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WHAT DETERMINES DEBT INTOLERANCE? THE ROLE OF POLITICAL AND MONETARY INSTITUTIONS

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Abstract

Why do some states default on their debt more often than others? We argue that sovereign default is the outcome of a political struggle among different groups of citizens. It is more likely to happen if: (i) domestic debt-holders are politically weak; (ii) the political costs of the financial turmoil typically triggered by a sovereign bankruptcy are small. We show that these conditions are in turn more likely to be present if a country lacks a politically strong middle class and/or a sufficiently independent central bank.

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Contents

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1 Introduction[1]

Reinhart et al. (2003, 2008) show that some countries are sistematically more likely to default than others. Moreover, most of these default episodes happened at relatively low levels of debt. On the contrary, other countries and governments are able to sustain much higher borrowing levels, without precipitating a crisis. In this paper we provide an explanation for this stylized fact, arguing that some sovereign borrowers are more prone to default than others due to the features of their political and monetary institutions.

Faced with a large amount of public debt obligations, governments either re-absorb them through fiscal consolidation (by cutting expenditure and/or increasing taxes), or cancel them out with a sovereign default. This choice is particularly compelling for countries in which inflating the debt away is not a viable option, either because it is short-term or because it is denominated in a foreign currency.

Different strategies to cope with a high-debt situation entail very different macroeconomic results, as well as very different redistributive consequences. We propose a model in which the government takes into account these redistributive effects when deciding whether to fulfill or default on its promises. It will default if and only if the implied costs for its constituency are lower than the benefits.

Typically, both the very poor and the very rich hold a relatively low share of their wealth in government bonds. Indeed, the former are often excluded from financial markets and hold most of their wealth in the form of cash, while the latter hold a relatively high share of their wealth in more sophisticated high-return, risky financial instruments. Therefore, our first point is that a large and politically influent middle class should improve debt sustainability.

However, if the default puts the financial system in jeopardy (e.g. if it triggers a bank run or a wave of panic selling) it can harm the rich, too. In such circumstances, a pro-rich ("elitist") government will pressure the central bank to inject an excessive amount of liquidity in the financial system, to sustain financial markets and shield the rich from the consequences of the default, even

[1] The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Bank of Italy. We thank for helpful comments Francesco Lippi, Giuseppe Cappelletti, Sandro Momigliano, two anonymous referees, seminar participants at the 63rd Congress of the International Institute of Public Finance, the 22nd Congress of the European Economic Association and the XVI edition of the International Tor Vergata Conference on Banking and Finance. The usual disclaimers apply.

if this policy results in a rise in inflation (indeed, inflation will mostly harm the poor as the rich invest more of their wealth in shares and other real assets).

Symmetrically, the poor will stand to lose from the bail out of the financial system because they are very much exposed to its inflationary consequences. A pro-poor ("populist") government will pressure the central bank not to inject liquidity in the financial system, even in circumstances in which this policy would be welfare-enhancing. Again, it takes a sufficiently independent central bank to resist these pressures.

Therefore, our second point is that an independent central bank increases debt sustainability, because it ensures that both the rich and the poor will bear at least part of the costs of the default, so that even a government which is not responsive to the middle class has an incentive to honour its debt.

To sum up, countries without the proper political and monetary institutions cannot sustain debt levels that are instead sustainable for others. According to the definition introduced by Reinhart et al. (2003), they suffer from "debt intolerance". In particular, we show that there is a country-specific debt threshold above which default occurs, and that this threshold gets higher as the middle class increases its political power and central banks gain greater independence.

We build on the seminal contribution by Calvo (1988). In his paper, and in ours as well, the policy-maker equates the marginal costs of servicing the public debt with the marginal costs associated with debt repudiation.

Calvo assumes that the government is benevolent and that agents are homogeneous. Both hypotheses are relaxed in Beetsma (1996). In his model agents differ in their holdings of public debt, and the government does not necessarily maximize social welfare. Beetsma argues that in this framework the policy-maker will be more tempted to default if its constituency holds relatively few government bonds.[2] While we take this insight as our starting point, with respect to Beetsma (1996) our paper represents a step forward in various respects.

First, we relate agents' portfolios to deeper characteristics of the economy (namely, financial market imperfections and the wealth of the different classes of agents).

Second, while in Beetsma there is a single policy-maker, we introduce the central bank into the picture. Indeed, several authors (e.g. Alesina, 1988) show that the behavior of monetary authorities is crucial in determining the outcome of the debt end-game.[3]

[2] See also Beetsma and van der Ploeg (1996).

[3] Of course, in the messy social and political context of a debt crisis, the pressures of the government on the

Third, we endogenize the costs associated with a sovereign default. In the literature, default costs have been traced back to the exclusion of the defaulting sovereign from the debt market (Eaton and Gersovits, 1981), and to broader reputational concerns (Cole and Kehoe, 1998).[4] To our knowledge, we are the first to formally model the idea that financial markets disruption and/or high inflation might be part of the costs of a sovereign default. In the real world defaults do tend to be associated with such unpleasant consequences (see Kaminsky and Reinhart, 1999, and the survey by De Paoli et al., 2006).

Our paper also relates to the vast literature that highlights the costs of economic inequality and political polarization (see e.g. Glaeser et al., 2003).

The paper is organized as follows: section 2 spells out the model, sections 3 and 4 describe its equilibria, section 5 concludes.

2 A model of the debt end-game

In our model economy there are: (i) two periods; (ii) four (types of) agents: a measure-one continuum of risk-neutral consumers/investors, a representative commercial bank, the government and the central bank (CB); (iii) four kinds of financial instruments: cash, inflation-indexed government bonds,[5] bank deposits and bank loans. The intertemporal discount factor is set equal to 1 throughout.

We introduce elements of financial market imperfection into the model by assuming that financial market participation is incomplete. We model this assumption in the most parsimonius way, by introducing minimum size requirements to buy certain kinds of assets.

