Monetary Policy in a Channel System

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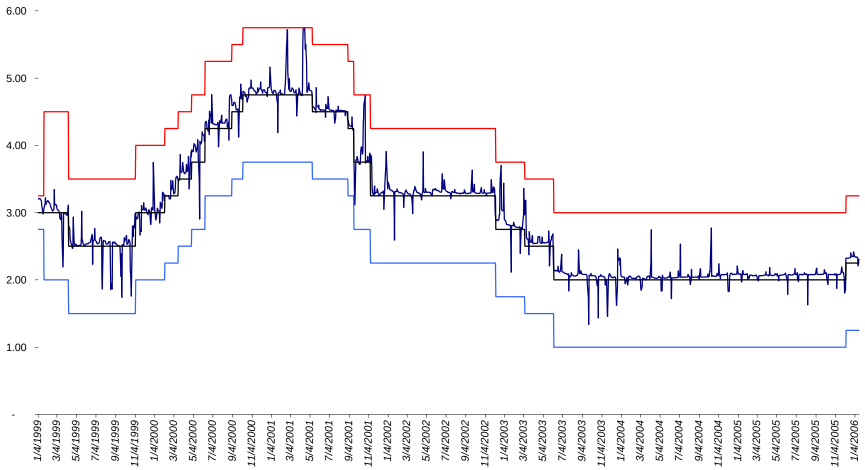
EONIA - Euro OverNight Index Average
Source: ECB



Features of "pure" channel systems

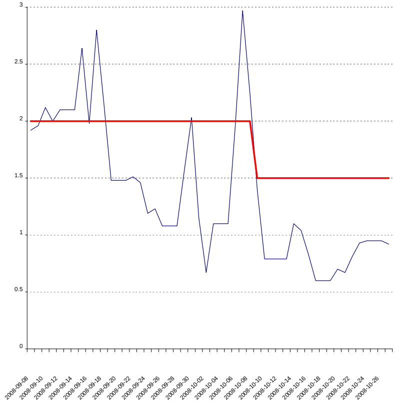
- Standing facilities
- All CB loans are secured with collateral (typically REPOS)
- Few or no open market operations
- Money market allocates reserves; reserves management

This Paper

- ... is on the optimal design of the MP implementation framework, given the CB uses a "pure" channel system.
- ...is not on the optimal monetary policy response to shocks.

Fed Fund Rate - 8 September- 28 October 08

(Source: BOG)



Eonia - 8 September - 28 October 2008

(source EBA and ECB)

Objectives

- Optimal interest-rate corridor.
- Shift of corridor vs. changing the size.
- Implications of collateral requirements for the optimal policy.
- Steering money market rates without open market operations.

Environment

- Based on current CB practice as much as possible.
- Version of Lagos and Wright (2005).
- Time discrete and infinite.
- $[0,1]$ continuum of ∞-lived agents (banks/households). Anonymity.
- Walrasian markets open/close sequentially, in each t.

Environment

Settlement market: Settle claims by trading a general good. Adjust money and collateral holdings.

Money market: Signals on liquidity needs. Borrow/lend money.

Goods market (liquidity shock):

- Produce with probability n at costs $c(q_s) = q_s$
- Consume with probability $1 - n$ and get $u(q)$

Standing facilities:
Open before and after the goods market.

- Borrow from lending facility against collateral at rate i_ℓ,
- Deposit money at rate i_d

Collateral

- General goods can be 'stored' at the CB.
- Return in $t+1$ is $R \geq 1$ with $\beta R < 1$.
- $1 + r = 1/\beta$ implies $R < 1 + r$.

Benchmark: First Best Allocation

Expected lifetime utility of a representative agent

$$(1-\beta)\mathcal{W} = (1-n)[u(q)-q] + (\beta R - 1)b$$

First best allocation (q^*, b^*), where:

$$u'(q^*) = 1, \text{and } b^* = 0.$$

Decentralization:
Anonymity implies money is necessary.

