

The Dire Effects of the Lack of Monetary and Fiscal Coordination

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Abstract

If the government's willingness to stabilize debt is waning, while the central bank is adamant about keeping inflation low, the economy enters a vicious spiral of higher inflation, monetary tightening, recession, and further debt accumulation. The mere possibility of this conflict represents a drag on the economy. A commitment to inflate away the debt accumulated during a large recession leads to welfare improvements and lower uncertainty by separating long-run fiscal sustainability from the short-run fiscal stimulus. This strategy can be used to avoid the zero lower bound. As a technical contribution, we explain how to build shock-specific policy rules.

Keywords: Monetary and fiscal policies, coordination, emergency budget, Markov-switching models, liquidity traps welfare, uncertainty.

JEL classification: E31, E52, E62, E63, D83

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‡The views in this paper are solely those of the authors and should not be interpreted as reflecting the views of the Federal Reserve Bank of Chicago or any other person associated with the Federal Reserve System.

1 “This is the United States government. First of all, you never have to default
2 because you print the money, I hate to tell you, OK?”

3 (Donald Trump, May 10, 2016, on CNN)

4 “Moreover, uncertainty regarding fiscal and other economic policies has increased.
5 [...] Participants noted that, in the circumstances of heightened uncertainty, it
6 was especially important that the Committee continue to underscore in its com-
7 munications that monetary policy would continue to be set to promote attain-
8 ment of the Committee’s statutory objectives of maximum employment and price
9 stability.”

10 (Minutes of the Federal Open Market Committee’s meeting of December 13-14, 2016)

11 **1. Introduction**

12 One of the main legacies of the Great Recession that several countries are now confronting
13 is a large level of the debt-to-GDP ratio. Some scholars have argued that fiscal imbalances,
14 meaning situations in which a large fiscal burden is not clearly backed by future surpluses, can
15 affect both inflation and real activity, even in the absence of plain default on government
16 debt (e.g., Sims 1994; Woodford 1994.) Whether these effects materialize or not largely
17 depends on expectations about future monetary and fiscal policies. One possibility is that
18 the fiscal authority is expected to eventually take the adequate corrective fiscal measures
19 to stabilize the dynamics of debt, while the central bank is credibly committed to keeping
20 inflation stable. In this case, the macroeconomic implications of fiscal imbalances have been
21 shown to be quite tenuous. Alternatively, the private sector may find it implausible that the
22 large debt can be stabilized by just future economic growth and fiscal adjustments. When
23 this type of belief starts materializing, inflation expectations tend to rise because the private
24 sector expects that inflation will ultimately stabilize the fiscal imbalance. If the central
25 bank is expected to accommodate this upsurge in inflation expectations, the real interest

1 rate falls, causing a temporary economic boom and a reduction in the fiscal burden. As the
2 first quotation reported above illustrates, this interdependence between monetary and fiscal
3 policies is well understood by policymakers, even if it is not always so bluntly spelled out.

4 In both cases that we have outlined, the private sector believes that the two authorities are
5 working together to implement policies that are coordinated to attain an appropriate inflation
6 rate. Nevertheless, a third scenario in which the private sector expects that policymakers
7 will follow non-coordinated policies could also arise. Specifically, the fiscal authority keeps
8 postponing indefinitely the necessary fiscal adjustments, while the monetary authority insists
9 that inflation stability will be preserved, remaining credibly committed to raise interest rates
10 to combat inflation. This policy mix is not coordinated, reflecting a disagreement between
11 the two authorities on whether inflation should or should not be used to stabilize debt. This
12 situation occurs when both the monetary and fiscal authorities engage in active policies.
13 In this paper, we investigate the macroeconomic consequences of the lack of coordination
14 between the monetary and fiscal authorities when there are large fiscal imbalances.

15 This third scenario is still not fully understood, as the lack of policy coordination has
16 not been extensively studied in the context of general equilibrium models such as the one
17 presented in this paper. This is because lack of coordination between monetary and fiscal
18 policies can lead to explosive dynamics for inflation, output, and debt. While explosive
19 dynamics are in principle compatible with the solution of general equilibrium models, non-
20 stationary solutions are generally ruled out when studying models approximated around a
21 steady state. Specifically, the policy combination that we are interested in would lead to
22 non-existence of stationary solutions if we were to consider a model without policy changes,
23 in which the explosive dynamics would persist indefinitely (see Leeper 1991.) In this paper,
24 we make progress on this issue by modelling the conflict between the two authorities as
25 a temporary situation. To this end, we introduce the possibility of regime changes in the
26 policy mix and we leverage the recent advancements in the literature on solution methods

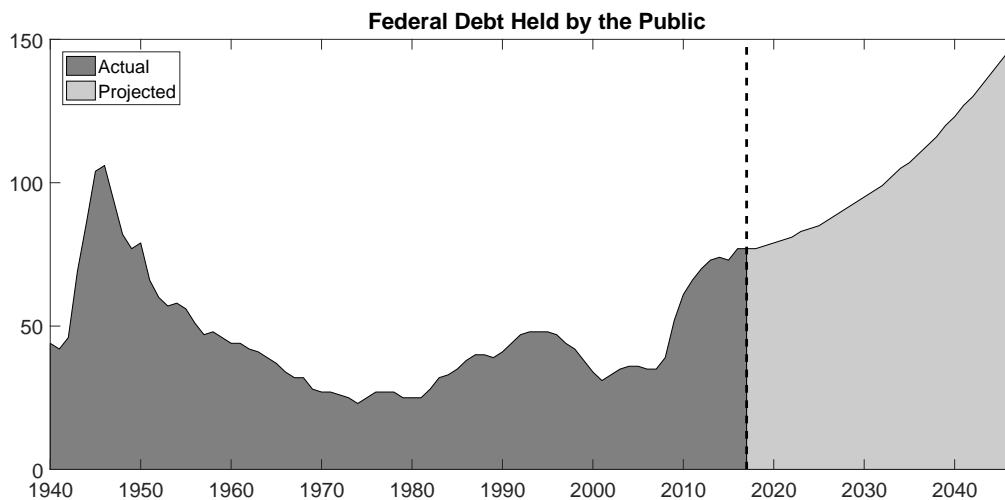


Figure 1: Debt is reported in percentage of GDP. Data from 2018 on are projected (light gray). Vertical dashed line marks fiscal year 2017. Source: Congressional Budget Office (2018)

1 for rational expectation models with parameter instability. These new solution methods
 2 allow for the possibility of *temporarily* explosive dynamics as long as the system as a whole
 3 remains stationary.

4 There are several reasons that make the lack of monetary and fiscal policy coordination
 5 particularly relevant. Currently, the U.S. public debt is on an unstable path. Figure 1
 6 shows the projected dynamics of the federal debt as a percentage of gross domestic product
 7 (GDP) under current law by the Congressional Budget Office (CBO) as of March 2018.¹ This
 8 picture strongly suggests that fiscal sustainability is far from being accomplished. Population
 9 aging and lower expected potential growth contribute to this gloomy outlook. Furthermore,
 10 U.S. debt is at its highest level since the beginning of the Korean War in 1950, suggesting
 11 that economic growth alone is unlikely to be enough to guarantee its sustainability without
 12 fiscal adjustments. As of now, no plan has been announced to reduce this severe fiscal

¹Figure 1 is a projection based on current legislation and on assumptions about future GDP growth, future interest payments on the federal debt, and demographic factors. This graph is not a forecast in that it does not reflect any assumption about when inflation and future primary government's surpluses will rise to stabilize the explosive fiscal imbalance projected by the CBO. The purpose of this paper is to explore the consequences of a policy conflict about the role of inflation in stabilizing debt.

1 imbalance. Given the explosive dynamics of U.S. debt, delaying fiscal consolidation will
2 call for more sizable corrective measures up to the point where the private sector could
3 become skeptical that such massive adjustments can be realistically implemented. Similarly,
4 uncertainty about the potential growth rate of the U.S. economy after the Great Recession
5 compounds the problem by making it harder to precisely quantify how large the corrective
6 measures have to be.² If the U.S. government overestimates the potential economic growth
7 rate, the fiscal adjustment alone may be considered insufficient by the public, calling for
8 an increase in inflation accommodated by the Federal Reserve. That said, as the second
9 quotation at the beginning suggests, the Federal Reserve seems committed not to give up
10 on inflation stabilization, especially in situations of high uncertainty about what the fiscal
11 authority is expected to do.

12 We first introduce a simple frictionless Fisherian model that allows us to derive analyti-
13 cal results and provide the intuition for the key results of the paper. We then build a more
14 elaborate model with nominal rigidities by extending the basic new-Keynesian framework
15 to include a fiscal rule, policy uncertainty modelled as regime changes, and the possibility
16 of discrete negative demand shocks that occasionally trigger large recessions and debt ac-
17 cumulation. We use this model to show that the lack of policy coordination can be highly
18 detrimental. For instance, if agents expect that the fiscal authority will disregard the level
19 of debt but the monetary authority will insist that inflation will not be allowed to rise, the
20 economy can go through a spiral of lower output, higher inflation, and higher debt. When
21 such an institutional conflict emerges, agents expect that inflation will eventually increase
22 because of the rising fiscal imbalances. The central bank raises the interest rate to keep
23 inflation at bay. However, this action causes the fiscal burden to become larger, inducing
24 agents to expect even higher inflation. Furthermore, the mere possibility of this conflict

²A recent article in the *New York Times* argues that President Donald Trump and the Federal Reserve have different views about the potential growth rate for the U.S. economy. See Appelbaum (2017). The Federal Reserve has continuously revised down its expectations for future growth since the end of the Great Recession (Leubsdorf 2016), highlighting the high uncertainty about the long-run growth of the U.S. economy.

1 materializing in the future represents a drag on the economy today, as agents expect the
2 possibility of a more prolonged and severe recession. In this case, hawkish monetary policy
3 not only is unable to keep inflation low, but also has the perverse effect of significantly de-
4 pressing economic activity. In fact, we show that if the fiscal authority is expected to prevail,
5 welfare would be higher if the central bank were to immediately accommodate the behavior
6 of the fiscal authority.

7 We then devote the last part of the paper to showing that the adverse consequences of the
8 institutional conflict can be avoided if policymakers accept to inflate away just the portion
9 of debt accumulated during the large contraction. In this scenario, policymakers concede
10 that the post-recession debt is likely to be too large to be stabilized by fiscal adjustments
11 alone and they are prepared to accept just enough inflation to stabilize the portion of debt
12 resulting from the large recession itself. Such policy has the important feature of separating
13 the problem of long-run fiscal sustainability from the need for stabilization policies in the
14 aftermath of a large contraction. We find that this strategy raises short-term inflation
15 expectations and, hence, mitigates the recession by lowering the real interest rate. Since
16 the recession is attenuated, public debt rises only moderately and so does inflation given
17 that only a small fiscal imbalance needs to be stabilized. Given that the policy clearly
18 separates long-run fiscal sustainability from short-run fiscal interventions, the pre-existing
19 fiscal burden does not contribute to create long-run inflationary pressures and macroeconomic
20 instability. Finally, once the initial contractionary shock is fully reabsorbed, the economy
21 naturally reverts to the pre-crisis policies and macroeconomic outcomes. As a methodological
22 contribution, we show how to model this type of coordinated strategy based on endogenous
23 targets in dynamic general equilibrium models.

24 If followed systematically, this strategy is shown to lead to a drastic reduction in macro-
25 economic uncertainty and an increase in welfare because it provides an automatic stabilizer
26 without giving up long-run fiscal discipline. The policy is particularly useful when large

1 deflationary shocks cause the nominal interest rate to hit its lower bound. By promising
2 to inflate away the debt resulting from exceptionally large recessions, the proposed strategy
3 works like an automatic stabilizer that raises inflation expectations exactly when monetary
4 policy would otherwise become constrained by the zero lower bound. In this respect, our
5 work is related to Woodford (2003) and Benhabib, Schmitt-Grohe and Uribe (2002) who
6 show that liquidity traps can be made fiscally unsustainable. Furthermore, the coordinated
7 strategy that we propose shares some features with the policy interventions that Chris Sims
8 has advocated at the 2016 Jackson Hole meeting to replace ineffective monetary policy at the
9 zero lower bound (Sims 2016). Sims calls for central banks “to explain that fiscal, as well as
10 monetary policy should be aimed at meeting inflation targets. This means, specifically, sta-
11 ting that inflation will intentionally be at least part of the means for financing current debt
12 and deficits.” In fact, our coordinated strategy can be implemented by explicitly announcing
13 that a projected portion of the debt-to-GDP ratio will be repaid through fiscal adjustments.
14 No fiscal plans are instead provided to stabilize the amount of the debt-to-GDP ratio that
15 exceeds that projection. Finally, our proposal is related to the debate about the necessity
16 of increasing the inflation target once the economy hits the zero lower bound because the
17 policy of inflating away a portion of the public debt can be thought as a way to achieve a
18 temporary increase in the inflation target (Coibion and Gorodnichenko 2011).

19 This paper belongs to a research agenda that aims to understand the role of fiscal policy
20 in explaining changes in the reduced form properties of the macroeconomy. Bianchi and Ilut
21 (2017) show that the Great Inflation of the 1970s can be explained in light of a fiscally-led
22 regime. Bianchi and Melosi (2013) introduce the notion of *dormant shocks* that are fiscal
23 shocks that raise inflation many years after they occurred. Bianchi and Melosi (2017) show
24 that policy uncertainty about the way debt will be stabilized empirically accounts for the
25 lack of deflation in the United States during the Great Recession. This paper differs from
26 the aforementioned contributions in several ways. We focus on the perils related to a lack

1 of coordination between the monetary and fiscal authorities when there is a large fiscal
2 imbalance. We emphasize that the *possibility* of this type of institutional conflicts now or
3 in the future can challenge the central bank’s ability to keep inflation stable and represents
4 a serious drag on economy activity. Furthermore, we show how policymakers can spark
5 an increase in inflation and economic activity by separating the problem of long-run debt
6 sustainability from short-run fiscal stimulus. Finally, we explain how to build shock-specific
7 rules, as a technical contribution. This method is general and it is of independent interest.

8 Our work is related to the vast literature that studies the interaction between monetary
9 and fiscal policies in determining inflation dynamics (Sargent and Wallace 1981; Leeper 1991;
10 Sims 1994; Woodford 1994, 1995, 2001; Cochrane 1998, 2001; Schmitt-Grohe and Uribe
11 2000; Bassetto 2002; Eggertsson, 2008; Canzoneri et al., (2010); Del Negro and Sims 2015;
12 Reis 2016; Mackowiak and Jarocinski 2017 ; among many others). Our focus is on the US
13 economy, but we believe that our results are also relevant for other countries. Davig, Leeper,
14 and Walker (2010) study how to resolve the “unfounded liabilities problem,” which stems
15 from the unsustainable exponential growth in the Social Security, Medicare, and Medicaid
16 spending with no plan to finance it. They provide a coordinated resolution of this long-
17 term fiscal imbalance. The emphasis in our paper is instead on the lack of coordination
18 between the monetary and fiscal authorities and on how to reconcile the benefits of short-
19 run stabilization policies with the need for long-run fiscal sustainability. In this respect, our
20 paper is related to Woodford (2001) and Loyo (1999) who use a perfect foresight endowment
21 economy to show that if the central bank follows the Taylor principle while the fiscal authority
22 does not stabilize debt, an explosive path for the price level arises. In our model, the
23 possibility of recurrent changes in the policy mix guarantees that a stationary equilibrium still
24 exists, while allowing for *temporarily* explosive dynamics. Furthermore, the new-Keynesian
25 framework makes the lack of coordination more costly than in an endowment economy.
26 While Fernandez-Villaverde et al. (2015) study the macroeconomic effects of changes in the

1 magnitude of fiscal *shocks*, we focus on the effects of uncertainty about the future monetary
2 and fiscal policy mix.

3 The paper is organized as follows. In Section 2., we introduce a simple Fisherian model
4 to study the implications of monetary and fiscal policy coordination for price dynamics. The
5 simplicity of this model and the absence of policy uncertainty allow us to derive all results
6 analytically. The New Keynesian model with policy uncertainty is introduced in Section 3..
7 In Section 4., we calibrate the New Keynesian model and simulate the effects of expecting
8 a lack of coordination between the monetary and fiscal authority. The coordinated strategy
9 and its implications are studied in Section 5.. In Section 6., we study the implications of
10 these different policies for social welfare and macroeconomic uncertainty. In Section 7., we
11 present our conclusions.

12 **2. A Simple Model of Inflation Determination**

13 We introduce a simple model to lay the groundwork for how monetary and fiscal policies
14 jointly determine equilibrium dynamics for inflation. The model is similar to the one used in
15 previous studies by Leeper (1991); Leeper and Walker (2013); Sims (1994); Woodford (2001).
16 We extend the analysis and use this simple model to formalize the problem of the lack of
17 coordination between monetary and fiscal policy, which is the distinctive topic of this paper.
18 The results obtained in this framework will be useful to interpret the findings derived in a
19 more complex new-Keynesian general equilibrium model.

20 *2.1. The Model*

21 An infinitely lived representative household has concave and twice continuously differ-
22 entiable preferences over non-storable consumption goods. The household is endowed with
23 a constant quantity of non-storable goods Y and derives utility $U(\cdot)$ from consuming these
24 goods C_t . The household's discount factor is affected by an independent and identically

1 distributed (i.i.d.) exogenous process, which we denote with ϵ_t^d . The fiscal authority issues
 2 one-period debt that can be traded for one unit of goods at price P_t . Government liabili-
 3 ties have purchase price $Q_t < 1$. The fiscal authority raises real net surpluses τ_t to repay
 4 its maturing liabilities according to the following fiscal rule: $\tau_t - \tau_* = \delta(b_{t-1} - b_*) + \epsilon_t^\tau$,
 5 where the starred variables denote the value of the variables at the deterministic steady
 6 state, $b_t \equiv B_t/P_t$ denotes the real value of the government liabilities at time t , and the fiscal
 7 shock ϵ_t^τ follows an i.i.d. exogenous process. The government budget constraint reads as
 8 follows: $\tau_t + Q_t b_t = b_{t-1}/\Pi_t$. The monetary authority controls the nominal interest rate on
 9 government bond $R_t = Q_t^{-1}$ by using the rule $R_t/R_* = (\Pi_t/\Pi_*)^\psi$.

10 We solve the households' problem and linearized the model equations around the steady-
 11 state equilibrium in the online appendix. We use \tilde{x} to denote the log-deviation of a variable
 12 x from its steady-state value, whereas we use \hat{x} to denote its linear deviation from the steady
 13 state. We linearize the primary surplus τ_t and the real value of debt b_t around the steady
 14 state as these variables can potentially be negative. The equilibrium of this simple economy
 15 is represented by the following two equations:

$$\psi \tilde{\pi}_t = \epsilon_t^d + \mathbb{E}_t \tilde{\pi}_{t+1}, \quad (1)$$

$$\hat{b}_t = [\beta^{-1} - \delta] \hat{b}_{t-1} + b_* (\psi - \beta^{-1}) \tilde{\pi}_t - \epsilon_t^\tau, \quad (2)$$

16 which we refer to as the *monetary-block equation* and the *fiscally-block equation*, respectively.

17 Leeper (1991) shows that there are two areas of the parameter space that guarantee
 18 determinacy of a unique rational expectations equilibrium (REE). First, the active monetary
 19 and passive fiscal policy mix (AM/PF or monetary-led policy mix): the central bank adjusts
 20 the nominal interest rate strongly to inflation deviations from steady state ($\psi > 1$) and the
 21 fiscal authority is committed to raise taxes so as to keep the dynamics of the real value of
 22 debt \hat{b}_t on a stable path ($\delta > \beta^{-1} - 1$). Second, passive monetary and active fiscal policy mix
 23 (PM/AF or fiscally-led policy mix): the central bank does not adjust the nominal interest

1 rate strongly to inflation deviations from steady state ($\psi \leq 1$) and the fiscal authority is not
 2 committed to raise taxes so as to keep the dynamics of the real value of debt \hat{b}_t on a stable
 3 path ($\delta \leq \beta^{-1} - 1$).

