Monetary Policy when Banks Have Market Power

Rafael Repullo

CEMFI, Madrid, Spain

4th Bank of Canada FSRC Macro-Finance Conference

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A Critical Review of the Reversal Rate and the Deposits Channel

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Introduction

- Monetary policy when banks have market power
  - → Growing area of research
  - → Corbae and Levine (2018)
  - → Wang, Whited, Wu, and Xiao (2019)
  - → Martinez-Miera and Repullo (2020)
- Focus on two papers in which market power plays key role
  - → Brunnermeier and Koby (2019)
  - → Drechsler, Savov, and Schnabl (2017)

The reversal interest rate

"What is the effective lower bound on monetary policy? We suggest that it is given by the reversal interest rate, the **rate at which accommodative monetary policy reverses its effect and becomes contractionary for lending**."

Brunnermeier and Koby (2019)

The deposits channel

"We show that **when the Fed funds rate rises**, banks widen the spreads they charge on deposits, and **deposits flow out of the banking system**. Since banks rely heavily on deposits for their funding, these outflows **induce a contraction in lending**."

Drechsler, Savov, and Schnabl (2017)

Why market power?

- In Brunnermeier and Koby (BK)
  - → Monetary policy affects bank profitability
  - → Low rates erode equity capital (below reversal rate)
  - → Low equity capital leads to lower lending
- In Drechsler, Savov, and Schnabl (DSS)
  - → Monetary policy affect deposit spreads
  - → High rates widen spreads (more in concentrated markets)
  - → Wider spreads lead to lower deposits and lower lending

This presentation

- Provide critical comment on BK and DSS
- Main criticism of BK
  - → Key capital constraint is not properly justified
  - → Reversal rates, depending on bank characteristics
  - → Only relevant (if at all) for high deposit banks
- Main criticism of DSS
  - → Novel channel does not follow from theoretical model
  - → Novel channel is not implied by empirical results

Part 1

The reversal interest rate

The BK mechanism

- Lower monetary policy rates
  - → Reduce bank profitability
  - → Reduce equity capital (below reversal rate)
  - → Reduce bank lending (if there is a capital constraint)
- Structure of BK's paper
  - → Mechanism presented in partial equilibrium model
  - → Model embedded in New Keynesian macro model
- This presentation: Focus on partial equilibrium model

Model setup (i)

- Two dates $t = 0, 1$
- Local monopoly bank that at $t = 0$ can
  - → Raise deposits D
  - → Grant (safe) loans L
  - → Invest in economy-wide debt securities S
- Initial level of equity capital K
  - → Balance sheet identity

$$L + S = D + K$$

Model setup (ii)

- Bank faces

  → Upward sloping local *supply of deposits* $D(r_D)$

  → Downward sloping local *demand for loans* $L(r_L)$

- Bank takes as given interest rate r on debt securities

  → Monetary policy rate set by central bank

Bank's objective function

- Bank chooses r_D and r_L to maximize equity value at $t = 1$

$$V = (1 + r_L)L(r_L) + (1 + r)S - (1 + r_D)D(r_D)$$

- Substituting $S = D + K - L$ from balance sheet identity

$$V = \underbrace{(r_L - r)L(r_L)}_{\text{Profits from lending}} + \underbrace{(r - r_D)D(r_D)}_{\text{Profits from deposit-taking}} + (1 + r)K$$

Bank's constraints

- Bank maximization problem subject to two "financial frictions"

  → Capital constraint

$$\gamma L(r_L) \leq V$$

  → Liquidity constraint

$$\lambda D(r_D) \leq S$$

Additional assumption

- BK assume that initial level of equity K is decreasing in r

  → Revaluation effect due to capital gains on long-term assets

  → Completely ad hoc since bank starts with no such assets

- Moreover it tends to dampen effect of low rates on V

  → In what follows assume that K is constant

Comments on liquidity constraint

- According to BK, the liquidity constraint captures "the fact that banks need sufficient funds to avoid run risk."

  → Could be related to Basel III liquidity requirements

- However, it plays key (somewhat hidden) role in model

  → Balance sheet identity with binding liquidity constraint

$$L + \lambda D = D + K \quad \rightarrow \quad L = (1 - \lambda)D + K$$

  → Low rates reduce deposits which in turn reduce lending

  → This is not BK's narrative of the reversal rate

Comments on capital constraint (i)

- According to BK, the capital constraint captures "economic and regulatory factors"

  → No direct connection with existing capital regulation

  → Basel capital requirements are of the form

$$\gamma L \leq K$$

  → Current (accounting) value of equity K

  → Instead of future value of equity V

$$\gamma L \leq V$$

Comments on capital constraint (ii)

- Why do BK assume peculiar form of the capital constraint?

  → Because standard constraint cannot generate reversal

  → Just upper bound on lending

$$\gamma L \leq K \quad \rightarrow \quad L \leq K/\gamma$$

  → Need to bring bank profitability into model

Comments on capital constraint (iii)

- Can "economic factors" justify capital constraint?

  → Standard leverage constraint

$$\underbrace{(1+r_D)D}_{\text{Future value of debt}} \leq \underbrace{(1-\gamma)[\underbrace{(1+r_L)L+(1+r)S}_{\text{Future value of assets}}]}_{\text{Pledgeable assets}}$$

  → This implies

$$\gamma[(1+r_L)L+(1+r)S] \leq V$$

  → Not BK's capital constraint

What am I going to do?

