Macroeconomics and Banking

Banks in the Monetary Policy Transmission Mechanism.

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The views presented here do not necessarily agree with or reflect those of Norges Bank.

Credit rationing, banks and transmission mechanism of monetary policy: Three lectures

- Last time: Credit Rationing in Equilibrium. Literature: Arnold and Riley (A&R: Intuition, not math required). Chapter 5 of F&R (excluding section 5.4).
- Slides from last time: Skip part after Arnold/Riley & credit rationing. Was not covered in the lecture.
- Today: Recap+External Finance Premium/The Credit Channel/Bank Lending Channel of Monetary Policy. Literature: Bernanke and Gertler (B&G) + Disyatat (D) + Chapter 6 of F&R (sections 6.2.3, 6.2.4, and 6.3 may be skipped).The interbank market and how monetary policy (including open market operations) affect market interest rates and bank lending.
- Next time: Financial Intermediation and Macroeconomic Analysis. The effects of "Quantative Easing" and "Credit Easing" in deregulated financial markets. Monetary Policy and Financial Stability. Literature: Woodford + Haugland and Vikøren.

Arnold and Riley: Recap

- Mean return same for all projects, $y = \mu + z$, $E(y) = \mu$. Borrower needs expected return at least equal to zero, puts collateral C into the project, and gets

$$U(z, R) = \max(\mu + z - R, -C)$$

- For each borrower, the bank supplies one unit of funding and gets BR =whatever return the borrower does not get:

$$BR = \min(R, \mu + z + C)$$

As R increases, the borrower remains in the market only if upside is large enough to cover the increasing risk of collateral loss.

Arnold and Riley: Recap

- Example: Lender sets $R = \mu + X$. Prob. of default$= P_D$. ND=no default. Borrowers expected return

$$E(U(z,R)) = (1 - P_D) \cdot (\mu + E(z \mid ND) - R) + P_D \cdot (-C)$$

- Lender's return from each project (D =default):

$$E(BR) = (1 - P_D) \cdot (R) + P_D \cdot (\mu + E(z \mid D) + C)$$

- Assume all low-risk agents have left the market, and lender increases $R = \mu + X$ until $E(U(z,R)) = 0$.The probability of default increases towards 1 (Assume that the collateral $C \approx 0$).The expected return on each remaining loan is then:

$$V(R) = E(BR) = P_D \cdot (\mu + E(z \mid D)) \approx \mu$$

- And the return for the borrower (with $C \approx 0$) :

$$E(U(z,R)) = (1 - P_D) \cdot (\mu + E(z \mid ND) - R) + P_D \cdot (-C) \approx 0$$

Arnold and Riley: Recap

- The borrower remains in the market until R is increased so that

$$E(U(z,R)) = (1-P_D)\cdot(\mu + E(z \mid ND) - R) + P_D \cdot (-C) = 0$$

- With positive collateral C that the borrower can lose, the last remaining borrower will not accept a probability of default approaching 1, but will leave the market before that.
- But still, last borrower remaining in the market as $R \uparrow$ gets zero expected return: $\bar{U}(R) = 0$ =>expected average return for bank maximized when R reaches max. => *Mean* return to bank cannot be globally hump-shaped in Stiglitz-Weiss model:
$V(R^{\max}) = E(BR \mid R = R^{\max}) = \mu + E(z) - E(U(z, R^{\max})) = \mu$
- For each R, there is a certain number of interested borrowers = a certain volume of demand $1 - G(\theta(R))$, and therefore a certain demand for funding of loans.When the bank sets the rate very high, the need for funding is very low, but each loan funded gives a high mean return.

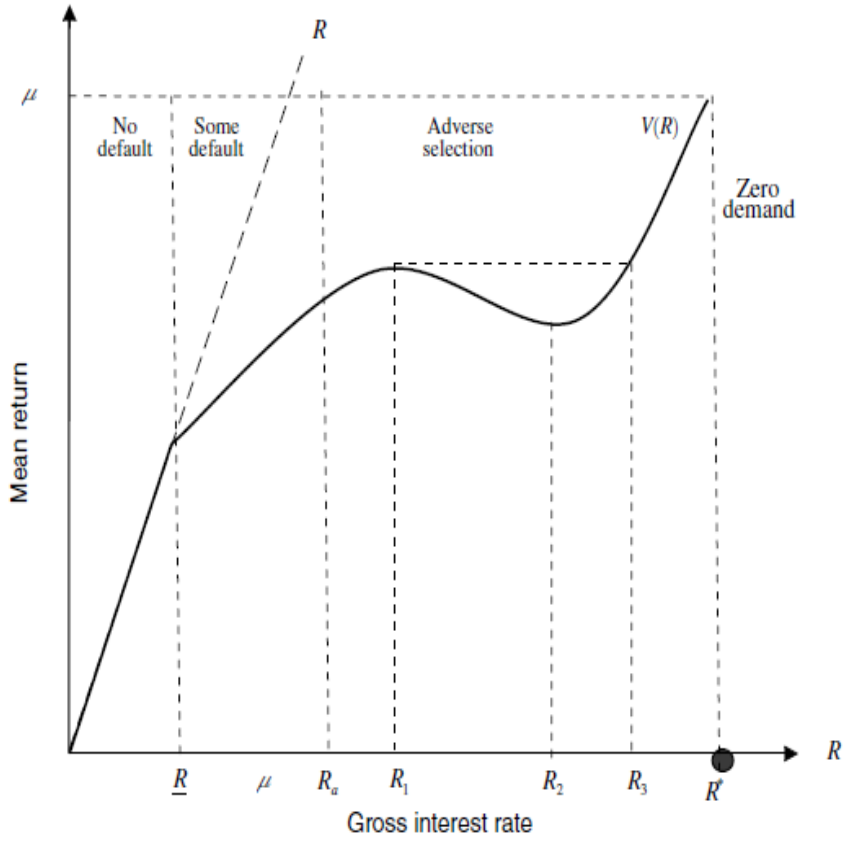
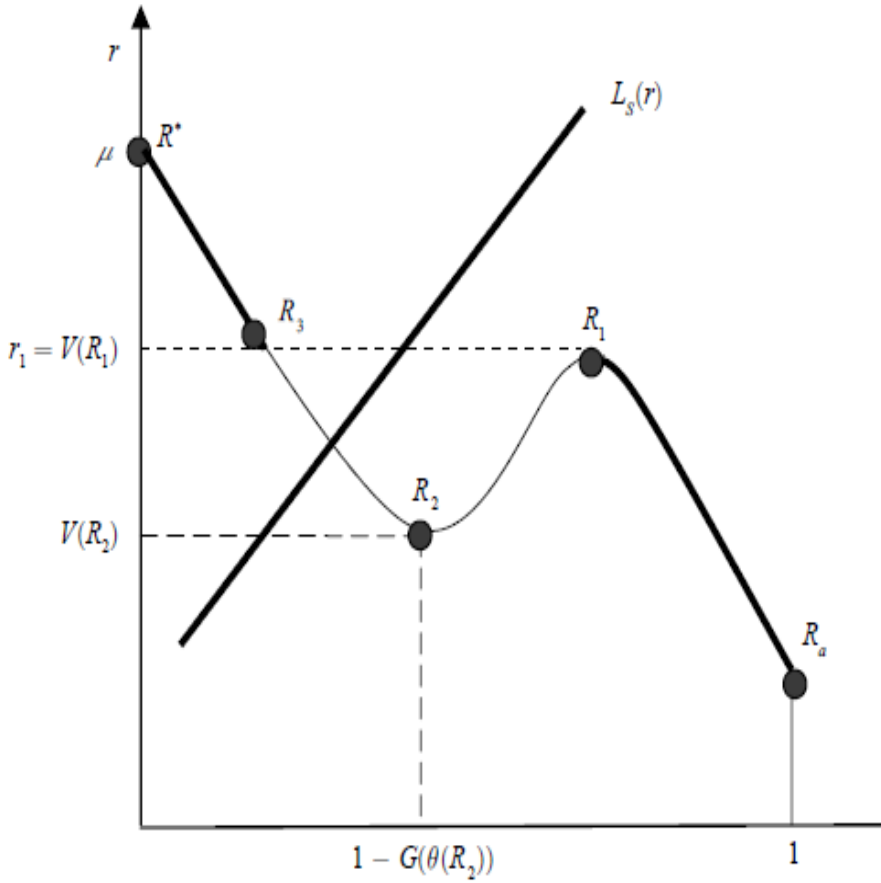