4 We focus on the case in which the central bank applies the Taylor principle ($\psi > 1$) and
 5 that the fiscal authority disregards the level of debt ($\delta < \beta^{-1} - 1$). In this case, monetary
 6 and fiscal policies are not coordinated in the sense that monetary and fiscal policies are not
 7 geared toward the determination of a unique and stable rate of inflation. Rather, the two
 8 policy authorities are in a sort of conflict to control inflation: the lack of response of the
 9 fiscal authority to the level of debt would call for debt stabilization *via* inflation, whereas
 10 the central bank adjusts the interest rate aggressively to prevent inflation from deviating
 11 from its steady-state (target) level. These two policies are clearly inconsistent. If this lack of
 12 coordination were to persist indefinitely, no stable rational expectations equilibrium would
 13 exist. However, this policy mix is still consistent with a stable equilibrium if it is not perceived
 14 to be permanent. In what follows, we use this simple model to study the macroeconomic
 15 implications of a situation in which both monetary and fiscal authorities temporarily conduct
 16 active policies in a struggle to control inflation.

17 We assume that the economy is at its steady-state equilibrium when at time $t = 1$, it
 18 is hit by a positive discount factor shock, $\epsilon_t^d > 0$. At this point, the fiscal authority starts
 19 disregarding the level of debt ($\delta = \delta_A < \beta^{-1} - 1$) while the monetary authority is conducting
 20 an active policy ($\psi = \psi_A > 1$). We assume that one of the two authorities will eventually
 21 have to concede the control of inflation in period $t = 2$ and revert to the passive policy. We
 22 consider two cases: one in which the monetary authority prevails and fiscal policy become
 23 passive ($\delta = \delta_P > \beta^{-1} - 1$) and the other in which the fiscal authority eventually prevails and
 24 monetary policy becomes passive ($\psi = \psi_P < 1$). To make our analysis as simple as possible,
 25 we assume that agents know with certainty what policy mix is adopted by policymakers at
 26 time $t = 1$ and in every subsequent period. Later on we will relax this assumption. Appendix

1 A contains all derivations for the results presented below.

2 **Case 1: Conflict and Monetary-Led Resolution.** In this case, the monetary au-
 3 thority is not adjusting its behavior in response to the fiscal authority's decision to withdraw
 4 fiscal backing. In period $t = 2$, the fiscal authority will revert to passive fiscal policy. This
 5 case is illustrative of a situation in which agents expect that after the initial period of conflict
 6 with the fiscal authority, the central bank will succeed in securing fiscal backing, a necessary
 7 condition for controlling inflation.

8 At time $t = 1$, agents anticipate that policymakers will eventually coordinate their policies
 9 in line with the monetary-led policy mix, implying that at time $t = 2$ inflation will depend on
 10 the discount factor shock that will realize at time $t = 2$. Therefore, it follows that $\mathbb{E}_1 \tilde{\pi}_2 = 0$.
 11 Consequently, REE inflation at time 1 is given by $\tilde{\pi}_1 = \psi_A^{-1} \epsilon_1^d > 0$. Since debt is at steady
 12 state at time $t = 0$, plugging the equilibrium inflation rate at time $t = 1$ into the fiscal-block
 13 equation (2) yields the real value of debt at time $t = 1$, which is $\hat{b}_1 = b_* (1 - \beta^{-1} \psi_A^{-1}) \epsilon_1^d$.

14 Notice that the fiscal authority's actions have no implications whatsoever for the equilib-
 15 rium in period 1. Agents understand that the fiscal authority has withdrawn its backing only
 16 in the short term and soon it will revert to passive policy. Importantly, the fiscal imbalance
 17 that arises in period 1 does not influence the dynamics of inflation at time $t = 1$ and in
 18 any subsequent period. The stronger the monetary authority responds to inflation (i.e., the
 19 higher ψ_A), the lower inflation in period 1. A proactive central bank will induce a larger
 20 fiscal imbalance, requiring the fiscal authority to raise taxes more aggressively from period 2
 21 onward. When the central bank's response to inflation is sufficiently strong, $\psi_A > \beta^{-1} \approx 1$,
 22 debt responds positively to the inflationary shock. This result is due to the fiscal effects of
 23 the contractionary monetary policy conducted in the first period.

24 **Case 2: Conflict and Fiscally-Led Resolution.** In this case, unlike in case 1, the
 25 fiscal authority is expected to emerge victorious. This case sheds light on what happens when
 26 the central bank fights back against the fiscal authority's decision to remove its support for

1 stabilizing inflation, but agents expect that fiscal backing will not be secured in the long run.

2 At time $t = 1$, agents know that policymakers will coordinate on the fiscally-led policy
 3 mix, and hence, they expect that $\mathbb{E}_1 \hat{\pi}_2 = \xi \hat{b}_1$, with $\xi \equiv \left[1 - \delta (\beta^{-1} - \psi)^{-1}\right] / b_*$ capturing the
 4 response of the expected inflation needed to stabilize the real stock of debt. Consequently,
 5 at time $t = 1$, the REE inflation must satisfy $\tilde{\pi}_1 = \psi_A^{-1} \epsilon_1^d + \psi_A^{-1} \xi \hat{b}_1$, and the stock of debt
 6 satisfies $\hat{b}_1 = b_* (\psi_A - \beta^{-1}) \tilde{\pi}_1$. We can solve these two linear equations and obtain

$$\tilde{\pi}_1 = \frac{1}{\xi b_* \beta^{-1} + \psi_A (1 - \xi b_*)} \epsilon_1^d, \quad (3)$$

$$\hat{b}_1 = \frac{b_* (\psi_A - \beta^{-1})}{\xi b_* \beta^{-1} + \psi_A (1 - \xi b_*)} \epsilon_1^d, \quad (4)$$

7 This is a slightly more complex equilibrium to analyze than the previous ones because both
 8 authorities' actions play some role in shaping macroeconomic outcomes in period 1. In
 9 particular, unlike in Case 1, fiscal policy can now affect inflation outcomes.

10 To simplify the analysis, let us assume that the fiscal authority does not respond at
 11 all to debt; that is, $\delta_A = 0$. In this case, one can use the fact that $\xi b_* = 1$ to simplify
 12 the equilibrium equations (3)-(4). It then follows that inflation in period $t = 1$ is equal to
 13 $\beta \epsilon_1^d$ and is therefore totally unaffected by the monetary authority's actions. The important
 14 lesson is that independent of how strongly the central bank responds to the inflationary
 15 consequences of the discount factor shock during the conflict period ($t = 1$), inflation raises
 16 by the fixed amount $\beta \epsilon_t^d$.

17 Furthermore, it should be noted that debt also rises after the shock because $\psi_A > \beta^{-1}$.³
 18 As in Case 1, this increase is due to active monetary policy: to control inflation the monetary
 19 authority raises the interest rate, which in turn determines an increase in the service cost of
 20 debt. Even more importantly, a more aggressive monetary policy during the conflict period
 21 causes a higher fiscal imbalance, which in turn brings about a higher inflation rate in the
 22 following period. The more hawkish monetary policy is during the conflict period, the larger

³Note that if $\delta_A = 0$, then equation (4) implies that $\hat{b}_1 = [b_* \beta (\psi_A - \beta^{-1})] \epsilon_1^d$.

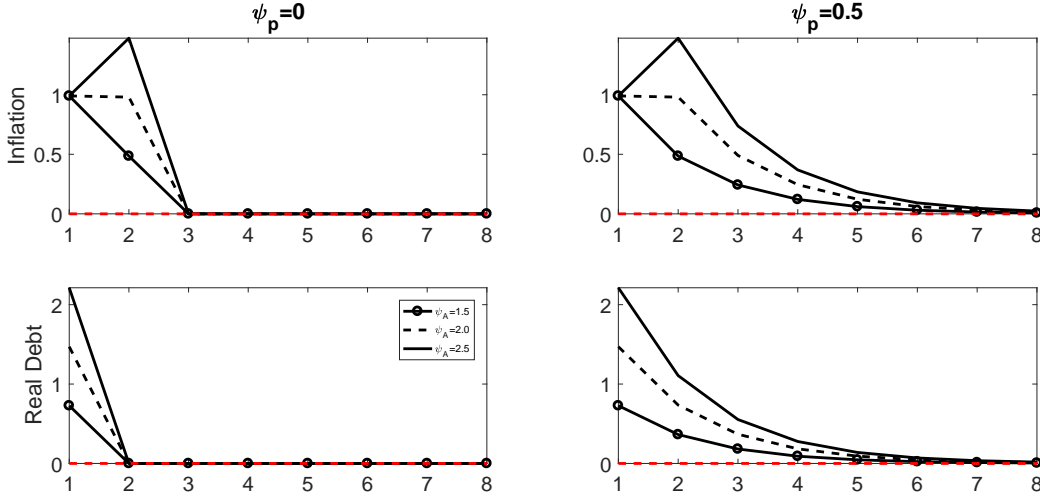


Figure 2: Conflict and fiscally-led Resolution. Response of inflation and real debt to a discount factor shock for different central bank's responses to inflation in period 1 (different lines, see the legend) and from period 2 on. In the left panels, the central bank does not respond to inflation in period 2 on. In the right panels, the central bank's response to inflation in period 2 and on is 0.5. Fiscal policy is active in all periods.

1 the stock of debt at the end of period 1 because monetary tightening raises the interest paid
 2 on government debt. If the central bank keeps responding to inflation in the post-conflict
 3 period ($\psi_P > 0$), then the hawkish policy strategy taken during the conflict period leads
 4 to a persistently higher path of inflation afterward. The central bank's timid responses
 5 to inflation brings about a sequence of fiscal imbalances, which ought to be stabilized by
 6 inflation in the next period.

7 Figure 2 illustrates these three results by showing the propagation of an inflationary
 8 shock for a set of central bank's responses to inflation in period 1, $\psi_A \in \{1.5, 2.0, 2.5\}$, and
 9 for a set of passive responses in subsequent periods, $\psi_P \in \{0, 0.5\}$ (left and right plots,
 10 respectively). We set the discount factor $\beta = 0.9901$. Furthermore, we assume that the
 11 steady-state debt-to-output ratio b_* is equal to 0.6 and the fiscal authority's active response
 12 (δ_A) is equal to 0. The key lesson that we learn from this exercise are as follows: If agents
 13 expect that the central bank has lost fiscal backing permanently, hawkish monetary policy
 14 backfires. Hawkish monetary policy not only fails to lower inflation during the conflict period,

1 but also ends up delivering higher inflation in the post-conflict periods because it generates
 2 an increase in the stock of debt that needs to be stabilized by inflation. As we shall see
 3 subsequently, this key lesson also applies to richer models.

4 **3. A New-Keynesian Model**

5 In this section we build a more elaborate model by extending the prototypical new-
 6 Keynesian model to include a fiscal rule, the possibility of occasionally large recession
 7 episodes that are associated with sizable debt accumulation, and uncertainty about the
 8 post-recession monetary and fiscal policy mix. The model is largely based on the one esti-
 9 mated in Bianchi and Melosi (2017). This will allow us to calibrate the model by borrowing
 10 many of the parameters estimated in that paper. It is worth mentioning that the results
 11 that follow are robust to using simpler or richer versions of the New-Keynesian model. The
 12 key ingredients are the presence of nominal rigidities, to create a link between inflation and
 13 real activity, and changes in policymakers' behavior, to create the possibility of a conflict
 14 between the monetary and fiscal authorities.

15 *3.1. The Model*

16 **Households.** Households derive utility from consumption C_t and disutility from labor
 17 h_t :

$$18 \quad \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \exp \left(\bar{d}_{\xi_t^d} \right) [\log (C_t) - h_t] \right], \quad (5)$$

where β is the household's discount factor and $\bar{d}_{\xi_t^d}$ is a discrete discount-factor shock that
 can assume two values: high or low (\bar{d}_h or \bar{d}_l). The variable ξ_t^d controls the regime in place
 and evolves according to the transition matrix H^d :

$$H^d = \begin{bmatrix} p_{hh} & 1 - pu \\ 1 - p_{hh} & pu \end{bmatrix},$$

1 where $p_{ji} = P(\xi_{t+1}^d = j | \xi_t^d = i)$. Henceforth, when the the variable $\xi_t^d = h$ and, hence,
 2 $\bar{d}_{\xi_t^d} = \bar{d}_h$, we say that the economy is in the *high state of demand*. Conversely, when the the
 3 variable $\xi_t^d = l$ and, hence, $\bar{d}_{\xi_t^d} = \bar{d}_l$, we say that the economy is in the *low state of demand*.

This specification is in the spirit of Christiano et al. (2011). However, in the current setup shocks to preferences are assumed to be recurrent, and agents take into account that these episodes can lead to unusual responses from policymakers, as discussed later on. The household budget constraint is given by:

$$P_t C_t + P_t^m B_t^m + P_t^s B_t^s = P_t W_t h_t + B_{t-1}^s + (1 + \rho P_t^m) B_{t-1}^m + P_t D_t - T_t + TR_t,$$

4 where D_t stands for real dividends paid by the firms, P_t is the price of consumption good, h_t
 5 is hours, W_t is the real wage, T_t is taxes, and TR_t stands for transfers. Following Woodford
 6 (2001), we assume that there are two types of government bonds: one-period government
 7 debt, B_t^s , in zero net supply with price P_t^s , and a more general portfolio of government debt,
 8 B_t^m , in non-zero net supply with price P_t^m . The former debt instrument satisfies $P_t^s = R_t^{-1}$.
 9 The latter debt instrument has the payment structure $\rho^{T-(t+1)}$ for $T > t$ and $0 < \rho < 1$. The
 10 asset can be interpreted as a portfolio of infinitely many bonds with an average maturity
 11 controlled by the parameter ρ . The value of such an instrument issued in period t in any
 12 future period $t + j$ is $P_{t+j}^{m-j} = \rho^j P_{t+j}^m$.

13 **Firms.** The representative firm j faces a downward-sloping demand curve with price
 14 elasticity $1/v$: $Y_t(j) = (P_t(j)/P_t)^{-1/v} Y_t$. Differentiated goods $Y_t(j)$ are aggregated into final
 15 goods Y_t through a standard CES aggregator function. Whenever a firm changes its price,
 16 it faces a quadratic adjustment cost:

$$17 \quad AC_t(j) = .5\varphi (P_t(j)/P_{t-1}(j) - \Pi)^2 Y_t(j) P_t(j)/P_t, \quad (6)$$

where $\Pi_t = P_t/P_{t-1}$ is gross inflation at time t and Π is the corresponding deterministic steady state. Shocks to the elasticity of substitution imply shocks to the markup $\aleph_t =$

$1/(1 - v_t)$. We assume that the rescaled markup $\mu_t = \kappa \log(\aleph_t/\aleph)$ follows an autoregressive process, $\mu_t = \rho_\mu \mu_{t-1} + \sigma_\mu \epsilon_{\mu,t}$, where $\kappa \equiv \frac{1-v}{v\varphi\Pi^2}$ is the slope of the Phillips curve. The firm chooses the price $P_t(j)$ to maximize the present value of future profits:

$$\mathbb{E}_t [\sum_{s=t}^{\infty} Q_s ([P_s(j)/P_s] Y_s(j) - W_s h_s(j) - AC_s(j))],$$

1 where Q_s is the stochastic discount factor for the representative household. Labor is the only
 2 input in the firm production function, $Y_t(j) = A_t h_t^{1-\alpha}(j)$, where total factor productivity
 3 A_t evolves according to an exogenous process: $\ln(A_t/A_{t-1}) = \gamma + a_t$, $a_t = \rho_a a_{t-1} + \sigma_a \epsilon_{a,t}$,
 4 $\epsilon_{a,t} \sim N(0, 1)$. Firms take as given the general price level, P_t , the equilibrium real wages,
 5 W_t , and the level of real activity, Y_t .

Government. Imposing the restriction that one-period debt is in zero net supply, the flow budget constraint of the government is given by:

$$P_t^m B_t^m = B_{t-1}^m (1 + \rho P_t^m) - T_t + E_t,$$

where E_t represents government expenditure, which is the sum of government transfers and government goods purchases: $E_t = TR_t + P_t G_t$. We rewrite the federal government budget constraint in terms of the debt-to-output ratio $b_t^m \equiv (P_t^m B_t^m) / (P_t Y_t)$:

$$b_t^m = (b_{t-1}^m R_{t-1,t}^m) / (\Pi_t Y_t / Y_{t-1}) - \tau_t + e_t,$$

6 where $R_{t-1,t}^m = (1 + \rho P_t^m) / P_{t-1}^m$ is the realized return of the maturity bond and all the
 7 fiscal variables in the above equation are expressed as a fraction of nominal output; that is,
 8 $\tau_t \equiv T_t / P_t Y_t$ and $e_t \equiv E_t / P_t Y_t$.

1 Let us denote the government transfers as a fraction of nominal output as tr_t . The
2 linearized transfers as a fraction of nominal output, \tilde{tr}_t , is assumed to follow

$$\begin{aligned} (\hat{tr}_t - \hat{tr}_t^*) &= \rho_{tr} (\hat{tr}_{t-1} - \hat{tr}_{t-1}^*) + (1 - \rho_{tr}) \psi_y (\tilde{y}_t - \tilde{y}_t^*) + \sigma_{tr} \epsilon_{tr,t}, \\ \hat{tr}_t^* &= \rho_{tr}^* \hat{tr}_{t-1}^* + \sigma_{tr^*} \epsilon_{tr^*,t}, \quad \epsilon_{tr^*,t} \sim N(0, 1), \quad \epsilon_{tr,t} \sim N(0, 1), \end{aligned}$$

3 where \hat{tr}_t^* represents a long-term component that is meant to capture the large programs that
4 arise as the result of a political process that is not modeled here.⁴ Transfers move around
5 this trend component as a result of business cycle fluctuations captured by the log-linearized
6 output gap $(\tilde{y}_t - \tilde{y}_t^*)$, where \tilde{y}_t^* is potential output in log-deviations from its steady-state
7 value. Potential output is defined as the output that would arise under flexible prices and
8 no markup shocks. The government also buys a fraction G_t/Y_t of total output. We define
9 $g_t \equiv 1/(1 - G_t/Y_t)$, and we assume that $\tilde{g}_t \equiv \ln(g_t/g)$ follows an autoregressive process:
10 $\tilde{g}_t = \rho_g \tilde{g}_{t-1} + \sigma_g \epsilon_{g,t}$, $\epsilon_{g,t} \sim N(0, 1)$.

11 **Policy Rules.** The monetary policy rule reads as follows:

$$12 \quad R_t/R = (R_{t-1}/R)^{\rho_{R,\xi_t^p}} \left[(\Pi_t/\Pi)^{\psi_{\pi,\xi_t^p}} (Y_t/Y_t^*)^{\psi_{y,\xi_t^p}} \right]^{(1-\rho_{R,\xi_t^p})} e^{\sigma_R \epsilon_{R,t}}, \quad (7)$$

13 where R is the steady-state gross nominal interest rate. The parameters ψ_{π,ξ_t^p} and ψ_{y,ξ_t^p}
14 capture the central bank's response to inflation and the output gap, which depends on the
15 policy mix ξ_t^p in place at time t . As explained in the next section, the policy mix in place
16 will also depend on the state of demand that, in turn, is controlled by ξ_t^d .

17 The fiscal authority sets taxes according to the following rule:

$$18 \quad \hat{\tau}_t = \rho_{\tau,\xi_t^p} \hat{\tau}_{t-1} + \left(1 - \rho_{\tau,\xi_t^p} \right) \left[\delta_{b,\xi_t^p} \hat{b}_{t-1}^m + \delta_y (\tilde{y}_t - \tilde{y}_t^*) \right] + \sigma_{\tau} \epsilon_{\tau,t}, \quad (8)$$

19 where $\hat{\tau}_t$ is the level of tax-revenues-to-GDP ratio in linear deviations from the steady state.
20 The parameter δ_{b,ξ_t^p} captures the fiscal authority's attitude toward debt stabilization, which

⁴In what follows, \tilde{x}_t denotes the log-deviations of a (stationary) variable from its steady-state value. For all the variables normalized with respect to nominal output (debt, expenditure, transfers, and taxes), \hat{x}_t denotes linear deviations from the steady state.

