Zombie Lending and Policy Traps

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Introduction

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

- Interaction between ZL & macro/prudential/monetary policies
- **Diabolical sorting** of undercapitalized banks with distressed borrowers
- Dynamic interplay of policies & ZL can lead to **policy trap** and **sclerosis**
- Importance of maintaining well-capitalized banks in good times

Zombie lending: What do we know?

Existing empirical studies

> Peek-Rosengren (2005), Caballero-Hoshi-Kashyap (2008), Giannetti-Simonov (2013), Acharya et al. (2015), McGowan-Andrews-Millot (2018), Banerjee-Hoffman (2018), Blattner et al. (2019), Schivardi-Sette-Tabellini (2019), Acharya et al. (2020), Bonfim et al. (2020), Passalacqua et al. (2020), Kulkarni et al. (2021), Schmidt et al. (2021), ...

document **four key facts** about zombie lending...

Zombie lending: What do we know?

#1 How ZL is done

Roll-over or extend more credit, at low interest rates

#2 Why weakly capitalized banks engage in ZL

Risk shifting incentives, avoiding recognition of losses (”evergreening”)

#3 Consequences of ZL

Misallocation, depressed entry and exit, congestion externalities, real spillovers

#4 How is ZL affected by monetary/financial stability policies

Unconventional MP, regulatory forbearance, capital and liquidity injections, capital requirements, banking supervision

Model

Model

A theory of ZL with the key empirical features

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

Heterogeneous firms: technology

Two types $i = G, B$

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

Projects require $1 of capital borrowed from a bank, and (labor) cost $c + \epsilon$

- Common cost c may be endogenous due to congestion
- Idiosyncratic cost shock $\epsilon \in [0, \bar{\epsilon}] \sim$ 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 ϵ produces if $\mathbf{E}[\text{profit}^i] \geq 0$ or

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

- Total mass 1 of active firms
- λ incumbents become distressed B, $1 - \lambda$ remain healthy G
- Fringe of λ 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. $\theta^{\mathbf{f}} = \mathbf{1}$
- loan to G firm: return $\mathbf{R^g}$ with prob. $\theta^{\mathbf{g}}$, 0 otherwise
- loan to B firm: return $\mathbf{R^b}$ with prob. $\theta^{\mathbf{b}}$, 0 otherwise

"Switching cost" of recognizing losses on legacy B borrower: $e \longrightarrow e - \delta$

- $\delta > 0$ 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)

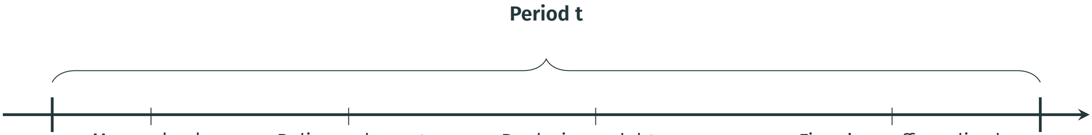
Debt pricing: Debt holders require expected return R^f, hence rate $\tilde{R}^i$

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

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

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

Timeline



- Macro shock z_t realized
- Idiosyncratic cost shocks ϵ realized

- Policy maker sets (p_t, R_t^f)

- Banks issue debt, decide to invest in safe assets or loans
- Firms decide to produce or exit (m_t^b, m_t^g)
- Credit market clears (R_t^b, R_t^g)

- Firms' payoffs realized
- Banks survive or are bailed out
- Bank creditors repaid

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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- Banks with $e > e^{**}$ do not lend and invest in safe assets

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

$\Rightarrow$ 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: $\lambda \cdot H(\theta^b(y^b - R^b) - c)$

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

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

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

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

Allocation of credit and aggregate output

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

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

Aggregate output

$$Y = \underline{Y} + \int_0^{\theta^g(y^g - R^g) - c} \underbrace{\left[\theta^g y^g - c - \epsilon - \underline{Y}\right]}_{>0} dH(\epsilon)$$

$$+ \lambda \int_0^{\theta^b\left(y^b - R^b\right) - c} \underbrace{\left[\theta^b y^b - c - \epsilon - \underline{Y}\right]}_{<0} dH(\epsilon)$$

