The Monetary Policy Haircut Rule

Markus Althanns[1*] Hans Gersbach [1†]

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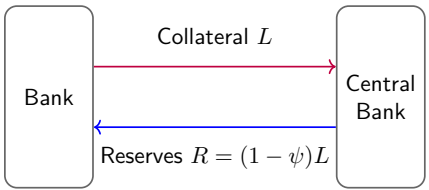
*malthanns@ethz.ch
†hgersbach@ethz.ch

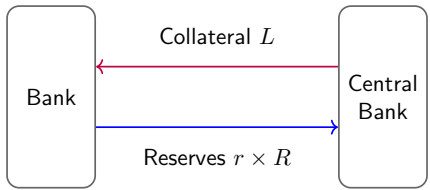
Collateral Framework

The central bank (CB) provides **collateralized credit** to commercial banks.

Step one: Reserve loan



Step two: Repayment of reserve loan



The CB applies a haircut ψ on the pledged collateral.

FED haircuts

$\rightarrow$ We establish an **analytical haircut rule**!

Link of Monetary and Real Economy

Bank is endowed with equity E and

- grants loans $L = \varphi E$ with leverage $\varphi \quad \rightarrow \quad$ **credit extension**,
- creates deposits $D = L - E \quad \rightarrow \quad$ **money creation**

Link of Monetary and Real Economy

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Commercial bank

Loans $L = \varphi E$	Deposits $D = (\varphi - 1)E$
	Equity E

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Commercial bank

Loans $L = \varphi E$	Deposits $D = (\varphi - 1)E$ $\xrightarrow{\text{outflow } \gamma D}$
	Equity E

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Commercial bank

Loans $L = \varphi E$	Deposits $D = (\varphi - 1)E$	outflow γD $\longrightarrow$
Reserve deposits $R^D = \gamma D$	Reserve loans R^L	
	Equity E	

Reserve loan must be smaller than the **collateral capacity**:

$$R^L \leq (1 - \psi)L \qquad \Leftrightarrow \qquad \varphi \leq \frac{\gamma}{\gamma - (1 - \psi)} \equiv \varphi^L.$$

The Central Bank's Trade-off

Setting haircut ψ, the central bank **balances**

- gains from liquidity provision
- default costs arising from excessive bank lending

Literature

Impact of collateral capacity on lending:

- Bernanke and Gertler (1989); Bernanke, Gertler, and Gilchrist (1999)
- Kiyotaki and Moore (1997)

Neoclassical **two-sector** economy:

- Lorenzoni (2008)
- Gersbach and Rochet (2012, 2017)
- Gersbach, Rochet, and Scheffel (2022)

Central-bank collateral requirements

- Bindseil (2004); Bindseil, Corsi, Sahel, and Visser (2017)
- Nyborg (2017)

References

Agents

Simplified two-period model with three types of agents:

- unit mass of ***households*** with aggregate capital endowment K
- unit mass of ***bankers*** aggregate capital endowment E
- mass $N = N^L + N^B > 0$ of ***workers***

Two production sectors:

- ***bond-financed firms***: frictionless access to capital markets
- ***loan-financed firms***: reliant on loan-financing

Bond-financed Firms

A bond-financed firm solves

$$\max_{N^B, K^B \geq 0} \left\{ A^B (N^B)^{1-\alpha} (K^B)^{\alpha} - r^B (Q K^B + W^B N^B) \right\}.$$

for

- capital price Q
- sector-specific wage W^B
- gross interest rate r^B on bonds

Solution:

$$r^B Q = \frac{\alpha Y^B}{K^B} \qquad \text{and} \qquad r^B W^B = \frac{(1-\alpha) Y^B}{N^B}$$

Loan-financed Firms

A loan-financed firm solves

$$\max_{N^L, K^L \geq 0} \mathbb{E}\left\{A_s^L (N^L)^{1-\alpha} K^\alpha - r_s^L (Q K^L + W^L N^L)\right\}$$

with idiosyncratic shock $s \in \{\underline{s}, \overline{s}\}$ and

- capital price Q
- sector-specific wage W^L
- gross interest rates $(r_{\underline{s}}^L, r_{\overline{s}}^L)$ on loans

Solution:

$$r_s^L Q = \frac{\alpha Y_{s,}^L}{K^L} \qquad \text{and} \qquad r_s^L W^L = \frac{(1-\alpha) Y_s^L}{N^L}, \qquad s \in \{\underline{s}, \overline{s}\}.$$

Households, Workers, and Bankers

Let r^D be the gross interest rate on deposits.

