Deposit Insurance and Money Market Freezes

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Research Question

What are the causes and consequences of a money market freeze?

The basic idea

- Money Markets (MM) facilitate the reallocation of funds from banks which can raise a lot of deposits to banks that cannot raise a lot of deposits
- In the presence of deposit insurance (DI), an increase in the risk of bank failure can disrupt MM and cause a freeze, with consequences of the real economy.

Key ingredients

1. Interregional savings/ investment imbalances:
   - There are regions. They have similar investment opportunities, but heterogeneous endowments of savings.
   - Labor markets and retail financial markets are regionally segmented.

   $\Rightarrow$ Banks use MM to borrow from and lend to each other (i.e. to reallocate savings across regions)

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2. Deposits are insured.
3. Crisis = exogenous increase in counterparty risk (solvency shock to firms $\rightarrow$ banks).
   - Banks that lend in MM remain financed at cheap deposit rates, banks that borrow in MM have to pay high MM spreads.
   - Allocation of capital across regions becomes asymmetric, spreads of 200bp $\rightarrow$ reductions of $\approx 75\%$ in MM volumes.

Related literature

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- Bhattacharya and Gale (1987) tradition:
  Heider-Hoerova-Holthausen (09), Freixas-Jorge (08),
  Allen-Carletti-Gale (08)
- Other approaches:
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Contribution: DI as a key latent distortion, more macro angle.

The Model: Overview

- Perfect competition, t=0,1, $j \in [0,1]$ regions, single good per period.
- Risk-neutral agents. In each region j:
  - a representative household
  - a (continuum of) firms
  - a representative bank
- a money market

A representative household

A representative household (in each j) with

- Exogenous initial savings:

$$\begin{cases} S_H & \text{in fraction } \pi \text{ of high-savings regions} \\ S_L < S_H & \text{in fraction } 1-\pi \text{ of low-savings regions} \end{cases}$$

- Inelastic labor supply $n_j = 1$ at (pre-paid) wage w_j
- the only means of transferring wealth being
  - insured regional deposits d_j: pay (expected) rate r_{dj}, promised rate $r_{dj} + s_{dj}$.
  - Bank equity e_j: residual claim.

A continuum of firms

(firms owned by penniless *entrepreneurs*)

- CRS technology

$$(k_i, n_i) \to \widetilde{z}_{ij}[AF(k_i, n_i) + (1-\delta)k_i] + (1-\widetilde{z}_{ij})(1-\lambda)k_i$$

where: $\widetilde{z}_{ij} \in \{0, 1\}$ indicates success or failure
$F(k_i, n_i) = k_i^{\alpha} n_i^{1-\alpha}$, with $\alpha \in (0, 1)$
δ, λ are depreciation rates

- Regional failure rate is

$$x_j = \begin{cases} 1 & \text{with prob. } \varepsilon \quad \text{(all firms fail at once)} \\ p & \text{with prob. } 1-\varepsilon \quad \text{(iid failures with pr } p\text{)} \end{cases}$$

- The "$x_j = 1$ events" are independent across regions.
- Firms pay in advance for (k_i, n_i) using a bank loan

$$\text{Obtain } l_{ij} = k_{ij} + w_j n_{ij} \;\longrightarrow\; \text{Pay } \min\{R_{ij}, (1-\lambda)k_{ij}\}$$

A representative bank

(bank owned by coalition of households)

Assets		Liabilities	
l_j	Loans	Deposits	d_j
a_j	Net MM assets	Equity	e_j

[a_j: net lending (>0) or net borrowing (<0)]

- Perfect competition (free entry)
- Firm-bank contract sets $(k_{ij}, n_{ij}, l_{ij}, R_{ij})$

  By virtue of competition:
  - Entrepreneur's surplus is maximized
  - Bank breaks even: $\max E[\text{final net worth}] = (1 + r_{dj})e_j$

The money market & the government

- MM liabilities = unsecured debt, junior to deposit liabilities.
- MM lending pays (expected) rate r, promised rate $r + s$.
- The government
  - grants / does not grant DI.
  - imposes diversification of lending across regional firms
  - imposes diversification of MM lending across banks
  - imposes minimum capital requirement: $e_j \geq \gamma l_j$

Parametric restrictions

A1 The capital requirement is low enough to guarantee that when all firms in a region fail ($x_j = 1$), the corresponding regional bank goes bankrupt.

A2 Deposit liabilities in low-savings regions are large enough for the recoveries of MM lenders to be zero.
$\Rightarrow$ spread is flat:

$$(1 - \varepsilon)(1 + r + s) = 1 + r$$

Economy without DI

- Banks have limited liability.

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- For MM borrower *and* MM lender, if $r_d > r$, banks prefer MM funding, deposits not used. If $r_d < r$, could increase deposits and MM lending without limit, make profits.
- Banks are indifferent between deposits and equity.

