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# Political instablility and seigniorage: An inseparable couple — or a threesome with debt?

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**Abstract**

In the literature, political instability is shown to raise seigniorage and/or debt, but there is no debt-seigniorage trade-off. However, what happens when the IMF gets involved? Based on a political economy model of intertemporal public finance this paper presents qualitatively new and robust results. First, political instability causes myopic government behaviour and produces more debt, not more seigniorage. Second, IMF policies requiring debtor countries to achieve both monetary and fiscal stability at the same time are ineffective. Third and surprisingly at first sight, debt conditionality aiming at monetary stability is particularly effective in heterogeneous societies with unstable governments.

## 1 | INTRODUCTION

Among the political turbulences and with ongoing (84%) inflation, Russia defaulted on its (GKO) bonds in 1998. The International Monetary Fund (IMF) stepped in with a loan and inflation went down in the following year. Similarly, Ecuador lost financial market access in 2000; the IMF approved a financial package and inflation went down. In Tanzania, the IMF had already facilitated loans in 2003, before Tanzania lost financial market access in 2004. Nonetheless, the inflation rate went down again, albeit from an already low level.[1]

What do these countries have in common? Owing to the loss in credibility associated with their financial restructuring, they suffer a financial squeeze. In Russia, for instance, the total federal budget in 1998, the year the government defaulted on its bonds, shrank in dollar terms to the size of the government budget of the Irish Republic. A desperately needed increase in tax revenues is typically not feasible; the tax base is relatively small and there are tax collection inefficiencies that cannot be overcome in the short run. The only other public finance resources are "moderate" inflationary finance

(seigniorage) and debt from the IMF or other international financial institutions. Many countries that find themselves in such a fragile situation also suffer from political instability. If we take the "Political Instability and Absence of Violence/Terrorism" index from the World Bank's (2015a) Worldwide Governance Indicators data set, the aforementioned countries Tanzania and Ecuador were in the lowest 20 to 26 percentile in the year they lost market access. Another particularly pointed example of political instability is Russia with its five changes of government between March 1998 and August 1999 without Duma or presidential elections.[2] In summary, these countries are politically unstable and they manage to obtain more external debt, but do not tap into seigniorage as an additional source of revenue.

This paper points out that the aforementioned cases are not well understood. What is discussed in the literature refers to debt in general, not IMF debt. It is shown that, under political instability, governments typically raise seigniorage and/or debt—in particular, there is no debt-seigniorage tradeoff. When the IMF gets involved, such a monetary-fiscal policy trade-off does, however, occur in some Latin American countries and elsewhere including the aforementioned examples. This paper offers one possible explanation which hinges on IMF conditionality. A simple political economy model of intertemporal public finance is used to illustrate the mechanism. More generally, this paper calls for a broader reevaluation of countries' alternative decisions on seigniorage and debt, including, but not limited to situations in which the IMF gets involved and IMF conditionality is applied.

In their seminal article Cukierman, Edwards, and Tabellini (1992) argue that political instability leads to higher levels of seigniorage, a claim that has been left unchallenged since. They present empirical evidence that is supported by a theoretical model; the level of seigniorage chosen depends on current tax collection inefficiencies that can only be overcome in the future (by investing in a tax collection technology now). In their model, political instability is treated as an exogenous probability of losing power. Their model suggests that governments in more unstable countries "may deliberately choose to maintain an inefficient tax system, so as to constrain the behavior of future governments ..." which will then have to "collect a larger fraction of their revenues through seigniorage ... ." In their model, the incumbent government focuses on current period gains rather than longer-term gains, because the longer-term gains may not fully accrue to itself. Such short-sightedness and lack of discernment for the longer-term interests of society as a whole will, henceforth, be referred to as myopic government behaviour. Cukierman et al.'s (1992) core idea is then that more political instability leads to more myopic government behaviour which, in turn, translates into higher levels of seigniorage, that is, less monetary stability. Additional empirical support, both for seigniorage and inflation, is provided by Edwards and Tabellini (1991).

An alternative line of reasoning posits that government myopia can lead to higher levels of deficit or debt. The literature emphasizes the strategic role of domestic debt for electoral success (for instance, Aghion & Bolton, 1990; Persson & Tabellini, 1990) and/or concludes that governments may borrow excessively when there is a chance of being voted out of office in the next period (for instance, Alesina & Tabellini, 1990; Persson & Svensson, 1989; Tabellini & Alesina, 1990). Özler and Tabellini (1991) explicitly capture default on sovereign debt and distinguish a constrained and an unconstrained scenario. Only in the latter can political instability lead to an increase in borrowing. Additional support for the political (and economic) determinants of budget deficits is provided by Edwards and Tabellini (1991) and Roubini (1991). They also find evidence for a positive correlation between deficit and seigniorage.

With the aforementioned articles the debate seemed to have come to an end. Nothing was said about a negative correlation, that is, a potential trade-off between debt and seigniorage (or inflation) under political instability. In 2013, Agnello and Sousa (2013) argued that political instability increases

deficit volatility which is—according to them—typically associated with high inflation and large deficits. Hence again a positive correlation. Boz (2011) emphasizes the importance of a country's choice between commercial debt and IMF loans. Simple correlation tables by Teunisse (2014a, 2014b) suggest for a sample of Latin American countries that there may be a trade-off between IMF credit and seigniorage.

Section 2 reviews the empirical evidence. It starts out by summarizing the findings of the core articles by Cukierman et al. (1992), Edwards and Tabellini (JIMF, 1991) and Roubini (JIMF, 1991). They offer support for the influence of political instability on seigniorage and inflation as well as deficit and debt. However, they also argue that "contrary to popular belief, we observe very wide differences in behavior within Latin America. ... Thus, any good theory that attempts to explain the determinants of fiscal policy and the inflation tax should be capable of explaining the different behavior encountered within the Latin American region." (Edwards & Tabellini, JIMF, 1991, p. S20). Section 2 proceeds by discussing the link between monetary and fiscal stability. A positive correlation between the change in debt and seigniorage is suggested by the two aforementioned JIMF papers. The positive correlation vanishes, however, when IMF debt and seigniorage are considered. Teunisse (2014a, 2014b) finds that, in the presence of political instability, there may be a trade-off between IMF credit and seigniorage in Latin American countries; and some countries may not at all resort to seigniorage when IMF debt is available. Given that IMF programs are quite specific to each country, it is doubtful that a multi-country panel study would produce any useful results. Focusing again on Latin America, some additional evidence is presented in this paper. When countries are under IMF programs, there is no support for a country-specific positive correlation between IMF debt and inflation, although I only find one case with a significant negative correlation. In view of a possible explanation, Section 2 also presents evidence for the relevance of IMF conditionality on monetary stability.

Section 3 presents the intertemporal model, discusses its economic and political components and offers an outline of the solution (with more details in the Appendix). It tries to make sense of the non-positive correlation and potential tradeoff between IMF debt and seigniorage. It focuses on a situation in which a country loses financial market access, but receives credits by the IMF, with debt conditionality attached.[3] The analytical model captures the government's optimal choice between seigniorage, IMF debt and government consumption and investment. The intuition is that political instability produces myopic government behaviour, which implies that the repayment of IMF credits will be more heavily discounted; credits become very desirable. If there is IMF conditionality on monetary stability, a low level of seigniorage facilitates a higher IMF credit expansion.