Potential output

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

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

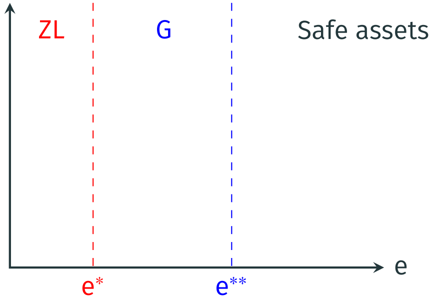
- no bank lends to B firm ($e^* \leq e_{min}$)
- no bank invests in safe assets ($e^{**} \geq e_{max}$)

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

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

Policy

Two policy tools to stimulate output



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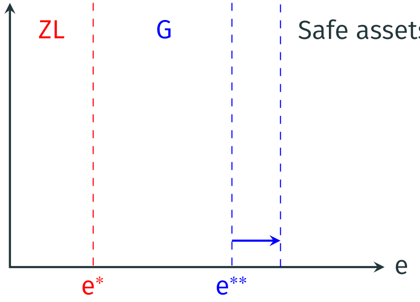


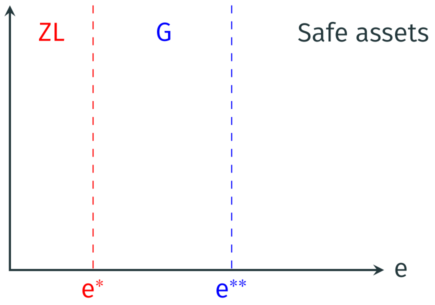
Decreasing R^f **for given** p

makes safe assets less attractive

lower hurdle rate stimulates lending

increases e^{**}

Two policy tools to stimulate output



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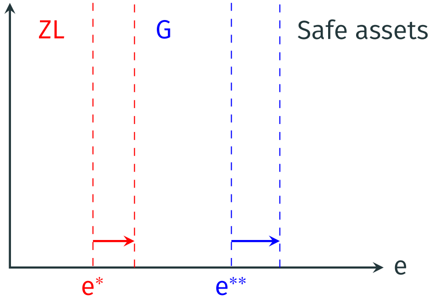


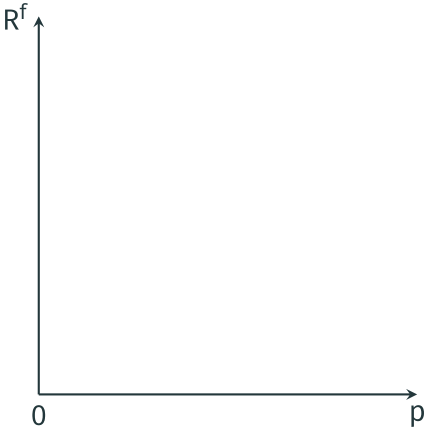
Decreasing R^f **for given** p

makes safe assets less attractive
lower hurdle rate stimulates lending
increases e^{**}

Increasing p **for given** R^f

makes safe assets less attractive
stimulates G lending by strong banks
but induces ZL by weak banks
increases e^{**} and e^*

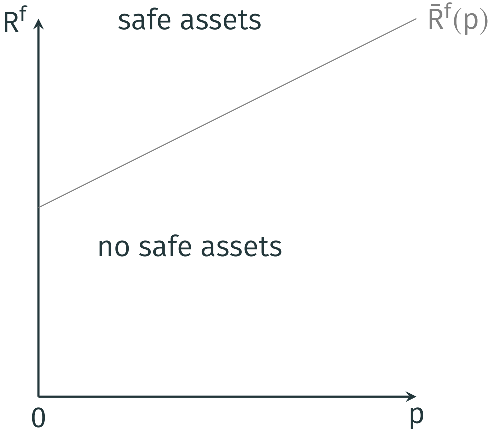
Which combinations (R^f, p) can achieve Y^*?



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 safe assets $\Leftrightarrow e^{**} \geq e_{max}$

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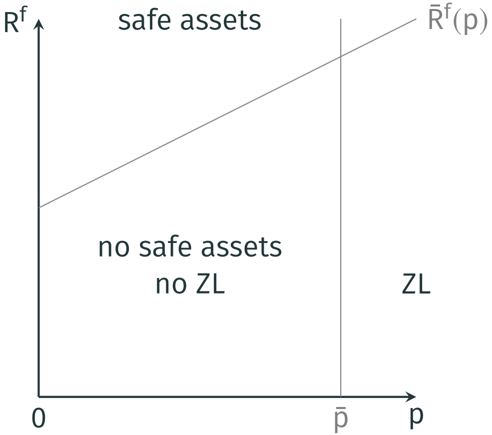
No ZL $\Leftrightarrow e^* \leq e_{min}$