- Review BK's model of reversal rate

  → Without liquidity constraint

  → With capital constraint of the form $\gamma L \leq V$

- Repullo (2020a) presents alternative model of reversal rate

  → Without liquidity constraint

  → With capital constraint of the form $\gamma L \leq K$

  → But making K endogenously provided by shareholders

  → Bank profitability becomes relevant for determining K

Bank's problem

- Convenient to work with

  → *Inverse supply of deposits* $r_D(D)$

  → *Inverse demand for loans* $r_L(L)$

- Bank's maximization problem

$$V = \max_{(D,L)} \left\{ [r_L(L) - r]L + [r - r_D(D)]D + (1 + r)K \right\}$$

  → subject to the capital constraint

$$\gamma L \leq V$$

Non-binding capital constraint

- If capital constraint $\gamma L \leq V$ is not binding

  → Bank lending obtained by solving

$$\max_L \{[r_L(L) - r]L\}$$

  → First-order condition

$$r_L(L) - r + r'_L(L)L = 0$$

  → Differentiating FOC and using SOC gives

$$\frac{dL}{dr} = \frac{1}{2r'_L(L) + r''_L(L)L} < 0$$

  → Lower rates always lead to higher lending: no reversal

Binding capital constraint (i)

- Let us define maximum profits from deposit taking

$$\pi_D(r) = \max_D \left\{ [r - r_D(D)]D \right\}$$

→ By envelope theorem we have

$$\pi'_D(r) = D > 0$$

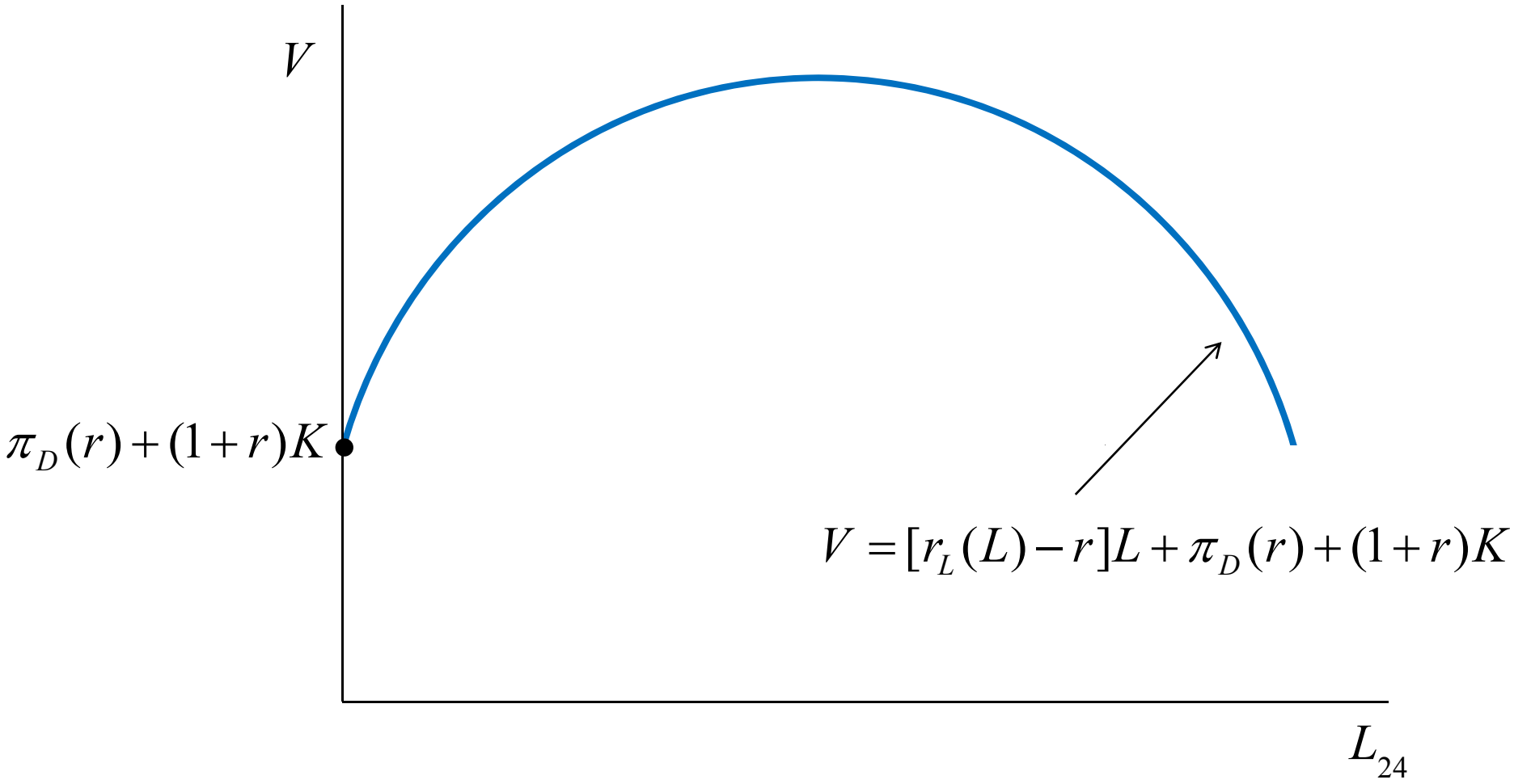
Binding capital constraint (ii)

