

A Unique Monetary Policy Framework: Secondary Floor with a Floor System

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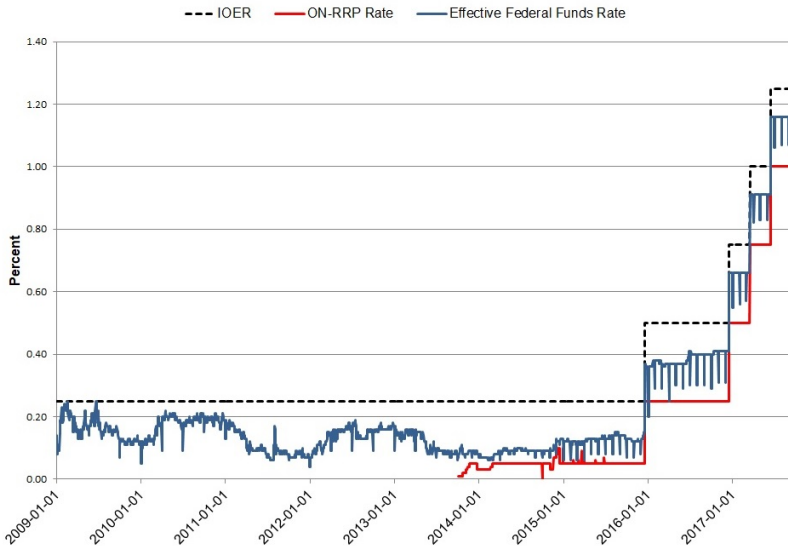
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Motivation

- (i) Since the Great Recession, there are three key changes in the U.S. monetary policy (MP):
 - (1) A reserve account earns an interest;
 - (2) MP works within a *floor* system instead of a *corridor* system;
 - (3) The normalization plan has been in place since September 2014.
- (ii) The interest rate on excess reserves (IOER) puts a floor for the Fed Funds rate (FFR) in theory whereas the evidence suggests that the latter runs below the former.
- (iii) How are the money market dynamics different on the quarter-ends?
- (iv) What are the implications of the Fed's impending "balance-sheet normalization" plan?

Key Interest Rates



Source: Federal Reserve Banks of New York and St. Louis

What I do?

- (i) Using *New-Monetarist* ideas, build a model with three relevant assumptions:
 - (1) the central bank adopts a floor system in which the reverse repurchase agreements (ON-RRP) are sufficiently scarce;
 - (2) the central bank determines the IOER, ON-RRP rate, and the size of its balance sheet;
 - (3) balance sheet costs (federal deposit insurance fee and capital requirements) and limited accessibility to the reserves account are key frictions.
- (ii) Use model to explain *secondary floor with a floor system*, irregular market dynamics on the quarter-ends, the effect of *policy normalization*, and changing dynamics of the fed funds market.

- (i) Given the balance sheet costs and limited accessibility, as the govt debt is sufficiently scarce,
 - * “secondary floor with a subfloor” effectively contains the FFR;
 - * traditional banks do not lend to each other.

- (ii) An increase in the balance sheet cost exerts downward pressure on the FFR and this leads to an increase in the ON-RRPs take-up.

- (iii) When the financial frictions are sufficiently weak (strong), a reduction in the balance-sheet size increases (decreases) welfare.

Evidence for the trade dynamics in the fed funds market

- (i) Afonso, Entz, LeSueur (2013a, 2013b), Martin, McAndrews, Palida, Skeie (2013), and Williamson (2016);

Monetary models for trade dynamics in the fed funds market and policy normalization

- (i) Afonso and Lagos (2015), Afonso, Armenter, Lester (2018)
- (ii) Armenter and Lester (2015), Williamson (2015).

Model

Following from Lagos and Wright (2005) model,

- (i) time is discrete with infinite horizon
- (ii) continuum of buyers, sellers, and bankers with each unit mass
- (iii) each period has two subperiods:
 - (1) Centralized Market (**CM**), or Walrasian trade
 - * Assets and goods are traded on competitive markets
 - * Buyers can produce only in the CM
 - (2) Decentralized Market (**DM**), or bilateral trade
 - * Limited commitment, no record-keeping
 - * Sellers can produce only at the DM
- (iv) one unit of good requires one unit of labor.