FIGURE 1. EXPECTED LENDER REVENUE AS A FUNCTION OF THE LOAN RATE



Bank's demand for funding, and supply of funding to banks:Recap

- If no default risk/collateral high enough: linear upward sloping return as $R \uparrow$. Declining slope as prob. of default increases. But Bank never offers lower rate than R_a, which maximizes return while no low-risk agents have exited yet (volume=1).
- As agents exit, and R increases above R_a, demand for funding is correspondingly lower.
- Adverse selection effect strongest at R_1, when exit of low-risk types is large enough to make mean return *fall*. Bank will not want to be in that area. Rather: let R increase all the way to R_3, when effect of higher R dominates over adverse selection effect. The low risk types have left anyway, and bank is better off increasing rate as much as it can. Volume of borrowing much lower, and demand for funding much lower.

The rationing case

Banks compete, and have zero profit in equilibrium. If supply of funding crosses through open part of demand curve, two possible lending rates will cover funding cost: $R = R_1$ or $R = R_3$.

- At $R = R_1$: demand high, borrowers low risk on average. Rationing necessary: funding not sufficient at $r = V(R_1)$.
- Ar $R = R_3$: demand low, borrowers high risk on average. Excess supply of funding at $r = V(R_3)$.

Possible rationing scheme: Select a fraction of borrowers who receive rate R_1. Remaining fraction offered R_3. Not all will accept, only the high risk group. Some high risk borrowers can now enjoy R_1, and some low-risk borrowers do not get access to a loan.

The transmission mechanism of monetary policy

- Conventional channel: Nominal rigidites make nominal interest rates have real effects.
- Credit channel
  - Balance sheet channel: Monetary policy effect via interest rate and **Firms and household's balance** sheets.
  - Bank lending channel: B&G: Monetary Policy effect via interest rate and **Banks' balance** sheets. Traditional: reserve requirements/ **supply of reserves** affects lending.

The Balance sheet channel: Bernanke and Gertler

- If lending only can happen against collateral, there is no default risk and no non-linearities, no moral hazard and no adverse selection.
- If collateral lower, default risk exists. This increases required interest rate payment for risk neutral lenders, standard also without credit frictions.
- But with moral hazard or adverse selection (agency costs), the risk neutral lender will require even higer interest rate (as with R_3), or the lender may decline to give a loan (as with R_1).
- The amount of collateral that the average borrower has, affects the price and volume of lending.

External finance premium

- Required return on borrowed capital higher than on own funds due to agency costs
- Extreme variant: Collateralized borrowing only (external finance premium infinite)
- Definition of financial crisis: collateral constraint suddenly binding (Christiano, Rust, Roldos (2002)): Monetary Policy in a Financial Crisis, NBER WP9005
- Variants of the premium in many modern models of credit channel, both at firm level (= balance sheet channel in terminology of B&G) and at bank level (=bank lending channel in terminology of B&G)

A simple external finance premium model: firm level

Example

Two periods, 0 and 1. Entrepreneur uses inputs in period 0 to produce in period 1. Fixed input K, variable input x_1.Market price of K at end of period is q_1 per unit. Output period 1: $a_1 f(x_1)$. Gross cashflow from previous production $a_0 f(x_0)$. Entrepreneur maximizes period 1 output net of debt repayment, $a_1 f(x_1) - r_1 b_1$, subject to accounting identity $x_1 = a_0 f(x_0) + b_1 - r_0 b_0$.

Unconstrained optimal value of x_1:

$$\underset{x1,b1}{Max}(a_1 f(x_1) - r_1 b_1) = \underset{b1}{Max}[a_1 f(a_0 f(x_0) + b_1 - r_0 b_0) - r_1 b_1]$$

implies $x_1 = x_1^*$ such that

$$a_1 f'(x_1^*) = r_1$$

An external finance premium cont.

But borrowing is subject to constraint (no unsecured borrowing)

$$b_1 \leq (q_1 / r_1) K \tag{1}$$

Which implies

$$x_1 \leq a_0 f(x_0) + (q_1 / r_1) K - r_0 b_0 \tag{2}$$

When x_1 is suboptimal,

$$x_1 < x_1^* \quad \Rightarrow a_1 f'(x_1) > r_1$$

($f(\cdot)$ is concave) $\Rightarrow$ Shadow price for internal funding $= a_1 f'(x_1)$, higher than r_1, reflects "agency costs".