- If capital constraint $\gamma L \leq V$ is binding

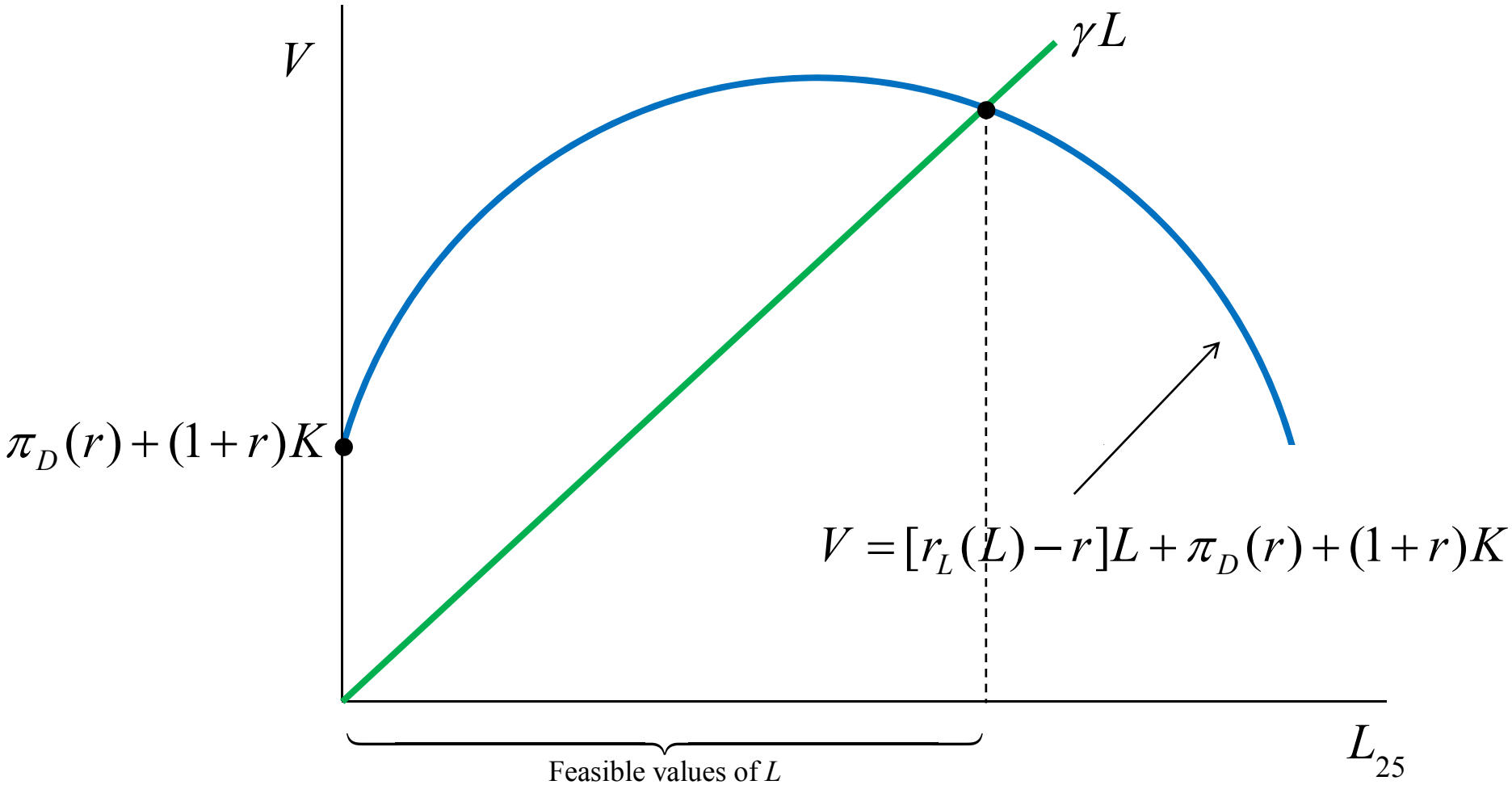
  → Bank lending is highest solution to equation