Money

- Central bank prints/burns paper money at not cost. Fiat.
- CB has no fiscal authority. No lump-sum transfers.
- Endogenous growth rate

$$M_t = M_{t-1} - (1-n)i_\ell L_{t-1} + n i_d D_{t-1}.$$

- Stationary equilibrium

$$\phi M = \phi_{+1} M_{+1} \text{ and denote } \gamma = M_{+1}/M$$

No Money Market
(signal totally uninformative)

Symmetric Stationary Equilibrium

Settlement stage:

$$W(m_{-1}, b_{-1}, \ell, d) = \max_{h,m,b} -h + V(m, b)$$
$$s.t. \quad \phi m + b = h + \phi m_{-1} + R b_{-1} + \phi(1 + i_d)d - \phi(1 + i_\ell)\ell.$$

First-order conditions ($m, b = \bar{m}, \bar{b}$ for all agents)

$$V_m \leq \phi \,(= \text{ if } m > 0) \tag{1}$$
$$V_b \leq 1 \,(= \text{ if } b > 0) \tag{2}$$

Envelope conditions

$$W_m = \phi; W_b = R; W_\ell = -\phi(1 + i_\ell); W_d = \phi(1 + i_d).$$

Equilibrium

Goods market:

$$V(m,b) = (1-n)V^b(m,b) + nV^s(m,b)$$

Sellers' problem

$$V^s(m,b) = \max_{q_s} \left\{-q_s + \beta Rb + \beta\phi_+ (m + pq_s)(1+i_d)\right\} + \beta\left[V\left(\bar{m},\bar{b}\right) - \phi_+\bar{m} - \bar{b}\right]$$

$$\text{FOC:} \qquad p\beta\phi_+(1+i_d) = 1 \tag{3}$$

Equilibrium

Buyers' problem

$$V^b(m,b) = \max_{q,\ell} \quad \left\{ \begin{array}{c} u(q) + \beta Rb + \beta\phi_+ (m+\ell-pq)(1+i_d) \\ -\beta\phi_+ \ell (1+i_\ell) \end{array} \right\}$$
$$+\beta\left[V\left(\bar{m},\bar{b}\right) - \phi_+ \bar{m} - \bar{b}\right]$$

$$\text{s.t.} \qquad pq \leq m+\ell \quad \text{and} \quad \phi_+ \ell (1+i_\ell) \leq Rb$$

$$\text{FOC:} \qquad u'(q) = \beta p \phi_+ (1+i_\ell) + \lambda_\ell \tag{4}$$

Equilibrium

Marginal value of money in the good market:

$$\phi \geq V_m = (1-n)u'(q)/p + n(1+i_d)\beta\phi_{+1} \quad (5)$$

$$\frac{\gamma/\beta - (1+i_d)}{(1+i_d)} \geq (1-n)\left[u'(q) - 1\right] \quad (6)$$

Marginal value of collateral in the good market:

$$1 \geq V_b = (1-n)\lambda_\ell \beta R/\left(1+i_\ell\right) + \beta R \quad (7)$$

$$\frac{1/\beta - R}{R} \geq (1-n)\left[u'(q)/\Delta - 1\right] \quad (8)$$

$$\Delta = \left(1+i_\ell\right)/\left(1+i_d\right).$$

Equilibrium

Definition

A symmetric stationary monetary equilibrium is a list $(\gamma, q, z_\ell, z_m, b)$ satisfying (9)-(13) with $z_\ell \geq 0$ and $z_m \geq 0$.

$$
\begin{aligned}
\frac{1/\beta - R}{R} &\geq (1-n)\left[u'(q)/\Delta - 1\right] && (9)\\
\frac{\gamma/\beta - (1+i_d)}{(1+i_d)} &\geq (1-n)\left[u'(q) - 1\right] && (10)\\
\gamma &= 1 + i_d - (1-n)(i_\ell - i_d)\frac{z_\ell}{z_m}, && (11)\\
q &= z_m + z_\ell && (12)\\
z_\ell &= \beta R b/\Delta && (13)
\end{aligned}
$$

Equilibrium

Proposition

For any $\Delta \geq 1$ there exists a unique symmetric stationary equilibrium such that

$$\begin{array}{lll} z_\ell > 0 \text{ and } z_m = 0 & \text{if and only if} & \Delta = 1 \\ z_\ell > 0 \text{ and } z_m > 0 & \text{if and only if} & 1 < \Delta < \tilde{\Delta} \\ z_\ell = 0 \text{ and } z_m > 0 & \text{if and only if} & \Delta \geq \tilde{\Delta}. \end{array}$$

where

$$\tilde{\Delta} = \frac{1 - n\beta}{1/R - n\beta} \text{ and } \Delta = \frac{1 + i_\ell}{1 + i_d}.$$

Optimal Policy

Equilibrium with a positive amount of collateral $1 \leq \Delta < \tilde{\Delta}$.
This defines constraints on q:
- $\hat{q}$ is the level of consumption when $\Delta = 1$.
- $\tilde{q}$ is the level of consumption when $\Delta > \tilde{\Delta}$

The central bank's problem is

$$\max_{q,b} \; (1-n)\left[u(q)-q\right] + (\beta R - 1)\, b$$

$$\text{s.t. } q = \beta b R F\left(\frac{R\beta(1-n)u'(q)}{1-nR\beta}\right)$$

$$\hat{q} \geq q \geq \tilde{q}$$

Optimal Policy

Proposition

There exists a critical value $\overline{R}$ such that if $R < \overline{R}$, then the optimal policy is $\Delta \geq \tilde{\Delta}$. Otherwise the optimal policy is $\Delta \in (1, \tilde{\Delta})$.