Section 4 presents the propositions (with details in the Appendix) and discusses the findings. Central Proposition 1 says that the government tries to fulfill the conditionality requirements including monetary stability in order to receive as much credit from the IMF as possible. Alternatively, seigniorage remains unchanged (i.e., does still not go up), if IMF conditionality is not placed on monetary stability. Both results correspond to the correlation panels presented in Table 1 (in Section 2). However, Proposition 1 sharply contrasts with findings by Cukierman et al. (1992) and Edwards and Tabellini (1991) who argue that political instability increases seigniorage. It is argued that the difference in results is due to the presence of IMF credit and conditionalities. Section 4 also presents Lemma 1 and Corollary 1. Lemma 1 studies the government's optimal response to the possible conditionalities and suggests that the IMF is faced by a trade-off between achieving monetary and fiscal stability. Corollary 1 combines Proposition 1 and Lemma 1—debt conditionality based on monetary stability considerations is particularly effective in heterogeneous societies with unstable governments. Section 5 concludes.

**T A B L E 1** Correlation between Inflation and change in IMF debt

| | infq | tfctrDIFF | | infq | tfctrDIFF |
|---|---|---|---|---|---|
| Argentina | | | Israel | | |
| infq | 1 | | infq | 1 | |
| tfctrDIFF | −0.0423 | 1 | tfctrDIFF | 0.519 | 1 |
| Bolivia | | | Mexico | | |
| infq | 1 | | infq | 1 | |
| tfctrDIFF | 0.0694 | 1 | tfctrDIFF | −0.0746 | 1 |
| Brazil | | | Peru | | |
| infq | 1 | | infq | 1 | |
| tfctrDIFF | 0.0235 | 1 | tfctrDIFF | −0.0369 | 1 |
| Chile | | | Uruguay | | |
| infq | 1 | | infq | 1 | |
| tfctrDIFF | 0.154 | 1 | tfctrDIFF | −0.0186 | 1 |
| Dom. Rep. | | | Turkey | | |
| infq | 1 | | infq | 1 | |
| tfctrDIFF | −0.301[*] | 1 | tfctrDIFF | −0.00507 | 1 |

[*]Depicts significance at the 10% level.

## 2 | EMPIRICAL FINDINGS ON POLITICAL, MONETARY AND FISCAL INSTABILITY

This section reviews the empirical literature and focuses on five issues: (i) the effect of political instability on seigniorage or inflation; (ii) the effect of political instability on deficit or debt including IMF debt; (iii) the link between seigniorage/inflation and the budget deficit; (iv) the link between seigniorage/inflation and the change in IMF debt; and (v) evidence of IMF conditionality applied to monetary stability.

As for (i), the relationship between political instability and monetary stability is elaborately studied by Cukierman et al. (1992) and Edwards and Tabellini (1991). (Similar results are obtained by Aisen and Veiga (2006 and 2008) on the basis of newer data and system generalised method of moments estimation.) Cukierman et al.'s (1992) core result is presented in their table 5 (p. 548). Seigniorage is determined in cross-country OLS regressions for averages over the time period 1971 to 1982 in 79 industrial and developing countries. All three specifications for political instability turn out to be significant; some non-political controls are also significant. Similar IV regressions (using pre-sample proxies for political instability) confirm their results. These results on seigniorage are confirmed for inflation by Edwards and Tabellini (1991). In their table 5 (p. S29), they present seemingly unrelated regressions for cross-country data of 50 developing countries specified over four alternative time periods of lengths between 5 and 10 years (taken from the sample period 1963 to 1988). In three of the four periods, at least one of the their political instability variables is significant. Most of Edwards and Tabellini's (1991) paper does, however, focus on per country analyses. They present descriptive statistics on average per country rates of seigniorage and inflation over the aforementioned four periods. Large fluctuations of seigniorage and inflation (with the widest fluctuations in Latin America) suggest that there is no optimal inflation smoothing. Instead, they argue on the basis of per country unit

root tests and simple OLS regressions that seigniorage is a residual source of revenue—seigniorage goes up when spending increases and/or taxes decrease. The argument that seigniorage depends on the availability of other sources of revenue is also made further down, when the correlation between seigniorage and IMF debt is studied.

As for (ii), Edwards and Tabellini (1991) also study the determinants of the budget deficit. Again, they present descriptive per country statistics to show that budget deficits vary across countries and between the aforementioned time intervals of lengths between 5 and 10 years. They claim (unspecified in their paper though) that parallels to the seigniorage and inflation data suggest some positive correlation between those monetary and fiscal variables. Roubini (1991, Table 2, p. S70) presents cross-country OLS regressions with yearly averages for the time period 1971 to 1982 for 77 industrial and developing countries. Compared wih other regression analyses conducted by Roubini (1991), the one that includes seigniorage produces significant results for both specifications of political instability (which are similar to those used by Cukierman et al. (1992), and Edwards and Tabellini (1991)). As for the inclusion of seigniorage, Roubini (1991) argues, inter alia, that seigniorage is used for financing deficit, that is the purchase of government bonds by the central bank.

This leads to issue (iii) on the link between seigniorage/inflation and the budget deficit. The financing argument and the significance of seigniorage in the regression suggest a positive correlation between seigniorage and the budget deficit. The result is supported by unit root tests and simpler regressions between seigniorage and the budget deficit, which Roubini (1991) presents earlier in his paper. Edwards and Tabellini (1991) arrive at the same conclusion, albeit based on purely descriptive statistics. They ground their argument on the "proportion of central bank's credit that goes to the (central) government" (p. S33; see table 8, p. S36) and their aforementioned (unspecified) inspection of per country parallels between the seigniorage and inflation data on the one hand and the budget deficit figures on the other hand. The fact that there is a positive effect of political instability on both seigniorage/inflation and deficit can be seen as additional support of a positive correlation between these monetary and fiscal variables.

As for (iv) on the correlation between seigniorage and the change in IMF debt, Teunisse (2014a) regresses two specifications of the change in IMF debt against two specifications of seigniorage. All adjusted $R^2$ values are low. Teunisse (2014a) does find negative coefficients, but only when seigniorage and the change in IMF debt are measured as a fraction of government revenue (rather than GDP) the coefficient on seigniorage turns significant. It is not clear, if it is the large variations both in the change in IMF debt and in seigniorage between countries that washes out the significance in the other specifications. In a sister study, Teunisse (2014b), therefore, turns to per country correlation tables for 19 Latin American countries and finds negative signs between seigniorage and the change in IMF debt in most cases, with significant negative correlations in five countries. The results by Teunisse (2014a, 2014b) are supplemented in this paper (see Table 1) with per country tables on the correlation between inflation and the change in IMF debt (as percent of revenue). The data is quarterly and stretches from 1957 to 2000. It covers eight Latin American countries with a substantial number of IMF programs plus Israel and Turkey. The correlation is calculated for years in which there is either a standby arrangement, an extended fund facility or another arrangement. Mostly, there is no significant correlation; four of the 10 signs are positive and six are negative, only one significantly negative though (at the 10% level). This underscores two key findings: (i) the link between monetary and (total or only IMF) debt variables can be very diverse; and (ii) the correlation between monetary variables and the change in IMF debt is not positive.

