Watering a Lemon Tree: Heterogeneous Risk Taking and Monetary Policy Transmission

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Puzzle

Monetary policy characterized as:

> *"too loose for too long, leading to excessive risk taking"*

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Open questions:

- Why isn't output responding more to stimulus?
- What risk taking are we concerned about?

This paper

General equilibrium model with:

- Agents with heterogeneous investment quality
    - → Endogenously split into borrowers and lenders

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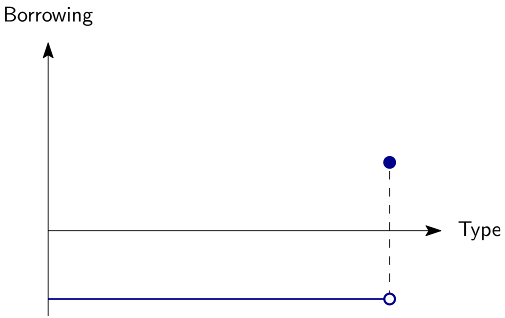
Equilibrium features:

- Heterogeneous responses to interest rates and prices
- More risk taking by the wrong agents

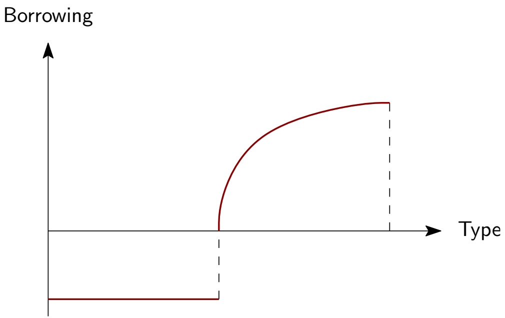
$\rightarrow$ Impaired transmission of stimulus to output

Intuition – first best



- First best: All funds invested by most productive type

Intuition – second best



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  $\rightarrow$ FOC with interior solution for every borrower type

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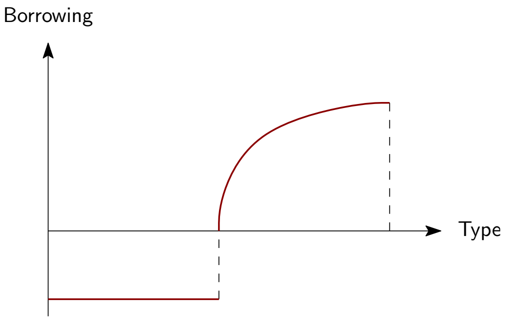
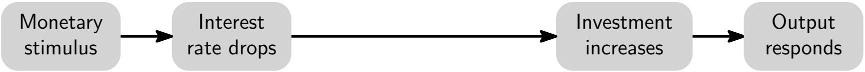


- Second best: Every type trades off net return vs. liquidity risk
  - $\rightarrow$ FOC with interior solution for every borrower type
- Types respond heterogeneously to equilibrium prices:
  - Changes in interest rate
  - Changes in liquidation values

Intuition – equilibrium mechanism



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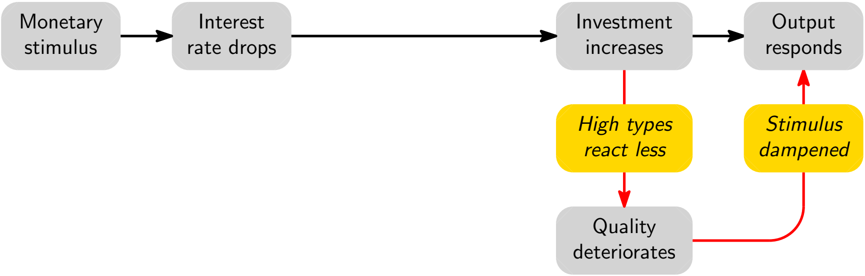

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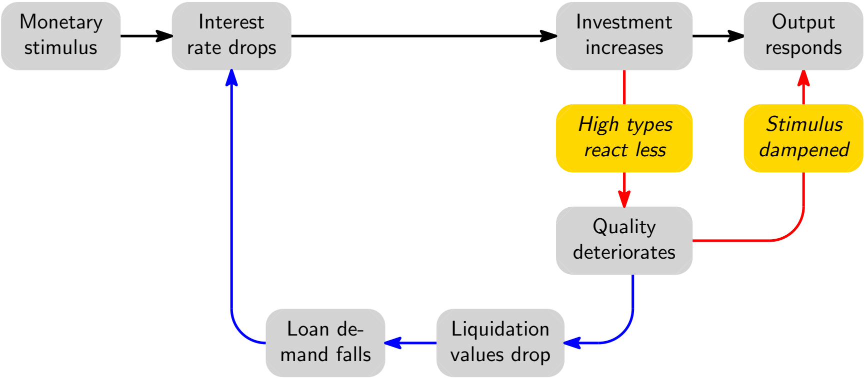

