

# Zombie Lending and Policy Traps

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**Zombie lending** (ZL) is the provision of subsidized credit to poorly performing firms

Topical issue

Japan 1990-, Europe 2008-, India 2012-, China, US?

Burgeoning empirical evidence but scant theoretical work

e.g., Caballero-Hoshi-Kashyap (2008) model **without banks/policies**

**This paper:** Equilibrium model of ZL consistent with evidence

- **Diabolical sorting** of undercapitalized banks with distressed borrowers
- **Reversal** level of unconventional policy due to ZL
- Dynamic interplay of policies & ZL can lead to **policy trap** and long-run **sclerosis**
- Importance of maintaining well-capitalized banks in good times

# Model

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# Model

A theory of ZL with the key empirical features

- **Heterogeneous firms**
- **Heterogeneous banks**
- **Policies affect ZL**

# Heterogeneous firms: technology

Two types  $i = G, B$

type  $i$  project yields  $\begin{cases} y^i(z) & \text{with prob. } \theta^i \\ 0 & \text{with prob. } 1 - \theta^i \end{cases}$

Projects require

- \$1 of capital borrowed from a bank
- idiosyncratic cost  $\epsilon \in [0, \bar{\epsilon}] \sim \text{cdf } H$

G firms safer and better than B:

$$\theta^g > \theta^b$$

$$\theta^g y^g - \bar{\epsilon} > \theta^b y^b$$

# Heterogeneous firms: entry and exit

Firm with type  $i$  and cost realization  $\epsilon$  produces if  $\mathbf{E}[\text{profit}^i] \geq 0$  or

$$\epsilon \leq \theta^i(y^i - R^i)$$

Total mass 1 of active firms

$\lambda$  incumbents become distressed **B**,  $1 - \lambda$  remain healthy **G**

Fringe of  $\lambda$  potential **G** entrants

**Creative destruction:** **G** entrants replace **B** incumbents...  
...if they obtain the capital

# Heterogeneous banks

Mass 1 of banks with equity  $e \sim$  cdf  $F$  over  $[e_{\min}, e_{\max}] \subset (0, 1)$   
 $e$  exogenous for now, endogenous later

Bank with capital  $e$  borrows  $1 - e$  debt, invests 1 in either

- safe assets: return  $\mathbf{R}^f$  with prob.  $\theta^f = \mathbf{1}$
- loan to G firm: return  $\mathbf{R}^g$  with prob.  $\theta^g$ , 0 otherwise
- loan to B firm: return  $\mathbf{R}^b$  with prob.  $\theta^b$ , 0 otherwise

“Switching cost” of recognizing losses on legacy B borrower:  $e \rightarrow e - \delta$

- $\delta > 0$  leads to evergreening in presence of cap. requirements
- start with  $\delta = 0$ : frictionless reallocation

# Two policy tools

**Conventional monetary policy  $R^f$**  affects:

- return on safe assets = hurdle rate for lending
- banks' cost of funds

but may be constrained by  $R^f \geq$  ELB constraint

**“Forbearance”  $p$**  captures any lending subsidy:

- regulatory forbearance
- deposit insurance
- bailouts/lender of last resort
- unconventional policy: ECB's OMT, Fed lending programs

Assume  $p$  untargeted [vs. targeted  $p(i, e)$ ], has fiscal cost



# Banks' choices

**Investment choice:** Expected return from choice  $i$  for bank with capital  $e$

$$\theta^i \left[ R^i - \tilde{R}^i(1 - e) \right]$$

where rate on debt  $\tilde{R}^i$  depends on policy variables  $(R^f, p)$

**Debt pricing:** Debt holders require expected return  $R^f$ , hence rate  $\tilde{R}^i$

$$\theta^i \tilde{R}^i + (1 - \theta^i)p = R^f$$

where  $p \in [0, 1]$  denotes lending subsidy set by policy

$p = 0$ : Modigliani-Miller (and no ZL)

# Roadmap

## 1. Equilibrium in the static model

**Diabolical sorting:** undercapitalized banks lend to bad firms

## 2. Optimal policy

**Combination of monetary policy  $R^f$  and subsidy  $p$**

## 3. Dynamic model and policy

**Policy trap and sclerosis:** transitory shocks can lead to permanent output losses

## 4. Extensions

Equity issuance

Capital requirements useful ex ante but **can backfire if raised too late**

# Diabolical sorting of weak banks and weak firms

## Proposition

- Banks with equity  $e < e^*$  lend to a B borrower
- Banks with  $e^* < e < e^{**}$  lend to a G borrower
- Banks with  $e > e^{**}$  do not lend and invest in safe assets

