Fiscal Inflation

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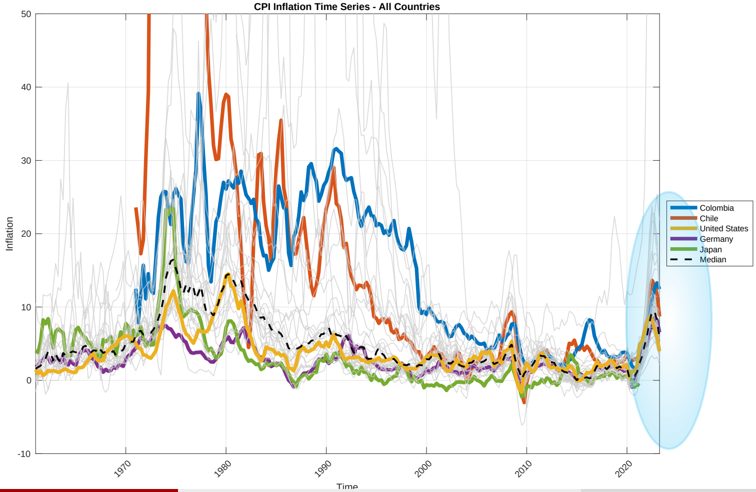
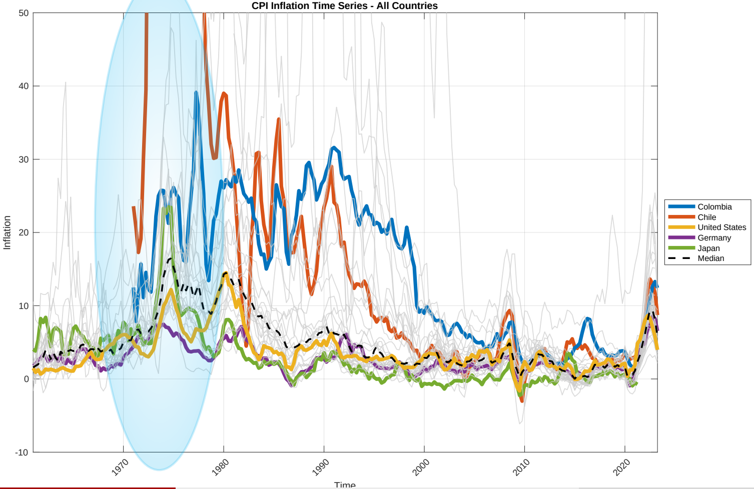
Inflation across space and time

- How does the post-pandemic increase in inflation compare with the past?



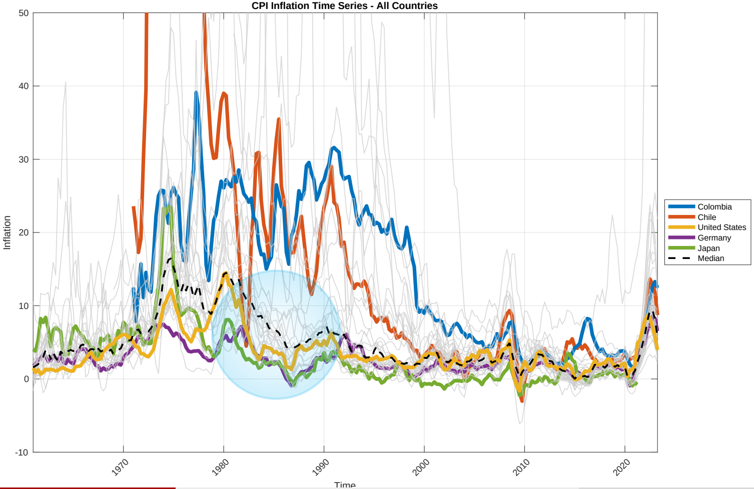
Inflation across space and time

- High and volatile inflation in several countries in the 1960s and 1970s



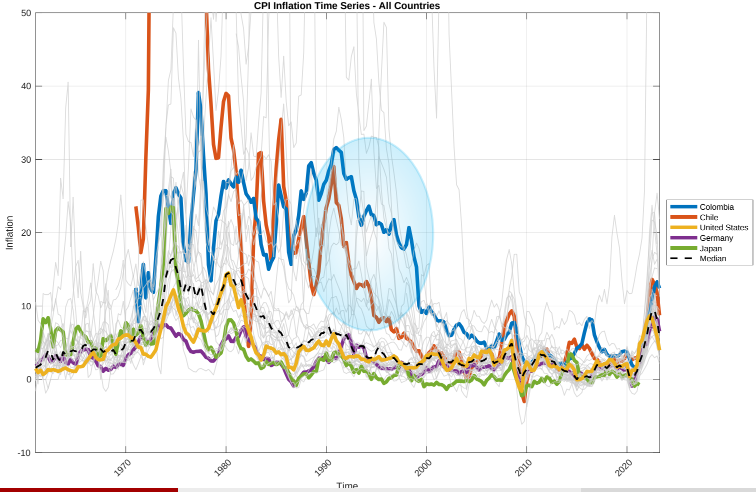
Inflation across space and time

- Break for advanced economies starting from the 1980s



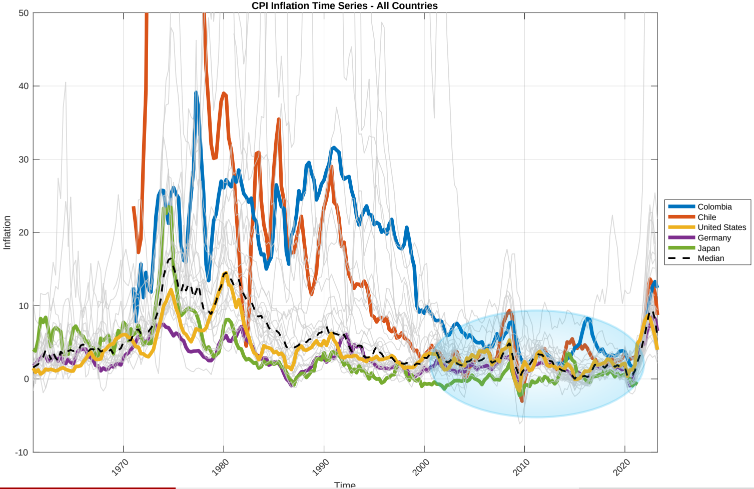
Inflation across space and time

- Break in the late 1990s for the other countries



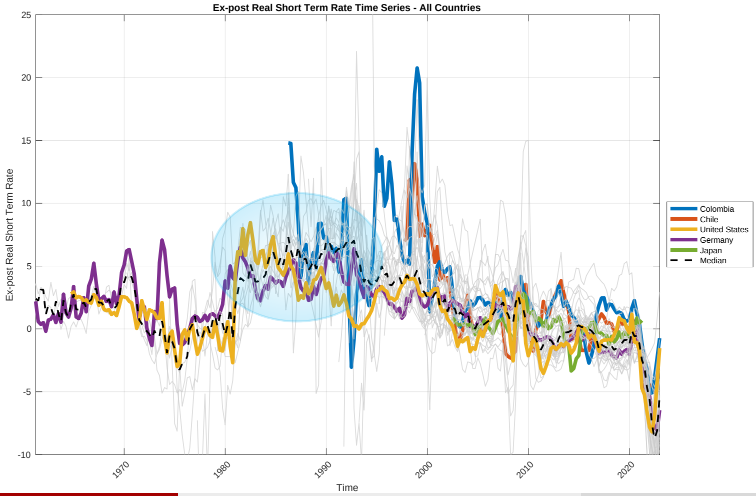
Inflation across space and time

- Remarkable convergence to low and stable inflation across countries in the 1990s



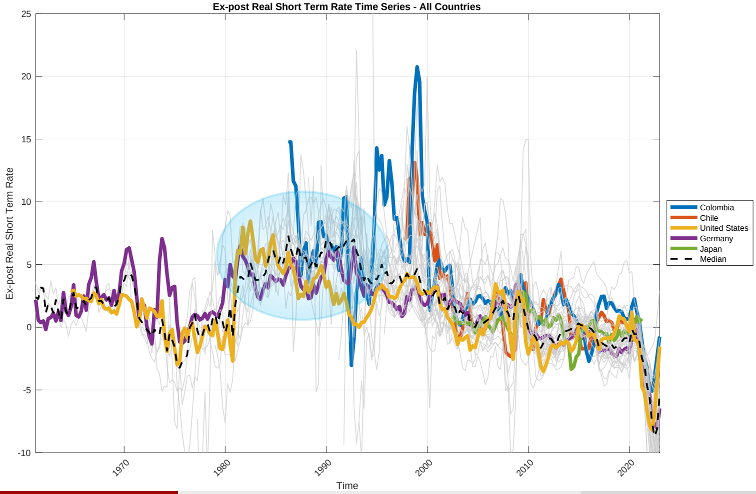
Large swings in real interest rates

- Decline in inflation associated with a prolonged period of high real interest rates



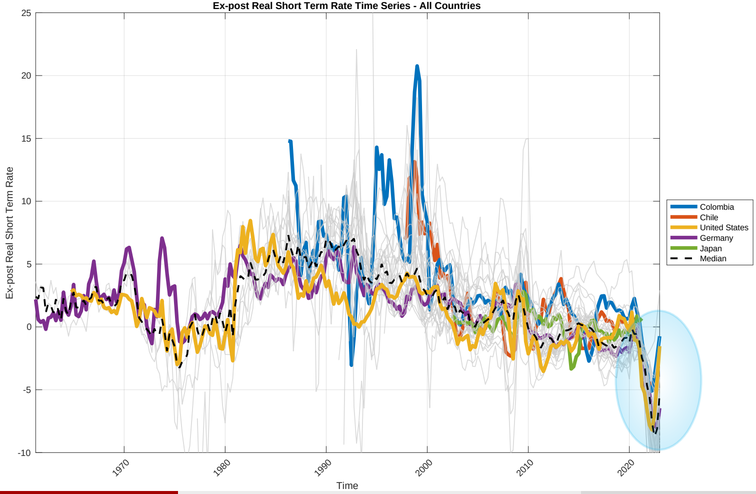
Large swings in real interest rates

- Emerging economies traditionally vulnerable to these structural changes



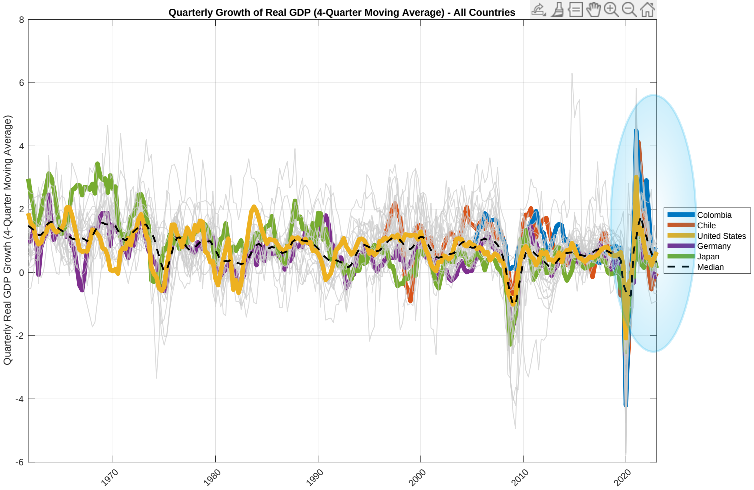
Large swings in real interest rates

- Economies experienced synchronized drop in (ex-post) real interest rates



Post-pandemic recovery

- Post pandemic inflation associated with a quick rebound in real activity



How to interpret the post-pandemic inflation?

- Decline in inflation often attributed to changes in monetary policy, but...
- ...conquest of inflation better understood as a monetary/fiscal policy phenomenon:
  1. Key role of central bank independence (US, UK, ...)
  2. Shift in fiscal practice (Euro Area, Chile, ...)
  3. Reduction in both the mean and volatility of inflation
- If the conquest of inflation is the result of a change from a Fiscally-led to a Monetary-led policy mix, how should we interpret the post-pandemic inflation?
  1. Return to a Fiscally-led policy mix?
  2. An emergency budget that generated a quick recovery?

Road map

We are going to discuss the role of fiscal policy for inflation determination in general equilibrium models, zooming in on post-COVID inflation and Great Inflation

1. Review of Leeper 1991
2. Unfunded fiscal shocks
   - Endowment economies
   - Production economies
3. Regime changes
4. Applications:
   - **A Fiscal Theory of Persistent Inflation** (QJE, 2023)
   - **Monetary/Fiscal Policy Mix and Agents' Beliefs** (RED, 2017)
   - **Inflation as a Fiscal Limit** (2022 Jackson Hole Economic Symposium)

Endowment economies

The Fisherian model

- The representative household solves:

$$\max \sum_{t=0}^{\infty} \beta^t U(C_t),$$

subject to the budget constraint $P_t C_t + Q_t B_t + P_t \tau_t = P_t Y + B_{t-1}$, where $Q_t = R_{n,t}^{-1}$.

- Government budget constraint: $Q_t B_t + P_t \tau_t = B_{t-1}$.
- Monetary rule: $R_{n,t} / R = (\pi_t / \pi)^{\phi}$.
- Fiscal rule: $\tau_t / \tau = (s_{b,t-1} / s_b)^{\gamma} e^{\zeta_t}$, where $s_{b,t} \equiv (Q_t B_t) / (P_t Y)$.
- Market clearing: $C_t = Y$.

Equilibrium determinacy

Linearize the model equations around the deterministic steady state:

$$\begin{aligned} \hat{r}_{n,t} &= \mathbb{E}_t \hat{\pi}_{t+1}, & (1) \\ \hat{s}_{b,t} &= \beta^{-1}[\hat{s}_{b,t-1} + \hat{r}_{n,t-1} - \hat{\pi}_t - (1-\beta)\hat{\tau}_t], & (2) \\ \hat{r}_{n,t} &= \phi \hat{\pi}_t, & (3) \\ \hat{\tau}_t &= \gamma \hat{s}_{b,t-1} + \zeta_t. & (4) \end{aligned}$$

Plugging the monetary rule into the Fisher equation leads to the monetary block:

$$\mathbb{E}_t \hat{\pi}_{t+1} = \phi \hat{\pi}_t. \tag{5}$$

Combining the law of motion for debt with the fiscal rule yields the fiscal block:

$$\hat{s}_{b,t} = \beta^{-1}[1-(1-\beta)\gamma]\hat{s}_{b,t-1} + \beta^{-1}\left[\phi \hat{\pi}_{t-1} - \hat{\pi}_t - (1-\beta)\zeta_t\right]. \tag{6}$$

Inflation determination in a Fisherian model

Two regions of the parameter space deliver a unique stationary solution (Leeper, 1991)

- Monetary-led policy mix: The fiscal authority is committed to implementing the necessary fiscal adjustments. Fiscal policy is passive ($\gamma > 1$) because it passively accommodates the behavior of the active monetary authority ($\phi > 1$).

  $\Rightarrow$ The macroeconomy is insulated from the fiscal block.

- Fiscally-led policy mix: The fiscal authority is not committed to implementing the necessary fiscal adjustments. Monetary policy is passive ($\phi \leq 1$) because it passively accommodates the behavior of the active fiscal authority ($\gamma \leq 1$).

  $\Rightarrow$ The macroeconomy is not insulated from the fiscal block.

Inflation determination in a Fisherian model

The other two regions lead to indeterminacy or non-existence of a stable solution

- Indeterminacy: The fiscal authority is committed to implementing the necessary fiscal adjustments. Fiscal policy is passive ($\gamma > 1$). However, monetary policy is also passive, violating the Taylor principle ($\phi \leq 1$).

  $\Rightarrow$ The macroeconomy is insulated from the fiscal block, but not from sunspot shocks.

- Non-existence: The fiscal authority is not committed to implementing the necessary fiscal adjustments. Monetary policy is active ($\phi > 1$) and does not accommodate the behavior of the active fiscal authority ($\gamma \leq 1$).

  $\Rightarrow$ Explosive dynamics for debt and inflation if no regime change.

Leeper's (1991) Partition

	Active Fiscal (AF)	Passive Fiscal (PF)
Active Monetary (AM)	Non-existence	Determinacy
Passive Monetary (PM)	Determinacy	Indeterminacy

- Active Monetary: Taylor principle satisfied ($\psi > 1$)
- Passive Monetary: Taylor principle not satisfied ($\psi \leq 1$)
- Active Fiscal: fiscal policy does not stabilize debt ($\gamma \leq 1$)
- Passive Fiscal: fiscal policy stabilizes debt ($\gamma > 1$)

Blanchard–Kahn Conditions

Predetermined and jump variables

- Predetermined variable: $\hat{s}_{b,t}$
- Jump variable: $\hat{\pi}_t$

Two eigenvalues

$$\lambda_\pi = \phi, \qquad \lambda_s = \beta^{-1}[1 - (1 - \beta)\gamma]$$

BK condition for a unique solution:

Number of unstable eigenvalues = number of jump variables.

Monetary-Led Regime: Forward Solution

Policy mix

$$\phi > 1 \quad \text{(active monetary policy)}, \qquad \gamma > 1 \rightarrow \lambda_s < 1 \quad \text{(passive fiscal policy)}$$

Economic intuition

- Inflation is a *forward-looking jump variable*
- Monetary policy pins down expected future inflation
- Fiscal policy adjusts to stabilize debt for any price level

Monetary-Led Regime: Forward Solution

From the monetary block:

$$\mathbb{E}_t \hat{\pi}_{t+1} = \phi \hat{\pi}_t$$

Iterating forward:

$$\hat{\pi}_t = \lim_{j \to \infty} \phi^{-j} \mathbb{E}_t \hat{\pi}_{t+j}$$

Since $\phi > 1$, stability implies:

$$\boxed{\hat{\pi}_t = 0}$$

Macroeconomy insulated from fiscal block, fiscal policy passively ensures debt stability:

$$\hat{s}_{b,t} = \beta^{-1} [1 - (1 - \beta)\gamma] \hat{s}_{b,t-1} - \beta^{-1} (1 - \beta) \zeta_t$$

Fiscally-Led Regime

Policy mix

$$\phi < 1 \quad \text{(passive monetary policy)}, \qquad \gamma > 1 \rightarrow \lambda_s > 1 \quad \text{(active fiscal policy)}$$

Key equilibrium logic

- Monetary policy does *not* anchor inflation
- Debt dynamics are unstable unless inflation adjusts
- Inflation is determined by fiscal solvency

Monetary Block Solution

The monetary block implies:

$$\mathbb{E}_t \hat{\pi}_{t+1} = \phi \hat{\pi}_t$$

The rational expectations solution is:

$$\boxed{\hat{\pi}_{t+1} = \phi \hat{\pi}_t + \eta^{\pi}_{t+1}}$$

where η^{π}_{t+1} is an inflation expectation error, $\mathbb{E}_t \eta^{\pi}_{t+1} = 0$

Since $\phi < 1$, inflation is stable with persistence pin down by Taylor rule parameter $\phi < 1$ (Fisherian effect).

Fiscal Dynamics

Recall:

$$\lambda_s \equiv \beta^{-1}\left[1-(1-\beta)\gamma\right]$$

The fiscal block becomes:

$$\hat{s}_{b,t} = \lambda_s \hat{s}_{b,t-1} + \beta^{-1}\left(\phi\hat{\pi}_{t-1} - \hat{\pi}_t\right) - \beta^{-1}(1-\beta)\zeta_t$$

Under active fiscal policy:

$$\lambda_s > 1$$

Debt dynamics unstable without price level adjustment $\Rightarrow$
Inflation jumps to satisfy solvency

Jump is possible because of central bank accommodation:
What happens if central bank does not accommodate jump?

