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Monetary and Fiscal Coordination: Who Imposes Discipline on Whom?

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Abstract

In an insightful paper entitled *Some Unpleasant Monetarist Arithmetic*, Sargent and Wallace (1981) have argued that, when monetary and fiscal policy are not coordinated, inflation can get out of control if the monetary authority does not impose discipline on the fiscal authority. This paper shows that discipline can be reciprocal if the policy interaction is repeated and the rationality of the authorities is fully taken into account through the equilibrium concept.

Keywords: Policy coordination, chicken game, forward induction

JEL codes: C72, E31, E52, E63

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1 Introduction

The large level of outstanding public liabilities combined with the high inflation of the post-pandemic period has revived interest in the potential conflict between the monetary authority's task of keeping inflation under control and the objectives of the fiscal authority.[1] In particular, any attempt by independent and uncoordinated public authorities to simultaneously rein in inflation and reduce taxation must take into account the *unpleasant arithmetic* of Sargent and Wallace (1981), who have argued that a monetary authority intent on controlling inflation and a fiscal authority intent on reducing taxation are bound to come into conflict, through a *game of chicken*.[2]

According to Sargent and Wallace (1981), the conflict emerges because both authorities, while pursuing their independent policy goals, need to contribute to finance the public sector budget through taxation and seignorage to avoid sovereign default. When a conflict arises, the authorities can be aggressive or chicken out. If they are both aggressive, simultaneously reducing inflation and taxation, the public revenue collapses, triggering sovereign default. If one authority is aggressive and the other chickens out, either inflation or taxation remains high, but default is avoided. If both authorities chicken out, nothing happens. This game of chicken has two pure equilibria in which one authority prevails and the other gives in. When the monetary authority has the upper hand, inflation is under control, while taxation remains high to avoid default. When the fiscal authority has the upper hand, taxation is under control, while inflation remains high to provide the seignorage needed to avoid default, giving rise to Sargent and Wallace's unpleasant monetarist arithmetic, as inflation gets out of control despite the monetary authority's price stability goal.

In this paper, we show that if the interaction is repeated over time, there exist robust scenarios in which inflation remains under control provided that the authorities' rationality is taken into account through the equilibrium concept. In the finitely repeated version of the chicken game, there are pure equilibria in which the same authority is repeatedly in control of policy, and others in which the authorities control policy alternately over time. Using a forward-induction argument based on the notion of strategic stability à la Kohlberg and Mertens (1986), we show that the only stable pure equilibrium paths of the repeated chicken game feature alternating control of policy by the two authorities over time. The

[1] See for instance Jerome Powell's speech at the Symposium on Central Bank Independence held at the Sveriges Riksbank in 2023.

[2] Sargent refers to it as *Wallace's Game of Chicken*, see Sargent (2013, ch. 6, p. 204).

reason why forward induction eliminates the equilibria in which the same authority controls policy for two or more consecutive periods is that a costly deviation by the opponent forcing default is interpreted by the authority in control as a signal of the opponent's intention of being aggressive in the future. In these circumstances, the answer to the Sargent and Wallace (1981) final question "Who imposes discipline on whom?" is "both alternately over time".

The unpleasant monetarist arithmetic has been the subject of a vast literature,[3] but, to the best of our knowledge, surprisingly the only existing game-theoretic formalization of the conflict between the fiscal and monetary authorities described by Sargent and Wallace (1981), is contained in the paper by Barthélemy et al (2024). At the heart of their paper, there is the inability of the authorities to commit to a profile of policies to force the opponent to give in. In this situation, to gain the upper hand, the fiscal authority front loads expenditures overissuing debt from the start to force the monetary authority to give in. In their paper, the logic of backward induction pins down equilibrium behavior using past decisions of the authorities as commitment devices for future behavior. In our model in which the authorities devise a complete and coherent plan of action for the entire repeated interaction, it is the logic of forward induction that pins down equilibrium, using current costly choices as signaling devices for future behavior. In modeling the conflict between public authorities over policy control, we follow Barthélemy et al (2024) and the literature à la Alesina (1987), Alesina and Tabellini (1987), Dixit and Lambertini (2003) and Schreger et al (2024). Since our focus is on unpleasant monetarist arithmetic, we sidestep the issues of time consistency and credibility that take center stage in this literature, assuming the commitment of the public authorities as in Sargent and Wallace (1981).