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$$\theta^i \left[ R^i - \tilde{R}^i(1 - e) \right] = \underbrace{\theta^i R^i - R^f}_{\text{M-M return}} + \underbrace{p(1 - \theta^i)(1 - e)}_{\text{subsidy}}$$

⇒ complementarity between policy  $p$ , risk  $1 - \theta^i$  and leverage  $1 - e$

# General equilibrium

## Supply of loans

to B firms:  $F(e^*)$

to G firms:  $F(e^{**}) - F(e^*)$

## Demand for loans

from B firms:  $\lambda \cdot H(\theta^b(y^b - R^b))$

from G firms:  $H(\theta^g(y^g - R^g))$

**Loan market clearing** [ $e^*$ ,  $e^{**}$  depend on  $R^b$ ,  $R^g$  and policy]

$$F(e^*) = m^b = \lambda \cdot H(\theta^b(y^b - R^b))$$

$$F(e^{**}) - F(e^*) = m^g = H(\theta^g(y^g - R^g))$$

# Aggregate output

Let  $\underline{Y}$  = (inelastic) baseline output from investing in safe assets, with

$$\theta^b y^b < \underline{Y} < \theta^g y^g - \bar{\epsilon}$$

Aggregate output  $Y$

$$Y \leq Y^* = \theta^g y^g - \mathbf{E}[\epsilon]$$

**Potential output  $Y^*$**  is attained when all banks lend to G firms

- no bank lends to B firm ( $e^* \leq e_{\min}$ )
- no bank invests in safe assets ( $e^{**} \geq e_{\max}$ )

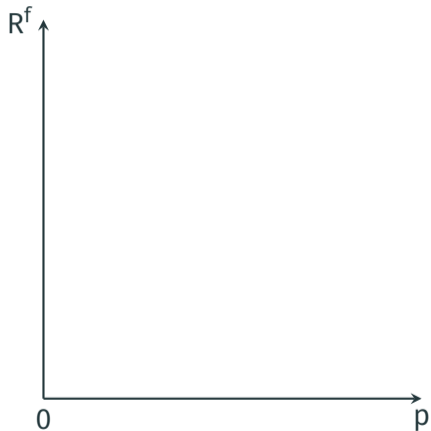
Requires **maximal creative destruction**: all B incumbents are replaced by entrants

Next: can policy  $(R^f, p)$  implement  $Y^*$ ?

# Policy

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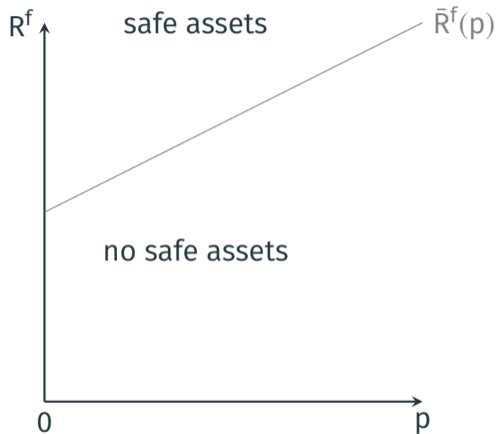
**Which combinations  $(R^f, p)$  can achieve  $Y^*$ ?**





## Which combinations $(R^f, p)$ can achieve $Y^*$ ?

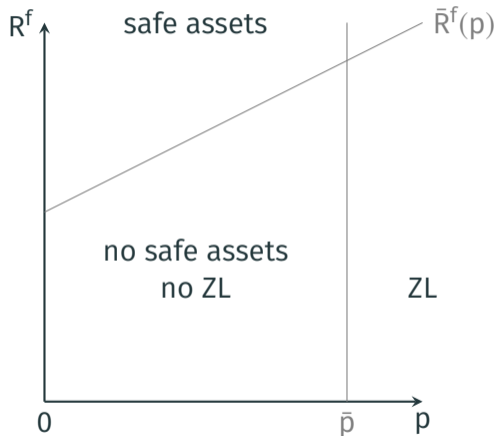
No safe assets  $\Leftrightarrow e^{**} \geq e_{\max}$   
 $\Leftrightarrow R^f \leq \bar{R}^f(p)$



