The (In)stability of the International Monetary System without Direct Default Costs★

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Abstract

This letter considers a repeated version of the International Monetary System model of Farhi and Maggiori (2018) without a direct default cost. The Hegemon issues a safe asset but must respect a no-default condition that trades off the short-term benefit of default against the continuation value of not defaulting. It is optimal for the Hegemon to keep the issuance constant over time. However, the policy of constant issuance may be unstable. In particular, it is unstable if the Hegemon adopts a simple, short-sighted, heuristic rule that bases current issuance on the issuance of the previous period. If, however, the Hegemon uses a heuristic that is based on the demand for risky assets from the rest of the world, then the corresponding equilibrium is stable.

Keywords:
International Monetary System, Reserve Currency, Safe Assets, Triffen Dilemma, Instability
JEL: C61, F33, G15

1. Introduction

Farhi and Maggiori (2018) provide a model of the international monetary system in which a Hegemon monopolistically issues a safe asset, denominated in its reserve currency, to the rest of the world. The key insight is that the international monetary system can be fragile and unstable. In particular, there is a Triffen dilemma: issuance of the safe asset may collapse because of the temptation of the Hegemon to devalue its currency in a bad state. This insight is derived from a one-period model in which devaluation has a direct utility cost, such as a trade sanction.

Farhi and Maggiori (2018) explain that in a repeated model, the default cost might be interpreted as a reputation cost and present a formal analysis in their online appendix. That analysis has two main limitations. First, the analysis is restricted to a case where the quantity of safe assets the Hegemon can issue is fixed over time, and second, the issue of stability is not considered. The purpose of this letter is to address these limitations. In particular, it shows that the constancy of issuance is optimal. However, if the Hegemon adopts a simple, heuristic policy rule, the equilibrium outcome is unstable. In the concluding section, we discuss some of the assumptions of the model and suggest some further avenues for future research.

2. One-Period Model

This section presents the basic one-period model. There is a single, non-storable (numeraire) consumption good. There is a risky asset in infinite supply. There are two states, high and low, that occur with probability $(1-\lambda)$ and λ. The expected gross return on the risky asset is $\bar{R} = R_{\mathrm{L}} + (1-\lambda)\Delta > 1$ where R_{L} is the gross return in the low

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state, $R_H = R_L + \Delta > R_L$ is the gross return in the high state. The variance of the return is $\sigma^2 = \lambda(1-\lambda)\Delta^2$. There are two agents, a risk-neutral Hegemon that issues a safe asset with gross return S in the reserve currency, and the rest of the world (RoW) that has an initial endowment of w and buys a portfolio of safe and risky assets. RoW has mean-variance preferences and seeks to maximize $\mathbb{E}[C] - (\gamma/2)\operatorname{var}[C]$, where C is consumption at the end of the period. The Hegemon can use the proceeds of the sale of the safe asset for consumption at the start of the period or to buy the risky asset and consume at the end of the period. The Hegemon is indifferent between consumption at the start and the end of the period. That is, the Hegemon's discount factor is $\delta = 1/\bar{R}$.

With mean-variance preferences, the demand for the safe asset from the RoW is linear. Let $S(b)$ denote the gross return of the safe asset when the Hegemon issues an amount b. With the market for safe assets in equilibrium, $S(b) = \bar{R}(1-\gamma\kappa(w-b))$, where $\kappa = \sigma^2/\bar{R}$ is the coefficient of dispersion. To ensure $S(0) \geq 0$, it is assumed $\gamma\kappa w \leq 1$. Let $P(b) := bS(b)$ be the total amount paid by the Hegemon when it issues b safe assets. The function $P(b)$ is increasing and convex, with $P(0) = 0$ and $P'(b) = S(b) + bS'(b) = \bar{R}(1 - (\gamma\kappa(w-2b))$. Since the Hegemon is risk neutral and has a discount factor $\delta = 1/\bar{R}$, the net per-period benefit for the Hegemon is $f(b) := b\bar{R} - P(b)$, which is concave in b and $f(0) = f(w) = 0$. The Hegemon chooses the issuance b to maximize $f(b)$. The first-order condition, $P'(b) = \bar{R}$, satisfies the standard elasticity formula for a monopolist: $bS'(b) = \bar{R} - S(b)$. That is, the Hegemon recognizes that as the issuance is increased, the nominal return on the safe asset increases, reducing profits. Optimally, the Hegemon restricts the issuance of the safe asset below the competitive level. In particular, with $P'(b) = \bar{R}(1-\gamma\kappa(w-2b))$, the Hegemon's optimal issuance is $b = w/2$. This is below the competitive equilibrium outcome of $b = w$. For future reference, let $b^* = w/2$ be the Hegemon's optimal issuance with corresponding utility $v^* = f(b^*) = \bar{R}\gamma\kappa(w/2)^2$.