Inflation Surprise

Iterating forward:

$$\hat{s}_{b,t} = \sum_{j=0}^{\infty} \lambda_s^{-j-1} \left[\beta^{-1} \left(\phi \hat{\pi}_{t+j-1} - \hat{\pi}_{t+j} \right) - \beta^{-1}(1-\beta)\zeta_{t+j} \right]$$

Define:

$$\eta_{t+1}^{\pi} = \hat{\pi}_{t+1} - \mathbb{E}_t \hat{\pi}_{t+1}$$

Then:

$$\boxed{\eta_{t+1}^{\pi} = -\Delta \mathbb{E}_{t+1} \left[\sum_{j=0}^{\infty} \beta^j (1-\beta) \zeta_{t+1+j} \right]}$$

Fiscal innovations generate unexpected inflation.

Inflation Dynamics

Combining initial impulse with propagation:

$$\hat{\pi}_{t+1} = \phi \hat{\pi}_t - \Delta \mathbb{E}_{t+1} \left[\sum_{j=0}^{\infty} \beta^j (1-\beta) \zeta_{t+1+j} \right]$$

- Size of the jump: fiscal policy
- Persistence: monetary policy (Fisherian effect)

Monetary policy can affect initial jump in more complex models

Key Takeaways

- Passive monetary policy ($\phi < 1$)
- Active fiscal policy ($\gamma < 1 \Rightarrow \lambda_s > 1$)
- Inflation keeps debt on a stable path
- Taylor rule governs propagation only

Inflation is fiscally determined

Indeterminacy (Passive Monetary/Passive Fiscal Policy)

Policy mix

- Passive monetary policy: $\phi < 1$
- Passive fiscal policy: $\gamma > 1$

Implications

- Inflation dynamics:

$$\mathbb{E}_t \hat{\pi}_{t+1} = \phi \hat{\pi}_t \quad \Rightarrow \quad \hat{\pi}_t \text{ stable but not anchored}$$

- Debt stabilized by fiscal feedback:

$$\beta^{-1}[1 - (1 - \beta)\gamma] < 1 \Rightarrow \hat{s}_{b,t} \text{ stable}$$

- No policy authority stabilizes inflation uniquely

Result: Indeterminacy (non-unique equilibrium) $\Rightarrow$ sunspot shocks

Conflict (Active Monetary/Active Fiscal Policy)

Policy mix

- Active monetary policy: $\phi > 1$
- Active fiscal policy: $\gamma \leq 1$

Implications

- Inflation dynamics unstable on their own:

$$\phi > 1 \Rightarrow \hat{\pi}_t \text{ explodes without fiscal backing}$$

- Debt dynamics:

$$\beta^{-1}[1 - (1 - \beta)\gamma] > 1 \Rightarrow \text{ debt not stabilized by taxes}$$

- Inflation and debt both unstable

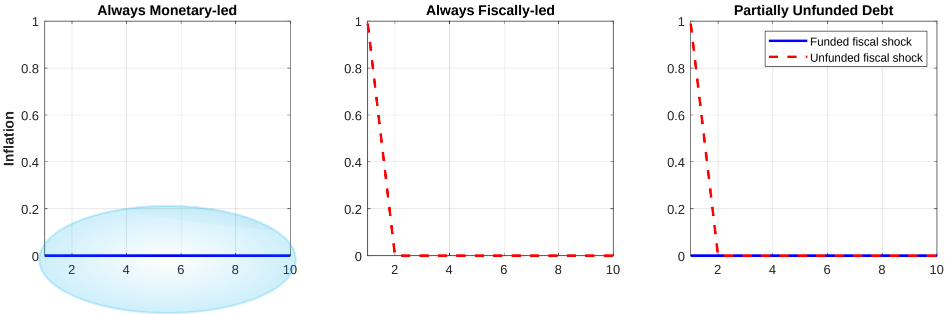
Result: No stable rational expectations equilibrium

Parameterization

In what follows, we use the following parameters:

- The discount factor β is 0.99 and the steady-state value of debt-to-GDP s_b is 1
- The policy parameters are $\phi^M = 2$ and $\gamma^M = 20$ under the Monetary-led regime
- The fiscal rule parameters are $\phi^F = 0$ and $\gamma^F = 0$ under the Fiscally-led regime

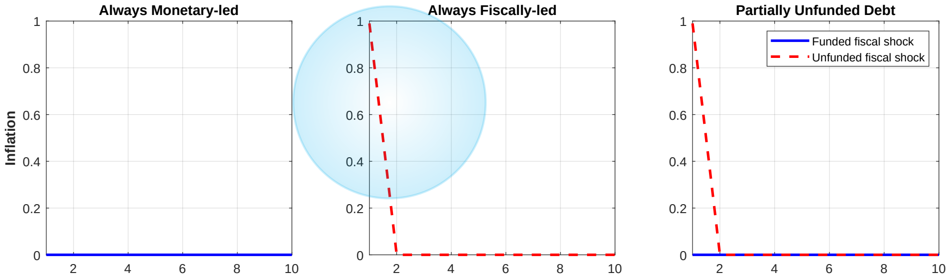
Inflation response to fiscal shocks



Impulse responses:

1. Inflation does not respond under the Monetary-led policy mix

Inflation response to fiscal shocks



Impulse responses:

2. Inflation responds under the Fiscally-led policy mix

Partially unfunded debt

Beyond a strict separation between policy regimes

- A Monetary-led regime can still be understood in the context of the FTPL
- It implies a ironclad commitment of the fiscal authority to keep debt on a stable path
- Typically assumed in models used for policy analysis and in academia
- Is such commitment reasonable? Credible? Optimal?
- Two (not mutually exclusive) ways to deviate from such a strong assumption without imposing that inflation is always and everywhere a fiscal phenomenon:
  1. Partially unfunded debt
  2. Regime changes and beliefs about regime changes

Fisherian model with partially unfunded debt

Bianchi, Faccini, Melosi (2023) introduce the notion of partially unfunded debt:

- Fiscal rule:

$$\tau_t/\tau = \left(s_{b,t-1}/s^F_{b,t-1}\right)^{\gamma^M}\left(s^F_{b,t-1}/s\right)^{\gamma^F} e^{\zeta^M_t+\zeta^F_t}, \tag{7}$$

  where ζ^M_t and ζ^F_t denote funded and unfunded fiscal shocks, $\gamma^M > 1$, $\gamma^F < 1$
- Unfunded debt $s^F_{b,t}$ accumulated as a result of the unfunded fiscal shocks
- Monetary rule:

$$R_{n,t}/R_n = (\pi_t/\pi^F_t)^{\phi^M}(\pi^F_t/\pi)^{\phi^F}, \tag{8}$$

  where π^F_t denotes fiscal inflation, inflation due to unfunded fiscal shocks
- With respect to fiscal inflation, monetary policy is passive, $\phi^F \leq 1$. The central bank is active in stabilizing inflation in deviations from fiscal inflation: $\phi^M > 1$.

Fisherian model with partially unfunded debt

Linearized rules:

- Fiscal rule:

$$\hat{\tau}_t = \gamma^M \left(\hat{s}_{b,t-1} - \hat{s}^F_{b,t-1} \right) + \gamma^F \hat{s}^F_{b,t-1} + \zeta^M_t + \zeta^F_t . \quad (9)$$

  where ζ^M_t and ζ^F_t denote funded and unfunded fiscal shocks, respectively, and $\gamma^F < 1$, and $\gamma^M > 1$.

- Monetary rule:

$$\hat{r}_{n,t} = \phi^M \left(\hat{\pi}_t - \hat{\pi}^F_t \right) + \phi^F \hat{\pi}^F_t . \quad (10)$$

  where $\hat{\pi}^F_t$ denotes fiscal inflation, i.e., the amount of inflation that is tolerated by the central bank to stabilize the share of unfunded debt $\hat{s}^F_{b,t-1}$, $\phi^M > 1$ and $\phi^F \leq 1$.

Fiscal Inflation as a Time Varying Inflation Target

- If $\phi^F = 0 \Rightarrow$ monetary rule isomorphic to a rule with a time-varying target:

$$\hat{r}_{n,t} = \phi^M \left(\hat{\pi}_t - \hat{\pi}_t^F \right).$$

- The "time-varying target" $\hat{\pi}_t^F$ corresponds to fiscal inflation, the amount of inflation tolerated by the central bank to stabilize unfunded debt.
- Thus, $\hat{\pi}_t^F$ is not an unrestricted additional shock to the model, but rather an endogenous variable that needs to satisfy cross-equation restrictions.

Monetary and Fiscal Blocks with partially unfunded debt

- Substituting the monetary rule into the Fisherian equation yields the monetary block:

$$\mathbb{E}_t \hat{\pi}_{t+1} = \phi^M \left(\hat{\pi}_t - \hat{\pi}_t^F \right) + \phi^F \hat{\pi}_t^F.$$

- Plugging the policy rules in the law of motion of debt, yields the fiscal block ($\gamma^F = 0$)

$$\hat{s}_{b,t} = \beta^{-1}[1 - (1-\beta)\gamma^M]\hat{s}_{b,t-1} + \beta^{-1}[(1-\beta)\hat{s}^F_{b,t-1} + \hat{r}_{n,t-1} - \hat{\pi}_t - (1-\beta)(\zeta_t^M + \zeta_t^F)]$$

- To close the model, we need to characterize the dynamics of fiscal inflation, $\hat{\pi}_t^F$, and of the associated amount of unfunded debt, $\hat{b}_t^F$.

Keeping track of unfunded debt

- BFM construct a shadow economy in which the Fiscally-led policy mix is always in place and only the shocks to unfunded spending ζ_t^F occur.
- The shadow monetary block:

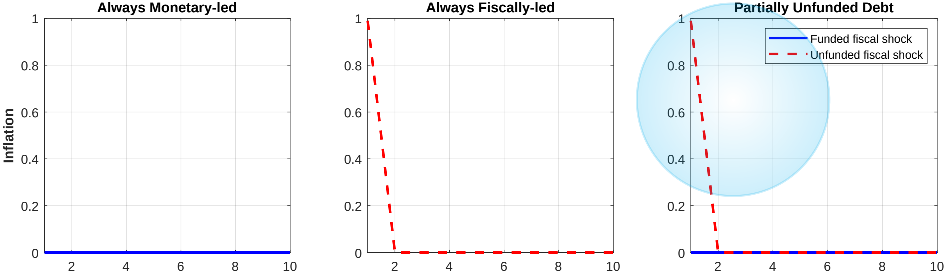
$$\mathbb{E}_t \hat{\pi}_{t+1}^F = \phi^F \hat{\pi}_t^F. \tag{11}$$

- The shadow fiscal block:

$$\hat{s}_{b,t}^F = \beta^{-1}\left[(1-\beta)\hat{s}_{b,t-1}^F + \phi^F \hat{\pi}_{t-1}^F - \hat{\pi}_t^F - (1-\beta)\zeta_t^F\right] \tag{12}$$

- Similar to the way economists build potential or natural output. However, structure of the economy is kept fixed, only shocks vary
- Method can be applied more broadly (see Smets and Wouters, 2025)

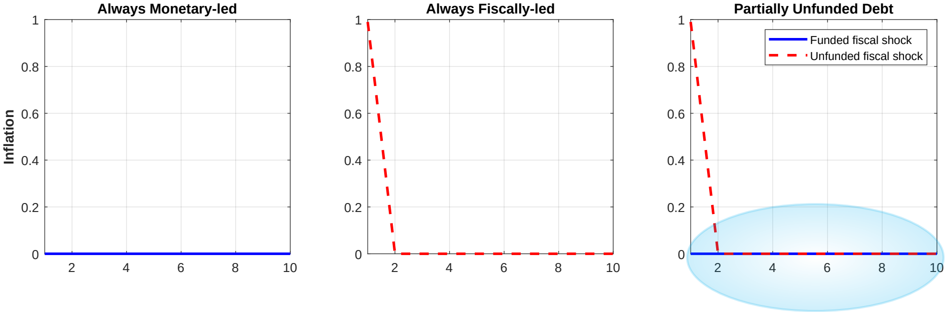
Inflation response to funded and unfunded fiscal shocks



Impulse responses:

1. Inflation responds to unfunded fiscal shock

Inflation response to funded and unfunded fiscal shocks



Impulse responses:

2. No inflation response to funded fiscal shock

Two shadow economies

The *linearized* actual economy can be thought as the **sum of two shadow economies**: funded and unfunded

$$\hat{s}_{b,t} = \hat{s}^M_{b,t} + \hat{s}^F_{b,t}$$
$$\hat{\pi}_t = \hat{\pi}^M_t + \hat{\pi}^F_t$$

To prove this, we have to show that the two following claims are true:

1. The difference between the overall stock of debt and its unfunded share is funded: $\hat{s}_{b,t} - \hat{s}^F_{b,t} = \hat{s}^M_{b,t}$ at each point in time, for given initial values $\hat{s}_{b,0} = \hat{s}^M_{b,0} + \hat{s}^F_{b,0}$
2. The inflation rate the central bank aims to stabilize with active monetary policy in the actual economy is the actual rate of inflation net of fiscal inflation: $\hat{\pi}^M_t = \hat{\pi}_t - \hat{\pi}^F_t$.

Two shadow economies

Both claims can be proved by constructing yet another parallel economy to pin down:

1. Inflation that the monetary authority aims to control with active monetary policy: $\hat{\pi}_t^M$
2. Funded debt, i.e. the amount of debt backed by future fiscal adjustments: $\hat{s}_{b,t}^M$

This parallel economy is as follows:

$$\mathbb{E}_t \hat{\pi}_{t+1}^M = \hat{r}_{n,t}^M, \tag{13}$$

$$\hat{s}_{b,t}^M = \beta^{-1}(\hat{s}_{b,t-1}^M - \hat{r}_{n,t-1}^M - \hat{\pi}_t^M - (1-\beta)\hat{\tau}_t^M), \tag{14}$$

$$\hat{r}_{n,t}^M = \phi^M \hat{\pi}_t^M, \tag{15}$$

$$\hat{\tau}_t^M = \gamma^M \hat{s}_{b,t}^M + \zeta_t^M. \tag{16}$$

Details

In this parallel economy, all fiscal shocks are funded, ζ_t^M, and the policy mix is monetary led ($\phi^M > 1$ and $\gamma^M > 1$). The monetary and fiscal blocks are:

$$\mathbb{E}_t \hat{\pi}_{t+1}^M = \phi^M \hat{\pi}_t^M, \tag{17}$$

$$\hat{s}_{b,t}^M = \beta^{-1} \left[1 - (1-\beta)\gamma^M\right] \hat{s}_{b,t-1}^M + \beta^{-1} [\hat{r}_{n,t-1}^M - \hat{\pi}_t^M - (1-\beta)\zeta_t^M]. \tag{18}$$

The first claim requires us to show that $\hat{\pi}_t^M = \hat{\pi}_t - \hat{\pi}_t^F$.
This can be done by subtracting equations (17) and (11) from equation (12):

$$\mathbb{E}_t(\hat{\pi}_{t+1} - \hat{\pi}_{t+1}^F - \hat{\pi}_{t+1}^M) = \phi^M(\hat{\pi}_t - \hat{\pi}_t^F - \hat{\pi}_t^M). \tag{19}$$

Because $\phi^M > 0$, the above expression implies $\hat{\pi}_t - \hat{\pi}_t^F - \hat{\pi}_t^M = 0$, i.e., $\hat{\pi}_t^M = \hat{\pi}_t - \hat{\pi}_t^F$.

Details

The second claim requires us to show that $\hat{s}^M_{b,t} = \hat{s}_{b,t} - \hat{s}^F_{b,t}$.
Substituting the fiscal rule, equation (9), and the monetary rule, equation (10), into the law of motion of debt, equation (2), we obtain (with $\gamma^F = 0$):

$$\beta \hat{s}_{b,t} = (1 - (1-\beta)\gamma^M)\hat{s}_{b,t-1} + (1-\beta)\gamma^M \hat{s}^F_{b,t-1} + \phi^M(\hat{\pi}_{t-1} - \hat{\pi}^F_{t-1}) \tag{20}$$

$$+\phi^F \pi^F_{t-1} - \pi_t + (1-\beta)(\zeta^M_t + \zeta^F_t). \tag{21}$$

The analogous for the funded shadow economy is:

$$\beta \hat{s}^M_{b,t} = (1 - (1-\beta)\gamma^M))\hat{s}^M_{b,t-1} + \phi^M \hat{\pi}_{t-1} - \hat{\pi}^M_t + (1-\beta)\zeta^M_t. \tag{22}$$

Repeating the same steps for the unfunded shadow economy:

$$\beta \hat{s}^F_{b,t} = (1 - (1-\beta)\gamma^F))\hat{s}^F_{b,t-1} + \phi^F \hat{\pi}_{t-1} - \hat{\pi}^F_t + (1-\beta)\zeta^F_t. \tag{23}$$

Details

Subtracting $\beta\hat{s}^M_{b,t}$ and $\beta\hat{s}^F_{b,t}$ from $\beta\hat{s}_{b,t}$ yields:

$$\beta(\hat{s}_{b,t} - \hat{s}^M_{b,t} - \hat{s}^F_{b,t}) = (1 - (1-\beta)\gamma^M)(\hat{s}_{b,t-1} - \hat{s}^M_{b,t-1} - \hat{s}^F_{b,t-1}) \tag{24}$$

$$+\phi^M(\hat{\pi}_{t-1} - \hat{\pi}^F_{t-1} - \hat{\pi}^M_{t-1}) - \hat{\pi}_t + \hat{\pi}^F_t + \hat{\pi}^M_t. \tag{25}$$

Using the first claim, $\hat{\pi}^M_t = \hat{\pi}_t - \hat{\pi}^F_t$, it follows that $\hat{s}^M_{b,t} = \hat{s}_{b,t} - \hat{s}^F_{b,t}$ for every period t.

Production economies

Production economies

We now extend the analysis to a production economy.

- Simple environment with no capital, but endogenous labor supply and production
- Two alternatives:
  1. Flexible prices
  2. Nominal rigidities
- Nominal rigidities and unfunded shocks deliver a fiscal theory of persistent inflation:
  1. Persistent movements in inflation
  2. Persistent movements in real interest rates
  3. Persistent movements in output (real effects)

Flexible prices

- Euler equation
$$\mathbb{E}_t \hat{y}_{t+1} = \hat{y}_t + \hat{r}_t \tag{26}$$
- Labor supply
$$\frac{n}{1-n}\hat{n}_t = \hat{y}_t + \widehat{w}_t^r \tag{27}$$
- Labor demand
$$\hat{w}_t^r = -\alpha \hat{n}_t \tag{28}$$
- Production function
$$\hat{y}_t = (1-\alpha)\hat{n}_t \tag{29}$$

Flexible prices

Equations (26) to (29) denote an autonomous system that solves for the real block of the economy, $\hat{y}_t$, $\hat{n}_t$, $\hat{w}_t^r$, $\hat{r}_t$. However, inflation is not determined. We introduce the behavior of the monetary and fiscal authorithies to pin down the path of inflation.