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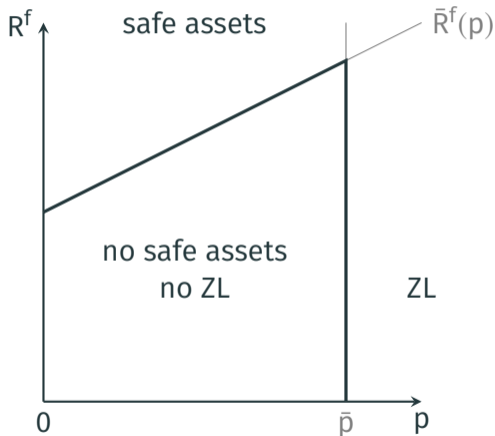
No ZL  $\Leftrightarrow e^* \leq e_{\min}$   
 $\Leftrightarrow p \leq \bar{p}$



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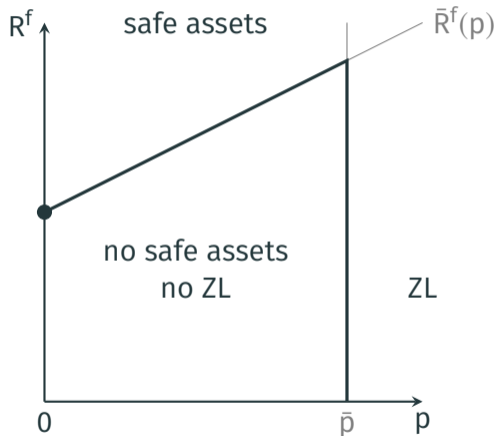
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$$\Leftrightarrow p \leq \bar{p}$$



# Shocks $z$ to potential output

Macro supply/demand/financial shock leads to **output loss**  $z \geq 0$  for good firms

$$y^g(z) = \bar{y}^g(1 - z)$$

More generally **gap-reducing shocks**  $\frac{d}{dz} [\theta^g y^g - \theta^b y^b] < 0$

⇒ Potential output  $Y^*$  depends on  $z$

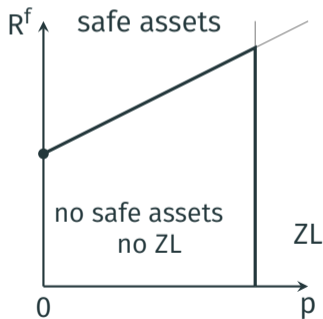
$$Y^*(z) = \theta^g \bar{y}^g(1 - z) - \mathbf{E}[\epsilon]$$

**Q: What is the optimal joint policy response** ( $R^f(z), p(z)$ )?

# Unconstrained interest rate policy

## Proposition

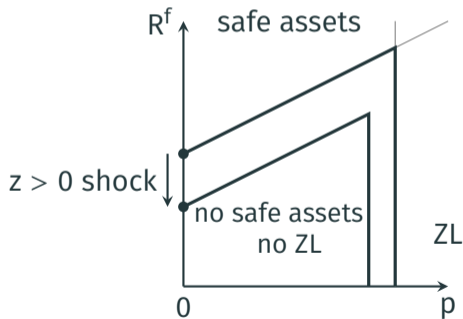
If  $R^f$  can adjust freely, **conventional MP alone**  $R^f(z)$  with  $p(z) = 0$  implements  $Y^*(z)$ .



# Unconstrained interest rate policy

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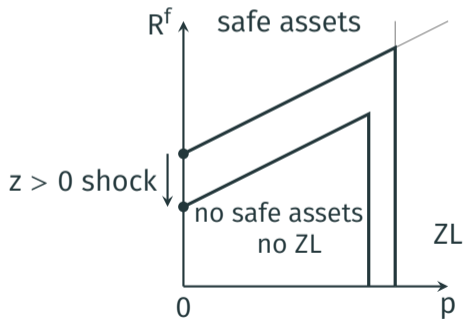
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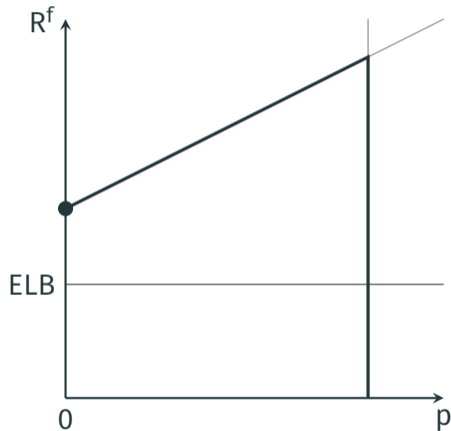
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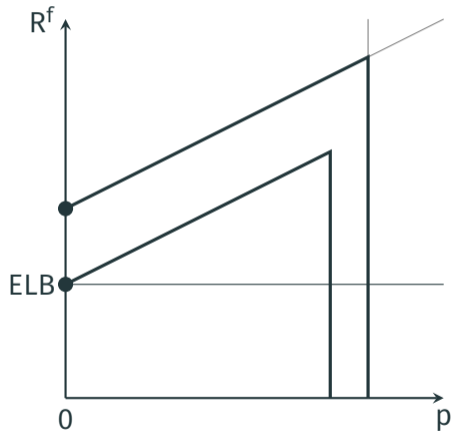
No role for  $p$ ? Unless required  $R^f$  too low and hits **ELB constraint**...



