Monetary Policy and the Credit Rationing Effects of Liquidity

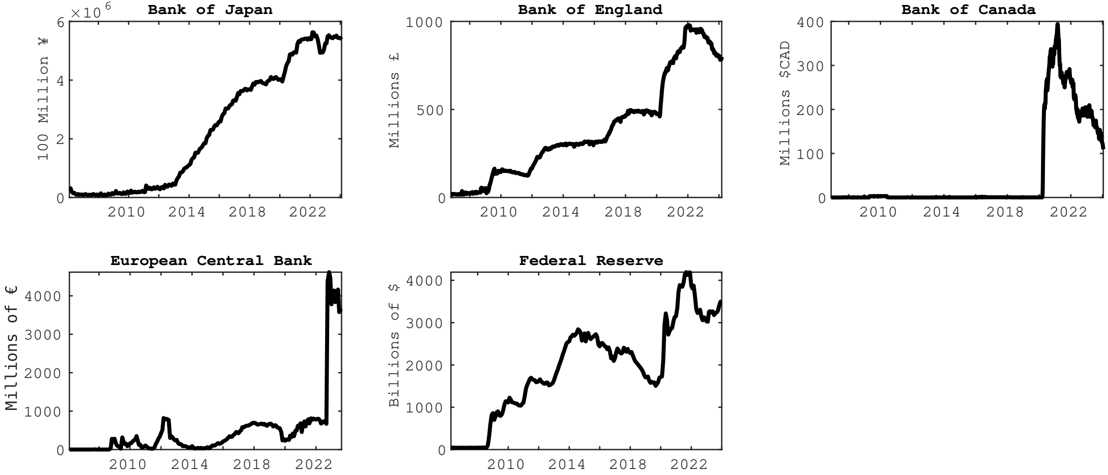
Jonathan Swarbrick

University of St Andrews

jms48@st-andrews.ac.uk — www.jonathanswarbrick.uk

MMF Annual Conference
University of Reading
8 September 2025

Sky-rocketing banking sector liquidity



Shows central bank reserve balances / deposit facility use

Bank liquidity and the credit channel

Increasing banking sector liquidity and UMPs have had an unclear affect on bank lending

Central banks injected huge amounts of liquidity, but banks often increase excess reserves rather than increase lending:

- 2008–2009 excess reserves in US $\uparrow$ while lending standards were tightened (source: SLOOS)
- 2010–2012 lots of liquidity in eurozone banking sector without increasing lending in stressed economies

Aim of Paper

Present some stylized facts on relationship between interest rates, policy corridors, liquidity and lending

Build a model to rationalise some of this evidence

- The ambiguous link between liquidity and lending
- Small business lending frictions

Use this to study:

- Role of monetary policy (interest rates, interest rate corridors, and UMPs)
- Interaction between liquidity and credit frictions

Some motivating evidence

Regression equation: $\ln X_t = \alpha_X + \beta_X s_t + \gamma_{\mathbf{X}}' \cdot \mathbf{z}_t + u_{X,t}$

	a) $s_t \equiv R_t^{tr} - \underline{R}_t$			b) $s_t \equiv R_t - \underline{R}_t$		
	$\ln DF_t$	$\ln L_t$	LS_t	$\ln DF_t$	$\ln L_t$	LS_t
s_t	-0.481^{***} (0.134)	0.0221^{***} (0.002)	2.367 (1.758)	-0.931^{***} (0.144)	0.0084^{**} (0.0038)	-3.769^{**} (1.825)
R_t^*	-0.497^{***} (0.025)	-0.0028^{***} (0.0005)	1.649^{***} (0.257)	-0.294^{***} (0.041)	-0.0041^{***} (0.0011)	2.654^{***} (0.506)
Obs	141	141	47	141	141	47
Adj. R^2	0.855	0.894	0.893	0.879	0.845	0.899

Notes: Standard errors in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

- X_t is DF_t (excess reserves), L_t (total loans), LS_t (net % banks tightening lending standards)
- Monthly (DF_t and L_t) and quarterly (LS_t) data 2008M1–2019M12
- Controls: GDP, CPI inflation, Eonia, financial risk (Gilchrist & Mojon 2018), ECB asset purchases

