final issue, which is that credibility is still costly. It is not clear why we should have average targeting procedures; it is certainly an easy tool to legislate, but it does not provide us necessarily with the optimal outcome. Furthermore changing legislation is probably cumbersome and costly. Walsh (1995) examined the issue of the optimal contract by noting the moral hazard nature of the problem. In our case, we can view the debt official as the agent, the government as the principal and the optimal contract as the one which ensures the realization of the cooperative outcome [equations (15) and (16)]. Problems of moral hazard usually involve finding a state-contingent contract that forces the agent to choose the action preferred by the principal. This is a realistic assumption in debt management only if the debt official is bound to be rewarded in relation to his/her actions. One may claim that this is rarely the case in the Civil Service. However, in some countries, debt management authorities are being set up. Those authorities (or agencies), while retaining their public nature and goals, usually benefit from work contracts which differ from the standardized ones of the Public Administration and, therefore, are bound to offer more flexible and state-contingent contracts. Suppose, therefore, that the debt official receives a wage, w, from the government. The debt official now maximizes utility (assuming separability of wages and social losses, and risk-neutrality of the official), U_t, given by:

[25] France has calendars of issues, but with no pre-commitment to issue large quantities of specific bonds, as in the Italian case.

$$U_t = w_t - \mathcal{L}_t = w_t - u_t Q_t + \alpha Q_t^e - a(Q_t - F)^2 \; w_t,\, u_t,\, a,\, \alpha \geq 0. \tag{19}$$

Equation (19) is maximized subject to $U(w - \mathcal{L}) > U^0$, a reservation level of utility which we normalize to 0 for simplicity. As a contract with the debt official is going to be based only on verifiable variables, information on the budget (or monetary) forecast will not matter for the specification of the contract. Let us assume for the moment that it is dependent only on the volume of each single bond issued and let us see if the optimal outcome can be reached: $w_t = w(Q_t)$. The government will pay to the debt manager a wage that depends on the amount issued by the debt official, now working for the authority. The wage schedule achieves the optimal outcome $Q_t^e = F + ((\alpha - e_t)/(2a))$ if it maximizes equation (19) for all budget forecasts of the debt official, given that he/she has private knowledge of them.

Solving first for the expected quantity by the market (unconditional expectation), we obtain:

$$E_t\left(\frac{dw}{dQ_t}\right) - E_t(u_t) - 2aE_t(Q_t - F) = 0; \tag{20}$$

$$Q_t^e = F - \frac{\bar{u}}{2a} + \frac{1}{2a} E_t\left(\frac{dw}{dQ_t}\right). \tag{21}$$

Replacing equation (21) in the utility maximization of equation (19), and remembering that $(E_t(u_t/e_t)) = e_t$, one obtains the first-order conditions for the debt manager:

$$(E_t|e_t)\left(\frac{dw}{dQ_t}\right) - (E_t|e_t)(u_t) - 2a(Q_t - F) = 0; \tag{22}$$

$$Q_t = F - \frac{e_t}{2a} + \frac{1}{2a} (E_t|e_t)\left(\frac{dw}{dQ_t}\right). \tag{23}$$

Notice that in the absence of a reward to the debt official, we get equations (15) and (16), the discretionary outcome. To get $Q = Q^c$, we must therefore have:

$$\frac{\alpha}{2a} = \frac{1}{2a} (E_t|e_t)\left(\frac{dw}{dQ_t}\right). \tag{24}$$

Integrating equation (24) we get:

$$w_t = w^0 + \alpha Q_t, \tag{25}$$

where w^0 is set so as to ensure the reservation level for the debt official. The transfer is only a function of the observed level of the bond issued, and it achieves the optimal outcome. The higher the quantity issued, the higher the salary of the debt official. The higher the liquidity premium, the higher the marginal reward of issuing one more unit of the bond. The costs of credibility under asymmetric information are finally eliminated. The optimal incentive contract still allows the debt official to react efficiently to budget news while at the same time, on average, achieving the optimal issue-size. One can also see that in this case, the private information at the disposal of the debt manager becomes irrelevant, as the contract is based only on observed values, that is, the quantity effectively issued by the debt manager.

V. Conclusions

We have tried to sketch a theory of debt management that is more closely related to the issues debt managers face. We have been able to rationalize a trade-off which seems to be present in the world between the needs of flexibility and those of regularity in debt management. Our model explains the relevant issue of when and why calendars exist. For one, they do not exist in countries which have a well-established reputation for being market-oriented, i.e., which have always had liquid and efficient markets (United States, United Kingdom). According to our model, calendars may surface where private information returns are low, to help debt managers gain independence from Central Banks or Treasuries which may disrupt regularity and liquidity, through the use of debt management for monetary or budgetary policy purposes. If, however, the debt manager has the capacity to appropriate substantial returns by taking views on the future behavior of fundamentals, then independence is best achieved through the creation of a debt-management agency. As superior information of government officials is a plausible hypothesis, this may explain why New Zealand and Ireland have granted independence to debt managers through the creation of an agency; at the same time, it may indicate that the Italian authorities have followed a sub-optimal path to obtain independence from the Central Bank by establishing calendars which surrender all scope for flexibility. Finally, if independence is not an issue but credibility is, then calendars should not be binding in the presence of returns from private information. This may explain the choice of France—a country less known for market-oriented policies—which has had to overcome the problems of credibility that arise when committing to regularity and liquidity, without hampering its capacity to take views on the market.

It is not through the centralization of debt-management operations that the performance of debt management is improved. Caselli et al. (1994, pp. 49–50) argued, for example, that Belgium operates within "coordinated debt management facilities," while in Italy the operations are "divided between the Treasury, the Bank of Italy and the commercial banks," and that this difference has little reason to exist in a single financial market like the European one. However, centralization may not be enough: surrendering debt management to Central Banks or Treasuries may achieve the same sub-optimal results as a joint operation with different authorities. It is often claimed that debt managers around the world, too, and not only central bankers, may need their independence. Public debt-management theory until now has lacked a rationale for this statement. We believe and have indicated in this paper that a greater attention to the issues of liquidity, regularity and transparency provides that rationale.

This is a revised version of the second chapter of my dissertation at Columbia University. This paper, even though it draws extensively from experience gained while working at the Italian Ministry of the Treasury for more than a year, does not necessarily represent the views of the Italian Treasury. I wish to thank Alberto Giovannini, Alessandro Missale, Lorenzo Pecchi, Roberto Perotti, Patricia K. Thomas, Carl E. Walsh and two anonymous referees for their comments, as well as participants of La Sapienza and LUISS seminars. My biggest thanks goes to Stefano Scalera, who has inspired me with several never-ending conversations we have had on the subject. Responsibility for the content of the paper remains mine.

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