# Safe Assets, Liquidity and Monetary Policy

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# Introduction

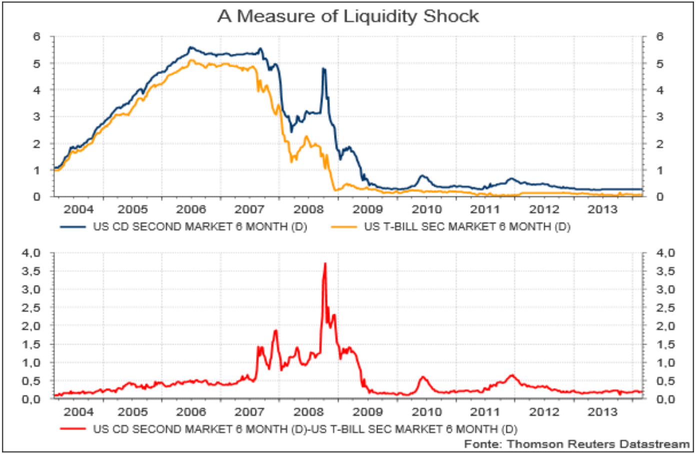
Link three facts from the financial crisis:

- Deterioration of the quality of assets, shortage of safe assets;
- Deep and prolonged recession;
- Conventional and unconventional responses of monetary policy.

# Objective

- Provide a model where safe and pseudo-safe assets coexist (Safeness has a double meaning here: no credit **and** liquidity risk)
- Analyze propagation mechanism of a liquidity shock (worsening the quality of pseudo-safe assets) to the economy
- Understand role of conventional and unconventional monetary policy

# Liquidity shock



# Related Literature

- Lagos (2010): financial assets are valued for the degree to which they are useful in exchange for goods
- Kiyotaki and Moore (2012): time-varying liquidity properties of equity. Trani (2012): multiple collaterals having different liquidity properties
- Belongia and Ireland (2006, 2012), Canzoneri et al. (2005, 2008, 2011): models with multiple assets and liquidity properties.
- Eggertsson and Woodford (2003), Eggertsson and Krugman (2012): ZLB policies, shocks to natural rate or exogenous deleveraging.
- Curdia and Woodford (2010, 2011), Gertler and Karadi (2011), Gertler and Kiyotaki (2011): credit spreads and unconventional monetary policy.

# Comparison with the literature

- **Literature** (EK, EW, CW) has emphasized negative (endogenous or exogenous) shocks to the natural rate of interest. **Here** liquidity shock is purely "nominal" and natural rate of interest is not affected at all.
- **Literature** (CW, GK, GKK) has emphasized financial shock in terms of spread between lending and deposit rate. **Here** liquidity shock raises the deposit rate which is passed-through into the lending rate.
- In the **literature**, to better stabilize inflation and output, policy rate should be lowered, eventually up to the zero lower bound. **Here**, to stabilize inflation and output, unconventional policy (increase in reserves) is needed to offset the shortage of safe assets, otherwise deflation cum recession.
- In the **literature**, unconventional policies are in general needed to reduce the credit spread and avoid distributional costs. **Here**, policy rate should be lowered (eventually up to zlb) to avoid distributional costs between borrowers and savers.

# Modeling liquidity and liquidity shocks

- Portfolio of N assets (risk-free securities), chosen in period $t-1$, that can be used to purchase goods in $t \Rightarrow$ broad definition of what is ultimately relevant for purchasing goods.
- Liquidity constraint

$$\sum_{j=1}^{N} \gamma_t(j)\Big(1+i_{t-1}(j)\Big)B_{t-1}(j) \geq P_t C_t$$

- Liquidity properties of securities available as a medium of exchange can vary over time and after portfolio choices.
- $\gamma_t(j)$ is the degree of "acceptance" or "intrinsic liquidity" of security $j$ known only at time $t$
  - time-varying and stochastic
  - $\gamma_t(1) = 1$ is the security which can be immediately available for liquidity purposes.
- No possibility of portfolio rebalancing at the time of goods purchasing