Preferences

(i) Buyer's preferences: $U^b = - \overbrace{H_t}^{CM} + \overbrace{u(x_t)}^{DM}$

* H_t is labor supply in the CM, x_t is consumption at the DM

(ii) Seller's preferences: $U^s = \overbrace{X_t}^{CM} - \overbrace{h_t}^{DM}$

* X_t is consumption in the CM, h_t is labor supply at the DM

(iii) Banker's preferences: $U^i = \overbrace{\theta_i X_t^i}^{CM} - H_t^i$

* Each banker produces and consumes only in the CM

* Three types of banks: $i = h, l, q$ with $0 < \theta_h < \theta_l < \theta_q = 1$

* Domestic commercial banks (h), foreign commercial banks (l), and shadow banks (q)

- (i) No unsecured loans, collateral must be provided at the DM
- (ii) A buyer (depositor) of a bank i meets a seller that verifies either only liquid assets or all the assets, each with a positive probability
- (iii) Each bank insures its depositors against the need for different assets at the DM
- (iv) When a buyer needs interest bearing assets at the DM, she transfers the ownership of a tradeable claim (private bank notes) through a financial intermediary to the seller. Otherwise, the bargaining finalizes on the spot

$$\begin{array}{ccccccc}
 \text{Currency} & & \text{Reserves} & & \text{ON-RRPs} & & \text{Fiscal Debt} \\
 \underbrace{\hat{c}} & + & \underbrace{z^m \hat{m}} & + & \underbrace{z^o \hat{o}} & + & \underbrace{z^b \hat{b}} \\
 \underbrace{\hspace{10em}} & & & & & & + \underbrace{\psi s + \phi a} \\
 \text{Central Bank Liabilities} = \pi & & & & & & \text{Private Assets} \\
 \underbrace{\hspace{10em}} & & & & & & \\
 \text{Consolidated Government Debt} = \Sigma & & & & & &
 \end{array}$$

- (i) The monetary policy has three dimensions: the price of reserves (z^m), the price of ON-RRPs (z^o) and the size of Fed's balance sheet (π)
- (ii) The interactions of private agents determine how the outside money is split among currency, reserves, and ON-RRPs
- (iii) The fiscal authority sets the taxes such that Σ is constant forever
 - * c = currency, m = reserves, o = ON-RRPs, b = govt debt, s, a = private assets

Timeline

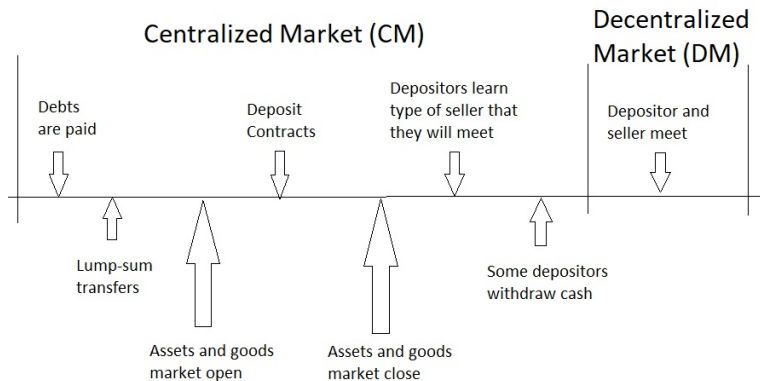


Figure: 2

Problem of (Shadow) Bank q

Maximize $U^q = -k^q + \gamma u\left(\frac{\beta o^q}{\gamma \mu}\right) + (1 - \gamma)u\left(\beta d^q\right)$ subject to

$$\underbrace{k^q + z^f f^q - z^b b^q - z^o o^q}_{\text{Deposit minus value of asset purchases}} - \underbrace{(1 - \gamma)\beta d^q + \frac{\beta(b^q - f^q)}{\mu}}_{\text{Expected payoff in the next period}} \geq 0 \quad (1)$$

$$- \underbrace{(1 - \gamma)\beta d^q}_{\text{Maturity value of liabilities}} + \underbrace{\frac{\beta(b^q - f^q)}{\mu}}_{\text{Maturity value of collateral}} \geq 0 \quad (2)$$

* μ = money growth rate, k = deposits,
 f = quantity of interbank loans, $\frac{\beta o^q}{\gamma \mu} = x_1^q$, $\beta d^q = x_2^q$.