1 depends on the type of policy mix ξ_t^p in place at time t . Even for the fiscal rule, the policy
 2 rule in place will also depend on the state of demand that, in turn, is controlled by ξ_t^d .

3 3.2. Policy Regimes

4 The Markov-switching process ξ_t^p determines the policy mix *conditional* on the state of
 5 demand ξ_t^d . This exogenous variable captures in reduced form the complex interplay between
 6 the monetary and fiscal authorities. The fact that the state of demand is discrete makes it
 7 easier to condition the type of monetary and fiscal policies adopted, which is captured by ξ_t^p ,
 8 on the state of demand, which is captured by ξ_t^d . Agents are rational, and they understand
 9 that recessions and expansions affects the way in which the monetary and fiscal authorities
 10 coordinate their policies.

11 When the state of the demand is high ($\xi_t^d = \bar{d}_h$), three possible policy mixes can arise
 12 depending on ξ_t^p . Policymakers can conduct a *monetary-led policy mix* ($\xi_t^p = M$), with
 13 monetary policy geared toward inflation stabilization ($\psi_\pi = \psi_{\pi,M} > 1$) and fiscal policy
 14 aimed at adjusting primary surpluses to stabilize the debt-to-output ratio ($\delta_b = \delta_{b,M} >$
 15 $\beta^{-1} - 1$). When demand is high, policymakers can also follow a *fiscally-led policy mix*
 16 ($\xi_t^p = F$), with the monetary authority that de-emphasizes inflation stabilization ($\psi_\pi =$
 17 $\psi_{\pi,F} \leq 1$) and the fiscal authority that disregards the level of debt ($\delta_b = \delta_{b,F} \leq \beta^{-1} - 1$).
 18 Finally, a *non-coordinated* (or *conflict*) *policy mix* ($\xi_t^p = C$) can arise, with the monetary
 19 authority that is resolute in his commitment to stabilize inflation ($\psi_\pi = \psi_{\pi,C} > 1$) and
 20 the fiscal authority that disregards debt stabilization ($\delta_b = \delta_{b,C} \leq \beta^{-1} - 1$). As shown in
 21 the Fisherian model, the third policy mix leads to no stable rational expectations equilibria
 22 when considered in isolation.⁵ In this case, the fiscal authority would like inflation to adjust
 23 to stabilize debt, whereas the central bank does not want to let inflation go up. Thus, this

⁵Leeper's results for the Fisherian model would apply to this New Keynesian model if the policy regimes were not allowed to change. With Markov-switching, the analysis of global stability of the system is more complicated. We will focus on parameterizations that ensure mean square stability of the model (Costa, Fragoso, and Marques 2004).

1 regime captures the possibility that the monetary and fiscal authorities go through a conflict
 2 over the determination of the rate of inflation. We refer to this type of policy mix as non-
 3 coordinated in the sense that policymakers are not in agreement about what is the rate of
 4 inflation that they see as appropriate.

5 When the state of demand is low ($\xi_t^d = \bar{d}_l$), we assume that the monetary authority
 6 de-emphasizes inflation stabilization and the fiscal authority carries out a fiscal stimulus by
 7 momentarily disregarding the level of debt. Therefore, when the state of demand is low, the
 8 policy mix is fiscally led ($\psi_\pi = \psi_{\pi,F} \leq 1$ and $\delta_b = \delta_{b,F} \leq \beta^{-1} - 1$). It is worth clarifying that
 9 the fact that policymakers respond with the fiscally-led policy mix to large recessions is not
 10 essential for the main results of this paper. However, we believe that this assumption is quite
 11 plausible, since policymakers arguably put less emphasis on inflation and debt stabilization
 12 during severe economic downturns.

More formally, the joint dynamics of demand and policy regimes are captured by the following transition matrix Q :

$$Q = \begin{bmatrix} p_{hh}Q^H & (1 - p_{lu})Q^O \\ (1 - p_{hh})Q^I & p_{lu}Q^L \end{bmatrix}.$$

13 The columns of this matrix sum to one. The matrix Q^H controls the dynamics of the policy
 14 regime ξ_t^p conditional on being in a high state of demand. As we discussed earlier, when
 15 the state of demand is high, the policy regime can be monetary led, fiscally led, or non-
 16 coordinated. Q^L is the transition matrix that governs the evolution of policy regimes during
 17 the large recession triggered by the discrete demand shock ξ_t^d (the low state of demand). As
 18 we noticed before, these regimes are all characterized by the fiscally-led policy mix. However,
 19 the regimes differ in terms of the policy mix that is likely to prevail once the negative
 20 preference shock is reabsorbed. These possible outcomes are captured by the transition
 21 matrix Q^O . The matrix Q^I controls the policy regime dynamics when the low state of

1 demand materializes ($\xi_t^d = \bar{d}_l$).

2 This modelling framework captures rational agents' uncertainty about the response of
3 policymakers to the potentially large accumulation of debt that occurs in response to a large
4 contractionary shock. As we shall see, agents' beliefs about what will happen after a large
5 recession are critical for the macroeconomic dynamics during the recession. These beliefs
6 are captured by the matrix Q^O . The remaining shocks are assumed to be small, and hence,
7 recessions caused by these shocks are assumed not to give rise to relevant fiscal strain.

8 We linearize the fiscal variables around the steady state and log-linearize all the non-fiscal
9 variables. Details on how we solve the linearized model are in Appendix B.

10 3.3. *Policy Conflicts and Solution*

11 In this paper, we contemplate scenarios in which agents expect that the fiscal authority
12 can disregard the level of debt (active fiscal policy) while the central bank remains committed
13 to stabilizing inflation (active monetary policy). We call this mix of active monetary and
14 fiscal policies non-coordinated because it is inconsistent with determining the unique path for
15 inflation. In fact, if this policy mix were followed forever, Leeper (1991) shows that there is
16 no stable rational expectations equilibria. To see why, suppose that inflation is above target
17 and that the Federal Reserve tries to push it down by increasing the federal funds rate more
18 than one-to-one in response to the observed deviation. This action prompts an increase in
19 the real interest rate, a contraction in output, and, consequently, an acceleration in the rise of
20 the debt-to-output ratio. This acceleration in the dynamic of the debt-to-output ratio would
21 require an increase in taxation, but agents know that this is not going to happen because
22 the fiscal authority is active. Therefore, the adjustment has to come through an increase
23 in inflation that triggers an even larger increase in the interest rate and so on. Clearly, the
24 economy is on an explosive path, and if this situation were to persist, no *stationary* solution
25 would exist. This explains while this scenario has been largely neglected in the study of

1 monetary/fiscal policy interactions.

2 However, if the conflict regime is expected to eventually end, the model can still admit
3 a stable and unique rational expectations equilibrium. The model could present temporary
4 explosive dynamics, but as long as these are not expected to last for too long, a stationary
5 solution would still exist. This is the key insight that allows us to solve the model allowing
6 for periods of conflict by leveraging the recent advancements in the literature on solution
7 methods for Markov-switching general equilibrium models. We use the solution algorithm
8 proposed by Farmer, Waggoner, and Zha (2009). This solution method requires the solution
9 to satisfy mean square stability: First and second moments need to be stationary when taking
10 into account the possibility of regime changes. However, quite importantly, the solution
11 method does *not* impose that all regimes taken in isolation are stationary, allowing for
12 temporary explosive dynamics. Given that agents form expectations by taking into account
13 the possibility of regime changes, their expectations are still finite at every horizon, even
14 when the economy is temporarily on an explosive path because of the conflict between the
15 two authorities. As we shall see, the properties of the solution are determined by which
16 authority agents expect to eventually give up by moving to a passive policy.

17 **4. The Effects of Lack of Policy Coordination**

18 The goal of this section is to describe the calibration of the model parameters as well as
19 to study the implications of the lack of coordination between monetary and fiscal policies.
20 As we shall clarify, agents' expectations about the policy mix that will arise after the conflict
21 between the two authorities play a critical role in shaping macroeconomic outcomes during
22 the conflict.

Parameter	Value	Parameter	Value
$\psi_{\pi,M}$	1.7890	p_{hh}	0.9999
$\psi_{y,M}$	0.4413	p_{ll}	0.9465
$\rho_{R,M}$	0.8697	p_{MM}	0.9902
$\delta_{b,M}$	0.0778	p_{FF}	0.9932
$\rho_{\tau,M}$	0.9666	p_{CC}	0.9000
$\psi_{\pi,F}$	0.6903	δ_y	0.2814
$\psi_{y,F}$	0.2655	ϕ_y	-2.0000
$\rho_{R,F}$	0.6576	ρ_{tr}	0.4620
$\delta_{b,F}$	0.0000	\bar{d}_h	0.0429
$\rho_{\tau,F}$	0.6501	\bar{d}_l	-0.1300
$\psi_{\pi,C}$	2.0000	κ	0.0072
$\psi_{y,C}$	0.0000	$b_*/4$	0.2795
$\delta_{b,C}$	0.0000	$100 \ln \gamma$	0.4120
$\rho_{R,C}$	0.0000	$100 \ln \Pi$	0.5000
$\rho_{\tau,C}$	0.6501	$100 \ln R$	1.0628

Table 1: Parameter values and transition matrix elements calibrated based on Bianchi and Melosi (2017). Only the parameters that matter for the simulations in the main text of the paper are reported in the table. The complete table is shown in Appendix C.

1 4.1. Calibration

2 Table 1 shows the parameter values used in this paper. We denote the probability of
3 staying in the monetary-led, fiscally-led, and conflict policy mix as p_{MM} , p_{FF} , and p_{CC} ,
4 respectively. Most of the parameter values and transition probabilities are based on a previ-
5 ous estimation by Bianchi and Melosi (2017). Nonetheless, the model estimated by Bianchi
6 and Melosi (2017) does not feature non-coordinated regimes. We calibrate the probability
7 $p_{CC} = 0.90$, implying that agents expect the conflict regime to last 10 quarters. Moderate
8 changes to this parameter values in this parameter would not affect the key mechanisms that
9 will be discussed later. We assume that during the conflict the central bank responds even
10 more strongly to inflation than in the monetary-led case ($\psi_{\pi,C} = 2.0 > \psi_{\pi,M}$). Furthermore,
11 the central bank is totally focused on controlling inflation and completely disregards the
12 level of real activity $\psi_{y,C} = 0$. This parameter choice serves the important purpose of clearly
13 showing the leading mechanisms at play when policymakers do not coordinate their policies

1 or when they are expected not to coordinate their policies after a large recession. To induce
 2 large debt accumulation during the low state of demand, we assume that transfers adjust
 3 more strongly to business cycle conditions (δ_y) than during regular business cycle fluctua-
 4 tions. These parameter choices allow us to see the effects of a lack of monetary and fiscal
 5 policy coordination more clearly in the graphs that follow but these choices do not affect the
 6 main results of the paper.

7 The magnitude of the negative demand shock (\bar{d}_l) is three times smaller than the shock
 8 that caused the Great Recession based on the estimates of Bianchi and Melosi (2017). We
 9 set the value of the negative demand shock to be smaller in order to avoid the issue of the
 10 zero lower bound of interest rates. Increasing the magnitude of the negative discrete demand
 11 shock would strengthen the results of the paper but at the costs of making the exposition
 12 of the key mechanisms unnecessarily more complicated. We consider the zero lower bound
 13 case when discussing a possible resolution of the conflict. The parameter $b_*/4$ denotes the
 14 steady-state debt-to-output ratio on an annualized basis whose value is estimated by Bianchi
 15 and Melosi (2017). The other parameters do not play a key role in determining the results
 16 that follow. The table with all the parameter values is shown in Appendix C.

17 Following Bianchi and Melosi (2017), the probability that a large recession hits in every
 18 high-demand period is very tiny, since the probability p_{hh} is very close to one. This para-
 19 meterization simplifies the analysis substantially by implying that once the economy exits
 20 the recession, the high-demand regime is very close to an absorbing state. The value for the
 21 parameter ρ captures the average duration of U.S. debt which is roughly five years. The
 22 parameter controlling the elasticity of substitution between differentiated goods, ν , and the
 23 parameter controlling the degree of nominal rigidities φ are not separably identifiable once
 24 the model is log-linearized and, hence, as in Bianchi and Melosi (2017), we directly calibrate
 25 the slope of the New Keynesian Phillips curve, κ , that links inflation $\tilde{\pi}_t$ to real activity \hat{y}_t .
 26 The value of β is pinned down by $\gamma\Pi/R$, whose values are provided in Table 1.

1 We use the calibrated model to run a series of simulations to study situations in which
2 agents lose their trust in the fiscal authority's commitment to make the necessary fiscal
3 adjustments to stabilize debt. Apart from the initial debt-to-output ratio, which is calibrated
4 to match the U.S. debt at the end of 2016 according to the CBO (77%), in all simulations
5 we assume that all variables are at the steady state when the economy is hit by a negative
6 discrete demand shock. We then simulate the economy conditional on a certain path for the
7 regimes. Agents do not have perfect foresight about this regime sequence, but, consistently
8 with the model, they observe the current regime and know the probabilities of moving across
9 the different regimes.

10 When the negative demand shock hits, policymakers adopt a fiscally-led policy mix in an
11 attempt to carry out a fiscal stimulus. The debt-to-output ratio increases and agents expect
12 one of the following post-recession outcomes: (i) the fiscal authority is committed to make
13 the necessary fiscal adjustments to stabilize the growing debt-to-output ratio (monetary-led
14 policy mix); (ii) the fiscal authority is not committed to stabilize the post-recession debt
15 and the central bank is expected to accommodate this decision by de-emphasizing inflation
16 stabilization (fiscally-led policy mix); (iii) the fiscal authority is not committed to stabilize
17 the post-recession debt and the central bank is expected to fight back against the fiscal
18 authority in an attempt to stabilize inflation (non-coordination). This institutional conflict
19 lasts only temporarily, and agents form expectations about which authority will eventually
20 emerge victorious from the conflict. If agents expect that the fiscally-led (monetary-led)
21 policy mix will be adopted following the conflict, we say that the fiscal (monetary) authority
22 is expected to prevail in the conflict over the control of the rate of inflation. To simplify the
23 exposition of the results, we assume that agents' beliefs turn out to be correct.

These four possible post-recession scenarios ($\xi_t^p = M$, $\xi_t^p = F$, $\xi_t^p = C$ with the fiscal authority expected to win, and $\xi_t^p = C$ with the monetary authority expected to win) and the out-of-the-recession outcomes are modeled by introducing eight regimes. The first two

regimes capture the coordinated policy mixes under the high state of demand. The third and fourth regimes are non-coordinated regimes that differ in their probability of moving to the monetary-led policy mix as the conflict ends. The third regime is assumed to lead to the monetary-led policy mix with probability one, whereas the fourth regime is assumed to lead to the fiscally-led policy mix with probability one. The four fiscally-led regimes during the low state of demand differ on the probability of moving to the four high-demand policy combinations. This parameterization implies that during the low state of demand, agents know with certainty which policy mix will be realized once the economy moves back to the high state of demand. While this is certainly a strong assumption, it allows us to isolate the key mechanisms at work. We show how this assumption affects our results in the appendix. All in all, the evolution of these eight regimes is captured by the following transition matrix for regimes (ξ_t^d, ξ_t^p) :

$$Q = \begin{bmatrix} p_{hh}Q^H & (1 - p_{ll}) \cdot I_4 \\ (1 - p_{hh})0.25 \cdot \mathbf{1}_{4 \times 4} & p_{ll} \cdot I_4 \end{bmatrix},$$

where $\mathbf{1}_{4 \times 4}$ is a 4×4 matrix of ones, I_n denotes the $n \times n$ identity matrix, and the dynamics of the policy regimes when the recession is over (or more precisely, when the state of demand is high $\xi_t^d = \bar{d}_h$) is given by

$$Q^H = \left[\begin{array}{cc|cc} p_{MM} & 1 - p_{FF} & 1 - p_{CC} & 0 \\ 1 - p_{MM} & p_{FF} & 0 & 1 - p_{CC} \\ \hline 0 & 0 & p_{CC} & 0 \\ 0 & 0 & 0 & p_{CC} \end{array} \right].$$

- 1 Agents take into account the possibility of large recessions and the consequent changes in
- 2 policymakers' behaviors.

1 *4.2. Macroeconomic Dynamics with Lack of Coordination*

2 Figure 3 shows the macroeconomic dynamics of the output gap, inflation, the federal
 3 funds rate, the debt-to-GDP ratio, the price of government bonds ($\ln P_t^m$), and the ex-ante
 4 real federal funds rate under the following sequence of events. At time $t = 0$, the economy is
 5 at the steady state, except for the (annualized) debt-to-GDP ratio at 77.0%. At time $t = 1$
 6 the economy is hit by the negative demand shock until time $t = 10$ ($\xi_t^d = \bar{d}_l$ for $1 \leq t \leq 10$).
 7 This low-demand period is highlighted by the dark gray area. From period $t = 11$ through
 8 period $t = 30$, the economy switches back to the high state of demand. We consider two
 9 cases. In the first case, during the low state of demand, agents expect that policymakers will
 10 conduct a fiscally-led policy mix (coordination) once the state of demand switches back to
 11 high in period 11 (dashed line). In the second case, during the low state of demand, agents
 12 expect that policymakers will compete for the control over the rate of inflation once the
 13 state of demand switches back to high in period 11. Furthermore, we assume that agents
 14 expect that the fiscal authority will eventually prevail. In other words, when the conflict
 15 ends, the central bank is expected to change policy and the policy mix becomes fiscally led.
 16 This second case is captured by the solid line.

17 We assume that if it occurs, the conflict regime lasts for ten quarters and then the fiscally-
 18 led policy mix will stay in place from period 21 through period 30. The period of conflict
 19 between the two authorities is highlighted by the light gray area in Figure 3. Agents do not
 20 know ex-ante the exact duration of the recession (the dark gray area), how many periods the
 21 post-recession institutional conflict will last (the light gray area), and how long the high state
 22 of demand will persist (the light gray area and the white area). However, agents observe the
 23 history of regimes and know their likely durations.

24 **Conflict and Fiscally-led Resolution.** When agents expect an institutional conflict
 25 followed by the fiscally-led policy mix, agents anticipate that the large and growing stock
 26 of debt will be inflated away. Hence, inflation expectations and inflation rise. During the

1 conflict period ($11 \leq t \leq 20$) the central bank applies the Taylor principle to rein in these
2 inflationary pressures. The monetary tightening conducted during the conflict period deter-
3 mines an increase in real interest rates. As a result, the service cost of debt increases and
4 the economy enters a recession. Both effects of the monetary policy intervention lead to
5 further debt accumulation, exacerbating the fiscal imbalance, despite the fact that the mar-
6 ket value of debt (price of bonds) declines in response to the increase in interest rates. The
7 further debt accumulation, in turn, strengthens the inflationary pressures because agents
8 expect the fiscal authority to eventually prevail and, hence, disregard debt stabilization for
9 a long time. But higher inflationary pressures call for further monetary tightening, which
10 leads to an even larger recession and greater fiscal imbalance. Therefore, when agents expect
11 a conflict between policymakers, the economy goes through a vicious spiral of higher debt,
12 higher inflation, higher interest rate, and lower real activity.

13 Monetary policy interventions, consequently, lead to a double-dip recession. The second
14 recession is entirely due to policymakers' behaviors because the state of demand is high from
15 period 11 on. Furthermore, during the first recession, forward-looking and rational agents
16 anticipate the macroeconomic dynamics that will occur during the conflict. Therefore, ex-
17 pecting an institutional conflict causes the economic crisis to be more severe and gives rise to
18 upward pressures on inflation during the recession period (the dark gray area). Interestingly,
19 the dynamics of the variables depicted in Figure 3 are temporarily explosive during the con-
20 flict period (the light gray area). As explained earlier in the paper, if these dynamics were
21 to persist forever, they would not be consistent with a stationary solution for the model.
22 However, the model is solved taking into account that this pattern is only temporary and
23 that eventually the conflict will come to an end.