- Real rate definition

$$\hat{r}_t = \hat{r}_{n,t} - \mathbb{E}_t \hat{\pi}_{t+1} \tag{30}$$

- Taylor rule

$$\hat{r}_{n,t} = \phi_\pi^M (\hat{\pi}_t - \hat{\pi}_t^F) + \phi_\pi^F \hat{\pi}_t^F \tag{31}$$

- Evolution of debt-to-GDP

$$\hat{s}_{b,t} = \beta^{-1} \left(\hat{y}_{t-1} - \hat{y}_t + \hat{r}_{n,t-1} - \hat{\pi}_t + \hat{s}_{b,t-1} - (1-\beta)\hat{\tau}_t \right) \tag{32}$$

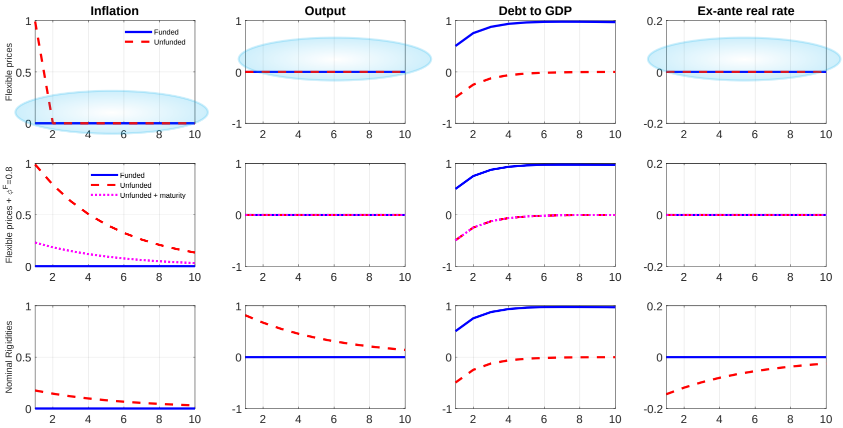
- Fiscal rule

$$\hat{\tau}_t = \gamma^M (\hat{s}_{b,t-1} - \hat{s}_{b,t-1}^F) + \gamma^F \hat{s}_{b,t-1}^F + \zeta_t^F + \zeta_t^M \tag{33}$$

Nominal rigidities

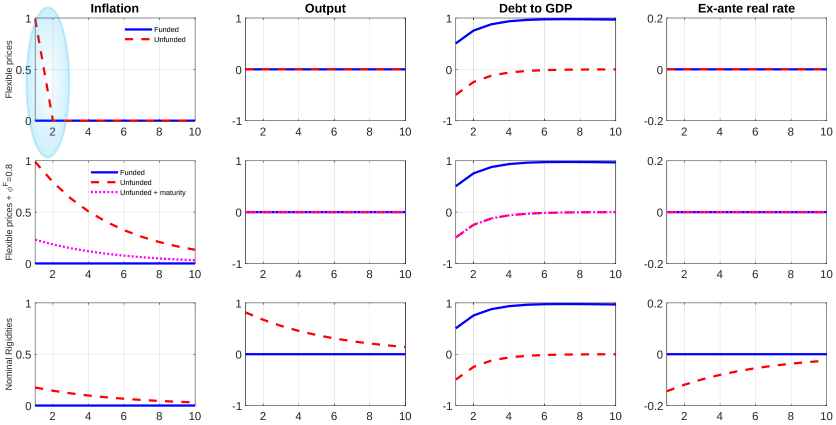
- Euler equation
$$\mathbb{E}_t \hat{y}_{t+1} = \hat{y}_t + \hat{r}_{n,t} - \mathbb{E}_t \hat{\pi}_{t+1}, \tag{34}$$
- NK Phillips curve
$$\hat{\pi}_t = \tilde{\kappa} \hat{y}_t + \beta \mathbb{E}_t \hat{\pi}_{t+1}, \tag{35}$$
where $\tilde{\kappa} = \left(\frac{\eta}{1-\alpha} - 1\right) \kappa$ and $\eta = \frac{n}{1-n}$
- Taylor rule
$$\hat{r}_{n,t} = \phi_\pi^M (\hat{\pi}_t - \hat{\pi}_t^F) + \phi_\pi^F \hat{\pi}_t^F \tag{36}$$
- Evolution of debt-to-GDP
$$\hat{s}_{b,t} = \beta^{-1} \left(\hat{y}_{t-1} - \hat{y}_t + \hat{r}_{n,t-1} - \hat{\pi}_t + \hat{s}_{b,t-1} - (1-\beta)\hat{\tau}_t \right) \tag{37}$$
- Fiscal rule
$$\hat{\tau}_t = \gamma^M (\hat{s}_{b,t-1} - \hat{s}_{b,t-1}^F) + \gamma^F \hat{s}_{b,t-1}^F + \zeta_t^F + \zeta_t^M \tag{38}$$

Persistent Fiscal Inflation



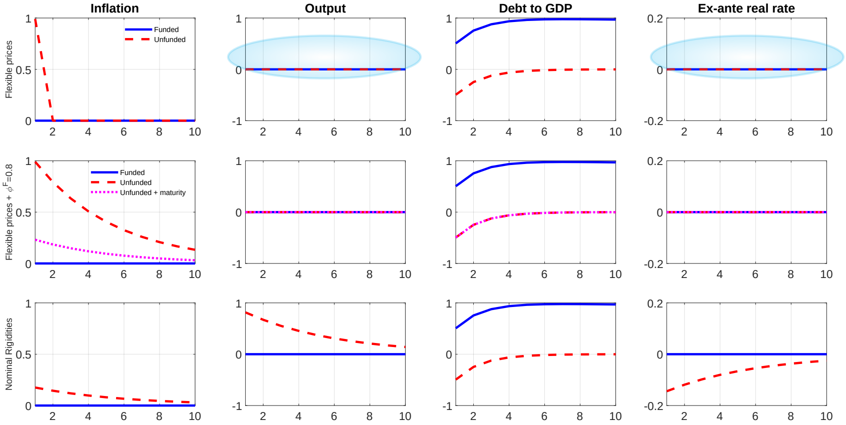
1. **Absent nominal rigidities,** macro-fiscal dichotomy holds for funded shocks

Persistent Fiscal Inflation



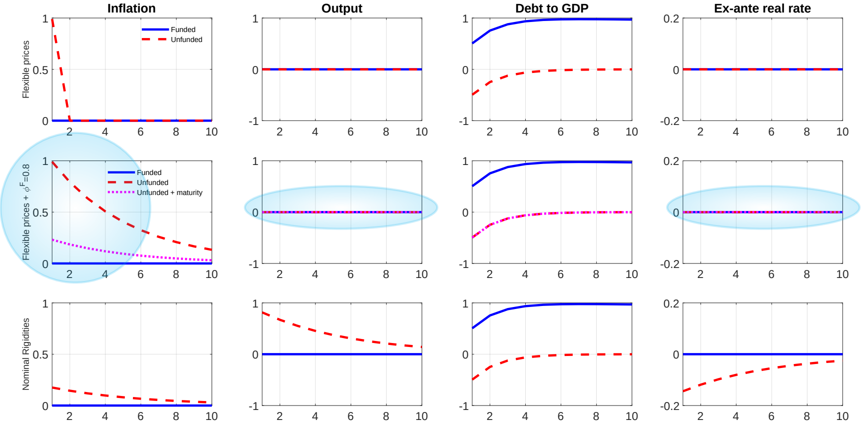
2. **Absent nominal rigidities**, price level increases after unfunded shocks as in the Fisherian model

Persistent Fiscal Inflation



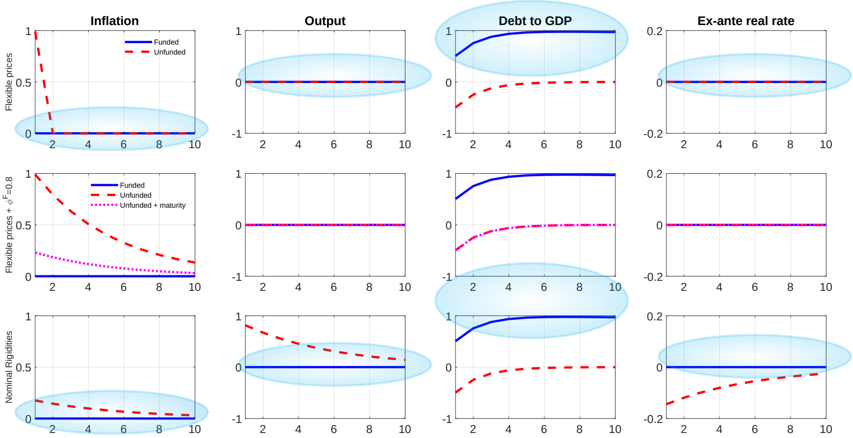
3. **Absent nominal rigidities**, real economy unaffected by unfunded shocks

Persistent Fiscal Inflation



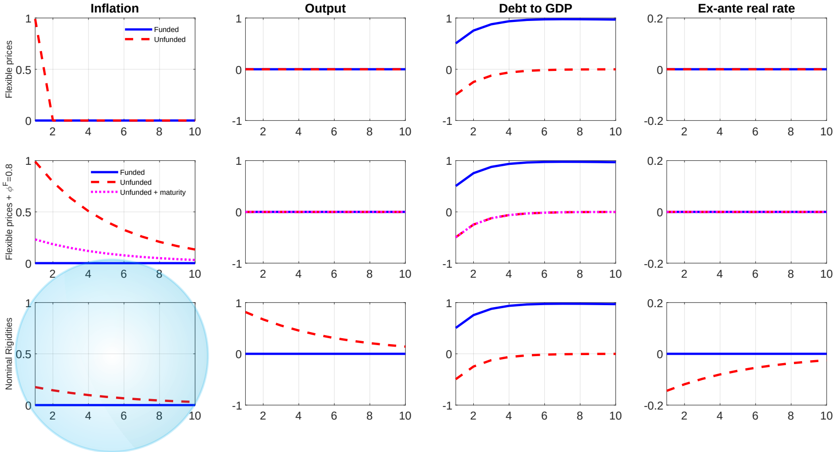
4. **With flexible prices and $\phi_\pi^F > 0$**, persistent inflation but no real effects in response to unfunded shocks

Persistent Fiscal Inflation



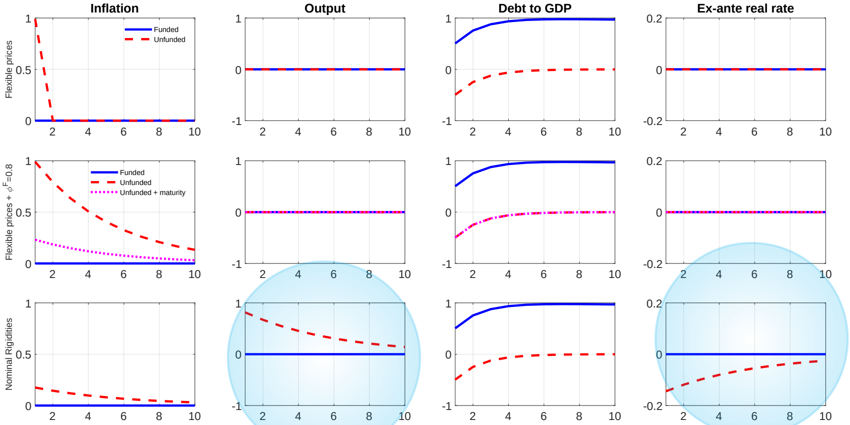
5. **Nominal rigidities:** No macro effects of funded shocks as in flex prices
$\rightarrow$ macro-fiscal dichotomy

Persistent Fiscal Inflation



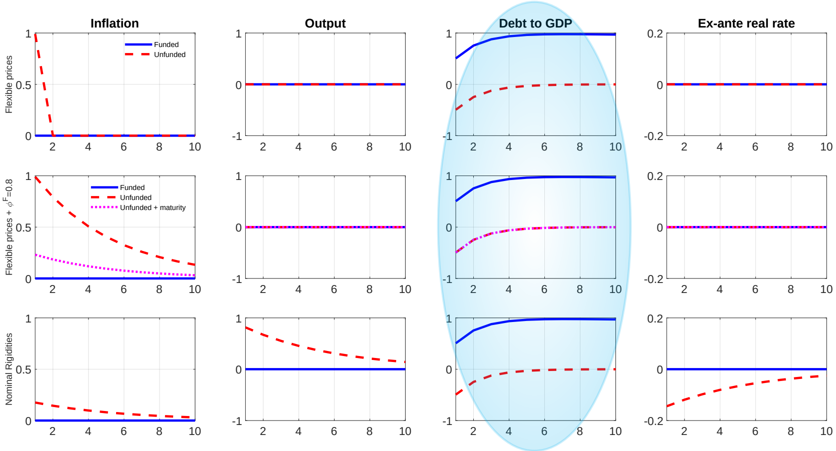
6. **Nominal rigidities:** persistent and moderate inflation response to unfunded shocks

Persistent Fiscal Inflation



7. **Nominal rigidities:** persistent decline in the real interest rate and real effects of unfunded shocks

Persistent Fiscal Inflation



8 **Across all cases:** Debt declines in response to an unfunded shock, while it increases in response to a funded shock

Model Overview

What is the role of the maturity structure in response to an unfunded shock?

- Flexible prices, non-distortionary taxation, Taylor rule.
- Focus: inflation response to fiscal shocks.
- Two bond types:
  - One-period bonds: B_t, price $R_{n,t}^{-1}$.
  - Long-term bonds: B_t^m, price $P_t^{(m)}$, payments $\rho^{T-(t+1)}$.
- ρ controls average maturity.

Real Block Equations

The real block pins down real variables with no reference to inflation

$$\begin{aligned}
\text{Euler:}\quad & \mathbb{E}_t[\hat{y}_{t+1}] - \hat{y}_t = \hat{r}_t \\
\text{Labor Supply:}\quad & \frac{n}{1-n}\hat{n}_t = \hat{y}_t + \hat{w}_t^r \\
\text{Labor Demand:}\quad & \hat{w}_t^r = -\alpha \hat{n}_t \\
\text{Production:}\quad & \hat{y}_t = (1-\alpha)\hat{n}_t
\end{aligned}$$

- We can solve for $\hat{y}_t$, $\hat{n}_t$, $\hat{w}_t^r$, $\hat{r}_t$.
- Inflation not determined.

Inflation and Policy Rules

- Monetary and fiscal policy pin down inflation:

$$\begin{aligned} \text{Real Rate:} \quad & \hat{r}_t = \hat{r}_{n,t} - \mathbb{E}_t[\hat{\pi}_{t+1}] \\ \text{Taylor Rule:} \quad & \hat{r}_{n,t} = \phi\hat{\pi}_t \\ \text{Fiscal Rule:} \quad & \hat{\tau}_t = \rho_\tau \hat{\tau}_{t-1} + \varepsilon_\tau \end{aligned}$$

- Debt dynamics depend on maturity structure:

$$\begin{aligned} \text{With maturity:} \quad & \hat{s}^m_{b,t} = \beta^{-1}(\hat{s}^m_{b,t-1} + \hat{r}^m_{n,t-1,t} - \hat{\pi}_t - \Delta\hat{y}_t - (1-\beta)\hat{\tau}_t) \\ \text{Without maturity:} \quad & \hat{s}_{b,t} = \beta^{-1}(\hat{s}_{b,t-1} + \hat{r}_{n,t-1} - \hat{\pi}_t - \Delta\hat{y}_t - (1-\beta)\hat{\tau}_t) \end{aligned}$$

- If maturity structure:

$$\begin{aligned} \text{Return:} \quad & \hat{r}^m_{n,t,t+1} = \varpi\hat{p}^{(m)}_{t+1} - \hat{p}^m_t \\ \text{Non-arbitrage:} \quad & \hat{r}_{n,t} = \mathbb{E}_t[\hat{r}^m_{n,t,t+1}] \end{aligned}$$

where $\varpi = \rho/R_n < 1$ pins down the average maturity.

Forward Solutions and Expectations

- We derive two relations from forward solution of bond pricing.

$$\hat{p}_t^m = -\sum_{j=1}^{\infty} \omega^{j-1} \hat{r}^m_{n,t,t+j}$$

$$\Delta\mathbb{E}_{t+1}[\hat{r}^m_{n,t,t+1}] = -\sum_{j=1}^{\infty} \omega^{j} \Delta\mathbb{E}_{t+1}[\hat{r}^m_{n,t+j,t+1+j}]$$

- See Cochrane's textbook for details.

No Maturity Structure

Linearized budget constraint (shifted forward):

$$\hat{s}_{b,t+1} = \beta^{-1}\left(\hat{s}_{b,t} + \hat{r}_{n,t} - \hat{\pi}_{t+1} - \Delta\hat{y}_{t+1}\right) - \beta^{-1}(1-\beta)\hat{\tau}_{t+1}$$

Solving forward:

$$\hat{s}_{b,t} = \mathbb{E}_t\left[\sum_{j=0}^{\infty}\beta^j\left((1-\beta)\hat{\tau}_{t+1+j} - (\hat{r}_{n,t+j} - \hat{\pi}_{t+1+j}) + \Delta\hat{y}_{t+1+j}\right)\right]$$

Inflation Surprise

Change in expectations between t and $t+1$:

$$\eta_{t+1}^{\pi} = \hat{\pi}_{t+1} - \mathbb{E}_t(\hat{\pi}_{t+1}) = \Delta\mathbb{E}_{t+1}[\hat{\pi}_{t+1}]$$

Driven by fiscal shock:

$$\eta_{t+1}^{\pi} = -(1-\beta\rho_\tau)^{-1}(1-\beta)\varepsilon_{\tau,t+1}$$

Inflation jumps on impact due to the change in expected future surpluses.

Inflation Propagation

Fisher equation and Taylor rule:

$$\phi \hat{\pi}_t = \mathbb{E}_t[\hat{\pi}_{t+1}]$$

Inflation dynamics:

$$\hat{\pi}_{t+1} = \phi \hat{\pi}_t + \eta^{\pi}_{t+1}$$

- ϕ controls persistence of inflation.
- Central bank sets expected inflation via nominal rate.
- Initial jump unaffected by ϕ (as in the endowment economy).

With Maturity Structure

Budget constraint with maturity:

$$\hat{s}^m_{b,t+1} = \beta^{-1}\left(\hat{s}^m_{b,t} + \hat{r}^m_{n,t,t+1} - \hat{\pi}_{t+1} - \Delta\hat{y}_{t+1}\right) - \beta^{-1}(1-\beta)\hat{\tau}_{t+1}$$

Solving forward:

$$\hat{s}^m_{b,t} = \mathbb{E}_t\left[\sum_{j=0}^{\infty}\beta^j\left((1-\beta)\hat{\tau}_{t+1+j} - (\hat{r}^m_{n,t+j,t+1+j} - \hat{\pi}_{t+1+j}) + \Delta\hat{y}_{t+1+j}\right)\right]$$

Longer maturity introduces expectations about future returns into debt valuation.

Inflation Surprise with Maturity

Change in expectations following a fiscal shock:

$$0 = \Delta \mathbb{E}_{t+1} \left[\sum_{j=0}^{\infty} \beta^j \left((1-\beta) \hat{\tau}_{t+1+j} \right) \right] - \Delta \mathbb{E}_{t+1} \left[\hat{r}^m_{n,t,t+1} - \hat{\pi}_{t+1} \right]$$

where we have used the fact that real interest rates and growth are exogenous

- Inflation surprise now reflects the expected return on long-term debt, not just short-term nominal rates.

Key Identity

We begin with a fundamental identity linking expected returns and inflation:

$$\Delta\mathbb{E}_{t+1}\left[\hat{r}^{m}_{n,t,t+1}\right] = -\sum_{j=1}^{\infty} \varpi^{j} \Delta\mathbb{E}_{t+1}\left[\hat{r}^{m}_{n,t+j,t+1+j}\right]$$

This can be rewritten using the Fisher equation:

$$\Delta\mathbb{E}_{t+1}\left[\hat{r}^{m}_{n,t,t+1}\right] = -\sum_{j=1}^{\infty} \varpi^{j} \Delta\mathbb{E}_{t+1}\left[\hat{\pi}_{t+1+j}\right]$$

Changes in expected returns are driven by changes in expected inflation.

Inflation Surprise Equation

Combining the above with the government budget constraint, we obtain:

$$\sum_{j=0}^{\infty} \varpi^j \Delta \mathbb{E}_{t+1} [\hat{\pi}_{t+1+j}] = -\Delta \mathbb{E}_{t+1} \left[\sum_{j=0}^{\infty} \beta^j (1-\beta) \hat{\tau}_{t+1+j} \right]$$

This equation links the inflation path to the PDV of future primary surpluses.