The notion of strategic stability introduced by Kohlberg and Mertens (1986) and refined by Mertens (1989, 1991) and Govindan and Mertens (2004) is the strongest Nash equilibrium refinement criterion available in the literature that satisfies all the properties considered desirable to characterize strategic rationality.[4] Forward induction, which is a key requirement of strategic stability, was applied to a different finitely repeated coordination game by van Damme (1989).

The paper proceeds as follows. Section 2 presents the model and the chicken game. Section 3 presents its repeated version. Section 4 concludes.

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[3] See the chapter in the *Handbook of Monetary Economics* by Canzoneri et al (2011).

[4] Hillas and Kohlberg (2002) examine such properties. Govindan and Wilson (2008) provide a comprehensive and accessible survey of the literature on Nash equilibrium refinements. For a decision-theoretic viewpoint see Govindan and Wilson (2009, 2012).

2 Model

The model is based on Alesina (1987) and Alesina and Tabellini (1987). We set up the model, whose derivation appears in the appendix, to characterize the economy as *monetarist*, in the terminology of Sargent and Wallace (1981).

2.1 Economy

The underlying economy is characterized by an aggregate supply function à la Lucas (1972). The income of the private sector y depends positively on unexpected inflation, that is, the difference between actual inflation π and expected inflation π^e, and negatively on distortionary taxation τ as follows:

$$y = \pi - \pi^e - \tau, \tag{1}$$

expressed in logarithmic terms. Assuming that the private sector has rational expectations over future prices, expected inflation equals actual inflation

$$\pi^e = \pi, \tag{2}$$

hence, income cannot be systematically affected by inflation. The demand side of the economy gives rise to the quantity theory equation, as in the cash-in-advance model à la Lucas (1972), which implies a direct proportionality between the price level and the money stock. As a consequence, the growth of the money stock μ equals inflation

$$\mu = \pi. \tag{3}$$

There is a government sector that collects revenue from various sources to finance public expenditures. The ratio of the public budget to the money stock g is financed by the revenue raised through taxation or the seignorage collected through the growth of the money stock, that is, $g = \tau + \mu$. Using the quantity theory equation (3), we obtain

$$g = \tau + \pi. \tag{4}$$

The government needs to service a consol bond that pays real interest r every period. Denoting the bond-to-money ratio with d, the government must guarantee a real payment rd on the debt, which we normalize to unity $rd = 1$ to reflect the upper limit on the stock of bonds relative to the size of the economy that makes the conflict between the authorities relevant in Sargent and Wallace (1981).

2.2 Public Policy

Public policy controls inflation and taxation. There are two independent policy authorities indexed by $a = m, f$. The monetary authority m chooses inflation $\pi \in \{0, 1\}$ and the fiscal authority f chooses taxation $\tau \in \{0, 1\}$. We follow Sargent and Wallace (1981), assuming that the public authorities make their policy decisions before the market interaction takes place, as described above, with the commitment to stick to the initial decisions. For this reason, we have assumed that the rational expectations condition (4) holds and the authorities anticipate that the output cannot be influenced by inflation. As a consequence, issues of time inconsistency à la Kydland and Prescott (1977) and Barro and Gordon (1983) do not arise in this setting. We assume that both authorities dislike inflation but would like to boost the private sector's income while caring about the public budget, trying to avoid default that is costly for the public authorities. Thus, the payoff of authority a is

$$\mathcal{U}_a = -\alpha_a \pi + \eta_a y + \gamma_a g - \kappa_a (1 - g)^+. \tag{5}$$

where $(\alpha_a, \eta_a, \gamma_a, \kappa_a)$ are nonnegative parameters and $(1 - g)^+ \equiv \max\{1 - g, 0\}$. Default occurs when the public budget is not sufficient to finance interest payment, i.e. $g < 1$. As in Barthélemy et al (2024), for fiscal authority, the cost of default reflects the loss due to the temporary exclusion from financial markets; for monetary authority, the cost reflects the spillover of sovereign default onto the banking sector that generates financial instability. Inserting the private sector income (1) with the rational expectation condition (2) and the public budget (4) into (5), we obtain the payoff as a function of the policies

$$\mathcal{U}_a(\pi, \tau) = -(\alpha_a - \gamma_a)\pi + (\gamma_a - \eta_a)\tau - \kappa_a (1 - \tau - \pi)^+. \tag{6}$$

2.3 Game of Chicken

Next, we fit the model to the canonical chicken game as described by Rapoport and Chammah (1966), which is a two-by-two anti-coordination game with opposite players' incentives and a cost of mutual aggression, also known as the hawk-dove game. We restrict parameter values $(\alpha_a, \eta_a, \gamma_a)$ for both authorities $a = m, f$ to generate the conflict that induces the anti-coordination game between them.