$$\gamma L = [r_L(L) - r]L + \pi_D(r) + (1 + r)K$$

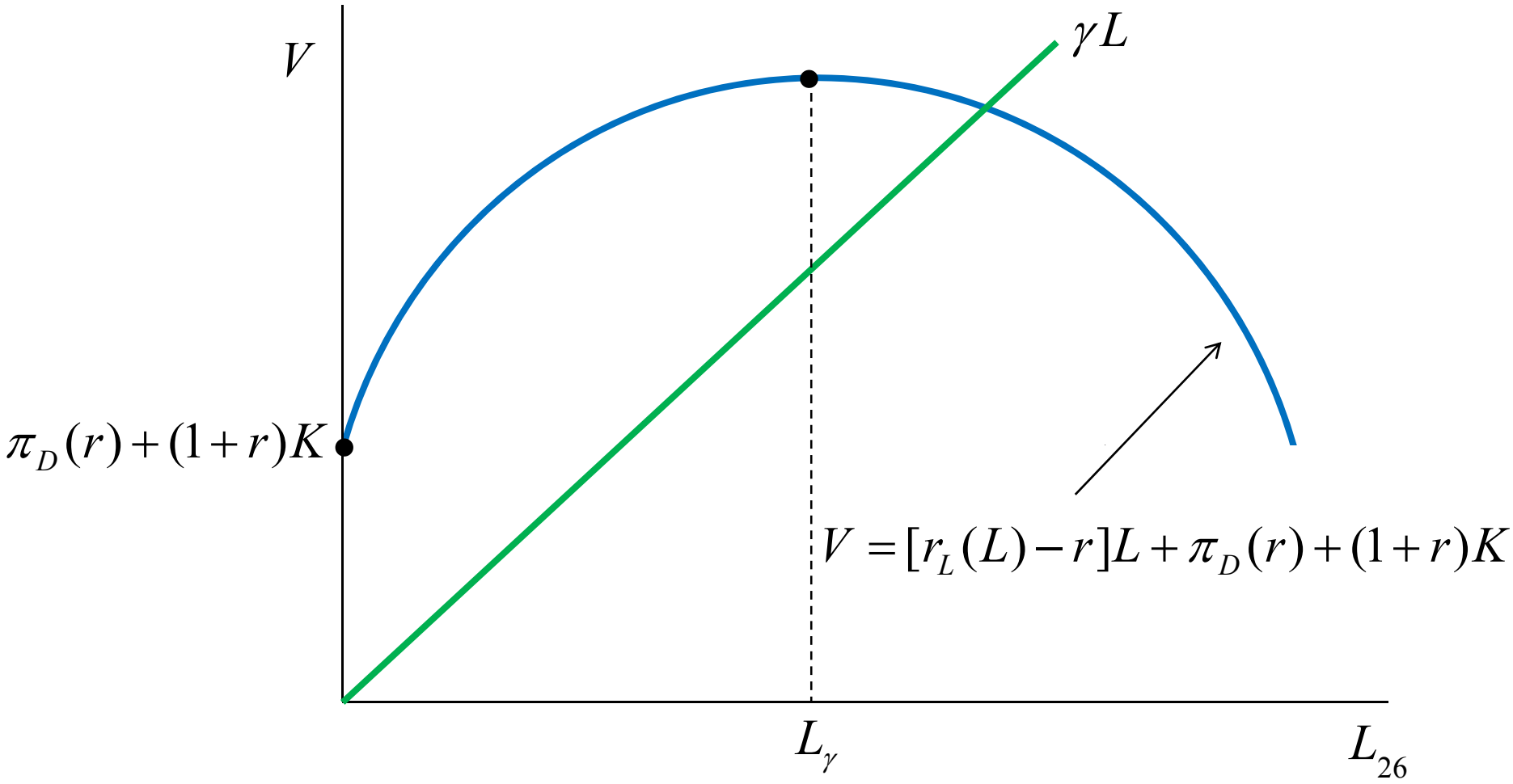
Non-binding capital constraint



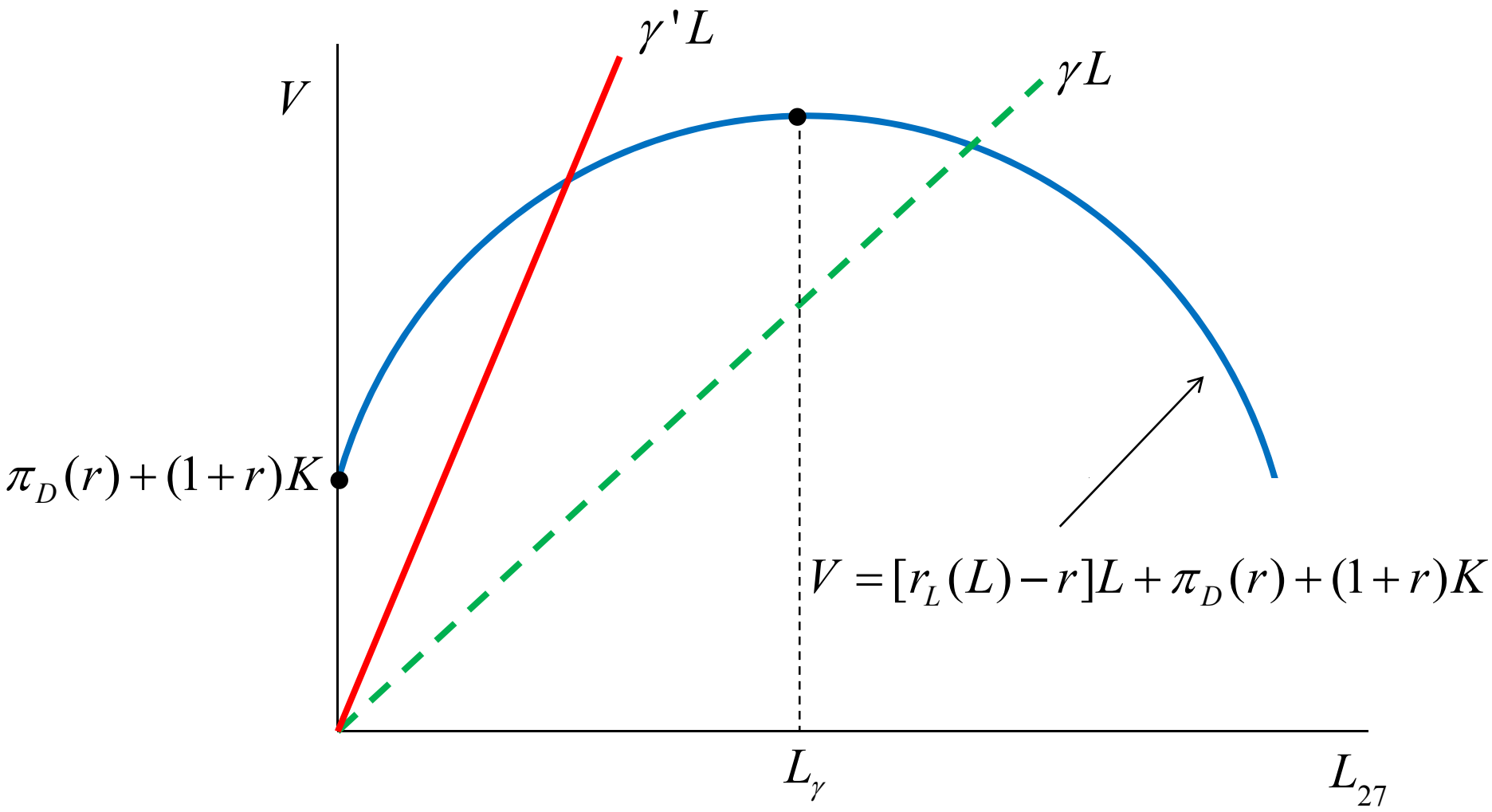
Non-binding capital constraint



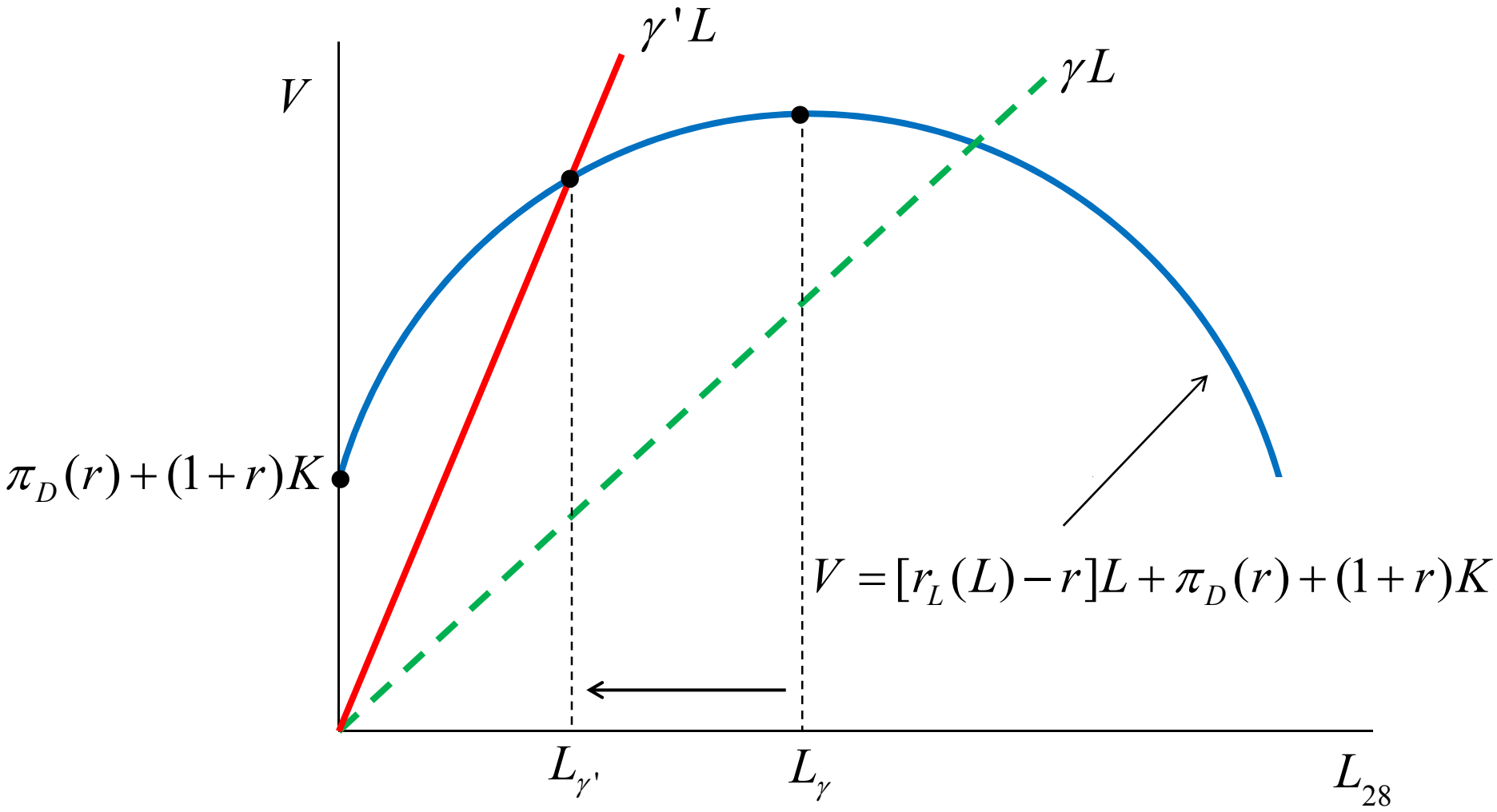
Non-binding capital constraint



Binding capital constraint



Binding capital constraint



Binding capital constraint (ii)

- If capital constraint $\gamma L \leq V$ is binding

  → Bank lending is highest solution to equation

$$\gamma L = [r_L(L) - r]L + \pi_D(r) + (1 + r)K$$

  → Differentiating this condition gives

$$\frac{dL}{dr} = \frac{D + K - L}{\gamma - [r_L(L) - r + r'_L(L)L]}$$

$$= \frac{S}{\gamma - [r_L(L) - r + r'_L(L)L]}$$

Binding capital constraint (iii)

- Sign of denominator is positive

$$\gamma - [r_L(L) - r + r'_L(L)L] > 0$$

- If capital requirement $\gamma L \leq V$ is binding

  → Increasing L has higher impact on capital requirement γL

  → than on profits from lending $[r_L(L) - r]L$

Is there a reversal rate?

- By our previous results we have

$$\frac{dL}{dr} = \frac{S}{\gamma - [r_L(L) - r + r'_L(L)L]} > 0 \quad \Leftrightarrow \quad S > 0$$

- Lower rates lead to lower lending (a reversal rate) if and only if

  → Bank is net investor in debt securities

- Hence, there is no single reversal rate

  → Reversal rate depends on bank characteristics

  → Reversal rate does not exist if bank is net borrower in securities market ($S < 0$)

An alternative model

- Identical to previous model except for
  - → Form of capital constraint $\gamma L \leq K$
  - → Corresponds to Basel regulation
- Endogenous equity capital K
  - → Bank shareholders require return $r + \rho$
  - → Excess cost of capital $\rho > 0$