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



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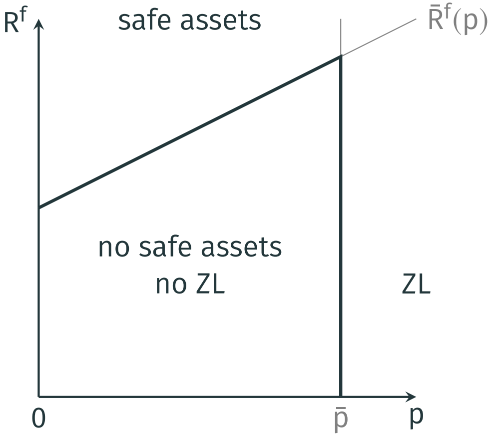

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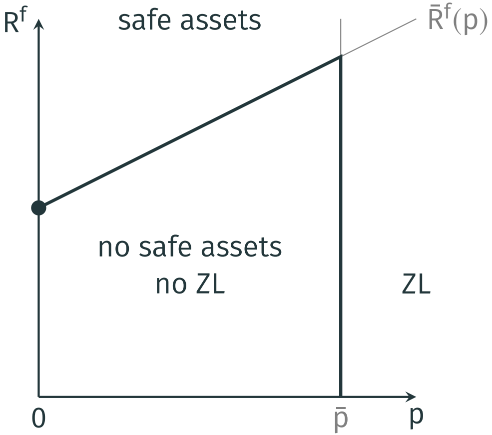


Shocks z to potential output

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

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

therefore potential output Y^* depends on z

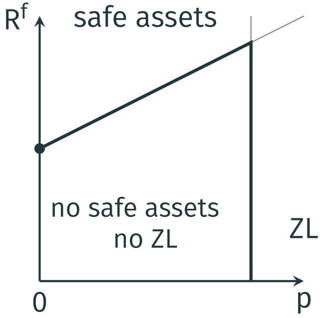
$$Y^*(z) = \theta^g \bar{y}^g (1 - z) - c - \mathbf{E}[\epsilon]$$

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 $Y^*(z)$.



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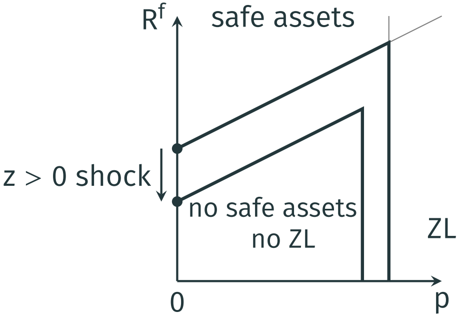

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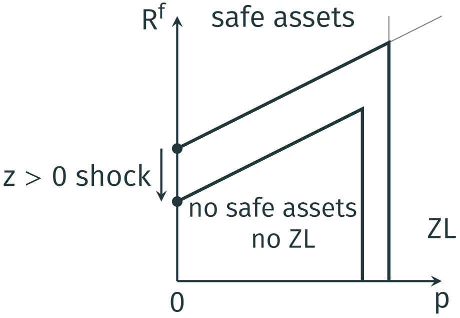
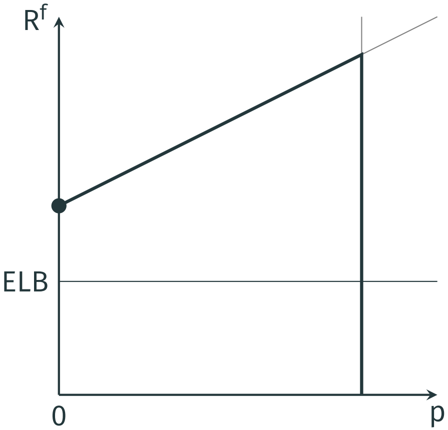


No role for p? Unless required R^f too low and hits **ELB constraint**...