The Hegemon can reduce its payment on the safe asset by devaluing its currency if the low state occurs. In particular, it can choose a currency value $e \in \{e_L, 1\}$ at the end of the period, where $e_L = R_L/R_H$. If the Hegemon devalues the currency to $e_L < 1$, the real return on the safe asset is $S(b)e_L$. The benefit for the Hegemon from a devaluation is $P(b)(1-e_L)$. However, if the Hegemon devalues, it bears a direct default cost χ, proportional to the devaluation. Therefore, the Hegemon devalues in the low state if and only if:

$$\underbrace{P(b)(1-e_L)}_{\textit{Benefit of devaluation}} > \underbrace{\chi(1-e_L)}_{\textit{Cost of devaluation}} .$$

That is, the Hegemon devalues if and only if $P(b) > \chi$.

3. Repeated Model

The repeated model follows that set out in the supplementary appendix of Farhi and Maggiori (2018) with dates $t = 0, 1, 2, \ldots$. There is no direct default cost: $\chi = 0$. The risky asset has an outcome that is independently and identically distributed. The RoW is a sequence of one-period lived agents that invest when young (start of the period) and consume the returns when old (end of the period). In their appendix, Farhi and Maggiori (2018) assume issuance is constant. Here we relax that assumption. At date t, the Hegemon issues b_t one-period assets with a safe return $S(b_t)$ and can choose the exchange rate $e_t \in \{e_L, 1\}$ at the end of each period. The Hegemon discounts the payoffs at the end of the period as outlined in the baseline model.[2]

We look for an equilibrium with no devaluation. The Hegemon chooses a sequence of issuances $\{b_t\} := (b_t)_{t\in\mathbb{N}}$. Its corresponding per-period and expected discounted utilities are:

$$v_t = f(b_t) = b_t\bar{R} - P(b_t) \text{ and } V_t := \sum\nolimits_{\tau=0}^{\infty} \delta^\tau v_{t+\tau} = v_t + \delta V_{t+1}.$$

The Hegemon considers the decision on devaluation at the end of the period and only in the low state where it can choose $e_t \in \{e_L, 1\}$. If it chooses $e_t = 1$, then its end-of-period payoff is the return from the risky asset, $x_t R_L$, minus the amount paid out to the RoW on the safe asset it issued at the start of the period, $P(b_t)$, where x_t is the amount the Hegemon invested in the risky asset in period t (recall that the Hegemon is indifferent between consuming at the start or the end of the period). The future payoff, at the end of the period, is V_{t+1}. If the Hegemon chooses

[2] An earlier version of this paper considered a model where the Hegemon has quasi-hyperbolic preferences (of the type considered, for example, by Laibson, 1997).

$e_t = e_L$, then it receives its payoff $x_t R_\mathrm{L}$ from the risky investment, but the payment on the safe asset is reduced to $P(b_t)e_L$. However, if $e_t = e_L$, the risky asset and the safe asset are perfect substitutes, and we assume that the demand for the safe asset decreases to zero from the next period onward. Hence, the Hegemon will choose $e_t = 1$ when $x_t R_\mathrm{L} - P(b_t) + \delta V_{t+1} \geq x_t R_\mathrm{L} - P(b_t)e_L$. That is, any equilibrium with no devaluation must satisfy the inequality:

$$\delta V_{t+1} \geq P(b_t)(1 - e_L). \tag{ND}$$

We will refer to this as the no-default condition.

4. Results

This section considers the implications of the no-default condition (ND) for the Hegemon's choice of $\{b_t\}$. Lemma 1 describes the parameter values such that $b_t = b^*$ for all t satisfies condition (ND). Lemma 2 discusses the properties of the difference equation $b_{t+1} - b_t$ that satisfies condition (ND) with equality. Proposition 1 summarizes the implications of these results.