Why endogenous capital?

- Key intuition of BK's model

  → Bank profitability matters for lending

- If shareholders do not get adequate return for their investment

  → They may not want to contribute capital to bank

  → Or shift it to alternative uses

  → With a capital constraint this would reduce lending

- Question: Can this argument be properly formalized?

  → Repullo (2020a)

Main results of alternative model

- Low deposit banks
  - → Lower rates increase the net value of the bank
  - → Profitability constraint will never be binding
  - → No reversal rate
- High deposit banks
  - → Profitability constraint may become binding
  - → For a sufficiently negative policy rate
  - → But then banks could start paying negative deposit rates
  - → No reversal rate either

Final remark

- Results in line with "Life below Zero"

"Using annual balance-sheet data, we show that while overall bank lending increases after the setting of negative policy rates, the **lending of high-deposit banks increases less than the lending of low-deposit banks**."

Heider, Saidi, and Schepens (2019)

→ No reversal but heterogeneous effects on lending

Part 2

The deposits channel

A most radical claim

"We show that **when the Fed funds rate rises**, banks widen the spreads they charge on deposits, and **deposits flow out of the banking system**. Since banks rely heavily on deposits for their funding, these outflows **induce a contraction in lending**. Our estimates imply that **the deposits channel can account for the entire transmission of monetary policy** through bank balance sheets."

Drechsler, Savov, and Schnabl (2017)

Is there a deposits channel?