24 What is concerning is that during the institutional conflict (the light gray area), the
25 central bank is incapable of reining in inflation. The monetary authority follows the Taylor
26 principle and raises the interest rate aggressively to lower inflation. Nonetheless, inflation

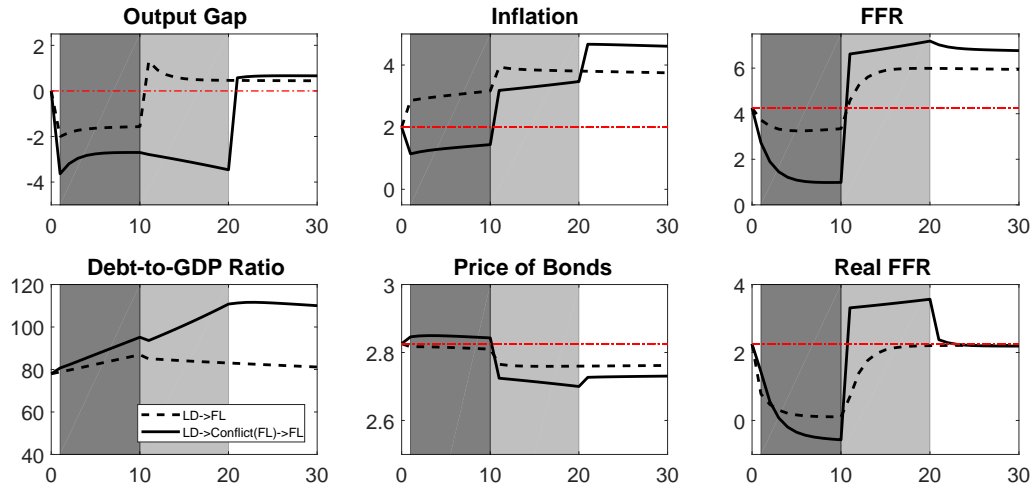


Figure 3: Dynamics of the output gap, inflation, the federal funds rate (FFR), the debt-to-GDP ratio, the price of bonds, and the ex-ante real federal funds rate when a negative discrete demand shock occurs in period 1 and persists until period 10 (the dark gray area). The discrete demand shock switches back to high from period 11 through period 30. The dashed line captures the macroeconomic dynamics when agents expect that policymakers will coordinate to follow the fiscally-led policy mix once the discrete demand shock switches back to high. The solid line captures the situation when agents expect a conflict between the two authorities to break out right after the end of the low-demand period. The conflict is assumed to occur from period 11 through period 20 (the light gray area) and agents expect that the fiscal authority will win; that is, the policymakers will engage in fiscally-led policies from period 21 on. The dashed-dotted line captures the steady-state values.

1 keeps growing. The lesson we learn is that when the central bank lacks the necessary fiscal
 2 backing, hawkish monetary policy is not only ineffective, but also counterproductive, as it
 3 leads to a spiral of low output and high inflation. The central bank's inability of controlling
 4 inflation during the institutional conflict can make the Federal Reserve an easy target for
 5 the media that could bring into question the central bank's ability to control inflation and
 6 the soundness of the implemented policies.

7 If instead agents expect that policymakers will immediately coordinate on the fiscally-led
 8 policy mix once the state of demand switches back to high, the large stock of debt leads to
 9 heightened and persistent inflation, with a consequent decline in the market value of debt
 10 that helps mitigate the fiscal burden. Since heightened inflation expectations reduce the real

1 value of debt, debt-to-GDP ratio grows only moderately during the recession. Furthermore,
2 the dovish monetary policy keeps the real interest rate low, which contributes to mitigating
3 the severity of the recession during the low-demand period (the dark gray area) and leads
4 to an economic boom when the discrete demand shock becomes positive again ($t \geq 11$).

5 The outcomes of both the coordinated and the uncoordinated strategies are clearly far
6 from being desirable. While the coordinated strategy clearly dominates the non-coordinated
7 both in terms of output stabilization and in terms of achieving a lower inflation rate, in both
8 cases policymakers miss their objective of keeping inflation low. During the low-demand
9 period (the dark gray area) and the post-conflict period (from period 21 on) policymakers
10 follow the same policy mix (i.e., the fiscally-led policy mix). Therefore, in Figure 3 the
11 vertical difference between the solid line and the dashed line during the low-demand period
12 (the dark gray area) captures the effects of expecting a conflict followed by the fiscally-led
13 policy mix on the macroeconomy. These effects are fairly large. The recession is more severe
14 and prolonged and the larger stock of debt pushes inflation on a higher path. The vertical
15 difference between the solid and the dashed line from period 11 on (the light gray area)
16 captures the macroeconomic implications of going through a conflict. These implications are
17 also very severe especially for real activity.

18 **Conflict and Monetary-led resolution.** Figure 4 compares the scenario that we
19 just discussed (solid line) with the opposite polar case in which the monetary authority is
20 expected to eventually prevail (dotted line). When the monetary authority is expected to
21 prevail, the fiscal stimulus is ineffective in raising inflation expectations and, hence, to lower
22 the real interest rate during the low-demand period. As a result, the economy goes through
23 an output contraction and experiences a sizable drop in inflation. The market value of debt
24 increases given that no inflation is expected to occur in the future, while interest rates are
25 low. Inflation moves close to the target once the demand shock switches back to the high
26 state. Nonetheless, the central bank tries to fight the persistent inflation that arises after

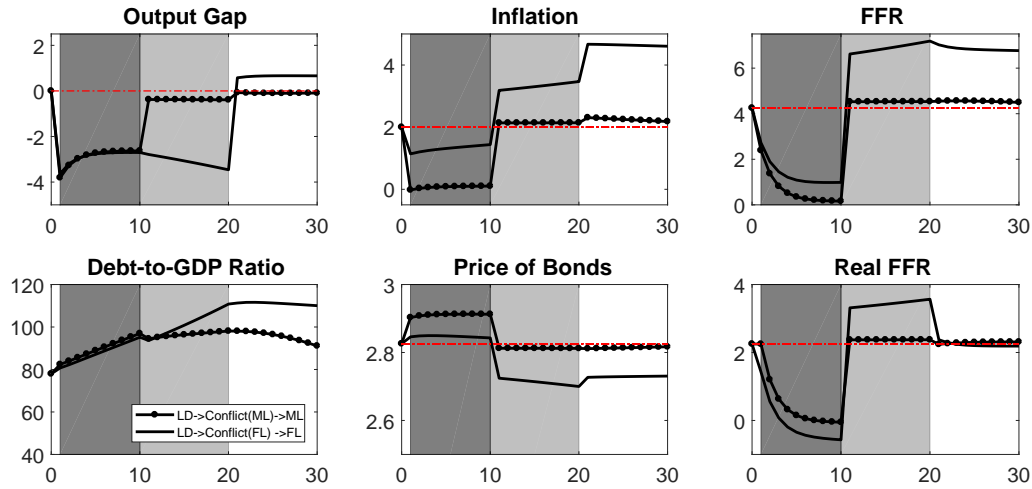


Figure 4: Dynamics of the output gap, inflation, the federal funds rate (FFR), the debt-to-GDP ratio, the price of bonds, and the ex-ante real federal funds rate when a negative discrete demand shock occurs in period 1 and persists until period 10 (the dark gray area). The discrete demand shock switches back to high from period 11 through period 30. Agents expect a conflict between the two authorities following the end of the low demand shock period. The conflict is assumed to occur from period 11 through period 20 (the light gray area). The solid line captures the case in which agents expect that the fiscal authority will win the conflict and, hence, the policy mix is expected to be fiscally led after the conflict. The dotted line captures the case in which the monetary authority is expected to prevail and, hence, the policy mix is expected to be monetary led after the conflict period. The dashed-dotted line captures the steady-state values.

1 the recession and, in doing so, impairs the economic activity, with the output gap remaining
 2 in negative territory for the duration of the institutional conflict. Once the fiscal authority
 3 gives up and switches to passive fiscal policy, economic activity improves but still remains
 4 in negative territory because of the contractionary monetary policy.

5 Output remain slightly below target after the conflict is resolved and policymakers follow
 6 the monetary-led policy mix because the central bank conducts an active policy and tries
 7 to rein in inflation that remains persistently above target. In turn, inflation is slightly
 8 above target because of the large stock of debt accumulated during the recession and the
 9 institutional conflict. Since agents are aware of regime changes, they understand that the
 10 government can always renege on its commitment to stabilize the large stock of debt by

1 raising taxes and move to the fiscally-led policy mix. However, the probability of this event is
2 quite small: $1 - p_{MM} = 0.68\%$. When the stock of debt is low, a low probability that the fiscal
3 authority will give up on stabilizing debt does not raise inflation expectations significantly.
4 Nonetheless, when the stock of debt is so high as the one accumulated during the large
5 recession (the dark gray area) and the subsequent institutional conflict (the light gray area)
6 in Figure 4, inflation remains above its steady-state value even though the probability that
7 policymakers will engage in the fiscally-led policy mix in the future is small. This is for
8 two reasons. First, such a large stock of debt can be stabilized only over a long period of
9 time and the probability that policymakers will switch to the fiscally-led policies during this
10 long period of time is not negligible. Second, if the switch to fiscally-led policies happens
11 when debt is high, the inflationary consequences will be very severe. Furthermore, it should
12 be noted that the little bump in inflation after the conflict and the associated amelioration
13 of the output gap are due to the less aggressive anti-inflationary policy conducted by the
14 central bank under the monetary-led policy mix compared with the monetary policy carried
15 out during the conflict period ($\psi_{\pi,M} < \psi_{\pi,C}$; see Table 1).

16 It is also interesting to notice that the output gap falls by a similar amount during the
17 low-demand period independently of the private sector's expectations about future monetary
18 and fiscal policies. In this respect, it is worth noting that there are two main effects on the
19 output gap during the low-demand period. If agents expect a conflict followed by the fiscally-
20 led policy mix, they also expect a double-dip recession when the demand switches to the
21 high state from period 11 until the end of the institutional conflict. These expectations
22 worsen the recession during the low-demand period. If agents expect a conflict followed by
23 the fiscally-led regime, the more persistent (in expectations) the conflict regime, the deeper
24 the high-demand recession, and the worse the low-demand recession. There is, however, a
25 second effect. When agents expect that the monetary authority will prevail, policymakers
26 fail to raise inflation and, in fact, inflation is close to zero during the low-demand period.

1 On the contrary, when the fiscal authority is expected to prevail, inflation does not drop and
 2 remains close to target. Therefore, in the former case the real interest rate is higher and,
 3 hence, consumption and output are lower, everything else being equal.

4 Given our calibration based on the US economy, it turns out that these two effects tend
 5 to cancel each other out. Thus, the output gap during the low-demand period is remarkably
 6 similar regardless of the expected resolution of the conflict. This result is not general and
 7 implies by no means that the expected resolution of the conflict is inconsequential for the
 8 output dynamics during the low-demand period. In Appendix E, we illustrate this point via
 9 a counterexample.

10 **Conflict and Uncertain Resolution.** So far, we have considered the two polar cases
 11 in which agents expect either the monetary-led resolution to the conflict with certainty or
 12 the fiscally-led resolution with probability one. We have chosen these polar cases in order
 13 to simplify the explanation of the mechanisms at play. Nevertheless, in practice, agents
 14 are likely to be fairly uncertain about the outcome of an institutional conflict like the one
 15 studied in this paper.⁶ Furthermore, their beliefs might vary over time based on news about
 16 the resolution of the conflict. This type of news induces further macroeconomic volatility as
 17 the economy fluctuates between the two polar cases. As agents become convinced that one of
 18 the authorities will win the conflict, the output gap and inflation suddenly jump on the paths
 19 implied by the two polar cases (the solid and the dotted lines). The higher the probability
 20 that the fiscal (monetary) authority will win, the closer the macroeconomic dynamics will
 21 be to the solid (dotted) line. If beliefs about which authority will prevail after the conflict
 22 are erratic, macroeconomic volatility does increase. This case is dealt with in Appendix D.

⁶To model these dynamics, we add one more conflict regime to the set ξ_t^p . This additional conflict regime is characterized by equal probabilities of moving to the two coordinated high-demand regimes (i.e., the monetary-led regime and the fiscally-led regime). Furthermore, we introduce a fifth low-demand (fiscally-led) regime that leads to this additional conflict regime with probability one when the state of demand switches to high. We also set non-zero probability to observe switches among the three different resolutions during the conflict.

4.3. *News and Inflation Expectations After the Great Recession*

As shown in Figure 1, the Great Recession led to a substantial increase of the U.S. debt-to-GDP ratio. Since the end of the recession, the fiscal authority has not come up with a thorough plan to stabilize the growing fiscal imbalance. According to the CBO, after the increase experienced during the recession, the federal deficit shrank from 2009 through 2015. However, the CBO deemed this fiscal consolidation to be insufficient to stabilize debt. In his Budget and Economic Outlook: 2015 to 2025 the CBO stated that “According to the Congressional Budget Office’s estimates, this year’s deficit will be noticeably smaller than what the agency projected in March, and fiscal year 2015 will mark the sixth consecutive year in which the deficit has declined as a percentage of gross domestic product (GDP) since it peaked in 2009. Over the next 10 years, however, the budget outlook remains much the same as CBO described earlier this year: If current laws generally remain unchanged, within a few years the deficit will begin to rise again relative to GDP, and by 2025, debt held by the public will be higher relative to the size of the economy than it is now.” In sum, the end of the Great Recession ushered a period of heightened uncertainty about how the federal budget will be stabilized. At the same time, the Federal Reserve has repeatedly stated that inflation stability remains its central objective. To achieve this objective, the Fed has begun to lift the federal funds rate as inflation expectations started raising in December 2015.

According to our model, this policy mix (active fiscal policy and active monetary policy) configures a conflict between about whether inflation should be used to stabilize the fiscal imbalance. As previously discussed, during this conflict inflation and output dynamics are largely affected by changes in the private sector’s beliefs about how the latent conflict will be resolved. A fiscal resolution of the conflict occurs if the monetary authority accepts a higher inflation rate to stabilize the debt to output ratio. A monetary resolution of the conflict implies that the fiscal authority will generate fiscal surpluses large enough to stabilize the debt to output ratio. As expectations about a fiscal resolution of the conflict strengthen, the

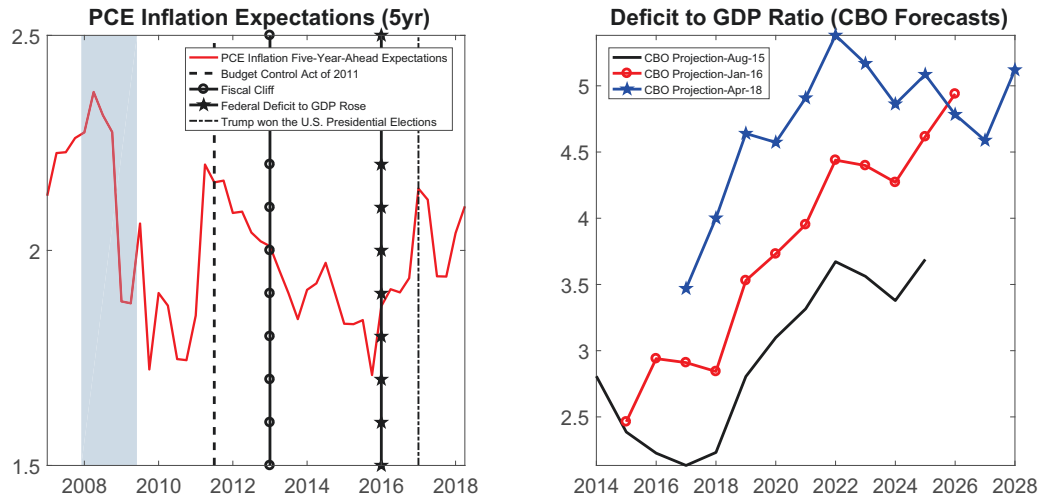


Figure 5: Left plot: Five-year ahead PCE inflation expectations computed using the mean of forecasts reported in the Survey of Professional Forecasters. Right Plot: CBO's projections for the deficit-to-GDP ratio taken in different time periods.

1 model predicts that inflation expectations increase. Conversely, inflation expectations fall
 2 when the private sector receives news reinforcing its beliefs about a monetary resolution of
 3 the conflict. These are the key predictions we will evaluate using the post-Great Recession
 4 data.

5 To this end, we look at the behavior of the Survey of Professionals Forecasters' PCE
 6 inflation expectations at five-year horizon in conjunction with major fiscal events occurring
 7 during the post-Great Recession recovery. We look at inflation expectations mainly because
 8 their dynamics in the last eight years have been very intriguing. While the labor market was
 9 gradually and steadily improving, inflation expectations have declined from 2011 through
 10 the end of 2015, only to experience a sudden reversal in 2016. These patterns are hard
 11 to reconcile using standard models, which predict a positive link between hours worked
 12 and inflation. Our model can explain these apparently inconsistent dynamics of hours and
 13 inflation expectations considering changes in beliefs about how the latent conflict between the
 14 monetary and fiscal authorities will be resolved. Since such expectations are not observed,
 15 we make the reasonable assumption that events that improved (deteriorated) the CBO's

1 projections for the deficit-to-GDP ratio lowered (raised) expectations about a fiscal resolution
2 of the conflict.⁷ This exercise, while not a formal econometric test of the model's fit, is useful
3 to assess whether the key model predictions are consistent with what observed in the data.

4 The left plot of Figure 5 shows that as the U.S. economy recovery started in 2009Q2
5 inflation expectations increased as standard models would predict. Nonetheless, from 2011
6 through 2018Q2, inflation expectations followed a U-shaped pattern that is hard to reconcile
7 with the behavior of real activity. Inflation expectations started falling in the third quarter of
8 2011, which is denoted by the first vertical dashed line in the figure. Our model rationalizes
9 this fall in expectations as the result of the arrival of news about a likely monetary resolution
10 of the conflict during that quarter. During the third quarter of 2011 the debt-ceiling crisis of
11 2011 was resolved with the signing of the Budget Control Act of 2011 into law on August 2,
12 2011. The law introduced several complex mechanisms, such as creation of the Congressional
13 Committee on Deficit Reduction, options for a balanced budget amendment, and automatic
14 budget sequestration, as a disincentive to be activated only if Congress did not pass deficit
15 reduction legislation. This resolution of the debt-ceiling crisis signaled the Congress' will-
16 ingness to correct the federal deficits and have arguably contributed to reinforce beliefs that
17 the national debt will be eventually stabilized via fiscal adjustments. In line with our model,
18 these changes in beliefs led to a declining pattern in inflation expectations.

19 The Committee did not come to agreement on any plan, which activates the sequestration.
20 The sequestration was to come into force on January 1, 2013 and was considered part of the
21 fiscal cliff, but the American Taxpayer Relief Act of 2012 delayed it until March 1 of that
22 year, which is marked by the second vertical line in the left graph. In that month inflation
23 expectations accelerate their downward trend. The law can be interpreted as a victory for
24 the Republican-led House of Representatives and a clear sign that Tea Party movement could

⁷Professional forecasters receive the survey questionnaire at the end of the first month of each quarter. This introduces a lack of synchronization with the fiscal episodes discussed in this section. We will flag this lack of synchronization all the times this is an issue.

1 successfully drive the party's agenda as well as the Congress' decisions towards the need of
2 balancing the federal budget. According to our model, higher odds in favor of a monetary
3 resolution of the institutional crisis would lead to lower expected inflation. This prediction
4 can explain why after falling off the fiscal cliff inflation expectations accelerated their decline.