Some motivating evidence

R^{tr} = *main policy interest rate*

R = *market rate*

$\underline{R}$ = *floor (IoER)*

Regression equation: $\ln X_t = \alpha_X + \beta_X s_t + \boldsymbol{\gamma}'_X \cdot \mathbf{z}_t + u_{X,t}$

	a) $s_t \equiv R_t^{tr} - \underline{R}_t$			b) $s_t \equiv R_t - \underline{R}_t$		
	$\ln DF_t$	$\ln L_t$	LS_t	$\ln DF_t$	$\ln L_t$	LS_t
s_t	-0.481^{***}	0.0221^{***}	2.367	-0.931^{***}	0.0084^{**}	-3.769^{**}
	(0.134)	(0.002)	(1.758)	(0.144)	(0.0038)	(1.825)
R_t^*	-0.497^{***}	-0.0028^{***}	1.649^{***}	-0.294^{***}	-0.0041^{***}	2.654^{***}
	(0.025)	(0.0005)	(0.257)	(0.041)	(0.0011)	(0.506)
Obs	141	141	47	141	141	47
Adj. R^2	0.855	0.894	0.893	0.879	0.845	0.899

Notes: Standard errors in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

- X_t is DF_t (excess reserves), L_t (total loans), LS_t (net % banks tightening lending standards)
- Monthly (DF_t and L_t) and quarterly (LS_t) data 2008M1–2019M12
- Controls: GDP, CPI inflation, Eonia, financial risk (Gilchrist & Mojon 2018), ECB asset purchases

Some motivating evidence

R^{tr} = *main policy interest rate*

R = *market rate*

$\underline{R}$ = *floor (IoER)*

Regression equation: $\ln X_t = \alpha_X + \beta_X s_t + \gamma'_{\mathbf{X}} \cdot \mathbf{z}_t + u_{X,t}$

	a) $s_t \equiv R^{tr}_t - \underline{R}_t$			b) $s_t \equiv R_t - \underline{R}_t$		
	$\ln DF_t$	$\ln L_t$	LS_t	$\ln DF_t$	$\ln L_t$	LS_t
s_t	-0.481^{***}	0.0221^{***}	2.367	-0.931^{***}	0.0084^{**}	-3.769^{**}
	(0.134)	(0.002)	(1.758)	(0.144)	(0.0038)	(1.825)
R^*_t	-0.497^{***}	-0.0028^{***}	1.649^{***}	-0.294^{***}	-0.0041^{***}	2.654^{***}
	(0.025)	(0.0005)	(0.257)	(0.041)	(0.0011)	(0.506)
Obs	141	141	47	141	141	47
Adj. R^2	0.855	0.894	0.893	0.879	0.845	0.899

Notes: Standard errors in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

- X_t is DF_t (excess reserves), L_t (total loans), LS_t (net % banks tightening lending standards)
- Monthly (DF_t and L_t) and quarterly (LS_t) data 2008M1–2019M12
- Controls: GDP, CPI inflation, Eonia, financial risk (Gilchrist & Mojon 2018), ECB asset purchases

Some motivating evidence

R^{tr} = *main policy interest rate*

R = *market rate*

$\underline{R}$ = *floor (IoER)*

Regression equation: $\ln X_t = \alpha_X + \beta_X s_t + \boldsymbol{\gamma}'_{\mathbf{X}} \cdot \mathbf{z}_t + u_{X,t}$

	a) $s_t \equiv R^{tr}_t - \underline{R}_t$			b) $s_t \equiv R_t - \underline{R}_t$		
	$\ln DF_t$	$\ln L_t$	LS_t	$\ln DF_t$	$\ln L_t$	LS_t
s_t	-0.481^{***} (0.134)	0.0221^{***} (0.002)	2.367 (1.758)	-0.931^{***} (0.144)	0.0084^{**} (0.0038)	-3.769^{**} (1.825)
R^*_t	-0.497^{***} (0.025)	-0.0028^{***} (0.0005)	1.649^{***} (0.257)	-0.294^{***} (0.041)	-0.0041^{***} (0.0011)	2.654^{***} (0.506)
Obs	141	141	47	141	141	47
Adj. R^2	0.855	0.894	0.893	0.879	0.845	0.899

Notes: Standard errors in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

- X_t is DF_t (excess reserves), L_t (total loans), LS_t (net % banks tightening lending standards)
- Monthly (DF_t and L_t) and quarterly (LS_t) data 2008M1–2019M12
- Controls: GDP, CPI inflation, Eonia, financial risk (Gilchrist & Mojon 2018), ECB asset purchases