# Modeling liquidity and liquidity shocks

After good purchasing, asset markets open:

$$\begin{aligned}\sum_{j=1}^{N} B_t(j) &= \sum_{j=1}^{N}(1-\gamma_t(j))\Big(1+i_{t-1}(j)\Big)B_{t-1}(j) + P_t Y_t + T_t \\ &\quad + \left[\sum_{j=1}^{N}\gamma_t(j)\Big(1+i_{t-1}(j)\Big)B_{t-1}(j) - P_t C_t\right]\end{aligned}$$

where:

- fraction of $(1-\gamma_t(j))$ of assets not "accepted" for liquidity purposes remains in financial account
- unspent assets from goods purchasing go to financial account
- new asset holdings are chosen for next-period goods market.

# The general model with an inside “pseudo-safe” asset

# The general model

- Heterogeneous-agent model: savers ($\chi$) and borrowers ($1-\chi$) have the same inter-temporal discount factor.
- Intermediaries issue deposits to finance loans. Savers hold deposits, borrowers get credit through loans. Both hold CB's reserves as an asset. (can exploit same discount factor to pick up an initial distribution of wealth and make it determined.)
- Consumers can use assets to purchase goods $\Rightarrow$ deposits and CB's reserves can be valuable as a medium of exchange. Liquidity properties of deposits (pseudo-safe asset) can vary over time. Loans are not assets (for consumers) and therefore do not have liquidity properties.
- Model naturally implies an endogenous spread between lending and deposit rates and positive profits of intermediation. Assets of intermediaries are less liquid then their liabilities.

# Households' problem

Agents maximize, for $j = b, s$:

$$E_t \sum_{T=t}^{\infty} \beta^{T-t} \left[ U(C_T^j) - V(L_T^j) \right] \tag{1}$$

subject to a liquidity constraint:

$$(1 + i_{t-1}^m) M_{t-1}^j + \gamma_t (1 + i_{t-1}^d) I_{t-1}^j B_{t-1}^j \geq P_t C_t^j, \tag{2}$$

and a flow budget constraint:

$$\begin{aligned} P_t C_t^j + M_t^j + B_t^j \quad \leq \quad & (1 + i_{t-1}^d) I_{t-1}^j B_{t-1}^j + (1 + i_{t-1}^b)(1 - I_{t-1}^j) B_{t-1}^j \\ & (1 + i_{t-1}^m) M_{t-1}^j + W_t^j L_t^j + \Psi_t^j + \Upsilon_t^j + T_t^j \end{aligned} \tag{3}$$

- $I_t^j = 1$ if $j = s$ and 0 otherwise, for all $t$.

# Asset Pricing

Deposit rates $i_t^d$ depend on the liquidity properties of deposits while loans rates $i_t^b$ do not. In general $i_t^b \geq i_t^d \geq i_t^m$.

$$\frac{i_t^d - i_t^m}{1+i_t^d} E_t \left\{ \frac{U_c(C_{t+1}^s)}{P_{t+1}} \right\} = E_t \left\{ (1-\gamma_{t+1}) \varphi_{t+1}^s \frac{U_c(C_{t+1}^s)}{P_{t+1}} \right\}, \qquad (4)$$

$$\frac{i_t^b - i_t^m}{1+i_t^b} E_t \left\{ \frac{U_c(C_{t+1}^b)}{P_{t+1}} \right\} = E_t \left\{ \varphi_{t+1}^b \frac{U_c(C_{t+1}^b)}{P_{t+1}} \right\}, \qquad (5)$$

where the multipliers on the liquidity constraints are given by:

$$\varphi_t^j = 1 - \beta(1+i_t^m) E_t \left\{ \frac{U_c(C_{t+1}^j)}{U_c(C_t^j)} \frac{P_t}{P_{t+1}} \right\}. \qquad (6)$$

for each j=b,s.