Lemma 1. *The no-default constraint* (ND) *is satisfied for $b_t = b^*$ $\forall t \in \mathbb{N}$ when parameters w, γ, κ, e_L and $\bar{R}$ satisfy:*

$$w \geq \hat{w} := \left(\frac{2}{\gamma\kappa}\right)\left(1 - \frac{1}{e_L + \bar{R}(1 - e_L)}\right).$$

Proof. With $b^* = w/2$ and $V^* := v^*/(1 - \delta) = \bar{R}v^*/(\bar{R} - 1)$, it follows that $\delta V^* \geq P(b^*)(1 - e_L)$ when $w \geq \hat{w}$.

From now on, assume $w < \hat{w}$, so that the first-best issuance b^* violates the no-default condition. In this case, condition (ND) holds with equality and

$$\delta V_{t+1} = P(b_t)(1 - e_L) = V_t - v_t = V_t - f(b_t) = V_t - \left(\bar{R}b_t - P(b_t)\right).$$

Therefore, it follows that $V_t = \bar{R}b_t - e_L P(b_t)$. Since $P(b) = bS(b)$ and $S(b) = \bar{R}(1 - \gamma\kappa(w - b))$, this can be written as $V_t = F(b_t)$ where

$$F(b) := \bar{R}b - e_L P(b) = \bar{R}b\left(1 - e_L + e_L\gamma\kappa(w - b)\right).$$

The function $F(b)$ is concave with $F(0) = 0$. It is increasing in b for $b < \tilde{b}$ where $\tilde{b} > b^*$. Let $\tilde{V} := F(\tilde{b})$.[3] The inverse function $F^{-1}(V)$ is defined on $[0, \tilde{V}]$ and is increasing and convex with $F^{-1}(0) = 0$. Then, since $\delta = 1/\bar{R}$, if condition (ND) holds with equality, it follows that $b_{t+1} = G(b_t)$ where:

$$G(b) := F^{-1}\left(\bar{R}P(b)(1 - e_L)\right).$$

Since both $P(b)$ and $F^{-1}(V)$ are increasing and convex, and $F^{-1}(0) = 0$ and $P(0) = 0$, it follows that $G(b)$ is increasing and convex, and $G(0) = 0$. The corresponding difference equation $D_G(b) = G(b) - b$, where $D_G\colon [0, \tilde{b}] \to \mathbb{R}$, is convex.[4] It has two roots $b_{[1,2]}$, with $b_{[1]} = 0$. If $w \geq \hat{w}$, then by Lemma 1, there is a positive root $b_{[2]} \geq b^*$. If $w \leq \hat{w}/2$, then $b_{[2]} = 0$. The next lemma considers the case where $w \in (\hat{w}/2, \hat{w}]$.

Lemma 2. *If $w \in (\hat{w}/2, \hat{w}]$, then there is a unique positive root of the difference equation $D_G(b)$ where $b_{[2]} = b^\infty := w - \hat{w}/2 \in (0, b^*]$.*

Proof. Since $D_G(V)$ is concave, there are two roots. Since $G(0) = 0$, there is one root $b_{[1]} = 0$. It can be checked that with $b^\infty = w - \hat{w}/2$, $F(b^\infty) = \bar{R}P(b^\infty)(1 - e_L)$. Hence $b_{[2]} = w - \hat{w}/2$, which is increasing in w. If $w > \hat{w}/2$, then $b^\infty > 0$, and if $w = \hat{w}$, then $b^\infty = w/2 = b^*$.

The difference equation $D_G(b)$ is illustrated in Figure 1 for a case where $w \in (\hat{w}/2, \hat{w})$. Since $D_G(b) < 0$ for $b \in (0, b^\infty)$ and $D_G(b) > 0$ for $b > b^\infty$, the root $b_{[2]} = b^\infty$ is unstable, whereas the root $b_{[1]} = 0$ is stable.