ELB constraint on R^f calls for unconventional policy



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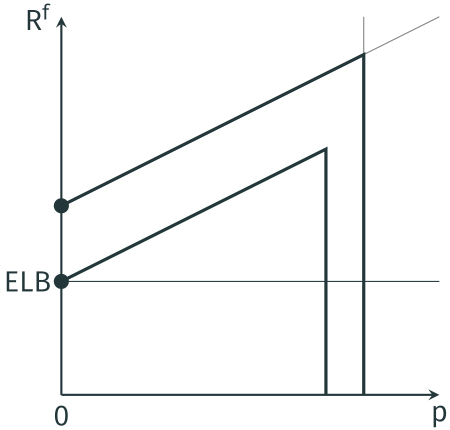
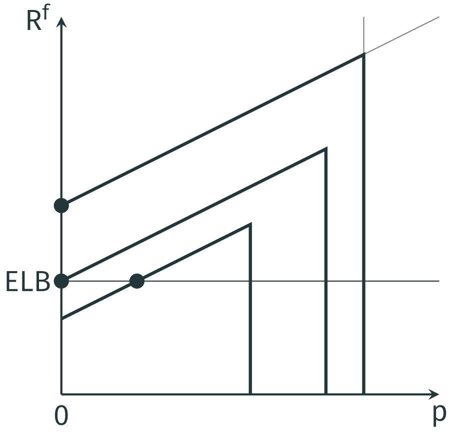


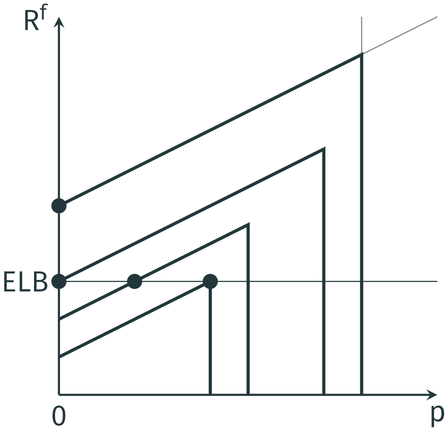
ELB binding for large enough shocks z

ELB constraint on R^f calls for unconventional policy



Optimal p increases to subsidize G lending...

ELB constraint on R^f calls for unconventional policy



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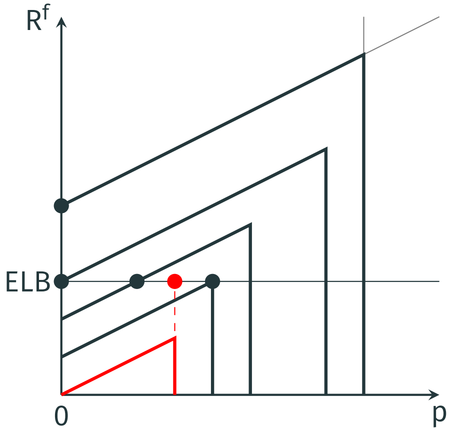

Optimal p decreases to prevent ZL!

Optimal p is non-monotonic

Proposition

$z \in [0, \underline{z}]$: optimal policy can achieve $Y = Y^*(z)$ with R^f alone and

$$p = 0$$

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$z \in (\underline{z}, \bar{z}]$: **ELB binding**, optimal policy can achieve $Y = Y^*(z)$ with

$$p(z) > 0 \text{ increasing in } z$$

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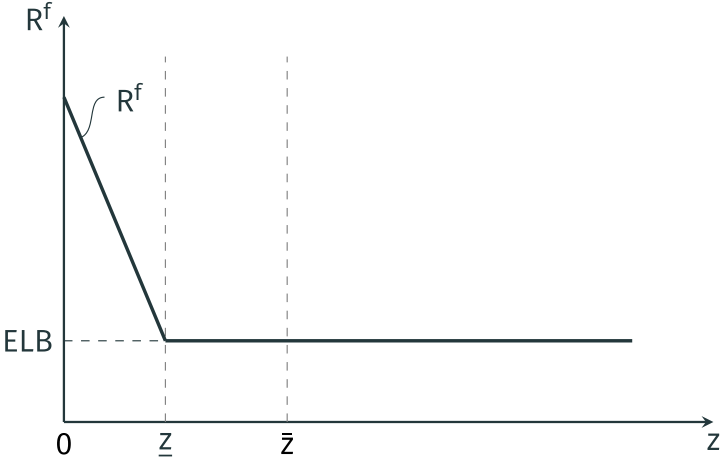
$$p(z) > 0 \text{ increasing in } z$$