The timing of the game is the following (see figure 1). In period 1 the goverment issues debt; individuals allocate their wealth between cash, government bonds and bank deposits; the bank invests a portion of its assets in government bonds and the rest in high-return, risky, illiquid loans; the market-clearing return on goverment bonds is determined. At the beginning of period 2, the

national central bank are typically very strong. However, central bank independence is more a matter of degree than a 0/1 feature (Franzese, 1999). Besides, while the government can exert pressures on the central bank, there are typically other groups in society which stand ready to defend its independence.

[4] Surveys of this literature can be found in Eaton and Fernandez (1995) and in Sturzenegger and Zettelmeyer (2006).

[5] The assumption that government bonds are inflation-indexed makes the analysis much simpler without affecting the main results, at least qualitatively. Our set-up is equivalent to one in which the government issues foreign currency-denominated bonds, and the CB controls the exchange rate. This institutional set-up is particularly suitable for studying the problems of developing countries, in which a large portion of public debt is denominated in a foreign currency, typically US dollars. This stylized fact has been documented by Eichengreen and Hausman (2005), who call it the "original sin" of developing economies.

government sets taxes and decides how much to default on debt, subject to its budget constraint; the government decision, together with the state of the risky loans, determines the bank's financial position; the CB sets the inflation rate after having observed both the amount of default and the state of the bank loans; after having observed the inflation rate set by the CB, investors decide whether to withdraw their deposits from the bank or not. At the end of period 2, if the bank has survived, it is liquidated and each individual consumes his/her wealth.

2.1 Preferences and constraints

The private sector. Agent i is initially endowed with wealth w_i. In period 1 she allocates her wealth between cash, government bonds and bank deposits to maximize final consumption c_i. Let $1-\pi$ be the rate of return on cash;[6] R^b be the real interest factor on government bonds; θ the default rate. Also, let τ denote the tax rate, which is equal for all the agents;[7] R^{BANK} the real return from investing in the financial market through the bank.

The consumption of agent i will be:

$$c_i = w_i \left\{ \mu_{1i}(1-\pi) + \mu_{2i}(1-\theta)R^b + \mu_{3i}R^{BANK} - \tau \right\}, \tag{1}$$

where $\mu_{1i}, \mu_{2i}, \mu_{3i} \geq 0$ are her portfolio shares of cash, government bonds and bank deposits, respectively, so that $\mu_{1i} + \mu_{2i} + \mu_{3i} = 1$. As agents are risk neutral, their portfolio allocation problem at time 1 is trivial. They simply invest their wealth in the asset which yields the higher expected return, subject to the constraints on financial market participation.

The assumption of incomplete financial market participation can be written as:

Assumption 1

$$\begin{aligned} \text{if } w_i &< \underline{\mathrm{w}}\ ,\ \mu_{2i} = \mu_{3i} = 0 \\ \text{if } w_i &< \bar{\mathrm{w}}\ ,\ \mu_{3i} = 0. \end{aligned}$$

We introduce this assumption as a simple means of modeling the fact that the rich are relatively more protected from the consequences of inflation. The cross-sectional distribution of currency holdings and transaction patterns by income level, as well as the survey evidence on the perceived costs of inflation strongly suggest that inflation disproportionally harms the poor (we refer to Albanesi (2007) for a summary of the relevant empirical literature). Limited financial market

[6] π is an increasing transformation of the inflation rate, and takes values in $(-\infty; 1]$.

[7] Assuming a progressive or regressive tax system would not change our results, at least qualitatively.

participation is just one simple way to introduce this asymmetry.[8] Parenthetically, limited financial diversification for the poor has also been extensively documented (see Allen and Gale, 1994, 2007, Guiso et al. 2003).

The government. At the beginning of period 2, the government sets the tax rate and decides the percentage of defaulted debt (τ and θ, respectively) to satisfy the following budget constraint:

$$\tau = g + (1-\theta)R^b b + \delta\theta R^b b, \tag{2}$$

where b is the amount of government debt per unit of domestic wealth, δ stands for an exogenous unit cost of repudiation and g is (wasteful) public expenditure.[9] Since the world ends with period 2, the government cannot finance its expenditure by issuing new debt.[10]

The political process is such that the government maximizes a weighted average of citizens' welfare,

$$\int_i \left[\mu_{1i}(1-\pi) + \mu_{2i}(1-\theta)R^b + \mu_{3i}R^{BANK} - \tau\right] w_i dF_{GOV}(i) \tag{3}$$

where the probability measure F_{GOV} summarizes the importance that the government attaches to the different groups of citizens. The objective function in equation 3 can also be rewritten as

$$\mu_{1m}(1-\pi) + \mu_{2m}(1-\theta)R^b + \mu_{3m}R^{BANK} - \tau,$$

Where the $\mu's$ are defined as

$$\mu_{km} = \frac{\int_i \mu_{ki} w_i dF_{GOV}(i)}{\int_i w_i dF_{GOV}(i)}$$

for k=1,2,3. The weights $\mu_{1m}, \mu_{2m}, \mu_{3m}$ can be interpreted as the portfolio shares of cash, government bonds and deposits for a particular individual (individual m). The objective function of the government is such that it maximizes the indirect utility function of m.

The central bank. The CB sets the inflation rate $\pi \geq 0$ in period 2, after having observed the government's choice about how much to default. Like the government, the CB maximizes a weighted sum of citizens' welfare:

$$\int_i \left[\mu_{1i}(1-\pi) + \mu_{2i}(1-\theta)R^b + \mu_{3i}R^{BANK} - \tau\right] w_i dF_{CB}(i)$$

[8] For example, the assumption of absolute risk aversion delivers the same qualitative results as our joint assumptions of risk-neutrality and limited financial market participation.

[9] In Calvo (1988) and Beetsma (1996) δ is the only cost associated with debt repudiation. In our model some of the costs are endogenized.