5 Inflation expectations abruptly started increasing in 2016. We observe two discrete jumps
6 in inflation expectations after 2016 in the left plot of Figure 5. The first increase happened
7 in the first quarter of 2016 and the second one in the first quarter of 2017. The first revision
8 occurred while the CBO announced that the deficit-to-GDP ratio increased for the first time
9 in the last six years. This piece of news was associated with a substantial revision of the
10 CBO's projected deficit to GDP ratio as shown in the right plot of Figure 5. The solid line
11 marks the CBO forecasts released in August 2015 and the line with circles stands for the
12 CBO's forecasts in January 2016, when the deficit-to-GDP ratio deteriorated for the first
13 time after six years of continuous improvement. In August 2015, the CBO expected that the
14 deficit-to-GDP ratio would have not started deteriorating earlier than the 2018. However,
15 in January 2016, the CBO revised its estimates and anticipated the deterioration of the
16 deficit-to-GDP ratio to 2016.

17 The second bump in inflation expectations occurred in the first quarter of 2017. It can
18 be argued that this revision of expectations is linked to the election of Donald Trump as
19 45th President of the United States. It should be noted that the Philadelphia Fed conducted
20 the survey between October 28 and November 8, 2016. Therefore, the survey reflects this
21 event only starting from the first quarter of 2017. Hence, the panelists were not aware of
22 the results of the presidential election when they submitted their responses for the fourth
23 quarter of 2016. Throughout his campaign, and again in the wake of his victory, President
24 Trump pledged to rebuild America's infrastructure. In his victory speech he said: "We're
25 going to rebuild our infrastructure, which will become, by the way, second to none. And
26 we will put millions of our people to work as we rebuild it." Furthermore, in the weeks

1 since his election, infrastructure has emerged as a potential bipartisan meeting ground for
2 Trump and national Democrats. On December 20th 2016, Senate Minority Leader Charles
3 Schumer replied to President Trump's infrastructure plan as follows: "We think it [the
4 infrastructure plan] should be large. He's mentioned a trillion dollars. I told him that
5 sounded good to me." This news happened while the U.S. economy was expanding and
6 could have been interpreted by the private sector as a signal that the fiscal authority became
7 less willing to take the necessary fiscal adjustments to stabilize its debt. A few Fed officials,
8 including the Fed chairwoman Janet Yellen, pointed out an increase in fiscal uncertainty
9 under the newly elected administration. On February 11 2017, U.S. Federal Reserve Vice
10 Chair Stanley Fischer speaking at the Warwick Economics Summit said: "There is quite
11 significant uncertainty about what's actually going to happen, I don't think anyone quite
12 knows. It's a process which involves both the administration and the Congress in deciding
13 fiscal policy." And he added: "*At the moment* we're going strictly according to what we see
14 as our responsibility according to the law, which is maintaining full employment and getting
15 inflation to 2 per cent."

16 President Trump implemented a massive tax cut in December 2018 and launched a plan
17 to increase government expenditure in February 2018, which was known by the professional
18 forecasters only in the second quarter of 2018 (the very last data point in the left plot). The
19 effects of President Trump's fiscal stimulus are expected to be quite large according to the
20 CBO that in April 2018 substantially revised its forecasts for the deficit-to-GDP ratio (the
21 line with stars in the right plot). The left plot shows that inflation expectations rose quite
22 markedly in 2018. These patterns can be explained by our model if the private sector has
23 considered President Trump's fiscal stimulus as news that the fiscal authority is less willing
24 to take the necessary fiscal adjustments and therefore a fiscal resolution of the institutional
25 conflict is now more likely.

5. The Emergency-Budget Rule

In this section, we study a coordinated strategy that can be implemented when the private sector loses confidence in the fiscal authority's ability/willingness to stabilize debt through fiscal adjustments. This strategy commits the central bank to accept just enough inflation to stabilize the debt-to-output ratio resulting from an exceptionally large recession. At the same time, the fiscal authority remains committed to making the necessary fiscal adjustments to guarantee long-run fiscal backing.

As shown here, this coordinated strategy can be implemented by explicitly projecting the debt-to-GDP ratio that the fiscal authority pledges to repay through future fiscal adjustments. No fiscal plans are instead provided to stabilize the remaining amount of the debt-to-GDP ratio, which policymakers have agreed to inflate away. This portion is defined as the debt-to-output ratio that would have prevailed absent large demand shocks, ξ_t^d . The central bank allows inflation to rise just enough to inflate away the debt that exceeds the projection. This strategy is reminiscent of President Franklin Delano Roosevelt's decision of running two types of budget deficits to fight the dire consequences of the Great Depression: A "regular budget" that he committed to balance and an "emergency budget" that he did not clearly commit to balance. Henceforth, we call the strategy studied in this section "the emergency-budget rule."

5.1. General Case

To model this coordinated strategy geared to inflate away the amount of debt resulting from large recessions, we assume that policymakers respond to inflation and the debt-to-output ratio according to the monetary-led policy mix all the time, except when responding to the discrete demand shock ξ_t^d . Specifically, we assume that the response of the nominal interest rate to inflation and that of primary surpluses to debt are both zero *if* movements in these variables result from the large demand shock. Furthermore, policymakers respond

1 to all other fluctuations in inflation and the debt-to-GDP ratio that are driven by Gaussian
 2 shocks by following the monetary-led policy mix. As explained earlier, Gaussian shocks
 3 are assumed to be too small to raise fiscal strains that can fuel expectations that the fiscal
 4 authority may be incapable of making the necessary fiscal adjustments to stabilize debt.
 5 To simplify the analysis, we also assume that policymakers respond to the output gap by
 6 following the monetary-led policy mix regardless of the nature of the shocks that have hit
 7 the economy.⁸

8 In order to implement this policy we construct a *shadow economy* to keep track of the
 9 amount of debt and inflation resulting from the discrete preference shock. We denote the
 10 debt and inflation of the shadow economy in which discrete demand shocks are shut down
 11 as \hat{b}_t^S and $\tilde{\pi}_t^S$, respectively. We then write the linearized policy rules as follows:

$$\hat{\tau}_t = \rho_{\tau,M} \hat{\tau}_{t-1} + (1 - \rho_{\tau,M}) \left[\delta_{b,M} \hat{b}_{t-1}^S + \delta_{b,F} (\hat{b}_{t-1} - \hat{b}_{t-1}^S) + \delta_y (\tilde{y}_t - \tilde{y}_t^*) \right] + \sigma_\tau \epsilon_{\tau,t} \quad (9)$$

$$\tilde{R}_t = \rho_{R,M} \tilde{R}_{t-1} + (1 - \rho_{R,M}) (\psi_{\pi,M} \tilde{\pi}_t^S + \psi_{\pi,F} (\tilde{\pi}_t - \tilde{\pi}_t^S) + \psi_{y,M} (\tilde{y}_t - \tilde{y}_t^*)) + \sigma_R \epsilon_{R,t} \quad (10)$$

12 where we assume $\delta_{b,F} = \psi_{b,F} = 0$. These policy rules imply that the fiscal authority is not
 13 responsible for stabilizing the emergency-budget debt-to-output ratio $(\hat{b}_{t-1} - \hat{b}_{t-1}^S)$, which
 14 is due to the discrete demand shock, and that the central bank allows inflation to rise by
 15 $(\tilde{\pi}_t - \tilde{\pi}_t^S)$, just enough to stabilize that portion of debt-to-output ratio. More details on how
 16 to write the model equations when policymakers follow the rules (9)-(10) are in Appendix
 17 F.

18 The solid line in Figure 6 captures the macroeconomic implications of adopting the co-
 19 ordinated strategy. The starred line shows the regular-budget debt-to-GDP ratio, which is
 20 pinned down by the shadow economy. We assume that before the negative preference shock

⁸The last assumption is motivated by the fact that we have defined monetary and fiscal policy coordination in terms of policymakers' behaviors towards inflation and debt stabilization. However, this assumption can be relaxed by letting policymakers respond differently to the output gap depending on the nature of the shocks that have hit the economy.

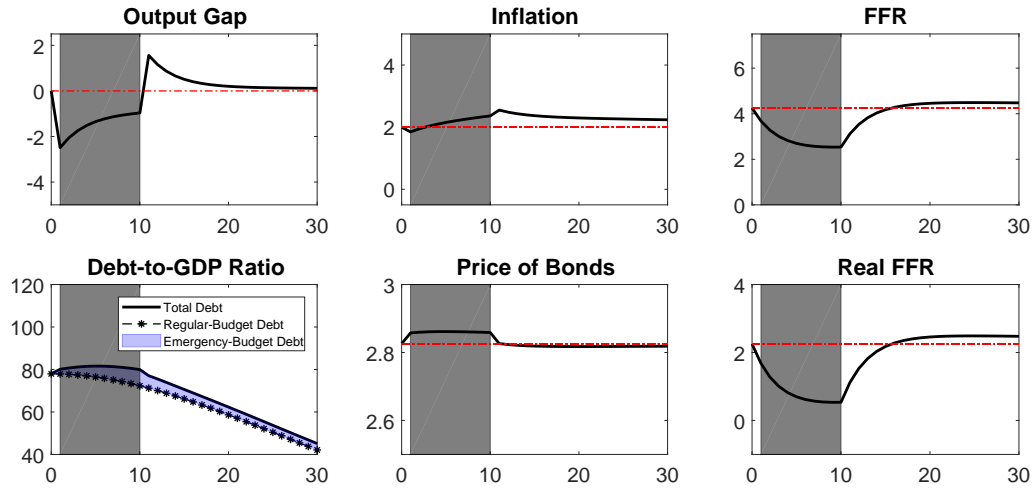


Figure 6: Dynamics of the output gap, inflation, the federal funds rate (FFR), the debt-to-GDP ratio, the price of bonds, and the ex-ante real federal funds rate after a negative discrete demand shock that occurs in period 1 and persists until period 10 (the gray area). The state of demand switches to the high regime from period 11 through period 30. The solid line captures the macroeconomic dynamics when the emergency-budget rule is implemented. The starred line captures the regular debt-to-GDP ratio, which is the portion of the public debt policymakers are responsible to stabilize by making fiscal adjustments. The shaded area between these two lines captures the emergency-budget debt-to-GDP ratio, which will be inflated away. The dashed-dotted line captures the steady-state values.

1 occurs, all the pre-existing debt is part of the regular budget and, thus, the emergency-budget
 2 debt-to-output ratio is zero. The fiscal authority is committed to stabilize the regular-budget
 3 debt-to-GDP ratio through higher taxes and hence, this portion of debt does not bring about
 4 any inflationary pressure. The shaded area between these two lines captures the emergency-
 5 budget debt-to-GDP ratio that the fiscal authority does not pledge to stabilize. The mone-
 6 tary authority will passively accommodate the inflationary pressures needed for stabilizing
 7 the emergency-budget debt-to-GDP ratio. To ease the comparison with the outcomes im-
 8 plied by the non-coordinated cases, we keep the scale of the y-axis the same across Figures
 9 3 to 6.

10 Contrary to the non-coordinated case, this coordinated strategy successfully raises infla-
 11 tion expectations during the recession by promising that no fiscal adjustment will be imple-

1 mented in response to the accumulation of debt experienced during the economic downturn.
2 This promise determines an increase in inflation that the central bank accommodates both
3 during and after the recession. Thus, the inflationary effects of the emergency budget are
4 persistent and survive after the recession. The coordinated policy rules (9)-(10) imply that
5 policymakers follow the fiscally-led policy mix only in response to the debt-to-output ratio
6 and inflation resulting from the low state of demand, while the central bank always follows
7 an active monetary policy in response to output gap fluctuations. This is the reason why
8 the interest rate falls during the recession and then increases smoothly after the recession:
9 the central bank does not try to counteract the inflationary pressure occurring after the
10 recession and the sharp increase of the real federal funds rate (FFR) observed under the
11 non-coordinated case does not occur (see Figure 3). Forward-looking agents understand
12 that this coordinated strategy leads to only a smooth and small increase in the real rate in
13 response to the persistently higher output gap once the recession is over, while the higher
14 level of inflation does not lead to any response. Consequently, during the recession the drop
15 in the output gap is mitigated compared with the cases where an institutional conflict is
16 expected to break out after the recession.

17 Given that the recession is contained, the emergency-budget debt-to-GDP ratio grows
18 only moderately and so does inflation necessary to stabilize it. As the emergency-budget
19 debt-to-GDP ratio is slowly reabsorbed, the price dynamics slow down and inflation gets
20 closer to its two-percent target. This policy determines only modest fluctuations in the
21 market value of debt. During the recession the market value increases as the FFR declines,
22 but it drops quickly as the recession ends and remains close to the steady state.

23 Finally, as shown in Appendix G, the dynamics of output gap, inflation, and nominal
24 interest rate are totally unaffected by the pre-crisis size of the debt-to-GDP ratio, which will
25 be stabilized by taking the necessary fiscal measures. This makes it clear that the proposed
26 policy separates the issue of long-run fiscal sustainability from the need to intervene during

1 exceptional events. This is a feature of the coordinated strategy that we will investigate
2 further in the following section.

3 5.2. *Avoiding Liquidity Traps*

4 The zero lower bound for nominal interest rates can be a significant constraint on the
5 ability of a central bank to combat deflation. Krugman (1998) and Eggertsson and Woodford
6 (2003) propose the use of forward guidance, which are announcements about the likely future
7 path of the policy rate, to ease this constraint on monetary policy. These scholars suggest
8 promising a period of monetary accommodation once the recession is over. In doing so, the
9 central bank is promising a boom and higher inflation after the recession, leading to a fall
10 in the real rate that mitigates the recession as well as the drop in inflation.

11 Our coordinated strategy can be regarded as an alternative way of promising higher
12 inflation after a period of very low demand. The distinctive feature of our approach is
13 the coordination between monetary and fiscal policies so as to rule out zero lower bound
14 episodes by generating inflationary pressures from fiscal imbalances. As for forward guidance,
15 higher inflation lowers the real interest rate and, in doing so, stimulates economic activity,
16 reducing the size of the output contraction and stabilizing the price dynamics during periods
17 of extremely low demand. As we shall show, this mechanism can be strong enough to prevent
18 the economy from hitting the zero lower bound. At the same time, agents understand that
19 the increase in inflation is the result of a well-defined, exceptional contractionary event,
20 which policymakers are not responsible for, while policy strategies to cope with standard
21 disturbances are unchanged.

22 Figure 7 shows the dynamics of the output gap, inflation, federal funds rate, the debt-
23 to-GDP ratio, the market value of debt (price of government bonds, $\ln P_t^m$), and the ex-ante
24 real federal funds rate following a very large negative demand shock, which is calibrated to
25 be as big as the one that caused the Great Recession based on estimates by Bianchi and

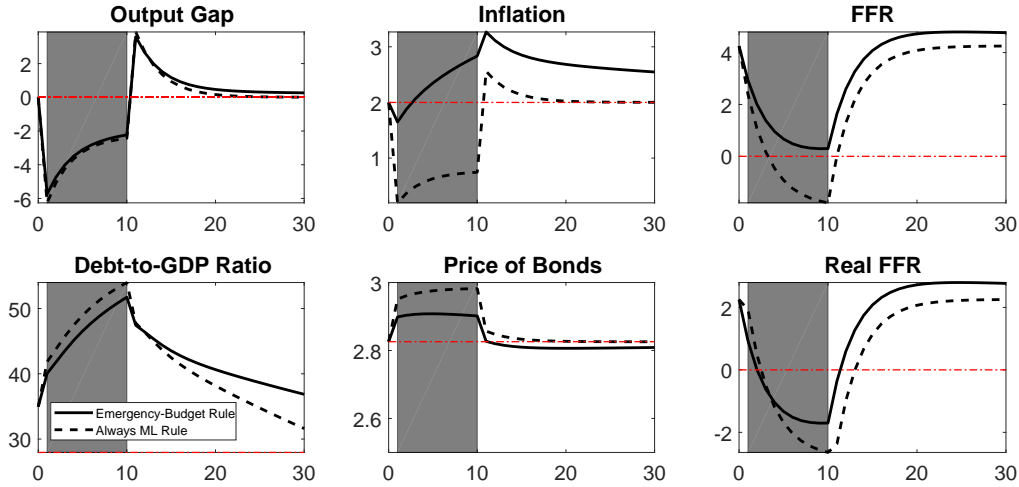


Figure 7: Dynamics of the output gap, inflation, the federal funds rate (FFR), the debt-to-GDP ratio, the price of bonds, and the ex-ante real federal funds rate after a negative discrete demand shock that occurs in period 1 and persists until period 10 (the gray area). The magnitude of this shock is comparable to the demand shock that caused the Great Recession (Bianchi and Melosi 2017). The state of demand switches to the high regime from period 11 through period 30. The solid line captures the dynamics when the emergency-budget rule is implemented. The dashed line captures the macroeconomic dynamics when the monetary-led policy mix is implemented in every state of the world. The dashed-dotted line captures the steady-state values.

1 Melosi (2017). We calibrate the initial debt to be 35% of GDP, which was the debt-to-
 2 GDP ratio in the U.S. before the Great Recession according to CBO's estimates. Changing
 3 the size of the initial debt-to-GDP ratio is inconsequential for the results that follow given
 4 that, as we argued above, the Emergency Budget rule separates the issue of stabilizing
 5 the pre-existing debt from the issue of stabilizing the emergency budget. The dashed line
 6 captures the macroeconomic dynamics when policymakers follow a monetary-led policy mix
 7 during the low-demand period (the gray area) and agents expect that this policy mix will
 8 be followed in every future period. We observe that this strong commitment to monetary
 9 dominance would lead monetary policy to become constrained by the zero lower bound during
 10 the recession.⁹ The solid line captures the macroeconomic dynamics under the emergency-

⁹Monetary policy does not become constrained exactly when the recession starts but only a few quarters after because the central bank adjusts the interest rate smoothly ($\rho_{R,M} = 0.8697$).

1 budget rule. This coordinated commitment to inflate away the amount of debt accumulated
2 during the recession allows the central bank to avoid the zero lower bound by raising inflation
3 expectations. Furthermore, the policy only leads to more contained fluctuations in the
4 market value of debt as a result of the more stable path for the FFR.

5 The proposed monetary and fiscal policy strategy is in line with the policies advocated
6 by Sims (2016) who suggests replacing ineffective monetary policies at the zero lower bound
7 with an “effective fiscal policy.” According to Sims, effective fiscal policy at the zero lower
8 bound requires that both the monetary and fiscal authorities clearly announce that fiscal
9 accommodation will not be removed until inflation will attain a given inflation target. Sims
10 also argues that a commitment to generate inflation that involves the fiscal authority might
11 also be more credible than one that relies solely on the behavior of the monetary authority,
12 given the time that it takes to revert fiscal decisions. We consider this as an interesting
13 direction for future research.

14 Our shock-specific rule is also related to Correia et al. (2013), who show how distortionary
15 taxes can be used to replicate the effects of negative nominal interest rates, and Galí (2014),
16 who analyzes the effects of a fiscal stimulus financed through money creation. Both these
17 papers work under the assumption that a monetary-led policy mix is always in place. Our
18 mechanism is based on a systematic policy response to exceptionally large shocks and does
19 not require using distortionary taxation or printing money (even if, of course, we could intro-
20 duce money and derive its implied path.) Instead, our shock-specific rule works by making
21 debt fiscally unsustainable by specifying the way policymakers react to exceptionally large
22 shocks. In this respect, our shock-specific rule is in the spirit of Benhabib, Schmitt-Grohe,
23 and Uribe (2002) who, following Woodford (2003), work in a deterministic environment to
24 show that a deflationary steady state can be made fiscally unsustainable.