A Financial Accelerator

- Internal funds special value, they provide cheaper funding
- Agency premium, or external finance premium $= a_1 f'(x_1) - r_1$, increases when $a_0 f(x_0) \downarrow$ or $(q_1 / r_1) K \downarrow$ or $r_0 b_0 \uparrow$ because borrowing constraint more binding
- Higher agency premium reduces spending x_1 and production $f(x_1)$

Definition

Financial accelerator: Fluctuations in real activity affect net worth which again affects real activity =>downturns and upturns may be amplified and prolonged via balance–sheet effects and the external finance premium.

Monetary policy + the financial accelerator = the balance sheet channel of monetary policy

- Monetary policy may affect firms and household's cash flow (lower interest rate payments), thereby capitalization (net worth) of firms and households. Also, the interest rate directly affects the value of assets (including houses) => A change in the interest rate may make it easier and cheaper for firms and households to finance production and consumption.
- The financial accelerator may make the effect of monetary policy bigger and longer lasting.

Effects of monetary policy in financial accelerator model

[blackboard graph in here]

The financial accelerator and F&R, section 2.5:

Result 2.5: (High) monitoring costs and (low) probability of project success may make it too expensive for firms to borrow in market, they may be able to borrow in bank, or may be declined credit.

Result 2.6: Firms may build reputation and thereby lower external finance premium, and be able to issue direct debt.

Example

Positive shock to income, or suddenly higher probability of success, may impact the economy for many periods: easier for firms to get financing, projects with positive NPV that did not get financing before, now get started. Feedback to income and probability of success possible.

The financial accelerator and F&R, section 2.5:

- Result 2.7: At equilibrium, only well-capitalized firms ($A \geq \bar{A}$) can issue direct debt. Firms with intermediate capitalization ($\underline{A}(\beta, r) \leq A \leq \bar{A}$) borrow from banks, and undercapitalized firms ($A \leq \underline{A}(\beta, r)$) cannot invest.

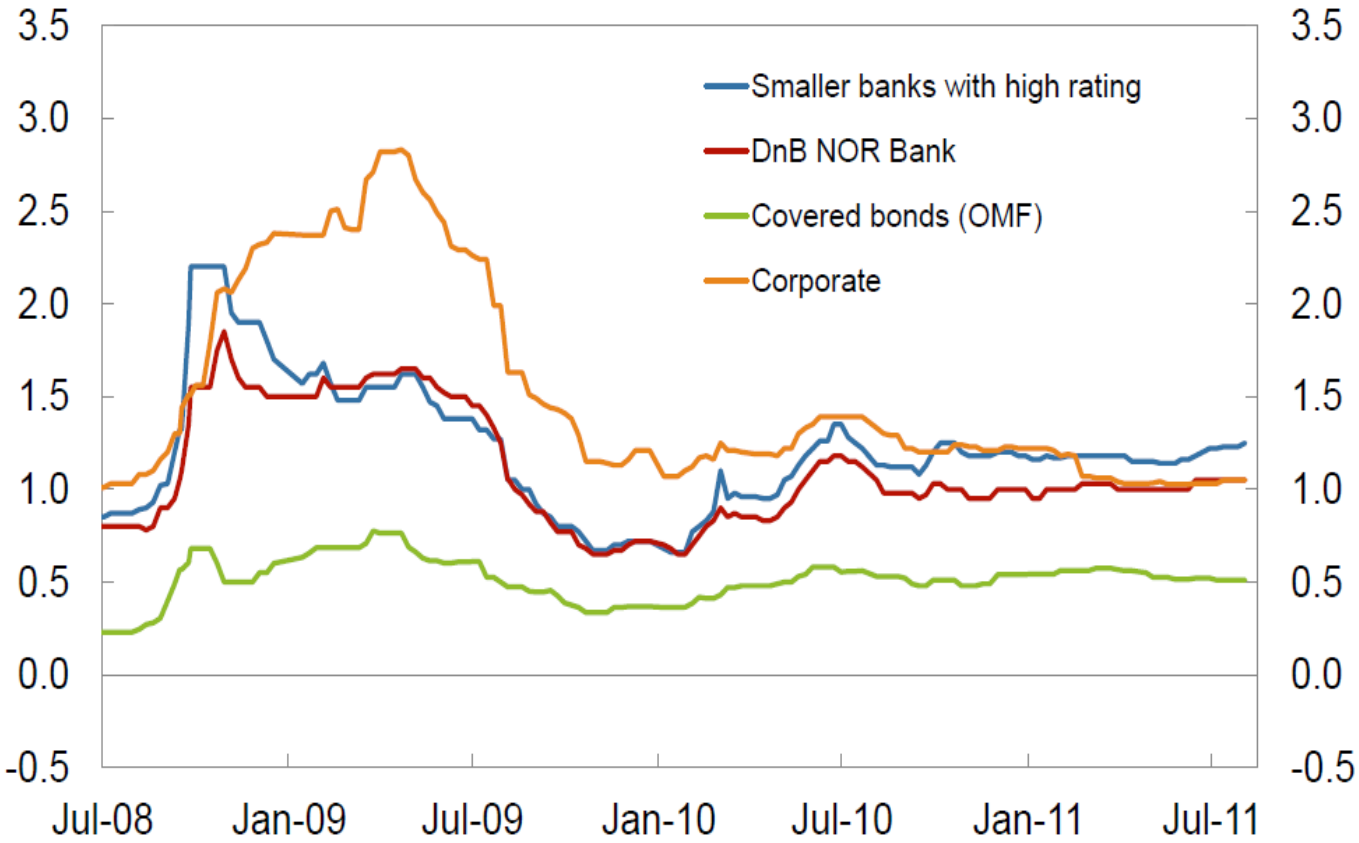
Example

Higher income increases A in the next period. More firms can issue direct debt, borrow from banks, and fewer are not able to invest. This again increases A...

External finance premium: Firms' and banks' direct borrowing

Market reactions – Premiums on Norwegian bonds

Spread over five-year swap rates. Per cent. Week of 2 July 2007 – week of 1 August 2011



The traditional bank lending channel for monetary policy. Some background.