## ELB constraint on $R^f$ calls for unconventional policy

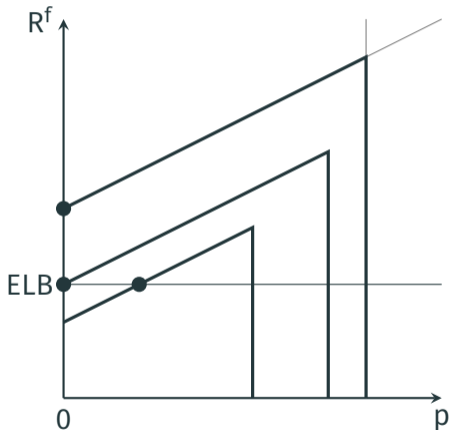


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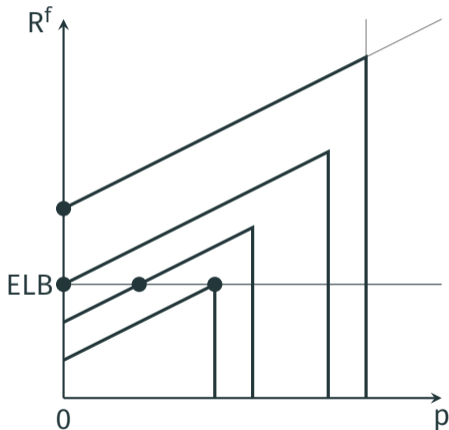
ELB binding for large enough shocks  $z$

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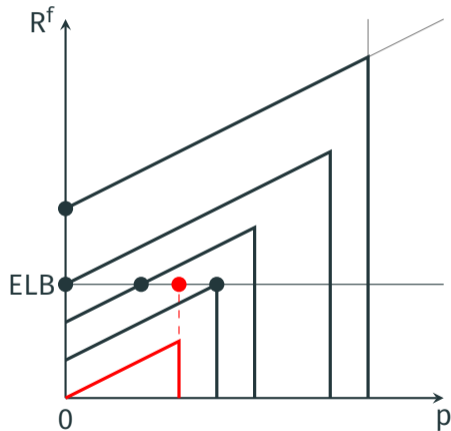
Optimal  $p$  increases to subsidize G lending...

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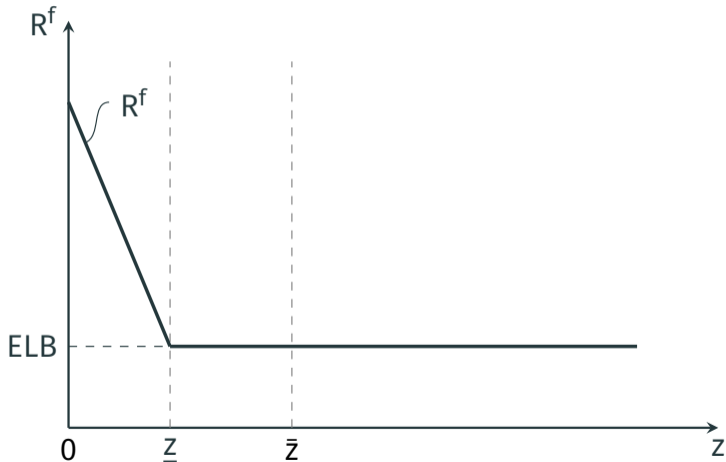
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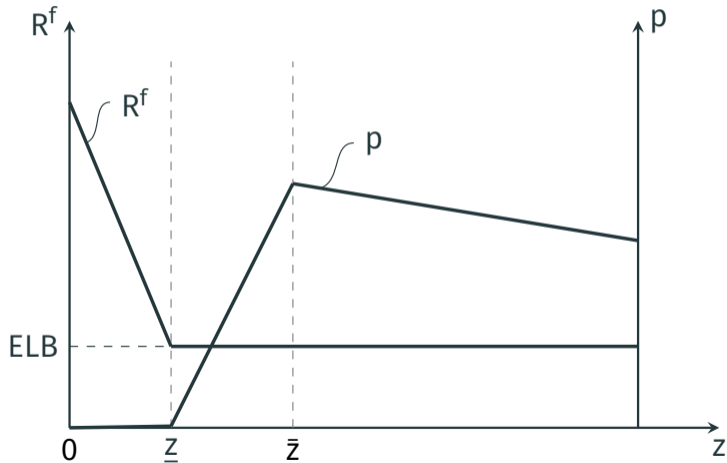