6. Welfare Analysis and Uncertainty

In this section, we study the welfare implications of the different scenarios presented above. Following Woodford (2003), the period welfare loss is obtained by taking a log-quadratic approximation of the representative household's utility function:

$$\mathbb{L}_t = \sum_{s=0}^{\infty} \beta^s [\mathbb{E}_t (\Delta p_{t+s}^2) + (\kappa/\nu) \mathbb{E}_t (y_{t+s}^2)] \quad (11)$$

where κ is the slope of the Phillips curve and ν is the elasticity of substitution between two differentiated goods. The output gap enters the welfare function because it reflects the difference between the marginal rate of substitution and the marginal product of labor, which is a measure of the economy's aggregate inefficiency. Inflation deviations from its steady-state level reduce welfare by raising price dispersion. The elasticity of substitution between two differentiated goods ν raises the weight of inflation fluctuations relative to the output gap because it amplifies the welfare losses associated with any given price dispersion. Nominal rigidities, whose size is inversely related to the slope of the New Keynesian Phillips curve κ , raise the degree of price dispersion resulting from any given deviation from the steady-state inflation rate. In what follows, we fix the value of ν to 6, a value in line with what is used in the literature. However, given the estimated low value for the slope of the Phillips curve κ , the results are robust to different values for this parameter. Bianchi (2016) shows how to compute the welfare loss in (11) taking into account the current state of the economy and the possibility of regime changes.

We analyze the evolution of the welfare losses period by period for the simulations described in Figures 3, 4, and 6. Specifically, we consider four policy paths: (i) a path that involves a coordination over the fiscally-led policy mix following the recession (upper-left plot); (ii) a path that involves a conflict with expected fiscal resolution (upper-right plot); (iii) a path that involves a conflict with expected monetary resolution (lower-left plot); (iv) the emergency budget previously introduced in this section (lower-right plot). The evolution

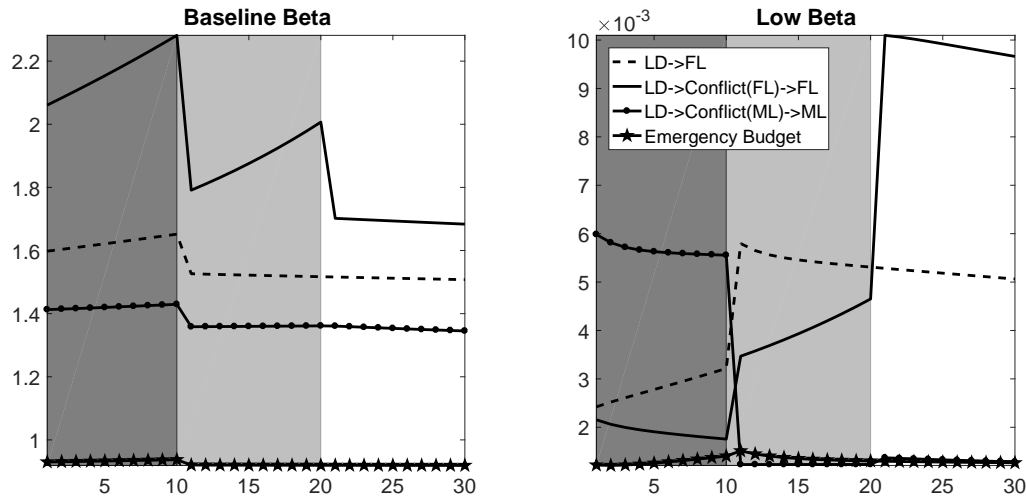


Figure 8: Dynamics of welfare loss as four different scenarios: agents expect that the policy-makers will follow a fiscally-led policy mix as the recession is over (the solid line; LD->FL); agents expect that an institutional conflict will break out after the recession with fiscal resolution (the dashed line; LD->CF(FL)->FL); agents expect that an institutional conflict will break out after the recession with fiscal resolution (the dotted line; LD->CF(ML)->ML; the emergency budget strategy (the line bullets). The dark gray area denotes the realized duration of the recession and the light gray area the duration of the conflict (if any). The right plot welfare is discounted using the households' discount factor; the left plot we use a lower beta (0.50) to discount future welfare losses.

1 of the welfare losses under the benchmark parameterization are reported in the left panel of
 2 Figure 8.

3 Welfare losses are minimized when policymakers coordinate on the Emergency Budget
 4 approach. This is true independently if the macroeconomy is in a state of high or low
 5 demand. This strategy leads to a welfare increase even with respect to the case in which after
 6 the recession policymakers move to the monetary-led regime because it completely removes
 7 uncertainty about the way debt will be stabilized while providing a short run stabilization
 8 policy. With respect to the other three strategies, the conflict with monetary-led resolution
 9 is preferred to the other two scenarios because it preserves long-run macroeconomic stability.
 10 Finally, the conflict with fiscal resolution implies larger welfare losses with respect to the
 11 case in which policymakers immediately move to the fiscally-led regime avoiding the conflict.

1 This last result is of particular interest. When the fiscal authority is expected to eventu-
2 ally prevail, engaging in a conflict results in a larger welfare loss *at each point in time* despite
3 the fact that the central bank is able to keep inflation closer to the target during the conflict
4 period (see second panel in 3). This is because eventually inflation will rise and welfare is
5 computed taking into account losses that can be quite far into the future. In fact, the longer
6 the conflict, the higher the final increase in inflation, the larger the welfare loss, as exempli-
7 fied by the increase in the solid black line during the conflict period. In other words, if the
8 central bank is faced with a scenario in which it is unfeasible or politically unsustainable for
9 the fiscal authority to implement fiscal adjustments, welfare would be higher if the central
10 bank were to immediately accommodate the behavior of the fiscal authority and let inflation
11 increase.

12 But what if policymakers are myopic and value welfare losses far into the future less than
13 what the representative household does? To address this case, we assume that policymakers
14 discount the future using a factor equal to 0.50, which is much lower than the one used
15 by the representative household ($\beta = 0.9985$). We can think about this scenario as one in
16 which the central bank is very much focused on delivering on the promise of low and stable
17 inflation period-by-period.

18 The results for this alternative parameterization are reported in the right panel of 8.
19 Three interesting results emerge. First, the Emergency Budget rule still implies very low
20 welfare losses in both the low and high states of demand. This is consistent with the point
21 that we made above: The Emergency Budget rule resolves the tension between the short-run
22 and the long-run policymakers' goals. Thus, even if policymakers value the present more,
23 this rule is still desirable because its gains are not postponed into the future. Second, the
24 welfare ranking between the conflict with fiscal resolution and the coordinated fiscally-led
25 strategy is not monotonic anymore. In particular, during the conflict with fiscal resolution
26 the welfare loss is now lower with respect to the case in which policymakers immediately move

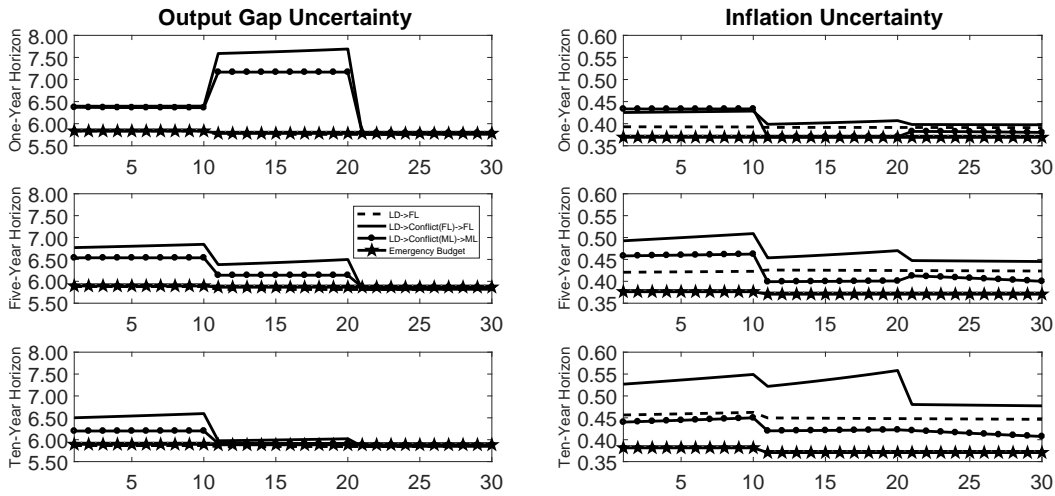


Figure 9: Evolution of agents' uncertainty about the future output gap (right panels) and inflation (left panels) at one-year (upper panels), five-year (center panels), and ten-year horizon (lower panels). The uncertainty is measured as forecasts standard deviations in percent.

1 to the fiscally-led regime. This is because during the conflict the central bank is successful
 2 in keeping inflation close to the target. Of course, this comes at the cost of a larger output
 3 loss and higher future inflation, but these losses have little weight under this alternative
 4 parameterization. Finally, during the period of low demand the ranking of the first three
 5 scenarios is completely reversed. Now the conflict with monetary-led resolution implies the
 6 largest welfare loss because it is associated with large deviations of inflation and output gap
 7 from their targets, while the long-run benefits of this scenario are heavily discounted. These
 8 results suggest that if policymakers have different horizons in mind when evaluating their
 9 policies, conflicts between the two authorities are more likely to arise. We consider this an
 10 interesting direction for future research.

11 **Macroeconomic Uncertainty.** Macroeconomic uncertainty is linked to welfare and
 12 gives us a sense about the macroeconomic risk associated with each of the strategies consid-
 13 ered in this paper.¹⁰ Figure 9 shows the dynamics of uncertainty about the future output

¹⁰Welfare depends on the square deviations of inflation and output gap from their steady-state values. In a stochastic environment, expected values of squared deviations affect uncertainty.

1 gap and inflation along the four scenarios considered above. Three important lessons emerge
2 from this analysis. First, conflicts are inevitably associated with a significant increase in
3 short-run uncertainty about the output gap, even when agents attach a large probability to
4 a certain exit strategy. This is in large part due to the swing in real activity that follows
5 the resolution of the conflict and uncertainty regarding when the conflict will be over. As
6 shown in Figure 4, the end of the conflict leads to a boost in output and hence the short-
7 term uncertainty about the output gap rises during conflicts. The effect is particularly large
8 when a resolution in favor of the fiscal authority is expected, given that the swing in real
9 activity is particularly large. Such an increase in uncertainty contributes to reduce welfare
10 and represents in itself a reason to avoid a situation of conflict between the two authorities.

11 Second, abandoning fiscal discipline to embrace the fiscal-led policy mix after the recession
12 leads to a persistent rise in inflation uncertainty (the solid line in the right panels), especially
13 at long horizons (the right-lower graph). This is an important result that confirms an
14 intuitive result: While moving to the fiscally-led regime helps in boosting real activity in
15 the short run, it also implies an increase in long-run macroeconomic uncertainty as the
16 macroeconomy becomes subject to additional disturbances linked to fiscal imbalances.

17 Third, the level of macroeconomic uncertainty associated with the emergency-budget
18 strategy (the red starred line) is relatively low and tends to be quite stable over the periods
19 of implementation. Under the emergency budget rule, policymakers follow the monetary-led
20 regime during regular times. This insulates the macroeconomy with respect to fluctuations
21 that have a fiscal nature. At the same time, the emergency budget rule acts as a sort
22 of automatic stabilizer. When the negative preference shock hits, the expectation of debt
23 accumulation implies an increase in inflation expectations that, in turn, helps in mitigating
24 the recession. The result is that in equilibrium macroeconomy uncertainty is largely reduced
25 because the recession is smaller, very little debt is accumulated, and there is no uncertainty
26 about the way the emergency budget will be stabilized. With respect to this last point, it

1 should be noted that the emergency-budget strategy attains a level of inflation uncertainty
2 that is lower than that associated with following the fiscally-led strategy in recessions and
3 moving to the monetary-led strategy once the preference shock is reabsorbed. Unlike the
4 emergency-budget strategy, this strategy does not completely rule out the possibility that
5 the fiscally-led policy mix will be adopted in the future, generating uncertainty about the
6 way the fiscal imbalance will be resolved.

7 **7. Conclusions**

8 What is the implication of the lack of coordination between the monetary and fiscal
9 authorities? When agents expect that policymakers will not coordinate their policies after
10 a large recession, two outcomes can arise. Under the first scenario, agents expect that fiscal
11 adjustments will eventually be implemented and policymakers appear to be incapable of
12 raising inflation expectations to rescue the economy from the recession. The other possible
13 outcome is also dire. The economy enters a spiral of growing debt, declining output, and
14 raising inflationary pressures. Quite interestingly, in this scenario the central bank raises the
15 policy rate but fails to rein in inflation, which actually accelerates during the conflict period.
16 This scenario seems that most relevant from an historical point of view. As a prominent
17 example, at the peak of the Great Inflation and after repeated failed attempts to cut inflation,
18 the Fed Chairman Arthur Burns (1979) acknowledged that “[...] the central bank’s practical
19 capacity for curbing an inflation that is driven by political forces is very limited.”

20 We then consider a coordinated policy strategy aimed at mitigating the recession by
21 raising inflation expectations in an orderly manner. This strategy consists of a commitment
22 to inflating away only the portion of debt that exceeds an announced projection. This
23 projection is defined as the debt-to-output ratio that would have prevailed absent the large
24 contractionary shock. In practice, an approximate measure of such a debt-to-GDP ratio
25 can be obtained by projecting the pre-recession stock of debt into the future. The central

1 bank allows inflation to rise just enough to inflate away the portion of debt that exceeds
2 the projected level of debt. This strategy succeeds in mitigating deep recessions because
3 it affects agents' beliefs about policymakers' *long-run* behavior in response to a specific
4 large shock. In fact, policymakers are committing to *never* increasing taxes in response to
5 the amount of debt accumulated during large contractions and, at the same time, to not
6 combating the resulting increase in inflation. This policy triggers an increase in *short-run*
7 inflation expectations and an immediate increase in inflation as large demand shocks hit
8 the economy. The proposed strategy has the virtue of clearly separating short-run policy
9 interventions from the issue of long-run fiscal sustainability. This coordinated strategy can
10 also be used to promise a rate of inflation after a severe recession so as to avoid hitting the
11 zero lower bound for the nominal interest rate.

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1 **Appendix (Not For Publication)**

2 **A The Fisherian Model: Analytical Derivation**

The Representative Household's Problem The problem for the representative household reads as follows

$$\max_{C_t, B_t} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \exp(\epsilon_t^d) U(C_t),$$

3 subject to the flow budget constraint $P_t C_t + Q_t B_t + P_t \tau_t = P_t Y + B_{t-1}$. Solving the household's
4 problem yields the Fisher equation:

$$5 \quad R_t = \mathbb{E}_t \left(\beta^{-1} \frac{\exp \epsilon_t^d}{\exp \epsilon_{t+1}^d} \Pi_{t+1} \right). \quad (12)$$

6 The government budget constraint can be equivalently rewritten as

$$7 \quad \tau_t + R_t^{-1} b_t = \frac{b_{t-1}}{\Pi_t}, \quad (13)$$

8 where $b_t \equiv B_t/P_t$ denotes the real value of the government liabilities at time t .

9 The fiscal authority's ability or willingness to raise primary real surpluses τ_t across periods
10 is captured by the following fiscal rule (expressed in real terms):

$$11 \quad \tau_t - \tau_* = \delta (b_{t-1} - b_*) + \epsilon_t^\tau, \quad (14)$$

12 where ϵ_t^τ follows an i.i.d. exogenous process. Note that according to this simple fiscal rule,
13 the fiscal authority adjusts primary surpluses to respond to the previous period's real stock
14 of debt. We refer to equations (13) and (14) as the fiscal block of the economy.

15 We linearized the model equations around the steady-state equilibrium. The Fisher
16 equation (12) and the monetary rule can be expressed as follows:

$$\tilde{R}_t = \epsilon_t^d + \mathbb{E}_t \tilde{\pi}_{t+1}, \quad (15)$$

$$\tilde{R}_t = \psi \tilde{\pi}_t. \quad (16)$$

1 The two equations that make up the fiscal block can be written as follows:

$$2 \quad \hat{\tau}_t + \hat{b}_t = \beta^{-1}\hat{b}_{t-1} + b_*\tilde{R}_t - \beta^{-1}b_*\tilde{\pi}_t, \quad (17)$$

$$3 \quad \hat{\tau}_t = \delta\hat{b}_{t-1} + \epsilon_t^\tau, \quad (18)$$

4 where we use \tilde{x} to denote the log-deviation of a variable x from its steady-state value, whereas
 5 we use \hat{x} to denote its linear deviation from the steady state. Note that we linearize the
 6 primary surplus τ_t and the real value of debt b_t around the steady state as these variables
 7 can potentially be negative. In what follows, we always assume that the steady-state real
 8 value of debt is positive ($b_* > 0$).

9 Equation (17) highlights the *two key links* between monetary and fiscal policy. The first
 10 link is captured by the interest rate appearing on the right-hand side of equation (17): A
 11 monetary tightening brings about fiscal imbalances. The second link is captured by the
 12 inflation term appearing on the right-hand side of equation (17): A fall (rise) in inflation
 13 raises (reduces) the real burden of government debt. These two links make monetary policy
 14 and fiscal policy interdependent. Notice that both inflation $\tilde{\pi}_t$ and the nominal interest rate
 15 \tilde{R}_t are multiplied by the magnitude of the steady-state real value of debt b_* in equation
 16 (17). Therefore, the larger the average value of fiscal imbalances, the stronger the degree
 17 of interdependence between monetary and fiscal policy. As argued in the introduction,
 18 policymakers are aware of this interdependence. As we shall see, these links play a central
 19 role in determining whether there exists a unique stable rational expectations equilibrium
 20 (determinacy), or infinitely many of them (indeterminacy), or none of them in our simple
 21 model.

22 Plugging the monetary rule (16) into the Fisher equation (15) yields the monetary-block
 23 and the fiscal-block equations (1) and (2). Notice that whether higher inflation reduces or
 24 increases the real stock of debt primarily depends on how strongly the monetary authority
 25 responds to inflation (ψ). Inflation raises the real value of debt if the central bank aggressively

1 raises the interest rate in response to inflation deviations from the target ($\psi > \beta^{-1}$). This
 2 rise in the interest rate ends up increasing the fiscal burden by making its serving cost larger
 3 via the first link that we discussed when presenting equation (17). This is an important
 4 point to which we will return.

5 Defining the rational expectations errors $\eta_t \equiv \tilde{\pi}_t - \mathbb{E}_{t-1}\tilde{\pi}_t$ and replacing $\tilde{\pi}_t$ with $\mathbb{E}_{t-1}\tilde{\pi}_t$
 6 $+\eta_t$ in both equations (1)-(2) yield a system of linear equations:

$$\begin{aligned} \begin{bmatrix} \mathbb{E}_t \tilde{\pi}_{t+1} \\ \hat{b}_t \end{bmatrix} &= \begin{bmatrix} \psi & 0 \\ b_*(\psi - \beta^{-1}) & \beta^{-1} - \delta \end{bmatrix} \begin{bmatrix} \mathbb{E}_{t-1} \tilde{\pi}_t \\ \hat{b}_{t-1} \end{bmatrix} \\ &+ \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} \epsilon_t^d \\ \epsilon_t^r \end{bmatrix} + \begin{bmatrix} \psi \\ b_*(\psi - \beta^{-1}) \end{bmatrix} \eta_t. \end{aligned} \quad (19)$$

7 This system has two eigenvalues: ψ and $\beta^{-1} - \delta$. There is only one non-predetermined
 8 variable ($\mathbb{E}_t \tilde{\pi}_{t+1}$). Since the second eigenvalue lies outside the unit circle if $\delta < \beta^{-1} - 1$,
 9 this exercise confirms the partition of the parameter space introduced by Leeper (1991):
 10 The two policy parameters ψ and δ determine these eigenvalues and, hence, the existence
 11 and uniqueness of a stable rational expectations equilibrium for this Fisherian economy.
 12 There are four possible cases: (i) active monetary and passive fiscal policy mix (AM/PF
 13 or monetary-led policy mix): the central bank adjusts the nominal interest rate strongly to
 14 inflation deviations from steady state ($\psi > 1$) and the fiscal authority is committed to raise
 15 taxes so as to keep the dynamics of the real value of debt \hat{b}_t on a stable path ($\delta > \beta^{-1} - 1$);
 16 (ii) passive monetary and active fiscal policy mix (PM/AF or fiscally-led policy mix): the
 17 central bank does not adjust the nominal interest rate strongly to inflation deviations from
 18 steady state ($\psi \leq 1$) and the fiscal authority is not committed to raise taxes so as to keep
 19 the dynamics of the real value of debt \hat{b}_t on a stable path ($\delta \leq \beta^{-1} - 1$); (iii) active monetary
 20 and active fiscal policy mix (AM/AF): the central bank adjusts the nominal interest rate
 21 strongly to inflation deviations from steady state ($\psi > 1$) and the fiscal authority is not

1 committed to raise taxes so as to keep the dynamics of the real value of debt \hat{b}_t on a stable
2 path ($\delta \leq \beta^{-1} - 1$); (iv) passive monetary and passive fiscal policy mix (PM/PF): the central
3 bank does not adjust the nominal interest rate strongly to inflation deviations from steady
4 state ($\psi \leq 1$) and the fiscal authority is committed to raise taxes so as to keep the dynamics
5 of the real value of debt \hat{b}_t on a stable path ($\delta > \beta^{-1} - 1$).