Some motivating evidence

R^{tr} = *main policy interest rate*

R = *market rate*

$\underline{R}$ = *floor (IoER)*

Regression equation: $\ln X_t = \alpha_X + \beta_X s_t + \gamma'_{\mathbf{X}} \cdot \mathbf{z}_t + u_{X,t}$

	a) $s_t \equiv R_t^{tr} - \underline{R}_t$			b) $s_t \equiv R_t - \underline{R}_t$		
	$\ln DF_t$	$\ln L_t$	LS_t	$\ln DF_t$	$\ln L_t$	LS_t
s_t	-0.481^{***}	0.0221^{***}	2.367	-0.931^{***}	0.0084^{**}	-3.769^{**}
	(0.134)	(0.002)	(1.758)	(0.144)	(0.0038)	(1.825)
R_t^*	-0.497^{***}	-0.0028^{***}	1.649^{***}	-0.294^{***}	-0.0041^{***}	2.654^{***}
	(0.025)	(0.0005)	(0.257)	(0.041)	(0.0011)	(0.506)
Obs	141	141	47	141	141	47
Adj. R^2	0.855	0.894	0.893	0.879	0.845	0.899

Notes: Standard errors in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

- X_t is DF_t (excess reserves), L_t (total loans), LS_t (net % banks tightening lending standards)
- Monthly (DF_t and L_t) and quarterly (LS_t) data 2008M1–2019M12
- Controls: GDP, CPI inflation, Eonia, financial risk (Gilchrist & Mojon 2018), ECB asset purchases

Some motivating evidence

R^{tr} = *main policy interest rate*

R = *market rate*

$\underline{R}$ = *floor (IoER)*

Regression equation: $\ln X_t = \alpha_X + \beta_X s_t + \gamma'_{\mathbf{X}} \cdot \mathbf{z}_t + u_{X,t}$

	a) $s_t \equiv R_t^{tr} - \underline{R}_t$			b) $s_t \equiv R_t - \underline{R}_t$		
	$\ln DF_t$	$\ln L_t$	LS_t	$\ln DF_t$	$\ln L_t$	LS_t
s_t	-0.481^{***}	0.0221^{***}	2.367	-0.931^{***}	0.0084^{**}	-3.769^{**}
	(0.134)	(0.002)	(1.758)	(0.144)	(0.0038)	(1.825)
R_t^*	-0.497^{***}	-0.0028^{***}	1.649^{***}	-0.294^{***}	-0.0041^{***}	2.654^{***}
	(0.025)	(0.0005)	(0.257)	(0.041)	(0.0011)	(0.506)
Obs	141	141	47	141	141	47
Adj. R^2	0.855	0.894	0.893	0.879	0.845	0.899

Notes: Standard errors in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

- X_t is DF_t (excess reserves), L_t (total loans), LS_t (net % banks tightening lending standards)
- Monthly (DF_t and L_t) and quarterly (LS_t) data 2008M1–2019M12
- Controls: GDP, CPI inflation, Eonia, financial risk (Gilchrist & Mojon 2018), ECB asset purchases

Competing channels

Regression equation: $\ln L_t = \alpha_L + \beta_{L,s<\mathcal{S}} i_t R_t + \beta_{L,s>\mathcal{S}} (1 - i_t) R_t + \boldsymbol{\gamma}_{\mathbf{L}}' \cdot \mathbf{z}_t + u_{L,t}$

- $i_t = 1$ if $s_t = R_t - \underline{R}_t < \mathcal{S}$
- Consider different threshold values $\mathcal{S}$

Competing channels

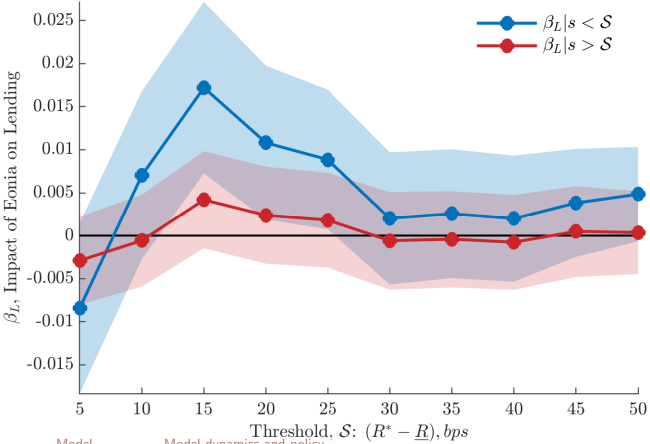
Regression equation: $\ln L_t = \alpha_L + \overbrace{\beta_{L,s<\mathcal{S}} i_t R_t}^{\textit{Interbank rate close to the floor}} + \underbrace{\beta_{L,s>\mathcal{S}} (1 - i_t) R_t}_{\textit{Interbank rate far from the floor}} + \boldsymbol{\gamma}_{\mathbf{L}}' \cdot \mathbf{z}_t + u_{L,t}$

