Monetary Policy with Supply Regimes

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[1]The views expressed in this manuscript are those of the authors and do not necessarily represent the views of the Banco de España, or the Eurosystem.

Introducing supply regimes

→ This paper studies monetary policy in a New Keynesian model with supply regimes, that is, sustained increases in production costs due to:

- Wars.
- Geopolitical fragmentation.
- Tariffs.

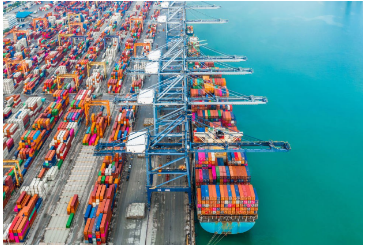


Figure: Examples of supply shocks: COVID, War, Tariffs.

Supply shocks are often persistent

- Persistent supply shocks $\rightarrow$ increases in production costs, which can persist over years or even decades.
- Due to factors such as wars or geopolitical fragmentation:
  - Federle et al. (2024) $\rightarrow$ the macro. effect of war on nearby countries' output remains substantial 8 years after the outbreak.
  - Fernandez-Villaverde et al. (2024) $\rightarrow$ find that while geopolitical fragmentation has increased substantially after the 2007-2008 financial crisis.
- This contrasts with the standard assumption of (temporary) supply shocks as AR(1).

What are the implications for monetary policy?

- We use a New Keynesian model with two types of supply shocks.
  - **Standard models:** Use temporary, transitory AR(1) shocks.
  - **Our model:** Adds persistent **supply regimes** (e.g., wars, tariffs).
- We model this as a **Markov chain** switching between:
  - **Normal times** (zero mean cost-push)
  - **Bad times** (high mean cost-push)
- We analyze optimal policy (Commitment & Discretion) and a state-dependent pricing extension.
- **Technical contribution:** We use a deep learning method to find the globally optimal policy in this model.

Preview of Findings

1. Supply regimes create a **regime-switching natural rate (r^*)** driven by precautionary savings.
2. Optimal policy under **commitment**: The price level does not revert. The CB treats past inflation as **"bygones are bygones"**.
3. Optimal policy under **discretion**: A persistent **inflationary bias** emerges during "bad times".
4. Traditional **Taylor rules fail** because they miss the r^* shift. An **adapted rule** that tracks the regime-dependent r^* succeeds.
5. A **state-dependent pricing** (menu-cost) extension **mitigates** this inflationary bias because the Phillips curve steepens.

Some Related Strands of Literature

- **Optimal monetary policy in non-linear New Keynesian models**
  Commitment: Benigno and Woodford (2005); Yun (2005); Benigno and Rossi (2021)
  Discretion: Albanesi et al. (2003); King and Wolman (2004); Zandweghe and Wolman (2019); Arellano et al. (2020); Afrouzi et al. (2023)

- **Monetary policy in regime-switching models**
  Schorfheide (2005); Davig and Doh (2014); Davig (2016); Blake and Zampolli (2011); Debortoli and Nunes (2014); Bianchi and Melosi (2017)

- **Determinants of the natural rate of interest**
  Structural: Cesa-Bianchi et al. (2022); Gagnon et al. (2021); Del Negro et al. (2017); Sahuc et al. (2023); Romei et al. (2025); Mian et al. (2021)
  Policy-driven: Rachel and Summers (2019); Bayer et al. (2023); Kaplan et al. (2023); Campos et al. (2024); Fernández-Villaverde et al. (2024); Bianchi et al. (2021)

- **Optimal policy with state-dependent pricing / menu costs**
  Nakov and Thomas (2014); Adam and Weber (2019); Blanco (2021); Caratelli and Halperin (2024); Karadi et al. (2024)

- **Deep-learning methods for high-dimensional GE models**
  Maliar et al. (2021); Han et al. (2021); Azinovic et al. (2022); Friedl et al. (2023); Gu et al. (2024); Fernandez-Villaverde et al. (2024)

- **Monetary policy response to tariffs**
  Bergin and Corsetti (2023); Bianchi and Coulibaly (2025); Monacelli (2025); Werning et al. (2025)

Outline of the Talk

1. Model

2. Regime-based natural rate

3. Calibration, and solution method

4. Optimal Monetary Policy Response to Persistent Supply Shocks

   Monetary policy rules

   Extension: state-dependent pricing

A New Keynesian model with supply regimes

Households

- Households consume goods c_t, and supply labor h_t to firms:

$$E_0 \left[\sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\gamma}}{1-\gamma} - \frac{h_t^{1+\omega}}{1+\omega} \right],$$

where $c_t = \left[\int_0^1 c_t(j)^{\frac{\epsilon-1}{\epsilon}} dj \right]^{\frac{\epsilon}{\epsilon-1}}$ and subject to:

$$p_t c_t + B_t \leq p_t w_t h_t + (1 + i_t) B_{t-1} + T_t.$$

  - B_t are holdings of a nominal bond.
  - $1 + i_t$ is the nominal interest.
  - w_t is the real wage.
  - p_t is the price level.
  - T_t are the profits from monopolistic producers.