[10] Our model could be easily turned into an infinite horizon model, in which a long-lived government interacts with non-overlapping generations of agents, and b is the steady state level of debt (Beetsma and Van der Ploeg, 1996).

or

$$\mu_{1a}(1-\pi)+\mu_{2a}(1-\theta)R^{b}+\mu_{3a}R^{BANK}-\tau$$

where

$$\mu_{ka}=\frac{\int_i \mu_{ki}w_i dF_{CB}(i)}{\int_i w_i dF_{CB}(i)}$$

for k=1,2,3. F_{CB} is the probability measure that summarizes the importance attached by the CB to the welfare of different groups of citizens. As in the case of the government's objective function, $\mu_{1a}, \mu_{2a}, \mu_{3a}$ can be interpreted as the portfolio shares for the individual (individual a) whose indirect utility the CB maximizes. Note also that, as θ and τ are not within the control of the CB, its objective is equivalent to the minimization of the following loss function:

$$L^{CB}(\theta,\pi,R^{r})=\beta\pi-R^{BANK}$$

where $\beta=\frac{\mu_{1a}}{\mu_{3a}}$. Intuitively, the bank trades off the goals of price stability (low π) and of banking sector profitability (high R^{BANK}), with β capturing the relative importance of the former objective relative to the latter.

2.2 The financial sector

The representative bank offers to its depositors/stockholders a fairly standard contract: investors deposit their funds at the beginning of period 1 and can choose either to wait until the end of period 2 or to withdraw earlier. The contract gives each investor withdrawing early a nominal interest rate equal to $1+r$. It turns out that the exact value of r is immaterial for our results, provided that it is not too negative. In particular, it is sufficient that the following holds:

Assumption 2 r>$\alpha-1$

which we take for granted from now on (the intuition behind this assumption will become clear in section 3.2). The assumption is quite realistic (it is satisfied by any deposit rate greater than 0, like the ones that we observe in the real world). Moreover, in the appendix we also consider an extension to the baseline model where r is endogenously set at the beginning of the game by the bank in order to maximize expected returns. It turns out that choosing an r which satisfies assumption 3 has no cost for a return-maximizing commercial bank.

If the amount required to meet early withdrawals is higher than its assets, the bank fails, and the assets are shared equally among the depositors.[11]

[11] This "equal treatment" provision makes our contract different from the one studied in Diamond and Dybvig's

If it survives until the end of period 2, investors who have waited until then get their pro-rata share of the remaining assets.

The bank invests a percentage α of the available deposits in government bonds and a percentage $1-\alpha$ in an illiquid risky asset, with a real long-run return factor $\tilde{R}^r$ and a short-term return factor equal to 0. $\tilde{R}^r$ is distributed according to a uniform probability distribution with support in $[0, \bar{R}]$. We take the proportion α to be exogenously given. In the appendix we show that our results go through even if the bank is free to choose α, as long as the law or prudential regulations set an upper limit to the share of risky loans in the bank's portfolio - i.e. a lower bound $\alpha_{\min} > 0$ (in particular, it turns out that a return-maximizing commercial bank will set $\alpha = \alpha_{\min}$).

The return from investing in the bank is consequently given by:

$$R^{BANK}(\theta, \pi, R^r) = \begin{cases} \alpha(1-\theta)R^b & \text{if the bank fails} \\ 1 + r - \pi & \text{if the inv. withdraws and the bank doesn't fail} \\ \alpha(1-\theta)R^b + (1-\alpha)R^r & \text{if the inv. doesn't withdraw and the bank doesn't fail} \end{cases}$$

where the notation makes explicit that R^{BANK} depends not only on the return on bank loans, but also on the choices of the policy-makers (θ, π).

The institutional features that characterize the representative bank can be summarized as follows: (i) its liabilities have a shorter maturity than its assets (which implies that it can be subject to runs); (ii) its assets are relatively more protected from inflation than its liabilities (which implies that inflation improves the bank's financial position). Taken together, these features imply that, in some circumstances, the CB may want to inflate the economy in order to keep the bank alive.

It seems to us that both features capture - admittedly in a very stylized way - important real world features not only of commercial banks, but also of several other financial intermediaries.

3 Solving the model

To recap, at the beginning of period 1 the government issues bonds (b). Individuals allocate their wealth between cash (μ_1), government bonds (μ_2), and bank deposits (μ_3) through which they gain indirect access to high-return, but risky and illiquid projects. The bank invests a share α of its deposits in government bonds and the rest in the illiquid asset. The return on goverment bonds (R^b) is set.

(1983) classical essay, which involves a sequential service requirement. There are, however, many models of bank crises without such a requirement. See for example: Gorton (1985) and Allen and Gale (1998). From a technical point of view, the advantage of disposing of the Diamond-Dybvig "first-come first-served" assumption is that we do not have to consider self-fulfilling runs and multiple equilibrium issues.

At the beginning of period 2 the government sets taxes on income and debt, τ and θ, to satisfy its budget constraint. The return on investment in the risky asset (R^r) is then realized. After having observed θ and the realization of the random variable R^r, but before agents can run to the bank, the CB sets the inflation rate. Finally, after having observed R^r, as well as the inflation rate set by the CB, investors decide whether to withdraw money from the bank or not. At the end of period 2 the bank is liquidated and individuals consume their realized wealth according to equation (1).

As usual, we find the subgame perfect equilibrium by solving the model using backward induction, starting from period 2.

As observed by Calvo (1988), an equilibrium with complete default and in which R goes to infinity always exists, for any range of parameters and for any level of debt. So the interesting question is whether and under what conditions there are other equilibria.

3.1 The problem in period 2

Private sector choices. For the shareholder/depositor it is (weakly) dominant to withdraw if and only if:

$$\alpha(1-\theta)R^b + (1-\alpha)R^r < 1 + r - \pi.$$

Equivalently, the probability of a bankruptcy once R^r has been observed is:

$$\begin{cases} 1 & \text{if } \pi < \pi^{nf} \equiv 1 + r - \alpha(1-\theta)R^b - (1-\alpha)R^r \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

where π^{nf} is the minimum level of inflation needed to save the commercial bank.