# Intermediaries' problem

Intermediaries finance loans through deposits and are subject to a cost of increasing their liabilities with respect to a threshold (to determine initial distribution of wealth). They maximize:

$$\frac{\Upsilon_t}{P_{t-1}} = (1 + i^b_{t-1})a_{t-1} - (1 + i^d_{t-1})d_{t-1} - \varpi \cdot \phi\left(\frac{(1 + i^d_{t-1})}{(1 + \bar{i}^d)}\frac{d_{t-1}}{\bar{d}}\right)$$

subject to their balance sheet $a_t = d_t$ where

$$a_t \equiv -(1-\chi)B^b_t / P_t \qquad d_t \equiv \chi B^s_t / P_t$$

$$\phi'(1) = 1 \qquad \phi''(1) > 0$$

**Equilibrium condition:**

$$1 + \delta_t \equiv \frac{(1 + i^b_t)}{(1 + i^d_t)} = \left[1 + \bar{\delta}\phi'\left(\frac{b_t}{\bar{b}}\right)\right]$$

Note that liquidity shock affects first the interest rate on deposits and then is passed-through into the loan rate.

# Other features

- Model features monopolistic competition and price frictions like in the Calvo's mechanism. Prices are indexed to an inflation target $\bar{\Pi}$.
- Use some simplifying assumptions on preferences for aggregation purposes and to keep tractability (exponential utility from consumption, Cobb-Douglas aggregator in the production function).
- Note that the financial friction translates into an inefficient wedge between the labor/consumption marginal rate of substitution and the real wage (in the steady state, this wedge is the same across the two households):

$$\frac{V_l(L_t^j)}{U_c(C_t^j)} = (1 - \varphi_t^j)\frac{W_t^j}{P_t}.$$

# Liquidity shocks and Optimal Monetary Policy

# Experiment

- Analyze the optimal response to a negative liquidity shock (a fall in $\gamma_t$ for some periods and with some stochastic properties)

- Starting (and final) point: efficient allocation, implemented by the following monetary policy:

  ✓ $\Pi_t = \bar{\Pi}$ where $\bar{\Pi} \geq \beta$.
  ✓ $i_t^m = \bar{\imath}^m$ where $0 \leq \bar{\imath}^m \leq \bar{\Pi}/\beta - 1$.

Note:

1. two monetary policy instruments (reserves pay interest rate!)
2. Friedman's rule is irrelevant for welfare in the efficient steady state, i.e. $\bar{\varphi}$ can take any value in the interval

$$0 \leq \bar{\varphi} \leq 1 - \beta/\bar{\Pi}.$$

# Steady state: implementation of the efficient allocation

Efficient allocation solve the maximization of:

$$E_t\left\{\sum_{T=t}^{\infty}\beta^{T-t}\left[\tilde{\chi}\Big(U(C_T^s)-V(L_T^s)\Big)+(1-\tilde{\chi})\Big(U(C_T^b)-V(L_T^b)\Big)\right]\right\}$$

under

$$\chi C_t^s+(1-\chi)C_t^b=(L_t^s)^{\chi}(L_t^b)^{1-\chi}$$

To implement efficient allocation:

- initial distribution of wealth should be efficient: relative weight $\tilde{\chi}$ such that $\bar{U}_c^s/\bar{U}_c^b=\chi(1-\tilde{\chi})/[(1-\chi)\tilde{\chi}]$
- no labor wedge: employment subsidy $\tau$ such that $(1-\tau)=(1-\bar{\varphi})/(1+\bar{\mu})$
  - ✓ this implies: $V_l(\bar{L}^j)/U_c(\bar{C}^j)=\bar{Y}/\bar{L}^j$ for each $j=b,s$
- no price dispersion: $\Pi_t=\bar{\Pi}$

# Welfare analysis: quadratic loss function

Under above conditions can analyze optimal response to the liquidity shock through the following simple loss function:

$$\frac{1}{2}E_t\left\{\sum_{T=t}^{\infty}\beta^{T-t}\left[\hat{Y}_T^2+\lambda_\pi(\pi_T-\bar{\pi})^2 + \chi(1-\chi)\lambda_c\left(\hat{C}_T^R\right)^2+\chi(1-\chi)\tilde{\lambda}_l\left(E_T\hat{C}_{T+1}^R\right)^2\right]\right\}$$

- Aggregate targets: inflation and output.
- Distributional targets: consumption and labor risk sharing.
  - ✓ Note: labor-risk sharing, because of the liquidity frictions, depends on expected next-period consumption.