Inflation Dynamics

Using the Taylor rule and Fisher equation:

$$\phi\hat{\pi}_t = \mathbb{E}_t[\hat{\pi}_{t+1}], \quad \hat{\pi}_{t+1} = \phi\hat{\pi}_t + \eta^{\pi}_{t+1}$$

We get

$$\Delta\mathbb{E}_{t+1}[\hat{\pi}_{t+1+j}] = \phi^j \eta^{\pi}_{t+1}$$

Change in the expected path of inflation depends on ϕ.

Solving for Inflation Surprise

Plugging into the inflation equation:

$$\eta^{\pi}_{t+1} = -(1-\phi\varpi)\Delta\mathbb{E}_{t+1}\left[\sum_{j=0}^{\infty}\beta^{j}(1-\beta)\hat{\tau}_{t+1+j}\right]$$

Under AR(1) process:

$$\hat{\tau}_{t+1} = \rho_{\tau}\hat{\tau}_{t} + \varepsilon_{\tau,t+1}$$

Then:

$$\eta^{\pi}_{t+1} = -(1-\phi\varpi)(1-\beta)\left(1-\beta\rho_{\tau}\right)^{-1}\varepsilon_{\tau,t+1}$$

Inflation jumps on impact due to the fiscal shock.

Interaction between monetary policy and maturity

Interaction between monetary policy rule and maturity structure

- Initial inflation jump depends on both fiscal policy and monetary policy because of revaluation effects
    1. ϕ controls inflation persistence via the Taylor rule.
    2. ϖ controls average maturity of debt.
    3. Higher ϕ or ϖ $\rightarrow$ stronger revaluation of long-term bonds $\rightarrow$ smaller initial inflation jump.
- If either $\phi = 0$ or $\varpi = 0$, the model collapses to the no-maturity case.

Fiscal Influences on Inflation in OECD Countries, 2020-2023

- Barro and Bianchi (2026) build on this framework to explain the cross-country variation in **post-pandemic inflation**
- They derive a simple relation between **change in inflation** and **COVID fiscal stimulus** rescaled for **amount** and **duration** of outstanding **government debt**

$$\pi - \pi^* = \eta \left(\sum_{i=1}^{M} \Delta \frac{G_{t+i}}{Y_{t+i}} \right) / \left(\frac{B_t^*}{P_t Y_t} \frac{T}{2} \right)$$

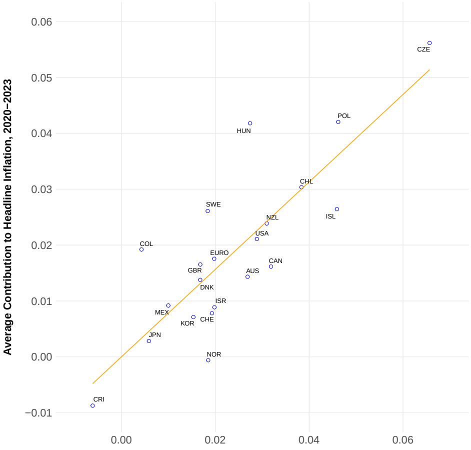
- Verify whether relation can explain **cross-country variation** in inflation

$$\pi_{i,t} = \pi_i^* + \eta \Delta G_i + \beta Z_{i,t} + X_t + \epsilon_i$$

where π_i^* and X_t are country and time fixed effect

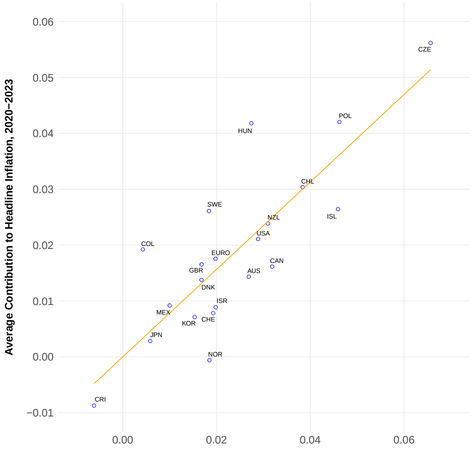
Explaining cross-country variation of inflation: Headline

- Strong relation between rescaled spending and inflation: $\eta = .78$ and $R^2 = .79$



Explaining cross-country variation of inflation: Headline

- Only other variable that matters is border with Russia or Ukraine



Nominal rigidities

Without nominal rigidities:

- Persistence still uniquely pinned down by monetary policy
- No real effects $\Rightarrow$ no movements in real interest rates and output

With nominal rigidities:

- Inflation persistence not a one-to-one function of Taylor rule parameter
- Real effects: They contribute to stabilization and are more in line with the data
- Maturity structure still potentially important in affecting the initial jump in inflation
- With realistic tax schemes, less inflation is necessary because changes in real activity affect tax revenues (see also Angeletos, Lian, and Wolf)

A Fiscal Theory of Persistent Inflation

with Renato Faccini and Leonardo Melosi (QJE, 2023)

Optimistic view (A Fiscal Theory of Persistent Inflation):

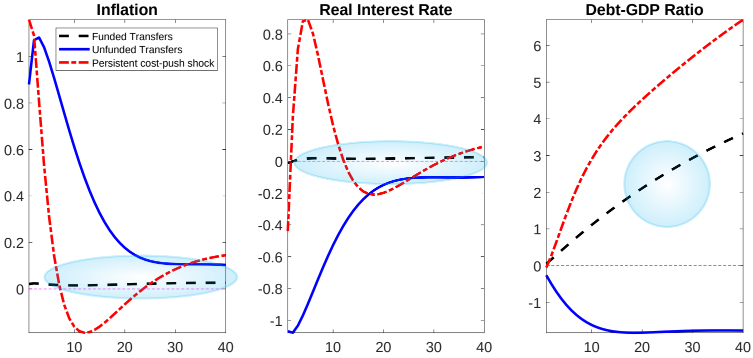
- Policy coordination generated a quick rebound of the economy from the pandemic
- Large spur of fiscal inflation was the cost
- **Mission accomplished**, we are on our way back to **normality**

A Fiscal Theory of Persistent Inflation

- New class of general equilibrium models with partially unfunded government debt
  1. At any given point in time, part of the outstanding government debt is unfunded
  2. Unfunded debt is not backed by future fiscal adjustments $\Rightarrow$ Inflationary pressure accommodated by the central bank
  3. Debt stability achieved with a mix of fiscal adjustments and inflation
- With nominal rigidities, unfunded fiscal shocks cause persistent movements in inflation and in real interest rates $\rightarrow$ A fiscal theory of persistent inflation
- We estimate a TANK model augmented with **unfunded fiscal shocks** on US data:

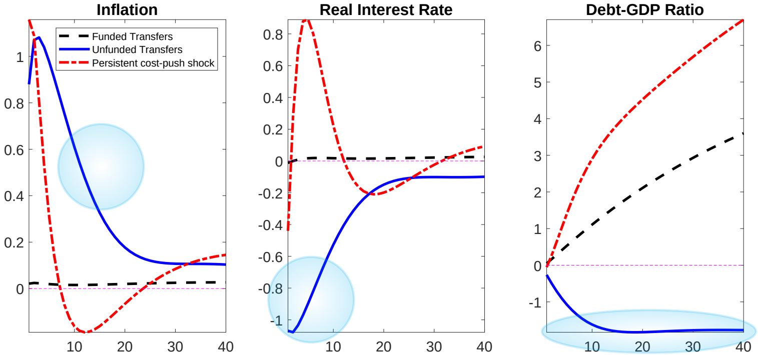
  $\Rightarrow$ Post-pandemic inflation and recovery were the result of unfunded fiscal shocks: Two massive fiscal stimuli and a new monetary framework
- Optimistic view: Inflation expected to slowly revert to its 2% target

Identification of unfunded transfers shocks



- **Funded transfers**: Modest impact on the macroeconomy, debt increases
- **Unfunded transfers**: Persistent inflation increases, real rate and debt decline
- **Phillips curve shifter**: Short-lasting inflation spike, real rate and debt increase

Identification of unfunded transfers shocks



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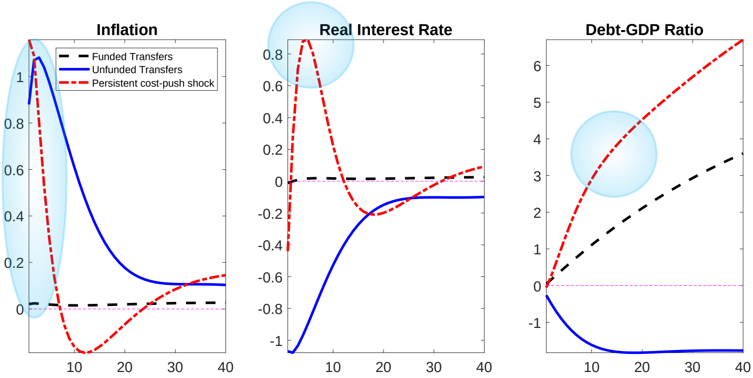
Identification of unfunded transfers shocks



- **Funded transfers**: Modest impact on the macroeconomy, debt increases
- **Unfunded transfers**: Persistent inflation increases, real rate and debt decline
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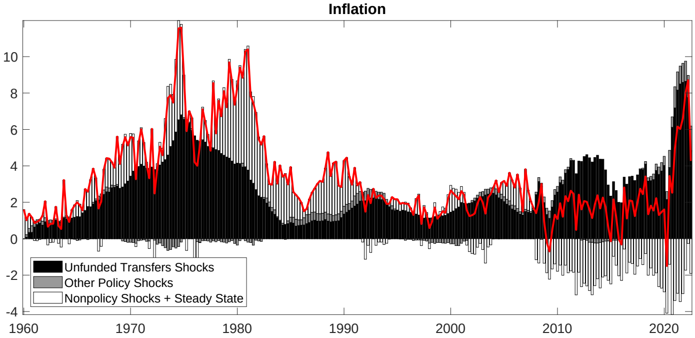
Drivers of Inflation

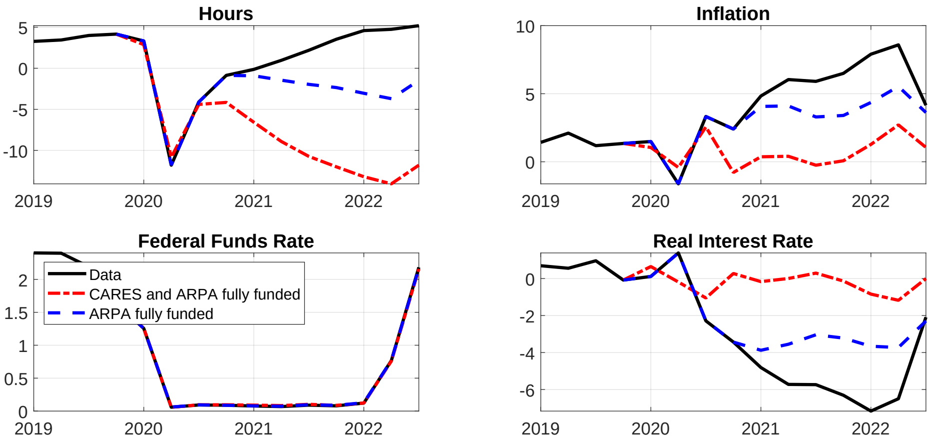


Unfunded transfers shocks:

1. Accounts for rise of trend inflation in the 1960s-1970s and decline in the 1980s
2. Offsets the deflationary bias that non-policy shocks have set off since early 1990s

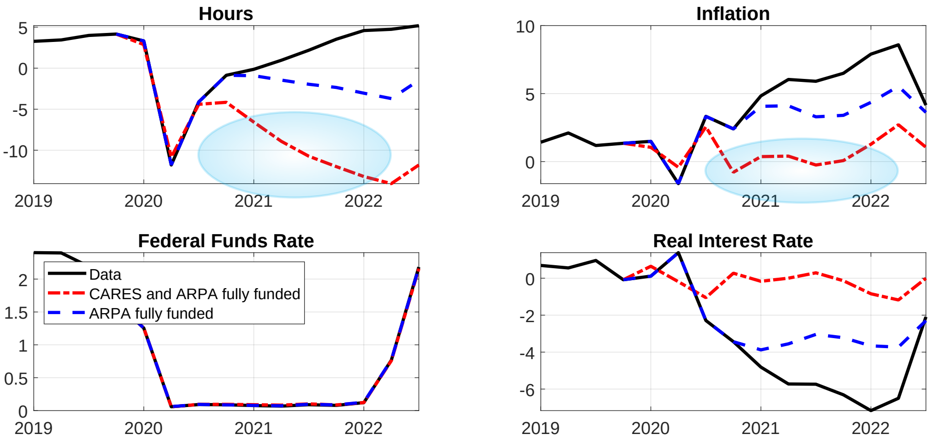
Unfunded Debt and Reflation of the Economy

- Counterfactual simulations to assess the effects of unfunded share of fiscal stimuli



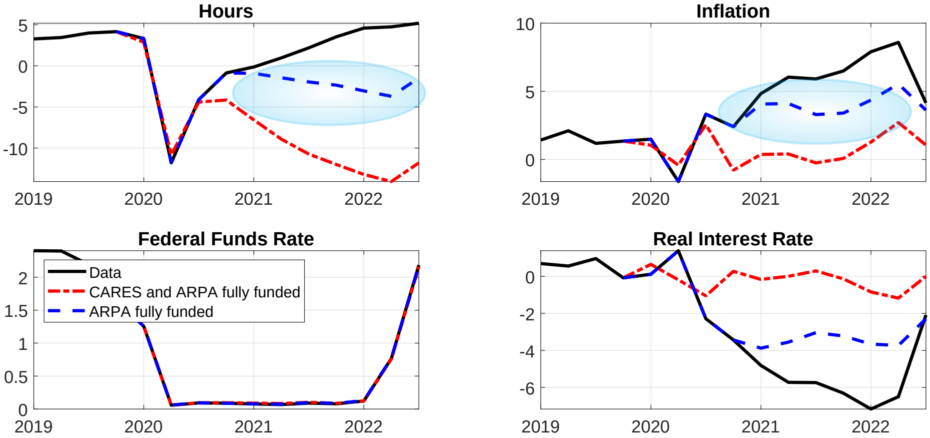
Unfunded Debt and Reflation of the Economy

- No unfunded fiscal shocks



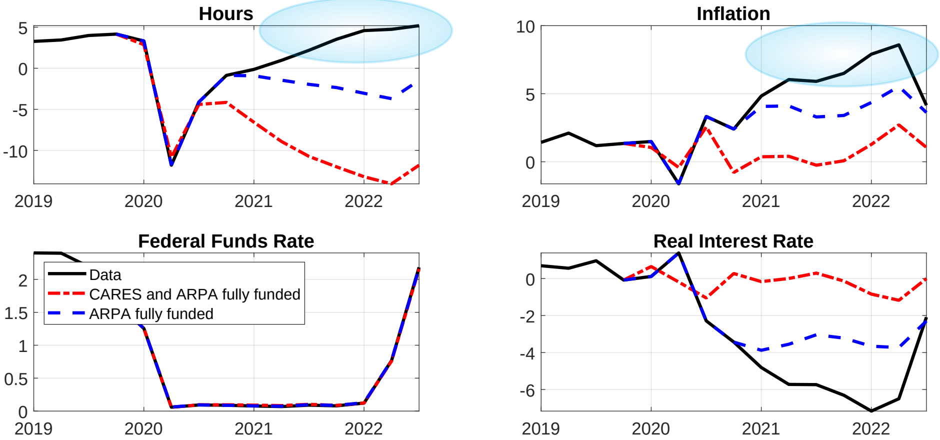
Unfunded Debt and Reflation of the Economy

- Effect of CARES act



Unfunded Debt and Reflation of the Economy

- Effect of CARES act + ARPA



Regime changes

Inflation determination in a Fisherian model

- Suppose that policymakers' behavior can change over time and that agents are aware of the possibility of regime changes
- Assume that these regime changes and/or the beliefs about future regime changes can be captured by a transition matrix $\mathbf{H}_p$
- The **monetary block** becomes:

$$\mathbb{E}_t \hat{\pi}_{t+1} = \phi_{\xi_t^p} \hat{\pi}_t. \tag{39}$$

- The **fiscal block** becomes:

$$\hat{s}_{b,t} = \beta^{-1}[1 - (1-\beta)\gamma_{\xi_t^p}]\hat{s}_{b,t-1} + \beta^{-1}\left[\phi_{\xi_t^p}\hat{\pi}_{t-1} - \hat{\pi}_t - (1-\beta)\zeta_t\right]. \tag{40}$$

Solution of a MS-DSGE model

- Conditional on a regime ξ_t^p, rewrite the system of equations in canonical form:

$$\Gamma_0\left(\xi_t^p,\theta\right)\mathbf{s}_t=\Gamma_1\left(\xi_t^p,\theta\right)\mathbf{s}_{t-1}+\mathbf{Q}\varepsilon_t+\eta_t$$

- The model can be solved following Farmer, Waggoner, and Zha (2010):

$$\mathbf{s}_t=\mathbf{T}\left(\xi_t^p,\theta,\mathbf{H}_p\right)\mathbf{s}_{t-1}+\mathbf{R}\left(\xi_t^p,\theta,\mathbf{H}_p\right)\mathbf{Q}\varepsilon_t$$

  where the transition matrix $\mathbf{H}_p$ controls the probability of moving across regimes
- The probabilities of regime changes affect the matrices **T** and **R**. This is important for the statistical properties of the model and the propagation of the shocks.
- Agents' beliefs affect the response of the macroeconomy to a fiscal shock

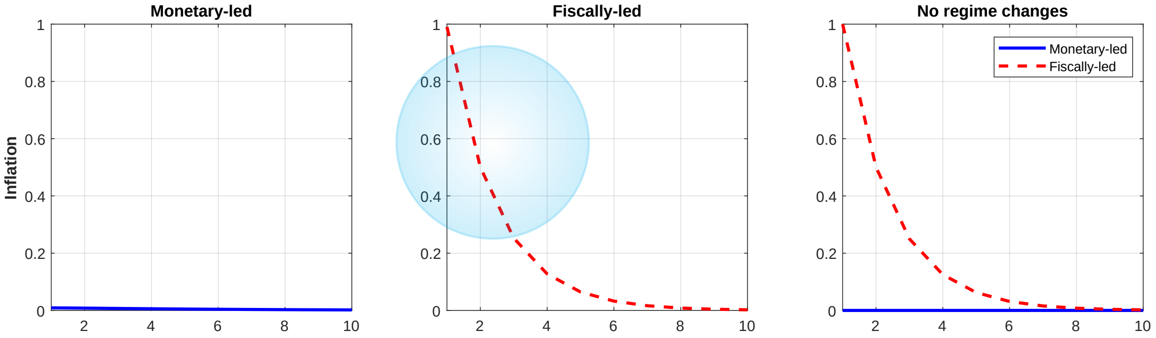
Case 1: Modest probability of Fiscally-led regime