PCs

Marginal productivity of k is equalized across regions

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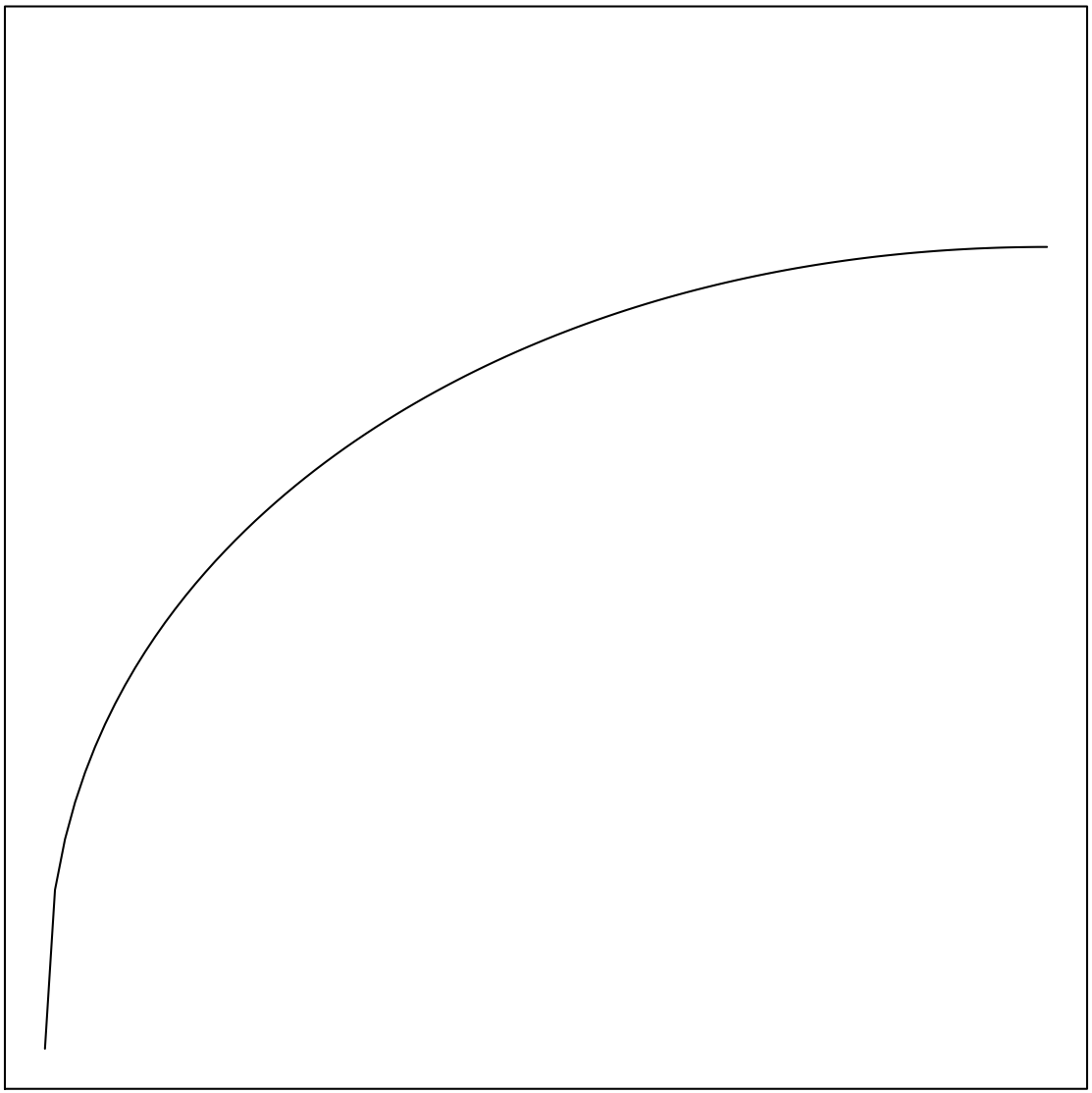

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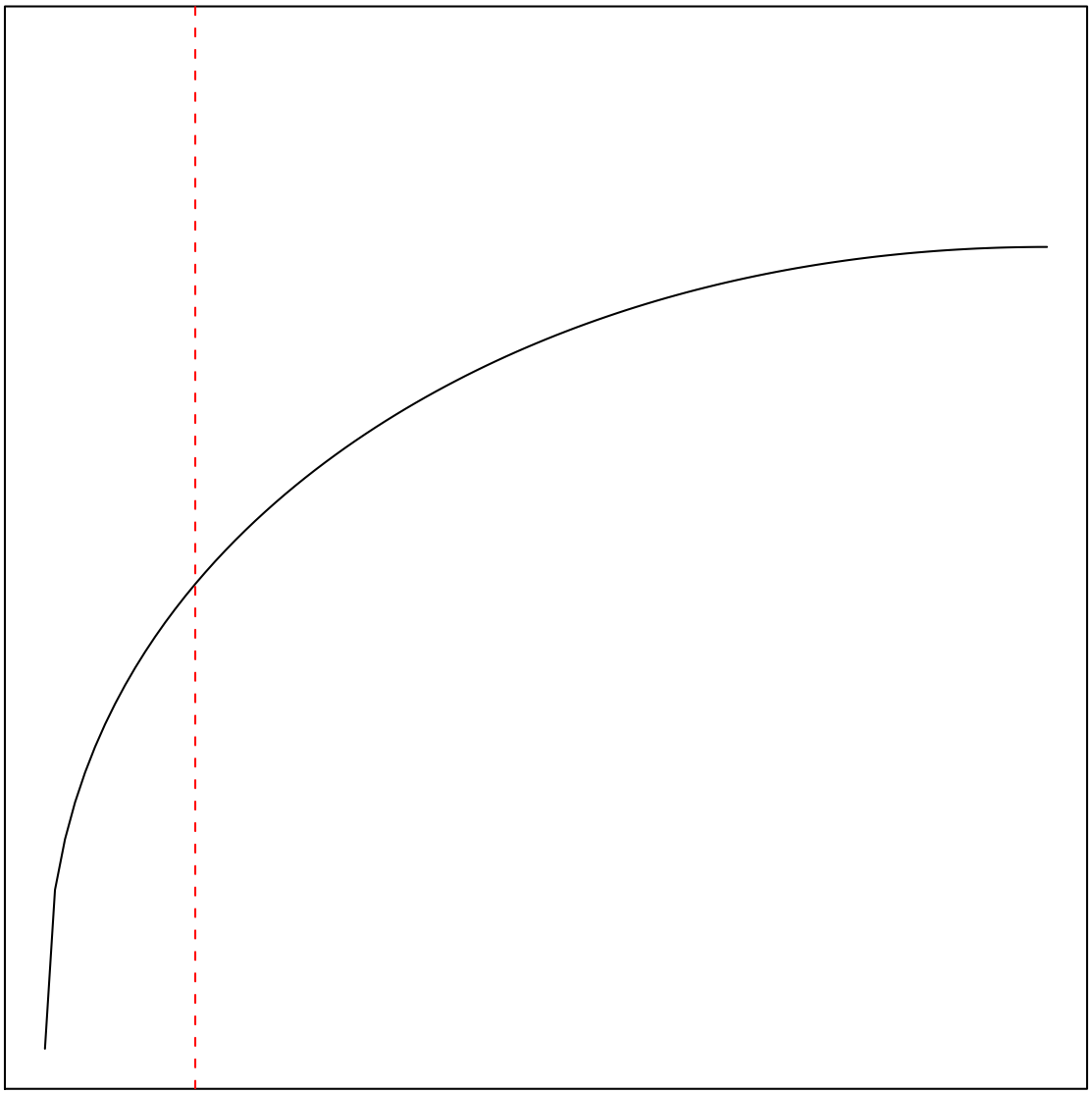

