Sharing the Burden: Monetary and Fiscal Responses to a World Liquidity Trap

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Global Policy Responses to a Liquidity Trap

- Paper looks at optimal fiscal and monetary policy in global liquidity trap
- Large negative demand shock emanating from one country
- Pushes down world ‘natural real interest rates’
- Standard tools of monetary policy cannot achieve first best
- How should monetary and fiscal policy be jointly used?
  - What should be global response?
  - How should the response be borne across individual countries?
Background

Motivation: Policy

- Great recession caused large fall in demand in US; heterogeneous affect on other countries
- Reduced policy interest rates globally
- Led to disparate responses of fiscal policy
- Return to positive interest rates at different rates

Motivation: Theory
(Krugman, 1999, Eggertson and Woodford, 2003, Jung et al. 2005)

- Literature focuses on zero bound constraint in one country
- Looks at monetary fiscal mix responses
- In situation of global LT with heterogeneous affects
  - Monetary-fiscal mix becomes more complicated
  - Standard description of monetary policy may not be optimal

\[
r_t = \max(0, \tilde{r}_t)
\]
Main Results

Focus on shock differentially hitting one country

- When trade is fully open (no home bias)
  - Liquidity traps are global - all countries identically affected
  - Under discretion - only option is coordinated expansionary fiscal expansion

- With less than full trade openness countries differentially affected
  - Exchange rate plays a destabilizing role in liquidity trap
  - Optimal cooperative monetary policy may be for monetary contraction in foreign country
  - Optimal fiscal responses depends critically upon monetary responses
Model Description

Standard Two Country New Keynesian Model:

- Complete Assets Markets
- Calvo Price Adjustment
- Private and Public Goods Production
- Time Preference Shocks
Model

Home Preferences

\[ U_t = E_0 \sum_{t=0}^{\infty} (U(C_t, \xi_t) - V(N_t) + J(G_t)) \]

\( \xi_t \) is a preference shock, and \( U_{12} > 0 \)

Composite consumption defined as

\[ C_t = \Phi C_{Ht}^{v/2} C_{Ft}^{1-v/2}, \quad v \geq 1 \]

Simplifying assumptions for analytical solution

Standard Euler equations, labor supply, price setting
Natural Real Interest Rates

For any variable $x_t$, define the world average and world relative level, $x_t^W = \frac{x_t + x_t^*}{2}$ and $x_t^R = \frac{x_t - x_t^*}{2}$.

Wicksellian (‘natural’) real interest rates are a function of the demand shocks

Shock continues (ends) with probability $\mu$, $(1 - \mu)$

$$\tilde{r}_t = \bar{r} + \left( \frac{\phi c_y}{\phi + \sigma} \varepsilon_t^W + \frac{\phi c_y (v - 1)}{\Delta} \varepsilon_t^R \right) (1 - \mu)$$

$$\tilde{r}_t^* = \bar{r} + \left( \frac{\phi c_y}{\phi + \sigma} \varepsilon_t^W - \frac{\phi c_y (v - 1)}{\Delta} \varepsilon_t^R \right) (1 - \mu)$$

For $v = 1$, natural real interest rates are identical
Take shock from Home country $\varepsilon_t^* = 0$ and $\varepsilon_t^W = \varepsilon_t^R = \frac{\varepsilon_t}{2}$
World Averages and Relatives:

Averages:

\[
\pi^W_t = k(\phi + s)\hat{n}^W_t - ks \cdot \hat{c}_t^W + \beta E_t \pi^W_{t+1}
\]

\[
sE_t(\hat{n}^W_{t+1} - \hat{n}^W_t) - sE_t(\hat{c}_t^W_{t+1} - \hat{c}_t^W) = E_t (r^W_t - \tilde{r}^W_t - \pi^W_{t+1})
\]

Relatives:

\[
\pi^R_t = k(\phi + s_D)\hat{n}^R_t - ks_D \hat{c}_t^R + \beta E_t \pi^R_{t+1}
\]

\[
sD E_t(\hat{n}^R_{t+1} - \hat{n}^R_t) - sD E_t(\hat{c}_t^R_{t+1} - \hat{c}_t^R) = E_t (r^R_t - \tilde{r}^R_t - \pi^R_{t+1})
\]

\[
\hat{c}_t^i \equiv (1 - c_y)\hat{g}_t^i, \quad i = W, R, \quad s_D < s; \text{ relative vs world elasticity}
\]
Policy rates should target natural real interest rates

Write natural real interest rates as

$$\tilde{r}_t = \tilde{r}(\varepsilon_t, \nu), \quad \tilde{r}_t^* = \tilde{r}^*(\varepsilon_t, \nu)$$

- If $\tilde{r}_t > 0$, $\tilde{r}_t^* > 0$, then optimal policy is

  $$r_t = \tilde{r}_t, \quad r_t^* = \tilde{r}_t^*, \quad g_t = g_t^* = 0$$

- Then no gain for cooperation in policy

- Fiscal policy should close all gaps
Zero lower bound on policy rates

Now define

\[ \varepsilon_H(v) < 0, \text{ such that } \tilde{r}(\varepsilon_H, v) = 0 \]