The bank is closed whenever the realized return R^r on the real investments is too low and/or the share of reneged debt θ is too high. Moreover, the bank is more likely to fail if inflation is lower, as the opportunity cost of withdrawing the amount promised by the deposit contract is also lower. This effect, together with the fact that the assets of the banks are shielded from inflation, is the reason why the CB is able to implicitly bail out the bank by raising π.

The CB's choice. Given the probability of a bankruptcy that we have just derived, the only two inflation levels which can be optimal for the CB are either 0 or π^{nf}. First, note that $\pi^{nf} > 0$ if and only if:

$$R^r < \frac{1 + r - \alpha(1-\theta)R^b}{1-\alpha} \equiv R^r_h,$$

because for values of R^r above R^r_h the Bank survives even if the CB does not intervene.

Second, whenever $\pi^{nf} > 0$, setting inflation equal to π^{nf} will be optimal for the CB if and only if

$$R^r > \frac{\beta}{1+\beta}\left[\frac{1+r-\alpha(1-\theta)R^b}{1-\alpha}\right] \equiv R^r_l,$$

because for values of R^r below the threshold R^r_l the CB indeed considers it too costly, in terms of inflation, to rescue the bank.

The ex-ante probability of a bail out (i.e. the probability before R^r is observed), which is also the probability of a positive inflation, is a function of θ and of R^b:

$$\begin{cases} 0 & \text{if } \theta \leq \theta_l(R^b) \\ \frac{1+r-\alpha(1-\theta)R^b}{(1+\beta)(1-\alpha)\bar{R}} & \text{if } \theta > \theta_l(R^b) \end{cases}$$

where

$$\theta_l(R^b) \equiv 1 - \frac{1+r}{\alpha R^b}$$

is obtained by imposing R^r_h =0.

Expected inflation, conditional on θ and R^b, is then:[12]

$$\pi = \pi^\star(\theta; R^b) = \begin{cases} 0 & \text{if } \theta \leq \theta_l(R^b) \\ \frac{[1+r-\alpha(1-\theta)R^b]^2}{2(1+\beta)^2(1-\alpha)\bar{R}} & \text{if } \theta > \theta_l(R^b) \end{cases} \tag{5}$$

Note that $\pi^\star$ is an increasing function of θ. Intuitively, for a given level of R^b, when θ rises, the probability that a positive level of inflation is needed to save the bank from a run increases. The cost of the CB intervention increases as well, but the first effect turns out to dominate the second. As a result, the probability of a bail out of the banking sector increases.

The expected return from bank investment, evaluated after the government's decision but before the realization of $\tilde{R}^r$ and the CB's choice, is also a function of θ and R^b and is given by:

$$R^{BANK}(\theta, R^b) = \alpha(1-\theta)R^b + (1-\alpha)\frac{\bar{R}}{2} - \frac{\max\left[Q(\theta, R^b), 0\right]^2}{2(1-\alpha)\bar{R}}$$

where

$$Q(\theta, R^b) = 1 + r - \alpha(1-\theta)R^b - \pi^\star(\theta; R^b).$$

The government's choice. Taking R^b as given the government will maximize c$_m$, subject to its budget constraint (2), the reaction function of the CB (5), and the condition $0 \leq \theta \leq 1$.

[12] We make use of the fact that: $\pi^\star(\theta, R^b)$ =Probability of CB's intervention$*E(\pi|\text{Intervention})$.

Substituting in (1) τ from the budget constraint and π from the CB's reaction, we get:

$$c_m = \mu_{1m}(1-\pi(\theta,R^b)) + \mu_{2m}(1-\theta)R^b + \mu_{3m}R^{BANK}(\theta,R^b) - [g+(1-\theta)R^b b+\delta\theta R^b b] \quad (6)$$

which is a concave function of θ, to be maximized on a compact interval. The government reaction function can be obtained by differentiating equation 7. If $\theta < \theta_l(R_b)$,[13] it is given by :

$$\theta^*(R^b) = \begin{cases} 0 & \text{if b}<\frac{1}{1-\delta}\mu_{2m} + \frac{\alpha}{1-\delta}\mu_{3m} \\ 1 & \text{otherwise} \end{cases} .$$

If instead $\theta > \theta_l(R_b)$ the government reaction function, which we define as $\theta^{**}(R^b)$, is more cumbersome to write in an explicit form, but it can be easily shown that $\theta^{**}(R^b)$ is a continuous, increasing function. It is equal to zero up to a certain value of R^b, and it increases afterwards, tending to 1 as R^b goes to $+\infty$ (see appendix). Its positive part is implicitly given by the following expression:

$$(1-\delta)bR^b = \left[\mu_{1m}\frac{\partial\pi^*}{\partial\theta} + \mu_{2m}R^b - \mu_{3m}\frac{\partial R^{BANK}}{\partial\theta}\right]. \quad (7)$$

The left-hand side of the equation represents the net benefits from default, which are due to the fact that in the event of default the government needs to levy a lower amount of taxes to satisfy its budget constraint. On the right-hand side there is the cost of default. It is given by the income loss suffered by individual m, due to the inflation-induces losses on her money holdings, to the lower return on her government bonds, and to the reduced profitability of the financial sector (due in turn to the capital losses suffered on government bonds and to the increased probability of runs).

3.2 The problem in period 1

As we have derived the response of the government as a function of the cost of public debt, we are now in a position to solve for the subgame perfect Nash equilibrium of the game.

To this end, note that no arbitrage in the market for government bonds implies that:

$$R^b = \frac{1}{1-\theta^{exp}}, \quad (8)$$

where θ^{exp} denotes the expected value of θ as of the beginning of period 1, and the real interest rate is equal to the subjective discount rate.