Compare **Optimal** policy with a **Passive** policy in which CB keeps $i_t^m$ and $M_t$ constant at the level before the shock hits.

A negative liquidity shock has two transmission channels (under a passive policy):

1. financial channel: higher liquidity premia on pseudo-safe assets raise the deposit rate and then loan rate.
   $\Longrightarrow$ distributional effects between borrowers and savers
2. real channel: shortage of assets available for liquidity purpose $\Longrightarrow$ disequilibrium in goods market, excess supply of goods $\Longrightarrow$ deflation cum recession
   $\Longrightarrow$ aggregate effects on output and inflation

# Results

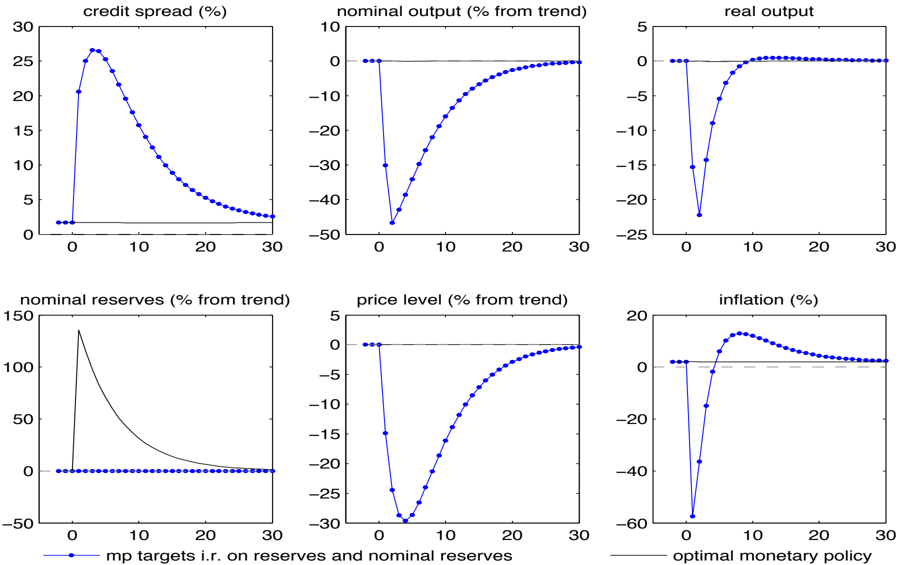
✓ Optimal Policy requires:

- cut in interest rate on reserves (up to ZLB, longer than shock)
  (*Note: Differently from ZLB literature, no natural-rate shock*)
- expansion of CB balance sheet (until the shock is back to mean)

✓ Approximating the Optimal Policy:

- Nominal-GDP targeting (with some long-run upward revision);
- lowering interest rate on reserves up to ZLB to insulate interest-rate on pseudo-safe assets (deposits) from the liquidity shock.

