# Nominal Interest Rates and Liquidity Premium: Evidence from the Korean Financial Market

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# OBJECTIVE

- Construct a New Monetarist (search) model with multiple means of payments, and implement empirical tests with Korean financial market data to examine the effect of the opportunity cost of holding money on liquidity premia.
    - What is the effect of the short-term interest rate on liquidity premia and thus prices or yields of financial assets?
    - How does the BOK base rate affect liquidity premia in the Korean financial market?
    - Is the channel system that the Bank of Korea introduced in 2008 positively affect liquidity premia?

# Literature

- Lagos and Wright (2005), Rocheteau and Wright (2005), Geromichalos et al. (2007), Lagos and Rocheteau (2009), Aruoba et al. (2011), Venkateswaran and Wright (2013), and Lee and Jung (2020), and Geromichalos et al. (2021)
- Longstaff (2004), Greenwood et al. (2015), Krishnamurthy and Vissing-Jorgensen (2012), Nagel (2016) and Lee (2020)
- Jang and Kim (2009), Jang and Kim (2009), Jang et al. (2012), and Shin and Kim (2015)

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- There are two types of agents, buyers and sellers, who live forever.

$$\text{Buyers}: \quad \mathcal{U}(X_t, H_t, q_t) = \quad u(q_t) + X_t - H_t \tag{1}$$

$$\text{Sellers}: \quad \mathcal{V}(X_t, H_t, q_t) = -c(q_t) + X_t - H_t, \tag{2}$$

where $q_t$ is the amount of DM goods that buyers consume, $X_t$ is the amount of CM goods that both types of agents consume, $H_t$ is hours worked for the CM goods production, and $c(q_t)$ is the cost of producing $q_t$.

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- A monetary authority adjusts the supply of money, which follows the rule: $M_{t+1} = (1 + \mu)M_t$.
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  - Money is injected (if $\mu > 0$) or withdrawn (if $\mu < 0$) through a lump-sum transfer ($T_t$) in the CM.
- One unit of real asset delivers one unit of consumption goods, or numeraire, in the next period's CM. Real assets are divided into two groups: liquid and illiquid.
  - Liquid assets such as gov't bonds can be easily used as collateral for loans or converted for money.

# Model Environment

- The supplies of liquid and illiquid real assets are fixed at $B^l > 0$ and $B^i > 0$, respectively.
- Agents can purchase any amount of money $(m_t)$, liquid $(b^l)$ and illiquid assets $(b^i)$ at prices, $\phi_t$, $\psi^l_t$, and $\psi^i_t$ in the CM, respectively.
- In the CM, buyers choose an asset portfolio as media of exchange that they will bring into the forthcoming DM.

# Model Environment

- In the DM, buyers meet a seller in a pairwise meeting.
- Buyers make a take-it-or-leave-it offer to the seller to determine terms of trade, i.e., the quantity and the price of DM goods that they will trade.
- Due to anonymity and limited commitment among agents, a MOE is necessary for transactions. Money and assets can be used as a means of payment.
- All money balances can be used as a MOE, whereas only a fraction $\theta^l$ ($\theta^i$) of liquid (illiquid) assets can be used as a MOE because they incur costs for liquidation. We assume $1 > \theta^l > \theta^i > 0$.

# Model Environment

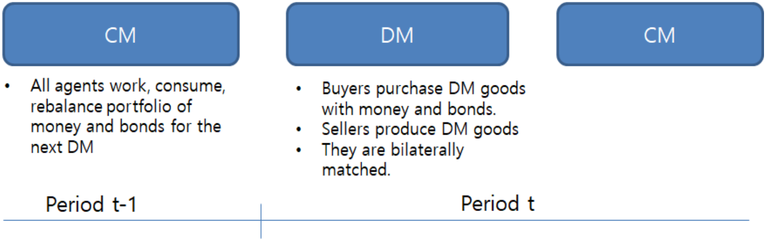


Figure: Timing of Markets

# Value Function and Optimal Choices

- Buyers make a decision of their portfolio that they will use in the next DM. The value function of buyers is given by

$$W^B(m_t, \mathbf{b}_t) = \max_{X_t, H_t, m_{t+1}, \mathbf{b}_{t+1}} \left\{ X_t - H_t + \beta V^B(m_{t+1}, \mathbf{b}_{t+1}) \right\} \quad (3)$$
$$\text{s.t.} \quad X_t + \phi_t m_{t+1} + \psi_t \mathbf{b}_{t+1} = H_t + \phi_t m_t + \mathbf{b}_t + T_t,$$

where $\mathbf{b}_t = (b_t^i, b_t^l)$ and $\psi_t' = (\psi_t^i, \psi_t^l)$. $V^B$ denotes the buyers' value function in the next period DM.