Equilibrium also requires θ^{exp}=θ, which together with eq. (9) gives:

$$\theta = 1 - \frac{1}{R^b}.$$

[13] It is immediate to check that, whenever $\theta < \theta_l(R_b)$, $Q(\theta,R^b) < 0$ and $\pi^*(\theta,R^b) = \frac{\partial\pi^*(\theta,R^b)}{\partial\theta} = 0$. If instead $\theta \geq \theta_l(R_b)$, $Q(\theta,R^b)$, $\pi^*(\theta,R^b)$ and $\frac{\partial\pi^*(\theta,R^b)}{\partial\theta}$ are all positive.

Can there be a $\theta = 0$ equilibrium? In such an equilibrium the rational-expectation condition entails that $R^b = 1$. Together with assumption 2, this entails that we are on the θ^{**} reaction function. So a $\theta = 0$ equilibrium exists if and only if the value of R^b after which θ^{**} crosses the horizontal line is greater than 1. A zero default equilibrium then exists only if:

$$(1-\delta)b - \mu_{1m}\frac{\partial \pi^*}{\partial \theta}(0,1) - \mu_{2m} - \mu_{3m}\left[\alpha + \frac{Q(0,1)}{(1-\alpha)\bar{R}}\frac{\partial Q}{\partial \theta}(0,1)\right] \leq 0. \tag{9}$$

We can summarize the above findings as follows:

PROPOSITION 1: *A zero-default equilibrium exists if and only if b does not exceed a threshold* $b^{\max}$ *equal to:*

$$\frac{1}{1-\delta}\left\{\frac{\alpha(1+r-\alpha)}{(1+\beta)^2(1-\alpha)\bar{R}}\mu_{1m} + \mu_{2m} + \alpha\left[1 + \frac{(1+r-\alpha)}{(1-\alpha)\bar{R}}(1 - \frac{1+r-\alpha}{(1+\beta)^2(1-\alpha)\bar{R}})(1 - \frac{1+r-\alpha}{2(1+\beta)^2(1-\alpha)\bar{R}})\right]\mu_{3m}\right\}$$

PROOF: by inspection of equation 10.

The next step is to understand better the role of political and monetary institutions in determining $\mathrm{b}^{\max}$. To this aim, one can show the following:

PROPOSITION 2: *In equilibrium, the ex-ante expected inflation rate is strictly positive, so that the ex ante return on government bonds (which is 1) is higher than the return on money (which is 1-π). Therefore,* $\mu_{1i} = 0$ *for each i such that* $w_i \geq \underline{w}$*. Moreover, as long as* $\bar{R}$ *is large enough, the ex-ante expected return from bank deposits is higher than the return on government bonds. As a consequence,* $\mu_{2i} = 0$ *for each i such that* $w_i \geq \bar{w}$*.*

PROOF: See the appendix.

In words, proposition 2 says that in equilibrium all the financial market participation constraints bind. Cash is only held by the poorer part of the population (those with $w_i < \underline{w}$). Middle class people (those with $\underline{w} \leq w_i < \bar{w}$) hold only government bonds, and the rich (those with $w_i \geq \bar{w}$) hold only bank deposits.

4 The determinants of debt intolerance

4.1 The role of government's preferences

Proposition 2 is useful to interpret proposition 1. Indeed, provided $\bar{\mathrm{R}}$ is sufficiently large, proposition 1 entails that debt sustainability increases with μ_{2m}. Suppose for simplicity that $w_i = w_P$ for any i such that $w(i) < \underline{\mathrm{w}}$, $w_i = w_R$ for any i such that $w(i) \geq \bar{w}$, and $w_i = w_M$ for any i such that $w(i) < \bar{w}$ and $w(i) \geq \underline{\mathrm{w}}$. Then proposition 2 implies that

$$\begin{aligned}
\mu_{1m} &= \frac{w_P}{Ew} F_{GOV}(\{i : w_i < \underline{\mathrm{w}}\}); \quad \mu_{2m} = \frac{w_M}{Ew} F_{GOV}(\{i : \bar{w} > w_i \geq \underline{\mathrm{w}}\}); \quad \mu_{3m} = \frac{w_R}{Ew} F_{GOV}(\{i : w_i \geq \bar{w}\}); \\
Ew &\equiv w_P F_{GOV}(\{i : w_i < \underline{\mathrm{w}}\}) + w_M F_{GOV}(\{i : \bar{w} > w_i \geq \underline{\mathrm{w}}\}) + w_R F_{GOV}(\{i : w_i \geq \bar{w}\}).
\end{aligned}$$

Putting things together, one has:

PROPOSITION 3:

(i)$b^{\max}$ *is maximized if :* $F_{GOV}(\{i : \bar{w} > w_i \geq \underline{\mathrm{w}}\}) = 1$*;*

(ii) for any couple of preferences F'_{GOV},F''_{GOV} *, such that* $F'_{GOV}(\{i : w_i \geq \bar{w}\}) = F''_{GOV}(\{i : w_i \geq \bar{w}\})$ and $F'_{GOV}(\{i : \bar{w} > w_i \geq \underline{\mathrm{w}}\}) > F''_{GOV}(\{i : \bar{w} > w_i \geq \underline{\mathrm{w}}\})$, $b^{\max}$ *is higher under* F'_{GOV} *than under* F''_{GOV} ;

(iii) for any couple of preferences F'_{GOV},F''_{GOV} *, such that* $F'_{GOV}(\{i : w_i < \underline{\mathrm{w}}\}) = F''_{GOV}(\{i : w_i < \underline{\mathrm{w}}\})$ and $F'_{GOV}(\{i : \bar{w} > w_i \geq \underline{\mathrm{w}}\}) > F''_{GOV}(\{i : \bar{w} > w_i \geq \underline{\mathrm{w}}\})$, *provided* $\frac{w_M}{w_R}$ *is not too low,* $b^{\max}$ *is higher under* F'_{GOV} *than under* F''_{GOV}*;*

PROOF: See appendix.