BANKS	
R	F
B	D
L	B_{banks}
	Net Worth

CB	
B_{CB}	M
F	R_G
V	R
	Net Worth

PRIVATE	
M	L
D	
B_{banks}	Net Worth

GOVERNMENT(G)	
R_G	B
	B_{CB}
Other	Net Worth

Simplified balance sheets

- The government holds reserves R_G in central bank, issues bonds that are held by the private sector/banks (B_P) and held by the central bank (B_{CB}). Deficits$=>$ Issued bonds$\uparrow$ or reserves $\downarrow$, Net worth (residual) $\downarrow$
- Banks hold government bonds (B), and reserves in the central bank (R) and lend L to private sector (simplified). They are funded by the private sector or central bank: F and D. Bank surplus$=>$assets$\uparrow$ or liabilities$\downarrow$ and Net worth$\uparrow$
- The central bank holds government bonds (B_{CB}) and loans to the banks (F) and foreign reserves (V).The central bank liabilities include R_G held by the government and R (=central bank reserves) held by banks and M held by households. Central bank surplus (seignorage) $=>$.....?
- Private: Net savings$=>M+D\uparrow$ and/or $L\downarrow$ and Net worth $\uparrow$

The bank lending channel: traditional

- Bank lending channel used to be assumed to work as follows: Banks were required to hold a certain share of deposits D (in F&R: αD) as a deposit $R^{\min}$. Requirement: $R \geq \alpha D = R^{\min}$.
- Logic: Central bank decides $R^{\min} \uparrow => L \downarrow$ because available funding for bank lending $\downarrow$. Through multiplier effect, the final effect on L bigger.
- But: Requirement α has to binding to be effective. If $R > \alpha D$ anyway, increasing $R^{\min}$ not effective constraint on L.
- And: If supply of R is determined in order to implement policy rate, and is not an independent instrument, any increase in $R^{\min}$ will be met by increased supply of R.
- And: If $B_{banks} \uparrow$ as $R^{\min} \uparrow$, requirement not affecting L.

The policy relevant money concept

- Monetary base: defined as $M + R$
- Policy relevant money concept (affects the interbank money market rate): R
- M provides cheap (interest free) financing for the government. But it is demand determined, cannot be increased at will as cheap financing.

Reserve management: the link between the CB balance sheet and the policy rate

- Monetary policy: set interest rate (policy rate) in order to achieve policy goals
- Reserve management: ensure "tomorrow/next" interest rate is close to policy rate, that is: implement the policy rate.

Why is there demand for central bank reseves?

- Central bank reserves: Private banks' deposits in the central bank (R)
- Why is it needed?
  - banks make transactions among themselves throughout every workday
  - The transactions are "netted out" at the end of the workday: Money from one bank's account with Norges Bank is transferred to a different bank's account with Norges Bank.

Example

Jon transfers 100 from his account with Nordea to Jane's account with DnB. If there are no other transactions that day, Nordea will transfer 100 from it's account with Norges Bank to DnB's account with Norges Bank at the end of the workday.I

- Banks uncertain about need for reserves at end of day in order to pay what they owe. They make estimates. The total amount of reserves will be close to zero if estimates are good, and if it pays more to hold funds in the money market than in the central bank.

What determines the amount of central bank reserves?

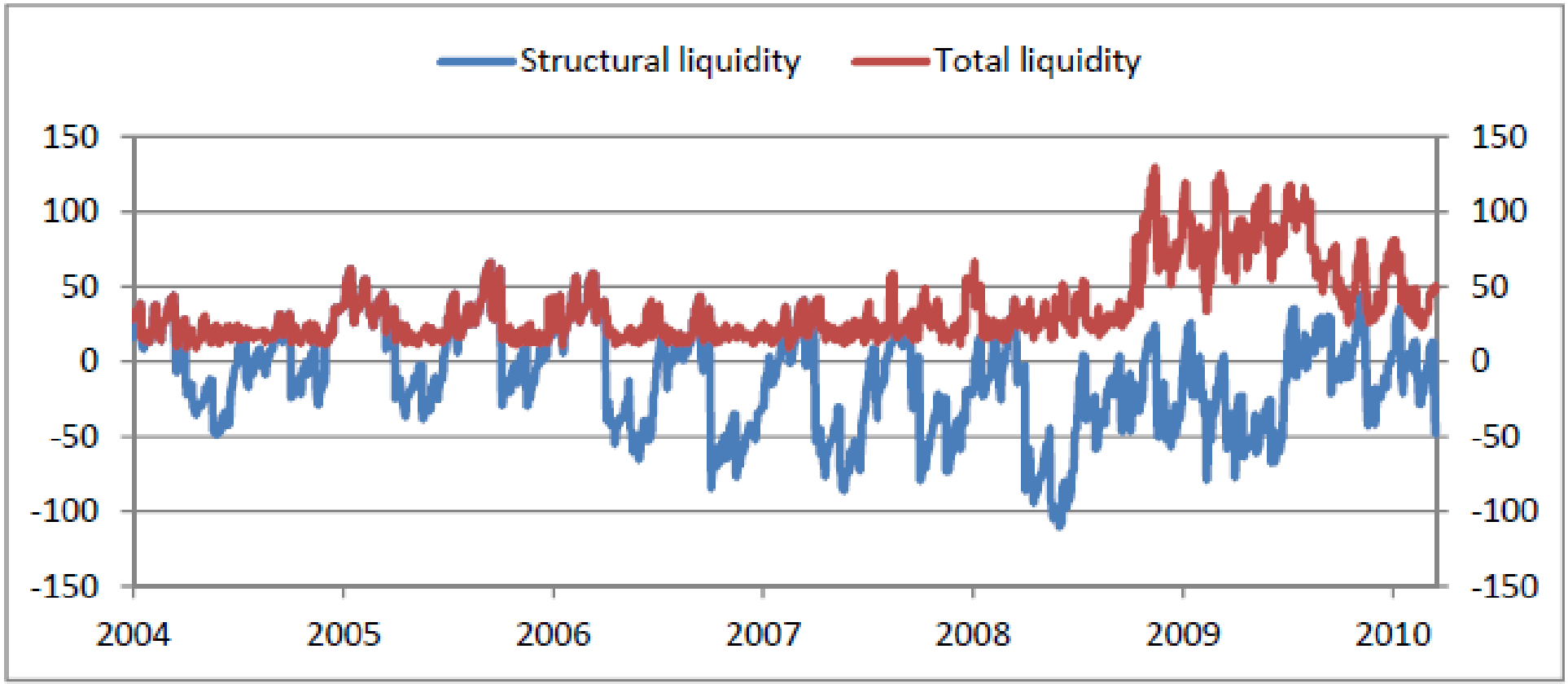
R is affected by:

- Government transactions affecting R_G : payment of taxes or issuance of government bonds make $R(\downarrow)$ and $R_G(\uparrow)$. Higher demand for M : $R \downarrow$ (="autonomous" changes in liquidity/reserves)
- The central bank lends to the banks (changes F) or conducts traditional open market operations (buys B from banks and pays with R) in order to affect total reserves
- What happens if all banks want to hold less R, or desire more R? Either, central bank accomodates (supplies or withdraws via F), or what happens....?