6 Leeper (1991) shows that only the first two policy mixes lead to the existence of a unique
7 rational expectations equilibrium (determinacy), whereas the other two policy combinations
8 lead to no stable rational expectations equilibrium or to the existence of infinitely many of
9 rational expectations equilibria (indeterminacy). When the monetary and fiscal policy mix
10 is monetary led, inflation can be shown to be i.i.d. and is completely insulated from the
11 fiscal block. In this case, fiscal imbalances are never relevant for inflation determination. We
12 call this feature *Monetary and Fiscal Dichotomy*.

13 **Steady State.** Let us assume that the real surplus in steady state is given by $\tau_* = b_*^\gamma$.
14 Then the steady state can be derived as follows:

$$i_* = \beta^{-1}\Pi_*, \quad (20)$$

$$\begin{aligned} \tau_t + i_t^{-1}b_t &= \frac{b_{t-1}}{\Pi_t}, \\ \tau_* + i_*^{-1}b_* &= \frac{b_*}{\Pi_*}, \\ \tau_* &= \left[\frac{1}{\Pi_*} - \frac{1}{i_*} \right] b_*, \end{aligned} \quad (21)$$

$$\begin{aligned} b_* &= \tau_* \left[\frac{1}{\Pi_*} - \frac{1}{i_*} \right]^{-1}, \\ b_* &= \tau_* \left[1 - \frac{\Pi_*}{i_*} \right]^{-1} \Pi_*, \end{aligned} \quad (22)$$

$$b_* = \tau_* \frac{\beta^{-1}}{\beta^{-1} - 1} \Pi_*, \quad (23)$$

$$\frac{b_*}{\Pi_*} = \frac{\beta^{-1}}{\beta^{-1} - 1} \tau_*. \quad (24)$$

1 Notice that inflation or the real value of debt cannot be separately pinned down.

2 **Monetary-Led Policy Mix.** Suppose that the monetary authority conducts an *active*
3 *monetary policy* by aggressively adjusting the interest rate to stabilize inflation. This policy
4 is captured by setting $\psi > 1$ in the monetary policy rule. Furthermore, let us assume that
5 the fiscal authority is committed to generate enough primary surpluses so as to stabilize the
6 real stock of debt \hat{b}_t . This goal is achieved by assuming that the fiscal authority adjusts
7 primary surpluses to debt fluctuations in a way to guarantee that debt always remains on a
8 stable path. More precisely, if the fiscal policy parameter δ is larger than $\beta^{-1} - 1$, then the
9 root $(\beta^{-1} - \delta)$ in the fiscal-block equation (2) is lower than one, which implies stationary
10 dynamics for the real value of debt \hat{b}_t . When policymakers follow this policy mix, there exists
11 a unique stable rational expectations equilibrium.¹¹

¹¹Active monetary policy induces an explosive root in the monetary-block equation. Since there is only one forward-looking variable, the Blanchard-Kahn conditions for determinacy are satisfied.

1 It should be noted that this kind of monetary and fiscal policy interactions leads poli-
 2 cymakers to coordinate their policies in a *countercyclical* manner. As an inflationary shock
 3 (e.g., $\epsilon_t^d > 0$) hits the economy, the central bank aggressively raises the interest rate. This
 4 aggressive monetary contraction leads to an increase in the debt service costs (\hat{i}_t) - equation
 5 (2) - and hence to a fiscal imbalance. The fiscal rule implies that the fiscal authority raises
 6 taxes aggressively ($\delta > \beta^{-1} - 1$) to make sure that the higher real stock of debt will be re-
 7 absorbed. The opposite happens after a deflationary shock. We call this form of interaction
 8 *monetary-led policy mix* meaning that the monetary authority is the leading authority, while
 9 the fiscal authority accommodates monetary policy decisions by adjusting primary surpluses
 10 in a way to keep debt on a stable path.

11 In our simple setting it is possible to characterize analytically the unique rational expec-
 12 tations equilibrium. In this equilibrium, the law of motion for inflation is as follows:

$$13 \quad \tilde{\pi}_t = \psi^{-1} \epsilon_t^d. \quad (25)$$

14 Combining this result with the fiscal-block equation (2) delivers the equilibrium law of motion
 15 of debt \hat{b}_t .

16 Equation (25) reveals an important property of this equilibrium: fiscal shocks ϵ_t^r do not
 17 affect inflation; they only affect fiscal variables (i.e., debt and primary surpluses). Since the
 18 fiscal authority is committed to systematically adjusting the stream of primary surpluses to
 19 repay its debt, inflation is completely insulated from the fiscal block and fiscal imbalances
 20 are never relevant for inflation determination. We call this feature *Monetary and Fiscal*
 21 *Dichotomy*. Again, the Dichotomy requires to assume that (i) the central bank strives to
 22 stabilize inflation, (ii) the fiscal authority is committed to raise taxes to stabilize debt, and
 23 (iii) agents believe that policymakers will carry out these policies in every state of the world.

24 **Fiscally-Led Policy Mix.** Now suppose that the fiscal authority is not committed
 25 to raise enough primary surpluses so as to guarantee fiscal sustainability. This scenario

1 is captured by setting the fiscal policy parameter δ in the fiscal rule strictly lower than
 2 the steady-state value of the net real rate $(\beta^{-1} - 1)$. Furthermore, we assume that the
 3 monetary authority conducts a passive monetary policy by weakly adjusting the interest
 4 rate to stabilize inflation. This policy is captured by setting $\psi \leq 1$ in the monetary policy
 5 rule. Now the root $(\beta^{-1} - \delta)$ in the fiscal-block equation (2) is larger than one, which implies
 6 that the fiscal authority is not taking the necessary fiscal adjustments to stabilize the debt.
 7 Therefore, when debt deviates from its value of steady state, agents want to sell government
 8 liabilities in exchange for consumption goods. They understand that the government will not
 9 repay debt with consumption goods. Consequently, the price of consumption goods must go
 10 up to clear the market.

11 However, for this scenario to be consistent with a stable equilibrium, the behavior of the
 12 central bank plays a key role. By responding to inflation less than one to one, the central bank
 13 accommodates the price adjustment that is necessary to stabilize the debt dynamics.¹² As a
 14 result, the dynamics of the forward-looking variable (i.e., inflation expectations) are pinned
 15 down by the need for making the real value of debt stationary. Hence, there exists a unique
 16 stable rational expectations equilibrium. In this simple framework, the relationship between
 17 inflation expectations and the deviations of debt from its steady state can be analytically
 18 characterized:¹³

$$19 \quad \mathbb{E}_t \tilde{\pi}_{t+1} = \frac{1}{b_*} \left[1 - \frac{\delta}{\beta^{-1} - \psi} \right] \hat{b}_t. \quad (26)$$

20 This equation quantifies by how much inflation expectations have to adjust to keep the
 21 real value of debt on a stable path and to ensure the uniqueness of the stable rational
 22 expectations equilibria. Furthermore, this equation is quite revealing about the interplay
 23 between monetary and fiscal policies. The active fiscal authority can disregard the level of
 24 debt because the passive monetary authority allows inflation to rise to stabilize fluctuations

¹²In technical jargon, the passive monetary policy makes the monetary-block equation's root stable, and hence, the Blanchard-Kahn conditions for determinacy are satisfied.

¹³A detailed derivation of this equation is provided in Appendix A.

1 in the real value of debt. We call this policy mix *fiscally-led policy mix*. Quite clearly,
 2 equation (26) breaks down the *Monetary and Fiscal Dichotomy*. Now inflation is no longer
 3 insulated from fiscal developments.

4 The rational expectation equilibrium (REE) can be characterized by plugging equation
 5 (26) into the monetary-block equation (1) to get rid of inflation expectations. We obtain

$$6 \quad \psi \tilde{\pi}_t = \epsilon_t^d + \xi \hat{b}_t, \quad (27)$$

7 with $\xi \equiv \frac{1}{b_*} \left[1 - \frac{\delta}{\beta^{-1} - \psi} \right]$ capturing the response of the expected inflation needed to stabilize
 8 the real stock of debt, as illustrated by equation (26). Combining equation (27) with the
 9 fiscal-block equation (2) yields a system of linear equations that can be solved by simply
 10 inverting a 2×2 matrix. Some tedious but straightforward algebra allows us to characterize
 11 the unique REE solution under the PM/AF policy mix:

$$12 \quad \begin{bmatrix} \tilde{\pi}_t \\ \hat{b}_t \end{bmatrix} = \begin{bmatrix} 0 & \xi \\ 0 & \psi \end{bmatrix} \begin{bmatrix} \tilde{\pi}_{t-1} \\ \hat{b}_{t-1} \end{bmatrix} + \begin{bmatrix} \frac{1}{\beta^{-1} - \delta} & -\frac{\xi}{\beta^{-1} - \delta} \\ -\frac{b_*(\beta^{-1} - \psi)}{\beta^{-1} - \delta} & -\frac{\psi}{\beta^{-1} - \delta} \end{bmatrix} \begin{bmatrix} \epsilon_t^d \\ \epsilon_t^r \end{bmatrix} \quad (28)$$

13 Two features of the solution (28) are worthy emphasizing. First, as already noticed,
 14 inflation is generally not insulated from fiscal shocks ϵ_t^r under this alternative policy mix.
 15 Second, the central bank's systematic response to inflation (ψ) induces the dynamics of debt
 16 and, hence, inflation to become persistent. This is strikingly different from the monetary-led
 17 case, in which inflation follows an i.i.d. process. Notice that this simple Fisherian model
 18 features only i.i.d. shocks. The persistent dynamics of inflation under the fiscally-led policy
 19 mix entirely stem from monetary contractions in response to inflation that occur so long
 20 as $\psi > 0$. These timid monetary contractions end up slowing down the inflation-driven
 21 reduction in the real value of debt and, in doing so, raise the amount of inflation that is
 22 necessary for stabilizing debt, everything else being equal.

1 B Log-linearization of the DSGE Model

2 The Markov-switching process for d_t represents a non-Gaussian shock. In order to log-
3 linearize the model, we follow these steps (for more details see Schorfheide 2005; Liu, Wag-
4 goner, and Zha 2011; Bianchi and Ilut 2017; and Bianchi, Ilut, and Schneider 2017):

- 5 1. Compute the ergodic mean \bar{d} for the preference shock d_t .
- 6 2. Verify that the zero lower bound is not binding at \bar{d} .
- 7 3. Define the regimes in terms of policymakers' behavior and the value for the preference
8 shock: $\xi_t \equiv (\xi_t^d, \xi_t^p)$.
- 9 4. Conditional on each regime, linearize/log-linearize all equations around the determin-
10 istic steady state and define deviations of the preference shock from its ergodic mean
11 as $\tilde{d}_t = d_t - \bar{d}$ and $\tilde{d}_{\xi_t^d} = \bar{d}_{\xi_t^d} - \bar{d}$. Notice that \tilde{d}_t can assume only two values \tilde{d}_h and \tilde{d}_l
12 and that the non-linearity associated to a regime change is retained.
5. Use the methods developed by Farmer et al. (2009) to solve the model. The solution
algorithm returns a MS-VAR whose parameters depend on the probability of moving
across regimes H , the structural parameters θ , and the current state ξ_t :

$$Z_t = c(\xi_t, H, \theta) + T(\xi_t, H, \theta) Z_{t-1} + R(\xi_t, H, \theta) Q \epsilon_t,$$

13 where Q is a diagonal matrix that contains the standard deviations of the structural
14 shocks and Z_t is a vector with all variables of the model.

15 Unlike other papers that have used the technique described here, our model allows for
16 non-orthogonality between policymakers' behavior and a discrete shock. This allows us to
17 solve a model in which agents take into account that a large preference shock leads to an
18 immediate change in policy, including the zero lower bound, and the ensuing exit strategies.

Parameter	Value	Parameter	Value
$\psi_{\pi,M}$	1.7890	p_{hh}	0.9999
$\psi_{y,M}$	0.4413	p_{ll}	0.9465
$\rho_{R,M}$	0.8697	p_{MM}	0.9902
$\delta_{b,M}$	0.0778	p_{FF}	0.9932
$\rho_{\tau,M}$	0.9666	p_{CC}	0.9000
$\psi_{\pi,F}$	0.6903	δ_y	0.2814
$\psi_{y,F}$	0.2655	ϕ_y	-2.0000
$\rho_{R,F}$	0.6576	ρ_{tr}	0.4620
$\delta_{b,F}$	0.0000	\bar{d}_h	0.0429
$\rho_{\tau,F}$	0.6501	\bar{d}_l	-0.1300
$\psi_{\pi,C}$	2.0000	κ	0.0072
$\psi_{y,C}$	0.0000	$b_*/4$	0.2795
$\delta_{b,C}$	0.0000	$100 \ln \gamma$	0.4120
$\rho_{R,C}$	0.0000	$100 \ln \Pi$	0.5000
$\rho_{\tau,C}$	0.6501	$100 \ln R$	1.0628
$100\sigma_r$	0.1912	$100\sigma_\tau$	0.4448
ρ_{tr}	0.4620	$100\sigma_{tr}$	0.2976
ρ_g	0.9796	$100\sigma_g$	0.2806
ρ_a	0.5005	$100\sigma_a$	0.6189
ρ_{tr^*}	0.9900	$100\sigma_{tr^*}$	0.1000
ρ_μ	0.4823	$100\sigma_\mu$	0.1749

Table 2: Parameter values and transition matrix elements calibrated based on Bianchi and Melosi (2017).

- 1 This proposed method is general and can be applied to other cases in which a shock induces
- 2 a change in the structural parameters.

3 C Parameter Values

4 Table 2 reports the parameter values we have used to calibrate the model that we have
5 studied in the main text of the paper. These are based on the posterior mode estimated by
6 Bianchi and Melosi (2017).

7 D Erratic Beliefs or News About the Conflict Resolution

8 In this section, we want to model a (likely) situation in which agents are uncertain about
9 the resolution of the conflict and change their mind about the likely outcome of the conflict
10 while the conflict is ongoing. To model these dynamics, we add one more conflict regime to

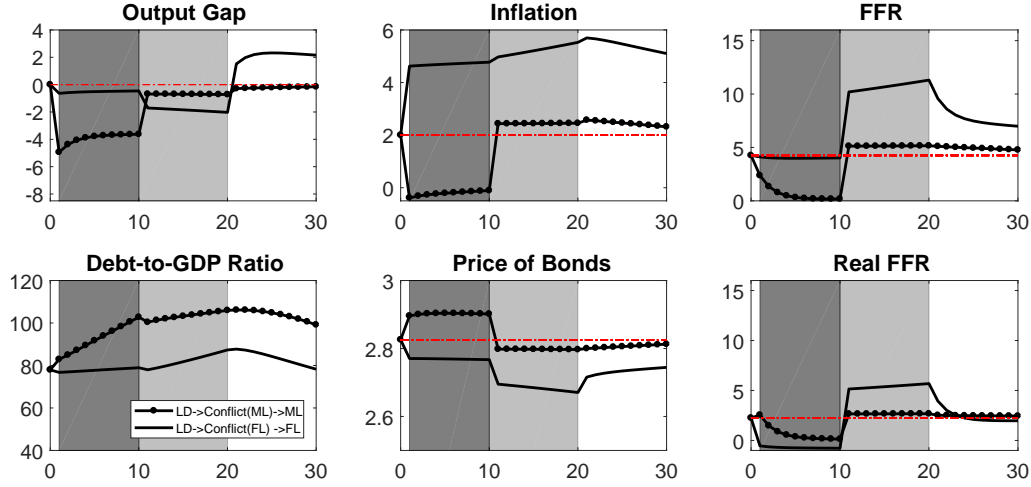


Figure 10: Dynamics of the output gap, inflation, the federal funds rate (FFR), and the debt-to-GDP ratio when a negative discrete demand shock occurs in period 1 and persists until period 10 (the dark gray area). The discrete demand shock switches back to high from period 11 through period 30. Agents expect a conflict between the two authorities following the end of the low-demand shock period. The conflict is assumed to occur from period 11 through period 20 (the light gray area). The solid line captures the case in which agents expect that the fiscal authority will win the conflict and, hence, the policy mix is expected to be fiscally led after the conflict. The dotted line captures the case in which the monetary authority is expected to prevail and, hence, the policy mix is expected to be monetary led after the conflict period. Unlike in the main text (Figure 4), the probability of staying in the conflict regime is 0.75 and the central bank’s response to inflation under the fiscally-led regime is 0.1. The dashed-dotted line captures the steady-state values.

1 the set ξ_t^p . This additional conflict regime is characterized by equal probabilities of moving
 2 to the two coordinated high-demand regimes (i.e., the monetary-led regime and the fiscally-
 3 led regime). We assume that there is a 5% probability that the outcome of the conflict
 4 changes during the conflict. Furthermore, we introduce a fifth low-demand (fiscally-led)
 5 regime that leads to this additional conflict regime with probability one when the state of
 6 demand switches to high.

7 Figure 11 shows the two extreme cases (i.e., 100% expected fiscally-led resolution and
 8 100% expected monetary-led resolution) that we have analyzed in Figure 4 along with a
 9 case in which agents’ beliefs about which authority will emerge victorious from the conflict
 10 change over time (the starred dashed line). For the sake of illustrating the mechanism, we

1 assume that as the conflict breaks out in period 11, agents expect that the two policymakers
2 have equal chance to prevail in the conflict. In period 14, beliefs change abruptly with
3 agents now believing that the fiscal authority will prevail for sure. In the aftermath of this
4 change in beliefs, the recession becomes deeper while inflation increases. In period 15, agents
5 radically change their beliefs and now feel that the monetary authority will eventually emerge
6 victorious with a probability of one. As a result, the output gap improves but remains in
7 the negative territory while inflation drops and becomes very close to zero. From period 16
8 through period 18, agents change again their beliefs and become confident that the fiscal
9 authority will eventually prevail. This abrupt change in beliefs exacerbates the recession and
10 causes inflation to suddenly rise and to start growing away from its steady-state value. After
11 period 18 through the end of the conflict in period 20, agents are uncertain again about
12 which authority will win and attach 50% probability to each authority to win the conflict.
13 Note that changes in agents' beliefs also determine swings in the market value of debt. Once
14 the conflict is over, agents observe which authority has won the conflict and the dynamics
15 of the macro variables slowly converge to the realized polar case. We do not shown this
16 convergence in Figure 11 to keep the graphs easier to read.

17 .

18 **E Expected Resolution and the Low-Demand Period's Output Gap**

19 As shown in Figure 4, the output gap during the low-demand period is remarkably similar
20 regardless of the expected resolution of the conflict. This result is not general and does not
21 imply that the expected resolution of the conflict is always inconsequential for the output
22 dynamics during low-demand periods.