Optimal  $p$  decreases to prevent ZL!

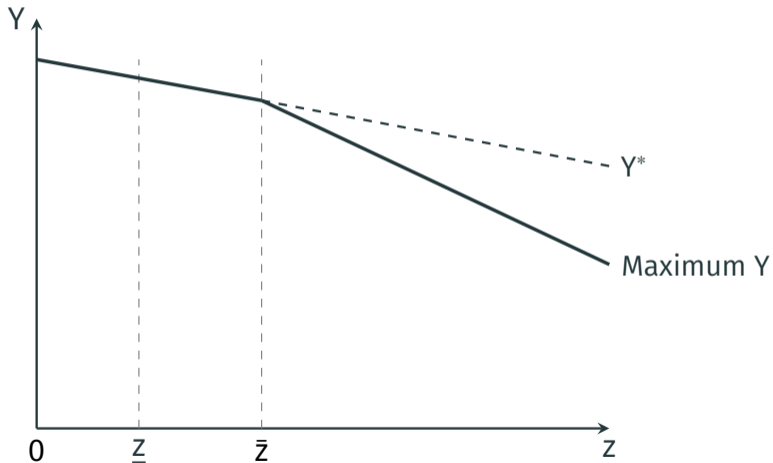
# Optimal joint policy $(R^f, p)$ in response to shocks $z$



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# Dynamic model

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# Congestion externalities

Now, unpack real costs of ZL. Suppose in the short run:

$$\underline{Y} < \theta^b y^b < \theta^g y^g - \bar{\epsilon}$$

vs. before:  $\theta^b y^b < \underline{Y} < \theta^g y^g - \bar{\epsilon}$

also stand-in for short-run costs of unemployment

empirically, congestion, lower investment and lower productivity over time

But **congestion externality**  $\alpha$  on **healthy firms** in the next period

$$y_{t+1}^g = \bar{y}^g (1 - z_{t+1})$$

$$\text{output loss } z_{t+1} = \underbrace{\eta_{t+1}^z}_{\text{exog.}} + \underbrace{\alpha m_t^b}_{\text{endog.}}$$

We consider dynamics following one-time shock  $z_0 = \eta_0^z > 0$

# Policy response depends on policymakers' horizon

**New trade-off:** maximize short-run output vs. hurt future productivity

$$\max_{R_t^f, p_t} Y_t + \beta Y_{t+1} + \beta^2 Y_{t+2} + \dots$$

Abstract from franchise value effects so no gains from commitment.

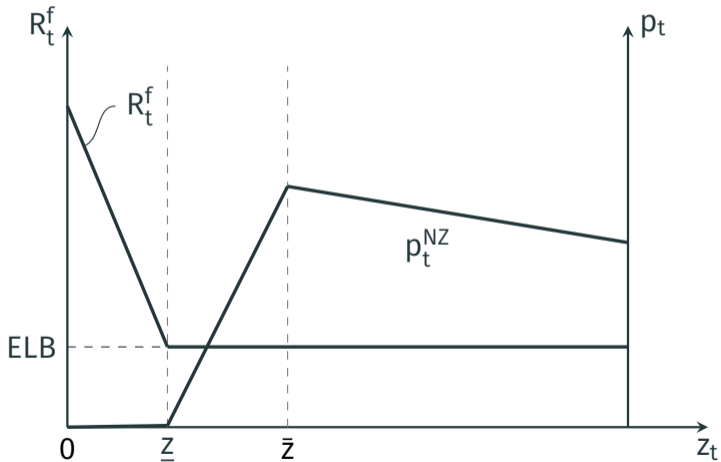
## Proposition

High  $\beta$  : **No-Zombie Lending policy**  $p_t = p^{NZ}(z_t)$  decreasing in  $z_t$