This takes us to issue (v). Why is a country's change in debt positively associated with seigniorage and inflation, but negatively, if we look at the correlation between the change in IMF debt and those same monetary variables? According to Blejer, Leone, Rabanal, and Schwartz (2002) and Epstein and

Heintz (2006) IMF programs are biased towards contractionary monetary policy. Although the IMF does not formally require inflation targeting as a condition, it does, formally or informally, promote inflation targeting (Epstein, 2006). Epstein (2006) argues that such a target does certainly produce lower inflation, but "the hoped for gains in employment have generally not materialised". Let us just look at two of many examples of IMF conditionality (IMF, 2001); take Ghana and Brazil around the turn of the century. In order to receive aid (in December 1998 in Brazil (Blejer et al., 2002) and after the elections of 2000 in Ghana (Epstein & Heintz, 2006)) each country had to meet certain conditions, for instance limit its net domestic assets. In addition, a new commitment was made by their central banks to reduce inflation that—according to Epstein and Heintz (2006)—implied setting an inflation target. The idea of monetary stability-promoting IMF conditionality is central to the model that is developed in the next section. It argues that IMF programs including conditionality combined with political instability may be one possible explanation for the non-positive and possibly even negative correlation between seigniorage and the change in IMF debt.

## 3 | A POLITICAL PUBLIC FINANCE MODEL

The model consists of two periods: period 1 (current period) and period 2 (next period). There are three sectors in the economy: (i) the government; (ii) partial interest groups; and (iii) the private sector. The model is specified in real terms. The government tries to satisfy both general welfare based on private sector consumption $C$ and partial interest welfare based on its spending $F$ and $G$ on two partial interest groups. Government preferences over periods 1 and 2 are given by the following utility function:

$$W = V_1(C_1) + H_1(G_1,F_1) + \mathrm{E}\{\rho\left(V_2(C_2) + H_2(G_2,F_2)\right)\}. \tag{1}$$

The $V.(\bullet)$ functions are concave and twice continuously differentiable utility functions in private sector consumption $C$. The $H.(\bullet)$ functions are the partial interest utility functions. Government spending $G$ and $F$ (henceforth partial interest spending) could also be interpreted as state capture.[4] E is the expectation operator and $\rho$ the government's discount factor. Total government utility is additively separable in two senses: (i) with respect to periods; and (ii) with respect to utility derived either from private consumption or from partial interest provision.

The government (policymaker) may be of type $i$ or $k$. Political instability subsumes: (i) the probability of government change; and (ii) political polarization. After the first period the incumbent government may lose office to the other type of government with a fixed probability $\pi$; it stays in power with probability $(1-\pi)$.[5] Political polarization captures the two governments' differences in partial interest preferences. Each of the two types of governments cares for both partial interest groups, but to differing degrees which is determined by exogenous parameter $\alpha$. Government $i$'s partial interest utility function $H^i$ for $F$ and $G$ is specified as follows:

$$H^i(G,F) = \frac{1}{\alpha(1-\alpha)} \min\{\alpha G,(1-\alpha)F\}. \tag{2}$$

The utility function is of a Leontief type, with normalization $\frac{1}{\alpha(1-\alpha)}$. $H^k$ is symmetrical, that is, $\alpha$ must be replaced by $(1-\alpha)$). Without limiting the general validity of the analysis, it is assumed that $1 > \alpha \geq \frac{1}{2}$. When $\alpha$ equals a half, the two types of government have identical preferences; the more distant it is from a half, the more they disagree on how much to spend on each of the two partial

interest groups. If preferences of both government types are very dissimilar, political polarization is large. However, there is no political instability, if the government stays in power with certainty ($\pi$ equals zero). Similarly, with no polarization ($\alpha$ equals a half), a government change cannot produce any instability either. Technically, how political polarization and political uncertainty affect political instability is shown in equation 7 further down.

In order to capture the potential current period trade-offs between seigniorage $S$, deficit $D$ and investment $I$ as parsimoniously as possible, the government budget constraints for both model periods (1 and 2) are specified as follows:

$$G_1 + F_1 + I \leq \tau \bar{Y} + S + D.$$
$$G_2 + F_2 + (1+r)D \leq \tau Y(I). \tag{3}$$

$G$ and $F$ refer to the government's partial interest spending, $Y$ is income, and $\tau$ is the tax rate. Government revenue in period 1 can be increased directly by raising seigniorage $S$ and/or by obtaining IMF credits $D$. Seigniorage $S$ is modelled as a (first) government instrument, because central banks are not truly independent in most developing countries.[6] IMF debt $D$ can be obtained in the current period, but must be repaid with interest at exogenous rate $r$ in the next period. The amount of available debt is not constrained by its price; instead, there is a debt ceiling (see Equation 5). Tax revenues in both periods are calculated from exogenous tax rate $\tau$ and income as tax base. First period income $\bar{Y}$ is exogenous (an endowment); second period income $Y$ is a function of investment $I$ which is made in the previous period. Investment $I$ is the second government instrument (besides seigniorage $S$). It can be interpreted as standard infrastructure investment, but also as investment in structural, property rights or anti-corruption measures leading to more efficiency and hence higher private sector production and income levels. Similar to Aghion and Bolton (1990), taxation is a fixed-rate, non-distortionary, proportional income tax. Endogenizing the tax rate would give the government another instrument, but the interpretation would run parallel to the one for seigniorage.[7]

Government expenditure consists of two kinds: investment I; and consumptive (partial interest) spending $F$ and $G$.[8] In most of the aforementioned similar models, government consumption is interpreted as expenditures for public goods. In this model, $F$ and $G$ are funds diverted from the government budget to two different groups, possibly some clientele of the two types of government (as suggested by note 4). The common feature of partial interest spending $F$ and $G$ is that they do not enter the private sector budget constraint. Partial interest groups are passive, that is, do not optimize or interfere with the government in any way. As in the real world, it is assumed that a large proportion of these funds are transferred to foreign bank accounts (see note 13).

The private sector budget constraints for both periods are given by:

$$C_1 \leq (1-\tau)\bar{Y} - S - \gamma(S).$$
$$C_2 \leq (1-\tau)Y(I). \tag{4}$$

Real private consumption depends on real income net of all taxes (including seigniorage taxation in period 1). As already mentioned, income taxation is assumed to be non-distortionary, but seigniorage carries a rising and convex deadweight loss $\gamma(S)$ in period 1 ($\gamma(0) = 0$; $\gamma' > 0$; $\gamma'' > 0$).[9] This assumption ensures that the optimal level of seigniorage is limited.[10] The model could be interpreted in per capita terms, but the private sector is passive (as, for instance, in Cukierman et al., 1992) in the sense that it cannot take optimizing decisions on labour, savings or investment. Thus the two private sector budget constraints are not linked intertemporally. Private sector budget constraints (4) and public sector budget constraints (3) hold with equality, because it will be optimal to use up all revenues to increase utility (1).

Consider next the country's ability to expand expenditures by using deficit-finance. If private creditors, domestic and international, have lost trust in the country's capability or willingness to honour its debt obligations, often the only recourse are international financial institutions like the International Monetary Fund (IMF).[11] This means that deficit is quantity constrained (with a fixed interest rate $r$), typically with some conditionality attached. Assuming (additively separable) linear relationships as the simplest possible debt conditionality criteria, the debt ceiling is specified in terms of repayment obligations:

$$(1+r)D \leq Z^0 - sS - dD + iI + \eta(F_1 + G_1) \text{ with } d, s, > 0 \text{ and } \eta < 0. \tag{5}$$

$Z^0$ represents the initial willingness of international financial institutions, say the IMF, to support a country, the other terms capture conditionalities that reduce or increase that willingness. Conditionality $s > 0$ on real seigniorage $S$ represents the IMF's monetary stability performance criterion.[12] If the government chooses to increase seigniorage, the IMF will reduce its support—as discussed at the end of Section 2. Similarly, for expanding its deficit. As for the IMF's deficit reduction criterion, conditionality $d > 0$ on deficit $D$ relates to the deficit-to-GDP ratio (because deficit and the deficit-to-GDP ratio are proportional because $Y$ (GDP/income) is exogenously given in the model). Conditionality $i > 0$ captures both the economic and the institutional infrastructure performance criteria. More investment $I$ has a positive effect on IMF support. Parameter $\eta < 0$ referring to partial interest spending $F$ and $G$ could be interpreted as additional conditionality on good governance. It could, for instance, be seen as the penalization of state capture.