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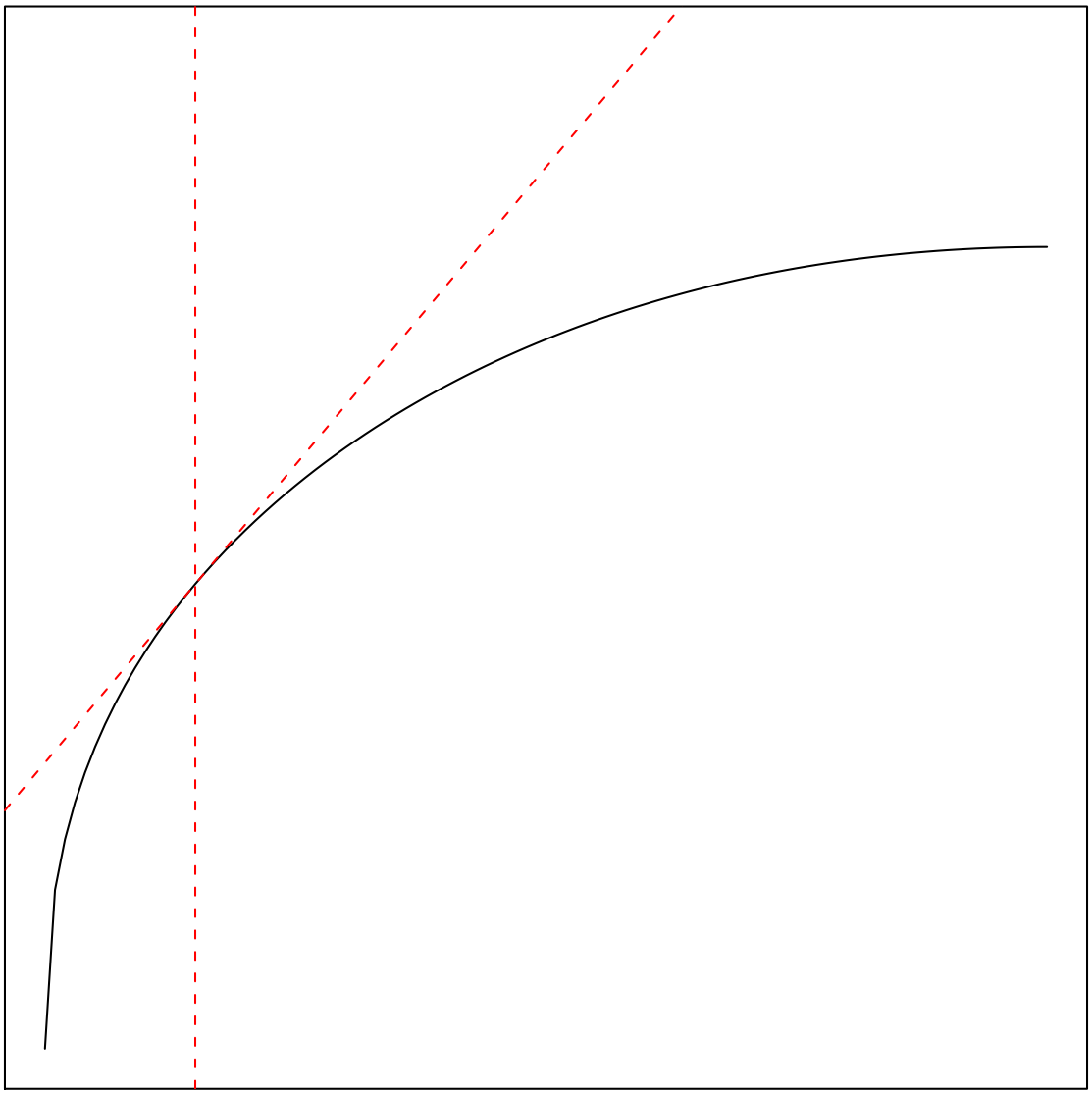