Households solve $\max_{\zeta \in [0,1]} \mathbb{E}\left[[\zeta r^D + (1-\zeta) r^B] Q K\right]$.

Workers solve $\max_{\xi \in [0,1]} \mathbb{E}\left[[\xi r^D + (1-\xi) r^B](W^B N^B + W^L N^L))\right]$.

Bankers found banks and consume equity return $\mathbb{E}[r^E] Q E$.

Banks

Banks are

- founded and owned by bankers
- one-to-one mapped with a loan-financed firm
- perfectly competitive
- subject to limited liability and deposit insurance

Banks' balance-sheet from credit extension and money creation:

Bank	
Loans $L = \varphi QE$	Deposits $D = (\varphi - 1)QE$
	Equity QE

for leverage leverage $\varphi \equiv L/QE$.

Banks' Liquidity Constraint

Liquidity demand for reserves: γD with $\gamma \in (0, 1)$

Collateral capacity: $(1 - \psi)\mathbb{E}[r_s^L]L/r_{CB}$ with

- haircut $\psi \in [0, 1)$
- r_{CB} gross interest rate on reserves.

Liquidity constraint $\varphi^L(\psi)$:

$$\varphi \leq \frac{\gamma r_{CB}}{\gamma r_{CB} - (1 - \psi)\mathbb{E}[r_s^L]} \equiv \varphi^L(\psi).$$

Banks' Maximization Problem

When the matched firm incurs shock s, the bank realizes equity return

$$r_s^E \equiv \max\{r_s^L \varphi - r^D(\varphi - 1), 0\}.$$

When a bank defaults, its depositors are protected by governmental **deposit insurance**.

Bank solves $\max_{\varphi \in [1, \varphi^L(\psi)]} \mathbb{E}[r_s^E]$. The bank faces solvency risk if

$$\varphi > \frac{r^D}{r^D - r_{\underline{s}}^L} \equiv \varphi^S.$$

Equilibrium Linkages

Lemma (Bank Leverage)

Banks leverage up to the liquidity constraint:

$$\varphi = \varphi^L(\psi) \qquad \textit{and} \qquad \frac{\mathrm{d}\varphi^L(\psi)}{\mathrm{d}\psi} < 0.$$

Lemma (Capital Allocation)

It holds that

$$K^L = \alpha\varphi E \qquad \textit{and} \qquad K^B = K + E - \alpha\varphi E.$$

Lemma (Interest Rate Parities)

Bonds, deposits, and CB reserves pay the same interest rate $r^B = r^D = r_{CB}$.

Policy

Interest-rate policy r_{CB} is **neutral**!

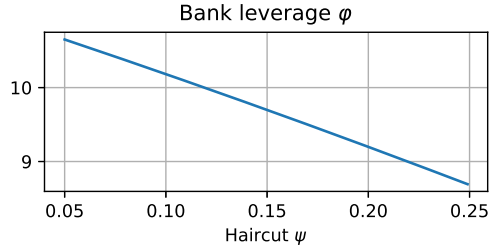
Haircut policy is **not neutral**: the CB maximizes aggregate production

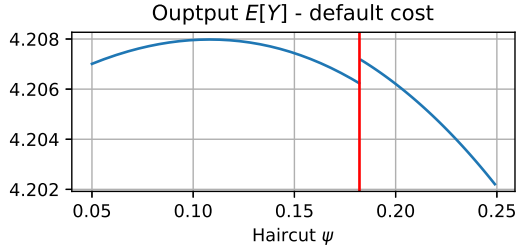
$$\mathbb{E}[Y] = Y^B + \mathbb{E}\Big[Y_s^L(1 - \lambda \mathbb{1}\{\varphi > \varphi^S \wedge s = \underline{s}\})\Big],$$

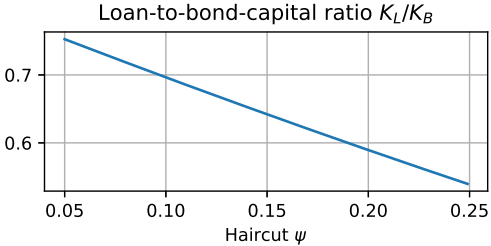
including possible **default costs** λY_s^L with $\lambda \in (0, 1)$.