With regard to monetary authority, we assume that it cares more about inflation than budget and more about budget than income with $\alpha_m > \gamma_m > \eta_m$. Thus, monetary authority has a clear mandate to control inflation relative to other goals. With regard to fiscal authority, we assume that it cares more about income than budget and more about budget than inflation with $\eta_f > \gamma_f > \alpha_f$. Thus, for fiscal authority, the support of income is a priority relative to other goals. In sum, the monetary authority places relatively more weight on the inflation target than on the income target with respect to the fiscal authority. In the terminology of Rogoff (1985), the central bank is more conservative than society as represented by the elected government. The public budget matters equally for the two authorities and is the second most important target for both. Finally, to characterize the situation as a chicken game, we assume that default is sufficiently costly to motivate genuine fear from the authorities of being unable to service debt. In particular, we require $\kappa_m > \alpha_m - \gamma_m$ for the monetary authority and $\kappa_f > \eta_f - \gamma_f$ for the fiscal authority.

To simplify the exposition, we set parameters' values to obtain a symmetric chicken game. In particular, we set $\gamma_m - \eta_m = \gamma_f - \alpha_f \equiv \delta$, $\alpha_m - \gamma_m = \eta_f - \gamma_f \equiv \theta$ and $\kappa_m = \kappa_f \equiv \kappa$. From payoff (6) for the monetary authority ($a = m$), we have the following

$$\mathcal{U}_m(\pi, \tau) = \delta\tau - \theta\pi - \kappa(1 - \tau - \pi)^+, \tag{7}$$

that depends negatively on inflation and positively on taxation and incorporates the cost of default; for the fiscal authority ($a = f$), we have

$$\mathcal{U}_f(\pi, \tau) = \delta\pi - \theta\tau - \kappa(1 - \tau - \pi)^+, \tag{8}$$

that depends negatively on taxation and positively on inflation and incorporates the cost of default. From the above assumptions, we have $\kappa > \theta > 0$, $\delta > 0$. Finally, assume that each authority prefers the opponent to chicken out, i.e. $\delta > \theta$.

In sum, we have a monetarist economy in which there is a conflict between the two public authorities that are in charge of public policy, are subject to a common budget constraint, and are keen on avoiding default. The conflict arises because the main goal of the monetary authority is to reduce inflation while the main goal of the fiscal authority is to reduce taxation, but inflation and taxation are substitutes as means of financing the public budget that is needed to service public debt. The conflict unfolds as follows. First, simultaneously and independently, the monetary authority chooses $\pi \in \{0, 1\}$ to maximize (7) and the fiscal authority chooses $\tau \in \{0, 1\}$ to maximize (8). Then, the payoffs are realized. The game can be represented in normal form by the following table.

A pure-strategy Nash equilibrium is a strategy combination (π, τ) such that

m vs f	0	1
0	$-\kappa, \quad -\kappa$	$+\delta, \quad -\theta$
1	$-\theta, \quad +\delta$	$\delta-\theta, \delta-\theta$

Table 1: Game of chicken: $\kappa > \theta > 0$, $\delta > \theta$.

unilateral deviations are not profitable. There are two pure-strategy equilibria of this game, namely, $(0, 1)$ and $(1, 0)$. There is also a mixed-strategy equilibrium in which the authorities chicken out with probability θ/κ, which, however, is not persistent in the sense of Kalai and Samet (1984).[5] Thus, from now on, we focus on pure-strategy equilibria.

In the pure-strategy Nash equilibria of the chicken game, either the monetary authority is in control of policy and the fiscal authority accommodates, or the fiscal authority is in control of policy and the monetary authority accommodates. This is the basis for the unpleasant monetarist arithmetic of Sargent and Wallace (1981), since in the latter equilibrium inflation is out of control. Therefore, in a monetarist economy in which the monetary authority has the clear mandate to keep inflation at bay, inflation may still get out of control, due to a conflict with the fiscal authority over how to finance the public budget to avoid default.

