Dynamic Inconsistency in Dual-Shock Monetary Policy

A Post-COVID Framework

Arthur Mota

University of São Paulo

June 2025

Outline

Motivation: The Post-COVID Inflation Puzzle

When Traditional Frameworks Break Down

Fed's 2020-2024 Experience:

- August 2021: Inflation characterized as "transitory"
- Attributed to supply chain disruptions
- March 2022: Fastest rate hiking cycle since 1980s
- 525 basis points in 17 months

The Problem

Traditional monetary policy frameworks assume central banks face standard inflation-unemployment trade-offs. But what happens when supply and demand shocks occur simultaneously with conflicting optimal responses?

This policy reversal highlights a fundamental gap in monetary theory

Traditional vs. Dual-Shock Environment

Why Existing Theory Falls Short

Kydland-Prescott (1977) assumes:

- Standard Phillips curve with symmetric shocks
- Homogeneous disturbances
- Clear inflation-unemployment trade-off

Modern reality features:

- **Supply shocks:** Create inflation without output expansion
- **Demand shocks:** Generate traditional trade-offs
- **Simultaneous occurrence:** Conflicting optimal responses
- **Imperfect information:** Difficulty distinguishing shock sources

Key Insight

When shocks require different policy responses, traditional dynamic inconsistency problems are amplified

Research Contributions

Three Key Innovations

1. **Extended Kydland-Prescott Framework**
   - Dual-shock environment with supply and demand disturbances
   - Shows how shock uncertainty amplifies time-inconsistency
   - Characterizes new sources of policy mistakes
2. **Dual-Shock Phillips Curve**
   - Separates supply from demand pressures
   - Modified Taylor rule with shock-specific responses
   - Asymmetric and nonlinear central bank optimization
3. **Empirical Application**
   - Fed's 2020-2024 experience as case study
   - Shows shock misidentification costs
   - Policy implications for modern central banking

The Dual-Shock Phillips Curve

Separating Supply from Demand Pressures

Traditional Phillips Curve:

$$\pi_t = \alpha \pi_t^e + \beta y_t + \varepsilon_t$$

Our Dual-Shock Phillips Curve:

$$\pi_t = \alpha \pi_t^e + \beta_D \max(D_t, 0) + \beta_S S_t + \varepsilon_t \tag{1}$$

Where:

- D_t = demand shocks (only positive shocks create inflation)
- S_t = supply shocks (affect inflation regardless of sign)
- π_t^e = inflation expectations

Key innovation: Asymmetric treatment reflects different inflationary mechanisms

Output Gap and Policy Rule

Completing the Model Structure

Output gap evolution:

$$y_t = \phi_D D_t - \phi_S |S_t| + \eta_t \tag{2}$$

- Demand shocks boost output
- Supply disruptions reduce output (regardless of direction)

Modified Taylor rule:

$$r_t = r^* + \phi_\pi(\pi_t - \pi^*) + \phi_y y_t + \phi_S f(S_t) + u_t \tag{3}$$

Where $f(S_t) = S_t \cdot 1(|S_t| > \bar{S})$ represents threshold-based supply shock responses

Central Bank Loss Function

State-Dependent Preferences

Enhanced loss function with shock-specific terms:

$$L_t = \mathbb{E}_0 \sum_{s=0}^{\infty} \beta^s \left[\alpha(\pi_{t+s} - \pi^*)^2 + \lambda_D (y_{t+s})^2 + \lambda_S \omega(S_{t+s}) + \gamma(\Delta\pi_{t+s})^2\right] \quad (4)$$

Key features:

- $\omega(S_t) = \exp(\kappa|S_t|) - 1$ captures non-linear costs of supply disruptions
- λ_D, λ_S represent differential weights on shock types
- $\gamma \geq 0$ reflects preferences for inflation smoothing

Innovation

Non-linear supply shock costs create convexity, amplifying dynamic inconsistency problems

Shock Processes and Information

Persistence and Signal Extraction

Both shocks follow persistent AR(1) processes:

$$D_t = \rho_D D_{t-1} + \epsilon_{D,t}, \quad \epsilon_{D,t} \sim N(0, \sigma_D^2) \tag{5}$$

$$S_t = \rho_S S_{t-1} + \epsilon_{S,t}, \quad \epsilon_{S,t} \sim N(0, \sigma_S^2) \tag{6}$$

With potential correlation: $\mathbb{E}[\epsilon_{D,t}\epsilon_{S,t}] = \sigma_{DS}$

Information friction:

- Central bank observes aggregate outcomes
- Faces signal extraction problem distinguishing shock sources
- Must infer D_t and S_t from π_t and y_t

Critical Point

Information friction creates additional dynamic inconsistency as policy commitments become suboptimal when shock composition differs from expectations

Equilibrium Existence

Mathematical Foundations

Theorem (Equilibrium Existence)

A unique rational expectations equilibrium exists if:

1. $|\alpha + \phi_\pi \beta_D \phi_D| < 1$ *(determinacy condition)*
2. $\sigma_D^2 + \sigma_S^2 < \infty$ *(bounded shocks)*
3. $|\rho_D|, |\rho_S| < 1$ *(stationary processes)*

Economic interpretation:

- Condition 1: Ensures unique stable inflation path
- Condition 2: Standard for well-behaved stochastic processes
- Condition 3: Prevents explosive shock dynamics

The model can be solved using standard linear rational expectations techniques after appropriate linearization

Optimal Policy Under Commitment

First-Best Response

Under commitment, central bank chooses entire sequence $\{\pi_t\}_{t=0}^{\infty}$:

$$\pi_t^C = \frac{\alpha\pi^* + \frac{\lambda_D \phi_D}{\beta_D} D_t + \frac{\lambda_S}{\beta_S} \frac{\partial \omega(S_t)}{\partial S_t} S_t}{\alpha + \frac{\lambda_D \phi_D^2}{\beta_D^2} + \frac{\lambda_S}{\beta_S^2} \left(\frac{\partial \omega(S_t)}{\partial S_t} \right)^2} \tag{7}$$

Key properties:

- $\frac{\partial \pi_t^C}{\partial D_t} > 0$ (accommodate positive demand shocks)
- $\frac{\partial \pi_t^C}{\partial S_t} < 0$ (lean against supply shocks)
- Response magnitudes depend on shock persistence

Insight

Optimal policy treats demand and supply shocks asymmetrically

Discretionary Policy Solution

Period-by-Period Optimization

Under discretion, central bank reoptimizes each period:

$$\pi_t^D = \frac{\alpha\pi^* + \lambda_D \phi_D D_t + \lambda_S \frac{\partial\omega(S_t)}{\partial S_t} S_t}{\alpha + \lambda_D \phi_D^2 + \lambda_S \left(\frac{\partial\omega(S_t)}{\partial S_t}\right)^2} \tag{8}$$

Comparison with commitment:

- Higher average inflation: $\mathbb{E}[\pi_t^D] > \mathbb{E}[\pi_t^C]$
- Suboptimal shock responses: $|\frac{\partial\pi_t^D}{\partial S_t}| < |\frac{\partial\pi_t^C}{\partial S_t}|$
- Welfare losses increasing in shock variances

Classic Kydland-Prescott inflation bias persists but is amplified by dual shocks

The Enhanced Time-Inconsistency Problem

New Sources of Policy Mistakes

Theorem (Enhanced Dynamic Inconsistency)

Policy chosen at $t = 0$ is time-inconsistent if any of the following hold:

1. ***Shock uncertainty:*** $Var_0(S_t) \neq Var_t(S_t)$ *due to learning*
2. ***Learning effects:*** $\mathbb{E}_0[D_t|\Omega_0] \neq \mathbb{E}_t[D_t|\Omega_t]$ *(evolving estimates)*
3. ***Correlation surprises:*** $Cov_0(D_t, S_t) \neq Cov_t(D_t, S_t)$ *realized*

Economic mechanism:

- Non-linear loss function creates convexity in shock responses
- Information updates change optimal policy prescriptions
- Initial commitments become suboptimal ex-post

Key Insight

Traditional time-inconsistency problems are amplified when central banks face imperfect information about shock composition

Welfare Analysis

Quantifying the Costs

Welfare loss from discretion: $\Delta W = \mathbb{E}[L^D] - \mathbb{E}[L^C]$

$$\Delta W = \underbrace{\frac{\alpha \lambda_D^2 \phi_D^2 \sigma_D^2}{(1-\beta)(\text{denom})^2}}_{\text{Demand component}} + \underbrace{\frac{\alpha \lambda_S^2 \mathbb{E}\left[\left(\frac{\partial \omega(S_t)}{\partial S_t}\right)^2\right] \sigma_S^2}{(1-\beta)(\text{denom})^2}}_{\text{Supply component}} + \text{cross terms} \tag{9}$$

Key findings:

- Welfare losses increase more than proportionally with shock variances
- Non-linear supply shock costs ($\omega(S_t)$) amplify welfare costs
- Cross-correlation between shocks creates additional welfare losses

Implication: Traditional frameworks perform poorly during high volatility periods

Modified Phillips curve with credibility:

$$\pi_t = \alpha[\theta_t \pi_t^{e,informed} + (1-\theta_t)\pi_t^{e,confused}] + \beta_D D_t + \beta_S S_t + \varepsilon_t \tag{10}$$

Where $\theta_t \in [0,1]$ = private sector confidence in central bank's shock identification

Communication challenges:

- Private agents must form expectations over both outcomes and central bank competence
- Low credibility (θ_t small) leads to poorly anchored expectations
- Creates additional welfare costs from suboptimal expectation formation

Policy Implication

Central bank communication becomes more complex but critical in dual-shock environments

Empirical Application: The Fed's Experience

Theory Meets Reality

Stylized Facts from 2020-2024:

1. **Co-occurrence of Supply and Demand Shocks**
   - Supply: COVID disruptions, Ukraine war, China zero-COVID
   - Demand: Massive fiscal stimulus, sectoral reallocation
   - NY Fed Supply Chain Pressure Index peaked while durable goods consumption surged
2. **Initial Shock Misidentification**
   - Fed characterized inflation as "transitory"
   - Attributed primarily to supply bottlenecks
   - Underweighted concurrent demand pressures
3. **Dramatic Policy Reversal**
   - March 2022: Fastest hiking cycle since 1980s
   - Treated situation as demand shock requiring aggressive tightening

Policy Mistakes and Dynamic Inconsistency

The "Transitory" Narrative

August 2021 - Chair Powell's Jackson Hole Speech:

> *"Inflation driven by a narrow group of goods and services directly affected by the pandemic"*

Our framework explains this as:

- Treating situation as pure supply shock
- Optimal response: accommodation
- Time-inconsistent as demand pressures intensified

March 2022 - Policy Reversal:

- 525 basis points in 17 months
- Effectively treating as demand shock
- Created financial stress (banking sector strains March 2023)

Theoretical Prediction Confirmed

Evolving information and shock misidentification led to time-inconsistent policy reversal

Taylor Rule Analysis
Why Traditional Rules Failed

Standard Taylor Rule in 2021:

- Suggested rates should rise to 2-3%
- Fed maintained near-zero rates
- Created significant policy gap

Our dual-shock framework would have prescribed:

- Earlier but more measured tightening
- Conditional on shock identification
- Avoiding both initial error and subsequent overcorrection

Communication challenges:

- "Transitory" messaging created forward guidance constraints
- Limited policy flexibility when new information emerged
- Market-based inflation expectations rose as confidence declined

Welfare Costs

Quantifying the Policy Mistakes

Observed outcomes:

- Core PCE inflation peaked at 5.6% (February 2022)
- 3.6 percentage points above target for extended period
- Real wages declined substantially
- Financial stress from subsequent policy correction

Our framework predicts:

- Welfare losses from discretionary policy increase under dual shocks
- Particularly severe when shock identification fails
- Cross-correlation between shocks amplifies costs

International Evidence

ECB communication became more complex (readability scores requiring 13-15 years education), confirming broader pattern of communication challenges

Policy Recommendations

Rethinking Monetary Policy Frameworks

1. **Develop Shock-Specific Policy Responses**
   - Separate response coefficients for supply and demand shocks
   - Improve real-time shock identification capabilities
   - Sectoral inflation decompositions and supply chain monitoring
2. **Enhanced Communication Strategies**
   - Conditional forward guidance linked to observable shock indicators
   - Explicit acknowledgment of uncertainty
   - Clear frameworks for policy flexibility
3. **Modified Rule-Based Frameworks**
   - Rules must account for shock heterogeneity
   - Simple Taylor rules fail when supply shock variance exceeds thresholds
   - Need for asymmetric and state-dependent responses

Future Research Directions

Extensions and Applications

1. **Fiscal-Monetary Interactions**
   - How fiscal policy affects dual-shock dynamics
   - Coordination challenges during crisis periods
   - Debt sustainability considerations
2. **International Spillovers**
   - Cross-border transmission of dual shocks
   - Coordination across central banks
   - Exchange rate implications
3. **Financial Stability**
   - Banking sector responses to dual shocks
   - Systemic risk considerations
   - Macroprudential policy interactions
4. **Empirical Validation**
   - Structural estimation of dual-shock models
   - Cross-country analysis
   - Historical episode studies

Key Contributions

Theoretical and Policy Advances

1. **Extended Kydland-Prescott Framework**
   - Shows dual-shock environments amplify dynamic inconsistency
   - Identifies new sources of time-inconsistency problems
   - Provides rigorous mathematical foundation
2. **Practical Policy Framework**
   - Dual-shock Phillips curve separates inflationary pressures
   - Modified Taylor rule with shock-specific responses
   - Enhanced loss function captures non-linear costs
3. **Empirical Relevance**
   - Fed's 2020-2024 experience validates theoretical predictions
   - Shock misidentification led to significant policy mistakes
   - Communication challenges affected expectation formation

Broader Implications

The Future of Monetary Policy

Traditional frameworks are increasingly inadequate:

- Global supply chain vulnerability
- Increased geopolitical tensions
- Climate-related supply disruptions
- Technological disruptions

Central banks must adapt:

- Enhanced shock identification capabilities
- More sophisticated communication strategies
- Flexible but credible policy frameworks
- International coordination mechanisms

Bottom Line

In an era of increased economic fragmentation and shock complexity, monetary policy theory must evolve beyond traditional assumptions while maintaining rigorous foundations

Thank You

Questions & Discussion

Contact Information:
Arthur Mota
University of São Paulo
`arthurmota@alumni.usp.br`

Key Takeaway

When central banks face simultaneous supply and demand shocks requiring conflicting responses, traditional dynamic inconsistency problems are fundamentally amplified, requiring new theoretical frameworks and policy approaches.