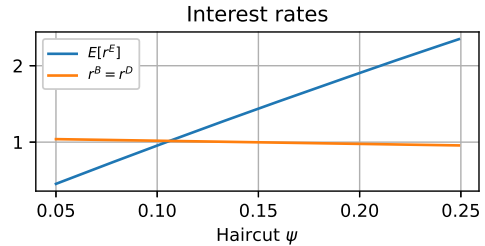
Equilibria for Different Haircut Levels

Calibration



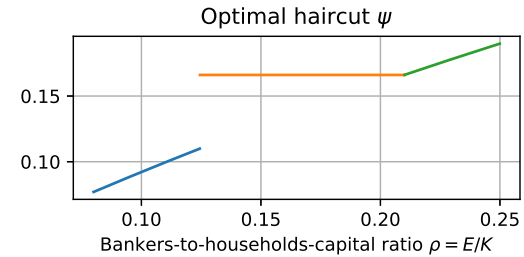


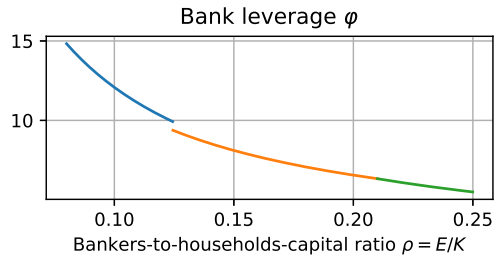


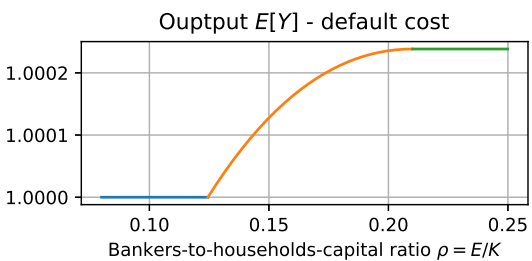


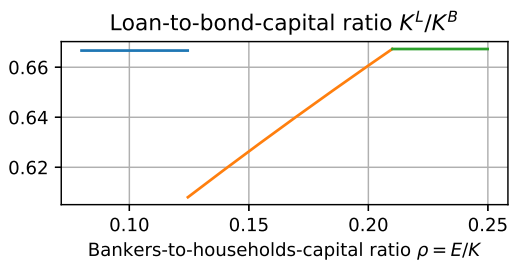
Changes in Capital-Ownership Share

Calibration









Haircut Rule

When CB accepts default risk (and bank equity is scarce), it implements haircut

$$\psi^\star = 1 - \gamma \left[1 - \alpha(1+\tilde{a}) \frac{E}{K+E} \right],$$

where

- γ: banks' liquidity demand;
- $E/(E+K)$: bankers' capital ownership share
- $\tilde{a}$: relative production capacity of bond-financed firms

$$\tilde{a} \equiv \frac{N^B}{N^L} \left(\frac{A^B}{\mathbb{E}[(1 - \mathbb{1}\{s = \underline{s}\}\lambda) A^L_{,s}]} \right)^{\frac{1}{1-\alpha}}$$

Conclusion

Distributional results:

- bankers/banks **benefit** from **tight** collateral requirements
- households/bond-holders **suffer** from **tight** collateral requirements

Calibration to US pre-crisis data

We establish an **analytical haircut rule** that balances

- gains from liquidity provision
- default costs from excessive bank lending

References I

Bernanke, B., & Gertler, M. (1989). Agency costs, net worth, and business fluctuations. *American Economic Review*, *79*(1), 14–31.

Bernanke, B., Gertler, M., & Gilchrist, S. (1999). The financial accelerator in a quantitative business cycle framework. In J. B. Taylor & M. Woodford (Eds.), *Handbook of Macroeconomics* (Vols. 1, Part C, p. 1341-1393). Elsevier, Amsterdam.

Bindseil, U. (2004). *Monetary Policy Implementation: Theory, Past, and Present*. Oxford University Press, Oxford.

Bindseil, U., Corsi, M., Sahel, B., & Visser, A. (2017). The Eurosystem collateral framework explained. *European Central Bank Occasional Paper*, *189*.

De Fiore, F., & Uhlig, H. (2011). Bank finance versus bond finance. *Journal of Money, Credit and Banking*, *43*(7), 1399–1421.