Central Bank(CB)	
B_{CB}	M
F	R_G
V	R

Central bank reserves affected by 1) autonomous factors =>structural liquidity and 2) intended policy

Chart 1. Total and structural liquidity in Norway. Billion kroner.



Connection between total reserves (liquidity) and the interest rate?

Chart 1. Total and structural liquidity in Norway. Billion kroner.

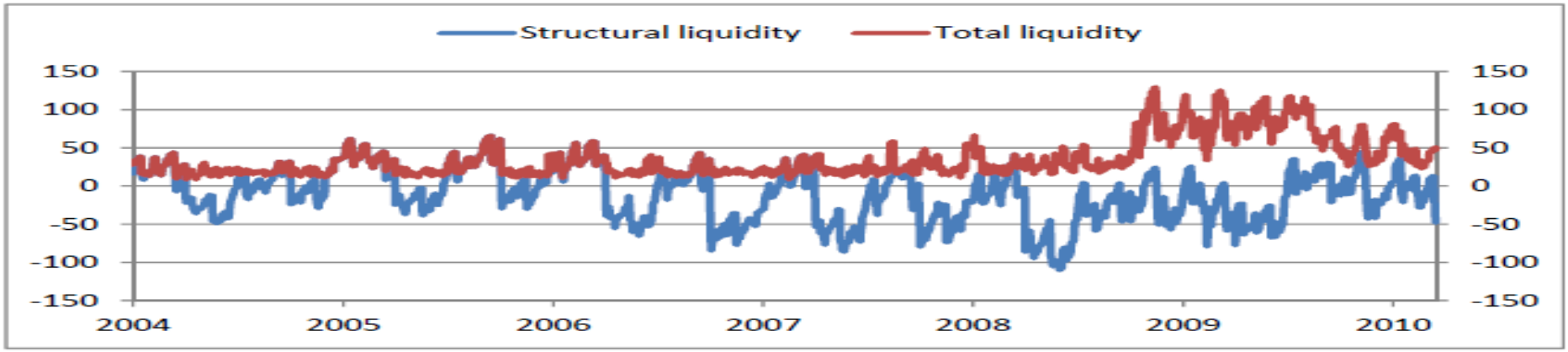
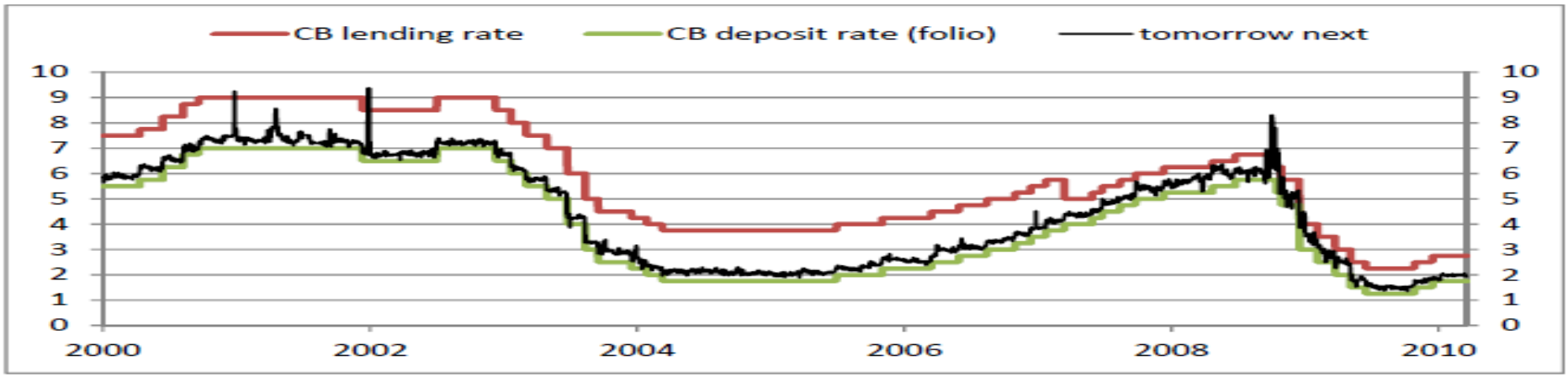
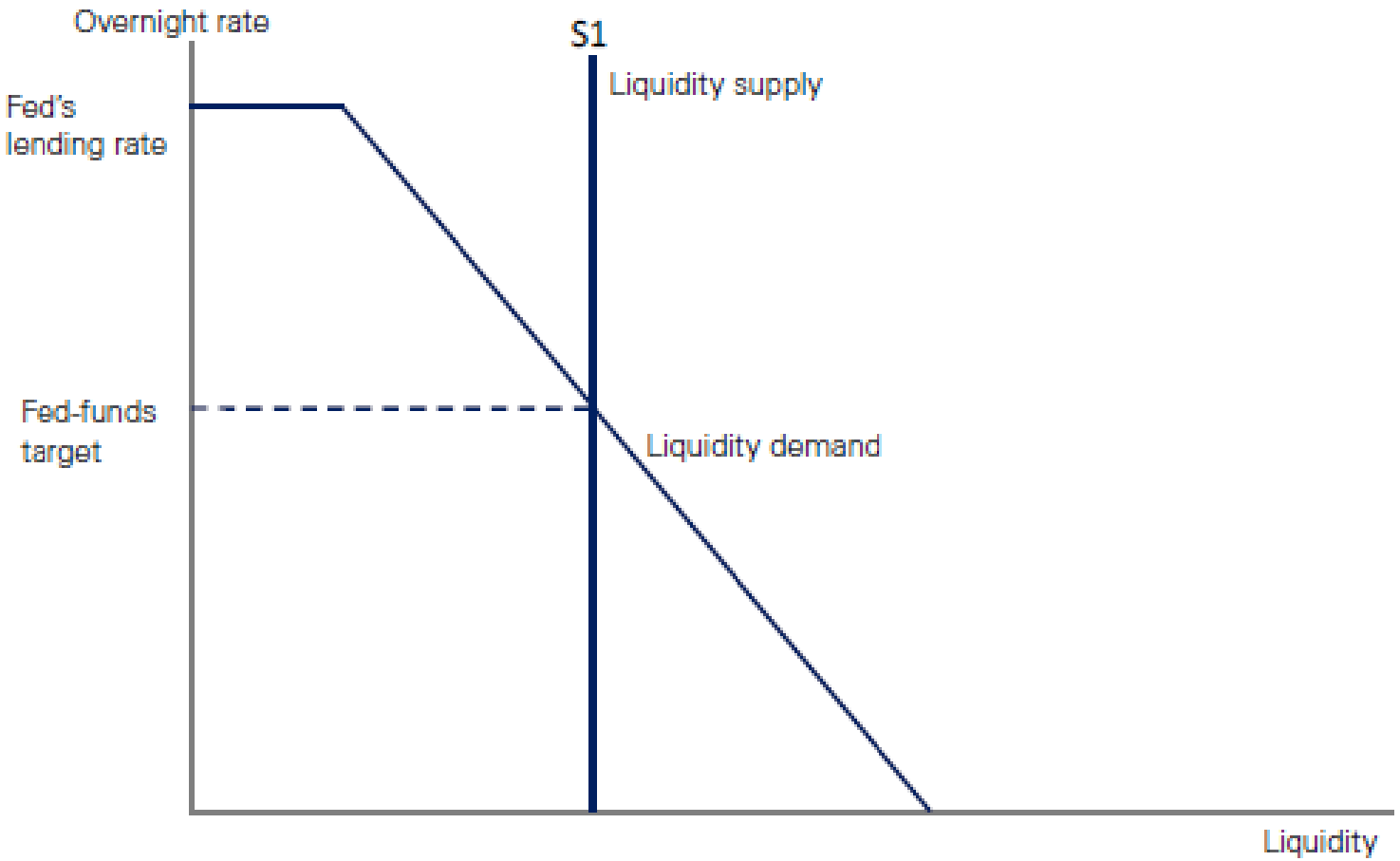