Debt ceiling (5) is delimited in two respects. First, it is a binding constraint because political instability causes myopia, which also implies that current expenditures are always preferred to future expenditures. The formal argument is based on the unit marginal utility property of partial interest utility function H (see Section A1 in the Appendix). Any increase in deficit raises utility by one unit this period, but costs less in terms of foregone discounted utility next period, namely only $(1+r)\rho\beta < 1$, where (i) $\beta \leq 1$ is the composite political instability measure depicted in Equation 7 further down; and (ii) the discount factor applied by the IMF ($\frac{1}{1+r}$) which is larger than the government's discount factor ($\rho$). (It is often assumed that $\frac{1}{1+r} = \rho$ under market conditions, but it is common practice by the IMF to offer loans at an interest rate that is actually below the market interest rate.) Second, default is not an issue here because (i) the government cannot expand its credit line beyond the limits set by the IMF; and (ii) default on IMF credits does almost never occur (Rogoff, 2002; Schadler, 2014).[13]

The model can now be solved. The incumbent government (assumed to be government $i$) maximizes its utility (1) subject to the government budget constraints (3), the private sector budget constraints (4), and the deficit/debt constraint (5). We focus on the government's choice for its two instruments, seigniorage $S$ and investment $I$, and how this affects the credit line $D$ extended to the government by international financial institutions. Albeit not the focus of this paper, the incumbent government also determines implicitly the total amount of partial interest spending in periods 1 and 2 according to partial interest utility (2). It is shown in Section A1 of the Appendix that both governments choose the same overall level of $X = F + G$, but different compositions. Government $k$'s optimal choice of the relative share of $F$ and $G$ is suboptimal for government $i$: $X^i = H^i(G^i, F^i) > H^i(G^k, F^k) = \frac{1-\alpha}{\alpha}X^i$.

The current period incumbent government chooses the amount of partial interest spending in period 1, but it may only take decisions in the next period, if it stays in power (otherwise the opposing government gets to choose). Utility function (1) becomes, therefore:

$$\begin{aligned} W &= V(C_1) + X_1 &+& \rho\left[(1-\pi)(V(C_2) + X_2) &+& \pi\left(V(C_2) + \frac{1-\alpha}{\alpha}X_2\right)\right] \\ &= V(C_1) + X_1 &+& \rho\left[V(C_2) + \beta(\alpha,\pi)X_2\right]. \end{aligned} \tag{6}$$

Formally, polarization $\alpha$ and political uncertainty $\pi$ are subsumed by composite political instability measure $\beta$ as follows :

$$0 < \beta(\alpha,\pi) = (1-\pi) + \pi\frac{1-\alpha}{\alpha} \leq 1. \tag{7}$$

$\beta(\alpha, \pi) = 1$, if both governments have identical preferences ($\alpha = \frac{1}{2}$) or if the government stays in power with certainty ($\pi = 0$). $\beta$ decreases with more political diversity (polarization $\alpha \uparrow$) and/or more political uncertainty (probability of government change $\pi \uparrow$). Then, political instability $\beta$ lowers the valuation of partial interest spending in period 2 and augments the effect of government discount factor $\rho$.

The government's decision problem can now be simplified and specified on the basis of utility function (6). See Section A2 of the Appendix. The problem exhibits several intertemporal links. First, higher investment increases private sector income as well as tax revenues in the following period. Second, increased investment relaxes the debt constraint, but augmented seigniorage and/or raised partial interest spending (as well as increased deficit) in period 1 tightens it. Third, increased deficit facilitates higher partial interest spending this period and/or higher investment (the latter leading to higher income and tax revenues next period), but results in higher repayment obligations next period. Fourth, higher seigniorage can also be used for higher partial interest spending and/or investment (the latter leading, again, to an increase in income and tax proceeds). Essentially, the government budget constraint exhibits a trade-off between the intertemporal effects of investment or partial interest spending financed by seigniorage vs. deficit.

The first order conditions (FOCs) with respect to the policy variables $S$ and $I$ clarify those linkages:

$$V_1'(c_1)(1+\gamma'(S)) = \frac{l-(1-\rho\beta(1+r))s-\rho\beta(1+r)\eta}{l-\eta} \tag{8}$$

$$\rho V_2'(c_2)((1-\tau)Y'(I)) + \rho\beta\tau Y'(I) = \frac{l-(1-\rho\beta(1+r))i-\rho\beta(1+r)\eta}{l-\eta} \tag{9}$$

where $l=1+r+d$.

Note, first of all, that the right-hand side of both equations would become unity, if there were no political instability ($\beta = 1$) and the IMF discount factor corresponded to the government's discount factor ($\frac{1}{1+r} = \rho$)–contrary to our assumptions made two paragraphs below Equation 5. Then the interpretation would be surprisingly simple—as outlined in Section A3 of the Appendix. The standard case is characterized by $\beta < 1$ and/or $\frac{1}{1+r} > \rho$ as well as $\eta < 0$, $d > 0$, $s > 0$, and $i > 0$. The right-hand sides of Equations 8 and 9 become smaller than unity, which implies (as a result of the curvatures of all functions involved) that, unambiguously, seigniorage has to be lower and that investment may be higher compared with the aforementioned special conditions case. This suggests (and is confirmed in Proposition 1) that political instability ($\beta < 1$) and/or preferential credit conditions ($\frac{1}{1+r} > \rho$) make IMF debt so attractive that it will be used up to the maximum allowed by the debt constraint (see also the argument made two paragraphs below Equation 5). Debt will now be used as a strategic tool to finance intertemporal shifts in consumption, which can be done in two ways: (i) by reducing seigniorage; and (ii) by raising investment. When the government is more myopic owing to $\beta < 1$ and/or $\frac{1}{1+r} > \rho$, the government chooses a lower level of seigniorage in order to raise the debt ceiling so that partial interest consumption can be increased in period 1. The reduction of seigniorage also allows the increase in private sector consumption.

The FOCs are not just necessary, but also sufficient conditions; the concavity properties of the optimization problem were scrutinized by checking the matrix of second derivatives (the Hessian) for semi-definiteness (see Section A3 of the Appendix). The FOCs help to understand the mechanisms of the model and provide some prima facie understanding of effects, but they do not capture any feedback effects. Therefore, the Implicit Function Theorem is applied to analyze perturbation results around the equilibrium with respect to the most relevant exogenous variables (see Section A4 of the Appendix). The probability of government change $\pi$ and political polarization $\alpha$ are represented by political instability parameter $\beta$ which was introduced in Equation 7. Parameters $d$, $s$, and $i$ indicate debt conditionality with respect to deficit, seigniorage, and public investment, respectively. The results are presented in Proposition 1, Lemma 1 and Corollary 1 and discussed in the next section.