- $i_t = 1$ if $s_t = R_t - \underline{R}_t < \mathcal{S}$
- Consider different threshold values $\mathcal{S}$

Competing channels

Regression equation: $\ln L_t = \alpha_L + \overbrace{\beta_{L,s<\mathcal{S}} i_t R_t}^{\text{Interbank rate close to the floor}} + \underbrace{\beta_{L,s>\mathcal{S}} (1 - i_t) R_t}_{\text{Interbank rate far from the floor}} + \gamma_{\mathbf{L}}' \cdot \mathbf{z}_t + u_{L,t}$

- $i_t = 1$ if $s_t = R_t - \underline{R}_t < \mathcal{S}$
- Consider different threshold values $\mathcal{S}$



Stylized facts

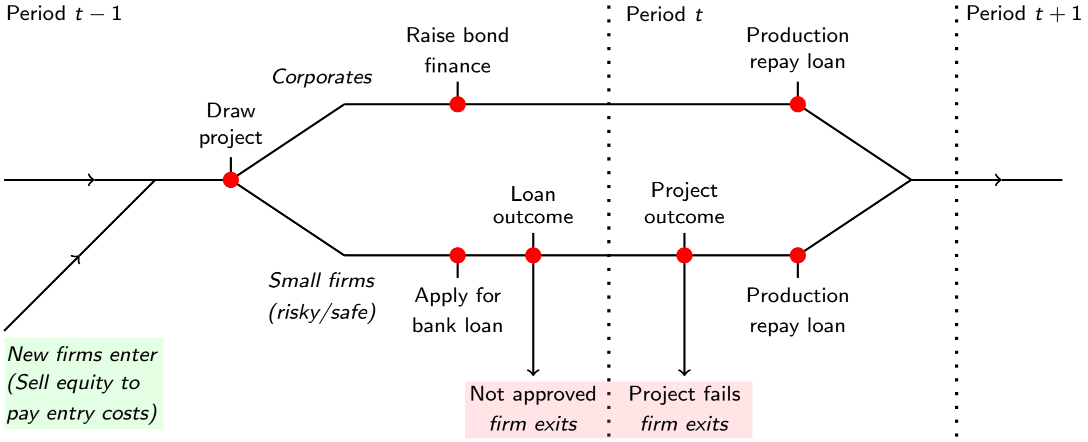
- Lower market rate ($R \downarrow$) predicts **more** lending
- Smaller spread between market rate and floor ($(R - \underline{R}) \downarrow$) predicts **less** lending
- A lower market rate ($R \downarrow$) predicts **less** lending *when it is close to the floor*
- Lending standards key tool: points to role of information frictions

Model Overview

New Keynesian (Calvo) model + frictional bank lending:

- Households are standard
- Follow Swarbrick (2023) – Stiglitz & Weiss (1981) information problem (see also, e.g., Ikeda 2020)
- Some firms have private information
- Each period draw either risky/safe projects (risk of productivity ω^i)
- Expected productivity the same $\rightarrow$ $1 = \omega_t^s = p_t \omega_t^r$
- Banks can separate borrowers using loan approval
- When risk is high, banks can ration credit and hold excess reserves (paying CB deposit rate)

Firms


Period $t-1$
Period t
Period $t+1$
Raise bond finance
Production repay loan
Corporates
Draw project
Loan outcome
Project outcome
Small firms (risky/safe)
Apply for bank loan
Production repay loan
New firms enter (Sell equity to pay entry costs)
Not approved firm exits
Project fails firm exits

Banks and lending 1/2

- Separate borrowers using loan approval
  - Abstract from collateral and loan size
  - Loan terms are repayment rate τ_t^i and approval rate x_t^i

Banks and lending 1/2

- Separate borrowers using loan approval
  - Abstract from collateral and loan size
  - Loan terms are repayment rate τ_t^i and approval rate x_t^i

- Safe **individual rationality** (IR) constraint binds (ignoring aggregate uncertainty)

$$R_{t+1}^s - \tau_t^s \geq 0 \tag{1}$$

Banks and lending 1/2

- Separate borrowers using loan approval
  - Abstract from collateral and loan size
  - Loan terms are repayment rate τ_t^i and approval rate x_t^i