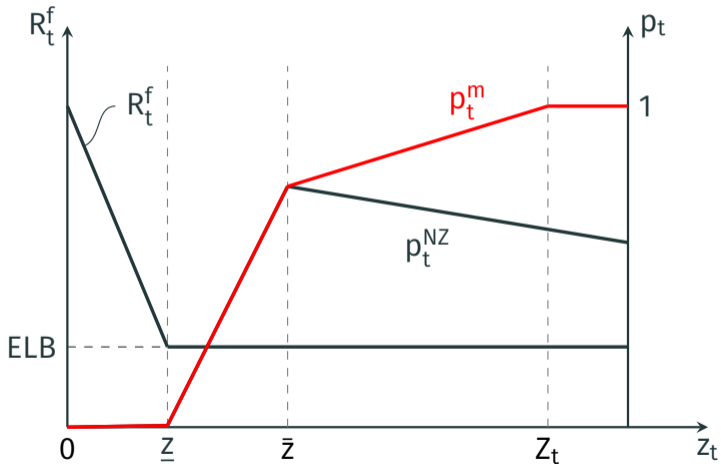
Low  $\beta$  : **Myopic policy**  $p_t = p^m(z_t)$  increasing in  $z_t$

Crucial parameters:  $(\alpha, \beta, z_0)$ . We simplify  $\beta$  dimension to focus on  $\alpha, z_0$

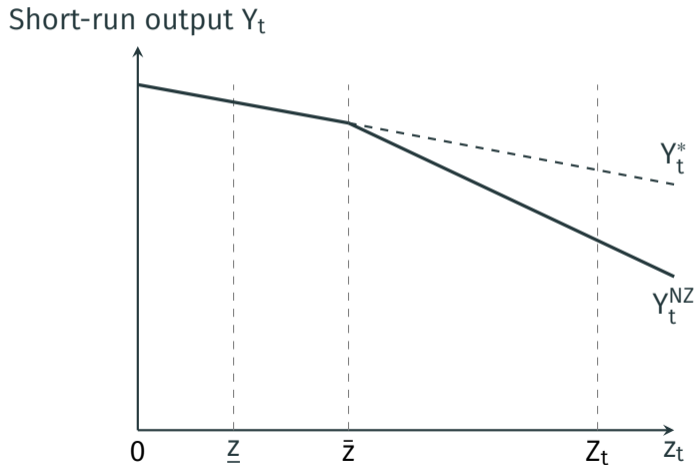
# Myopic vs. No-Zombie Lending policy



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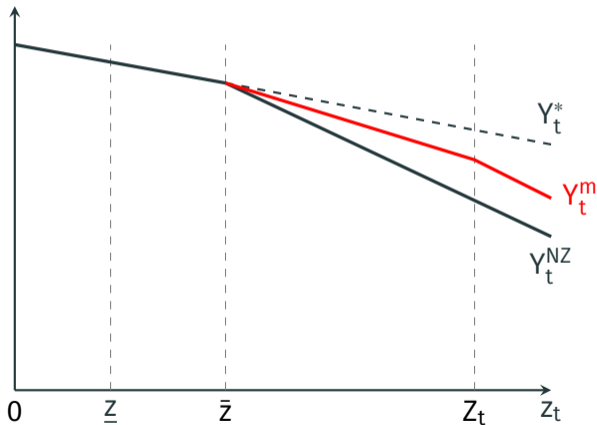


# Myopic vs. No-Zombie Lending policy



# Myopic vs. No-Zombie Lending policy

Short-run output  $Y_t$



# Myopic response leads to policy trap and sclerosis

**Sclerosis:** steady state with permanent output loss  $z > 0$

## Proposition

Suppose **high congestion externality**  $\alpha \geq \underline{\alpha}$  and **myopic policy**

There exist two stable steady states: **No-ZL** and **sclerosis**



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- for small shocks  $z_0 < z^*(\alpha)$   
the economy converges to the **No-ZL steady state** with  $p_t, z_t \rightarrow 0$