# Value Function and Optimal Choices

- The value function of sellers is given by

$$W^S(m_t, \mathbf{b}_t) = \max_{X_t, H_t} \left\{ X_t - H_t + \beta V^S(0, \mathbf{0}) \right\} \quad (4)$$
$$\text{s.t.} \quad X_t = H_t + \phi_t m_t + \mathbf{b}_t$$

$V^S$ represents the sellers' value function in the next period DM.

# Value Function and Optimal Choices

- Next, the value functions of buyers and sellers in the DM are given by

$$V^B(m_t, \mathbf{b}_t) = u(q_t) + W^B(m_t - p_t^m, \mathbf{b}_t - \mathbf{p}_t), \tag{5}$$

$$V^S(0, \mathbf{0}) = -q_t + W^S(p_t^m, \mathbf{p}_t), \tag{6}$$

where $(p_t^m, \mathbf{p}_t)$ is the amount of money and assets exchanged for DM goods, $q_t$.

# Value Function and Optimal Choices

- The terms of trade are determined by bargaining, where a buyer makes a take-it-or-leave-it offer to a seller. Then, the bargaining problem in DM meetings is expressed by

$$\max_{q_t, p_t^m, \mathbf{p}_t} \left\{ u(q_t) + W^B(m_t - p_t^m, \mathbf{b}_t - \mathbf{p}_t) - W^B(m_t, \mathbf{b}_t) \right\} \tag{7}$$

$$\text{s.t.} \quad -q_t + W^S(p_t^m, \mathbf{p}_t) - W^S(0, \mathbf{0}) = 0,$$

and the budget constraints, $p_t^m \leq m_t$ and $\mathbf{p}_t \leq \theta \mathbf{b}_t$, where $\theta = (\theta^i, \theta^l)$.

# Value Function and Optimal Choices

- Now, the optimization problem of buyers in (3) is simplified as follows.

$$\max_{m_{t+1},\mathbf{b}_{t+1}} -\phi_t m_{t+1} - \sqcup_t \mathbf{b}_{t+1} + \beta V^B(m_{t+1}, \mathbf{b}_{t+1}) \tag{8}$$

- Then, the Euler equations for money, liquid assets and illiquid assets are given by

$$\phi_t = \beta u'(q_{t+1})\phi_{t+1} \tag{9}$$

$$\psi_t^i = \beta \left\{ u'(q_{t+1})\theta^i + (1-\theta^i) \right\} \tag{10}$$

$$\psi_t^l = \beta \left\{ u'(q_{t+1})\theta^l + (1-\theta^l) \right\} \tag{11}$$

# Equilibrium

- In a steady state equilibrium, $\phi_t M_t = \phi_{t+1} M_{t+1}$ and thus $1+\mu = \frac{M_{t+1}}{M_t} = \frac{\phi_t}{\phi_{t+1}} = 1+\pi$. $\pi$ denotes the inflation rate.

**Definition**

A steady state equilibrium is a list $\{\psi_t, q_t, \phi_t M_t, \phi_t p_t^m, \psi_t \mathbf{p}_t\}$, where $q_t$ represents the amount of goods traded in the DM, $\phi_t M_t$ the real money balances, $\phi_t p_t^m$ the real money balances paid for DM trade, and $\psi_t \mathbf{p}_t$ the real asset balances paid for DM trade. The equilibrium objects are determined such that:

(i) Given prices, $\phi_t$ and $\psi_t$, a representative buyer solves the individual optimization problem (3).

(ii) Each market clears: $m_{t+1} = (1+\mu)M_t$ and $(b_t^i, b_t^l) = (B^i, B^l)$.