Firms

- Continuum of monopolistic firms with technology

$$y_t(j) = A_t h_t(j).$$

  - A_t is the stochastic total factor productivity.

- Firms face temporary ξ_t and persistent η_t cost-push shocks.

- Total costs are $\Psi\left(y_{t+k}(j)\right) \equiv \left(1+\tau_{y+k}\right) w_t \left(\frac{y_{t+k}(j)}{A_t}\right)$ where the labor wedge is

$$(1+\tau_t) \equiv (1-\bar{\tau}+\xi_t+\eta_t).$$

  - Labor subsidy $\bar{\tau} = \frac{1}{\epsilon}$.

- We assume price stickiness *à la* Calvo with a parameter θ.
- Firms maximize the stream of expected profits:

$$\max_{P_t^*(j)} \mathbb{E}_t \sum_{k=0}^{\infty} \theta^k \Lambda_{t,t+k} \left[\frac{P_t^*(j)}{p_{t+k}} y_{t+k}(j) - \Psi\left(y_{t+k},(j)\right) \right],$$

  - $\Lambda_{t,t+k}$ is the stochastic discount factor.

Market clearing

- Goods:

$$y_t = c_t + g_t.$$

  - Government spending $g_t = \bar{g}\tilde{g}_t$ where $\tilde{g}$ is a shock.

- Price level

$$1 = \theta\left(1+\pi_t\right)^{\epsilon-1} + (1-\theta)\left(\frac{P_t^*}{p_t}\right)^{1-\epsilon}.$$

- Aggregate production

$$y_t = A_t h_t \Delta_t^{-1},$$

  - Price dispersion $\Delta_t \equiv \int\left(\frac{p_t(j)}{p_t}\right)^{-\epsilon} dj = \theta\left(1+\pi_t\right)^{\epsilon}\Delta_{t-1} + (1-\theta)\left(\frac{P_t^*}{p_t}\right)^{-\epsilon}.$

Shocks

- TFP:

$$\log(A_t) = \left(1-\rho^A\right)\left(-\frac{\left(\sigma^A\right)^2}{2}\right) + \rho^A \log(A_{t-1}) + \varepsilon_t^A,$$

- Government spending

$$\log(\tilde{g}_t) = (1-\rho^g)\left(-\frac{(\sigma^g)^2}{2}\right) + \rho^g \log(\tilde{g}_{t-1}) + \varepsilon_t^g,$$

- (Temporary) cost push shock

$$\xi_t = \rho^\tau \xi_{t-1} + \varepsilon_t^\tau,$$

- The permanent cost-push shock follows a two-state Markov chain:
  - Normal times ($\eta_t = 0$) and bad times ($\eta_t = \bar{\eta} = \frac{1}{\varepsilon}$).
  - Transition probabilities $p_{12} = \mathbb{P}(\eta_t = \bar{\eta} \mid \eta_{t-1} = 0)$ and $p_{21} = \mathbb{P}(\eta_t = 0 \mid \eta_{t-1} = \bar{\eta})$.

Summary of the model

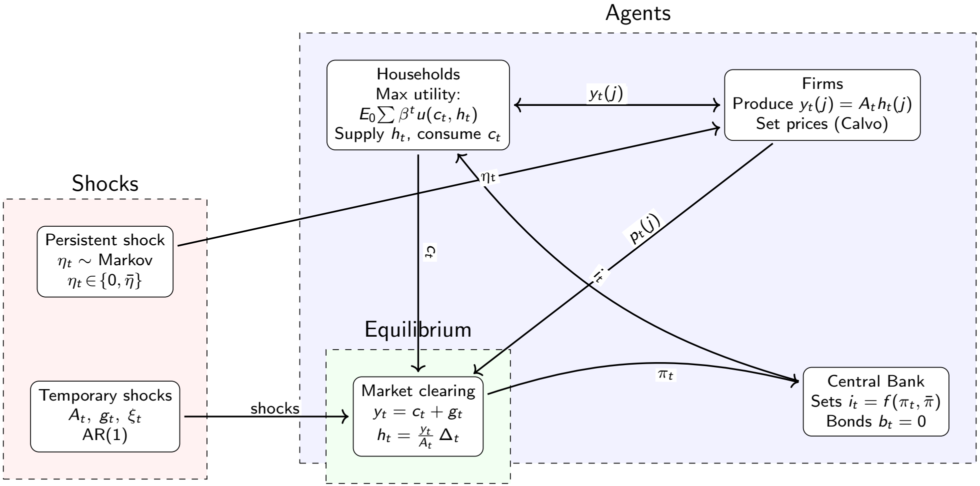


Figure: Schematic of agents, equilibrium conditions, and shocks.