Parameterization

- The discount factor β is 0.99 and the steady-state value of debt-to-GDP s_b is 1
- The policy parameters are $\phi^M = 2$ and $\gamma^M = 20$ under the Monetary-led regime
- The fiscal rule parameters are $\phi^F = 0$ and $\gamma^F = 0$ under the Fiscally-led regime
- Probability of moving across regimes

$$\mathbf{H}_p = \begin{bmatrix} .99 & .01 \\ .01 & .99 \end{bmatrix}$$

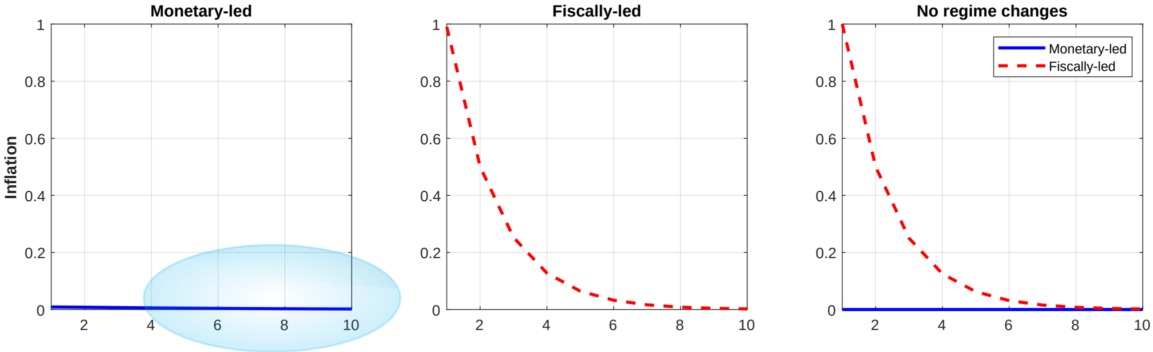
Case 1: Modest probability of Fiscally-led regime



Impulse responses:

1. Inflation response almost identical under the Fiscally-led policy mix

Case 1: Modest probability of Fiscally-led regime



Impulse responses:

2. Imperceptible inflation response under the Monetary-led policy mix

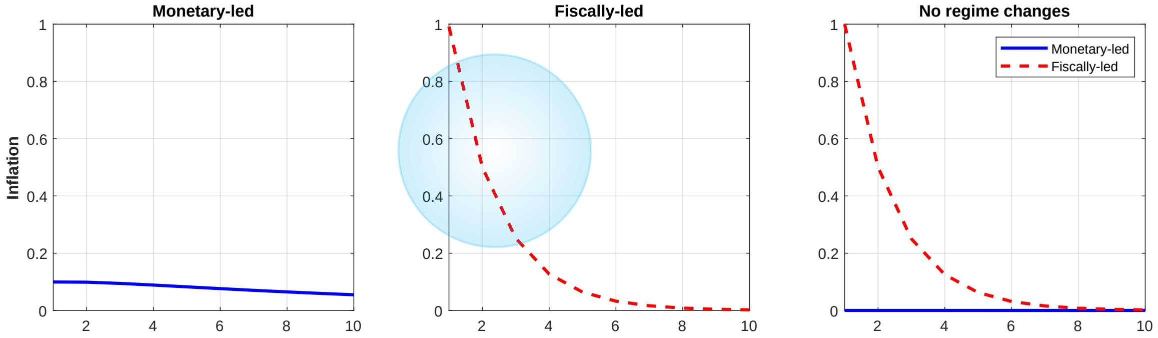
Case 2: High probability of Fiscally-led regime

Parameterization

- The discount factor β is 0.99 and the steady-state value of debt-to-GDP s_b is 1
- The policy parameters are $\phi^M = 2$ and $\gamma^M = 20$ under the Monetary-led regime
- The fiscal rule parameters are $\phi^F = 0$ and $\gamma^F = 0$ under the Fiscally-led regime
- Probability of moving across regimes

$$\mathbf{H}_p = \begin{bmatrix} .9 & .01 \\ .1 & .99 \end{bmatrix}$$

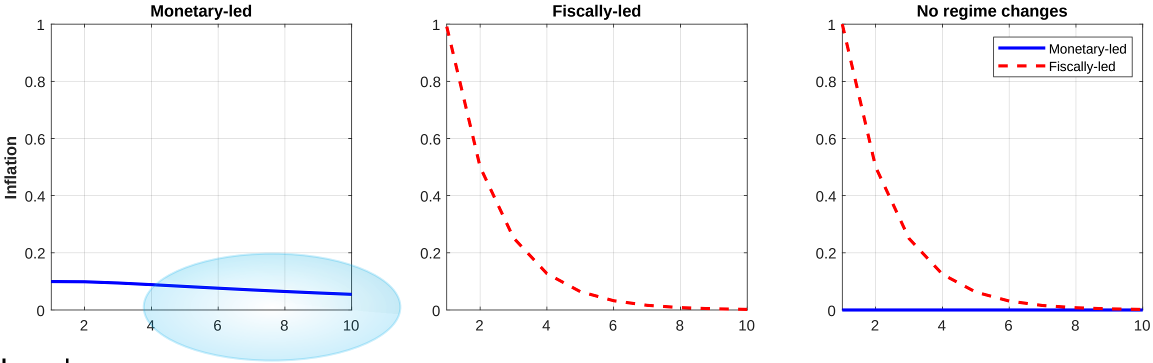
Case 2: High probability of Fiscally-led regime



Impulse responses:

1. Similar inflation response under the Fiscally-led policy mix

Case 2: High probability of Fiscally-led regime



Impulse responses:

2. Inflation responds also under Monetary-led policy mix

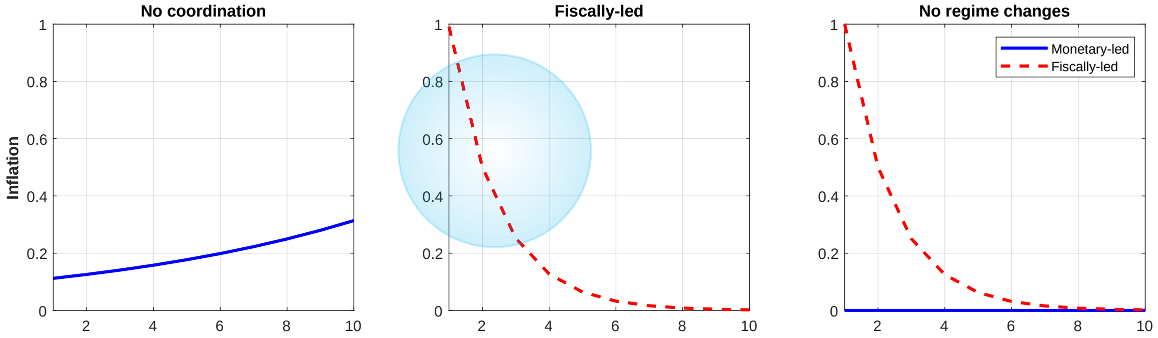
Case 3: Lack of coordination

Parameterization

- The discount factor β is 0.99 and the steady-state value of debt-to-GDP s_b is 1
- The policy parameters are $\phi^M = 2$ and $\gamma^F = 0$ under the No-coordination regime
- The policy parameters are $\phi^F = 0$ and $\gamma^F = 0$ under the Fiscally-led regime
- Probability of moving across regimes

$$\mathbf{H}_p = \begin{bmatrix} .9 & .01 \\ .1 & .99 \end{bmatrix}$$

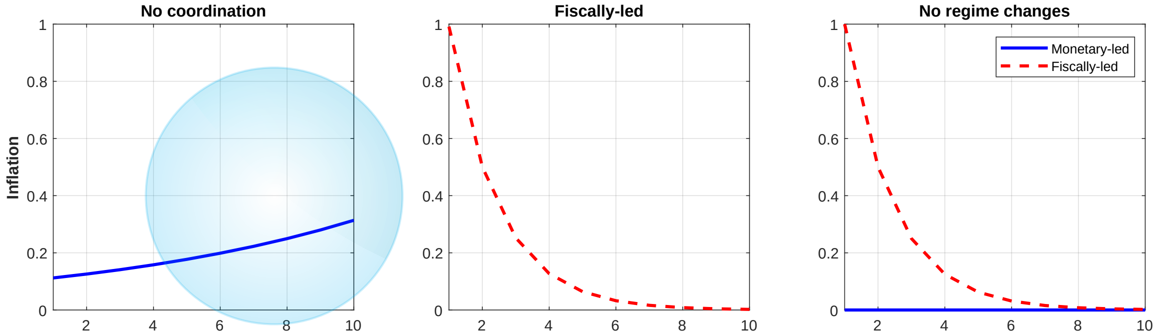
Case 3: Lack of coordination



Impulse responses:

1. Similar inflation response under the Fiscally-led policy mix

Case 3: Lack of coordination



Impulse responses:

2. Explosive inflation response when No coordination

An illustrative example

To understand the previous result, we can consider this pencil and paper example from Bianchi and Melosi (JME, 2019):

- The monetary-block (MB) equation

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

- The fiscal-block (FB) equation

$$\hat{b}_t = \left(\beta^{-1} - \delta\right) \hat{b}_{t-1} + b\left(\psi - \beta^{-1}\right) \tilde{\pi}_t - \epsilon_t^\tau$$

- Two eigenvalues: ψ and $(\beta^{-1} - \delta)$; one non-predetermined variable

$\Longrightarrow$ **Joint behavior of monetary and fiscal policy key for REE**

Monetary-Led Policy Mix (AM/PF)

- If $\psi > 1$ and $\delta > \beta^{-1} - 1$, the MB equation is explosive
- The unique REE for inflation must satisfy

$$\tilde{\pi}_t = \psi^{-1} \epsilon_t^d$$

- The REE dynamics of real debt:

$$\hat{b}_t = \left(\beta^{-1} - \delta\right) \hat{b}_{t-1} + b\left(\psi - \beta^{-1}\right) \psi^{-1} \epsilon_t^d - \epsilon_t^\tau$$

$\longrightarrow$ **Monetary and Fiscal Dichotomy and inflation is iid**

Fiscally-Led Policy Mix (PM/AF)

- If $\psi \leq 1$ and $\delta \leq \beta^{-1} - 1$, the FB equation is unstable
- The unique stable REE requires:

$$E_t \tilde{\pi}_{t+1} = \underbrace{\frac{\delta - \beta^{-1} + \psi}{b\left(\psi - \beta^{-1}\right)}}_{\Omega} \hat{b}_t$$

$\Longrightarrow$ Monetary and fiscal dichotomy does not hold

- REE:

$$\begin{bmatrix} \tilde{\pi}_t \\ \hat{b}_t \end{bmatrix} = \begin{bmatrix} 0 & \Omega \\ 0 & \psi \end{bmatrix} \begin{bmatrix} \tilde{\pi}_{t-1} \\ \hat{b}_{t-1} \end{bmatrix} + \begin{bmatrix} \frac{1}{\beta^{-1}-\delta} & -\frac{\Omega}{\beta^{-1}-\delta} \\ -\frac{b\left(\beta^{-1}-\psi\right)}{\beta^{-1}-\delta} & -\frac{\psi}{\beta^{-1}-\delta} \end{bmatrix} \begin{bmatrix} \epsilon_t^d \\ \epsilon_t^\tau \end{bmatrix}$$

$\Longrightarrow$ inflation is not iid b/c debt is not (unless $\psi = 0$)

Lack of Coordination

- So far monetary and fiscal policy have been coordinated to achieve a determinate rate of inflation
- Now, right after a shock $\epsilon_t^d > 0$, fiscal authority starts disregarding debt stabilization...
- ... while the CB tries to keep inflation stable
- We assume that this conflict lasts only one period, after which either the ML or FL policies are in place forever
- Agents' beliefs about which authority will prevail is key for macroeconomic outcomes

Case 1: The Monetary Authority is Expected to Prevail

- Monetary-led is expected to be in place at time 2 $\Longrightarrow \mathbb{E}_1(\hat{\pi}_2) = 0$
- Thus, inflation at time 1

$$\tilde{\pi}_1 = \psi_A^{-1} \varepsilon_1^d$$

- The stock of real debt is

$$\hat{b}_1 = b \left(1 - \frac{\beta^{-1}}{\psi_A}\right) \epsilon_1^d$$

- The monetary and fiscal dichotomy holds
- The more hawkish the central bank is during the conflict period, the lower inflation and the higher debt

Case 2: The Fiscal Authority is Expected to Prevail

- At time $t = 1$, agents know that the policy mix in period $t = 2$ will be fiscally led:

$$\mathbb{E}_1(\hat{\pi}_2) = \Omega_F \hat{b}_1$$

where $\Omega_F \equiv \frac{\delta_A - \beta^{-1} + \psi_P}{b(\psi_P - \beta^{-1})}$

- Consequently at time $t = 1$ the REE inflation must satisfy the monetary block:

$$\tilde{\pi}_1 = \psi_A^{-1} \epsilon_t^d + \psi_A^{-1} \Omega_F \hat{b}_1$$

and the stock of debt

$$\hat{b}_1 = b\left(\psi_A - \beta^{-1}\right) \tilde{\pi}_1$$

Case 2: The Fiscal Authority is Expected to Prevail

- The unique REE outcome at $t = 1$

$$\tilde{\pi}_1 = \frac{1}{\Omega_F b \beta^{-1} + \psi_A (1 - \Omega_F b)} \varepsilon_1^d$$
$$\hat{b}_1 = \frac{b \left(\psi_A - \beta^{-1}\right)}{\Omega_F b \beta^{-1} + \psi_A (1 - \Omega_F b)} \varepsilon_1^d$$

- Since in periods $t > 1$ policymakers coordinate their policies,

$$\begin{bmatrix} \tilde{\pi}_t \\ \hat{b}_t \end{bmatrix} = \begin{bmatrix} 0 & \Omega_F \\ 0 & \psi_P \end{bmatrix} \begin{bmatrix} \tilde{\pi}_{t-1} \\ \hat{b}_{t-1} \end{bmatrix}, \quad t > 1$$

Case 2: The Fiscal Authority is Expected to Prevail

A few remarks

1. If the fiscal authority does not respond at all to debt $(\delta_A = 0)$, then $\Omega_F b = 1$ and

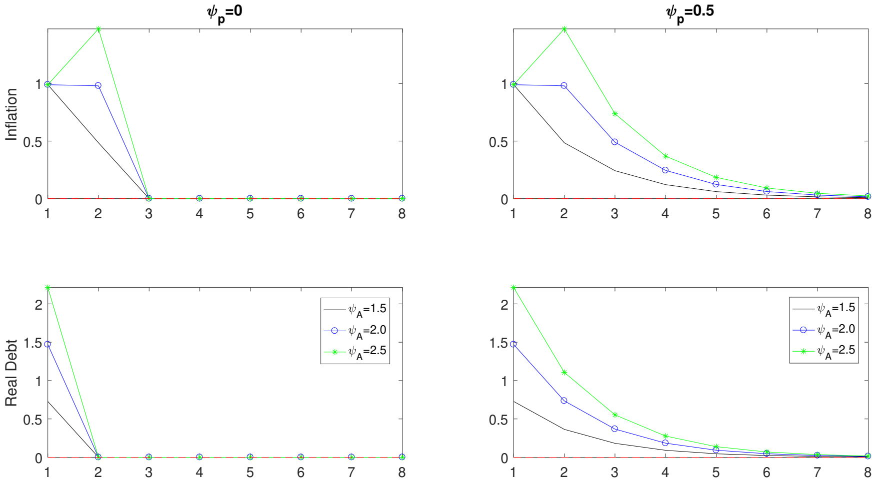
$$\tilde{\pi}_1 = \frac{1}{\beta^{-1}} \varepsilon_1^d$$

$\Rightarrow$ The central bank fails to affect inflation in period 1 as it lacks fiscal backing

2. But monetary policy response in $t = 1$, matters for inflation in periods $t > 1$

$\Longrightarrow$ A more combative central bank during the conflict period causes a higher fiscal imbalance $\left(\hat{b}_1 \uparrow\right) \Rightarrow$ higher inflation rate in the following period.

Case 2: The Fiscal Authority is Expected to Prevail



Case 2: The Fiscal Authority is Expected to Prevail

1. FA behaviors affect REE outcomes, including price dynamics
2. The more hawkish the central bank during the fight period, the larger real debt at the end of period 1, the larger the rise in inflation needed in periods $t \geq 2$ to stabilize debt
   - The central bank cannot stabilize inflation without fiscal backing
3. The more proactive passive monetary policy in periods $t \geq 2$, the more persistent the dynamics of debt and that of inflation necessary to stabilize it.

Monetary/Fiscal Policy Mix and Agents' Beliefs

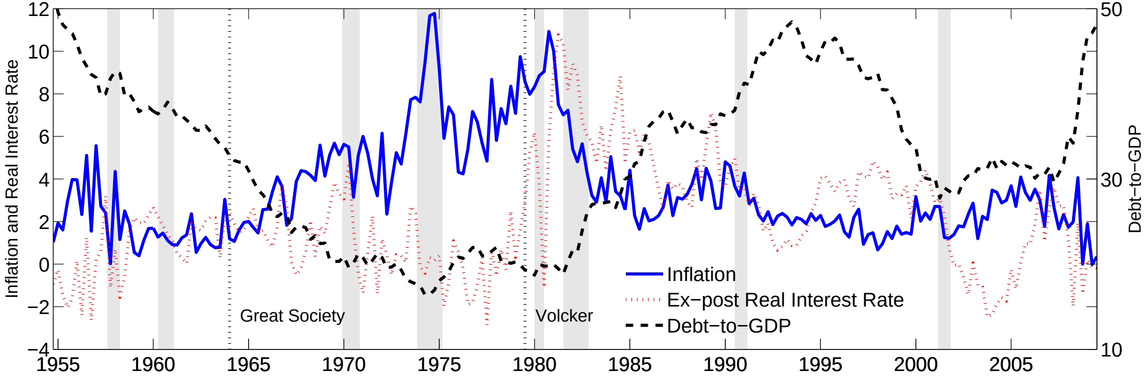
with Cosmin Ilut (RED, 2017)

Motivation

Ben Bernanke, New York University, February 2003:

[...] The primary cause of the Great Inflation, most economists would agree, was over-expansionary monetary and fiscal policies, beginning in the mid-1960s and continuing, in fits and starts, well into the 1970s. The fiscal expansion of this period had a variety of elements, including heavy expenditures for the Vietnam War and President Johnson's Great Society initiatives. Monetary policy first accommodated the fiscal expansion, and then [...] began to power the inflationary surge on its own. [...]