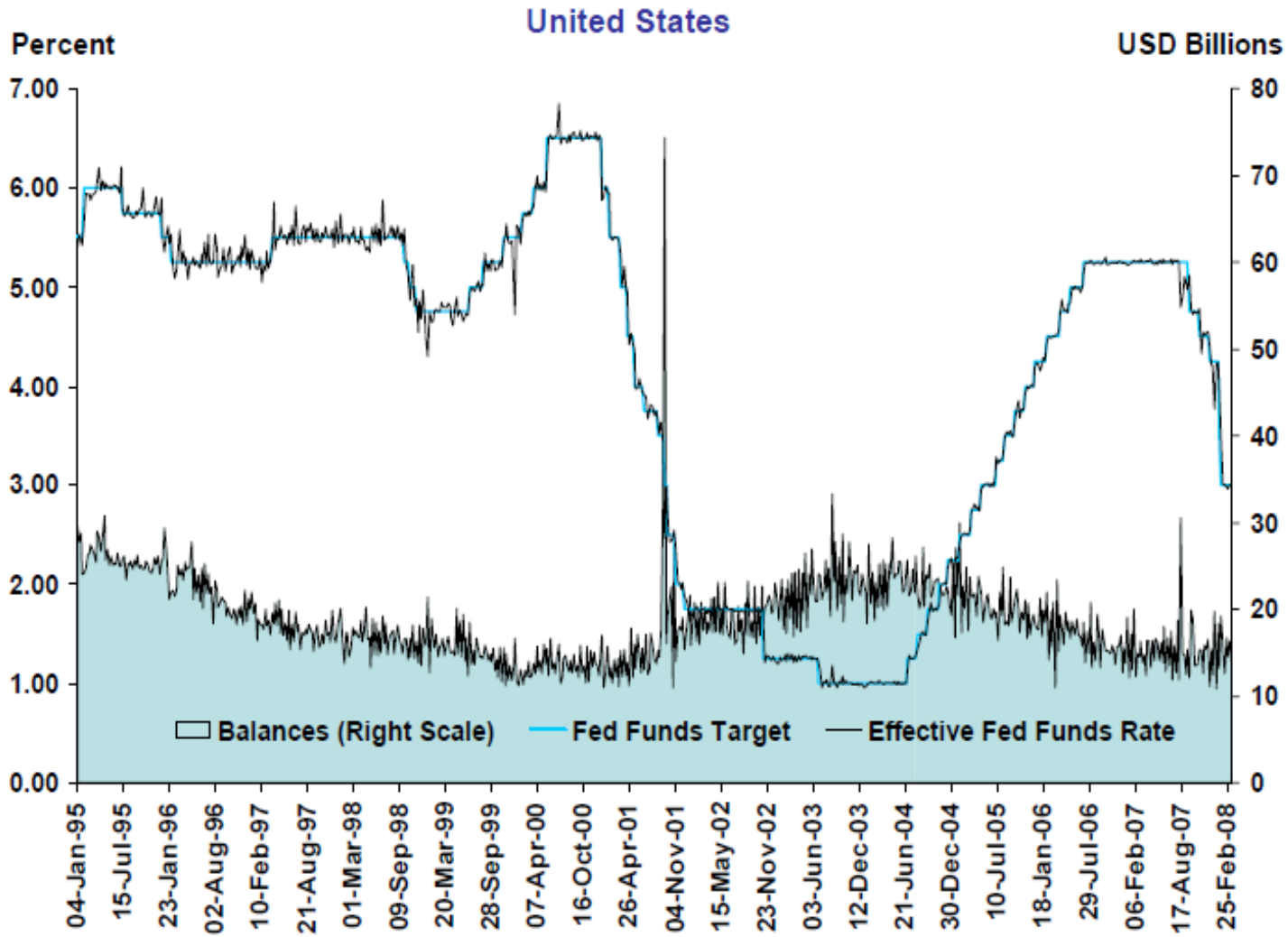
Chart 2. Norges Bank's lending and deposit rate and tomorrow next money market rate



"Textbook" version of reserve (liquidity) management and policy rate...