Problem of (Traditional) Bank I

$$\text{Maximize } U^I = -k^I + \omega u \left(\overbrace{\frac{\beta m^I}{\omega \mu}}^{x_1^I} \right) + (1 - \omega) u \left(\overbrace{\beta d^I}^{x_2^I} \right) \text{ subject to}$$

Net deposits minus value of asset purchases

$$\underbrace{\theta_I (k^I + z^f f^I l^I) + z^f f^I (1 - l^I) - z^b b^I - z^m m^I - z^o o^I - \phi a^I - (1 - \omega) \beta d^I - \frac{\beta f^I l^I}{\mu} + \beta \theta_I (\phi + y) a^I + \frac{\beta \theta_I}{\mu} [m^I + b^I + o^I - f^I (1 - l^I)]}_{\text{Expected payoff in the subsequent period}} \geq 0$$

$$-(1 - \rho) d^I - \frac{f^I l^I}{\mu} + \underbrace{\theta_I \nu (\phi + y) a^I + \frac{\theta_I \nu}{\mu} [m^I - m' + b^I + o^I - f^I (1 - l^I)]}_{\text{Maturity value of pledgeable collateral}} \geq 0$$

The Equilibrium with an Active Interbank Market

(i) The general incentive constraint satisfies

$$F(x_1^h, x_1^q, x_2^q) = \pi + (\Sigma - \pi) \left\{ \theta_l + \frac{1 - \nu}{\nu u'(x_2^q)} \right\}, \quad (3)$$

with satisfying $F_1 > 0$, $F_2 > 0$, $F_3 > 0$, and $F_{ij} = 0$ for $i \neq j$.

(ii) In equilibrium, the price of a reserve is given by

$$z^m = \frac{\theta_l [1 - \nu + \nu \theta_l u'(x_2^q)]}{\theta_h u'(x_1^h)} \quad (4)$$

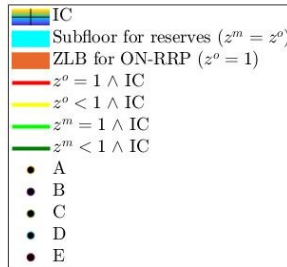
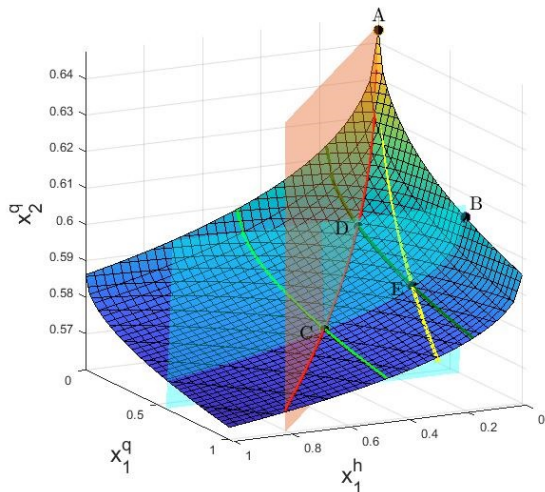
(iii) In equilibrium, the price of a ON-RRP is given by

$$z^o = \frac{u'(x_1^q)}{\theta u'(x_1^h)} \quad (5)$$

The equilibrium also requires

$$x_2^h = x_2^l = x_2^q \quad \text{and} \quad u'(x_1^l) = 1 - \nu + \nu \theta_l u'(x_2^q) \quad (6)$$

The Illustration of the Equilibrium



Finding #1: Secondary Floor with a Floor System

In equilibrium, the real rates of return are given by

$$r^o = \underbrace{\frac{1}{\beta u'(x_1^q)}}_{\text{ON-RRP rate}} \leq r^f = r^b = \underbrace{\frac{1}{\beta u'(x_2^q)}}_{\text{FFR}} < r^m = \underbrace{\frac{1}{\beta \theta_l [1 - \nu + \nu \theta_l u'(x_2^q)]}}_{\text{IOER}}$$

- (i) FFR stays within a *target range*, with the floor set by IOER and the secondary floor set by ON-RRP rate
- (ii) $\text{FFR} < \text{IOER}$ because of the balance sheet costs, i.e., $\theta_l < 1$, $\nu < 1$, and scarcity of government debt.
- (iii) $\text{ON-RRP rate} \leq \text{FFR}$ because of the scarcity of ON-RRPs, no balance sheet costs for shadow banks, and their inability to earn IOER

Finding #2: Who (Borrows) Lends in the Fed Funds Market?