- Repullo (2020b) argues that DSS claim

  → Does not follow from theoretical model

  → Does not follow from empirical results

- This presentation: Focus on theoretical model

Model setup

- Representative household with utility function that depends on
  - → Final wealth and liquidity services
  - → Liquidity services derived from cash and deposits
  - → Deposits are composite good produced by set of *n* banks
- Household can invest in cash, deposits, and bonds
  - → Cash pay zero interest rate
  - → Deposits pay equilibrium deposit rate chosen by banks
  - → Bonds pay monetary policy rate *r*

Households' utility function (i)

- CES utility function over final wealth W and liquidity services L

$$U(W,L) = \left(W^{\frac{\rho-1}{\rho}} + (\lambda L)^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}}$$

→ where $0 < \rho < 1$: wealth and liquidity are complements

- Liquidity is a CES function of cash M and deposits D

$$L(M,D) = \left(M^{\frac{\varepsilon-1}{\varepsilon}} + D^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

→ where $\varepsilon > 1$: cash and deposits are substitutes

Households' utility function (ii)

- Deposits are a composite good provided by n banks

$$D = \left(\frac{1}{n} \sum_{i=1}^{n} (nD_i)^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}$$

→ where $\eta > 1$: deposits of different banks are substitutes

Simplifying assumptions

- Assume that $\varepsilon = 2$, so the liquidity function simplifies to

$$L(M, D) = \left(M^{1/2} + D^{1/2} \right)^2$$

- Assume that deposits D are provided by monopoly bank: $n = 1$

Demands for cash and deposits

- Let X denote opportunity cost of liquidity held by household

$$X = Mr + Ds$$

- What is the best way to allocate X between M and D?

$$\max_{M,D} \left(M^{1/2} + D^{1/2} \right)^2 \quad \text{subject to} \quad Mr + Ds = X$$

- Solution

$$L(M, D) = \mu X$$

→ where μ is the Lagrange multiplier given by

$$\mu = \frac{1}{r} + \frac{1}{s}$$

Households' maximization problem

- Substituting

$$W = W_0(1+r) - X \quad \text{and} \quad L = \mu X$$

into the household's utility function implies following problem

$$\max_X \left((W_0(1+r) - X)^{\frac{\rho-1}{\rho}} + (\lambda\mu X)^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}}$$

→ Supply of deposits of monopoly bank

$$D(s) = \frac{X}{\mu s^2} = \frac{W_0(1+r)}{\mu s^2[1+(\lambda\mu)^{1-\rho}]}$$

Bank's maximization problem

- Assuming that bank earns the bond return r in its investments

  → and given that the cost deposits is $r_D = r - s$

  → bank profits are given by

$$\pi(s) = [r - (r - s)]D(s) = sD(s) = \frac{W_0(1+r)}{\mu s[1 + (\lambda\mu)^{1-\rho}]}$$

- Monopoly bank chooses deposit spread

$$s^* = \arg\max_s \pi(s)$$

  → Equilibrium amount of deposits

$$D^* = D(s^*)$$

Counterexample on DSS claim

- DSS claim that an increase in r leads to a reduction in D^*

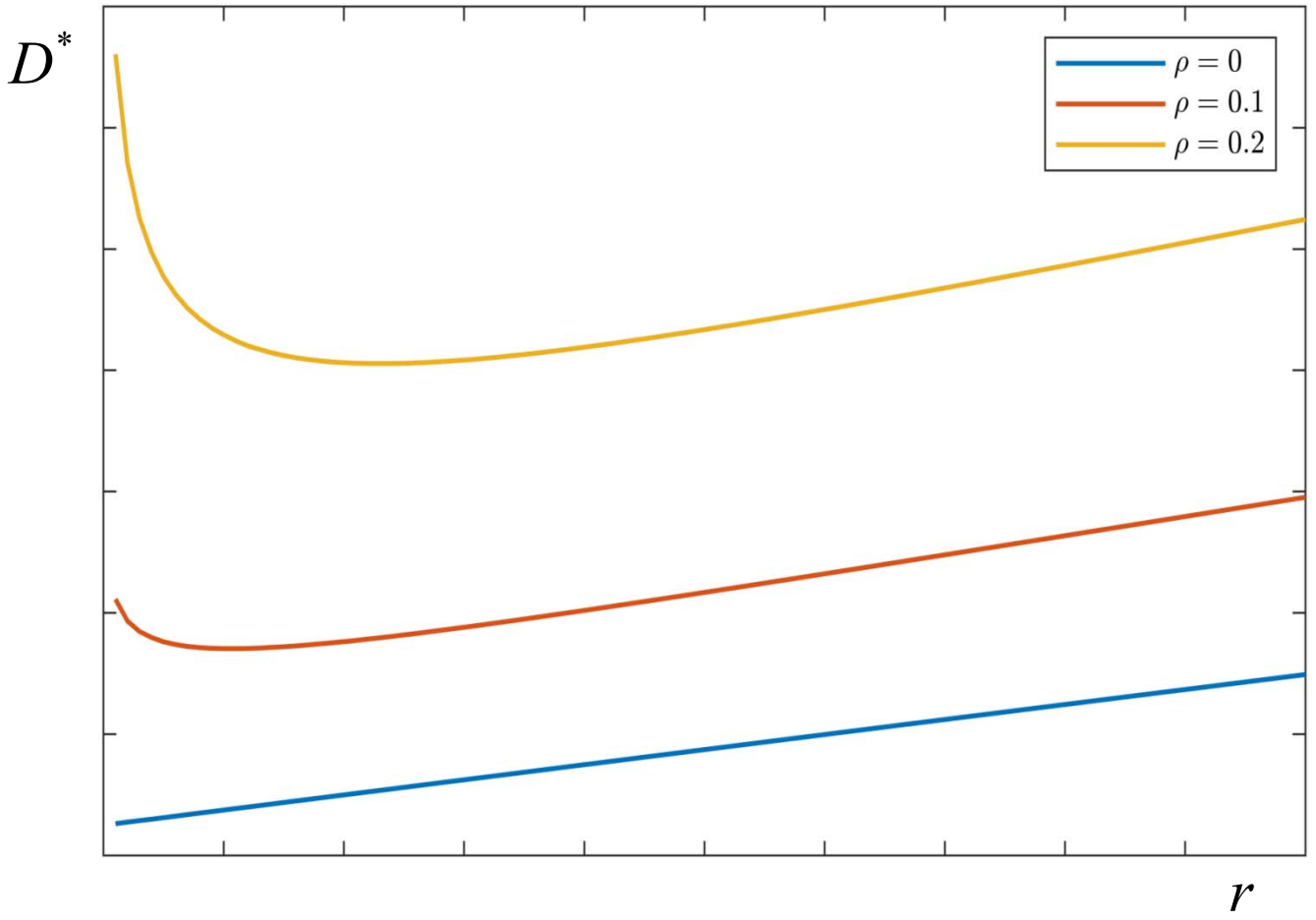
$$\frac{dD^*}{dr} = \frac{\partial D^*}{\partial r} + \frac{\partial D^*}{\partial s}\frac{\partial s^*}{\partial r} < 0$$

  → Deposits flow out of the banking system

- The following figure shows that this is not always the case

  → Numerical example for $\lambda = 4$ and $\rho = 0$, 0.1, and 0.2

U-shaped relationship in monopoly



Why downward-sloping region?