Clearly

\[ \varepsilon_H(v) \geq \varepsilon_F(v), \text{ with strict inequality when } v > 1 \]

Home has zero natural rate before foreign

Assume now that

\[ \varepsilon_t < \varepsilon_H(1) \]

Thus, \( \tilde{r}(\varepsilon_t, v) < 0 \) and cannot close all gaps
Threshold on foreign natural real interest rate

Define $v_F$ s.t. $\tilde{r}^*(\varepsilon_t, v_F) = 0$
Stance of Monetary Policy

- What is the optimal monetary policy?
- Focus on monetary policy under discretion
- Conjecture that the optimal monetary rule is:

  \[ r_t = \max(0, \tilde{r}_t), \quad r_t^* = \max(0, \tilde{r}_t^*) \]

- Natural extension of the optimal monetary rule in the closed economy
- Call this the ‘conventional’ monetary policy
Under this conjecture, look at effect of demand shocks

Case 1. For $v \leq v_F$, we have

\[
\hat{n}_t = (1 - \beta \mu) \left[ \frac{\tilde{r}_t^W}{\Delta_2} + \frac{\tilde{r}_t^R}{\Delta_2^D} \right]
\]

\[
\hat{n}_t^* = (1 - \beta \mu) \left[ \frac{\tilde{r}_t^W}{\Delta_2} - \frac{\tilde{r}_t^R}{\Delta_2^D} \right]
\]

In this case, the home output gap must fall, while the foreign output gap may rise or fall, depending on the size of $v$. 
Effect of Demand Shocks

Case 2. For \( v > v_F \), we have \( \tilde{r}_t^W = \tilde{r}_t^R = \frac{\tilde{r}_t}{2} \). Then we get:

\[
\hat{n}_t = (1 - \beta \mu)\tilde{r}_t \left[ \frac{1}{\Delta_2} + \frac{1}{\Delta_2^D} \right]
\]

\[
\hat{n}_t^* = (1 - \beta \mu)\tilde{r}_t \left[ \frac{1}{\Delta_2} - \frac{1}{\Delta_2^D} \right]
\]

Again, the home output gap must fall. But in this case, the foreign output gap will always rise, because, from the definitions above, we have \( \Delta_2 > \Delta_2^D \).
Significant asymmetries in effects when $\nu > 1$

Due to pathological effect of real exchange rate

Demand shock causes real exchange rate *appreciation*

In a liquidity trap, exchange rate response is exacerbating, not mitigating

Intuition

- Deflation in the home country raises home real interest rate
- Must generate expected terms of trade depreciation
- Hence immediate appreciation

$$i_t - E_t \pi_{t+1} = i_t^* - E_t \pi^*_{t+1} + E_{t+1}(\tau_{t+1} - \tau_t)$$
But is the conventional monetary policy optimal?

Look at cooperative monetary policy under discretion
Choose \( \hat{n}_t^W, \hat{n}_t^R, \pi_t^W, \pi_t^R, r_t, r^*_t \) to:

\[
\max L_t = -(\hat{n}_t^R)^2 \frac{A}{2} - (\hat{n}_t^W)^2 \frac{B}{2} - \frac{\theta}{4k} (\pi_t^W + \pi_t^R)^2 - \frac{\theta}{4k} (\pi_t^W - \pi_t^R)^2 \\
+ \lambda_{1t} \left[ \pi_t^W - k(\phi + s)\hat{n}_t^W - \beta E_t \pi_{t+1}^W \right] \\
+ \lambda_{2t} \left[ \pi_t^R - k(\phi + s_D)\hat{n}_t^R - \beta E_t \pi_{t+1}^R \right] \\
+ \psi_{1t} \left[ sE_t(\hat{n}_{t+1}^W - \hat{n}_t^W) - E_t \left( \frac{r_t + r^*_t}{2} - \hat{r}_t^W - \pi_{t+1}^W \right) \right] \\
+ \psi_{2t} \left[ s_D E_t(\hat{n}_{t+1}^R - \hat{n}_t^R) - E_t \left( \frac{r_t - r^*_t}{2} - \hat{r}_t^R - \pi_{t+1}^R \right) \right] \\
+ \gamma_{1t} r_t + \gamma_{2t} r^*_t
\]
First Order Conditions

\[ \psi_{2t} + \psi_{1t} = \gamma_{1t} \]
\[ \psi_{1t} - \psi_{2t} = \gamma_{2t} \]

Can be expressed as:

\[ \Omega_D \left( \frac{r_t - r_t^*}{2} - \tilde{r}_t^R \right) = \psi_2 \]
\[ \Omega \left( \frac{r_t + r_t^*}{2} - \tilde{r}_t^W \right) = \psi_1 \]

where \( \Omega_D \geq \Omega \), with strict inequality when \( v < 2 \).
When do both constraints bind?