[3] It can be checked that:

$$\tilde{b} = \frac{1 - e_L}{2e_L\gamma\kappa} + \frac{w}{2} > \frac{w}{2} = b^*; \quad \tilde{V} = \frac{\bar{R}\left(1 - e_L(1 - \gamma\kappa w)\right)^2}{4e_L\gamma\kappa}.$$

[4] It can be checked that $D_G(b) = -b + (1 - e_L(1 - \gamma\kappa w) - \sqrt{h(b)})/(2e_L\gamma\kappa)$ where $h(b) = (1 - e_L(1 - \gamma\kappa w))^2 - 4\bar{R}(1 - e_L)e_L\gamma\kappa(1 - \gamma\kappa(w - b))b$.

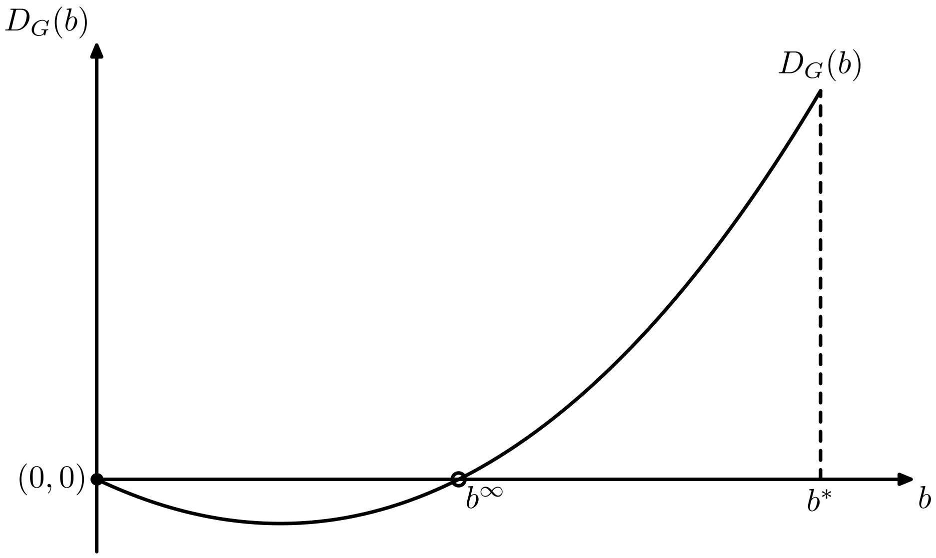

Figure 1: The Difference Equation $D_G(b) = F^{-1}(\bar{R}P(b)(1 - e_L)) - b$.

Note: The case illustrated is for $w \in (\hat{w}/2, \hat{w})$. There are two roots: $b_{[1]} = 0$ and $b_{[2]} = b^\infty$ with $b^\infty \in (0, b^*)$. The root $b_{[1]}$ is stable, the root $b_{[2]}$ is unstable.

Corresponding to an issuance of b^∞, the Hegemon's per-period utility is:

$$v^\infty = f(b^\infty) = \bar{R}b^\infty - P(b^\infty) = \bar{R}\left(w - \frac{\hat{w}}{2}\right)\left(\frac{\gamma\kappa\hat{w}}{2}\right).$$

With issuance constant at $b_t = b^\infty$, the Hegemon's discounted utility is:

$$V^\infty = \left(\frac{\bar{R}}{\bar{R} - 1}\right)v^\infty = F(b^\infty) = \bar{R}\left(w - \frac{\hat{w}}{2}\right)\left(1 - e_L + e_L\gamma\kappa\frac{\hat{w}}{2}\right).$$

Since the Hegemon's per-period utility $f(b)$, is increasing in b for $b < b^*$, it follows that when $w \in (\hat{w}/2, \hat{w})$, the Hegemon optimally chooses $b_t = b^\infty$ for all t. In their Appendix, Farhi and Maggiori (2018) assume that issuance is constant over time and show that the optimal constant issuance is $b = b^\infty$. Thus, the result here shows that the assumption of constant issuance is without loss of generality. However, Lemma 2 also shows that the outcome $b_t = b^\infty$ for all t is fragile. Suppose that the Hegemon follows a simple heuristic rule, setting its issuance according to $b_{t+1} = G(b_t)$. This might be justified by supposing, for example, that the decisions of the Hegemon are made by successive short-sighted ruling parties. If $b_t = b^\infty$, then $b_{t+1} = b^\infty$ and issuance remains constant and optimal. However, consider, for example, a one-period, unexpected negative shock to w, the income of RoW, at date t. Let $G_\varepsilon(b)$ denote the function $G(b)$ with the shock. With a negative shock, $G_\varepsilon(b) < G(b)$. Thus, if $b_t = b^\infty$ and $b_{t+1} = G_\varepsilon(b_t)$, then $b_{t+1} < b_t$, $b_{t+2} < G(b_{t+1})$ and so on. Issuance collapses unless the Hegemon re-optimizes.