- When market rates are close to zero

  → All rates converge to the zero interest on cash

  → Liquid assets (cash and deposits) are better than bonds

  → Very high proportion of wealth is invested in liquidity

- As interest rates go up households gradually move into bonds

  → Region for which deposits are decreasing in market rates

Why upward-sloping region?

- Consider simpler model without cash
- Household's final wealth

$$W = W_0(1 + r) - Ds$$

- Effect on supply of deposits of increase in r decomposed into
  - → Negative substitution effect due to increase in spread s
  - → Positive income effect due to higher return to initial wealth
  - → Positive income effect dominates

Moving away from limit monopoly case

- DSS empirical results are about

  → Effect of changes in Fed funds rate on deposits

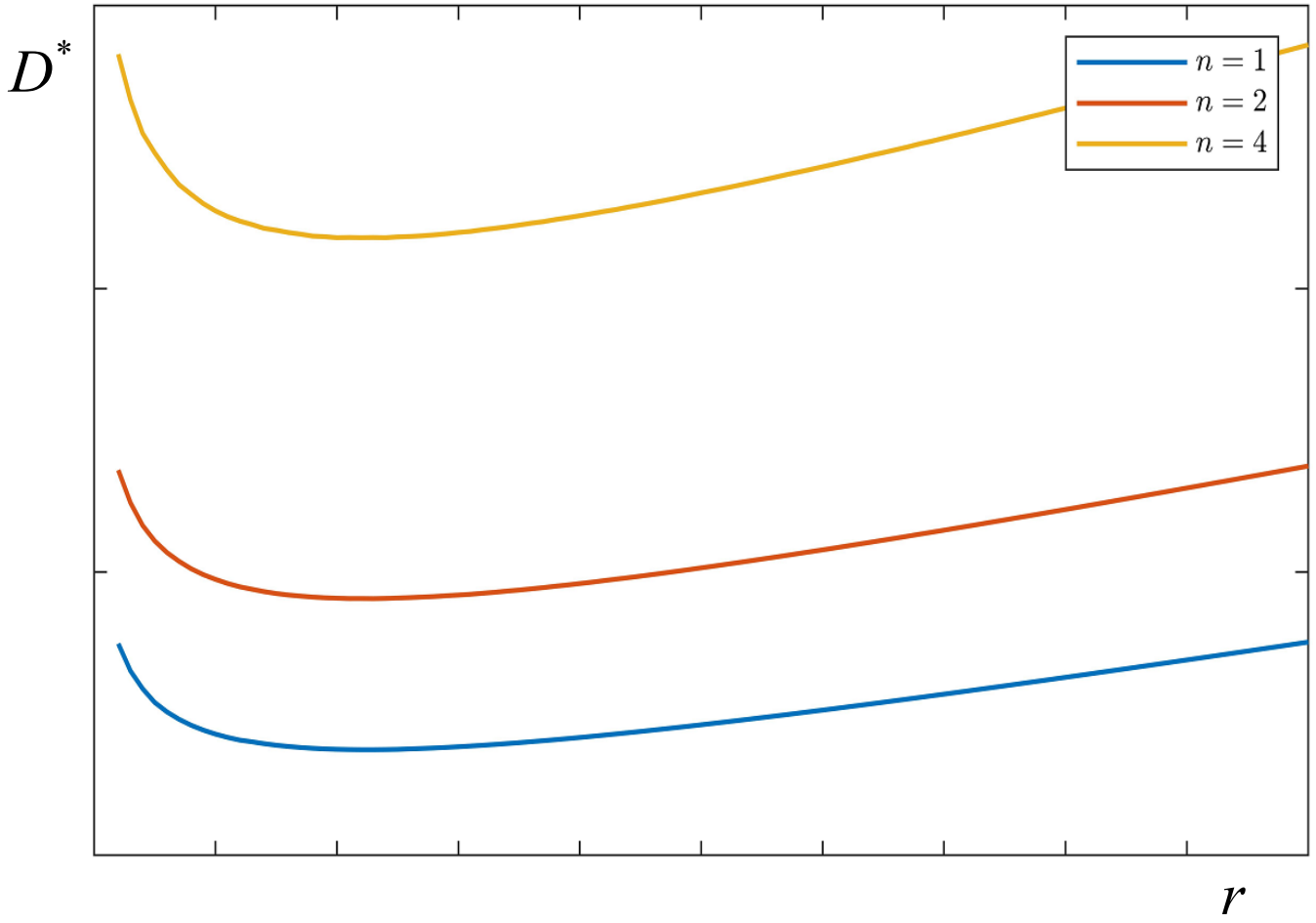
  → In local markets with different degrees of market power

- What happens when n banks compete by setting spreads s_i?