Point (i) is quite intuitive: as in a no-default equibrium public debt is mostly held by the middle class, $\mathrm{b}^{\max}$ is maximized when the government just cares about these citizens. Point (ii) and Point (iii) confirm the same intuition. Point (ii) simply says that, all else equal, if the government's concern for the middle class increases while its concern for the poor decreases, debt tolerance increases as well. Symmetrically, point (iii) states that, all else equal, if the government's concern for the middle class increases while its concern for the rich decreases, $\mathrm{b}^{\max}$ also increases.[14]

To sum up, debt sustainability improves if, all else equal, the middle class gets stronger.

[14] The caveat in point (iii) concerning $\frac{w_R}{w_M}$ is due to the fact that a preference shift in favour of the middle class and against the rich also causes μ_{1m} to increase, because Ew decreases. As the coefficient attached to μ_{1m} is lower then that attached to μ_{3m}, the decrease in Ew cannot be too sharp, which is what the condition on $\frac{w_M}{w_R}$ actually guarantees.

4.2 The role of CB's preferences

Until now, we did not make any assumption on F_{GOV} and F_{CB}. In many countries the richer part of the population enjoys a disproportionate political weight. Bribes and financial contributions notoriously buy access to politicians. Moreover, it is a well-established stylized fact that the turn-out rates of the poor are systematically and significantly below average in most countries (see for example Blais, 2000). So it seems interesting to study the implications for debt sustainability of a government that disregards the interests of the poorer part of the population.

The preferences of the CB are typically less extreme than politicians' preferences, because most countries have laws and regulations which at least partially insulate central bankers from political power, so that the CB can pursue policies which are closer to the welfare-maximizing ones.

The most parsimonious way to capture this institutional context we have in mind is to impose the following:

Assumption 3

$$F_{GOV}(\{i : w_i < \underline{w}\}) = 0;\ F_{CB}(i) = \epsilon L(i) + (1-\epsilon)F_{GOV}(i),$$

where L is the Lebesgue c.d.f. - the utilitarian benchmark assigned by law to the CB as an objective - and $\epsilon \in (0,1]$.

In words: the government is not concerned *at all* about the welfare of poor people (less extreme objective functions do not deliver qualitatively different results, but would complicate the algebra). The CB, were it free to pursue its preferred policy, would treat all citizens equally. As it is not fully independent, it maximizes a mix of its own objective function and the one of the government, with weights given by ϵ and 1-ϵ respectively, so that ϵ is a measure of CB's independence (Franzese, 1999, and Berger et al., 2001).

One can prove the following:

PROPOSITION 4: $b^{\max}$ *increases with* ϵ.

PROOF: See appendix.

That is: debt sustainability is higher if the CB is more independent from the political power. The intuition is quite straightforward: governments favour inflation because it avoids financial market crises, which are feared by the rich, while inflation costs are mainly paid by the poor. A welfare-maximizing CB takes into account that inflation dents the resources of a non-negligible part of the population, so it is more inflation-adverse (has higher β) than the government. Therefore, an independent CB acts as a disciplining device for the government, which understands that default will ultimately backfire on the very constituency that it wants to protect.

In the appendix, we also consider the polar case of a "populist" government, which disregards the welfare of the rich: $F_{GOV}(\{i : w_i \geq \underline{w}\}) = 0$. The result that central bank independence improves debt sustainability remains valid. In this case, the mechanism at work is different: a "populist" government is more prone to default if it is confident that default will not be translated into inflation, as inflation harms an important part of its constituency (the poor). Instead, it does not care about financial market disruption at all. But an independent, welfare-maximizing CB takes into account that financial market disruption is inefficient, and it is prepared to contrast the financial meltdown, even if this results in a rise in prices. Therefore, it acts as a disciplining device for "populist" governments as well.

5 Conclusions

We presented a model of monetary-fiscal policy interaction in which the presence of a large and politically influent middle class guarantees that public debt will be honoured, because middle class people invest most of their wealth in government bonds.

We also studied the role of CB independence. Due to limited financial market participation, the poor suffer relatively more from an unexpected surge in prices, whereas the rich suffer relatively more for a financial market crisis. As a sovereign default worsens the balance sheet of the financial sector, an "elitist" government will pressure the CB to over-react with a burst of inflation, in order to help financial intermediaries. Then, an independent CB reduces the government's incentive to default and rises debt tolerance. Indeed, in the absence of an inflationary response by the CB, a default would trigger a financial crisis which would back-fire on the very people the government aims to represent. Finally, we show that CB independence increases debt tolerance also in the face of an excessively pro-poor government.

While our model delivers interesting empirical implications, we leave their confirmation for future research. Some evidence already exists, showing that default is less likely if the government is responsive to the needs a wider set of citizens and political actors. For example, default seems less frequent if institutional checks and balances to the power of the executive are in place (van Rijckegem and Weder, 2004, Kohlscheen, 2007).

Appendix

The function $\theta^{**}(R^b)$. After some algebra, equation 10 can be written as:

$$\begin{aligned}(1-\delta)b &= \mu_{1m}\alpha\frac{1+r-\alpha(1-\theta)R^b}{(1+\beta)^2(1-\alpha)\bar{R}}+\mu_{2m}+\\ &+\mu_{3m}\alpha\left\{1+\frac{1+r-\alpha(1-\theta)R^b}{(1-\alpha)\bar{R}}\left[1-\frac{1+r-\alpha(1-\theta)R^b}{2(1+\beta)^2(1-\alpha)\bar{R}}\right]\left[1-\frac{1+r-\alpha(1-\theta)R^b}{(1+\beta)^2(1-\alpha)\bar{R}}\right]\right\},\end{aligned}$$

which is a cubic function of $(1-\theta)R^b$. Using the implicit function theorem, $\frac{\partial\theta^{**}(R^b)}{\partial R^b}=\frac{1-\theta}{R^b}$. It is an increasing, concave function which goes to -∞ as R^b goes to 1 and to 1 as R^b goest to $+\infty$.