23 To illustrate this point, we tweak the value of two key parameters. One parameter is the
24 probability p_{CC} , which controls the expected duration of the institutional conflict. We lower
25 this parameter from 0.90 (as noted in Table 1) to 0.75. This has the effect of mitigating the

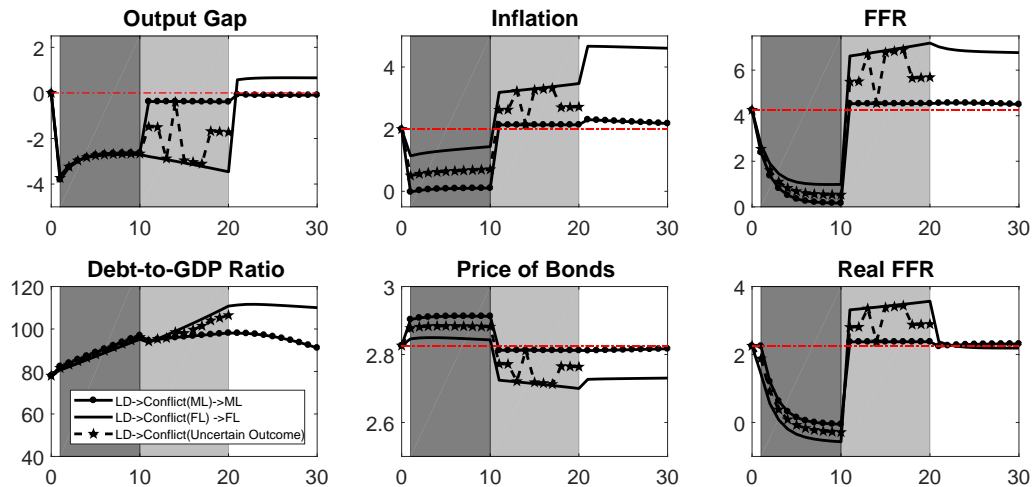


Figure 11: Dynamics of the output gap, inflation, the federal funds rate (FFR), the debt-to-GDP ratio, the price of bonds, and the ex-ante real federal funds rate when a negative discrete demand shock occurs in period 1 and persists until period 10 (the dark gray area). The discrete demand shock switches back to high from period 11 through period 30. Agents expect a conflict between the two authorities following the end of the low demand shock period. The conflict is assumed to occur from period 11 through period 20 (the light gray area). The solid line captures the case in which agents expect that the fiscal authority will win the conflict and, hence, the policy mix is expected to be fiscally led after the conflict. The dotted line captures the case in which the monetary authority is expected to prevail and, hence, the policy mix is expected to be monetary led after the conflict period. The starred dashed line captures the macroeconomic dynamics when beliefs about which authority will win the conflict varies erratically. The dashed-dotted line captures the steady-state values.

1 expected double-dip recession for the case in which agents expect a fiscally-led resolution
 2 of the conflict (i.e., the fiscal authority is expected to emerge from the institutional conflict
 3 victorious). Furthermore, we lower the central bank's response to inflation under the fiscally-
 4 led policy mix ($\psi_{\pi,F}$) from 0.6903 to 0.1. This alternative parameterization makes the central
 5 bank less aggressive when it comes to adjusting the nominal rate to stabilize inflation in the
 6 fiscally-led regime.

7 Figure 10 shows the outcomes under these alternative values assigned to the probability
 8 p_{CC} and the policy parameter $\psi_{\pi,F}$. Contrary to Figure 4, different expectations about how
 9 the conflict will be resolved lead to radically different implications for the dynamics of the
 10 output gap during the low-demand period (the dark gray area). If agents expect the the fiscal

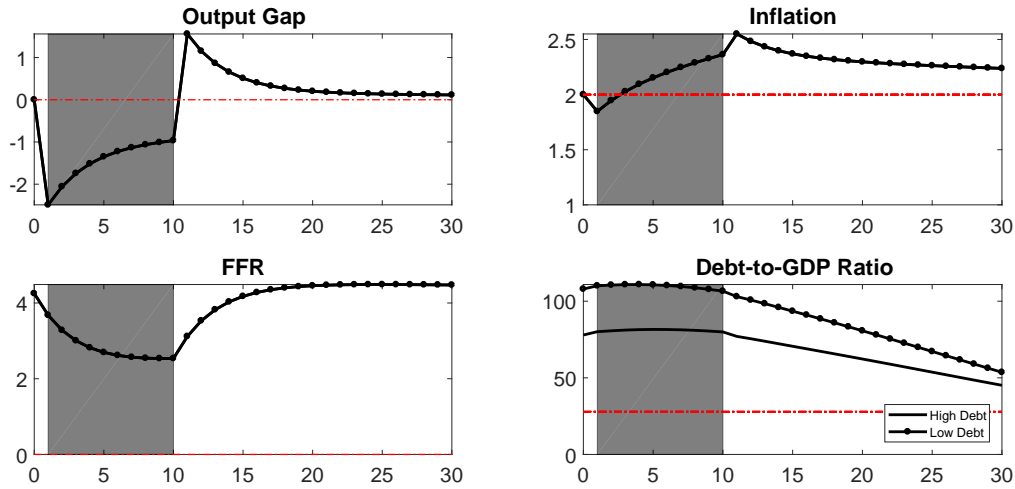


Figure 12: Dynamics of the output gap, inflation, federal funds rate (FFR), and debt-to-GDP ratio after a negative discrete demand shock that occurs in period 1 and persists until period 10 (the gray area). The state of demand switches to the high regime from period 11 through period 30. The lines capture these dynamics when the emergency-budget rule is implemented under two different initial debt-to-GDP ratios. The economy described by the dotted line starts with a higher initial debt. The dashed-dotted line captures the steady-state values.

1 authority will emerge victorious from the institutional conflict (solid line in both Figure 4 and
 2 Figure 10), the inflation generated from the fiscal imbalance leads to a lower real interest rate
 3 and, hence, to stronger economic activity compared with the case in which the central bank
 4 is relatively more hawkish when the fiscally-led regime is in place ($\psi_{\pi,F} = 0.6903$ as in Table
 5 1). Since forward-looking agents anticipate these effects, the recession is greatly mitigated
 6 and inflation jumps above target during the low-demand period. Furthermore, expecting a
 7 shorter lasting conflict following the low-demand period further improves economic activity
 8 during the low-demand period.

9 F Model with an Emergency-Budget Rule

10 To do the exercise in Section 5., we write the linearized equations derived from the model
 11 of Section 3.. Nonetheless, we use the policy rules (9)-(10) to describe the policymakers'

1 behavior. This set of equations describe the actual economy. For the model to be mathe-
 2 matically well specified, we need to add the equations that capture the law of motion for
 3 the debt and inflation in the shadow economy, which are denoted by \hat{b}_t^S and $\tilde{\pi}_t^S$. This set
 4 of equations is exactly the same as the one of the actual economy with the exception of the
 5 Euler equation that reads

$$6 \quad \tilde{y}_t^S = - \left[\tilde{R}_t^S - \mathbb{E}_t \tilde{\pi}_{t+1}^S - (1 - \rho_d) d_t \right] + \rho_a a_t + \mathbb{E}_t \tilde{y}_{t+1}^S + (1 - \rho_g) \tilde{g}_t, \quad (29)$$

7 and the fiscal and monetary rules that read

$$\hat{\tau}_t^S = \rho_{\tau,M} \hat{\tau}_{t-1} + (1 - \rho_{\tau,M}) \left[\delta_{b,M} \hat{b}_{t-1}^S + (1 - \rho_{\tau,M}) \delta_y (\tilde{y}_t^S - \tilde{y}_t^{*S}) \right] + \sigma_{\tau} \epsilon_{\tau,t}, \quad (30)$$

$$\tilde{R}_t^S = (1 - \rho_{R,M}) (\psi_{\pi,M} \tilde{\pi}_t^S + \psi_{y,M} (\tilde{y}_t^S - \tilde{y}_t^{*S})) + \sigma_R \epsilon_{R,t}. \quad (31)$$

8 Notice that the Euler equation of the shadow economy (29) does not feature the discrete
 9 demand shock \bar{d}_{ξ^d} . Furthermore, the policy rules (30)-(31) feature the monetary-led para-
 10 meterization. Furthermore, note that the discrete preference shock does not affect potential
 11 output. Thus, $\tilde{y}_t^{*S} = \tilde{y}_t^*$.

12 G Higher Initial Debt-to-Output Ratio

13 Figure 12 shows the dynamics of the output gap, inflation, the federal funds rate, and
 14 the debt-to-GDP when the coordinated strategy of inflating away only the portion of debt
 15 resulting from the recession is implemented. We consider two cases that differ from the
 16 initial level of debt. As one can see, the initial level of debt does not affect the dynamics
 17 of the output gap, inflation, and interest rate whatsoever. This is because policymakers
 18 are committed to following the monetary-led policy mix to stabilize the pre-existing level
 19 of debt. Since taxation is assumed to be non-distortive, there are no consequences of fiscal
 20 adjustments for the macroeconomy in these cases.

1 H Monetary-Led Regime in Low-Demand Periods

2 Figures 13 and 14 show that the main results of the paper are robust to assuming that
 3 the monetary-led regime is in place during the low-demand spell.

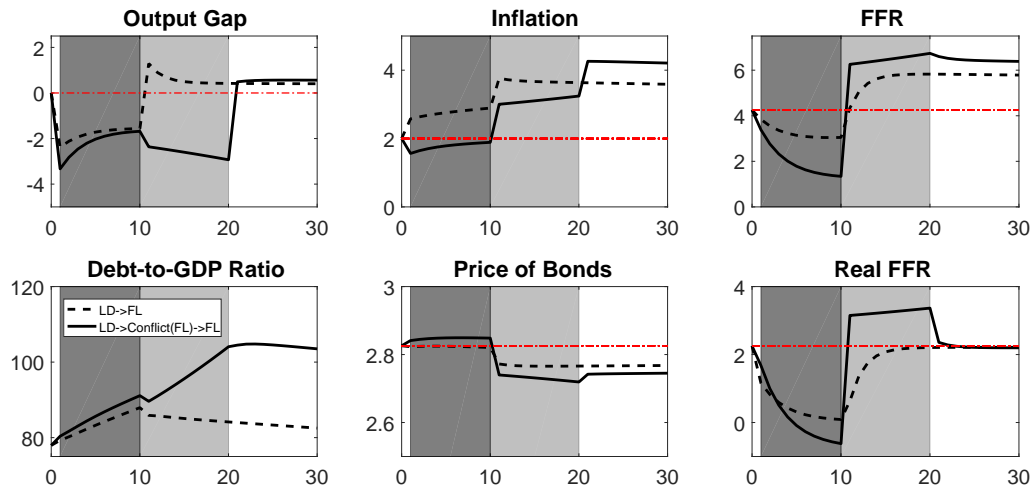


Figure 13: Dynamics of the output gap, inflation, the federal funds rate (FFR), the debt-to-GDP ratio, the price of bonds, and the ex-ante real federal funds rate when a negative discrete demand shock occurs in period 1 and persists until period 10 (the dark gray area). The discrete demand shock switches back to high from period 11 through period 30. The dashed line captures the macroeconomic dynamics when agents expect that policymakers will coordinate to follow the fiscally-led policy mix once the discrete demand shock switches back to high. The solid line captures the situation when agents expect a conflict between the two authorities to break out right after the end of the low-demand period. The conflict is assumed to occur from period 11 through period 20 (the light gray area) and agents expect that the fiscal authority will win; that is, the policymakers will engage in fiscally-led policies from period 21 on. The dashed-dotted line captures the steady-state values.

4 This is because of two reasons. First, what happens following the negative shock largely
 5 depends on expectations about future policy makers' behavior. Second, there is still large
 6 debt accumulation because of the (reasonable) assumption that during recessions transfers
 7 go up because of automatic stabilizers. From a modeling point of view, this is captured by
 8 the fact that taxes and transfers react to both the debt-to-GDP ratio *and* the state of the
 9 economy. This case is also interesting because it makes it even more likely that monetary
 10 policy becomes constrained by the zero lower bound because monetary policy is responding

1 more aggressively to inflation.

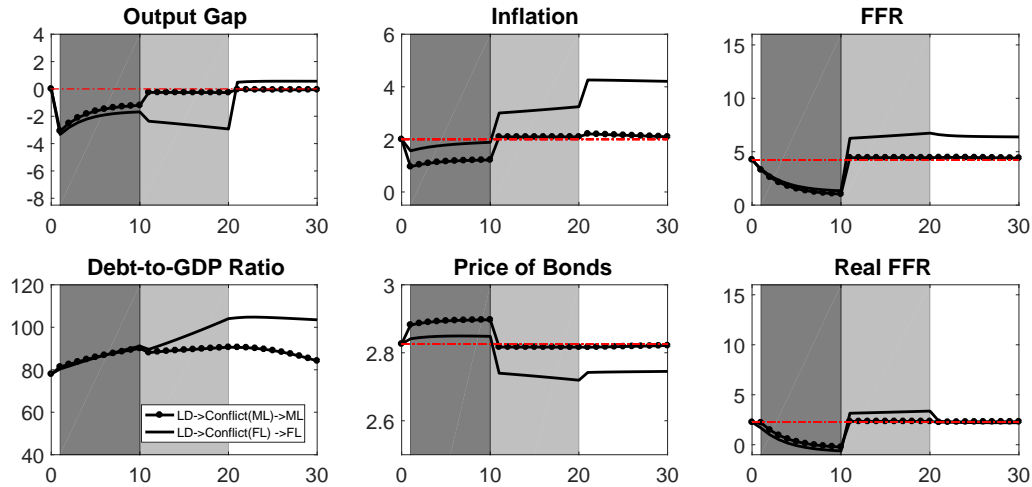


Figure 14: Dynamics of the output gap, inflation, the federal funds rate (FFR), the debt-to-GDP ratio, the price of bonds, and the ex-ante real federal funds rate when a negative discrete demand shock occurs in period 1 and persists until period 10 (the dark gray area). The discrete demand shock switches back to high from period 11 through period 30. Agents expect a conflict between the two authorities following the end of the low demand shock period. The conflict is assumed to occur from period 11 through period 20 (the light gray area). The solid line captures the case in which agents expect that the fiscal authority will win the conflict and, hence, the policy mix is expected to be fiscally led after the conflict. The dotted line captures the case in which the monetary authority is expected to prevail and, hence, the policy mix is expected to be monetary led after the conflict period. The dashed-dotted line captures the steady-state values.

2 I Less Hawkish Policy During the Conflict

3 Figures 15 and 16 replicate the main results of the paper assuming that during the conflict
 4 regime the response to inflation is equal to the one that prevails under the Monetary-led
 5 regime. Given that the main point of the paper is to bring attention to the perils of the lack
 6 of coordination between the two authorities, we chose a parameterization that was effective
 7 in highlighting the forces at play.

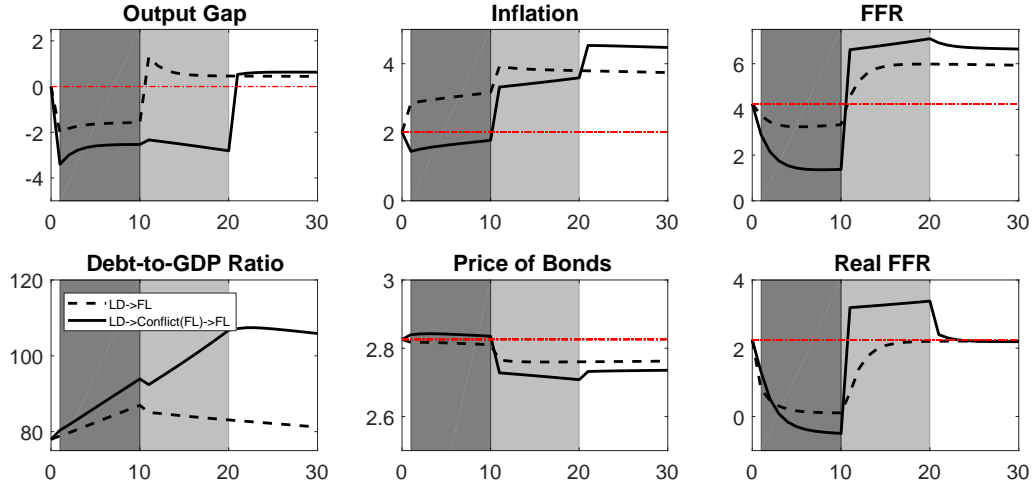


Figure 15: Dynamics of the output gap, inflation, the federal funds rate (FFR), the debt-to-GDP ratio, the price of bonds, and the ex-ante real federal funds rate when a negative discrete demand shock occurs in period 1 and persists until period 10 (the dark gray area). The discrete demand shock switches back to high from period 11 through period 30. The dashed line captures the macroeconomic dynamics when agents expect that policymakers will coordinate to follow the fiscally-led policy mix once the discrete demand shock switches back to high. The solid line captures the situation when agents expect a conflict between the two authorities to break out right after the end of the low-demand period. The conflict is assumed to occur from period 11 through period 20 (the light gray area) and agents expect that the fiscal authority will win; that is, the policymakers will engage in fiscally-led policies from period 21 on. The dashed-dotted line captures the steady-state values.

1 J Robustness

2 We check the robustness of our results to three alternative parameterizations. First, we
 3 assume that the conflict is less persistent in expectation ($p_{CC} = 0.8$). Second, we assume that
 4 the conflict is more persistent in expectation ($p_{CC} = 0.95$). Third, we entertain the possibility
 5 that the central bank responds to the output gap during the conflict ($\psi_{y,C} = \psi_{y,M} = 0.4413$).

6 In all these three scenarios, the welfare ranking shown in the right plot of Figure 8 is
 7 unchanged. Furthermore, the macroeconomic outcomes of the policies reported in Figure 3
 8 are only slightly different across the three scenarios. When the central bank responds to the
 9 output gap during the conflict, the output gap during the conflict is less negative than that
 10 in the benchmark case. Nevertheless, the output gap remains in negative territory and while

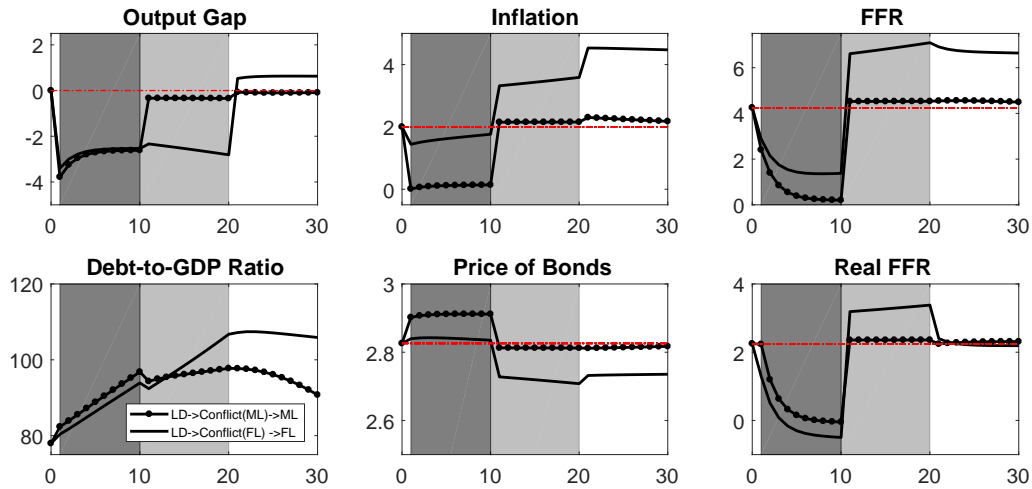


Figure 16: Dynamics of the output gap, inflation, the federal funds rate (FFR), the debt-to-GDP ratio, the price of bonds, and the ex-ante real federal funds rate when a negative discrete demand shock occurs in period 1 and persists until period 10 (the dark gray area). The discrete demand shock switches back to high from period 11 through period 30. Agents expect a conflict between the two authorities following the end of the low demand shock period. The conflict is assumed to occur from period 11 through period 20 (the light gray area). The solid line captures the case in which agents expect that the fiscal authority will win the conflict and, hence, the policy mix is expected to be fiscally led after the conflict. The dotted line captures the case in which the monetary authority is expected to prevail and, hence, the policy mix is expected to be monetary led after the conflict period. The dashed-dotted line captures the steady-state values.

- 1 the output gap improves during the conflict period compared to the recession period, the
- 2 economy persistently hovers below its potential for the entire duration of the institutional
- 3 conflict.