3 Repeated Game

Suppose now that the interaction between the authorities is repeated over time. The central bank's monetary policy committee and the government cabinet regularly meet to decide the policy choice concerning, respectively, inflation and taxation. Policy decisions become public after every committee and cabinet meeting. The underlying economy remains in stationary equilibrium, while the public authorities interact repeatedly. Formally, we model the situation as a chicken game that is repeated twice, in which the stage game is the one described in Table 1, with the outcome of the first round observed by both authorities before the start of the second round. As in Alesina (1987) and Alesina and Tabellini (1987), we assume that the authorities are relatively impatient, discounting the second period payoff at a rate $\beta \in [0, 1]$.

[5] A *retract* is the cartesian product of nonempty, closed and convex subsets of mixed strategies for each player. A *persistent retract* is a minimal retract that contains a best response to every strategy profile sufficiently close to it. A *persistent equilibrium* is a Nash equilibrium that belongs to some persistent retract.

3.1 Equilibrium

Define a pure reduced normal form strategy of the repeated chicken game as a triple (xwz) where $x \in \{0,1\}$ is the first-round choice of a player; $w \in \{0,1\}$ and $z \in \{0,1\}$ are the actions chosen by the player in the second round following the opponent's choice of 0 and 1, respectively, in the first round. The appendix contains the table that represents the reduced normal form of the game.

The pure-strategy Nash equilibria are the following:

a) $((000),(11z))$ and $((010),(11z))$ iff $\beta \leq \frac{\kappa-\theta}{\delta+\theta}$, leading to the equilibrium path in which the stage game strategy combination $(0,1)$ is played twice with payoffs $((1+\beta)\delta, -(1+\beta)\theta)$;

b) $((11z),(000))$ and $((11z),(010))$ iff $\beta \leq \frac{\kappa-\theta}{\delta+\theta}$, leading to the equilibrium path in which the stage game strategy combination $(1,0)$ is played twice with payoffs $(-(1+\beta)\theta, (1+\beta)\delta)$;

c) $((0w1),(100))$ and $((0w1),(101))$ iff $\beta \leq \frac{\theta}{\delta+\theta}$, leading to the equilibrium path in which the stage game strategy combination $(0,1)$ is played in the first round and $(1,0)$ in the second round with payoffs $(\delta-\beta\theta, \beta\delta-\theta)$;

d) $((100),(0w1))$ and $((101),(0w1))$ iff $\beta \leq \frac{\theta}{\delta+\theta}$, leading to the equilibrium path in which the stage game strategy combination $(1,0)$ is played in the first round and $(0,1)$ in the second round with payoffs $(\beta\delta-\theta, \delta-\beta\theta)$.

In sum, there are four pure Nash equilibrium paths in which the monetary authority is always in control of policy and the fiscal authority always accommodates and vice versa; or the monetary authority is in control initially and the fiscal authority subsequently and vice versa. The presence of a pure equilibrium path in which the monetary authority always accommodates the choice of the fiscal authority reinforces the unpleasant arithmetic of Sargent and Wallace (1981), since inflation becomes permanently out of control in such an equilibrium.

3.2 Refinement

The aim of equilibrium refinement is to eliminate all equilibria in which some irrational, that is, dominated, choice is imputed to the players in the course of play. The key requirements that the equilibrium notion should satisfy to exclude irrationality in strategic situations that unfold over time are backward and forward induction.

According to the backward induction requirement, the players, when making their choices optimally in any event, anticipate that their own and others' subsequent moves will be optimal, embedding the notion of sequential rationality. In the repeated chicken game, the logic of backward induction is captured by subgame perfection. All of the pure equilibria listed above are sustained by some subgame perfect equilibrium of the corresponding extensive form, thus, conforming to sequential rationality.