- (i) If the govt debt outstanding is sufficiently plentiful, then the traditional banks lend to each other just as it was the case before the Great Recession
- (ii) As the govt debts are sufficiently scarce, shadow bank q is the sole lender and both banks h and l are the borrowers in the interbank market
- (iii) Shadow bank can earn a higher interest on the interbank loan than the ON-RRP while traditional banks can borrow the fed funds and lend to the Fed at a higher rate

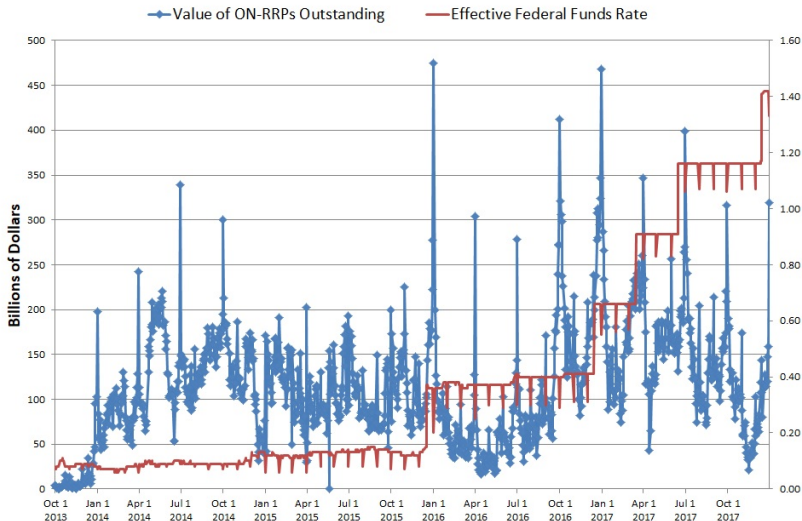
Finding #3: Irregular Market Dynamics at the Quarter-ends

The gap between the IOER and the FFR is given by

$$\Delta^{mf} = \frac{1}{z^m} - \frac{1}{z^f} = \frac{1}{z^m} \left\{ 1 - \nu \theta_l^2 - \frac{(1 - \nu) \theta_l}{u'(x_2^q)} \right\}. \quad (7)$$

- (i) As θ_l decreases, or balance sheet cost increases
 - * Δ^{mf} increases;
 - * the ON-RRPs outstanding $z^o \hat{o}$ increases for sufficiently large π .
- (ii) At the quarter-ends, (a) the FFR decreases, (b) the opportunity cost of holding ON-RRPs decreases, and (c) a shadow bank shifts its investment from riskier interbank loans to the risk-free ON-RRPs.

Large Take-up at the ON-RRP Facility at the Quarter-ends



Finding #4: Policy Normalization with Raising IOER

When the Fed follows, for sufficiently small $\Lambda > 0$,

$$\underbrace{r^m}_{\text{IOER}} = \underbrace{r^o}_{\text{ON-RRP rate}} + \underbrace{\Lambda}_{\text{constant}}, \quad (8)$$