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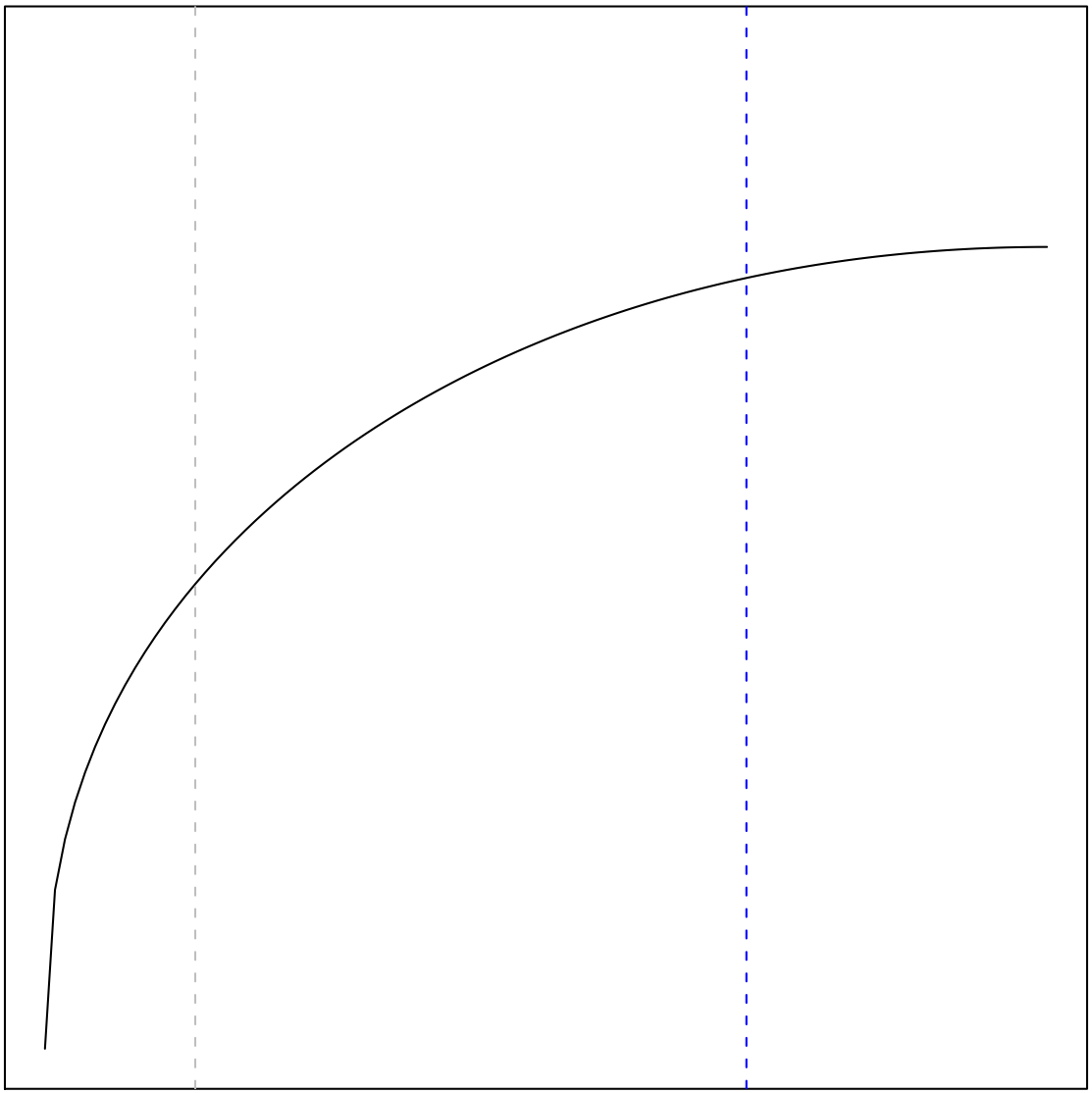

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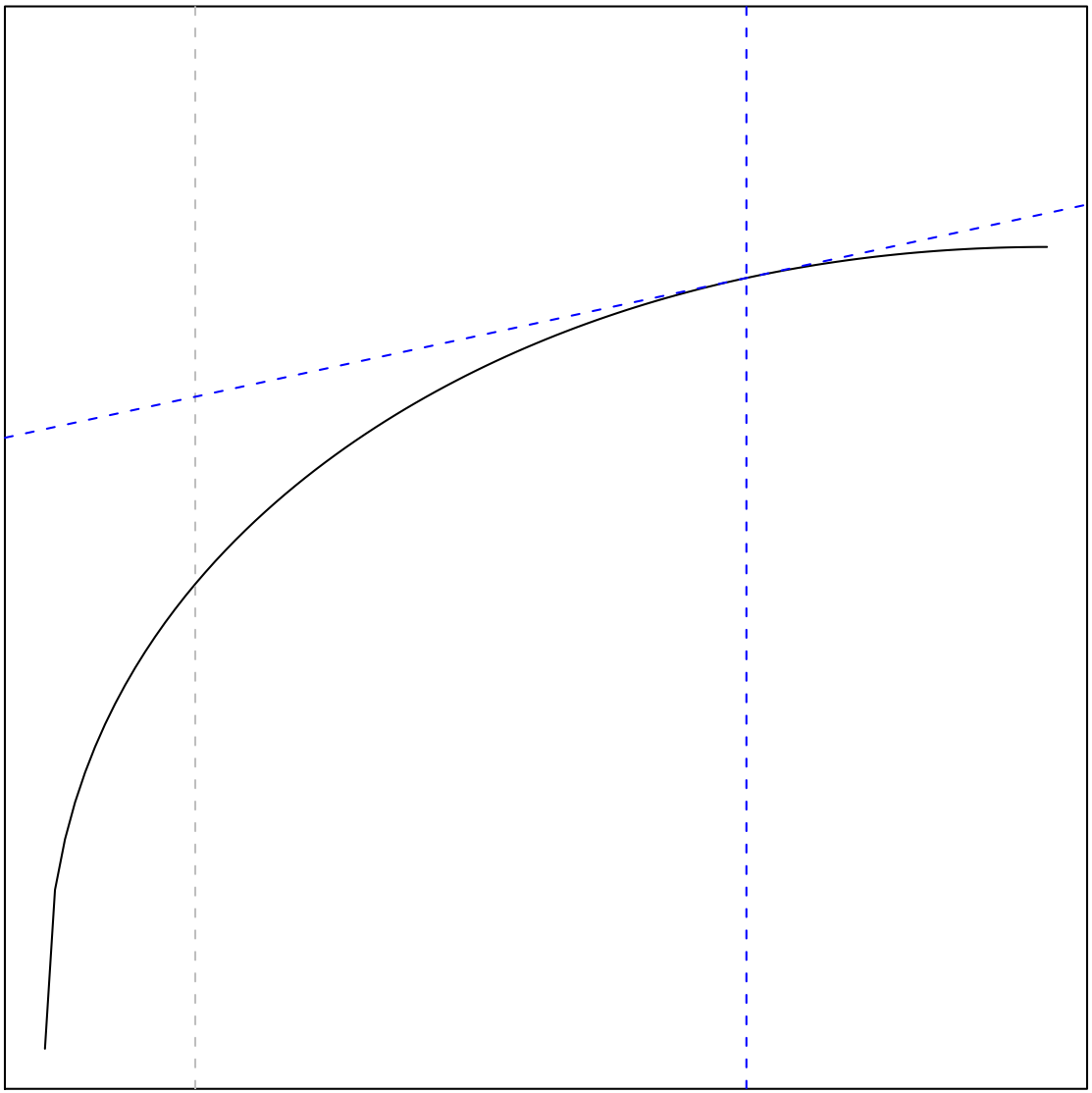