According to the forward induction requirement, the players, when making their choices optimally in any event, presume the optimality of others' past moves whenever possible. The logic of forward induction takes seriously the notion that a strategy is a complete and coherent plan of action for all future contingencies that should be undominated as a whole. As a consequence, not only profitable but also unprofitable one-shot deviations need to be considered. To gain an intuition why forward induction helps refine the equilibrium set in the repeated game of chicken, consider the equilibrium paths in which the same authority is always in control of policy, for example, the one in which the fiscal authority is always in control. Suppose that, contrary to what would be expected from equilibrium play, at the end of the first round f observes that a deviation of the opponent has occurred in this round triggering default. The logic of sequential rationality embedded in the backward induction requirement would call for an interpretation of such an event as a sudden fit of irrationality, from which f expects m to quickly recover going back to equilibrium play. Provided that the overall gain for m is greater than the equilibrium payoff, f can interpret the evidence differently as signaling the intention of m to be aggressive in the next round. In fact, it would be a dominated move to become aggressive currently forcing default only to plan to chicken out in the future. If this conjecture is taken seriously, f should chicken out in the next round, thus destabilizing the equilibrium. This is the logic of forward induction that interprets deviations, whenever possible, as part of a fully rational, coherent plan in which the players use currently costly actions to signal to their opponents their intention of future play. By symmetry, the same argument applies to the other equilibrium in which the monetary authority is always in control of policy. The remaining pure equilibrium paths in which the authorities alternately control policy over time are immune to such forward induction arguments, provided the authority that is first in control does not gain from postponing control.

3.3 Strategic Stability

The heuristic argument developed above can be made rigorous using the strategic stability requirements of Kohlberg and Mertens (1986) that embed the notions of backward and forward induction. In a nutshell, an ideal solution concept has to: exist for every game; satisfy admissibility, backward and forward induction; be robust to iterated elimination of dominated strategies; and be invariant under different strategically equivalent representations of the game. The solution concept of Mertens (1989) identifies the sets of equilibria – known as Mertens stable sets, henceforth simply *stable sets* – that satisfy all the requirements of strategic stability. For our purposes, it is enough to consider the following properties: *i*) stable sets always exist; *ii*) stable sets are strongly connected sets of normal-form perfect (hence admissible) equilibria; *iii*) stable sets of a game contain stable sets of any game obtained by deleting a pure strategy which is at its minimum probability in any (normal-form) ε-perfect equilibrium in the neighborhood of the stable set.[6] Property *iii* captures iterated dominance and forward induction.

To apply stability, we allow authorities to use mixed strategies; however, the focus is on pure equilibrium paths. The next lemma shows that the pure equilibrium paths in which the same authority is always in control of policy are not stable, provided that the net gain that accrues to the authority not in control of policy from signaling the intention to play aggressively in the future exceeds its equilibrium payoff, i.e. $-\kappa + \beta\delta > -(1+\beta)\theta$.

Lemma 1 *If* $\frac{\kappa-\theta}{\delta+\theta} < \beta < \frac{\kappa}{\delta}$*, no element of a stable set induces the outcomes in which the same authority controls the policy in both periods.*

Proof. Consider the equilibrium path in which $(0,1)$ is played twice, with payoffs $((1+\beta)\delta, -(1+\beta)\theta)$, and let $\frac{\kappa-\theta}{\delta+\theta} < \beta < \frac{\kappa}{\delta}$. We begin by deriving the set of (undominated) equilibria of the reduced normal form that induce it. The pure strategies that sustain this path are (000) and (010) for authority m and (110) and (111) for authority f, and are all undominated. Note that if the authority f randomizes between (110) and (111) based on any probability distribution, the authority m strictly prefers the strategies (000) and (010) over any other strategy. Let $p \in [0,1]$ be the probability that m assigns to (000) and $1-p$ the probability that she assigns to (010). For authority f, strategies (110) and (111) do (weakly)

[6] Loosely speaking, a *(normal-form) ε-perfect equilibrium* is a strategy combination such that every player assigns strictly positive probability to each one of her pure strategies, however, always less than ε to those that are non-optimal against that combination. A *normal-form perfect equilibrium* is the limit point of a sequence of ε-perfect equilibria as ε goes to zero.

better than strategies (000) and (001) whenever

$$p \geq \frac{\theta + \beta(\delta + \theta) - \kappa}{\beta(\delta + \kappa)} \equiv \bar{p},$$

do (weakly) better than strategies (010) and (011) whenever

$$p \geq \frac{\theta + \beta\delta - \kappa}{\beta\delta} \equiv \hat{p},$$

and always do strictly better than strategies (100) and (101). Since $\kappa > \theta$ and $\beta < \kappa/\delta$, we have $\bar{p} > \hat{p}$. Thus, denoting mixed strategies as convex combinations of pure strategies, we find that the set of (undominated) equilibria inducing the path under study is

$$\Phi = \{(p(000) + (1-p)(010), q(110) + (1-q)(111)); p \in [\bar{p}, 1], q \in [0,1]\}.$$

We can now show that the set Φ is disconnected from its complement in the set of undominated equilibria. If authority f plays according to any strategy in Φ, authority m strictly prefers strategies (000) and (010) over any other strategy, so this remains true for any sufficiently close strategy of f. If authority m plays any strategy $p \in (\bar{p}, 1]$, then authority f strictly prefers strategies (110) and (111) over any other strategy and this remains true for any sufficiently close strategy of m. If $p = \bar{p}$, then the authority f is indifferent between strategies (110), (111) and strategies (000), (001). However, if she assigns positive probability also to the latter strategies, then authority m has a unique best response, namely (010).