- Safe **individual rationality** (IR) constraint binds (ignoring aggregate uncertainty)

$$R_{t+1}^s - \tau_t^s \geq 0 \tag{1}$$

- Risky **incentive compatibility** (IC) constraint binds

$$\underbrace{x_t^r p_{t+1} \left(R_{t+1}^r - \tau_t^r\right)}_{\text{Surplus choosing risky loan}} \geq \underbrace{x_t^s p_{t+1} \left(R_{t+1}^r - \tau_t^s\right)}_{\text{Surplus choosing safe loan}} \tag{2}$$

- The other not-always-binding IC/IR constraints imply: $x_t^r \geq x_t^s$

Banks and lending 2/2

- Consider IR and IC with no aggregate uncertainty (and using $p_t R_t^r = R_t^s$):

$$\tau_t^s = R_{t+1}^s \tag{3}$$

$$x_t^r p_{t+1} \left(R_{t+1}^r - \tau_t^r \right) = x_t^s p_{t+1} \left(R_{t+1}^r - \tau_t^s \right)$$

$$\Rightarrow \quad \tau_t^r = R_{t+1}^r \underbrace{- \frac{x_t^s}{x_t^r} \left(1 - p_{t+1}\right) R_{t+1}^r}_{\text{Information rents}} \tag{4}$$

Banks and lending 2/2

- Consider IR and IC with no aggregate uncertainty (and using $p_t R_t^r = R_t^s$):

$$\tau_t^s = R_{t+1}^s \tag{3}$$

$$x_t^r p_{t+1}\left(R_{t+1}^r - \tau_t^r\right) = x_t^s p_{t+1}\left(R_{t+1}^r - \tau_t^s\right)$$

$$\Rightarrow \quad \tau_t^r = R_{t+1}^r - \frac{x_t^s}{x_t^r}\left(1 - p_{t+1}\right) R_{t+1}^r \tag{4}$$

- Illustrative numbers – safe projects 5% return, risky projects 15% *when successful*:

Loan 1	Loan 2
5%	8%
70% Chance of Approval	Guaranteed Approval

Banks and lending 2/2

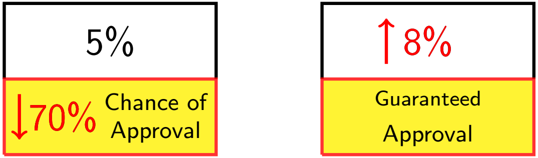
- Consider IR and IC with no aggregate uncertainty (and using $p_t R^r_t = R^s_t$):

$$\tau^s_t = R^s_{t+1} \tag{3}$$

$$x^r_t p_{t+1}\left(R^r_{t+1} - \tau^r_t\right) = x^s_t p_{t+1}\left(R^r_{t+1} - \tau^s_t\right)$$

$$\Rightarrow \quad \tau^r_t = R^r_{t+1} - \frac{x^s_t}{x^r_t}\left(1 - p_{t+1}\right) R^r_{t+1} \tag{4}$$

- Illustrative numbers – safe projects 5% return, risky projects 15% *when successful*:



Loan 1 Loan 2

- When risk is high, banks can ration credit and hold excess reserves (paying CB deposit rate)

Banks first-order conditions

Solution to the problem yields:

$$\mathbb{E}_t\left[\frac{\Lambda_{t,t+1}}{\Pi_{t,t+1}}\left(p_{t+1}R^r_{t+1}-\underline{R}_t\right)\right]=\varphi^r_t\frac{1}{1-\lambda}-\psi_t\frac{1}{1-\lambda} \tag{5}$$

$$\mathbb{E}_t\left[\frac{\Lambda_{t,t+1}}{\Pi_{t,t+1}}\left(\left(\lambda+(1-\lambda)\,p_{t+1}\right)R^s_{t+1}-\underline{R}_t\right)\right]=\varphi^r_t-\varphi^s_t \tag{6}$$

And

$$\varphi^s_t,\varphi^r_t,\psi_t\geq 0 \tag{7}$$

$$0\leq x^s_t\leq x^r_t\leq 1 \tag{8}$$

$$\varphi^s_t x^s_t = \varphi^r_t\left(1-x^r_t\right)=\psi_t\left(x^r_t-x^s_t\right)=0 \tag{9}$$

$\underline{R}_t$ (interest on reserve balances) is opportunity cost of funds (more generally could depends on interbank rate etc)

Credit rationing

Consider the equilibrium with $\varphi_t^s = 0$ ($x_t^s > 0$) and $\varphi_t^r > 0$ ($x_t^r = 1$)