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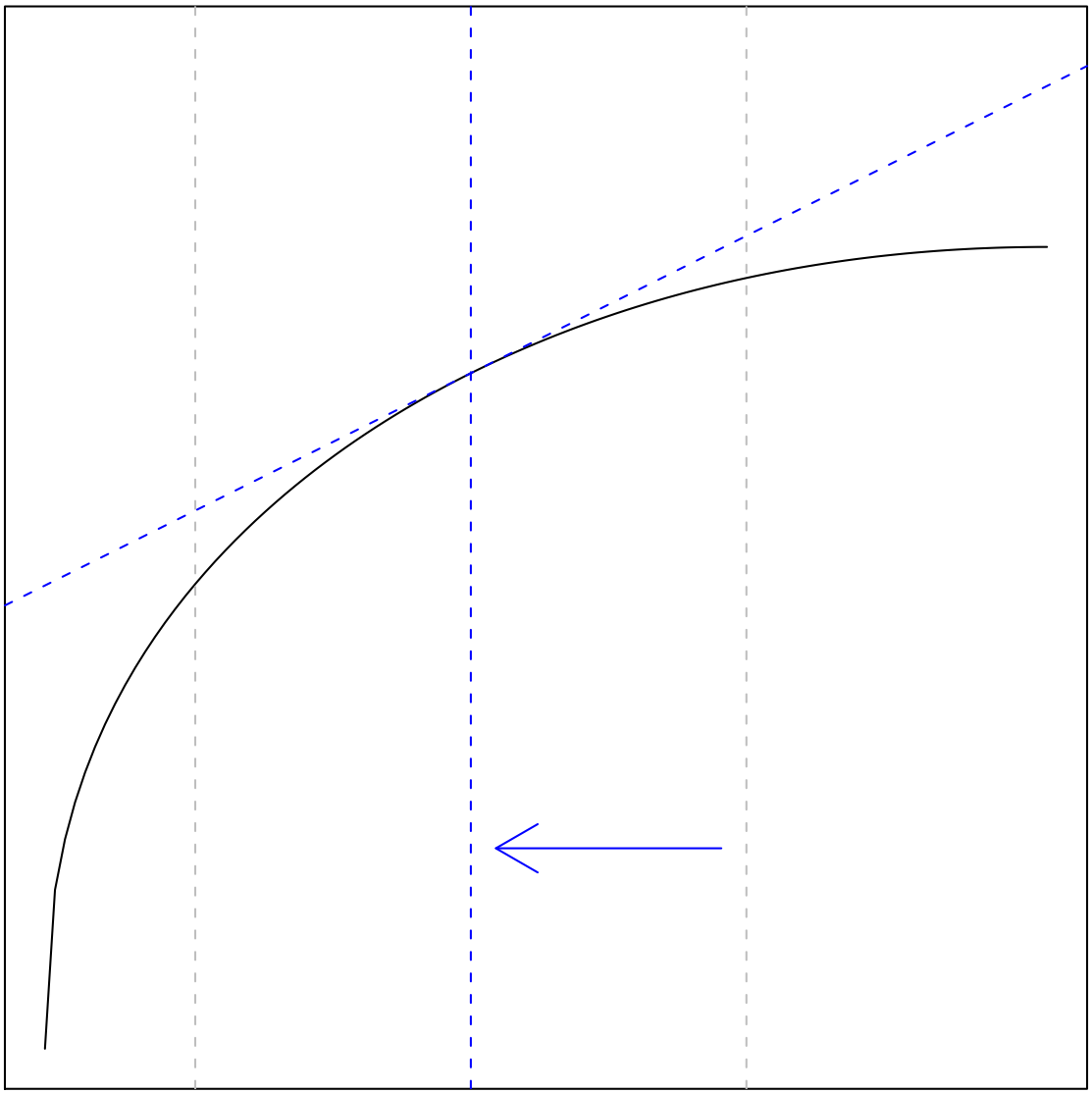