Finally, we can prove that the set Φ does not contain any stable set. For every $q \in \Phi$, every pure strategy of authority m other than (000) and (010) induces a payoff strictly lower than that induced by those strategies and, therefore, is used with minimum probability in any ε-perfect equilibrium close to Φ. Similarly, for every $p \in \Phi$, the strategies (010), (011), (100) and (101) of authority f induce a payoff that is strictly smaller than that of the strategies (110) and (111), so they are used with minimum probability in any ε-perfect equilibrium close to Φ. After eliminating all such inferior replies, strategy (000) becomes dominated by authority m and therefore can be further eliminated. Then, strategies (110) and (111) become dominated for authority f because $\beta > \frac{\kappa-\theta}{\delta+\theta}$. Thus, iterated elimination reduces the game to pure strategy (010) for authority m and pure strategies (000) and (001) for authority f, which were not in the equilibrium component with which we started. By symmetry, the same argument applies to the equilibrium path in which $(1,0)$ is played twice. ■

The next lemma shows that the pure equilibrium paths in which the authorities alternately control policy are stable, provided that the net gain that accrues to the authority that is first in control of policy from postponing control to the future is smaller than its equilibrium payoff, i.e. $\delta - \theta + \beta\delta < \delta - \beta\theta$.

Lemma 2 *If $\beta < \frac{\theta}{\delta+\theta}$, there exist stable sets that induce, with probability one, the outcomes in which the authorities alternately control the policy.*

Proof. Consider the path in which $(0,1)$ is played in the first round and $(1,0)$ is played in the second round, with payoffs $(\delta - \beta\theta, \beta\delta - \theta)$, and let $\beta < \frac{\theta}{\delta+\theta}$. The pure strategies that lead to this path are (001) and (011) for authority m and (100) and (101) for authority f. Note that if m randomly chooses between strategies (001) and (011), the authority f strictly prefers the strategies (100) and (101) over all other strategies and that if f randomly chooses between (100) and (101), the authority m strictly prefers the strategies (001) and (011) over all other strategies because $\beta < \frac{\theta}{\delta+\theta}$. It follows that the set of equilibria that induce the path under study is

$$\Psi = \{(p(000) + (1-p)(010), q(110) + (1-q)(111)); p \in [0,1], q \in [0,1]\}.$$

It is easy to see that the set Ψ contains an undominated best response for each authority to every strategy of the opponent that is sufficiently close to Ψ, so it is an absorbing retract as defined by Kalai and Samet (1984), that is, a retract such that every strategy profile sufficiently close to it has a best response in it. By Mertens (1992), Ψ contains a stable set. By symmetry, the same arguments apply to the equilibrium path in which $(1,0)$ is played in the first round and $(0,1)$ is played in the second round. ■

Since $\kappa > \theta$ by assumption, the upper bound on discounting in Lemma 2 is tighter than the upper bound in Lemma 1. Therefore, the previous lemmas immediately imply the following proposition, which contains the main result of the paper. The upper bound on the cost of default ensures that the upper and lower bounds on discounting are compatible.

Proposition 1 *If $\kappa < 2\theta$ and $\frac{\kappa-\theta}{\delta+\theta} < \beta < \frac{\theta}{\delta+\theta}$, the only stable pure equilibrium outcomes are those in which the authorities alternately control the policy.*

The result can be extended to any finite repetition of the chicken game. In particular, any equilibrium path in which the same authority is in control of policy consecutively for two periods or more is not strategically stable, as it does not satisfy forward induction, by the same argument used above. In sum, when the monetary and fiscal authorities enter into a repeated conflict over who imposes disciplines on whom, provided that their rationality is properly taken into account through the equilibrium concept using the strategic stability notion of Mertens (1989), there are robust scenarios in which the authorities alternately impose discipline on each other.