## 4 | DISCUSSION

As stated before, exogenous political instability takes two forms: political polarization and/or uncertainty about the future government. An increase in polarization means that policy choices of the other government, if in power in the second period, produce more undesirable results. A higher chance of government change means that it is less likely that policy choices that are optimal for the current government will be implemented in the future. In both cases, this causes the government to value the present more highly than an uncertain and undesirable future. This is the basis for the result of myopic government behaviour in the literature, which is confirmed, in principle, in the following proposition:

**Proposition 1** *(Political Instability). At the equilibrium, an increase in political instability (lower $\beta$) leads to a lower level of seigniorage (unless there is no conditionality on seigniorage (s) or good governance ($\eta$)) and may lead to a lower level of investment:*

(i) $\frac{dS}{d\beta} \geq 0$          (ii) $\frac{dS}{d\beta} = 0$   if $s = \eta = 0$

(iii) $\frac{dI}{d\beta} > 0$   if $i - \eta < \tau Y'(I)$.

**Proof:** See Section A4 in the Appendix.

Intuitively, result (i) can be explained as follows. Keep political instability initially unchanged. With debt conditionality based on seigniorage the debt ceiling could be raised above its optimal level, if the government were prepared to reduce seigniorage. Obviously, the government would not want to go beyond the optimal level. However, an increase in political instability leads to a lower valuation of debt repayment obligations. Thus the government desires a higher level of IMF debt which requires a reduction of seigniorage. Put together, the government does actually act myopically, but instead of raising revenues through seigniorage as in Cukierman et al. (1992), it reduces seigniorage in order to increase its IMF debt and, thereby, raises first period spending power. This trade-off effect is possible because the model is richer in the sense of having two alternative sources of revenue, IMF debt and seigniorage. Since debt is more attractive to a myopic government (because repayment costs are valued less), seigniorage can be reduced. When there is debt conditionality with respect to seigniorage ($s > 0$), the optimal level of seigniorage will have to be reduced. However, result (ii) says that when there is no debt conditionality with respect to seigniorage ($s = 0$) or good governance ($-\eta$, remembering that $\eta < 0$), seigniorage is not affected. Nonetheless, increased myopia will still prompt the

government to adjust its other policies with attached conditionality (for instance, on partial interest spending and/or investment) so that the IMF is willing to extend its credit line.

As for result (iii), additional political instability reduces investment, if the (marginal) tax revenue effect of increased investment in period 2 surpasses the (marginal) debt repayment effect, that is, the net marginal effect increased investment has on the expansion of the debt constraint, either directly through increased investment (conditionality $i$) or indirectly through a reduction of public consumption (conditionality $-\eta$), that is, $i-\eta < \tau Y'(I)$. In essence, this means that first period investment must raise net revenues in the second period. As increased political stability (higher $\beta$) raises the relative value of second period spending, it is clear that investment will increase in order to augment net revenues in the second period. There are weaker sufficient conditions, but for sufficiently small absolute values of $i$ and $\eta$, it is already guaranteed that more political instability leads to lower investment. Obviously, with $i = \eta = 0$ increased political instability will always lead to lower investment.

**Lemma 1** (*Debt Conditionalities*). *At the equilibrium, raising the debt conditionalities is effective:*

(i) $\frac{dS}{dd} > 0$          (ii) $\frac{dI}{dd} < 0$;

(iii) $\frac{dS}{ds} < 0$          (iv) $\frac{dI}{ds} = 0$;

(v) $\frac{dS}{di} = 0$          (vi) $\frac{dI}{di} > 0$.

**Proof:** See Section A4 in the Appendix.

Debt conditionalities are effective, but the mechanisms differ. Stricter debt conditionalities based on seigniorage (monetary stability) or deficit (fiscal stability) tighten the debt constraint. Higher punishment implies a lower debt ceiling. In the first instance, first period revenue becomes suboptimally low. How does an optimizing government adjust? In case the IMF shifts its focus more in the direction of deficit reduction (results (i) and (ii)), the government will switch from deficit to the less painful source of revenue, seigniorage, accepting that more seigniorage reduces the amount of credit the IMF is willing to provide. In addition, consumptive spending and investment will be reduced.[14] If monetary stability becomes more important for the IMF (results (iii) and (iv)), the government reduces seigniorage in order to limit the reduction of available debt. Investment is not affected. In both cases of debt conditionality, the government shifts away from the revenue source that is punished more harshly by the IMF. In the case of debt conditionality based on seigniorage, the government additionally uses the reduction of seigniorage to try to obtain as much deficit as possible. In both cases (results (i) to (iv)) there is a clear trade-off between achieving deficit reduction and attaining low inflation. Indiscriminate IMF policies used in the past requiring debtor countries to focus on both monetary and fiscal stability appear questionable. Taken together, these results lend theoretical support to the more holistic approach to conditionality now employed by the IMF.

Debt conditionality based on investment: if the IMF chooses to expand the debt ceiling by raising the reward for investment, it is clear that the government wants to make use of it by increasing investment. In the new optimum, the government should be better off in both periods. In period 2, it gains from increased private sector income and higher tax receipts, which must outweigh the increase in repayment burden owing to the higher deficit. In period 1, the deficit has gone up, but also investment. Interestingly, the optimal level of seigniorage is not affected.[15]

Let us now turn to Corollary 1 which combines findings from Proposition 1 and Lemma 1. It has been established that the IMF can positively affect monetary stability by applying debt conditionality based on seigniorage. Does a change in political stability affect this outcome? In Bohn (2006), it is claimed that very high political instability turns IMF conditionality based on monetary stability virtually ineffective, that is, it does not prompt the government to reduce seigniorage. The argument there is based on the assumption of ex ante conditionality which means that monetary stability must be shown ex ante, that is, in the previous period, before the IMF will extend its credit line. We know that more political instability always implies a relatively higher valuation of the current period. A rational government will, therefore, become less impressed with debt conditionality that only affects the future. It will prefer to increase present period revenue by raising its seigniorage tax instead of fulfilling conditions (low level of seigniorage) required for obtaining IMF debt in the future. In contrast to that model, here, we obtain the opposite result for the impact of political instability on effects caused by debt conditionality based on monetary stability. The difference is due to the fact that IMF debt is modelled more explicitly and conditionality is contemporaneous; IMF debt and seigniorage are alternative sources of first period government revenue; and there is an explicit debt repayment obligation in period 2. The result is summarized in

**Corollary 1** (*Debt conditionalities under increased political instability*). *Debt conditionality based on monetary stability is even more effective under increased political instability.*

**Proof:** See Section A4 in the Appendix.

This (unambiguous) result appears counterintuitive at first glance; debt conditionality based on monetary stability considerations is particularly effective in heterogeneous societies with unstable governments. Here is the intuition. First, consider higher debt conditionality based on monetary stability without changing political instability. As already discussed, seigniorage will be lowered to avoid that the debt ceiling is reduced too much. If there is also a higher level of political instability (i.e., the valuation of the second period is reduced), the government is less concerned with debt repayment in period 2. Thus the government can afford a higher level of IMF debt (and debt repayment) and will, therefore, reduce seigniorage by even more (in order to be granted a higher debt ceiling as a reward for increased monetary stability) compared with a situation with less political instability. Therefore, this reverses Bohn's (2006) finding that IMF conditionality based on seigniorage turns ineffective in politically highly unstable societies. In that model, there is ex ante conditionality, which means that increasing seigniorage does not have any immediate consequences as it does here. In Bohn (2006) the IMF "punishes" by reducing the amount of future credits, which is of little significance for a myopic government.