Regime-based natural rates

Efficient allocation

- The allocation produced by a social planner maximizing household welfare subject to technological constraints.
- The efficient allocation equates the MRS between consumption and labor, $\hat{h}_t^{\omega}\hat{c}_t^{\gamma}$, to the marginal rate of transformation, A_t.
- Efficient consumption $\hat{c}_t$ satisfies

$$\left(\frac{\hat{c}_t + \hat{g}_t}{A_t}\right)^{\omega} = A_t \hat{c}_t^{-\gamma}.$$

Flexible-price allocation

- Counterfactual equilibrium with flexible prices, $\theta = 0$.

- Mark-up $\mathcal{M} = \frac{\epsilon}{\epsilon - 1}$ now varies with the labor wedge $\mathcal{M}(1 + \tau_t) = \mathcal{M}(1 - \bar{\tau} + \xi_t + \eta_t)$; this drives regime-dependent natural rates and two distinct stochastic steady states.

- Now consumption satisfies

$$\left(\frac{c_t^* + g_t}{A_t}\right)^{\omega} = \frac{A_t c_t^{*\,-\gamma}}{\mathcal{M}(1 + \tau_t)}. \tag{1}$$

- The cost-push shock affects consumption.

Natural rate

- The natural rate is the real interest rate in the stochastic steady state of the flex-price economy

$$1 = \beta E_t \left[\frac{{c_t^*}^\gamma}{{c_{t+1}^*}^\gamma} \right] (1 + r_t^*) \,.$$

- If the economy is in regime 1, this equation implies

$$\frac{1}{\beta (1 + r_t^*)} = {c_{1,t}^*}^\gamma \left(p_{12} E_t \left[\frac{1}{{c_{2,t}^*}^\gamma} \right] + (1 - p_{12}) \, E_t \left[\frac{1}{{c_{1,t}^*}^\gamma} \right] \right),$$

where the notation $z_{n,t}$ denotes variable z at time t and regime $n = \{1, 2\}$.

The precautionary savings channel

- The flexible-price allocation has high consumption in normal times (c_1^*) and low consumption in bad times (c_2^*).
- **In Normal Times (Regime 1):**
  - Households fear switching to the low-consumption "bad" regime.
  - $\rightarrow$ They increase precautionary savings to self-insure.
  - $\rightarrow$ This excess supply of savings pushes r^* down.
- **In Bad Times (Regime 2):**
  - Households anticipate returning to the high-consumption "normal" regime.
  - $\rightarrow$ They want to borrow against future high income.
  - $\rightarrow$ This excess demand for borrowing pushes r^* up.
- **Main Takeaway:** The model endogenously generates two distinct natural rates. This is the core reason simple Taylor rules will fail.

Calibration and solution method

Calibration

Parameter		Value
Long-run productivity level	A	1
Inverse Frisch elasticity	ω	1
Inverse of intertemporal elasticity of substitution	γ	2
Discount factor	β	0.9975
Elasticity of substitution among varieties	ϵ	7
Government spending constant	$\bar{g}$	0.2
Calvo constant	θ	0.75
Taylor rule slope	ψ	2
Inflation target	$\bar{\pi}$	0
Labor subsidy	$\bar{\tau}$	$\frac{1}{\epsilon}$

Table: Key parameters of the model I.

Parameter		Value
Mean of cost-push shock during persistent supply shock	$\bar{\eta}$	$\frac{1}{\varepsilon}$
Transition probability from normal to negative supply times	p_{12}	$1/48$
Transition probability from negative supply to normal times	p_{21}	$1/24$
Persistence of TFP shock	ρ^A	0.99
Persistence of cost-push shock	ρ^τ	0.90
Persistence of government spending shock	ρ^g	0.97
Standard deviation of TFP shock	σ^A	0.009
Standard deviation of cost-push shock	σ^τ	0.0014
Standard deviation of government spending shock	σ^g	0.0052

Table: Key parameters of the model II.

Deep equilibrium nets

- A global solution to our model is crucial .
- Dimensionality is too high for standard methods.
- We extend the Deep equilibrium method of Azinovic et al. (2022).

Deep Equilibrium Nets

A **functional rational expectations equilibrium**: $\{f_i\}_{i=1}^{N_{\text{out}}}$, where

$$f_i : \mathcal{D} \subset \mathbb{R}^{N_{\text{in}}} \to \mathbb{R} : \underbrace{\mathbf{x}}_{\text{state}} \to \underbrace{f_i(\mathbf{x})}_{\text{endogenous variables}}, \text{ s.t. } : \underbrace{\mathbf{G}(\mathbf{x}, f_1, \ldots, f_{N_{\text{out}}}) = 0}_{\text{equilibrium conditions}}$$