$z > \bar{z}$: **ELB binding**, optimal policy can only achieve max output $\mathbf{Y} < \mathbf{Y}^*(\mathbf{z})$ with

$$p(z) > 0 \text{ decreasing in } z$$

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



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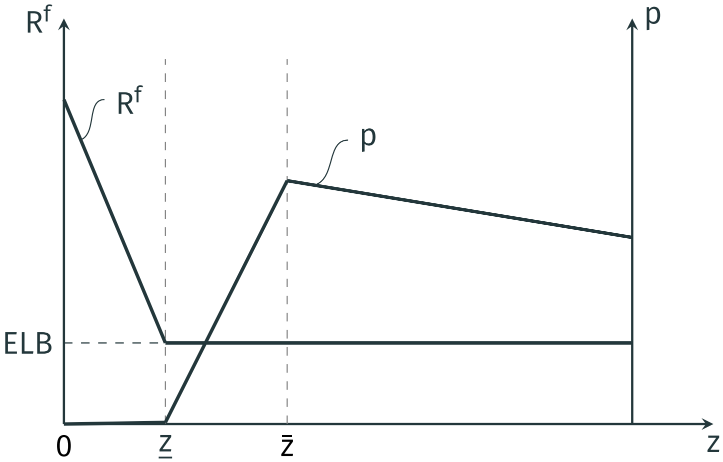

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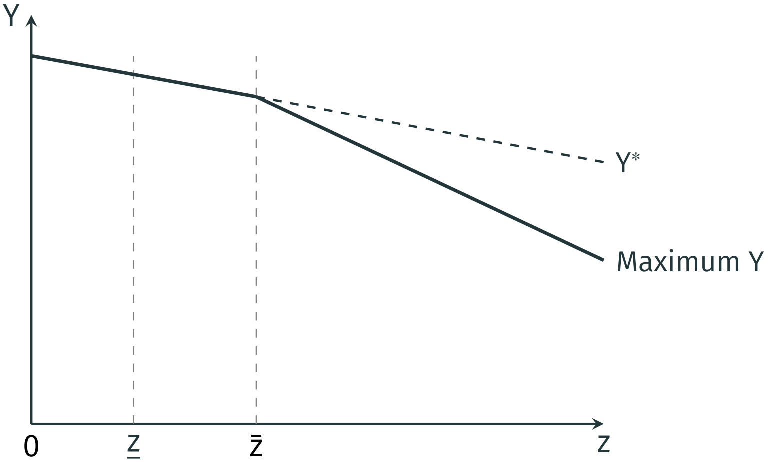


Dynamic model

Congestion externalities

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

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

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

also stand-in for short-run costs of unemployment
empirically, congestion, lower investment and lower productivity over time

But **congestion externality** α **on healthy firms** in the next period

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

$$\text{output loss } z_{t+1} = \underbrace{\eta^z_{t+1}}_{\text{exog.}} + \underbrace{\alpha m^b_t}_{\text{endog.}}$$

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

Dynamic equilibrium

Given shocks η_t^z, a dynamic equilibrium is a sequence of policies, allocations and prices

$$\left\{R_t^f, p_t, z_t, F_t(\cdot), e_t^*, e_t^{**}, R_t^g, R_t^b\right\}$$

such that for all t

- banks sort optimally given policies
- firms enter and exit optimally given rates and productivity
- loan markets clear
- z_t evolves according to congestion externality
- distribution of equity F_t evolves according to bank returns
- policies set optimally

Policy response depends on policymakers' horizon

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

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

Abstract from franchise value effects so no gains from commitment.