- Credit rationing can occur if $\psi_t = 0$ (no pooling), so $x_t^s < 1$
- First-order conditions become

$$\psi_t = \mathbb{E}_t \left[\frac{\Lambda_{t,t+1}}{\Pi_{t,t+1}} \left(\left[\lambda - (1-\lambda)(1-p_{t+1}) \right] R_{t+1}^s - \lambda \underline{R}_t \right) \right] \geq 0 \tag{10}$$

Credit rationing more likely if:

- More risk $1 - p_{t+1} \uparrow$
- Lower return on capital $R_{t+1}^s \downarrow$
- Higher opportunity cost of funds $\underline{R}_t \uparrow$

Implies thresholds beyond which banks ration credit

Monetary policy

Standard Taylor rule

$$r_t^{tr} = \bar{r} + \gamma_\pi \left(\pi_{t-1,t} - \pi^*\right) + \gamma_y \left(y_t - \bar{y}\right) \tag{12}$$

- Think of this as the central bank setting the main refinancing rate at regular full -allotment auctions
- Interest rate on HH deposits $R_t = R_t^{tr}$ in equilbrium

Central bank also has two standing facilities

- Deposit facility paying $\underline{R}_t$ (excess reserves)
- Lending facility charging $\overline{R}_t$

We also allow the bank to conduct QE through purchasing assets from HHs — more on this if time

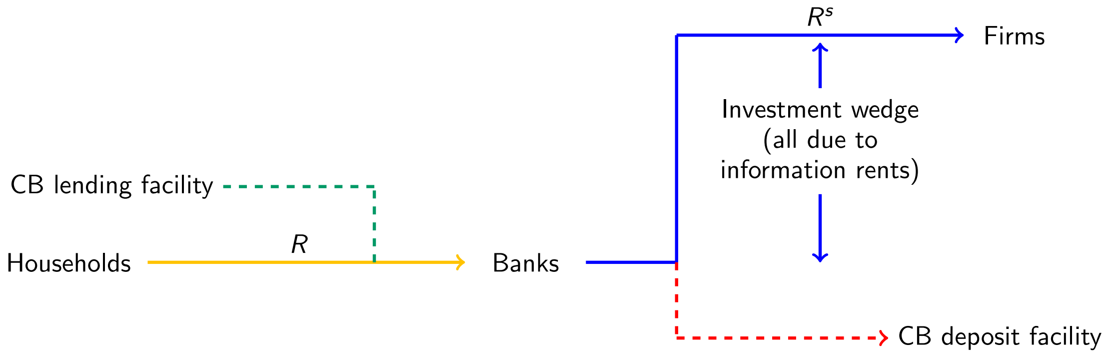
Interest rates

Benchmark – no liquidity risk, efficient financial markets

$$\text{Households} \xrightarrow{R} \text{Banks} \xrightarrow{R^s} \text{Firms}$$