A **deep equilibrium net**: $\mathcal{N}_{\boldsymbol{\rho}}$, where

$$\mathcal{N}_{\boldsymbol{\rho}} : \mathcal{D} \subset \mathbb{R}^{N_{\text{in}}} \to \mathbb{R}^{N_{\text{out}}} : \underbrace{\mathbf{x}}_{\text{state}} \to \underbrace{\mathcal{N}_{\boldsymbol{\rho}}(\mathbf{x})}_{\text{approximate endogenous variables}} \approx \begin{bmatrix} f_1(\mathbf{x}) \\ \ldots \\ f_{N_{\text{out}}}(\mathbf{x}) \end{bmatrix}$$

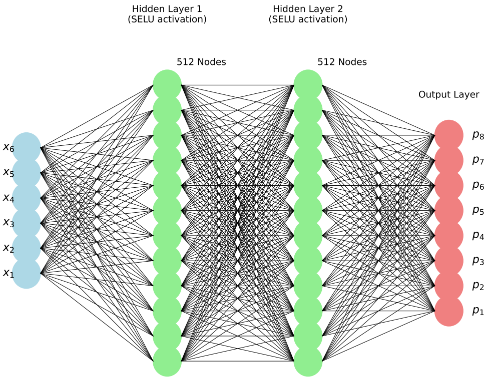
Preview of key ideas:

1. Use the definition a of the equilibrium functions, *i.e.* the implied error in the optimality conditions, as loss function.
2. Learn the equilibrium functions with stochastic gradient descent.
3. Take the data points from a simulated path.

What is a Deep Neural Net?

$$\begin{aligned} &\textbf{input} := \mathbf{x} \to \phi^1(W^1_{\boldsymbol{\rho}}\mathbf{x} + \mathbf{b}^1_{\boldsymbol{\rho}}) =: \textbf{hidden 1} \\ &\to \textbf{hidden 1} \to \phi^2(W^2_{\boldsymbol{\rho}}(\textbf{hidden 1}) + \mathbf{b}^2_{\boldsymbol{\rho}}) =: \textbf{hidden 2} \\ &\to \textbf{hidden 2} \to \phi^3(W^3_{\boldsymbol{\rho}}(\textbf{hidden 2}) + \mathbf{b}^3_{\boldsymbol{\rho}}) =: \textbf{output} \end{aligned}$$

The NN is then given by the choice of activation functions and the parameters $\boldsymbol{\rho}$.



Our loss function

As a loss function, we implement

$$\mathsf{l}_{\boldsymbol{\rho}} := \frac{1}{N_{\text{path length}}} \sum_{\mathbf{x}_i \text{ on sim. path}} \left(\mathbf{G}(\mathbf{x}_i, \mathcal{N}_{\boldsymbol{\rho}})\right)^2$$

where we use $\mathcal{N}_{\boldsymbol{\rho}}$ to simulate a path. $\mathbf{G}$ is chosen, such that the true equilibrium policy $\mathbf{f}(\mathbf{x})$ is defined by $\mathbf{G}(\mathbf{x}, \mathbf{f}) = 0 \ \forall \mathbf{x}$. Therefore, there is no need for labels to evaluate our loss function.

Training Deep Equilibrium Nets[2]

1. Simulate a sequence of states $\mathcal{D}^i_{\text{train}} \leftarrow \{\mathbf{x}^i_1, \mathbf{x}^i_2, \ldots, \mathbf{x}^i_T\}$ from the policy encoded by the network parameters $\boldsymbol{\rho}^i$.
2. Evaluate the errors of the equilibrium conditions on the newly generated set $\mathcal{D}_{\text{train}}$.
3. If the error statistics are not low enough:
    3.1 Update the parameters of the neural network with a gradient descent step (or a variant):
    $$\rho^{i+1}_k = \rho^i_k - \alpha_{\text{learn}} \frac{\partial \ell_{\mathcal{D}^i_{\text{train}}}(\boldsymbol{\rho}^i)}{\partial \rho^i_k}.$$
    3.2 Set new starting states for simulation: $\mathbf{x}^{i+1}_0 = \mathbf{x}^i_T$.
    3.3 Increase i by one and go back to step 1.

[2] Sample codes here: https://github.com/sischei/DeepEquilibriumNets.

Optimal monetary policy

Optimal policy under discretion

- The central bank maximizes household welfare under discretion (i.e., cannot commit to future policy paths).
- The CB re-optimizes every period, taking past price dispersion (Δ_{t-1}) as given.
- **Key Implication:** This creates an incentive to "surprise" inflate in the distorted "bad" regime, which (as we'll see) leads to an inflationary bias.