an increase in the IOER implies that

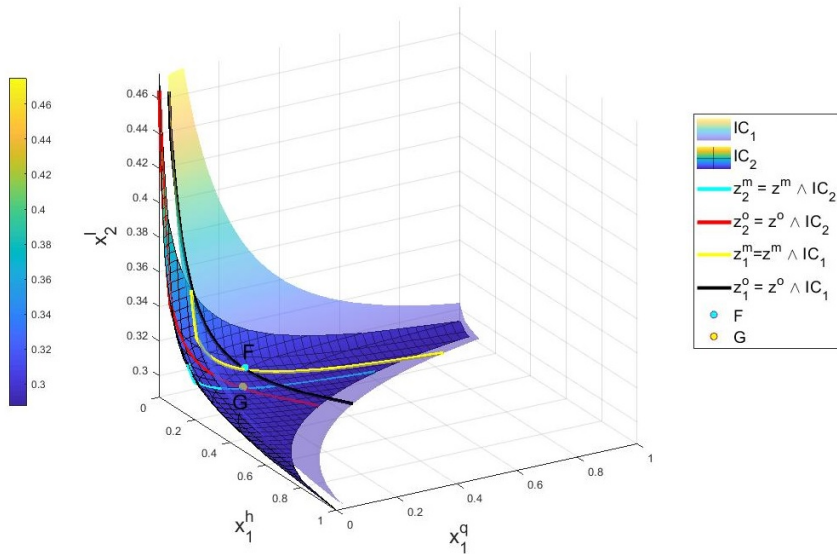
- * ON-RRP rate, FFR, and interest rate on govt debt increase
- * There is a substitution of reserves and ON-RRPs for currency
- * A shadow bank lends a larger quantity of interbank loans
- * Interbank borrowing shifts from domestic banks to the foreign banks

Finding #5: When is Balance-Sheet Reduction Ineffective?

As the financial frictions are sufficiently severe, or $x_2^q < \tilde{x}$, a balance sheet expansion is welfare improving just as it was the case from the onset of financial crisis to “lift-off” date.

- * All central bank liabilities increase, the increase in reserves outstanding is the largest.
- * A unit of increase in the fed funds held by the bank / requires a smaller increase in reserves outstanding held with the Fed
- * FFR increases and a shadow bank swaps fed funds for govt debt
- * The increase in the fed funds borrowed by foreign banks overwhelm the decrease in those borrowed by the domestic banks

Reduction in Fed's Balance Sheet Decreases Welfare

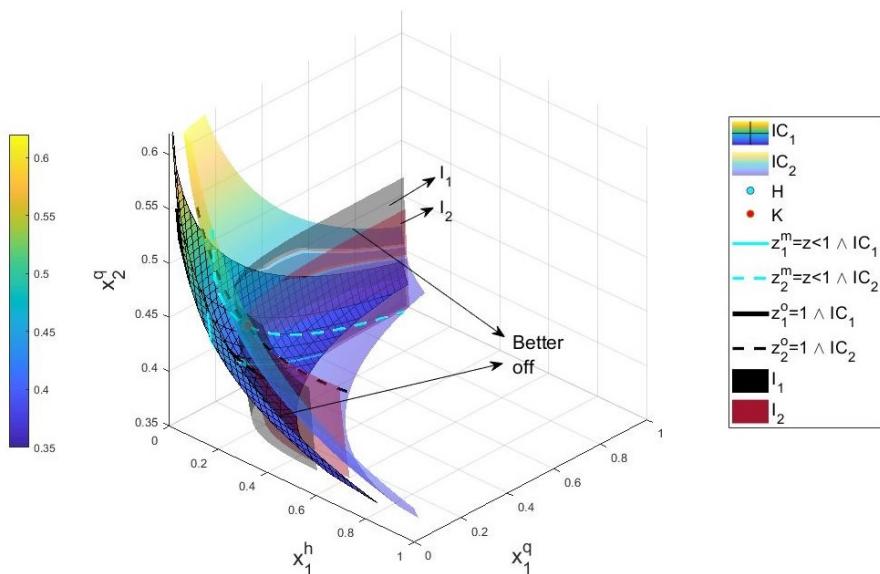


Finding #6: When is the Balance-Sheet Reduction Effective?

As the financial frictions are sufficiently weak, or $\tilde{x} < x_2^q$, a balance sheet reduction increases welfare.

- * The reduction in balance sheet leads to a large decrease in reserves outstanding because fed funds become too expensive for traditional banks
- * There is a substitution of currency and ON-RRPs for reserves
- * Rate of return on govt debt increases, shadow bank swaps govt debt for fed funds
- * There will be a stronger decline in the fed funds borrowed by the foreign banks than the domestic banks

Reduction in Fed's Balance Sheet Improves Welfare



- (i) Focus on the current policy issues in the U.S.
- (ii) The results that are associated with the Fed's monetary policy since the Great Recession are consistent with the empirical findings
- (iii) Project the effects on the impending balance-sheet normalization plan on the fed funds market and the composition of the Fed's liabilities
- (iv) Future work: How should the Fed get rid of reserves? Switching back to corridor system?