# A Model with an inside pseudo-safe asset



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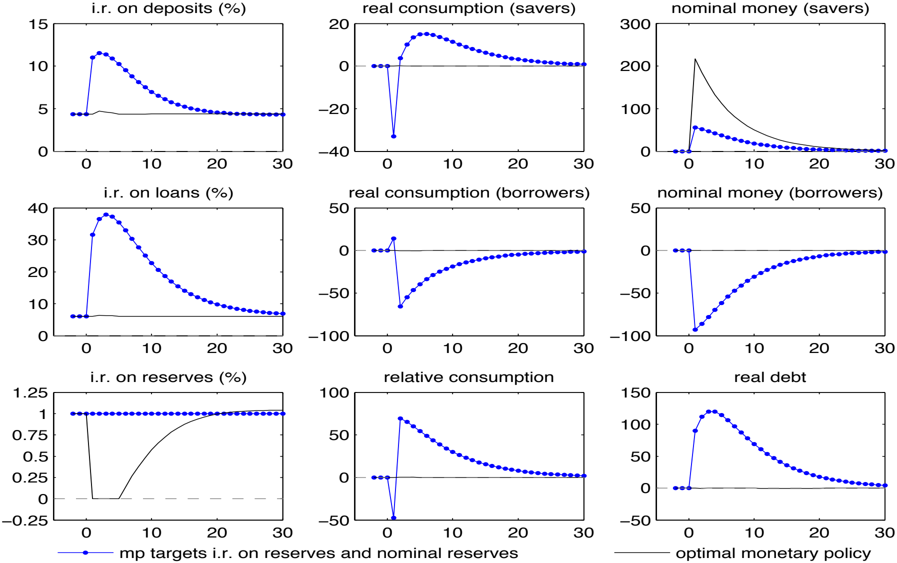


# Disentangling the policy responses

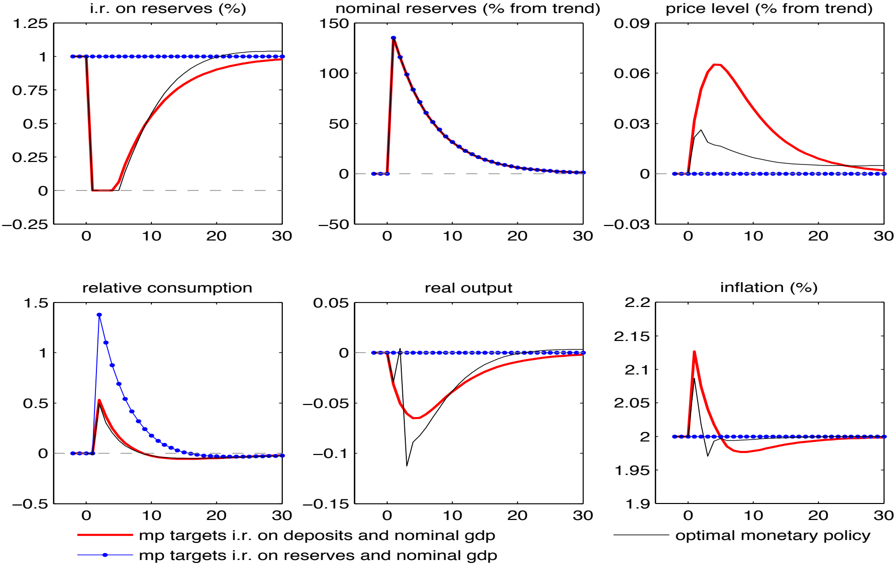
✓ Balance-Sheet policies are necessary to reach aggregate targets

✓ Interest-rate policies are necessary to achieve the risk-sharing target

Note the followings:

- a nominal GDP targeting policy **without** lowering the interest rate on reserves does not achieve optimal risk sharing between borrowers and savers, but only inflation and output stabilization;
- lowering interest rate on reserves **without** expanding the balance sheet does not avoid the deflation cum recession;
- there is also a trade-off between aggregate and risk-sharing targets.