## 5 | CONCLUSION

Based on empirical evidence this paper raises two questions that have, in my view, not received enough attention since the publication in the early 1990s of the aforementioned papers by Cukierman et al. (1992), Edwards and Tabellini (1991) and Roubini (1991). The first question is on the relationship between seigniorage and inflation on the one hand and deficit and debt on the other hand when a country is faced with political uncertainty and/or polarization. This paper has summarized the empirical findings, but most of them are based on 25-year-old cross-country studies and country comparisons. Hopefully this paper can ignite a renewed discussion.

The second question is why the positive correlation between monetary and fiscal stability indicators vanishes and sometimes even turns into a negative correlation when the country has lost access to international credit markets and international financial institutions like the IMF step in. Empirical studies have, again, been summarized, but also extended. It seems that effects are washed out in cross-country or panel studies because of "very wide differences in behavior" across countries. However, country-specific correlation tables suggest that there is either no correlation or a negative one. With respect to the correlation between monetary and fiscal variables, this paper goes a step further; it offers one possible explanation, IMF conditionality. If there is explicit conditionality placed on monetary stability (as can be found in agreements between individual countries and the IMF), a rational government may actually reduce inflation in order to receive more IMF support—hence a negative correlation. Even without monetary conditionality a country can obtain sufficient IMF credit, if it plays along with other IMF requirements. Hence no correlation.

The results are obtained in a parsimonious political public finance model. Despite its simplicity, it should, however, be noted that the results are robust in several respects. The same qualitative results are obtained for a number of model variants, for instance, for the inclusion of variable income taxes, for the inclusion of a second period deadweight loss of first period seigniorage, or for the inclusion of second period seigniorage. The potential trade-off between seigniorage and IMF credit persists.

Overall, this paper sheds new light on the link between seigniorage finance and deficit finance when a country is politically unstable. In particular, it suggests a potential negative correlation. It emphasizes, therefore, the need for further empirical work and/or case studies, thereby supplementing earlier work by Cukierman et al. (1992), Edwards and Tabellini (1991), Roubini (1991), Teunisse (2014a, 2014b) and others. New research should incorporate the specific conditions faced by individual countries—do they have access to international credit markets or do they have to rely on IMF loans? This paper cannot be more than a first step in answering the aforementioned questions on the concurrence or trade-off between monetary and fiscal stability under political instability.

## ENDNOTES

[1] The data is retrieved from World Bank (2015b, inflation data), Cruces and Trebesch (2013, market access data), and Fløgstad and Nordtveit (2013, IMF credits). Similar stories could be told, for instance, for the Dominican Republic in 2005, Uruguay in 2005, Moldava in 2000, or Honduras in 1999 and 2004. (All examples refer to cases prior to the overhaul of the IMF's lending framework in the second half of the 2000s.) However, Gelos, Sahay, and Sandleris (2011) find, for a panel of countries, "that, if anything, there is complementarity between official and private flows" and that there is not such a clear link between default and market access.

[2]Partly under internal pressure, President Yeltsin kept on replacing, alternately, representatives of the nomenclature (Chernomyrdin, Primakov, Putin) and so-called reformist Prime Ministers (Kiriyenko, Stepashin) in seemingly arbitrary and irregular intervals.

[3]IMF conditionality used to refer to a range of specific quantitative "performance criteria (e.g., fiscal deficit to GDP ratio, growth of money supply, etc.)" (Ray, 1998). With the overhaul of its lending framework the IMF approach is now more holistic and forward-looking, but still based on similar performance criteria (IMF, 2009a, 2009b, 2013, 2014).

[4]State capture is a problem in many developing countries where (i) different ethnic and political groups, especially in Africa, compete for power as, for instance, in Kenya (Shikwati, 2012; see also note 5); or (ii) members of the ruling classes (or near government institutions or firms) surrounding a long-time leader try to cut out a share of the pie (so-called oligarchs in Russia; rivaling clans in Zaïre under Mobutu; various segments of the Suharto family in Indonesia).

[5]Technically, this random change of government at fixed intervals is referred to as Markov switching (or Markov chain). If several time periods were considered and their lengths were fixed, for instance, at 6 months, some governments would only be in power for half a year, fewer would last for a year, and fewer yet for any longer period of time. This is a simple way of describing political uncertainty, but it matches the situation in many developing countries. In Kenya, for instance, the power shifted from the PNU (Kibaki) in 2008 to the OMD (Odinga, although Kibaki remained president) and then back to an organization allied with the PNU (TNA, Kenyatta). See also note 2 on Russia.

[6]Including second period seigniorage (as done in a draft version of this paper) obscures the insight of the model, because (i) an additional variable is floating around without changing the qualitative results, and (ii) it requires (unnecessarily and artificially) to consider time inconsistency (because of the finite horizon set-up).

[7]Cukierman et al. (1992) explicitly considered tax revenues (not the tax rate though) as well as seigniorage revenues as government instruments. Acknowledging the associated deadweight losses, $\gamma$ for seigniorage and $\delta$ for taxation (and ignoring tax inefficiencies considered by them), an additional first order condition is obtained, namely that the marginal costs of either instrument must be the same at the equilibrium, that is, $1+\gamma' = 1+\delta'$.

[8]By including government consumption on two types of partial interest spending, we capture the effect of political polarization as one component of political instability. See Equation 7. Investment is included because it provides an alternative intertemporal link besides IMF debt; investment allows to transfer funds to the second period; IMF debt does the opposite.

[9]As a critique of this paper as well as Cukierman et al. (1992), an argument could be made that seigniorage imposes a deadweight loss in both periods. However, the qualitative results are not changed and the tradeoff between seigniorage and deficit discussed further down is not fundamentally affected, as long as the deadweight loss in the next period is small relative to the debt repayment costs. This is likely to be so because—compared with the model without second period deadweight loss—the additional (second period) costs for seigniorage reduce the optimal amount of seigniorage. Since $\gamma$ is convex, the second period deadweight loss is likely to play a limited role. Nonetheless, under specific parameter constellations other results would be conceivable.

[10]This captures an implication of early studies of hyperinflations. Cagan (1956) showed empirically that seigniorage revenue actually decreases beyond some rate of money supply growth. Later, Sargent (1977) and Christiano (1987), for instance, confirmed this result.

[11]Notwithstanding the key role of the IMF, China has helped out, since the 2000s, with credits to many African countries, but also, for instance, to Ecuador, which received U.S.$11 billion after its 2008 default.

[12]Technically, the official IMF performance criterion money supply growth $\hat{M}$ and seigniorage are linked as follows: $S \equiv \frac{\dot{M}}{P} = \frac{\dot{M}}{M} \frac{M}{P} = \hat{M} * \frac{Y}{V}$, where $\dot{M}$ is the change in money and the quantity equation of money $M*V = Y*P$ is being used (with $V$ and $P$ depicting velocity and prices, respectively). There is proportionality between seigniorage and money growth for exogenously given income (as assumed for the first period) and given velocity.

[13]In 2003, Argentina toyed with the idea of default vis-à-vis the IMF, but was finally dissuaded from doing so. Nonetheless, the model could be interpreted in an alternative way to account for the possibility of default: (i) $F$ and $G$ are government funds (state capture) deposited on Swiss bank accounts; and (ii) part of them can be used as collateral, thereby relating the deficit ceiling to collateralized funds ($Z^0 = 0$ and $\eta > 0$ in Equation 5). To account for debt repudiation (under political uncertainty), the idea of seizing foreign assets is also used in Alesina and Tabellini (1989), whose core model is—just like here—based on a fixed amount of debt and no default. Default is studied more explicitly by, for instance, Cuadra and Sapriza (2008), Sandleris (2008), and Yue (2010).