The results in this section have shown that it is optimal for the Hegemon to choose a policy that keeps issuance constant. However, if the Hegemon adopts an intuitive heuristic to determine issuance recursively through the equation $b_{t+1} = G(b_t)$, then this constant issuance is unstable and may collapse after a one-period shock.

Proposition 1. *For $w \in (\hat{w}/2, \hat{w})$, a policy of constant issuance $b_t = b^\infty = w - \hat{w}/2$ is optimal. With a heuristic policy rule, $b_{t+1} = G(b_t)$, the policy of constant issuance is unstable.*

The instability result of Proposition 1 is different from the instability in the one-period model. In this repeated version, there is no default in equilibrium. In the one-period model of Farhi and Maggiori (2018), default can occur in equilibrium, and multiple equilibria can exist: an equilibrium in which the RoW correctly expects a devaluation and an equilibrium in which the RoW correctly expects no devaluation. In the former case, it is ex-post optimal for the Hegemon to devalue in the low state. In the latter case, it is not optimal for the Hegemon to devalue in the low state and indeed the asset issued by the Hegemon is safe. Farhi and Maggiori (2018) introduce a sunspot to coordinate on an equilibrium. The Hegemon faces a trade-off: it can keep issuance low or increase issuance with the risk that the sunspot might lead to an equilibrium with devaluation. It is this feature of the model that captures the *Triffin dilemma*. Issuing more nominal debt may lead to a situation where it is optimal for the Hegemon to devalue its currency.

Here the instability result of Proposition 1 is based on a short-sighted, heuristic in which current issuance depends on the issuance in the previous period.[5] While this is a natural heuristic, a differently targeted heuristic may have different stability properties. For example, if the Hegemon has a rule that targets the risky asset bought by the RoW, $z = w - b$, then the corresponding difference equation in z is stable at the root $z_{[2]} = w - b_{[2]}$. The choice of the rule matters for stability.

5. Discussion and Concluding Comments

This letter presents a tractable repeated version of Farhi and Maggiori (2018) in which it is optimal for the Hegemon to keep issuance of the safe asset constant. However, this issuance policy can be fragile and unstable. It is unstable if the Hegemon adopts a simple heuristic rule based on past issuance.

Although the model considered here is the natural extension of the baseline model of Farhi and Maggiori (2018) to a repeated setting, it has several limitations. Firstly, the one-period model of Section 2 can be extended in several directions. Farhi and Maggiori (2018) show that with more than one issuer, the rents from issuance are diluted, and the choice of issuance and default depend on the choices of the other issuers. The assumption of mean-variance preferences implies that the demand from the RoW is linear, but this preference assumption may be generalized (for a repeated version of a similar model with general preferences, see, for example, Fernández-Villaverde and Sanches, 2023). The assumption that $e_L = R_L/R_H$ is inessential, but future research should aim to make e_L an endogenous choice variable rather than a parameter. Secondly, our repeated model retains many of the assumptions made in the Appendix of Farhi and Maggiori (2018). In particular, the RoW is a sequence of one-period lived agents, and the no-default condition (ND) assumes that default is deterministic and full rather than partial. Furthermore, following default, the Hegemon always chooses e_L in every future period. The assumption that default is deterministic and that $e = e_L$ in every period following default, can be easily relaxed to assume that default occurs after a random draw, or that default leads to a finite or random number of periods of default without qualitatively altering the results. However, future research should aim to consider longer-lived agents that may capture persistent investor behavior and risk management, and consider partial default in addition to complete default.

Finally, we have presented two simple heuristics based on the no-default constraint, which have differing stability properties. Future research should ground the heuristics in realistic behavioral assumptions and embed the analysis within models of political turnover and current approaches to geoeconomics (see, for example, Aguiar and Amador, 2011; Clayton et al., 2025).

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