- Since $\beta R < 1$ it is **never** optimal to set a zero band.

  $$\gamma = 1 + i_d - (1-n)(i_\ell - i_d)\ell/m$$

- Set $i_d = i_\ell$ (0 corridor) so that $\gamma = 1 + i_d$. Return on cash is β/γ.
  Return on collateral is $\beta R > \beta/\gamma$, use only collateral, no money.
  Collateral is socially inefficient.
- Rather, set $i_\ell > i_d$: Makes borrowing less attractive, reduce inflation, holding money more attractive.

Money Market

(signal contains some information)

Record Keeping

- Berentsen, Camera and Waller (2006).
- Operated by the CB. Identifies participants and verifies collateral.
- Cannot keep record of goods market transactions.

Trade on the Money Market

Two Types: H (likely to be seller) and L (likely to be buyer)

- H-types lend money/L-types borrow money
- σ^k: probability of k-type.
- n^k: probability that a k-type turns seller.

Agents' Problems

essentially the same as before, except

- Short selling constraints on the money market:

$$\phi_+ y^k (1 + i_m) \le Rb \text{ and } m + y^k \ge 0.$$

- Borrowing constraint in the goods market:

$$\ell^k \le \bar{\ell}^k \equiv \frac{Rb}{\phi_+ (1 + i_\ell)} - y^k \frac{(1 + i_m)}{(1 + i_\ell)}$$

Equilibrium

Stationary equilibrium is determined by

$$\hat{\Delta} = \frac{1 + i_\ell}{1 + i_m} \quad \text{and} \quad \Delta = \frac{1 + i_\ell}{1 + i_d}$$

Equilibrium

Short-selling constraints are nonbinding, then

$$\hat{\Delta} = \frac{\Delta}{n\beta R\,(1-\Delta)+\Delta} \tag{14}$$

$$u'(q^k) = \frac{n^k}{1-n^k}\Delta\frac{1-n\beta R}{n\beta R}, \qquad k = H, L. \tag{15}$$

Definition

A symmetric stationary equilibrium where no short-selling constraint is binding in the money market is a time-invariant list $(\hat{\Delta}, q^L, q^H)$ satisfying (14) - (15) with $b \geq 0$, $z^L < \beta R b \hat{\Delta}/\Delta$ and $z^H > -z_m$.

Equilibrium

Let $n^H - n^L = \varepsilon$. So that $n^H = n + \sigma^L \varepsilon$ and $n^L = n - \sigma^H \varepsilon$.

Proposition

For any $1 < \Delta < \tilde{\Delta}$ there exists a critical value $\varepsilon_1 > 0$ such that if $\varepsilon < \varepsilon_1$ a symmetric monetary equilibrium exists where no short-selling constraint in the money market binds.

Results

1) *Money market rate and the corridor*

$$\hat{\Delta} = \frac{\Delta}{n\beta R(1-\Delta)+\Delta}$$

$$i_m = i_\ell - n\beta R(i_\ell - i_d)$$

- If $n = 1/2$ and $\beta R \to 1$, then $i_m \to (i_\ell + i_d)/2$.
- If $n = 1/2$ and $\beta R < 1$, then $i_m > (i_\ell + i_d)/2$

2) *Collateral requirement*

$$u'(q^k) = \frac{n^k}{1-n^k}\Delta\frac{1-n\beta R}{n\beta R}$$

- Collateral modifies the real allocation.

Results

3) *Need to specify a corridor rule*

- Symmetric increase of the corridor width leaves i_m constant but *has* real effects:

$$u'(q^k) = \frac{n^k}{1-n^k}\Delta\frac{1-n\beta R}{n\beta R}$$

- Need to specify a corridor rule as well as an interest rate rule.

Summary and final remarks

- Details of implementation framework matter.
- The more costly the collateral, the larger the band optimally. The least costly the collateral, $i_m \to (i_\ell + i_d)/2$.
- Shifting the corridor $\delta = i_\ell - i_d$ up increases the money market rate i_m.
- It does not matter whether the deposit rate is set to zero (i.e. deposits are not allowed).

EONIA - Euro OverNight Index Average
and Eurepo - reference rate for the Euro GC repo market
Source: European Banking Federation and ECB