4 Conclusion

According to the fiscal theory of the price level – see Leeper (1991); Sims (1994); Woodford (1995); Cochrane (2005, 2023) – a conservative monetary authority and a non-ricardian fiscal authority end up controlling inflation even if the monetary authority chickens out, provided government bonds are nominal, as a bond valuation equation that replaces the government budget constraint autonomously pins down the price level. Unlike fiscal theory, following Sargent and Wallace (1981), in this paper, we have assumed that government bonds are real, so the price level and inflation remain to be determined at equilibrium. We have shown that there are robust situations in which inflation remains under control even with real bonds if the interaction of the authorities is repeated over time and the rationality of the authorities is fully taken into account through the equilibrium concept. The switch of policy control between the monetary and fiscal authority over time is not a mere theoretical curiosity. Using post-WWII data for the US, Davig and Leeper (2011) found evidence of switching between monetary and fiscal policy control over time with no sign of explosive behavior for inflation.

5 Appendix

A. Derivation of the economic model. We derive the supply function and, using the quantity theory equation, we derive the public budget. This follows closely from Alesina and Tabellini (1987). Consider a representative firm that acts as a price taker in both the output and labor market. The competitive price of the final output is P and the competitive wage is W in nominal terms. Taxation τ is proportional to the firm's revenue. The firm operates a technology represented by the neoclassical production function $Y = \sqrt{AL}$, where A is a productivity parameter. Its aim is to maximize profits $\Pi = (1-\tau)PY - WL$. Inverting the production function and plugging it into the profit function, we obtain $\Pi = (1-\tau)PY - WY^2/A$. Setting for simplicity $A = 2$, the first-order condition for the optimal choice gives the supply function $Y = (1-\tau)P/W$. Take a logarithmic transformation, approximating $\ln(1-\tau) \approx -\tau$ and defining $y \equiv \ln Y$, $p \equiv \ln P$ and $w \equiv \ln W$, to obtain $y = p - w - \tau$. The labor supply is perfectly elastic and the competitive labor market clears with $w = p^e$. Defining inflation $\pi \equiv \Delta p$ as the deviation of the current output price from the price of the previous period, we obtain equation (1) in the text. In rational expectations equilibrium, condition (2) must hold. Assume that consumption needs to be financed with cash on hand. The binding cash-in-advance constraint equates nominal expenditures on consumption by the representative agent to money holdings $PC = M$. Using the output market clearing condition $C = Y$ and equating money demand and supply, we obtain the quantity theory equation $PY = M$. In stationary equilibrium, in terms of growth rates, the quantity theory equation reduces to (3) since income is time invariant. The public budget in nominal terms is $G = \tau PY + \Delta M$, where ΔM is the deviation of the current from the previous period money stock in nominal terms, representing seignorage in nominal terms. Use the quantity theory equation $PY = M$, dividing both sides of the public budget by M and defining $\mu \equiv \Delta M/M$, to obtain $g \equiv G/M = \tau + \mu$. Inserting (3), we get equation (4) in the text. The outstanding nominal stock of the consol bond is D, the bond-to-money ratio is $d \equiv D/M$ and the net real interest rate in every period is r. Sovereign default occurs whenever the public budget is insufficient to service the debt, that is, $g < rd$. Equivalently, for a one-period government bond, in stationary equilibrium, the reimbursement of the principal would be financed with a new bond issuance every period, and the interest payment would still have to be financed by the public budget. In the text, we assumed $rd = 1$.