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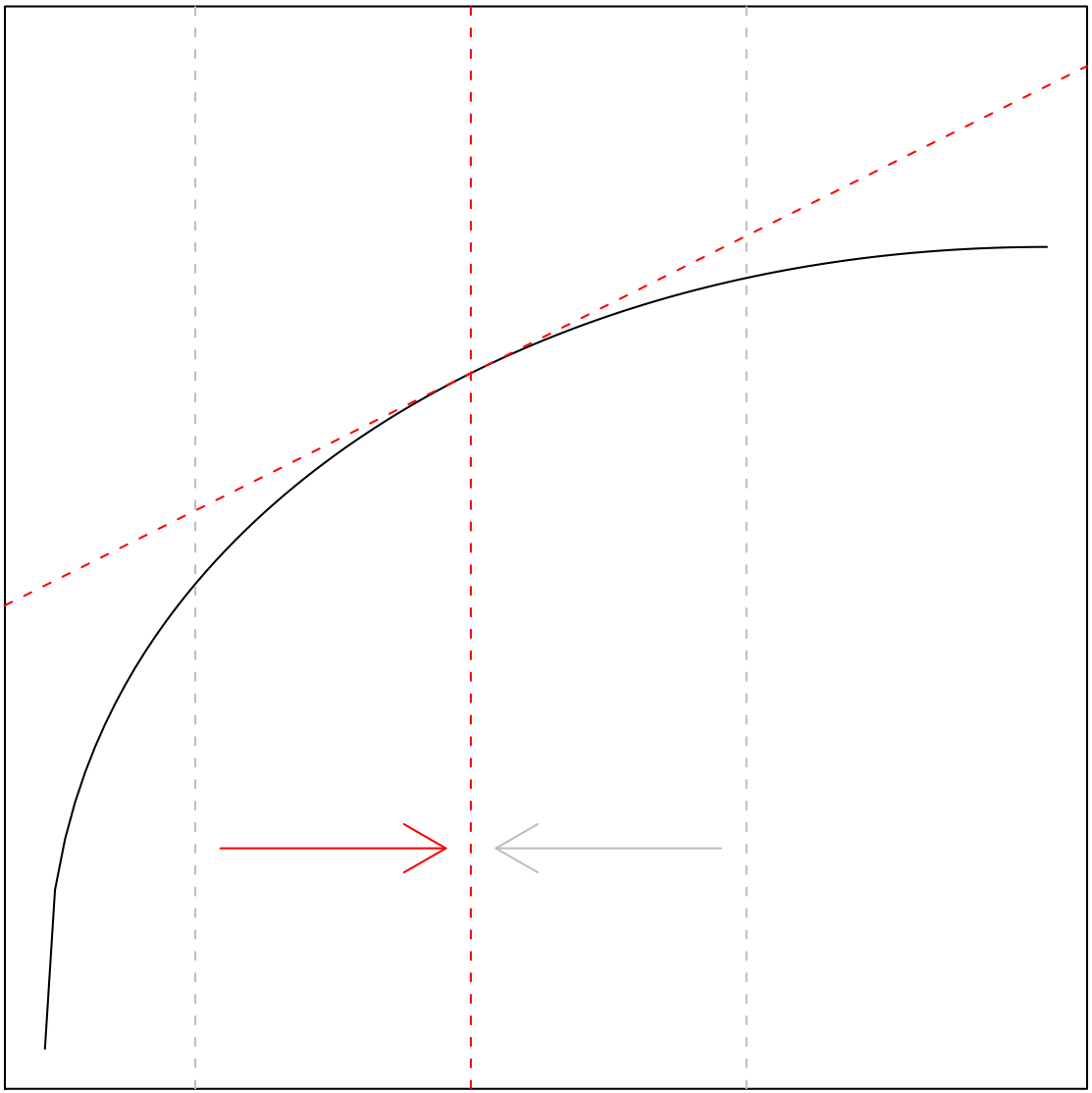

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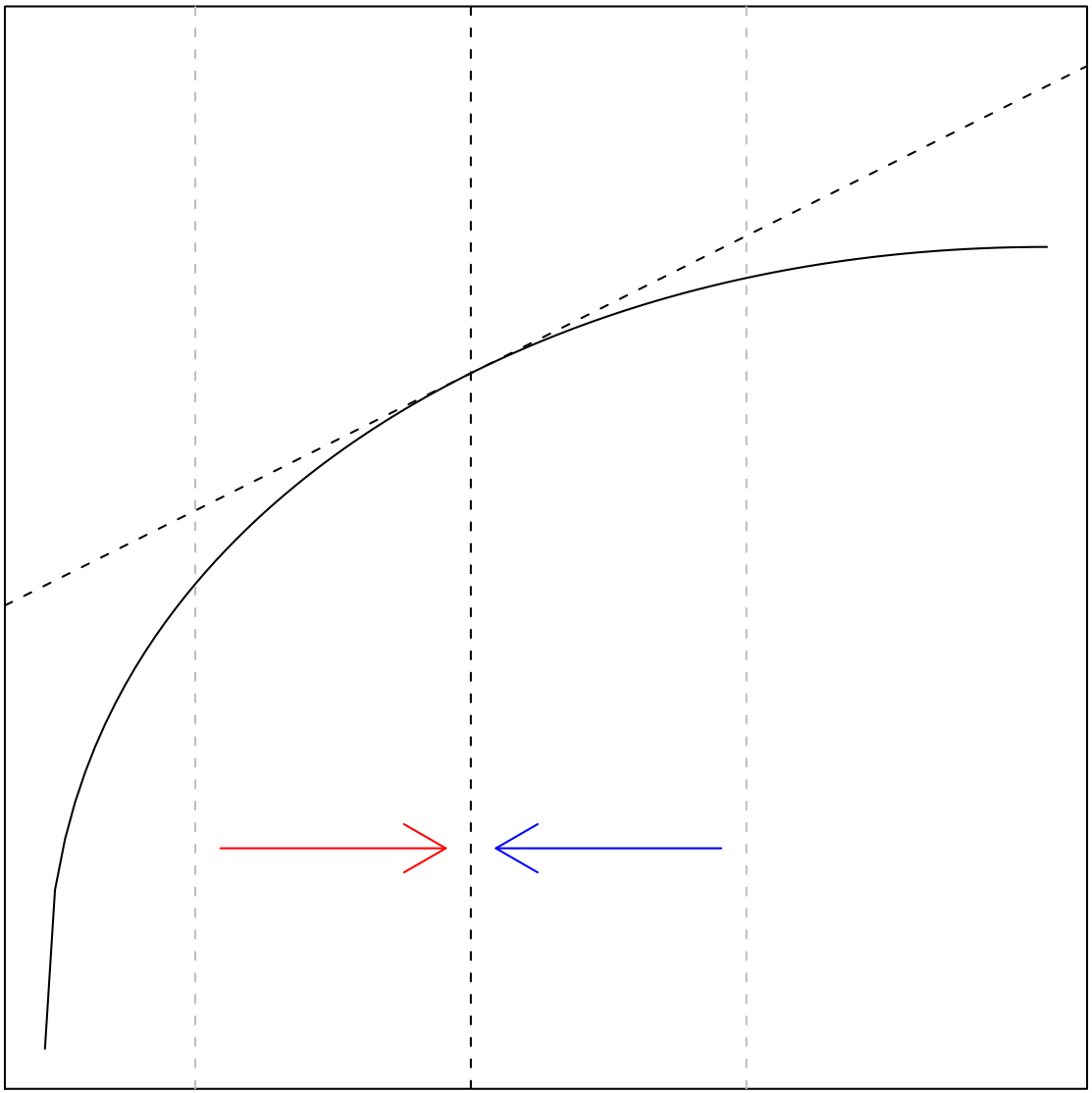
- For MM borrower, $r_d = r + s$, for MM lender, $r_d = r$ (otherwise, prefer one source of funding).
- Banks prefer cheaper insured deposits over equity.