[14]Alesina and Tabellini (1989) and Bohn (2007) showed that political instability reduces private and public investment, respectively. Here, conditionality reinforces the already negative effect of political instability on public investment.

[15]This changes when we include a second period deadweight loss of first period seigniorage.

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# APPENDIX

## A1 PARTIAL INTEREST SPENDING

Utility function $H$ for government $i$:

$$H^i(G^i, F^i) = \frac{1}{\alpha(1-\alpha)} \min\{\alpha G^i, (1-\alpha)F^i\}. \tag{A.1}$$

Since (A1) contains a minimum function, optimality can only be achieved for

$$(1-a)F^i = \alpha G^i. \tag{A.2}$$

Since utility function $H$ for government $k$ is symmetrical the optimal distribution between $F^k$ and $G^k$ is $(1-\alpha)G^k = \alpha F^k$.

Government $i$'s optimal total partial interest spending $X^i$ can be written as

$$X^i \equiv F^i + G^i = \frac{G^i}{1-\alpha} = \frac{F^i}{\alpha}. \tag{A.3}$$

By reinserting in utility function (A1) the optimal values for $F$ and $G$ in terms of $X$ ($G^i = (1-\alpha)X^i$, $F^i = \alpha X^i$) a simple result for total partial interest utility $H$ is obtained:

$$\begin{aligned} H^i(F^i, G^i) &= \frac{1}{\alpha(1-\alpha)} \min[\alpha(1-\alpha)X^i, (1-\alpha)\alpha X^i] \\ &= X^i = F^i + G^i. \end{aligned} \tag{A.4}$$

Note that optimal partial interest utility $H$ is the sum of its arguments owing to the normalization factor $\frac{1}{\alpha(1-\alpha)}$ in Equation A1; hence marginal utility of total partial interest spending $X$ is unity. The relative share of $F$ and $G$ in each period, however, depends on polarization parameter $\alpha$. Given that utility function (A1) is symmetrical for both types of government, the optimal values for $F$ and $G$ are crosswise identical ($F^i = G^k$ and $G^i = F^k$) and

$$H^i(F^i, G^i) = G^i + F^i \equiv X^i = X = X^k \equiv G^k + F^k = H^k(F^k, G^k). \tag{A.5}$$

## A2 THE GOVERNMENT MAXIMISATION PROBLEM

Combining Equations 3 to 6 the government maximization problem with binding constraints reduces to

$$\max_{S,I} W = V_1(C_1) + (G_1 + F_1) + \rho\left\{ V_2(C_2) + \beta(G_2 + F_2) \right\}$$

$s.t.$ (i) $G_1 + F_1 + I = \tau \bar{Y} + S + D$

(ii) $G_2 + F_2 + (1+r)D = \tau Y(I)$

(iii) $(1+r)D = Z^0 - dD - sS + iI + \eta(F_1 + G_1)$

(iv) $C_1 = (1-\tau)\bar{Y} - S - \gamma(S)$

(v) $C_2 = (1-\tau)Y(I).$

The two government budget constraints (i) and (ii) and the debt/deficit constraint (iii) are combined to obtain two modified government budget constraints solved for $X_1$ and $X_2$, respectively. These two modified government budget constraints and the two private sector budget constraints (iv) and (v) can then be substituted into objective function (A6).

## A2.1 Consolidating constraints

(iii) leads to (iii)$^*$:

$$D = \frac{Z^0}{e} - \frac{s}{e}S + \frac{i}{e}I + \frac{\eta}{e}(F_1 + G_1)$$

also: $\quad eD = Z^0 - sS + iI + \eta(F_1 + G_1)$

with $e = 1 + r + d$.

Insert (iii)$^*$ into (i) to obtain (i)$^*$:

$$G_1 + F_1 + I = \tau\bar{Y} + S + \frac{Z^0}{e} - \frac{s}{e}S + \frac{i}{e}I + \frac{\eta}{e}(F_1 + G_1)$$

$$(G_1 + F_1)\underbrace{\left(1 - \frac{\eta}{1+r+d}\right)}_{\frac{1+r+d-\eta}{1+r+d}} = -I\underbrace{\left(1 - \frac{i}{1+r+d}\right)}_{\frac{1+r+d-i}{1+r+d}} + S\underbrace{\left(1 - \frac{s}{1+r+d}\right)}_{\frac{1+r+d-s}{1+r+d}} + \tau\bar{Y} + \frac{Z^0}{1+r+d}$$

$$F_1 + G_1 = -I\left(\frac{e-i}{e-\eta}\right) + S\left(\frac{e-s}{e-\eta}\right) + \tau\left(\frac{e}{e-\eta}\right)\bar{Y} + \left(\frac{1}{e-\eta}\right)Z^0.$$

Inserting (i)$^*$ into (iii)$^*$ results in (iii)$^{**}$:

$$eD = -I\left(\frac{e-i}{e-\eta}\right)\eta + S\left(\frac{e-s}{e-\eta}\right)\eta + \tau\left(\frac{e}{e-\eta}\right)\eta\bar{Y} + \left(\frac{1}{e-\eta}\right)\eta Z^0 - sS + iI$$

$$= -I\left(\frac{(e-i)\eta}{e-\eta} - i\right) + S\left(\frac{(e-s)\eta}{e-\eta} - s\right) + \tau\left(\frac{e}{e-\eta}\right)\eta\bar{Y} + \left(\frac{1}{e-\eta}\right)\eta Z^0$$

$$= -I\underbrace{\left(\frac{e\eta - i\eta - ie + i\eta}{e-\eta}\right)}_{\frac{e(\eta-i)}{e-\eta}} + S\underbrace{\left(\frac{e\eta - s\eta - es + s\eta}{e-\eta}\right)}_{\frac{e(\eta-s)}{e-\eta}} + \tau\left(\frac{e}{e-\eta}\right)\eta\bar{Y} + \left(\frac{1}{e-\eta}\right)\eta Z^0$$

$$= \frac{e}{e-\eta}\left[(\eta - s)S - (\eta - i)I + \tau\eta\bar{Y} + \left(\frac{\eta}{e}\right)Z^0\right]$$

$$D = \frac{1}{e-\eta}\left[(\eta - s)S - (\eta - i)I + \tau\eta\bar{Y} + \left(\frac{\eta}{e}\right)Z^0\right]$$

and (iii)$^{**}$ into (ii) results in (ii)$^*$:

$$G_2 + F_2 + (1+r)\left[\frac{1}{e-\eta}\left[(\eta - s)S - (\eta - i)I + \tau\eta\bar{Y} + \left(\frac{\eta}{e}\right)Z^0\right]\right] = \tau Y(I)$$

$$G_2 + F_2 = \frac{1+r}{e-\eta}\left[(\eta - i)I - (\eta - s)S - \tau\eta\bar{Y} - \left(\frac{\eta}{e}\right)Z^0\right] + \tau Y(I)$$