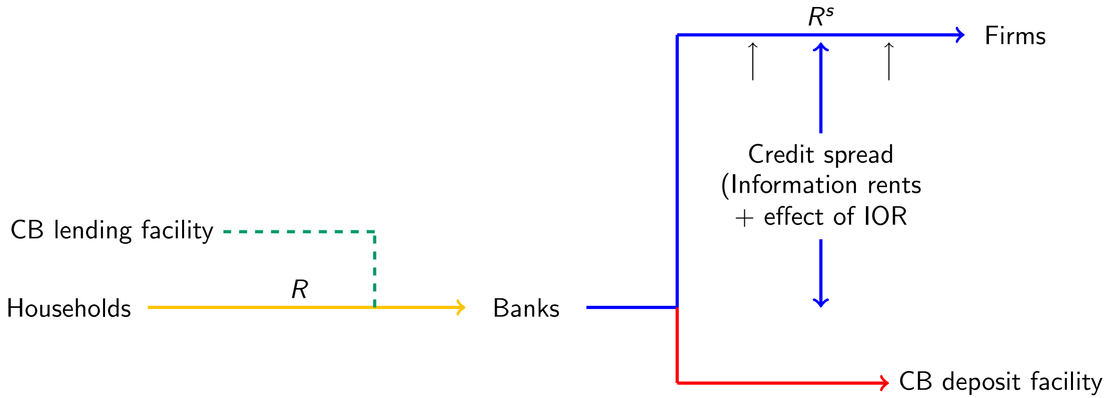
Interest rates

Benchmark – credit frictions, no liquidity risk, no excess liquidity



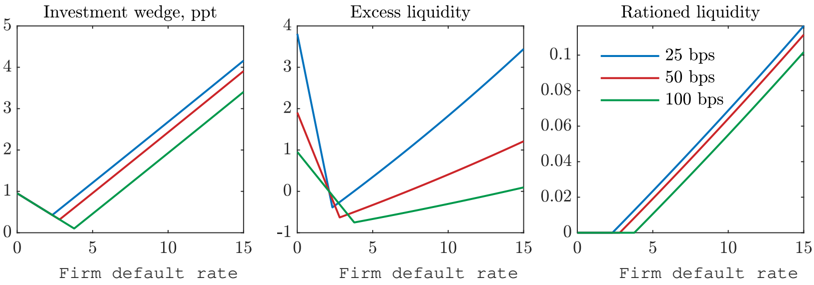
Interest rates

Benchmark – credit frictions, <u>with</u> excess liquidity, no liquidity risk



Note: interest rate corridor only matters when banks hold excess reserves

Comparative statics – role of corridor



Result: changes in interest on reserves only affect economy through the effect on credit rationing.

Constraint on lending

Quantitative Easing

Example implementation:

Central Bank

Liabilities	*Assets*

Bank

Liabilities	*Assets*
Deposits	Loans

e.g., Pension fund

Liabilities	*Assets*
Pension liabilities	Bonds

Quantitative Easing

Example implementation:

Central Bank

Liabilities	*Assets*
	Bonds

Bank

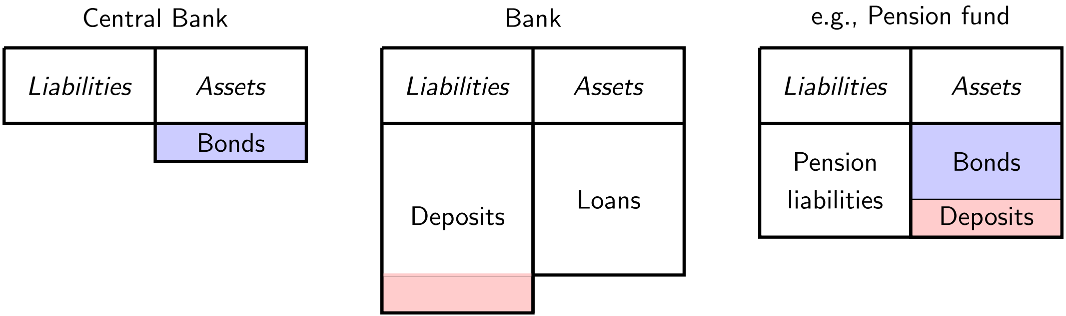
Liabilities	*Assets*
Deposits	Loans

e.g., Pension fund

Liabilities	*Assets*
Pension liabilities	Bonds
	Deposits

Quantitative Easing

Example implementation:



Quantitative Easing

Example implementation:

Central Bank

Liabilities	*Assets*
Reserves	Bonds

Bank

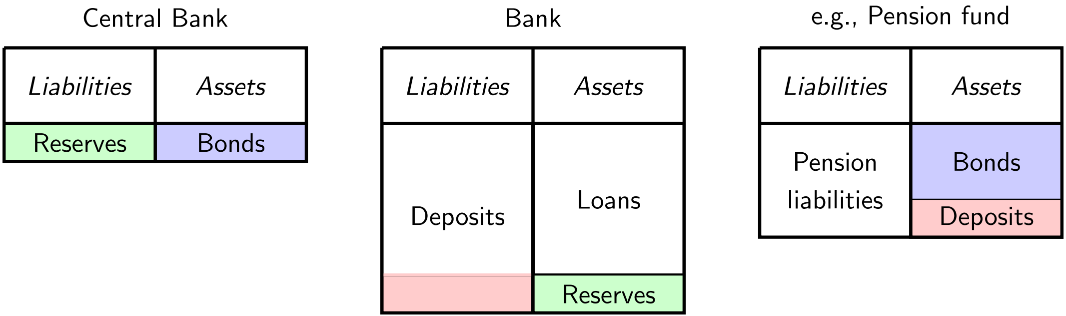
Liabilities	*Assets*
Deposits	Loans
	Reserves