Proof of proposition 2. In equilibrium, inflation is given by:

$$\pi=\pi^{\star}(0;1)=\frac{[1+r-\alpha]^2}{2(1-\alpha)(1+\beta)^2\bar{R}}>0$$

(from equation 6). Since the real return of money and bonds in a zero default equilibrium are respectively equal to 1-$\pi^{\star}(0;1)$ and 1, the first part of the proposition follows. In equilibrium, R^{BANK} is equal to:

$$R^{BANK}(0,1)=\alpha+(1-\alpha)\frac{\bar{R}}{2}-\frac{Q(0,1)^2}{2(1-\alpha)\bar{R}}$$

where

$$Q(0,1)=1+r-\alpha-\frac{[1+r-\alpha]^2}{2(1-\alpha)(1+\beta)^2\bar{R}}.$$

The second part of the proposition follows.

Proof of proposition 3. Provided $\bar{R}$ is big enough, the coefficient multiplying μ_{2m} in equation (11) is greater than the coefficient multiplying μ_{3m} which is in turn greater than the coefficient multiplying μ_{1m}. Equation (11) can be rewritten as:

$$\frac{(1-C)w_M M}{Ew}-\frac{(C-A)w_P P}{Ew}+C$$

where

$$\begin{aligned}A &= \frac{1+r-\alpha}{(1+\beta)^2(1-\alpha)\bar{R}};\quad C=\alpha+\alpha\frac{(1+r-\alpha)}{\bar{R}}(1-\frac{1+r-\alpha}{(1+\beta)^2(1-\alpha)\bar{R}})(1-\frac{1+r-\alpha}{2(1+\beta)^2(1-\alpha)\bar{R}});\\ M &= F_{GOV}(\{i:\bar{w}>w_i\geq\underline{w}\});\quad P=F_{GOV}(\{i:w_i<\underline{w}\}).\end{aligned}$$

then it is clear that a decrease in P matched by an equal increase in M increases $b^{\max}$. An infinitesimal increase in M matched by an analogous decrease in R has the following effect

$$\frac{Ew - \frac{w_R - w_M}{w_M}\left[-(1-C)w_m M + (C-A)w_P P\right]}{(Ew)^2}.$$

This expression decreases with P more quickly than it decreases with M, so it attains its minimum value when P=1:

$$\frac{w_P - \frac{w_R - w_M}{w_M}(C-A)w_P}{(Ew)^2}$$

Then, if

$$\frac{w_P - \frac{w_R - w_M}{w_M}(C-A)w_P}{(Ew)^2} > 0,$$

i.e. if:

$$w_M > \frac{C-A}{1+C-A} w_R,$$

an increase in M matched by an analogous decrease in R always increases $b^{\max}$.

In the same vein, an increase in P and a corresponding infinitesimal decrease in R increases $b^{\max}$ iff:

$$w_R - (w_R - w_M)M < \frac{1-C}{C-A}\frac{w_M}{w_P}M.$$

If

$$1 > \frac{w_R}{w_R - w_M + \frac{1-C}{C-A}\frac{w_M}{w_P}},$$

that is if

$$w_P < \frac{1-C}{C-A}$$

the inequality holds for any value of M.

Proof of proposition 4. A straightforward consequence of assumption 3 is that $\mu_{1m} = 0$. Then, proposition 1 implies that sustainability increases with β. β can in turn be written as:

$$\beta = \frac{\mu_{1a}}{\mu_{3a}} = \frac{\int_{\{i:w_i<\underline{\mathrm{w}}\}} w_i di}{\int_{\{i:w_i\geq\bar{\mathrm{w}}\}} w_i di}\left[1 + \frac{1-\epsilon}{\epsilon}\frac{\int_{\{i:w_i>\underline{\mathrm{w}}\}} w_i dF_{GOV}}{\int_{\{i:w_i>\underline{\mathrm{w}}\}} w_i di}\right]^{-1}.$$

The proposition follows. The weight given to inflation by the CB is greater than that of the government (which is 0) but lower than that of a utilitarian planner, equal to $\frac{\int_{\{i:w_i<\underline{\mathrm{w}}\}} w_i di}{\int_{\{i:w_i\geq\bar{\mathrm{w}}\}} w_i di}$. This is due to: $\frac{\int_{\{i:w_i>\underline{\mathrm{w}}\}} w_i dF_{GOV}}{\int_{\{i:w_i>\underline{\mathrm{w}}\}} w_i di}$, a term which captures the elitist bias of the government, and to $\frac{1-\epsilon}{\epsilon}$, a term which captures the fact that the CB is only partially independent.

Endogenous r and α. $R^{BANK}(0,1)$ is maximized if r is such that Q(0,1)<0. So any r is optimal as long as $1+r-\alpha-\frac{[1+r-\alpha]^2}{2(1-\alpha)(1+\beta)^2\bar{R}}<0$. Given the shape of such function, for any r<$\alpha-1$ which satisfies this condition, there is another r>$\alpha-1$ which also satisfies the condition. So choosing an r which satisfies assumption 2 has no cost for a return-maximizing commercial bank.

Given the expression for R^{BANK}, it is also obvious that a return-maximizing bank, if it can choose α under the constraint that $\alpha>\alpha_{\min}$ with $\alpha_{\min}>0$, will optimally set $\alpha=\alpha_{\min}$.

The case of a "populist" government. If this appendix we study the consequences of substituting the first part of assumption 3 with

$$F_{GOV}(\{i : w_i \geq \underline{\mathrm{w}}\}) = 0$$

So that the government is not concerned *at all* about the welfare of the rich.