B. Reduced normal form of the repeated chicken game

	(000)	(010)	(001)	(011)	(100)	(110)	(101)	(111)
(000)	$-(1+\beta)\kappa$ $-(1+\beta)\kappa$	$-\kappa+\beta\delta$ $-\kappa-\beta\theta$	$-(1+\beta)\kappa$ $-(1+\beta)\kappa$	$-\kappa+\beta\delta$ $-\kappa-\beta\theta$	$\delta-\beta\kappa$ $-\theta-\beta\kappa$	$+(1+\beta)\delta$ $-(1+\beta)\theta$	$\delta-\beta\kappa$ $-\theta-\beta\kappa$	$+(1+\beta)\delta$ $-(1+\beta)\theta$
(010)	$-\kappa-\beta\theta$ $-\kappa+\beta\delta$	$\beta(\delta-\theta)-\kappa$ $\beta(\delta-\theta)-\kappa$	$-\kappa-\beta\theta$ $-\kappa+\beta\delta$	$\beta(\delta-\theta)-\kappa$ $\beta(\delta-\theta)-\kappa$	$\delta-\beta\kappa$ $-\theta-\beta\kappa$	$+(1+\beta)\delta$ $-(1+\beta)\theta$	$\delta-\beta\kappa$ $-\theta-\beta\kappa$	$+(1+\beta)\delta$ $-(1+\beta)\theta$
(001)	$-(1+\beta)\kappa$ $-(1+\beta)\kappa$	$-\kappa+\beta\delta$ $-\kappa-\beta\theta$	$-(1+\beta)\kappa$ $-(1+\beta)\kappa$	$-\kappa+\beta\delta$ $-\kappa-\beta\theta$	$\delta-\beta\theta$ $\beta\delta-\theta$	$\beta(\delta-\theta)+\delta$ $\beta(\delta-\theta)-\theta$	$\delta-\beta\theta$ $\beta\delta-\theta$	$\beta(\delta-\theta)+\delta$ $\beta(\delta-\theta)-\theta$
(011)	$-\kappa-\beta\theta$ $-\kappa+\beta\delta$	$\beta(\delta-\theta)-\kappa$ $\beta(\delta-\theta)-\kappa$	$-\kappa-\beta\theta$ $-\kappa+\beta\delta$	$\beta(\delta-\theta)-\kappa$ $\beta(\delta-\theta)-\kappa$	$\delta-\beta\theta$ $\beta\delta-\theta$	$\beta(\delta-\theta)+\delta$ $\beta(\delta-\theta)-\theta$	$\delta-\beta\theta$ $\beta\delta-\theta$	$\beta(\delta-\theta)+\delta$ $\beta(\delta-\theta)-\theta$
(100)	$-\theta-\beta\kappa$ $\delta-\beta\kappa$	$-\theta-\beta\kappa$ $\delta-\beta\kappa$	$\beta\delta-\theta$ $\delta-\beta\theta$	$\beta\delta-\theta$ $\delta-\beta\theta$	$\delta-\theta-\beta\kappa$ $\delta-\theta-\beta\kappa$	$\delta-\theta-\beta\kappa$ $\delta-\theta-\beta\kappa$	$\delta-\theta+\beta\delta$ $\delta-\theta-\beta\theta$	$\delta-\theta+\beta\delta$ $\delta-\theta-\beta\theta$
(110)	$-(1+\beta)\theta$ $+(1+\beta)\delta$	$-(1+\beta)\theta$ $+(1+\beta)\delta$	$\beta(\delta-\theta)-\theta$ $\beta(\delta-\theta)+\delta$	$\beta(\delta-\theta)-\theta$ $\beta(\delta-\theta)+\delta$	$\delta-\theta-\beta\kappa$ $\delta-\theta-\beta\kappa$	$\delta-\theta-\beta\kappa$ $\delta-\theta-\beta\kappa$	$\delta-\theta+\beta\delta$ $\delta-\theta-\beta\theta$	$\delta-\theta+\beta\delta$ $\delta-\theta-\beta\theta$
(101)	$-\theta-\beta\kappa$ $\delta-\beta\kappa$	$-\theta-\beta\kappa$ $\delta-\beta\kappa$	$\beta\delta-\theta$ $\delta-\beta\theta$	$\beta\delta-\theta$ $\delta-\beta\theta$	$\delta-\theta-\beta\theta$ $\delta-\theta+\beta\delta$	$\delta-\theta-\beta\theta$ $\delta-\theta+\beta\delta$	$(1+\beta)(\delta-\theta)$ $(1+\beta)(\delta-\theta)$	$(1+\beta)(\delta-\theta)$ $(1+\beta)(\delta-\theta)$
(111)	$-(1+\beta)\theta$ $+(1+\beta)\delta$	$-(1+\beta)\theta$ $+(1+\beta)\delta$	$\beta(\delta-\theta)-\theta$ $\beta(\delta-\theta)+\delta$	$\beta(\delta-\theta)-\theta$ $\beta(\delta-\theta)+\delta$	$\delta-\theta-\beta\theta$ $\delta-\theta+\beta\delta$	$\delta-\theta-\beta\theta$ $\delta-\theta+\beta\delta$	$(1+\beta)(\delta-\theta)$ $(1+\beta)(\delta-\theta)$	$(1+\beta)(\delta-\theta)$ $(1+\beta)(\delta-\theta)$

Figure 1: Reduced Normal Form: top payoff of m, bottom payoff of f

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