PCs

Marginal productivity of k is not equalized across regions



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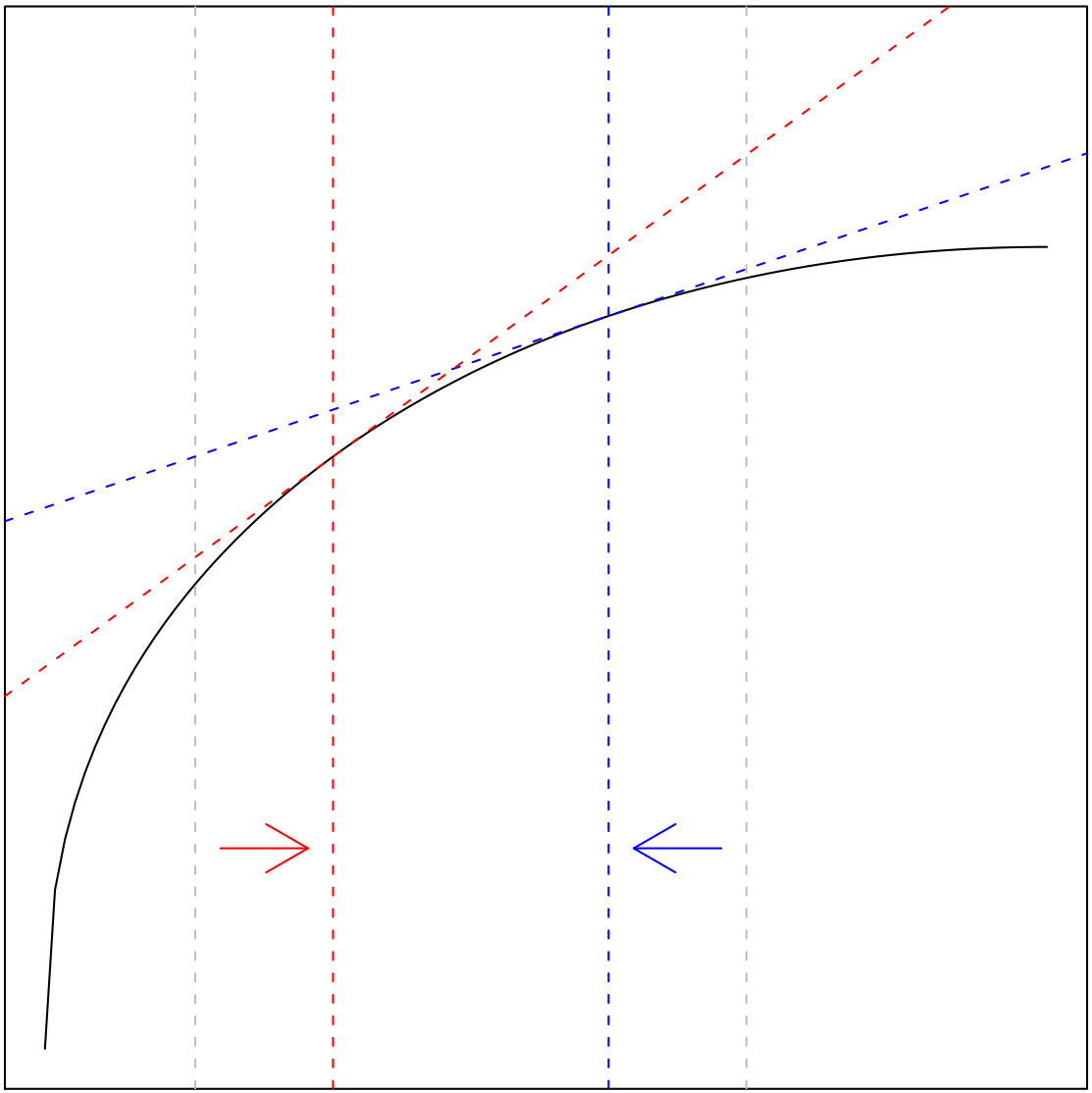

Table 1: Calibration (*)

[. . .]