# Model Predictions

- The nominal yields of illiquid and liquid bonds are expressed as follows.

$$1 + i = (1 + \pi)\frac{1}{\psi_t^i} = (1 + \pi)\left\{(1 + \iota)\theta^i + (1 - \theta^i)\right\}^{-1} \tag{12}$$

$$1 + l = (1 + \pi)\frac{1}{\psi_t^l} = (1 + \pi)\left\{(1 + \iota)\theta^l + (1 - \theta^l)\right\}^{-1} \tag{13}$$

The log difference between (12) and (13) shows that liquidity premia can be approximately measured by the following equation.

$$lp = i - l \approx \log\left[(1 + \iota)\theta^l + (1 - \theta^l)\right] - \log\left[(1 + \iota)\theta^i + (1 - \theta^i)\right] \tag{14}$$

# Data

- Liquidity premixa: i) 3-year Aa-corporate bond/Gov't Bond spreads and ii) 91-day CDs/Monetary Stabilization Bonds spreads
- Nominal interest rates: Call rates
- Control variables: 3-year credit default swap rates of Samsung Electronics, the ratios of the outstanding amount of MSBs and the monthly issued amount of three-year government bonds to nominal GDP

Table: Summary Statistics: Yield Spreads

| | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| 91-day CDs/MSB Spread | 108 | 12.0 | 6.0 | 0.0 | 35.0 |
| 3-year Corp. Bond(AA-)/Gov't Bond Spread | 108 | 50.2 | 15.3 | 22.4 | 88.0 |

Notes: The spreads reported above are expressed in terms of basis points of annual rates. Source: ecos.bok.or.kr.

# Data

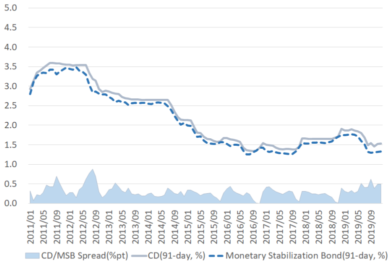


Figure: CD & MSB Rates

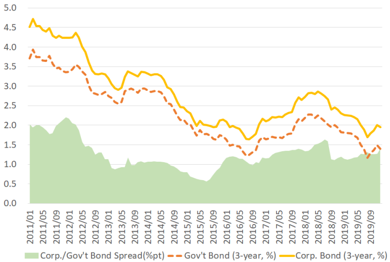


Figure: Corp. & Gov't Bond Rates

# Empirical Tests

Table: Impact on Liquidity Premia of MSBs and Government Bonds

| Dependent Vars | CD/MSB spread | | | | AA- Corp Bond/Gov't Bond spread | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Call Rate | 2.742** | 2.765** | 4.919*** | 4.830*** | 10.18*** | 5.375** | 12.53*** | 7.714*** |
| | (1.366) | (1.336) | (1.666) | (1.676) | (3.657) | (2.671) | (3.557) | (2.554) |
| CDS Rate | | -0.00218 | | 0.0172 | | 0.455*** | | 0.449*** |
| | | (0.0481) | | (0.0491) | | (0.0722) | | (0.0558) |
| MSB/GDP | | | -15.82** | -16.49** | | | | |
| | | | (7.422) | (7.496) | | | | |
| Gov't Bond/GDP | | | | | | | -14.98*** | -14.45*** |
| | | | | | | | (4.874) | (4.278) |
| Constant | 6.399** | 6.431** | 21.98*** | 22.40*** | 29.34*** | 22.81*** | 44.81*** | 37.84*** |
| | (2.651) | (2.942) | (8.114) | (8.072) | (7.057) | (5.926) | (7.180) | (6.523) |
| Observations | 108 | 108 | 108 | 108 | 108 | 108 | 108 | 108 |
| R-squared | 0.821 | 0.821 | 0.832 | 0.832 | 0.934 | 0.954 | 0.942 | 0.961 |
| Adjusted R-squared | 0.105 | 0.105 | 0.158 | 0.160 | 0.223 | 0.452 | 0.320 | 0.542 |