$$V\left(\Delta_{t-1}, A_t, \tau_t, g_t, n_t\right) = \max_{c_t, h_t, w_t, \pi_t, p_t^*, \Delta_t} \frac{c_t^{1-\gamma}}{1-\gamma} - \frac{h_t^{1+\omega}}{1+\omega} + \beta \mathbb{E}_t \left[V\left(\Delta_t, A_{t+1}, \tau_{t+1}, g_{t+1}\right)\right]$$

subject to the equilibrium conditions:

$$c_t^{-\gamma} = h_t^{\omega} / w_t, \tag{2}$$

$$1 = \theta\left(1+\pi_t\right)^{\epsilon-1} + (1-\theta)\left(p_t^*\right)^{1-\epsilon}, \tag{3}$$

$$\Delta_t = \theta\left(1+\pi_t\right)^{\epsilon} \Delta_{t-1} + (1-\theta)\left(p_t^*\right)^{-\epsilon}, \tag{4}$$

$$y_t = A_t h_t \left(\Delta_t\right)^{-1}, \tag{5}$$

$$y_t = c_t + g_t. \tag{6}$$

$$p_t^* = \mathcal{M} \frac{y_t w_t \left(1+\tau_t\right)\left(A_t\right)^{-1} + \mathbb{E}_t\left[\theta \Lambda_{t,t+1}\left(1+\pi_{t+1}\right)^{\epsilon} \Xi_{t+1}^{N}\right]}{y_t + \mathbb{E}_t\left[\theta \Lambda_{t,t+1}\left(1+\pi_{t+1}\right)^{\epsilon-1} \Xi_{t+1}^{D}\right]}. \tag{7}$$

Optimal policy under commitment

- The central bank maximizes household welfare under commitment (i.e., the Ramsey problem).
- The CB can credibly commit to a future state-contingent plan, allowing it to manage private sector expectations.
- **Key Implication:** This policy anchors inflation at 0% in the long run and avoids the inflationary bias seen under discretion.

$$\max_{\{c_t, h_t, w_t, \pi_t, p_t^*, \Delta_t\}_{t\geq 0}} \quad \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{c_t^{1-\gamma}}{1-\gamma} - \frac{\left(\frac{(c_t+g_t)\Delta_t}{A_t}\right)^{1+\omega}}{1+\omega} \right],$$

subject to the equilibrium conditions (2)-(6) and the constraints:

$$\begin{aligned}
p_t^* \Xi_t^D &= \mathcal{M} \Xi_t^N, \\
\Xi_t^N &= (c_t+g_t)^{1+\omega} \left(\frac{\Delta_t}{A_t}\right)^{\omega} c_t^{\gamma} (1+\tau_t) (A_t)^{-1} + \mathbb{E}_t \left[\beta \theta c_t^{\gamma} c_{t+1}^{-\gamma} (1+\pi_{t+1})^{\epsilon} \Xi_{t+1}^N\right], \\
\Xi_t^D &= (c_t+g_t) + \mathbb{E}_t \left[\beta \theta c_t^{\gamma} c_{t+1}^{-\gamma} (1+\pi_{t+1})^{\epsilon-1} \Xi_{t+1}^D\right].
\end{aligned}$$

Ergodic distribution: Commitment

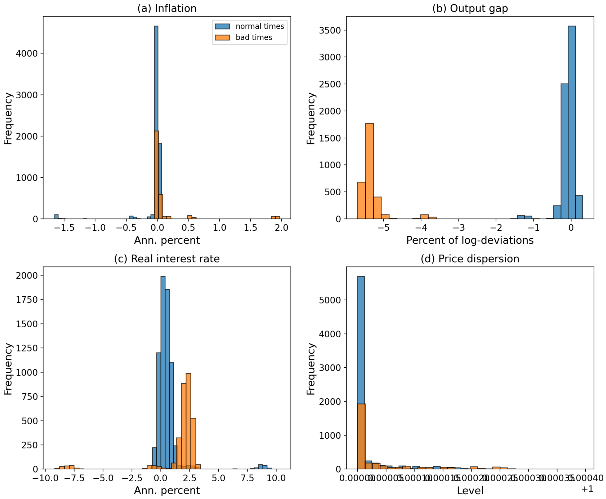


Figure: Ergodic distribution: commitment.

- Shows the long-run distributions under optimal commitment.
- **Inflation (a):** Anchored at 0% in both regimes (the optimal SSS).
- **Output Gap (b):** Bimodal. Centered at 0% in normal times, but clusters at a negative gap (around -5.5%) in bad times.
- **Real Rate (c):** Also bimodal, reflecting the two distinct r^* SSSs.

Ergodic distribution: Discretion

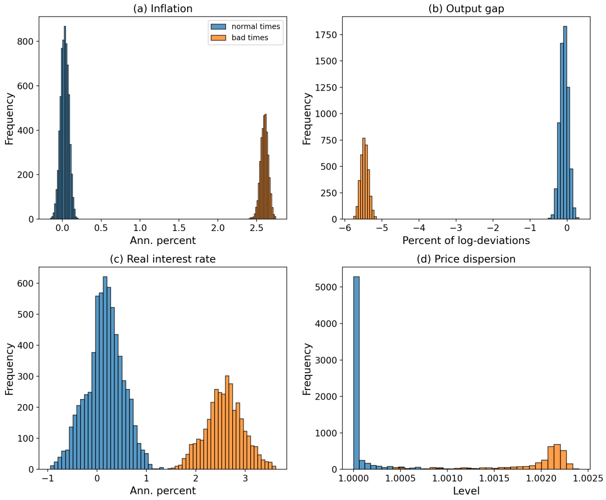


Figure: Ergodic distribution: discretion.