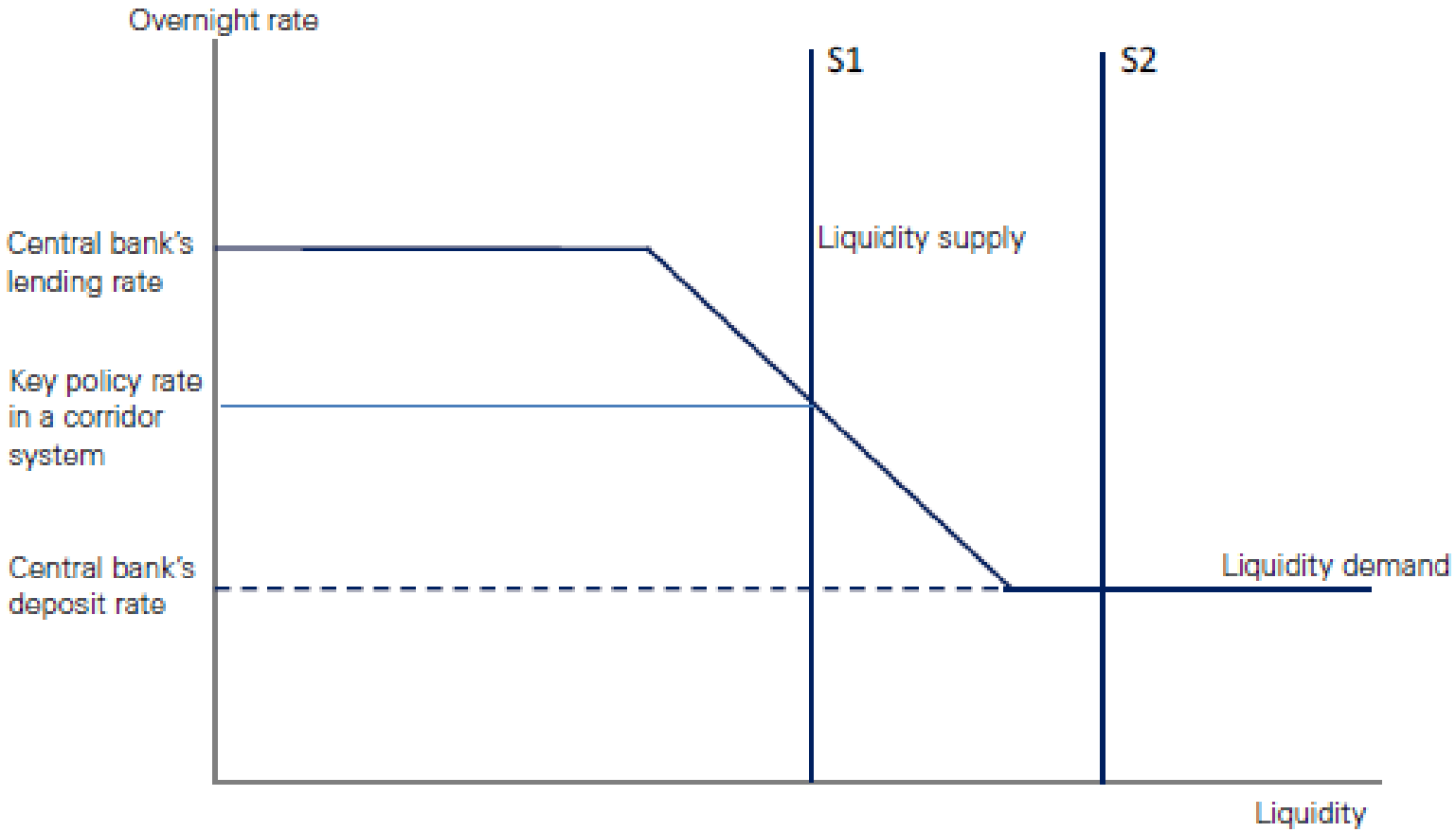


But in practice: Interest rate decoupled from amount of reserves R



How can the policy interest rate be decoupled from the volume of reserves? Standing facilities.

Chart 3. Demand for and supply of liquidity in a floor system and a corridor system



Amount of reserves (="liquidity") is decoupled from the policy rate....

- Standing facilities (banks' deposit rates and borrowing rates) determine how the system works.
- Floor system: One (deposit) interest rate consistent with different levels of reserves R.
- Useful if one wants to buy a lot of assets resulting in R increasing, but still keep control over the policy rate
- But also in corridor system (which is common internationally), there is not a one-to-one link between the quantity of money and the policy rate. *The quantity of reserves determines the difference between the floor and the target rate. By moving the floor, the central bank can move the policy rate without changing the quantity of money*:
  - See chapter 2, in Woodford (2003): "Interest and Prices" [not required reading].
  - Or Woodford (2010): "The Central Bank balance sheet as an Instrument of Monetary Policy", staff rep. no. 463, Federal Reserve Bank of New York [not required reading].

..And the amount of reserves is decoupled from the amount of lending in the economy

(Figure 1, Disyatat in here)

References, the norwegian money market [not required reading]

- Paper describing the pricing of loans between banks:
  - Akram and Christophersen (2011): "Norwegian overnight interest rates". Staff memo 1/2011, Norges Bank.
- Paper discussing the liquidity management system in Norway, US, UK, Euro area:
  - Bernhardsen and Kloster (2010): The liquidity management system: floor or corridor. http://www.norges-bank.no/templates/article_76665.aspx
- Paper describing measures taken during the financial crisis by Norges Bank, including description of premia:
  - Bernhardsen, Kloster, Smith and Syrstad (2009): "The financial crisis in Norway: effects on financial markets and measures taken", Swiss Society for Financial Market Research

Alternative to traditional bank lending channel:

A bank lending channel via the external finance premium

- Bernanke and Gertler, and Disyatat: Because of deregulation, importance of the *traditional* bank lending channel diminished. Where applied, the reserve requirement functions more like a tax on banks: cheap funding for central bank. Central bank accomodates any liquidity need ($F \uparrow$) when needed for liquidity purposes in order to implement policy rate.
- Disyatat points out: Banks do not technically need extra funding to issue a loan. D and L up by equal amounts. But they do need to have high enough Net worth (by regulation: Capital requirements), and they do need to manage risk, including liquidity risk.
- Banks face an external finance premium. Increasing when banks' net worth falling, or uncertainty about bank stability increasing. Financial accelerator: shocks to banks' profitability (or the value of their assets!) affects their ability to lend, and may amplify the economic cycle. Financial crisis, and public debt crisis in today's Europe.