Then $\mu_{3m}=0$, and proposition 1 implies that sustainability decreases with β. β can in turn be written as:

$$\beta=\frac{\mu_{1a}}{\mu_{3a}}=\frac{\int_{\{i:w_i<\underline{\mathrm{w}}\}} w_i di}{\int_{\{i:w_i\geq\bar{\mathrm{w}}\}} w_i di}\left[1+\frac{1-\epsilon}{\epsilon}\frac{\int_{\{i:w_i\leq\underline{\mathrm{w}}\}} w_i dF_{GOV}}{\int_{\{i:w_i\leq\underline{\mathrm{w}}\}} w_i di}\right].$$

The weight given to inflation by the CB is now lower than that of the government and higher than that of a utilitarian planner. It remains true than an increase in ϵ, by decreasing β, increases $b^{\max}$.

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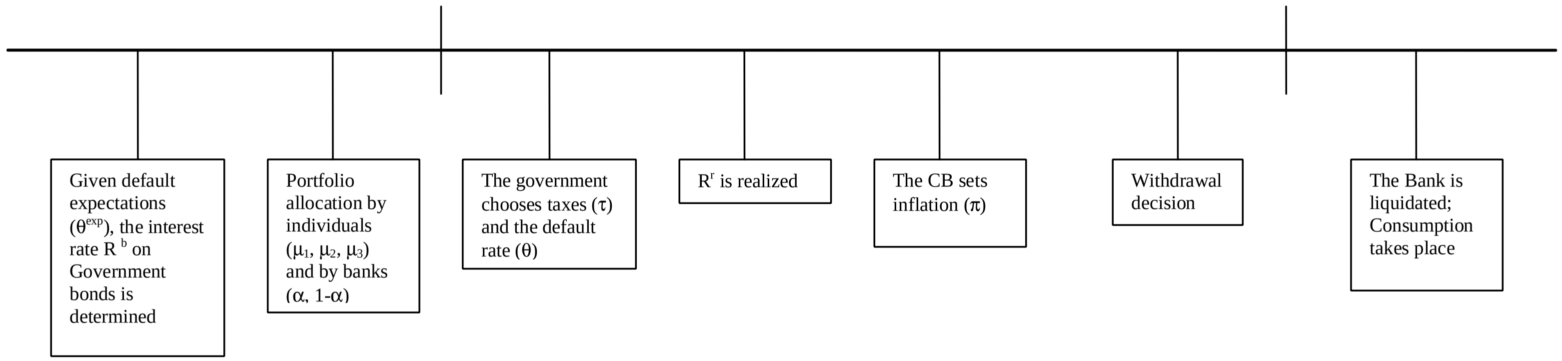

Figure 1: Timeline of the model

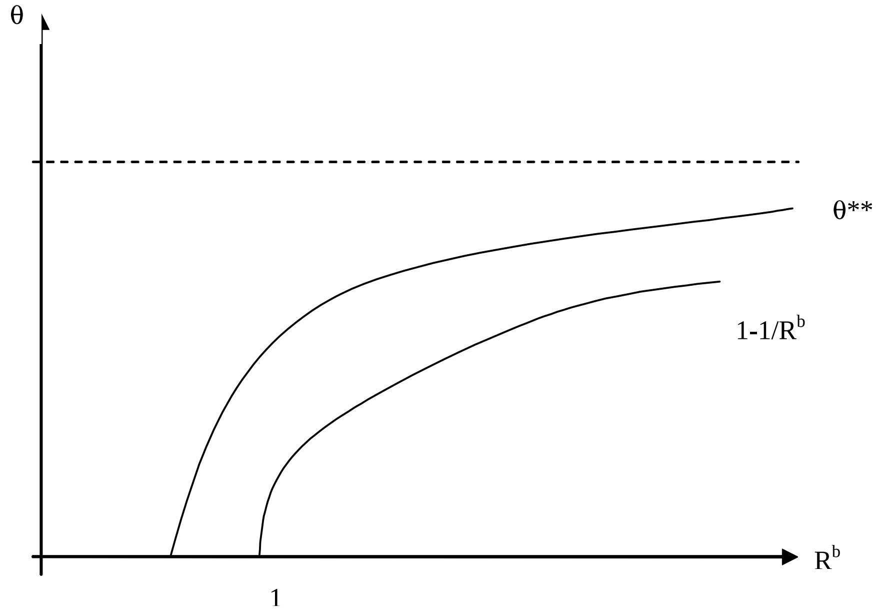

Figure 2: $b > b^{\max}$: no zero-default equilibrium exists

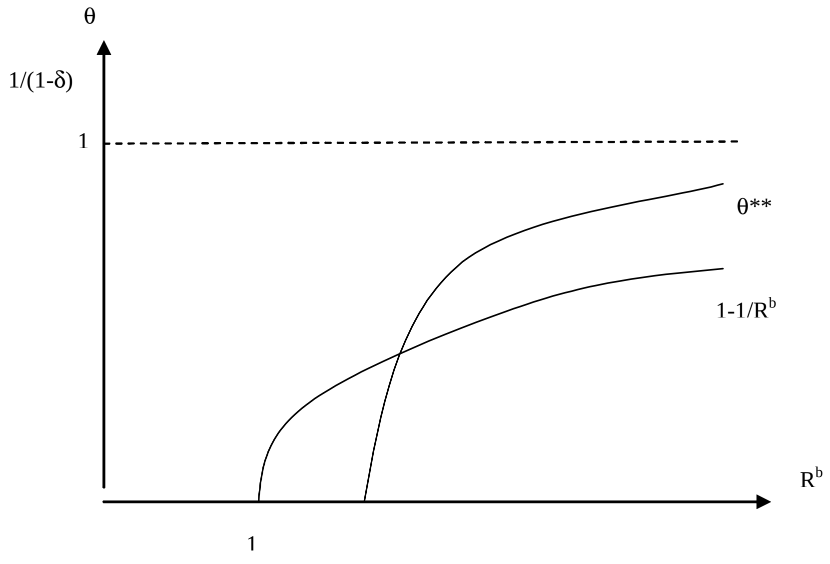

Figure 3: $b \leq b^{\max}$: a zero-default equilibrium exists

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