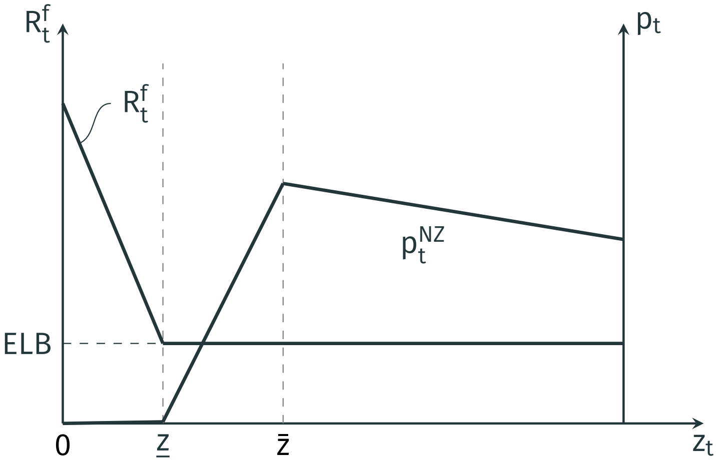
Proposition

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

Low β: **Myopic policy** $p_t = p^{m}(z_t)$ increasing in z_t

Crucial parameters: (α, β, z_0). We simplify β dimension to focus on α, z_0

Myopic vs. No-Zombie Lending policy



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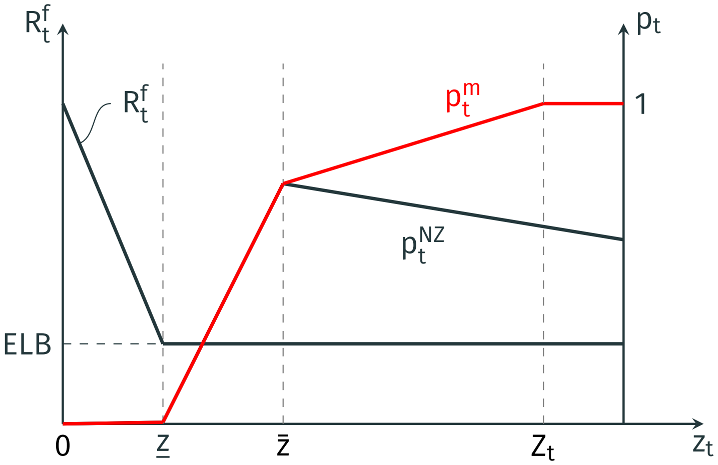

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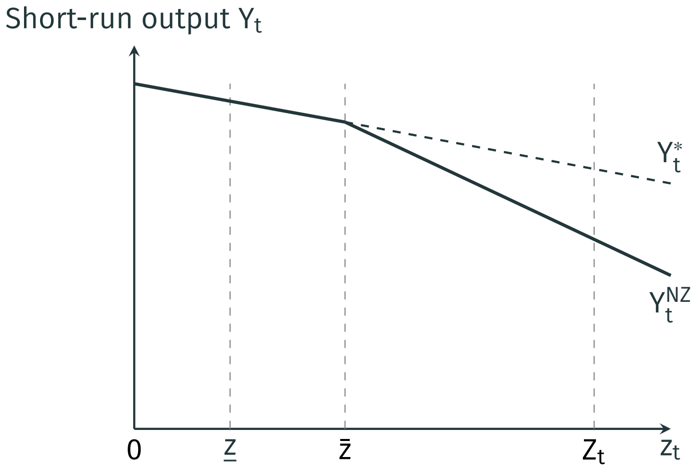

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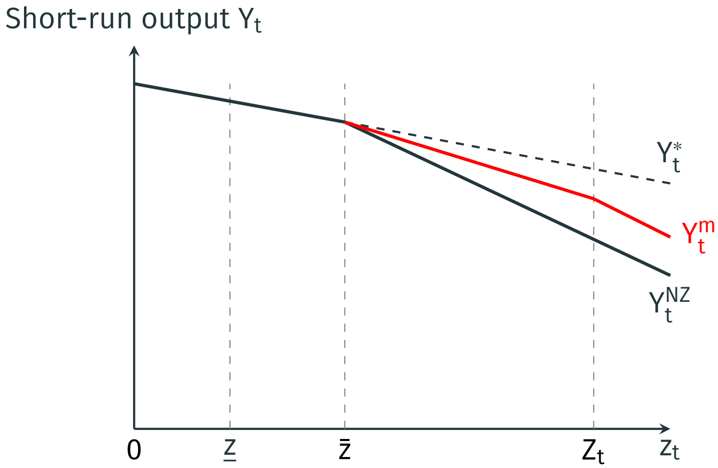

Equilibrium path under No-ZL policy

Proposition

Suppose $z_0 > \bar{z}$. Under the No-ZL policy, there is a **transitory recession**

$$R_0^f = ELB$$
$$p_0 > 0$$
$$Y_0 < Y^*(z_0)$$

followed by an **immediate recovery.** For $t \geq 1$

$$R_t^f > ELB$$
$$p_t = 0$$
$$Y_t = Y^*$$

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 $p_t, z_t \longrightarrow 0$