References II

Drechsler, I., Savov, A., & Schnabl, P. (2017). Replication data for: "The deposits channel of monetary policy". *Harvard Dataverse*. (Available at https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/KHNXYJ (accessed on January 9, 2023))

Federal Reserve. (2023). *Collateral valuation.* Retrieved from https://www.frbdiscountwindow.org/pages/collateral/collateral_valuation

Fernald, J. (2014). A quarterly, utilization-adjusted series on total factor productivity. *Federal Reserve Bank of San Francisco Working Paper*, *2012-19*.

Gersbach, H., & Rochet, J.-C. (2012). Aggregate investment externalities and macroprudential regulation. *Journal of Money, Credit and Banking*, *44*(s2), 73-109.

References III

Gersbach, H., & Rochet, J.-C. (2017). Capital regulation and credit fluctuations. *Journal of Monetary Economics*, *90*, 113-124.

Gersbach, H., Rochet, J.-C., & Scheffel, M. (2022). Financial intermediation, capital accumulation, and crisis recovery. *Review of Finance*, *in press*.

Kiyotaki, N., & Moore, J. (1997). Credit cycles. *Journal of Political Economy*, *105*(2), 211–248.

Lorenzoni, G. (2008). Inefficient credit booms. *Review of Economic Studies*, *75*, 809-833.

Nyborg, K. G. (2017). *Collateral frameworks: The open secret of central banks*. Cambridge University Press, Cambridge.

Calibration Targets

	Variable	Description	Source	Value
Calibration targets	$\overline{\sigma}$	aggregate saving rate	FRED	0.1814
	$\overline{(K+E)/\mathbb{E}^{\lambda}[Y]}$	capital-to-output ratio	PWT	12.1202
	$\overline{r^{D}WN/\mathbb{E}^{\lambda}[Y]}$	labor share of income	Fernald (2014)	0.6358
	$\overline{\varphi}$	bank leverage	Call Report	9.9212
	$\overline{r}^{E}$	gross return on bank equity	Call Report	1.0320
	$\overline{r}^{D}$	gross return on bank deposits	Drechsler, Savov, and Schnabl (2017)	1.0146
	$\overline{K^{L}/K^{B}}$	loan-to-bond-capital ratio	De Fiore and Uhlig (2011)	0.6667
	$\overline{\psi}$	haircut	Fed Board	0.1100
Constraints	$\overline{r}^{E}Q-\delta-\frac{1-\beta_I}{\beta_I}$	bankers' steady state		0.0000
	$\overline{r}^{D}Q-\delta-\frac{1-\beta_H}{\beta_H}$	households' steady state		0.0000
	W^{L}/W^{B}	long-run wage equality		1.0000
	$\frac{\mathbb{E}^{\lambda}[Y(\psi^{D})]}{\mathbb{E}[Y(\psi^{S})]}$	optimality of bank default tolerance		1.0000

Calibrated Parameters

Variable	Description	Source	Value
α	output elasticity of capital		0.3642
$\tilde{A}^B$	productivity in Sector B	normalization	1.0000
$\tilde{A}^L_{\underline{s}}$	productivity in Sector L after neg. shock		0.8426
$\tilde{A}^L_{\bar{s}}$	productivity in Sector L after pos. shock		1.0038
δ	capital depreciation rate		0.0150
N	labor endowment	normalization	1.0000
N^L/N^B	loan-to-bond-labor ratio		0.6667
β_H	time preference of households		0.9851
β_I	time preference of bankers		0.9846
λ	default costs		0.0354
γ	liquidity demand		0.9904

Steady States

	Capital levels						Output and leverage	
	ρ	E	K	$E+K$	K^L	K^B	$\mathbb{E}^\lambda[Y](\mathbb{E}[Y])$	φ
Regime D	0.1245	5.6018	45.0002	50.6020	20.2408	30.3612	4.1750	9.9212
Regime S	0.2058	8.6242	41.9120	50.5362	20.1750	30.3612	4.1740	6.4233

FED: Haircuts

Individually deposited loans	Fixed rate loans	Floating rate loans
Agricultural loans		
Minimal risk rated	5% - 10%	5% -19%
Normal risk rated	5% - 27%	5% -38%
Commercial real estate loans		
Minimal risk rated	5% - 44%	5% -51%
Normal risk rated	5% - 70%	5% - 74%
Construction loans		
Minimal risk rated	5% - 75%	5% -81%
Normal risk rated	7% - 82%	7% -84%

Table: Federal Reserve (2023) haircut ranges for selected loan classes.