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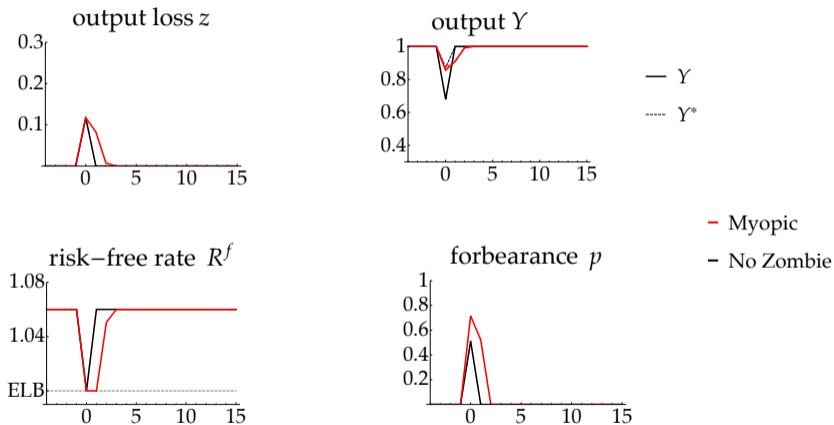
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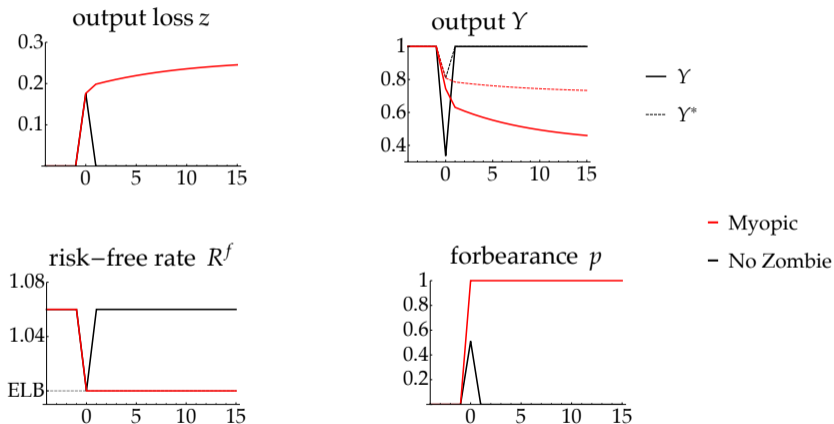
There exist two stable steady states: **No-ZL** and **sclerosis**

- for small shocks  $z_0 < z^*(\alpha)$   
the economy converges to the **No-ZL steady state** with  $p_t, z_t \rightarrow 0$
- for **large shocks**  $z_0 > z^*(\alpha)$   
the economy converges to the **sclerosis steady state**  
**Policy trap: ELB binds forever and**  $p_t \rightarrow 1$   
if  $z_0 \geq Z_0 > z^*(\alpha)$  then  $p_t = 1$  always

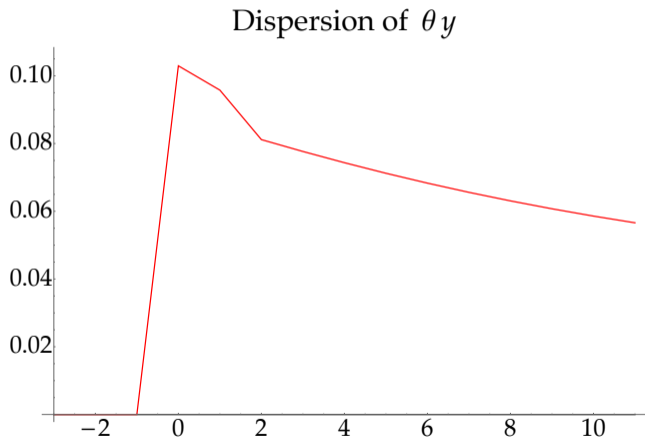
# Small shocks: endogenous persistence



# Large shocks: policy trap and sclerosis



# Measuring misallocation?



# Mapping parameters into economic factors

**Policy trap and sclerosis more likely** when

- High congestion externality  $\alpha$
- Low policy horizon  $\beta$
- High initial shock  $z_0$
- Low baseline productivity of G firms  $\theta^g \bar{y}^g$
- High rate of distress (and required creative destruction)  $\lambda$

# Extensions

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# Equity issuance

**Q: What if banks can issue equity?**

Suppose issuing  $\Delta e$  costs  $\kappa(\Delta e)$ ,  $\kappa$  increasing and convex

## **Proposition**

A decrease in  $R^f$  increases ZL.

An increase in  $p$  increases ZL more than without issuance.