- Shows the long-run distributions under optimal discretion.
- **Inflation (a):** Bimodal. It's 0% in normal times, but...
- ...a persistent inflationary bias of **2.8%** emerges in bad times.
- **Why?** The CB has an incentive to stimulate the distorted "bad" economy. Agents anticipate this, de-anchoring expectations.

Regime switch: commitment vs. discretion

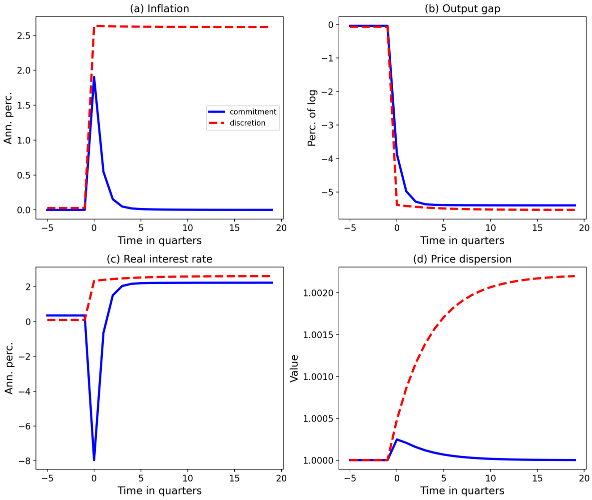


Figure: Response to a regime change.

- Compares the transition from "normal" to "bad" regime (at t=0).
- **Commitment (Blue):** CB lowers real rates (c) by letting inflation (a) rise. This cushions the fall in the output gap (b).
- **Discretion (Red):** Real rates (c) *rise*. Inflation (a) overshoots its new, higher SSS of 2.8%.
- The output gap (b) falls more sharply under discretion.

Bygones are bygones

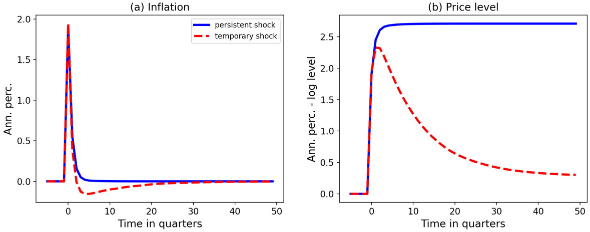


Figure: Comparison: Persistent Regime vs. Temporary AR(1) Shock.

- Compares a persistent *regime change* (blue) vs. a temporary *AR(1) shock* (red).
- **Temporary Shock (Red):** Standard result. The CB commits to future deflation (a) to bring the price level (b) back to 0.
- **Regime Change (Blue):** The CB does *not* do this. There is no deflationary phase.
- The price level (b) rises permanently. The CB treats past price rises as "bygones".

Intuition: why "Bygones are Bygones"?

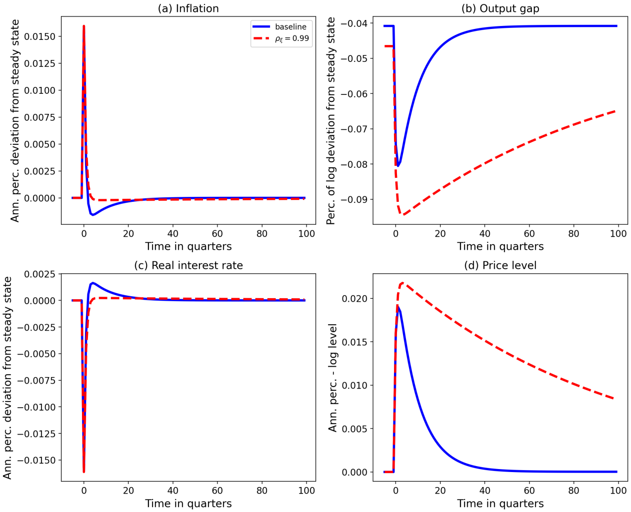


Figure: Response to AR(1) shocks of different persistence.

- This slide connects our "bygones" result to the standard AR(1) model.
- **Standard Shock (Blue, $\rho = 0.90$):** Causes a large, immediate deflation (a) to stabilize the price level (b).
- **Persistent Shock (Red, $\rho = 0.99$):** The deflation is smaller and delayed far into the future.

Are regimes necessary?