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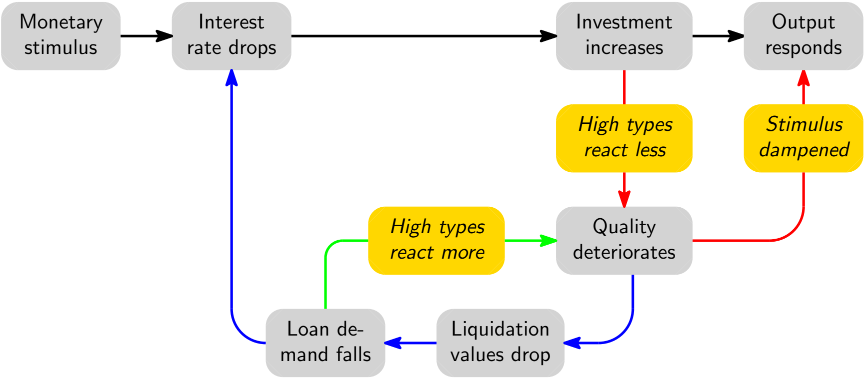

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$$\begin{cases} R\theta & \text{with prob. } p \\ 0 & \text{with prob. } 1-p \end{cases}$$

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- Borrowing/lending $D \geq -E$:
  - Borrowers pay r in expectation
  - Lenders receive r in expectation

$\rightarrow$ Equilibrium r clears market for loanable funds

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Liquidity risk:

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Lemons pricing:

- Asymmetric information in secondary market
- Liquidation value P only depends on average quality:

$$P = f(q) \quad \text{with} \quad f'(q) > 0$$

Monetary policy

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- Stimulus is not a "free lunch"
  - $\rightarrow$ Reduces output in $t = 2$ by $c(L)$ increasing in L
- Changes in L affect r through market clearing:

$$E + L = \int_0^1 D_\theta(r, P)\, d\theta$$

Equilibrium

Definition

The equilibrium is characterized by private decision variables $\{D_\theta\}$ and price variables r and P such that:

1. Agents choose optimal $D_\theta(r, P)$ taking r and P as given.
2. The risk free rate r clears the market for loanable funds:

$$E + L = \int_0^1 D_\theta(r, P)\, d\theta$$

3. The secondary market price P is given by $P = f(q)$.

Individual agent behavior

Optimal borrowing/lending

Objective function of type θ:

$$pR\theta\left(D+E\right)-\left(1+r\right)D-\alpha(D)\left(pR\theta-P\right)\left(D+E\right)$$

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Marginal type θ^* is indifferent: $1+r=pR\theta^*$

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First order condition for optimal $D_\theta>0$:

$$\underbrace{pR\theta-(1+r)}_{\text{marginal excess return}} \;=\; \underbrace{\big(\alpha'(D_\theta)\,(D_\theta+E)+\alpha(D_\theta)\big)\,(pR\theta-P)}_{\text{marginal liquidity cost}}$$

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Proposition 1

More productive agents borrow more and face higher liquidity risk

Response to interest rate changes

Proposition 2

All borrowers respond to changes in r:

$$\frac{\partial D_\theta}{\partial r} < 0 \text{ for all } \theta > \theta^*$$

But: Higher types respond **less** than lower types:

$$\left|\frac{\partial D_\theta}{\partial r}\right| \text{ is decreasing in } \theta$$

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Heterogenous response has two sources:

1. "Marginal risk": $\alpha'(D)\,(D+E)+\alpha(D)$ increasing in D
2. "Value at risk": $pR\theta - P$ increasing in θ

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Heterogenous response has two sources:

1. "Marginal risk": $\alpha'(D)\,(D+E) + \alpha(D)$ increasing in D
2. "Value at risk": $pR\theta - P$ increasing in θ

$\rightarrow$ Higher types need smaller adjustment in D

Response to price changes

Proposition 3

All borrowers respond to changes in P:

$$\frac{\partial D_\theta}{\partial P} > 0 \text{ for all } \theta > \theta^*$$

Higher types can respond **more** than lower types:

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Effect on first order condition:

- r: generates the same slack for all types
- P: generates more slack for higher types
- $\rightarrow$ goes against heterogeneous tightening through D

General equilibrium with monetary policy

Monetary policy transmission

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- Effect of changing stimulus L:

$$\frac{d\bar{Y}}{dL} = \underbrace{q \times \frac{dI}{dL}}_{\text{new investment}} + \underbrace{\frac{dq}{dL} \times I}_{\text{change in quality}} - \underbrace{c'(L)}_{\text{marginal cost}}$$

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- Who invests $\rightarrow$ change in quality is key

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- Who invests $\rightarrow$ change in quality is key
- Stimulus works through interest rate:

$$\frac{dq}{dL} = \underbrace{\frac{dq}{dr}}_{\text{quality elasticity}} \times \underbrace{\frac{dr}{dL}}_{\text{stimulus pass-through}}$$

Quality elasticity

$$q = \frac{\int_{\theta^*}^{1} pR\theta\big(D_\theta(r, P) + E\big)d\theta}{\int_{\theta^*}^{1} \big(D_\theta(r, P) + E\big)d\theta}$$

- Interest rate has direct and indirect effect:

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The direct effect of a decline in the interest rate r is a deterioration in average investment quality q, i.e., $\partial q/\partial r > 0$.