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

Proposition

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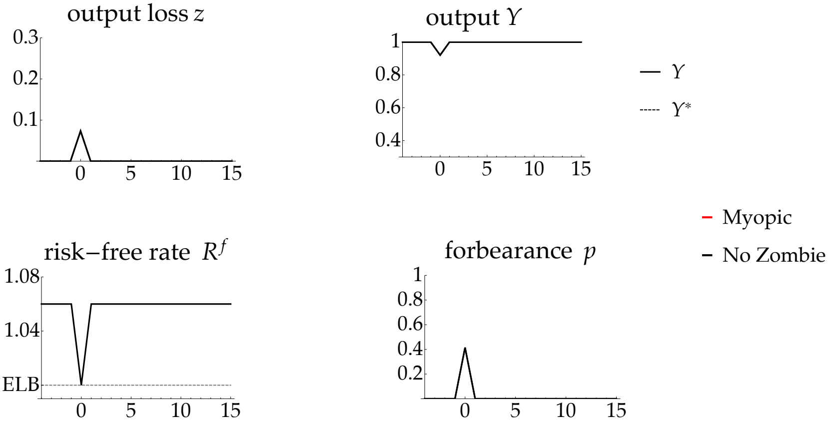
There exist two stable steady states: No-ZL and sclerosis

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

Small shocks: endogenous persistence



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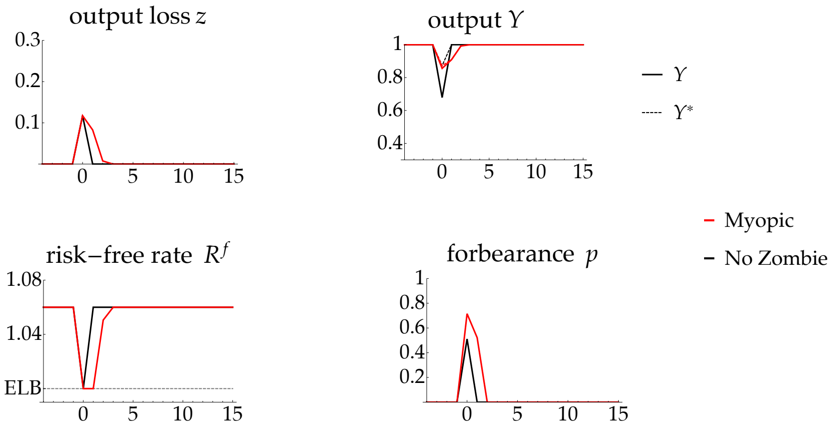

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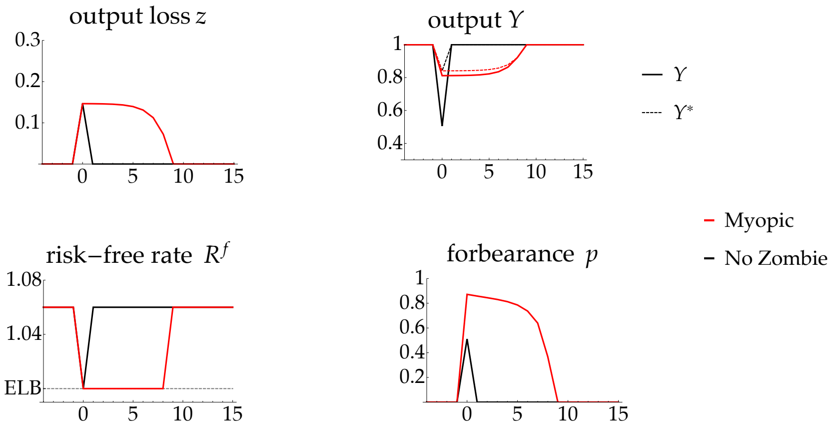
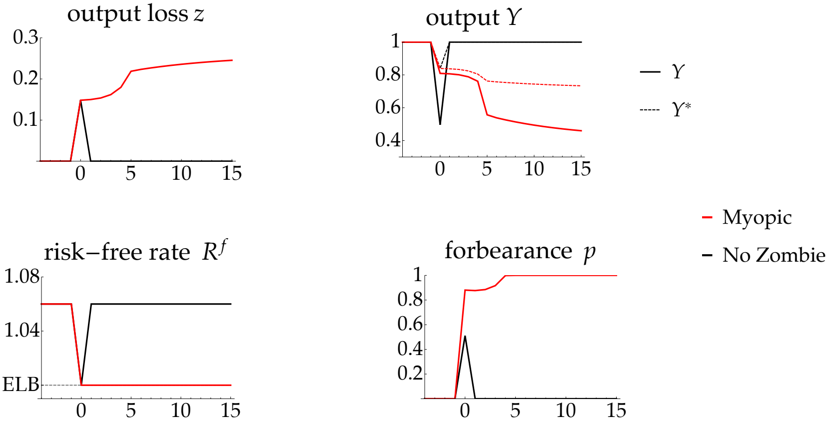