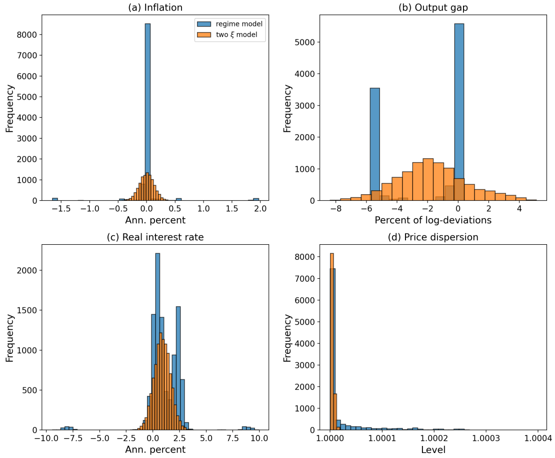


Figure: Baseline Regime Model (Blue) vs. AR(1) Model (Orange).

- **Question:** Can we just use a complex AR(1) model (orange) instead of our regime-switching model (blue)?
- **Answer:** No.
- The AR(1) model (orange) completely fails to generate the bimodal distributions for the output gap (b) and the real rate (c).
- **Takeaway:** The regime-switching mechanism is *essential* to explain the two distinct r^* states and the resulting macroeconomic dynamics.

What about simple policy rules?

- We've seen the optimal policy is complex. Can a simple rule work?
- We test a standard Taylor rule:

$$i_t = \frac{(1+\bar{\pi})}{\beta} - 1 + \psi\left(\pi_t - \bar{\pi}\right)$$

  where the intercept is based on the *single* steady state.

- **The Problem:** This rule fails. It has a fixed intercept, but our model has two different natural rates (r^*) due to precautionary savings.
- This mismatch means policy is:
  - Too tight in normal times (causes deflation).
  - Too loose in bad times (causes inflation).

Standard Taylor rule fails to stabilize

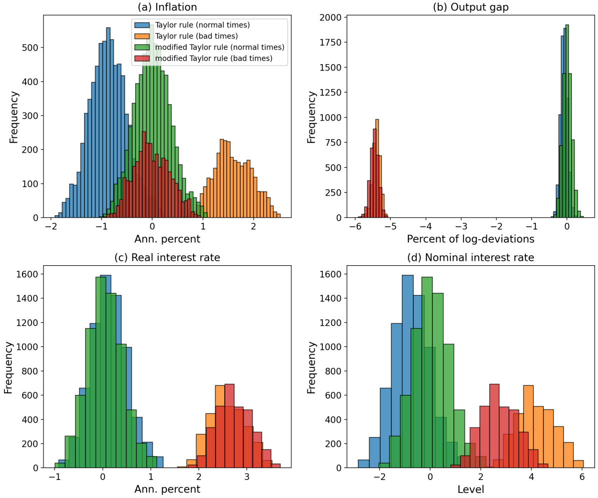


Figure: Ergodic distribution: Standard vs. Modified Taylor Rule.

- This figure shows the long-run distribution of inflation. The target is 0%.
- **Blue/Orange (Std. Rule):** The standard rule fails. Inflation is bimodal, clustering at -0.9% and +1.6%.
- **Green/Red (Mod. Rule):** The modified rule, which tracks r_n^*, succeeds. Inflation is tightly centered at 0%.

An adapted, regime-aware rule succeeds

- We propose a modified Taylor rule that adapts to the regime:

$$i_t = \bar{r}_t + \psi(\pi_t - \bar{\pi})$$

- The intercept $\bar{r}_t$ is *not* fixed. It tracks the correct natural rate for the current regime:

$$\bar{r}_t = r_n^*, \text{ if the regime at time } t \text{ is } n.$$

- **The Result:** This rule successfully anchors inflation at 0% in *both* regimes.
- (As seen in the **Green/Red** histograms from the previous slide).

Sensitivity to regime length

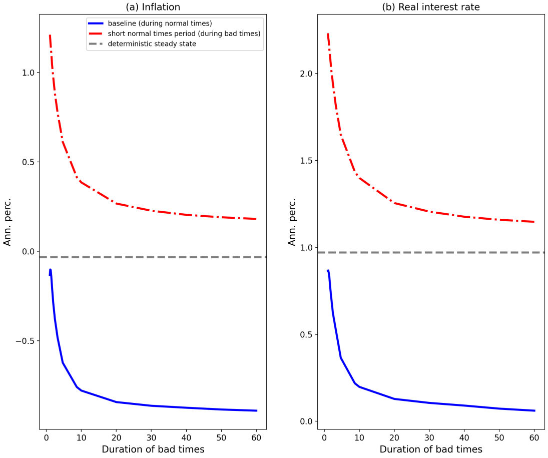


Figure: Sensitivity to duration of "bad times" regime.

- SSS inflation from the *standard* Taylor rule as we vary the persistence of the "bad" regime (from 1 to 24 quarters).
- **Blue Line (Normal Times):** When the bad regime is very persistent (24 qtrs), the r^* mismatch is large, causing -0.9% inflation in normal times.
- **Red Line (Bad Times):** Shows SSS inflation in the bad regime is also highly sensitive.
- **Takeaway:** The persistence of the regime causes the r^* mismatch and the failure of the standard Taylor rule.