Debt and Inflation



This paper

We estimate a DSGE model in which the monetary-fiscal policy can change over time

- We find that the fiscal authority was the leading authority in the '60s and '70s $\Rightarrow$ Passive Monetary/Active Fiscal (PM/AF) regime
- The appointment Volcker marked a change in the conduct of monetary policy $\Rightarrow$ Active Monetary/Active Fiscal (AM/AF) regime
- ...but it took two years for the fiscal authority to accommodate this change $\Rightarrow$ Active Monetary/Passive Fiscal (AM/PF) regime

Summary of the main results

1. The persistent rise in inflation is explained by a series of shocks to long term government expenditure that are inflationary under the PM/AF regime
   - If AM/PF regime had been in place throughout the entire sample or if agents had been confident about the switch to such a regime, the Great Inflation would not have occurred
2. The reversal in the debt-to-GDP dynamics, the sudden drop in inflation, and the fall in output of the early '80s are explained by the switch from the PM/AF to the AM/PF
   - Absent the regime change, inflation would have been high for another fifteen years
3. Even under the AM/PF regime, fiscal imbalances have some inflationary pressure given that agents take into account the possibility of a return to the PM/AF regime

Household

The representative household maximizes the following utility function:

$$E_0 \left[\sum_{s=0}^{\infty} \beta^s e^{d_s} \left[\log \left(C_s - \Phi C_{s-1}^A \right) - h_s \right] \right] \tag{41}$$

subject to the budget constraint:

$$\begin{aligned} P_t C_t + P_t^m B_t^m + P_t^s B_t^s \quad = \quad & P_t W_t h_t + B_{t-1}^s + \left(1 + \rho P_t^m\right) B_{t-1}^m \\ & + P_t D_t - T_t + TR_t \end{aligned}$$

The preference follows an autoregressive process:

$$d_t = \rho_d d_{t-1} + \sigma_{d,\xi_t^{vo}} \varepsilon_{d,t}$$

Maturity structure

There are two types of government bonds (Woodford):

- One-period government debt, B_t^s, in zero net supply with price $P_t^s = R_t^{-1}$
- A more general portfolio of government debt, B_t^m, in non-zero net supply with price P_t^m and payment structure $\rho^{T-(t+1)}$, $T > t$ and $0 < \rho < 1$

The return on the long term bond is:

$$R_{t,t+1}^m = \left(1 + \rho P_{t+1}^m\right) / P_t^m$$

and in the linearized equilibrium:

$$R_t = E_t \left[R_{t,t+1}^m\right] \text{ and } P_t^m = -E_t \sum_{T=t}^{\infty} (\rho\beta)^{T-t} \; R_T$$

Firms

- The monopolistically competitive firms face a downward-sloping demand curve:

$$Y_t(j) = (P_t(j)/P_t)^{-1/\upsilon_t} Y_t$$

- Whenever a firm wants to change its price, it faces quadratic adjustment costs:

$$AC_t(j) = .5\varphi \left(P_t(j)/P_{t-1}(j) - \Pi_{t-1}^{\varsigma} \Pi^{1-\varsigma} \right)^2 Y_t(j) P_t(j)/P_t$$

- Labor is the only input in a linear production function $Y_t(j) = A_t^{1-\alpha} h_t(j)$, where $\ln(A_t/A_{t-1}) = \gamma + a_t$ and a_t evolves according to:

$$a_t = \rho_a a_{t-1} + \sigma_{a,\xi_t^{vo}} \varepsilon_{a,t}$$

Monetary authority

The Central Bank moves the FFR according to the rule:

$$\frac{R_t}{R} = \left(\frac{R_{t-1}}{R}\right)^{\rho_{R,\xi_t^{sp}}} \left[\left(\frac{\Pi_t}{\Pi}\right)^{\psi_{\pi,\xi_t^{sp}}} \left(\frac{Y_t}{Y_t^*}\right)^{\psi_{y,\xi_t^{sp}}}\right]^{\left(1-\rho_{R,\xi_t^{sp}}\right)} e^{\sigma_{R,\xi_t^{vo}}\epsilon_{R,t}}$$

where R is the steady-state nominal interest rate, Y_t^* is the output target, Π is the inflation target, and ξ_t^{sp} is a hidden variable that determines the regime in place at time t.

Fiscal authority

- Federal total expenditure to GDP ratio $\widetilde{e}_t$ (in linear deviations from the steady state) is the sum of two components:

$$\widetilde{e}_t^L = \rho_{e^L}\widetilde{e}_{t-1}^L + \sigma_{e^L,\xi_t^{vo}}\epsilon_{e^L,t},\ \epsilon_{e^L,t} \sim N(0,1)$$
$$\widetilde{e}_t^S = \rho_{e^S}\widetilde{e}_{t-1}^S + (1-\rho_{e^S})\,\phi_y\left(\widehat{y}_t - \widehat{y}_t^*\right) + \sigma_{e^S,\xi_t^{vo}}\epsilon_{e^S,t}$$

- The total federal government expenditure is then divided into transfers, TR_t, and government purchases, G_t.
- The variable $\chi_t \equiv P_tG_t/E_t$ controls the fraction of expenditure devoted to government purchases and follows the process:

$$\widetilde{\chi}_t = \rho_\chi\widetilde{\chi}_{t-1} + (1-\rho_\chi)\,\iota_y\left(\widehat{y}_t - \widehat{y}_t^*\right) + \sigma_{\chi,\xi_t^{vo}}\epsilon_{\chi,t}$$

Fiscal authority

The federal government collects a lump-sum tax according to:

$$\widetilde{\tau}_t = \rho_{\tau,\xi_t^{sp}} \widetilde{\tau}_{t-1} + \left(1 - \rho_{\tau,\xi_t^{sp}}\right) \left[\begin{array}{c} \delta_{b,\xi_t^{sp}} \widetilde{b}_{t-1}^m + \delta_e \widetilde{e}_t \\ +\delta_y \left(\widehat{y}_t - \widehat{y}_t^*\right) \end{array} \right] + \sigma_{\tau,\xi_t^{vo}} \epsilon_{\tau,t}$$

and federal government debt evolves according to:

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

where $b_t^m = \left(P_t^m B_t^m\right) / \left(P_t Y_t\right)$ is the market value of government debt to GDP ratio

Monetary/Fiscal Policy Mix

When regimes are taken in isolation, the two policy rules and the linearized budget constraint are key to determine existence and uniqueness of a solution:

$$\widetilde{R}_t = \rho_{R,\xi_t^{sp}} \widetilde{R}_{t-1} + (1-\rho_R)\,\psi_{\pi,\xi_t^{sp}} \widetilde{\pi}_t + \ldots$$

$$\widetilde{\tau}_t = \delta_{b,\xi_t^{sp}} \widetilde{b}_{t-1}^m + \ldots$$

$$\begin{aligned} \widetilde{b}_t^m &= \beta^{-1} \widetilde{b}_{t-1}^m + \ldots - \widetilde{\tau}_t \\ &\rightarrow \quad b_t = \left(\beta^{-1} - \delta_{b,\xi_t^p}\right) b_{t-1} + \ldots \end{aligned}$$

where for simplicity we assumed that $\rho_{\tau,\xi_t^{sp}} = 0$.

Monetary/Fiscal Policy Mix

Leeper (1991) shows that two determinacy regions exist:

	ψ_{π,ξ_t^p}	δ_{b,ξ_t^p}
Active Monetary, Passive Fiscal	> 1	$> \beta^{-1} - 1$
Passive Monetary, Active Fiscal	< 1	$< \beta^{-1} - 1$

- AM/PF $\rightarrow$ Taylor principle is satisfied, fiscal police accommodates behavior of monetary authority $\rightarrow$ Macroeconomy is insulated (Ricardian regime)
- PM/AF $\rightarrow$ Taylor principle is not satisfied, inflation is free to move to keep debt on a stable path $\rightarrow$ Macroeconomy is not insulated (non-Ricardian regime)

Allowing for regime changes

- We allow for:
  1. two polar cases: AM/PF and PM/AF
  2. conflict between the two authorities: AM/AF
- We assume the following transition matrix:

$$H^{sp} = \begin{bmatrix} H_{11}^{sp} & H_{12}^{sp} & 0 \\ 1 - H_{11}^{sp} & H_{22}^{sp} & 1 - H_{33}^{sp} \\ 0 & H_{32}^{sp} & H_{33}^{sp} \end{bmatrix}$$

- Results similar if we allow for full transition matrix with all four policy combinations
- We use Farmer, Waggoner, and Zha (2010) to solve MS-DSGE models
- Allow for stochastic volatility controlled by Markov chain with transition matrix H^{vo}:

$$\mathbf{s}_t = \mathbf{T}\left(\xi_t^{sp}, \theta^{sp}, H^{sp}\right)\mathbf{s}_{t-1} + \mathbf{R}\left(\xi_t^{sp}, \theta^{sp}, H^{sp}\right)\mathbf{Q}\left(\xi_t^{vo}, \theta^{vo}\right)\varepsilon_t$$

Inference

- The solution assumes the form of a MS-VAR with cross equation restrictions
- This can be combined with an observation equation

$$
\begin{aligned}
\mathbf{y}_t &= \mathbf{D}(\theta) + \mathbf{Z}\mathbf{s}_t + \mathbf{U}\mathbf{v}_t \\
\mathbf{s}_t &= \mathbf{T}\left(\xi_t^p, \theta, \mathbf{H}_p\right)\mathbf{s}_{t-1} + \mathbf{R}\left(\xi_t^p, \theta, \mathbf{H}_p\right)\mathbf{Q}\left(\xi_t^v\right)\varepsilon_t \\
\xi_t^x &= 1 \ldots m^x,\ \mathbf{H}_{x,i,j} = p\left(\xi_t^x = i | \xi_{t-1}^x = j\right) \text{ for } x = p, a, v.
\end{aligned}
$$

- Likelihood cannot be evaluated with standard Kalman filter because both regime sequence and DSGE state vector need to be filtered out
- Two options:
    1. Likelihood approximation (Kim's, trimming approximation,...)
    2. Gibbs sampling
- First option more attractive in light of advancements in parallel computing

Inference

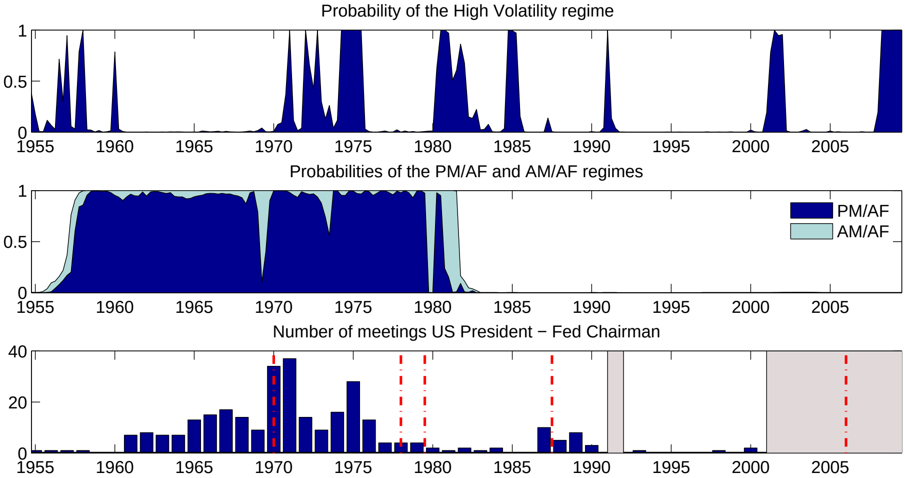
We estimate the model with Bayesian methods and include seven observables:

- Output growth
- Inflation
- FFR
- (Market Value of) Debt to GDP ratio
- Taxes to GDP ratio
- Expenditure to GDP ratio
- (A transformation of) government purchases to GDP ratio

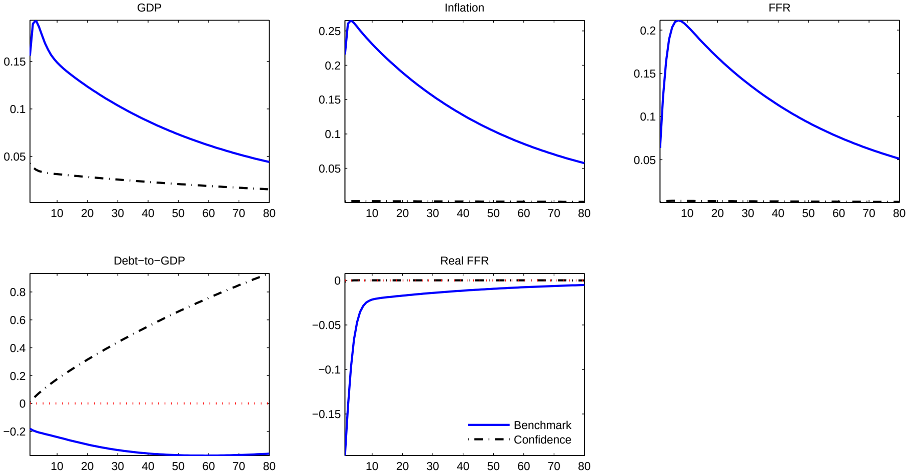
Parameter estimates: Policy parameters

	Mode	5%	95%	Type	Mean	Std Dev
$\psi_{\pi,PM}$	0.4991	0.3726	0.7082	*G*	0.8	0.3
$\psi_{\pi,AM}$	2.7372	1.9586	3.3946	*N*	2.5	0.5
$\psi_{y,PM}$	0.1520	0.0682	0.2160	*G*	0.15	0.1
$\psi_{y,AM}$	0.7037	0.3976	0.9875	*G*	0.4	0.2
$\delta_{b,AF}$	0	–	–	*F*	–	–
$\delta_{b,PF}$	0.0609	0.0375	0.0955	*G*	0.07	0.02
H_{11}^{sp}	0.9622	0.9277	0.9958	*Dir*	0.96	0.03
H_{22}^{sp}	0.3502	0.2094	0.6402	*Dir*	0.50	0.17
H_{33}^{sp}	0.9945	0.9839	0.9961	*Dir*	0.96	0.03
H_{12}^{sp}	0.6236	0.2119	0.7402	*Dir*	0.25	0.14

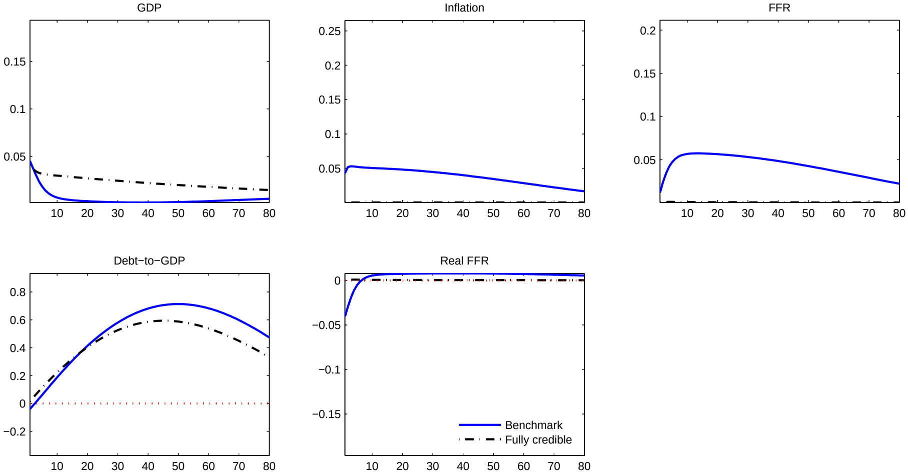
Regime probabilities



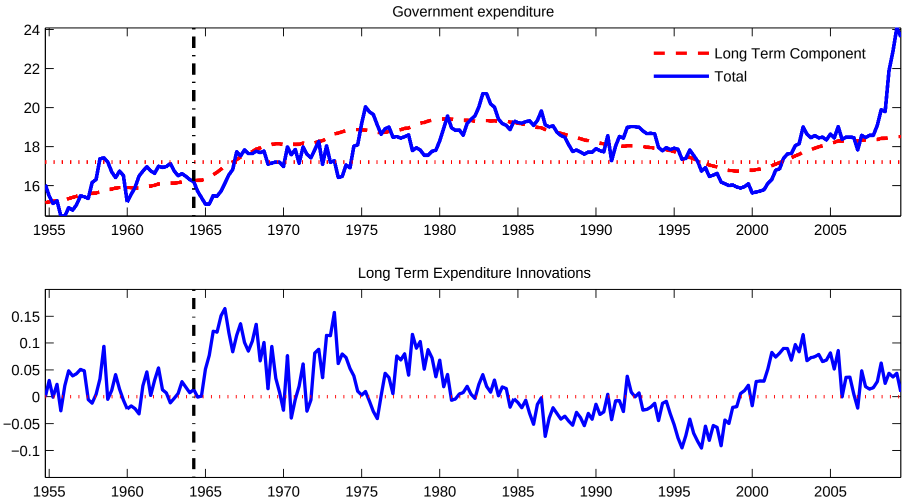
Long Term Government Expenditure under PM/AF



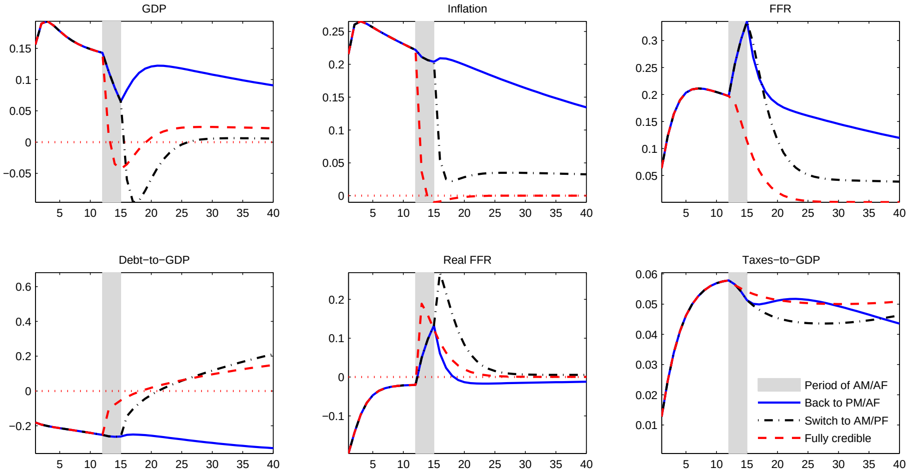
Long Term Government Expenditure under AM/PF



Total and Long Term Government Expenditure



From PM/AF to AM/PF: A sudden disinflation

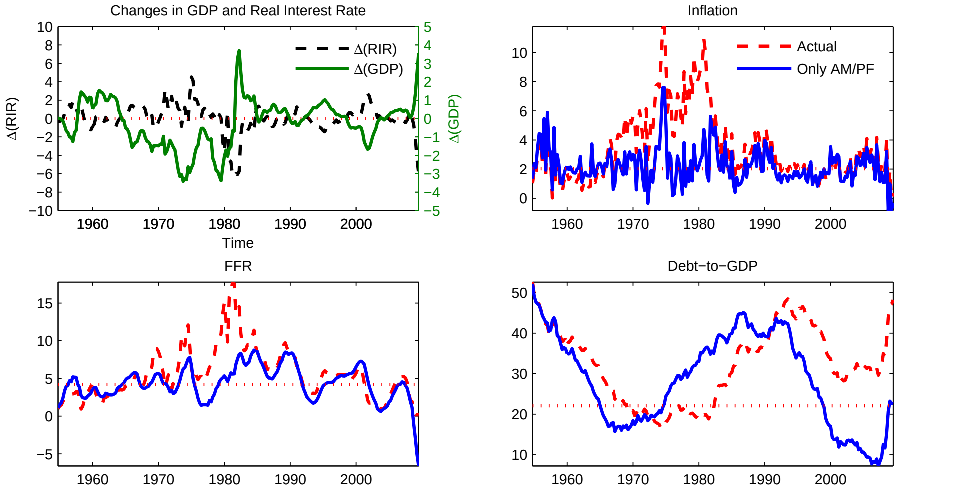


Counterfactual simulations

What if...?