  → Nash equilibrium can be solved numerically

  → Same results as in the monopoly model

U-shaped relationship in oligopoly



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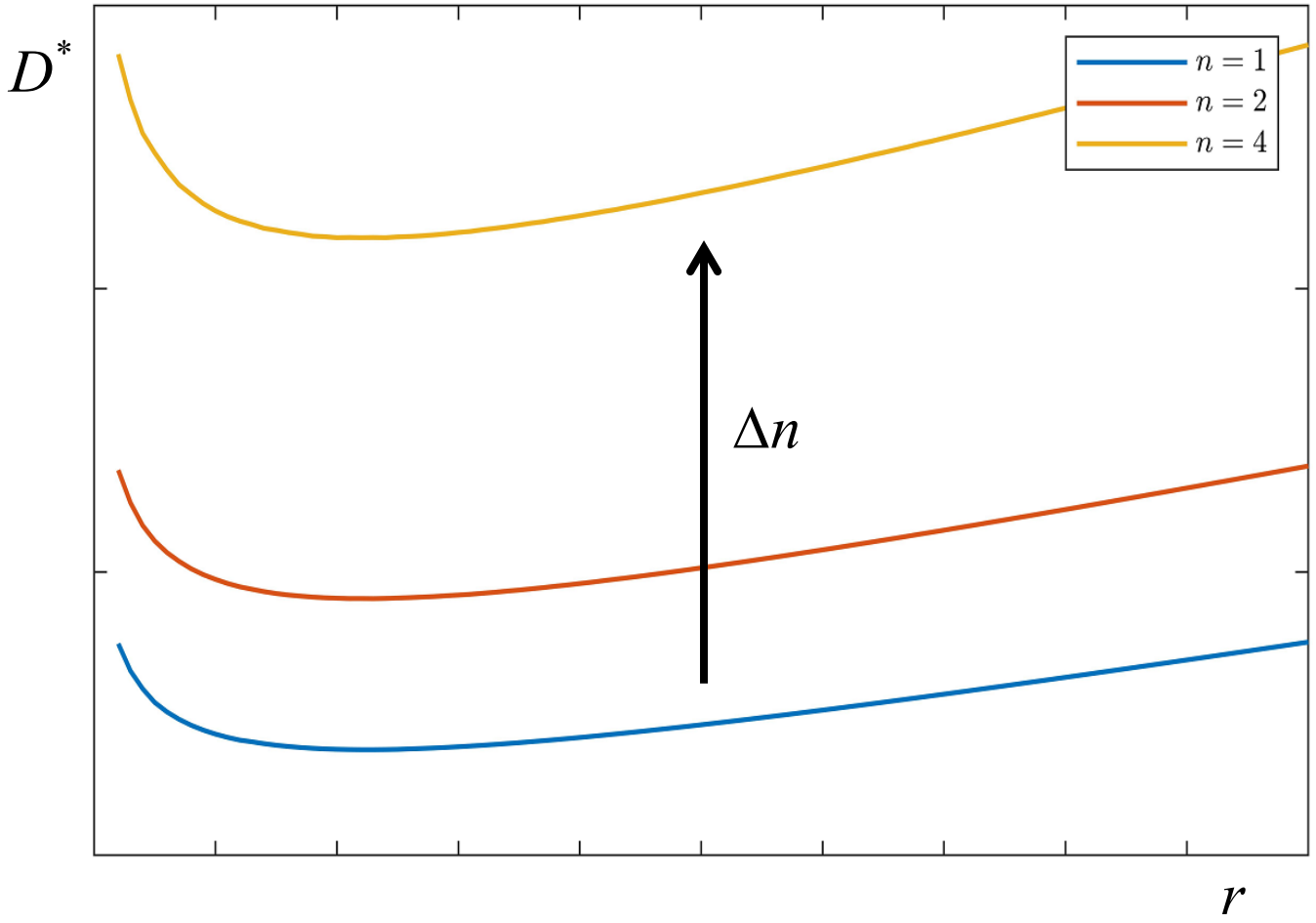

Alternative model

- Heterogeneous households
  - → Same level of wealth
  - → Different preferences for liquidity
- Households can invest in cash, deposits, and bonds
  - → Cash pay zero interest rate
  - → Deposits pay equilibrium deposit rate chosen by banks
  - → Bonds pay monetary policy rate r
- Compute Cournot equilibrium for market with n banks

Properties of equilibrium

- Deposits are increasing in the number of banks n

  → Higher competition leads to higher deposits

- Deposits are increasing in the market rate r

  → Contrary to the claim in DSS

- Cross derivative (of deposits with respect to n and r) is positive

  → As in empirical results in DSS

Final comment

- DSS look at effect of monetary policy on bank lending through the lens of deposit taking

  "Deposits are a special source of funding for banks, one that is not perfectly substitutable with wholesale funding."

- But if focus is on bank lending market power (and risk-taking) in lending should have a prominent role

  → Need models that encompass both sides of balance sheet

Summary and conclusion

Summing up

- Critical review of BK model

  → Reversal rate may not exist

  → If it does depends on bank characteristics

- Critical review of DSS model

  → Deposits may be increasing in the policy rate

  → Look for lending channel of monetary policy

Concluding remarks

- Results illustrate power of simple micro-io models of banking
- Approach could be extended to other relevant issues

  → The effect of introducing CBDCs
- But these models are essentially partial equilibrium

  → General equilibrium effects cannot be captured

  → Building block for better macro-finance models

Main references

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Appendix

DSS empirical results

Empirical model

- Key panel regression in DSS

$$\Delta D_{it} = \alpha_i + \gamma(\Delta r_t \times HHI_i) + \text{ Controls} + \varepsilon_{it}$$

→ ΔD_{it} : Annual log change in deposits of branch *i*

→ Δr_t : Change in Fed funds rate target

→ HHI_i : Herfindahl index of county where branch *i* is located

Interpretation of results

- DSS interpretation

> "Following an increase in the Fed funds rate, bank branches in more concentrated counties experience **larger outflows** relative to branches in less concentrated counties."

Interpretation of results

- DSS interpretation

  "Following an increase in the Fed funds rate, bank branches in more concentrated counties experience **larger outflows** relative to branches in less concentrated counties."

- Alternative interpretation

  "Following an increase in the Fed funds rate, bank branches in more concentrated counties experience **smaller inflows** relative to branches in less concentrated counties."

DSS unwarranted conclusion

- DSS use panel results to conclude

  "When the Fed funds rises, banks widen the spreads they charge on deposits, and **deposits flow out of the banking system**."

- But the fact that γ is negative and statistically significant in panel regression does not imply that increases in the Fed funds rate lead to reductions in the aggregate amount of deposits

  → It's a result on **relative not overall** changes in deposits