Large shocks: policy trap and sclerosis



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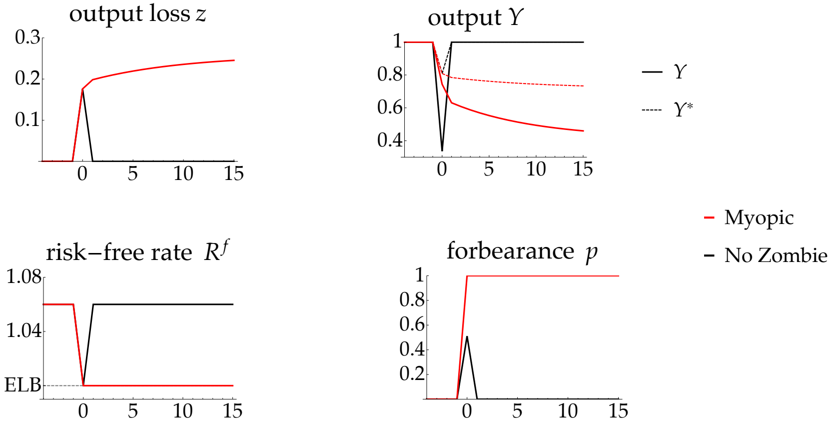


Mapping parameters into economic factors

Policy trap and sclerosis more likely when

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

Extensions

Equity issuance

Q: What if banks can issue equity?

Suppose issuing Δe costs $\kappa(\Delta e)$, κ 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 $\longrightarrow$ 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

δ = cost of recognizing losses and switching to new G borrower

Proposition

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

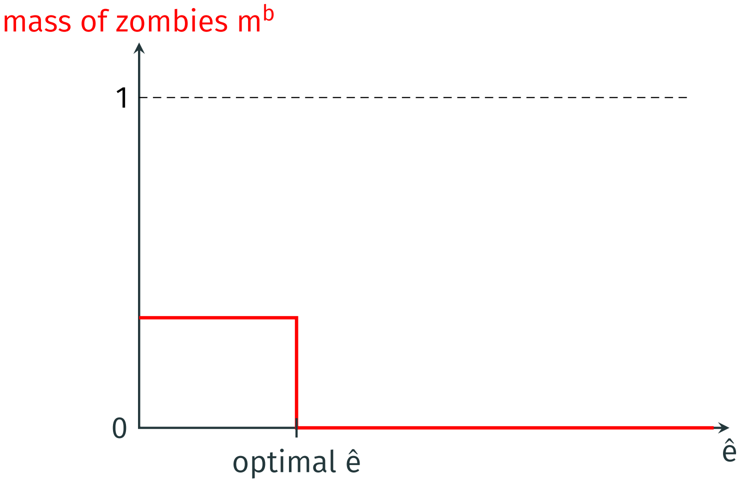
- forcing banks to recapitalize above e^* works

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

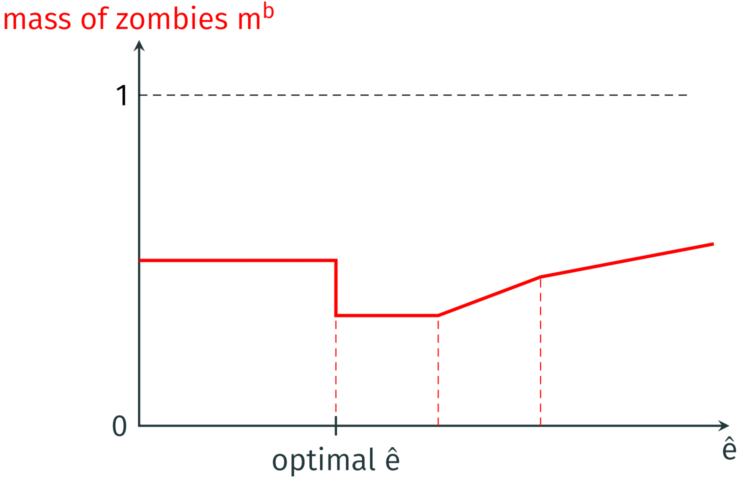
- starting from laissez-faire, ZL decreasing in $\hat{e}$...
- then increasing in $\hat{e}$
- positive ZL remains even at "optimal" $\hat{e}$

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

Low δ: capital requirement prevents ZL



High δ: ZL is non-monotonic in capital requirement



Conclusion

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)