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Corollary 2

If high types respond sufficiently strongly to changes in P, the indirect effect amplifies the quality deterioration.

Stimulus pass-through

- Quality deterioration depends on how much interest rate moves
- Stimulus pass-through is inverse of demand elasticity:

$$\frac{dr}{dL} = \left(\frac{d}{dr} \int_{\theta^*}^{1} \big(D_\theta(r, P) + E \big) \, d\theta \right)^{-1}$$

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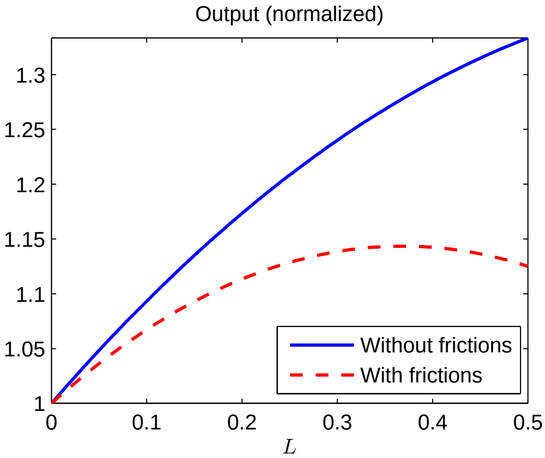
The indirect effect through the liquidation value P amplifies the stimulus pass-through by making loan demand less elastic.

Numerical example

Effect of frictions on transmission



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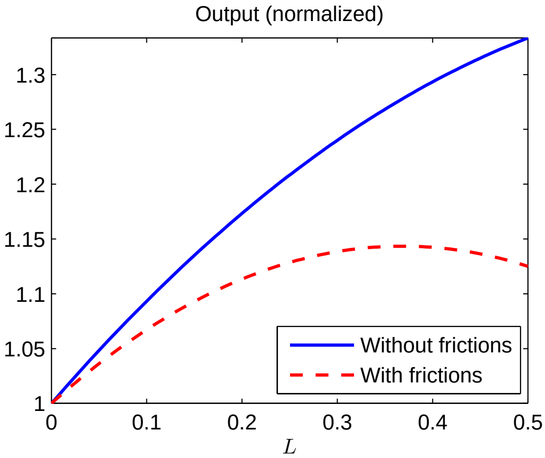

- Frictions can severely impair transmission of monetary policy
- Stimulus may end up counterproductive, reducing output

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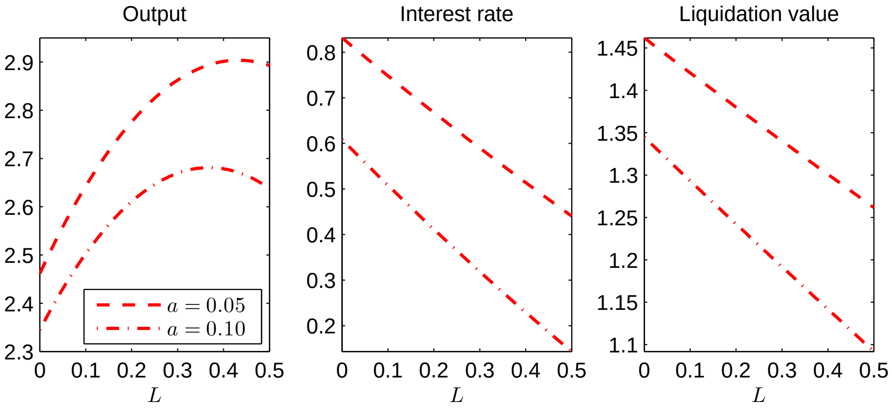

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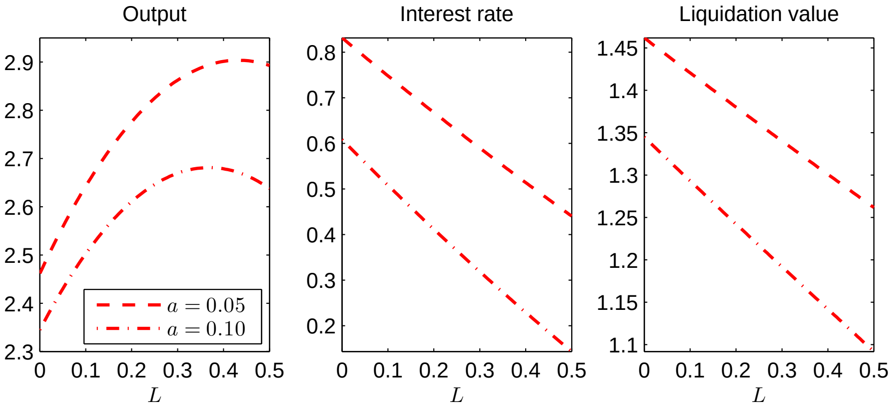

- More severe frictions reduce output further
  - Aggregate investment $I = E + L$ is the same
  - $\rightarrow$ Drop only due to change in distribution across types!

Conclusion

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