Panel B. Calibration targets

Variables		Values
Macroeconomic:	Pre-crisis MM funding / GDP	30%
	Pre-crisis MM rate	4%
	Labor share	70%
	Capital / GDP ratio	3
Financial:	MM spread	0%-2%
	Loan def. prob.	3%-5%
	Loan LGD	45%

parameters

Table 2: The effects of counterparty risk

		Probability of bank failure (ε)			
		0%	1%	2%	3%
Deposit rates	H	4.00	3.43	2.92	2.62
	L	4.00	4.48	5.02	5.33
MM / base GDP	Aggr.	31.86	19.29	6.93	0.00
Loan rates	H	5.56	5.04	4.59	4.36
	L	5.56	6.15	6.82	7.24
DI costs / base GDP	H	0.00	1.70	3.53	5.41
	L	0.00	1.14	2.63	4.24
	Aggr.	0.00	1.42	3.08	4.83

		Probability of bank failure (ε)		
		1%	2%	3%
Capital	H	7.89	15.65	20.00
	L	-7.89	-15.65	-20.00
GDP	H	1.28	2.37	2.45
	L	-3.41	-6.88	-9.28
	Aggr.	-1.06	-2.25	-3.41

Demand externalities (*)

- Effects of asymmetric allocation of k on output are small.
- Trade linkages? Demand externalities?
- Here: Reduced-form: Make A a CES aggregator of the levels of activity in the various regions:

$$A = \left[\int_0^1 k_j^\rho dj \right]^{\frac{\tau}{\rho}}$$

Table 3: Amplification via demand externalities (*)

		Probability of bank failure (ε)			
		0%	1%	2%	3%
Deposit rates	H	4.00	3.36	2.64	2.23
	L	4.00	4.40	4.73	4.82
MM / base GDP	Aggr.	31.86	19.20	6.22	0.00
Loan rates	H	5.56	4.96	4.29	3.95
	L	5.56	6.07	6.51	6.70
DI costs / base GDP	H	0.00	1.69	3.48	5.27
	L	0.00	1.13	2.60	4.12
	Aggr.	0.00	1.41	3.04	4.70

		Probability of bank failure (ε)		
		1%	2%	3%
Capital	H	7.95	16.10	20.00
	L	-7.95	-16.10	-20.00
GDP	H	0.51	-0.67	-2.30
	L	-4.18	-9.89	-13.49
	Aggr.	-1.84	-5.28	-7.89

Asymmetry of costs of insured v. uninsured funding

- Could eliminate DI, but we cannot provide full welfare analysis here.
- Could charge "fair" DI premia, but "formula" might be hard.
- Could insure MM funding $\longrightarrow$ fixed-rate full-allotment lending.

Table 4: Effects of subsidizing c.p. risk (*)

		Prob. of bank failure (ε)		
		1%	2%	3%
Cost of subs. / base GDP	Aggr.	0.33	0.66	0.99
Reduct. in DI costs / base GDP				
– Without dem. ext.	H	0.08	0.30	0.57
	L	0.18	0.72	1.39
	Aggr.	0.13	0.51	0.98
– With dem. ext.	H	0.07	0.25	0.43
	L	0.17	0.69	1.27
	Aggr.	0.12	0.47	0.85
Improvm. in GDP / base GDP				
– Without dem. ext.	H	-2.28	-4.37	-5.45
	L	2.41	4.88	6.28
	Aggr.	0.06	0.25	0.41
– With dem. ext.	H	-1.51	-1.33	-0.70
	L	3.18	7.89	10.49
	Aggr.	0.84	3.28	4.89

Conclusions

- The model highlights
  - the role of money markets in allocating capital across banks
  - the distortions arising from DI when the risk of bank failure become significant.
- Modest rise in counterparty risk can make MMs freeze, causing severe distortions to allocation of credit
- With demand externalities, the implications for aggregate output can be large
- Absorption or subsidization of counterparty risk by the government can reduce the effects of the distortion

Appendix

Panel A. Parameter values

Parameters			Value
Savings:	Measure of high-savings regions	π	0.5
	Savings asymmetry	$\mu \equiv \pi S_H / \bar{S}$	0.6
Techn.:	Capital elasticity parameter in F	α	0.3
	Depreciation rate if success	δ	4.5%
	Depreciation rate if failure	λ	35%
Risk:	Probability of idiosyncratic firm failure	p	3%
	Probability of bank failure	ε	0%-2%
Frict.:	Capital requirement	γ	8%

PC without DI

PC borrower:

$$(1-\varepsilon)[(1-p)R+p(1-\lambda)k-(1+r+s)(l-d-e)-(1+r_d+s_d)d] \geq (1+r_d)e.$$

PC lender:

$$(1-\varepsilon)[(1-p)R+p(1-\lambda)k+(1+r)(d+e-l)-(1+r_d+s_d)d] \geq (1+r_d)e.$$

$\Rightarrow$ the *same* PC:

$$(1-\varepsilon)[(1-p)R+p(1-\lambda)k]+\varepsilon(1-\lambda)k-(1+r)(l-d-e)-(1+r_d)d \geq (1+r_d)e.$$

PC with DI

PC borrower:

$$(1-\varepsilon)[(1-p)R+p(1-\lambda)k-(1+r+s)(l-d-e)-(1+r_d+s_d)d] \geq (1+r_d)e. \quad (1)$$

PC lender:

$$(1-\varepsilon)[(1-p)R+p(1-\lambda)k+(1+r)(d+e-l)-(1+r_d+s_d)d] \geq (1+r_d)e. \quad (2)$$

$\Rightarrow$ *different* PC:

$$(1-\varepsilon)[(1-p)R+p(1-\lambda)k-(1+r+s\xi)(l-d-e)-(1+r_d)d] \geq (1+r_d)e, \quad (3)$$