Intuition: lower  $R^f$  decreases cost of debt more than cost of equity



# Capital requirements & evergreening

## Q: How do capital requirements affect ZL?

healthier banks → lower risk-shifting incentives  
but may increase cost of recognizing losses on legacy loans

Extend the model:

- **Equity issuance:** recapitalization possible but costly
- **Capital requirement:** minimal level of equity  $\hat{e}$
- **Relationship lending:** Legacy  $\neq$  new loans  
zombie loan rolled over if positive surplus for bank+borrower pair  
at renegotiated low rate (Nash bargaining over surplus)

# Capital requirements useful, but may backfire

$\delta$  = cost of recognizing losses and switching to new G borrower

## Proposition

If  $\delta \leq \bar{\delta}$ , capital requirement  $\hat{e}$  can deter ZL completely

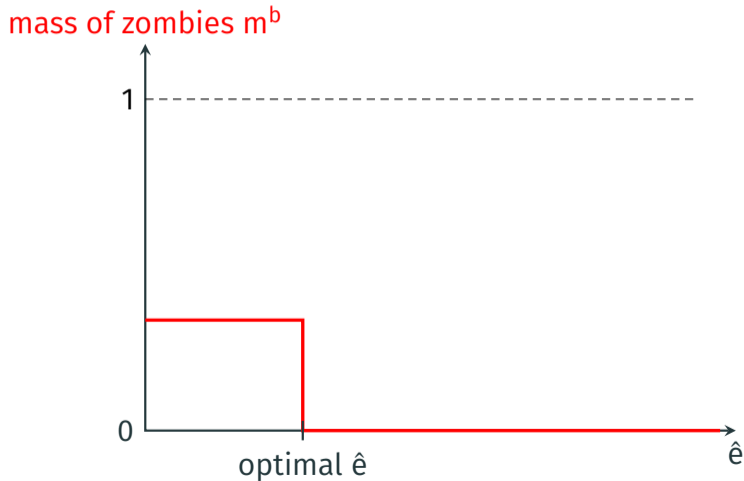
- forcing banks to recapitalize above  $e^*$  works

If  $\delta > \bar{\delta}$ , capital requirement  $\hat{e}$  **cannot** deter ZL completely

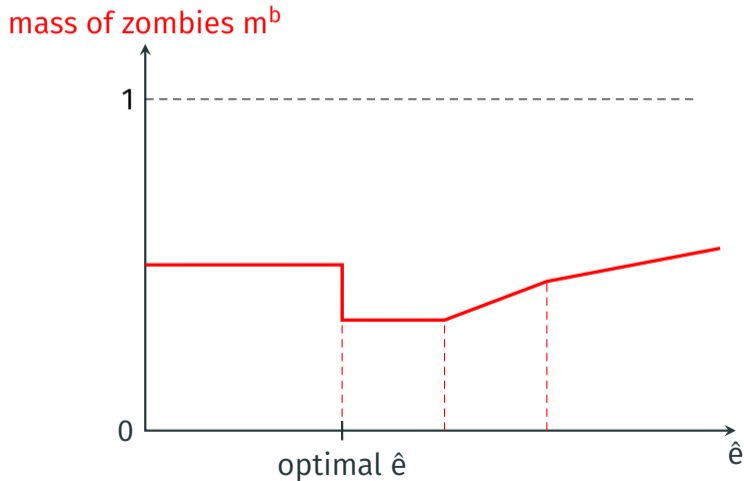
- starting from laissez-faire, ZL decreasing in  $\hat{e}$ ...
- then increasing in  $\hat{e}$
- positive ZL remains even at “optimal”  $\hat{e}$

Intuition: If both  $\delta$  and  $\hat{e}$  high, better to roll over than recapitalize from  $e - \delta$  to  $\hat{e}$

## Low $\delta$ : capital requirement prevents ZL



# High $\delta$ : ZL is non-monotonic in capital requirement



# Conclusion

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# Implications of our analysis

Model predictions consistent with existing empirical evidence on ZL

- Regulatory forbearance can distort credit allocation and have real effects
- Diabolical sorting of undercapitalized banks with poorly performing firms
- Imposing too high a capital requirement may backfire

Novel predictions regarding policy dynamics

- ZL creates **policy traps**
- Some accommodation is optimal once ELB binds, but not too much
- Focus on short-run stimulus may lead to long-run **sclerosis**

Tractable model could be foundation for many extensions

- Interaction with fiscal space (doom loop)