*Notes:* Coefficients are estimated by Newey-West estimators with 3 lags and their standard errors are presented in parenthesis. The dependent variable of (1) to (4) is the yield spread between CDs and MSBs, and that of (5) to (8) is the yield spread between AA-rated corporate bonds and government bonds, which are measured in a basis point. The primary explanatory variable is call rates. A control variable for default risk on illiquid assets is CDS rates. Control variables for supply effects are the ratios of the outstanding amount of MSBs and the monthly issued amount of three-government bonds to nominal GDP. MSB/GDP and Gov't Bond/GDP denote the former and the latter, respectively. CDS rates are measured by the monthly average of the daily closing annualized three-year credit default swap rates of Samsung Electronics. Source: BOK ECOS, Korea Treasury Bond and Bloomberg *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The further robustness check of the empirical results is relegated to the appendix.

# Empirical Tests: Channel System

## Channel System

- **Liquidity adjustment loans and deposits** were introduced and implemented from **March 2008**. They are standing facilities that enable financial institutions to borrow funds from the Bank of Korea and to deposit any surplus funds with the Bank of Korea.

- **The interest rates** on liquidity adjustment loans and deposits are $\pm$ **100 basis points above and below the BOK Base Rate**, respectively.
  - These loans and deposits thus serve to provide the call rate with a corridor.

- Currently, the liquidity adjustment loan and deposit interest rates can be adjusted to the same level as the Base Rate.

# Empirical Tests: Channel System

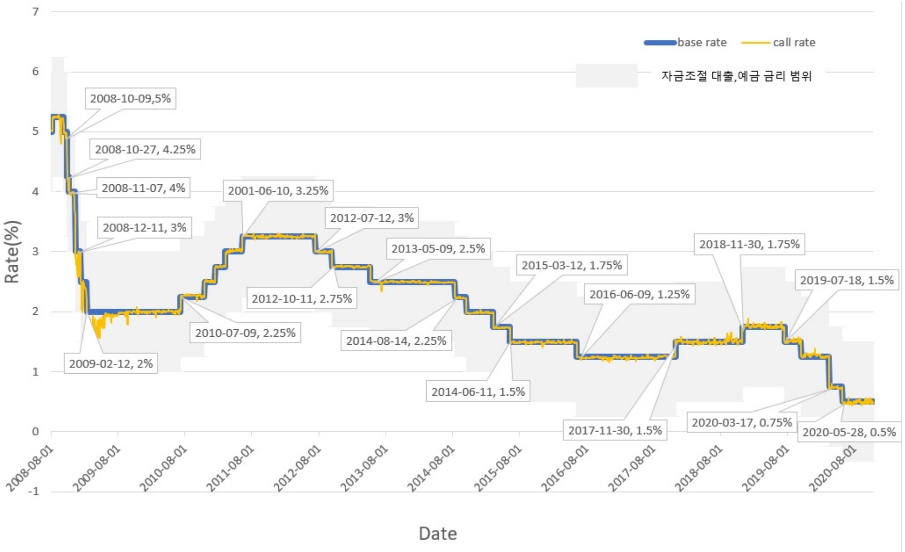


Figure: BOK Base Rate and Channel System

# Empirical Tests: Channel System

Table: Impact of Channel System on Liquidity Premia of MSBs

| | (1) | (2) | (3) |
|---|---|---|---|
| Call Rate | 1.389* | 3.302** | 4.251*** |
| | (0.802) | (1.430) | (1.617) |
| CDS Rate | 0.225*** | 0.218*** | 0.229*** |
| | (0.0439) | (0.0412) | (0.0420) |
| MSB/GDP | | -16.87** | -24.11*** |
| | | (6.949) | (8.472) |
| Channel × Call Rate | | | -2.186* |
| | | | (1.124) |
| Channel Dummy | 14.67*** | 16.49*** | 17.77*** |
| | (3.993) | (3.938) | (3.927) |
| Constant | 1.448 | 19.58*** | 30.46*** |
| | (2.567) | (6.208) | (8.798) |
| Observations | 160 | 160 | 160 |
| R-squared | 0.842 | 0.848 | 0.854 |
| Adjusted R-squared | 0.689 | 0.701 | 0.712 |

*Notes:* Coefficients are estimated by Newey-West estimators with no lag and their standard errors are presented in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The further robustness check of the empirical results is relegated to the appendix.