e.g., Pension fund

Liabilities	*Assets*
Pension liabilities	Bonds
	Deposits

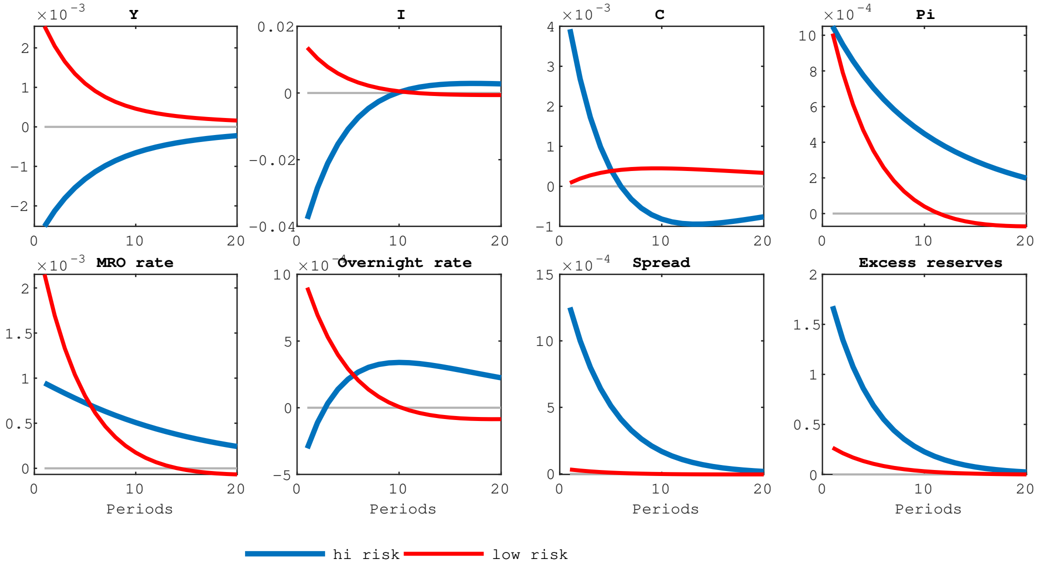
Quantitative Easing

Example implementation:

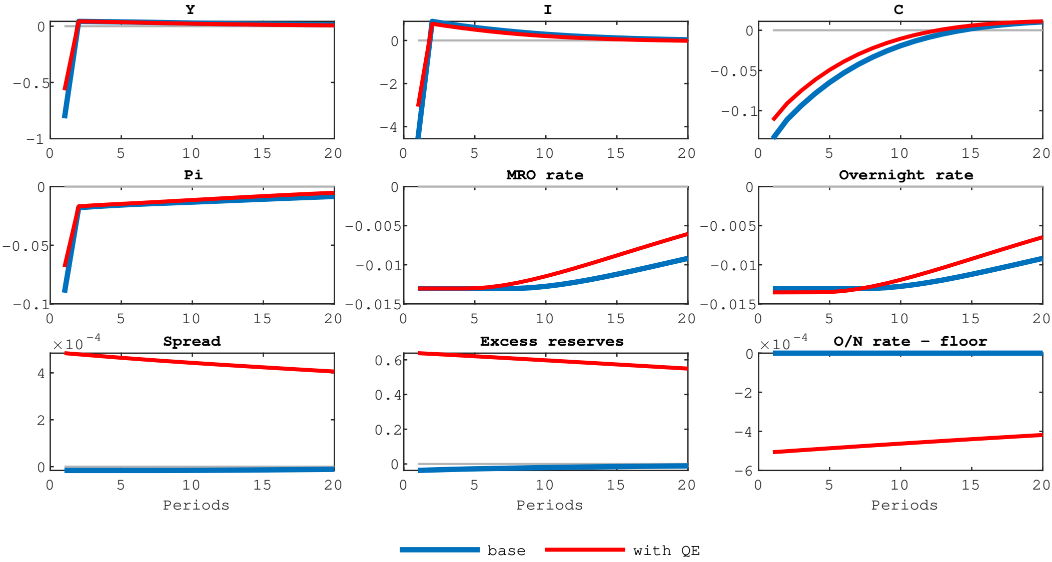


- Lowers the return on bank assets
- $\Rightarrow$ money markets only clear at a lower overnight rate
- Overnight rate moves towards the floor (interest on reserves)

QE programme -- high risk vs. low risk economy



Demand shock with/without QE -- high risk economy



References I

Gilchrist, S. & Mojon, B. (2018), 'Credit risk in the euro area', *The Economic Journal* **128**(1), 118–158.

Ikeda, D. (2020), 'Adverse selection, lemons shocks and business cycles', *Journal of Monetary Economics* **115**, 94–112.
URL: *https://www.sciencedirect.com/science/article/pii/S0304393219300947*

Stiglitz, J. E. & Weiss, A. (1981), 'Credit Rationing in Markets with Imperfect Information', *American Economic Review* **71**(3), 393–410.

Swarbrick, J. (2023), 'Lending standards, productivity, and credit crunches', *Macroeconomic Dynamics* **27**(2), 456–481.