# Disentangling the policy responses



# Other results

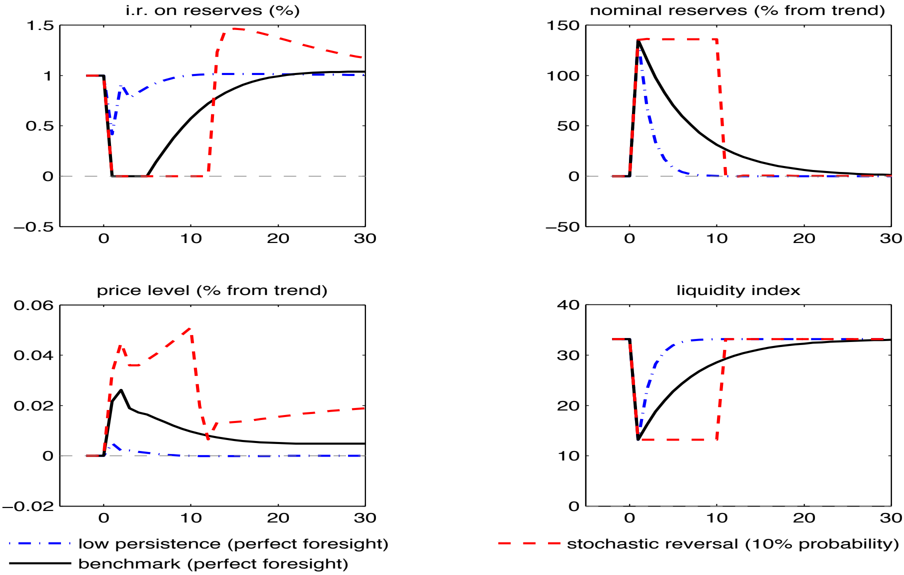
✓ Liquidity injection and its tapering follows properties of the shock

- the stronger the shock, the larger the liquidity injection
- the more persistent the shock, the slower the tapering of the stimulus

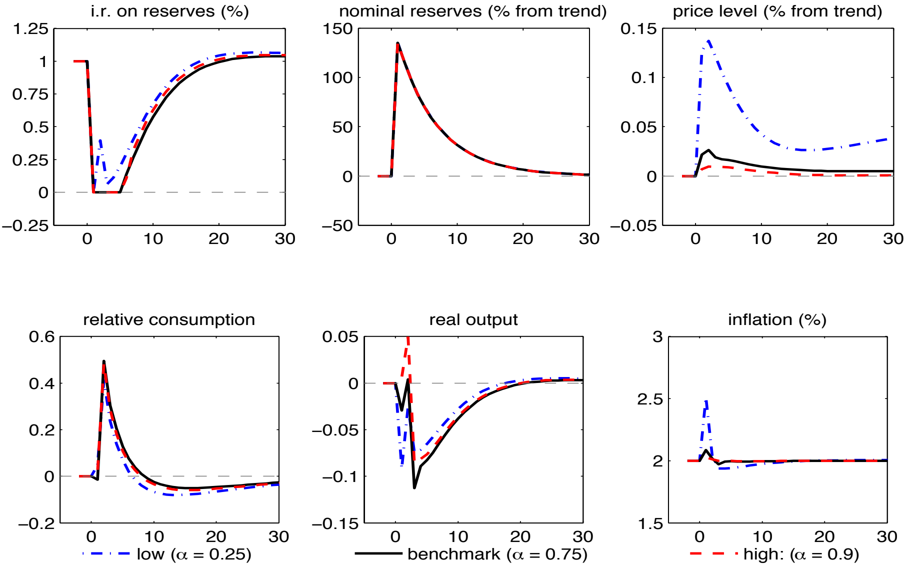
✓ Policy recommendations do not depend on degree of price rigidity

- stabilize *nominal* spending, since the shock is to the quality of *nominal* assets available for expenditure
- lowering interest rate on reserves, since it reduces distributional costs which are still present under flexible prices

# Tapering and exit from zero lower bound



# The role of price stickiness



# Conclusion

- Present models for monetary policy analysis with multiple securities having different liquidity properties.
- Examine propagation of liquidity shock into prices and real activity depending on monetary policy.
- Capture main features of financial crises, propagation to real activity and policy responses.
- Policy prescription I: temporary expansion in balance sheet is needed (inflation targeting, nominal GDP targeting) to react to temporary shortage of safe assets.
- Policy prescription II: lowering interest rate on reserves up to ZLB (if needed) has distributional effects and can improve risk-sharing of the shocks.