Extension: what if price stickiness is endogenous?

- **The Problem:** The inflationary bias under discretion (2.8%) might seem high. Is this just an artifact of Calvo (time-dependent) pricing?
  - In the Calvo model, firms reprice with probability $1 - \theta$ regardless of inflation.
- **The Extension:** We replace Calvo with a menu-cost model (*à la* Blanco et al. (2024)).
- **Key Mechanism:** The repricing frequency, n_t, is now endogenous.
  - When inflation is high, firms have a greater incentive to pay the menu cost and adjust prices more often.
  - This makes the Phillips curve steeper during high-inflation episodes.

State-dependent pricing mitigates inflationary Bias

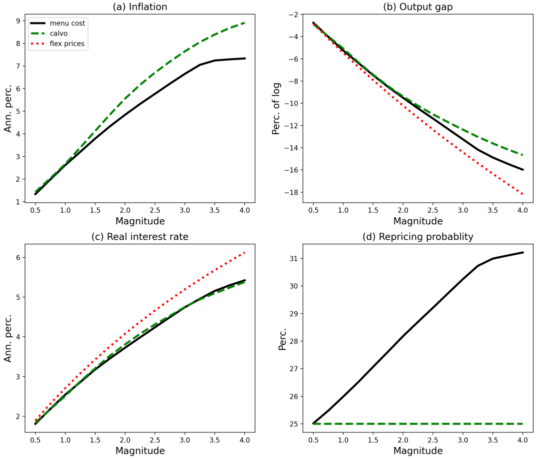


Figure: This figure shows the SSS in the "bad" regime as the shock size ($\bar{\eta}$) increases.

- **Panel (a) - Inflation:** SSS inflation. The **black line (State-Dep.)** is much *flatter* than the **green line (Calvo)**.
- This shows the inflationary bias is mitigated (smaller).
- **Panel (d) - The "Why":** As the shock (and inflation) gets larger, the adjustment frequency (n_t) endogenously increases.
- **Panel (b) - The Effect:** The output gap (black line) gets closer to the flex-price outcome (red line), showing policy is less effective.

The mechanism: why the bias is mitigated

- Look at the previous figure (Panel a):
  - **Dashed Green (Calvo):** Inflation bias rises sharply with shock size.
  - **Solid Black (State-Dep.):** Inflation bias is mitigated (lower) and rises less.
- **The Logic:**
  1. The discretionary inflation bias comes from the CB's incentive to stimulate the economy (close the output gap).
  2. In the menu-cost model, high inflation $\rightarrow$ high n_t (Panel d).
  3. High n_t $\rightarrow$ Steeper Phillips Curve.
  4. A steeper Phillips Curve $\rightarrow$ Monetary policy has less effect on the output gap.
  5. **Therefore:** The CB's incentive to stimulate is *reduced*, which in turn lowers the inflationary bias that agents expect.

Dynamics with state-dependent pricing

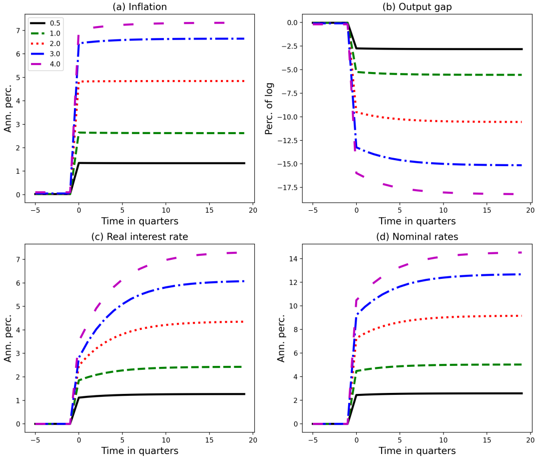


Figure: Response to regime change under state-dependent pricing.

- The *transition dynamics* (not SSS) for different shock sizes.
- **Panel (a) - Inflation:** The inflation jump is not linear. The $4\bar{\eta}$ shock (purple) is *not* 4x the $\bar{\eta}$ shock (green). They converge.
- **Panel (d) - Adjustment:** Larger shocks (purple) cause a much larger immediate increase in the adjustment frequency (n_t).
- **Takeaway:** The Phillips curve steepens *on impact*, immediately dampening the inflationary effect.

Conclusions

- **Supply Regimes Matter:** They shift the natural rate (r^*) via precautionary savings, creating bimodal distributions.
- **Optimal Policy Changes:**
  - **Commitment:** Leads to a "bygones are bygones" policy.
  - **Discretion:** Creates a persistent inflationary bias in bad times.
- **Simple Policies Fail:** Standard Taylor rules fail to stabilize inflation. An **adapted rule** that tracks the regime-dependent r^* succeeds.
- **Implications:** Monetary frameworks must account for persistent supply disruptions like wars or de-globalization.

Questions?

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