**Proposition**: $r_t = 0$ for all $v$. There exists $\bar{v} < v_F$, such that for $v \geq \bar{v}$, $r^* > 0$.

- Foreign interest rate is piecewise function of $v$
  - For $1 \leq \bar{v}$, $r^* = 0$
  - For $\bar{v} < v < 2$,

$$
r_t^* = \tilde{r}^*(\varepsilon_t, v) - \frac{(\Omega_D - \Omega)}{\Omega_D + \Omega} \tilde{r}(\varepsilon_t, v) > 0
$$

Foreign policy rate *above* the foreign natural real interest rate

Key intuition: rising foreign interest rate reduces the appreciation of the home currency
Behavior of foreign interest rate

\[ r^* \]

\[ \tilde{r}^* \]

\[ \hat{v} \]

\[ v_F \]

0
Size of $\bar{v}$ will also depend on size of shock

Trade off between $\varepsilon$ and $\bar{v}$
Now incorporate both fiscal and monetary policy

- Outside a liquidity trap, fiscal gaps should be zero
- But may want to trade off non-zero fiscal gaps when interest rates are zero

Extend welfare to allow for non-zero fiscal gaps:

\[
V_t = -\left(\hat{n}_t^R\right)^2 \cdot \frac{A}{2} - \left(\hat{n}_t^W\right)^2 \frac{B}{2} - \left(\hat{c}g_t^R\right)^2 \cdot \frac{F}{2} - \left(\hat{c}g_t^W\right)^2 \cdot \frac{H}{2} - J(\hat{n}_t^R)(\hat{c}g_t^R) \\
- L(\hat{n}_t^W)(\hat{c}g_t^W) - \frac{\theta}{4k}(\pi_t^W + \pi_t^R)^2 - \frac{\theta}{4k}(\pi_t^W - \pi_t^R)^2
\]
Fiscal multipliers

- World multiplier
  \[ \hat{n}_t^W = \frac{\Delta_3 \hat{c}g_t^W}{\Delta_2} \]
  - independent of home bias parameter
  - greater than unity when both \( r=r^* = 0 \)

- Relative multiplier
  \[ \hat{n}_t^R = \frac{\Delta_3 \hat{c}g_t^R}{\Delta_2 - (D - 1)\mu k\phi} \]
  - decreasing in home bias
  - greater than the world multiplier
Home and Foreign Multipliers

\[ \hat{n}_t = \hat{n}_t^R + \hat{n}_t^W = \left[ \frac{1}{2} \frac{\Delta_3}{\Delta_2} + \frac{1}{2} \frac{\Delta_D^3}{\Delta_D^2} \right] \hat{c}g_t \]

- **Home country multiplier**
  - Greater than unity when both \( r=r^*=0 \)
  - Larger than closed economy multiplier (decreasing in home bias v)
  - Government spending causes depreciation: crowds in net exports

\[ \hat{n}_t^* = \hat{n}_t^W - \hat{n}_t^R = \frac{1}{2} \left[ \frac{\Delta_3}{\Delta_2} - \frac{\Delta_D^3}{\Delta_D^2} \right] \hat{c}g_t \]

- **Foreign multiplier**
  - Negative
  - Home depreciation reduces foreign output
Optimal Monetary and Fiscal Policy

- When $r_t = r_t^* = 0$ binds in both countries
- World fiscal gap is positive
  - Persistent fiscal expansion causes expected inflation, reduces world output gap
  - World fiscal gap is independent of degree of home bias
- When $v > 1$, relative fiscal gap is positive, so home fiscal gap is always positive
Numerical Analysis of optimal policy

- Look at jointly optimal policy
- Foreign interest rate is piecewise function of $v$ as in theory
- Given $\varepsilon_t < \varepsilon_H(1)$, illustrate responses as function of $v$
Calibration

Model calibration

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Optimal Fiscal and Monetary Policy

Figure 2: Optimal Policy

(a) Output Gaps

(b) Fiscal Gaps

(c) Inflation

(d) Foreign Policy Rate, Foreign Natural Rate

(e) Terms of Trade
Optimal Fiscal and Monetary Policy

What would be result if foreign country used conventional monetary rule?

\[ r_t = \max(0, \tilde{r}_t), \quad r^*_t = \max(0, \tilde{r}^*_t) \]

In this case, for \( v > \bar{v} \), monetary policy is overly expansionary

Would result in optimal fiscal *contraction* for the foreign country.
Policy with Conventional Monetary Policy

Figure 3: Optimal and Constrained Policy

(a) Output Gaps

(b) Fiscal Gaps

(c) Inflation

(d) Foreign Policy Rate, Foreign Natural Rate

(e) Terms of Trade
Qualifications

- Have looked only at cooperative policy choice
- Non-cooperative much harder to do in analytical framework
- Shock here is purely exogenous - not related to liquidity, credit constraints, deleveraging
- Fiscal policy has Ricardian equivalence - no tax distortions, crowding out, or default