## A2.2 Rewriting the government maximization problem

$$W(S, I) = V_1\left[(1-\tau)\bar{Y} - S - \gamma(S)\right] + \rho V_2\left[(1-\tau)Y(I)\right]$$

$$-I\left(\frac{e-i}{e-\eta}\right) + S\left(\frac{e-s}{e-\eta}\right) + \tau\left(\frac{e}{e-\eta}\right)\bar{Y} + \left(\frac{1}{e-\eta}\right)Z^0$$

$$+ \rho\beta\left(\frac{1+r}{e-\eta}\left[(\eta - i)I - (\eta - s)S - \tau\eta\bar{Y} - \left(\frac{\eta}{e}\right)Z^0\right] + \tau*Y(I)\right)$$

$$W(S, I) = V_1\left[(1-\tau)\bar{Y} - S - \gamma(S)\right] + \rho V_2\left[(1-\tau)Y(I)\right]$$

$$+ \frac{1}{e-\eta}\Big(\left[-(e-i) + \rho\beta(1+r)(\eta - i)\right]I + \left[(e-s) - \rho\beta(1+r)(\eta - s)\right]S$$

$$+ \left[\tau - \rho\beta(1+r)\tau\eta\right]\bar{Y} + \left[1 - \rho\beta(1+r)\frac{\eta}{e}\right]Z^0\Big) + \rho\beta\tau Y(I).$$

## A3 FIRST AND SECOND ORDER CONDITIONS

### A3.1 First order conditions

$$W_S = V_1'(C_1)\left[-1-\gamma'(S)\right] + \frac{e-i}{e-\eta} - \rho\beta\frac{(1+r)(\eta-s)}{e-\eta} = 0$$
$$W_I = \rho V_2'(C_2)\left[(1-\tau)Y'(I)\right] - \frac{e-i}{e-\eta} + \rho\beta\frac{(1+r)(\eta-i)}{e-\eta} + \rho\beta\tau\, Y'(I) = 0.$$

For special conditions $\beta = 1$ (no political instability) and $\frac{1}{1+r} = \rho$ (IMF discount factor corresponds to government discount factor) the interpretation would be surprisingly simple. Consider the first FOC first. At the equilibrium, the marginal effect of seigniorage on (period 1) private consumption utility (inclusive of its deadweight loss effect) corresponds to the marginal effect a revenue increase, here through seigniorage, has on (period 1) partial interest utility which equals 1—as outlined in the main text (in the paragraph before Euation 6). The second FOC says that the discounted marginal effect of investment on (period 2) private consumption utility as well as on (period 2) partial interest utility corresponds to the marginal effect investment has on (period 1) partial interest utility which equals 1. As for the first FOC, raising an additional unit of seigniorage represents a costly tax for the private sector, but it can be used for increasing partial interest spending by one unit. The reverse holds for investment; raising an additional unit can be done by decreasing partial interest spending by one unit (right hand of the second FOC); the benefit is increased output in period 2 which, in turn, increases both private sector and partial interest utilities.

With special conditions $\beta = 1$ and $\frac{1}{1+r} = \rho$, the FOCs collapse to those of a maximization problem either without the possibility of raising a deficit or with an exogenous debt (deficit) ceiling, determined, for instance, by exogenous initial IMF willingness $Z^0$ only. The optimal amounts of seigniorage and investment do not depend on the actual level of IMF debt, that is the debt constraint (5) becomes irrelevant. The reason is that the government is indifferent to deficit-financed smoothing of government (and private sector) consumption; debt conditionality parameters $\eta$, $d$, $s$, and $i$ cease to have any effect on the optimum. Note that the same FOCs could be obtained for $\beta < 1$ and/or $\frac{1}{1+r} > \rho$, if the debt conditionality parameters were set to zero. Again, we would obtain exogenous debt ceiling $Z^0$ with optimal seigniorage and investment that are independent of the debt constraint.

### A3.2 Second order conditions

$$W_{SS} = V_1''(C_1)\left(-1-\gamma'(S)\right)^2 + V_1'(C_1)\left(-\gamma''(S)\right) < 0$$
$$W_{SI} = 0$$
$$W_{IS} = 0$$
$$W_{II} = \rho*V_2''(C_1)*\left((1-\tau)Y'(I)\right)^2 + \rho*V_2'(C_1)*\left((1-\tau)Y''(I)\right) + \rho*\beta*\tau*Y''(I) < 0$$

### A3.3. Hessian $H$ and semi definiteness

$$\det H_1 = W_{SS} < 0$$
$$\det H = \det H_2 = W_{SS}*W_{II} - (W_{SI})^2 > 0$$

## A4 IMPLICIT FUNCTION THEOREM AND PROPOSITIONS

$$
\begin{pmatrix} \frac{dS}{d\beta} & \frac{dS}{dd} & \frac{dS}{ds} & \frac{dS}{di} \\ \\ \frac{dI}{d\beta} & \frac{dI}{dd} & \frac{dI}{ds} & \frac{dI}{di} \end{pmatrix} = H^{-1} \begin{pmatrix} \frac{\partial W_S}{\partial \beta} & \frac{\partial W_S}{\partial d} & \frac{\partial W_S}{\partial s} & \frac{\partial W_S}{\partial i} \\ \\ \frac{\partial W_I}{\partial \beta} & \frac{\partial W_I}{\partial d} & \frac{\partial W_I}{\partial s} & \frac{\partial W_I}{\partial i} \end{pmatrix}
$$

$$
H^{-1} = -\frac{1}{\det H} \cdot H^*
$$

$$
= -\underbrace{\frac{1}{\det H_2}}_{\substack{>0 \\ <0}} \cdot \begin{pmatrix} W_{II} & -W_{SI} \\ -W_{IS} & W_{SS} \end{pmatrix}
$$

$$
\frac{\partial W_S}{\partial \beta} = \frac{-\rho(1+r) \overbrace{(\eta-s)}^{<0 \text{ for } \eta<0}}{\underbrace{e-\eta}_{>0 \text{ for } \eta<0}} > 0 \text{ for } \eta < 0
$$

$$
\frac{\partial W_S}{\partial d} = \frac{\overbrace{[\rho\beta(1+r)-1]}^{<0} \overbrace{(\eta-s)}^{<0 \text{ for } \eta<0}}{\underbrace{(e-\eta)^2}_{>0 \text{ for } \eta<0}} > 0 \text{ for } \eta < 0
$$

$$
\frac{\partial W_S}{\partial s} = \frac{\overbrace{\rho\beta(1+r)-1}^{<0}}{\underbrace{e-\eta}_{>0 \text{ for } \eta<0}} < 0 \text{ for } \eta < 0
$$

$$
\frac{\partial W_S}{\partial i} = 0
$$

$$
\frac{\partial W_I}{\partial \beta} = \rho \underbrace{\frac{(1+r) \overbrace{(\eta-i)}^{<0 \text{ for } \eta<0}}{\underbrace{e-\eta}_{>0 \text{ for } \eta<0}}}_{<0 \text{ for } \eta<0} + \underbrace{\rho\tau Y\prime(I)}_{>0} \gtrless 0
$$

$$
\frac{\partial W_I}{\partial d} = \frac{\overbrace{[1-\rho\beta(1+r)]}^{>0} \cdot \overbrace{(\eta-i)}^{<0 \text{ for } \eta<0}}{\underbrace{(e-\eta)^2}_{>0 \text{ for } \eta<0}} < 0 \text{ for } \eta < 0
$$

$$
\frac{\partial W_S}{\partial s} = 0
$$

$$
\frac{\partial W_S}{\partial i} = \frac{\overbrace{[1-\rho\beta(1+r)]}^{>0}}{\underbrace{e-\eta}_{>0 \text{ for } \eta<0}} > 0 \text{ for } \eta < 0.
$$