The financial accelerator and F&R, section 2.5: The B&G type bank lending channel

- Result 2.8:A Credit crunch (a decline in bank capital K_m), leads to higher required equilibrium return on bank loans and possibly less bank lending.

Example

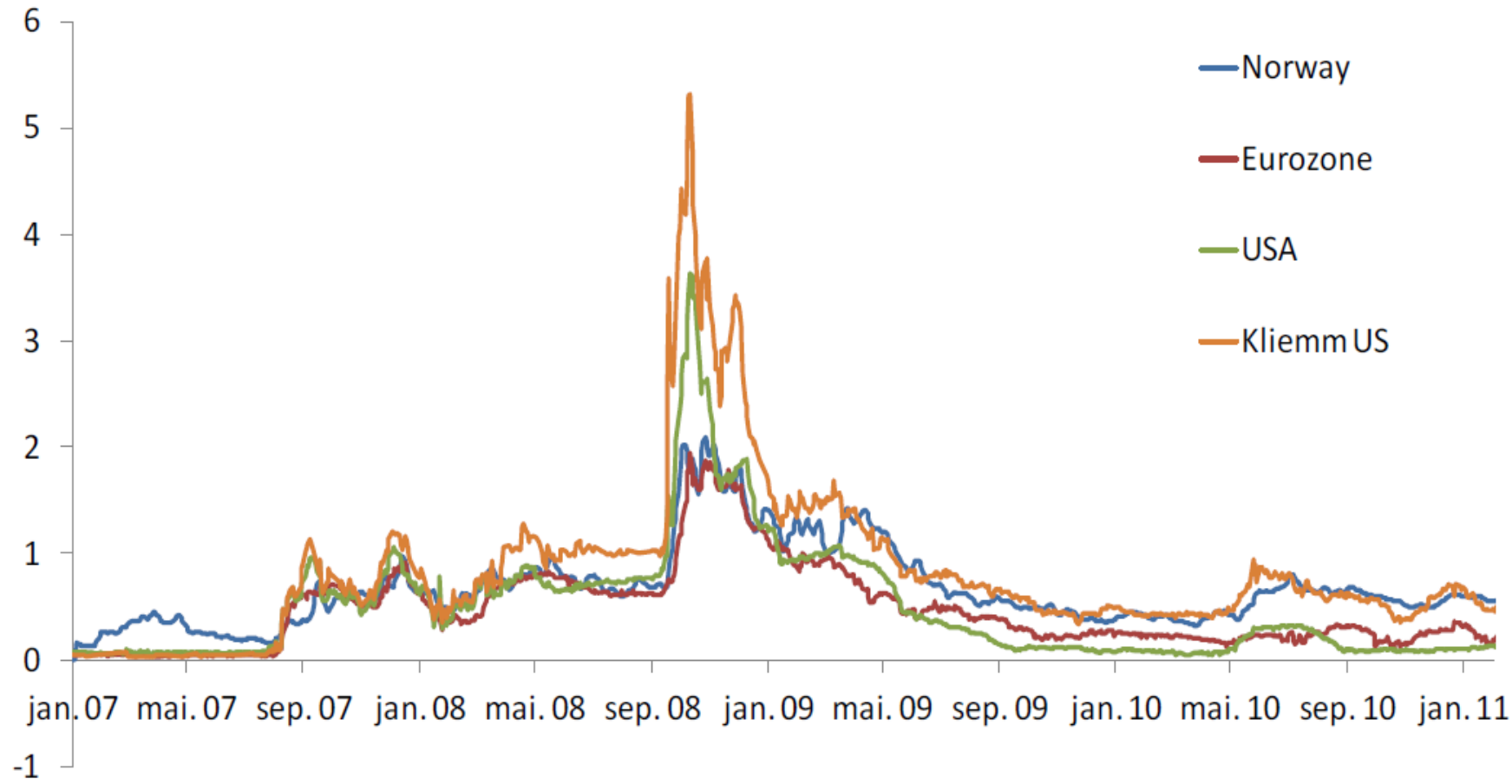
Financial accelerator via banks possible: Higher bank capital due to good bank earnings/low losses enable banks to lower their lending rate. More and cheaper bank lending may be self-reinforcing for a while, if it feeds back into higher bank capital.

- This may create a bank lending channel for monetary policy: Monetary policy may affect the value of banks' assets, thereby their K_m, and hence the pricing and volume of bank lending. Bernanke and Gertler (1995).

Unrest in money market may affect bank lending

Money market premiums

Difference between three-month money market rate and OIS, 1.1.2007-Feb. 2011.



But connection money growth/credit growth and economic activity?

- E. g. Favara and Giordani (2009): "Reconsidering the role of money for output, prices and interest rates", Journal of Monetary Economics, no. 59: Find that shocks to broad money aggregates have substantial and persistent effects on output, prices and interest rates. [not required reading]
- Possible explanation: Credit channel as explained by Bernanke and Gertler, or monetarist explanation? We do not know the causation.
- But the size of *central bank reserves* and policy interest rates decoupled, and size of *central bank reserves* and broad credit/money aggregates decoupled.

Side remark: How are interest rates in the norwegian money market calculated?

- NOK-USD swap market important for financing and investing for large banks and institutional investors.
- Oil companies exchange revenues from USD to NOK in order to pay taxes.
- NOK-USD swap market more liquid than NOK money market, and hence reference rate NIBOR is based on a formula for covered interest rate parity:

$$i_{NOK,SWAP} = i_{USD} + (f - e)$$

$i_{NOK,SWAP}$ = Norwegian money market rate calculated based on USD rate i_{USD}
$(f - e)$ = NOK-USD forward exchange premium. ($f > e \Rightarrow$ USD more expensive forward than spot)

- Arbitrage should make swap rates equal, using different currencies in the swap. But crisis: liquidity and counterparty risk.