1. Regime changes...
   - ...had not occurred
   - ...had occurred at different points in time
2. Agents' beliefs about the probability of moving across regimes had been different (Belief counterfactuals)

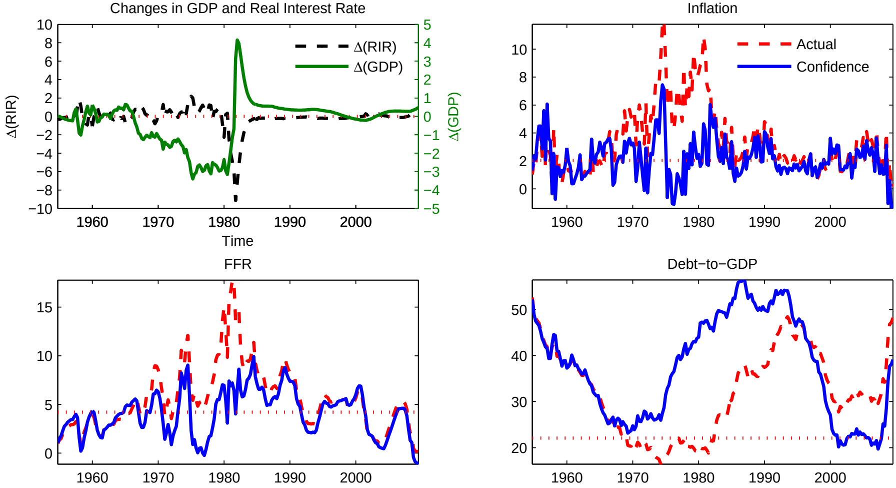
Counterfactual simulation: AM/PF always in place



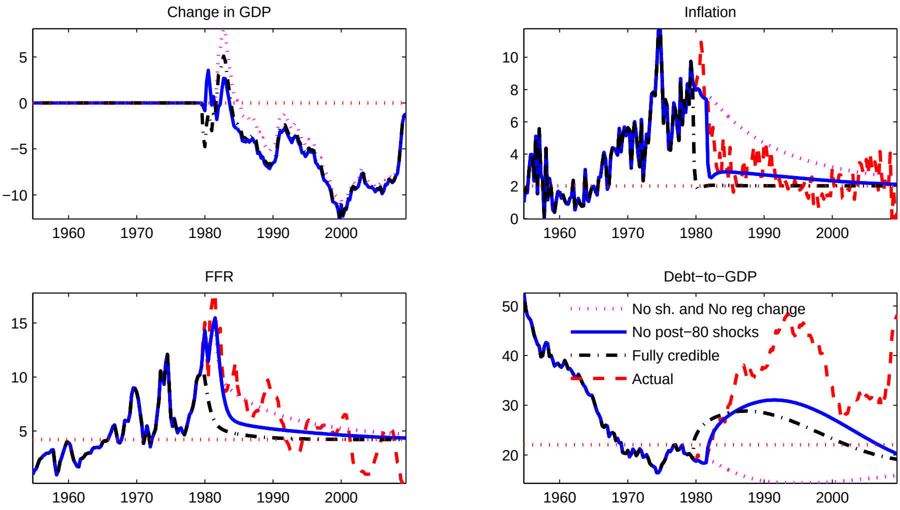
Belief Counterfactual simulation: Confidence

- Sequence of regimes unchanged, but agents aware and confident about the possibility of moving to the AM/PF regime
  $\rightarrow$ Conditional on leaving the AM/AF regime, the probability of moving to the PM/AF regime is decreased by 60%
  $\rightarrow$ This makes the AM/PF regime the most recurrent regime
- Agents aware of regime changes $\rightarrow$ their beliefs matter for macro dynamics

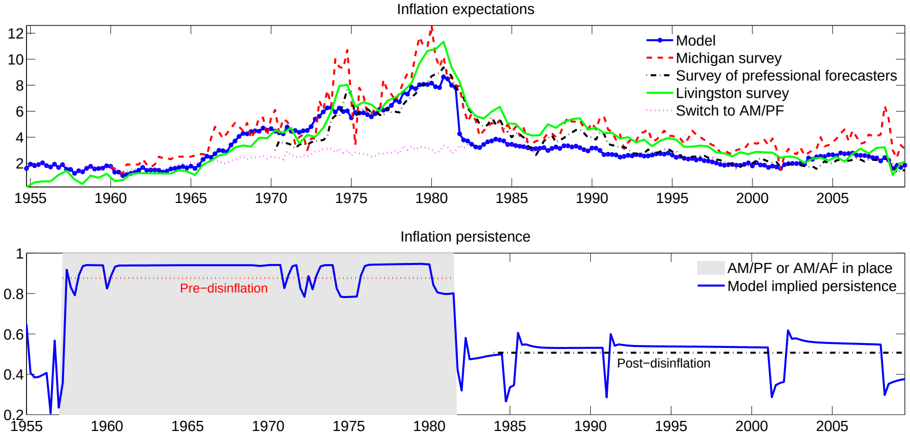
Belief Counterfactual simulation: Confidence



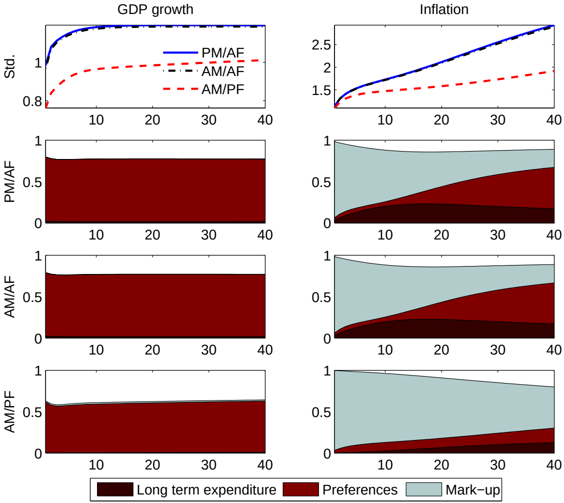
Counterfactual simulation: No switch to AM/PF



Inflation Expectations and persistence



Variance Decomposition



Conclusions

1. The Great Inflation is explained by changes in the long term component of government expenditure and the regime combination in place at that time
   - If an AM/PF regime had been in place throughout the sample the Great Inflation would not have occurred
2. The appointment of Volcker marked a change in monetary policy, but inflation fell only when the fiscal authority accommodated such change
   - Without such a regime change the US economy would have experienced fifteen additional years of high inflation
3. Fiscal imbalance affect inflation even when under the AM/PF regime
4. Changes in volatility and persistence of inflation are caused by the policy changes

Inflation as a Fiscal Limit
with Leonardo Melosi (2022 Jackson Hole Symposium)
Builds on Bianchi and Melosi (AER 2017)

Concerned view (Inflation as a Fiscal Limit):

- Large fiscal stimulus shifted the perception about future policy mix
- Fiscal inflation due to changes in policymakers' behavior and **beliefs**
- **What if fiscal and monetary policy fail to coordinate?**
- Monetary policy has changed, fiscal policy not yet $\Rightarrow$ **risk of fiscal stagflation**

Introduction

Inflation is back. After two decades of low inflation, policymakers are newly confronted with a high bout of fast-growing prices. **Will inflation recede or persist?**

- **Fiscal authority's credibility** in stabilizing a large fiscal imbalance matters:
  1. When the fiscal authority is not perceived as responsible for covering the existing fiscal imbalances, inflationary pressures arise to ensure sustainability of national debt.
  2. A large fiscal imbalance combined with a weakening fiscal credibility may lead trend inflation to drift away from the long-run target chosen by the monetary authority.
- This reasoning configures **a natural limit on fiscal policy**: Incompatibility between lax fiscal policy and a monetary framework aimed at achieving low inflation
- When inflation has a fiscal nature, monetary tightening can spark **fiscal stagflation**

Surge in fiscal inflation

We estimate a model that allows for changes between a **Monetary-led** and a **Fiscally-led** policy mix and **changes in agents' beliefs about the future policy mix**:

1. Movements in trend inflation are explained by fiscal shocks and by changes in the policy mix. Cost-push shocks have only transitory effects.
2. Following the ARPA, the probability of a return to the Fiscally-led regime has increased, helping the recovery, but also causing a **jump in fiscal inflation**.
3. Monetary tightening alone would not have prevented the increase in inflation.

⇒ The risk of **persistent high inflation** stems from the combination of the large public debt and the weakening credibility of the fiscal framework.

⇒ **Conquering the post-pandemic inflation necessitates an overhaul of the fiscal framework** aimed at financing the present and future public expenditure.

Households

Households. The representative household maximizes expected utility:

$$\mathbb{E}_0 \left[\sum_{s=0}^{\infty} \beta^t \exp\left(\zeta_t^d\right) \left[\log\left(C_t - \Phi C_{t-1}^A\right) - h_t\right]\right] \tag{42}$$

subject to the budget constraint:

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

We allow for a simplified maturity structure of government debt:

1. A short-term bond B_t^s in zero net supply with price $P_t^s = R_t^{-1}$
2. A portfolio of government debt, B_t^m, in non-zero net supply with price P_t^m.

Triggering the ZLB

We use a discrete shock to the trigger a large recession:

- The preference shock ζ_t^d is the sum of a continuous and discrete component: $\zeta_t^d = d_t + \overline{d}_{\xi_t^d}$.
- The continuous component d_t follows an AR(1) process, while the discrete component $\overline{d}_{\xi_t^d}$ can assume two values: high or low ($\overline{d}_h$ or $\overline{d}_l$).
- The variable ξ_t^d controls which of these two values is in place and evolves according a Markov-switching process with transition matrix H^d:

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

- This specification allows us to model recurrent shocks that are large enough to trigger the ZLB and policy changes.

Firms

Firms. The representative firm j faces a downward-sloping demand curve:

- Firms take as given the general price level, P_t, and the level of real activity, Y_t.
- We introduce sticky prices with a Rotemberg quadratic adjustment cost:

$$AC_t(j) = .5\varphi \left(P_t(j)/P_{t-1}(j) - \pi\right)^2 Y_t(j)P_t(j)/P_t \tag{43}$$

  where $\pi_t = P_t/P_{t-1}$ is gross inflation and π is its deterministic steady state.
- The firm chooses the price $P_t(j)$ to maximize the present value of future profits:

$$\mathbb{E}_t \left[\sum_{s=0}^{\infty} Q_s \left(\left[P_s(j)/P_s \right] Y_s(j) - W_s h_s(j) - AC_s(j) \right) \right]$$

- Labor is the only input in the firm production function, $Y_t(j) = A_t h_t^{1-\alpha}(j)$, where TFP growth evolves following an AR(1) process.

Government budget constraint

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

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

where $R_{t-1,t}^m = \left(1 + \rho P_t^m\right) / P_{t-1}^m$ is the realized return of the maturity bond, all the variables are expressed as a fraction of GDP.
Transfers as a fraction of GDP, $\widetilde{tr}_t$, behave according to the following process:

$$\begin{aligned} \left(\widetilde{tr}_t - \widetilde{tr}_t^*\right) &= \rho_{tr}\left(\widetilde{tr}_{t-1} - \widetilde{tr}_t^*\right) + \left(1 - \rho_{tr}\right)\phi_y\left(\widehat{y}_t - \widehat{y}_t^*\right) + \sigma_{tr}\epsilon_{tr,t} \\ \widetilde{tr}_t^* &= \rho_{tr^*}\widetilde{tr}_{t-1}^* + \sigma_{tr^*}\epsilon_{tr^*,t},\ \epsilon_{tr^*,t} \sim N\left(0,1\right),\ \epsilon_{tr,t} \sim N\left(0,1\right) \end{aligned}$$

where $\widetilde{tr}_t^*$ corresponds to long-term transfers.

Policy rules

Policy Rules. Policymakers' behavior:

- Monetary policy rule

$$\begin{aligned}\widetilde{R}_t &= \left[1 - Z_{\xi_t^d}\right]\left[\rho_{R,\xi_t^p}\widetilde{R}_{t-1} + \left(1 - \rho_{R,\xi_t^p}\right)\left(\psi_{\pi,\xi_t^p}\widetilde{\pi}_t + \psi_{y,\xi_t^p}\left[\widehat{y}_t - \widehat{y}_t^*\right]\right) + \sigma_R \epsilon_{R,t}\right] \\ &+ Z_{\xi_t^d}\left[\rho_{R,Z}\widetilde{R}_{t-1} - \left(1 - \rho_{R,Z}\right)\psi_Z \log\left(R\right) + \sigma_Z \epsilon_{R,t}\right]\end{aligned}$$

- Fiscal rule

$$\widetilde{\tau}_t = \rho_{\tau,\xi_t^p}\widetilde{\tau}_{t-1} + \left(1 - \rho_{\tau,\xi_t^p}\right)\left[\delta_{b,\xi_t^p}\widetilde{b}_{t-1}^m + \delta_{e^*}\left(\widetilde{tr}_t^* + g^{-1}\widetilde{g}_t\right) + \delta_y\left(\widehat{y}_t - \widehat{y}_t^*\right)\right] + \sigma_\tau \epsilon_{\tau,t}$$

Policy mix

To characterize changes in policymakers' behavior out of the ZLB, we build on the partition of the parameter space introduced by Leeper (1991):

1. **Monetary-led**: The Taylor principle is satisfied, the fiscal authority keeps debt on a stable path: $\psi_\pi^{AM} > 1$ and $\delta_b^{PF} > \beta^{-1} - 1$ (Active Monetary/Passive Fiscal)
2. **Fiscally-led**: Taylor principle not satisfied, fiscal authority not committed to keeping debt on a stable path: $\psi_\pi^{PM} < 1$ and $\delta_b^{AF} < \beta^{-1} - 1$ (Passive Monetary/Active Fiscal)
3. **Uncoordinated policies**: Taylor principle not satisfied, fiscal authority not committed to stabilizing debt: $\psi_\pi^{PM} < 1$ and $\delta_b^{AF} < \beta^{-1} - 1$ (Active Monetary/Active Fiscal)
4. **Both passive**: Both authorities follow passive rules. Absent regime changes, this area of the parameter space leads to multiple solutions.

Policy changes

- When the preference shock is high ($\xi_t^d = h$), the evolution of policymakers' behavior is captured by a two-regime Markov chain with transition matrix H^p
- When the low value for the preference shock occurs ($\xi_t^d = l$), the Fed moves to the ZLB ($Z_{\xi_t^d} = 1$), and fiscal policy focus on output stabilization.
- We consider two ZLB episodes. Beliefs about the future policy mix are captured by two distinct parameters, $p_{Z_F M}$ and $p_{Z_M M}$
- The joint evolution of policy mix and the discrete preference shock is controlled by the chain $\xi_t \equiv [\xi_t^p, \xi_t^d] = \{[M,h],[F,h],[Z_M,l],[Z_F,l]\}$ with transition matrix H:

$$H = \begin{bmatrix} p_{hh}H^p & (1-p_{ll})\begin{bmatrix} p_{Z_M M} & p_{Z_F M} \\ 1-p_{Z_M M} & 1-p_{Z_F M} \end{bmatrix} \\ (1-p_{hh})\begin{bmatrix} .5 & .5 \\ .5 & .5 \end{bmatrix} & p_{ll}\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \end{bmatrix}.$$

Inference

- The solution assumes the form of a MS-VAR with cross equation restrictions:

$$S_t = C\left(\xi_t^p, \theta, H\right) + T\left(\xi_t^p, \theta, H\right) S_{t-1} + R\left(\xi_t^p, \theta, H\right) Q\left(\xi_t^v, \theta^v\right) \varepsilon_t \qquad (44)$$

- We use Bayesian methods and include GDP growth, inflation, FFR, debt-to-GDP, tax revenues to GDP, expenditure to GDP, and government purchases to GDP.
- We fix the regime sequence based on VAR evidence presented in Bianchi and Melosi (2017) and estimate the belief parameters:

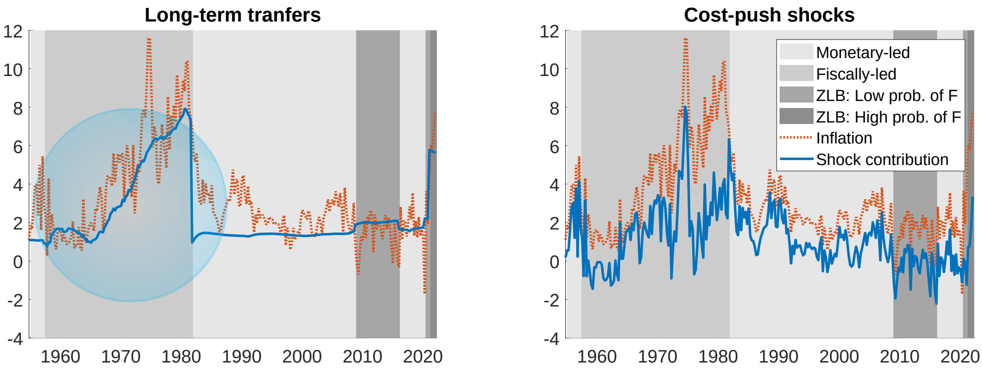
Subsample	Policy regime	Volatility regime
1955:Q4-1957:Q1	Monetary-led (M)	Pre-pandemic volatility
1957:Q2-1981:Q3	Fiscally-led (F)	Pre-pandemic volatility
1981:Q4-2008:Q3	Monetary-led (M)	Pre-pandemic volatility
2008:Q4-2015:Q4	ZLB low prob of F (Z_M)	Pre-pandemic volatility
2016:Q1-2020:Q1	Monetary-led (M)	Pre-pandemic volatility
2020:Q2-2020:Q4	ZLB low prob of F (Z_M)	Pandemic volatility
2021:Q1-2022:Q1	ZLB high prob of F (Z_F)	Pandemic volatility

Change in beliefs

Para	Mode	Para	Mode	Para	Mode	Para	Mode
$\psi_{\pi,M}$	2.1441	$\psi_{\pi,F}$	0.7009	$\delta_{b,M}$	0.0493	$p_{Z_M M}$	0.9834
$\psi_{y,M}$	0.5539	$\psi_{y,F}$	0.2806	$\delta_{b,F}$	0.0000	$p_{Z_F M}$	0.7107
$\rho_{R,M}$	0.8826	$\rho_{R,F}$	0.6474	$\overline{d}_l$	-0.1756	p_{MM}	0.9992
$\rho_{\tau,M}$	0.9780	$\rho_{\tau,F}$	0.6070	ψ_Z	0.9720	p_{FF}	0.9992

Table: **Prior and posterior moments of policy parameters.**

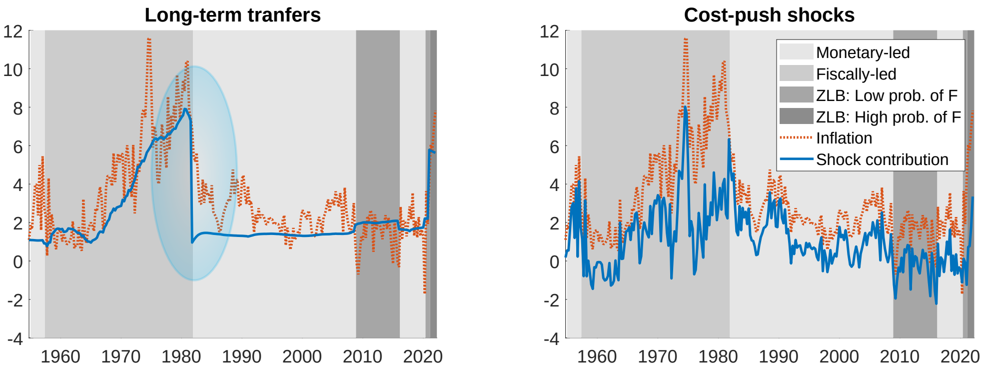
Fiscal Inflation



Trend inflation is a fiscal phenomenon, cost-push shocks explain transitory movements:

1. The Great Inflation: Large rise in spending + Fiscally-led policy mix

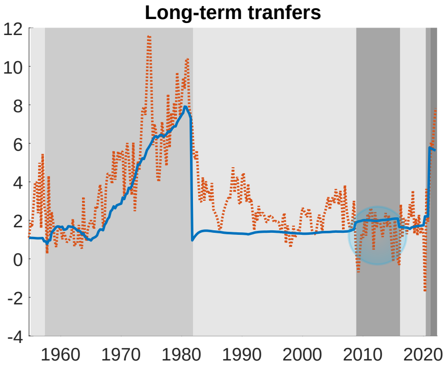
Fiscal Inflation

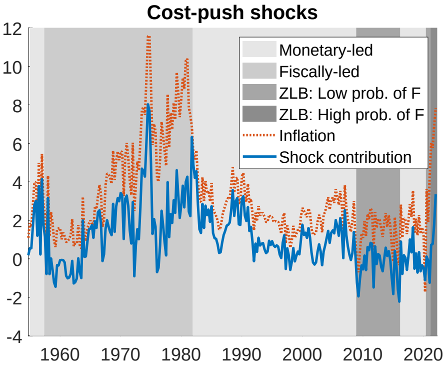


Trend inflation is a fiscal phenomenon, cost-push shocks explain transitory movements:

2. The Volcker disinflation: Switch to a Monetary-led policy mix

Fiscal Inflation

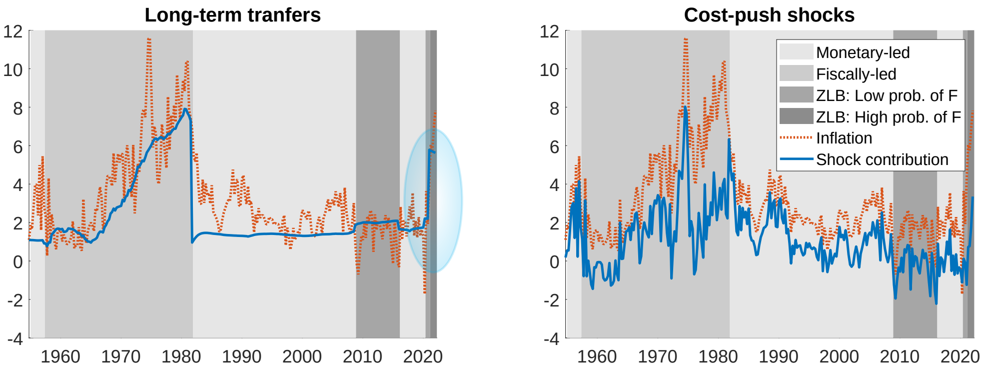




Trend inflation is a fiscal phenomenon, cost-push shocks explain transitory movements:

3. The Great Recession: Fiscal inflation counteracts deflationary pressure

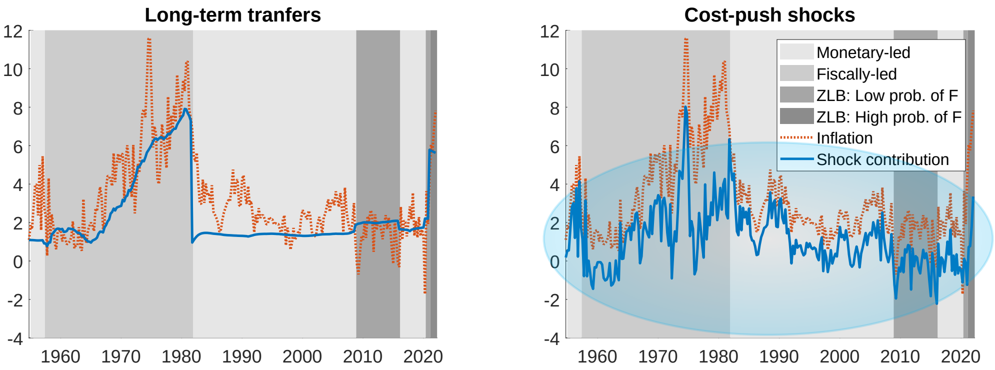
Fiscal Inflation



Trend inflation is a fiscal phenomenon, cost-push shocks explain transitory movements:

4. The pandemic: Fiscal stimulus + shift in beliefs → fast recovery + inflation

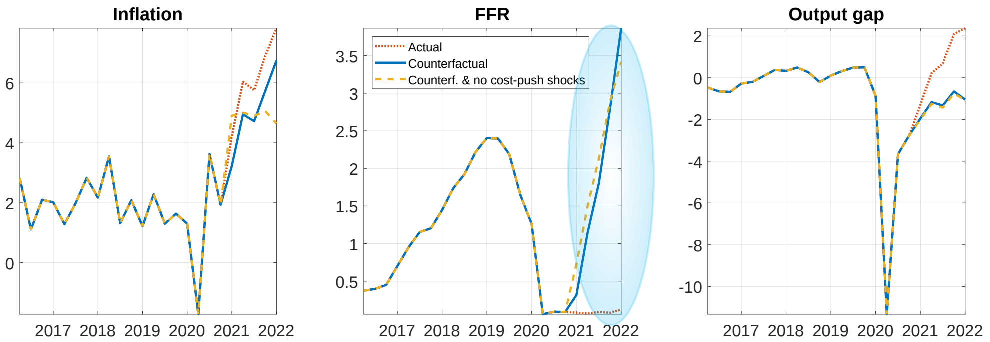
Fiscal Inflation



Trend inflation is a fiscal phenomenon, cost-push shocks explain transitory movements:

5. Cost-push shocks explain transitory movements in inflation

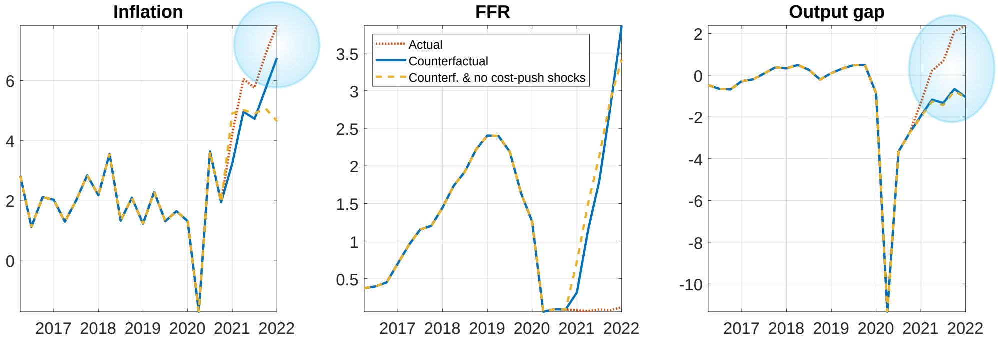
Could monetary policy have averted the recent rise in inflation?



Counterfactual: Increase in interest rates, but with same beliefs about future policy mix

1. The Federal Reserve increases rates in response to inflation

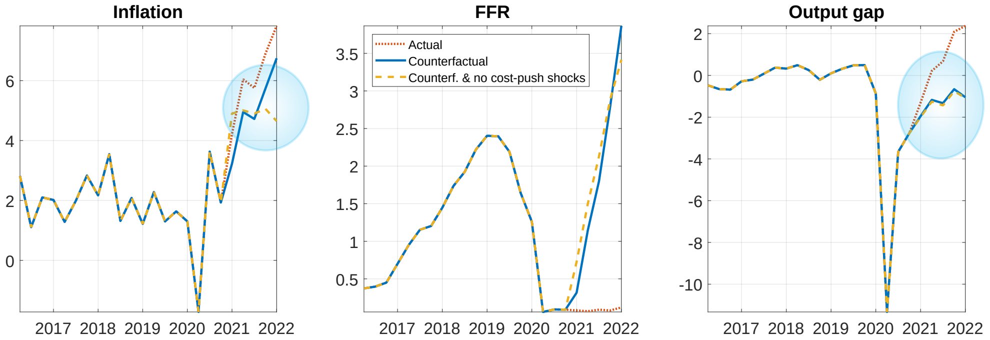
Could monetary policy have averted the recent rise in inflation?



Counterfactual: Increase in interest rates, but with same beliefs about future policy mix

2. Modest gain in terms of inflation, at the cost of a large output loss

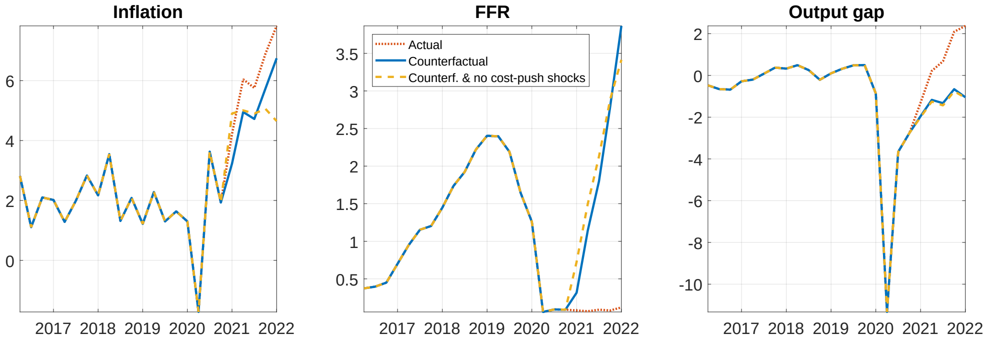
Could monetary policy have averted the recent rise in inflation?



Counterfactual: Increase in interest rates, but with same beliefs about future policy mix

3. The result is not driven by cost-push shocks

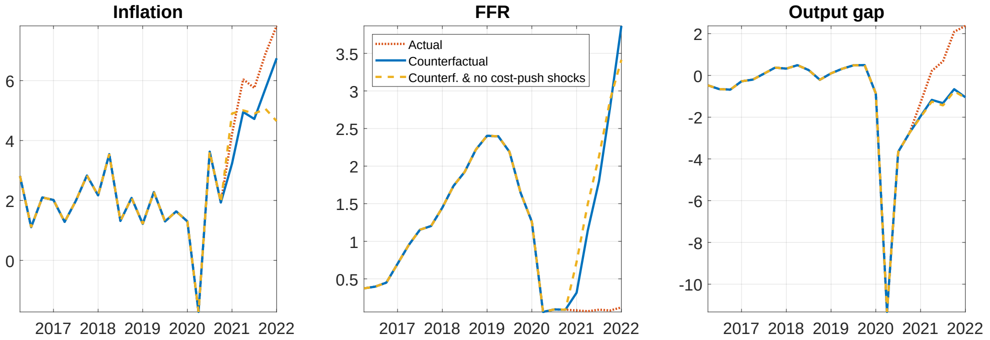
Could monetary policy have averted the recent rise in inflation?



Counterfactual: Increase in interest rates, but with same beliefs about future policy mix

4. When inflation has a fiscal nature, increasing rates, in itself, is not enough

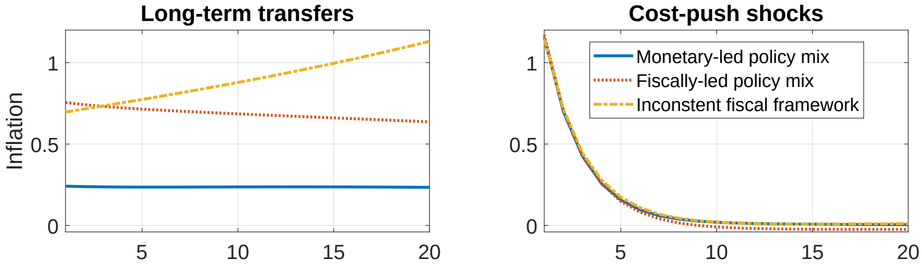
Could monetary policy have averted the recent rise in inflation?



Counterfactual: Increase in interest rates, but with same beliefs about future policy mix

5. The whole policy mix needs to adjust to avoid **fiscal stagflation**

Fiscal stagflation

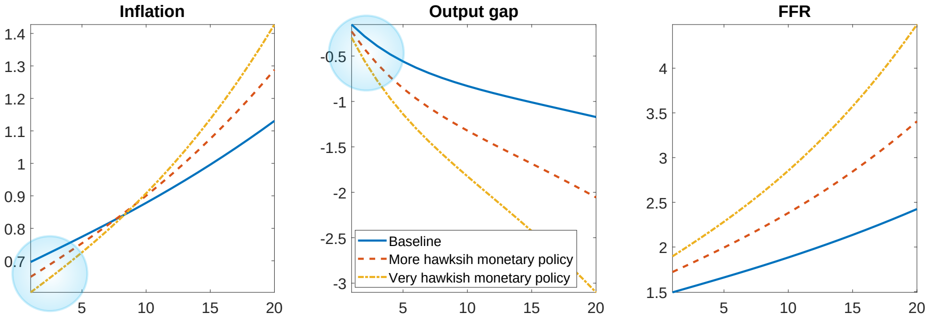


Fiscal stagflation arises when fiscal framework not consistent with low inflation target

1. By increasing rates, the central bank pushes the economy in a recession
2. The recession causes further debt accumulation
3. The additional fiscal burden causes additional inflationary pressure

Instead, cost-push shocks generate temporary movements in inflation for all regimes

How to conquer the post-pandemic inflation?



More hawkish monetary policy?

1. Inflation lower in the short run, at the cost of a larger output loss
2. Short-term inflation gain is ephemeral, as inflation paths eventually cross

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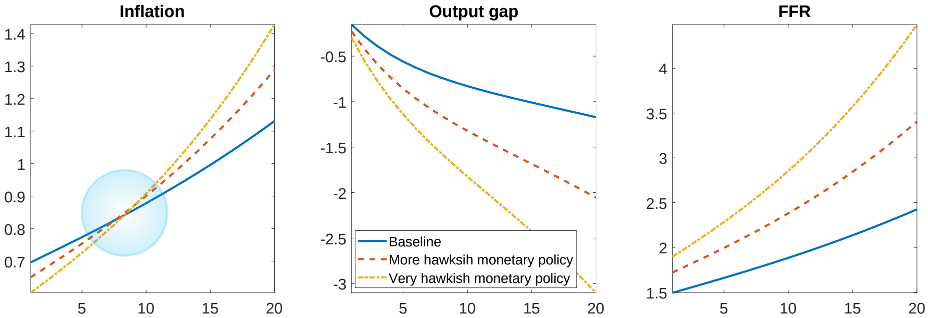

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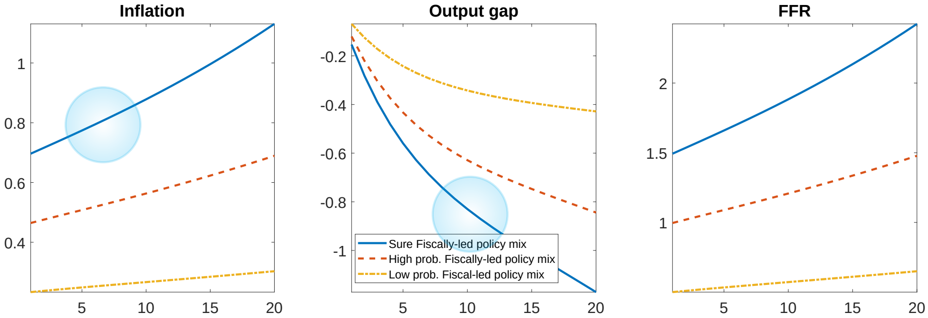

More sustainable fiscal policy?

1. As we progressively reduce the probability of a change to the Fiscally-led policy mix, the inflationary pressure goes down and fiscal stagflation is mitigated
2. If a change to the Fiscally-led policy mix is completely ruled out, the inflationary pressure and fiscal stagflation disappear

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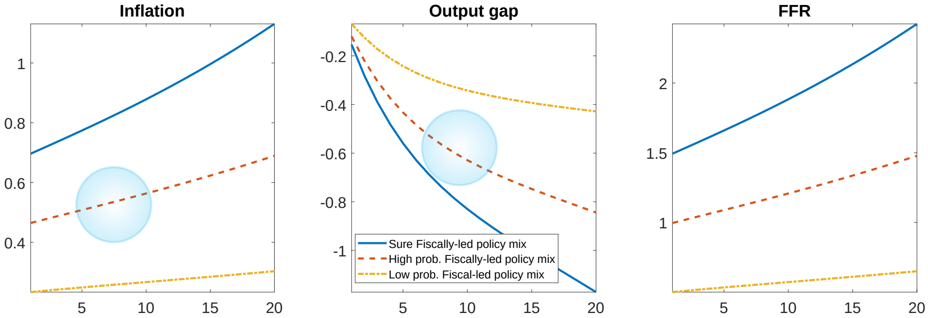

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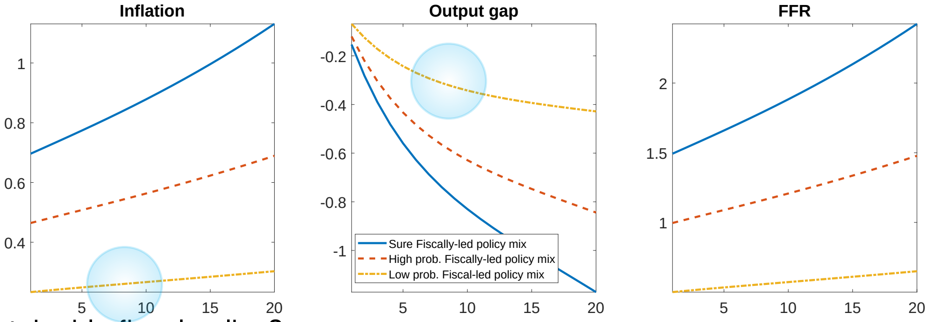

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Summary

- Historically, movements in fiscal inflation account for changes in trend inflation. Thus, an implicit **fiscal limit** arises to the extent that **a low and stable inflation target requires fiscal policies that are consistent with this goal**
- Following the COVID pandemic, the United States has implemented robust fiscal interventions $\Rightarrow$ Quick rebound of the economy, but also **surge in fiscal inflation**
- Increasing rates earlier, by itself, would not have prevented the surge in inflation
- The Fed is now increasing rates very quickly $\Rightarrow$ Signal about future policy changes? Fiscal situation is very different from the 1980s
- Conquering the post-pandemic inflation requires mutually consistent monetary and fiscal policies providing a clear path for both inflation and debt sustainability

Appendix

Maturity Structure Details

Market value budget constraint:

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

Normalized by GDP:

$$s_{b,t}^m = s_{b,t-1}^m \left(\frac{\pi_t Y_t}{Y_{t-1}} \right)^{-1} R_{n,t-1,t}^m - \tau_t$$

This formulation simplifies tracking debt dynamics.

Bond Return Definition

Return on a bond issued k periods ago:

$$R^{m-k}_{n,t-1,t} = \frac{1 + \rho P^m_t}{P^m_{t-1}} = R^{(m)}_{n,t-1,t}$$

This modeling choice avoids tracking issuance dates explicitly.

Linking Returns via Euler Equation

We use the Euler equation to derive a non-arbitrage condition between short-term and long-term bond returns:

$$R^m_{n,t,t+1} = \frac{1 + \rho P^m_{t+1}}{P^m_t}, \quad R_{n,t} = \mathbb{E}_t[R^m_{n,t,t+1}]$$

Interpretation: The expected return on long-term bonds must equal the short-term nominal interest rate.

Steady State Relationship

In steady state, the nominal interest rate satisfies:

$$R_n = \frac{1 + \rho P^m}{P^m} = R_n^{(m)}$$

This links the price of long-term bonds to the steady-state interest rate and maturity parameter ρ*.*

Loglinearization

Loglinearizing the non-arbitrage condition:

$$R_n \hat{r}^m_{n,t,t+1} = \rho \mathbb{E}_t[\hat{p}^m_{t+1}] - \frac{1+\rho P^m}{P^m} \hat{p}^m_t$$

Using $R_n = \frac{1+\rho P^m}{P^m}$:

$$R_n \hat{r}^m_{n,t,t+1} = \rho \mathbb{E}_t[\hat{p}^m_{t+1}] - R_n \hat{p}^m_t$$

This expresses the return on long-term bonds in terms of expected and current prices.

Return Equations

We derive two key equations:

$$\hat{r}^m_{n,t,t+1} = R_n^{-1}\rho\hat{p}^m_{t+1} - \hat{p}^m_t$$

$$\hat{r}_{n,t} = \mathbb{E}_t[\hat{r}^m_{n,t,t+1}]$$

The first gives the return on long-term bonds; the second links it to the short-term rate.

Maturity Structure Parameter

Define:

$$\varpi \equiv \frac{\rho}{R_n} < 1$$

Then the return equation becomes:

$$\hat{r}^m_{n,t,t+1} = \varpi \hat{p}^m_{t+1} - \hat{p}^m_t$$

This form is used in cochrane2023fiscal to model the effect of maturity on bond returns.

Economic Intuition

- ϖ captures the average maturity of debt.
- A higher ϖ implies longer maturity and greater sensitivity of bond returns to expected future prices.
- The central bank influences $\hat{r}_{n,t}$ via the short-term nominal rate, which affects expectations of long-term returns.