

Imperfect Information, Lending Standards and Capital Requirements

Pedro Gete and Natalie Tiernan

Georgetown University

May 2013

This paper makes three contributions:

- 1) Proposes new way to model lending standards
- 2) Studies banks when there is imperfect information about the economy:
 - Sometimes growth is persistent, sometimes not
 - Banks observe past growth, solve signal extraction problem to forecast next period

3) Policy implications of imperfect information + banks' limited liability + regulators (with same info as banks) that cover bank losses:

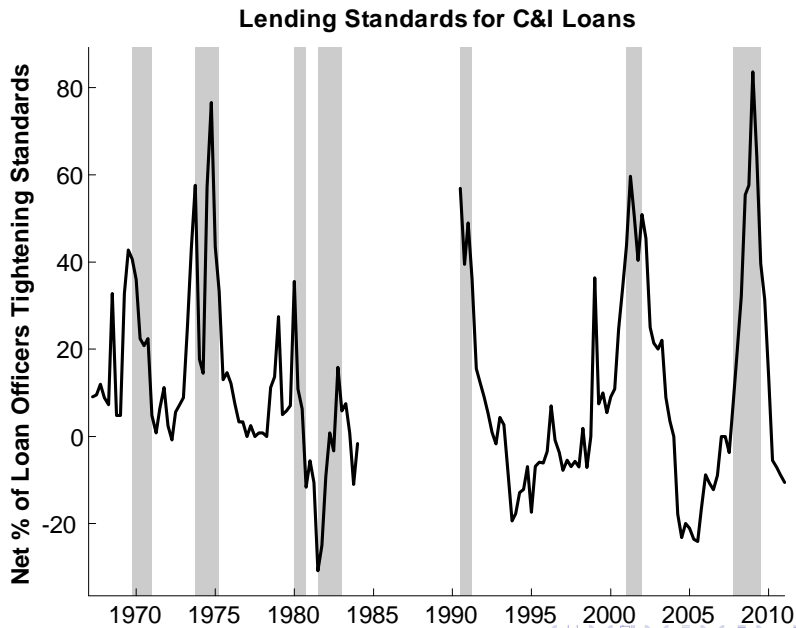
- ▶ State-dependent capital requirements
- ▶ Lean against bank's beliefs:
 - ▶ Tighten if optimism
 - ▶ Relax if pessimism

1. New way to model lending standards

Why care about lending standards?

- ▶ Cause of the crisis: U.S., Spain, U.K., Iceland, Ireland, Greece...
- ▶ Driver of business cycles

Lending Standards are cyclical



How do we model lending standards?

- ▶ Borrowers are heterogeneous in idiosyncratic characteristics (ω)

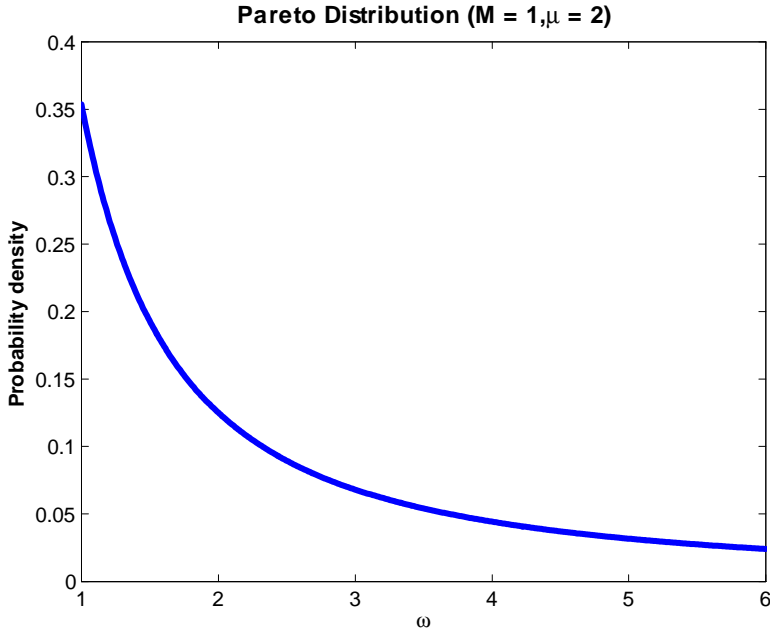
$$\omega \sim \text{Pareto} [M, \mu]$$

- ▶ Borrowers' income depends on idiosyncratic and aggregate productivity

$$y_t(\omega, s_{t+1}, l_t) = s_{t+1} \omega^\alpha f(l_t)$$

- ▶ s_{t+1} = aggregate productivity shock
- ▶ ω = idiosyncratic productivity
- ▶ l_t = function of loan amount. E.g. use loan to buy capital: $f(l_t) = \left(\frac{l_t}{q_t}\right)^\phi$

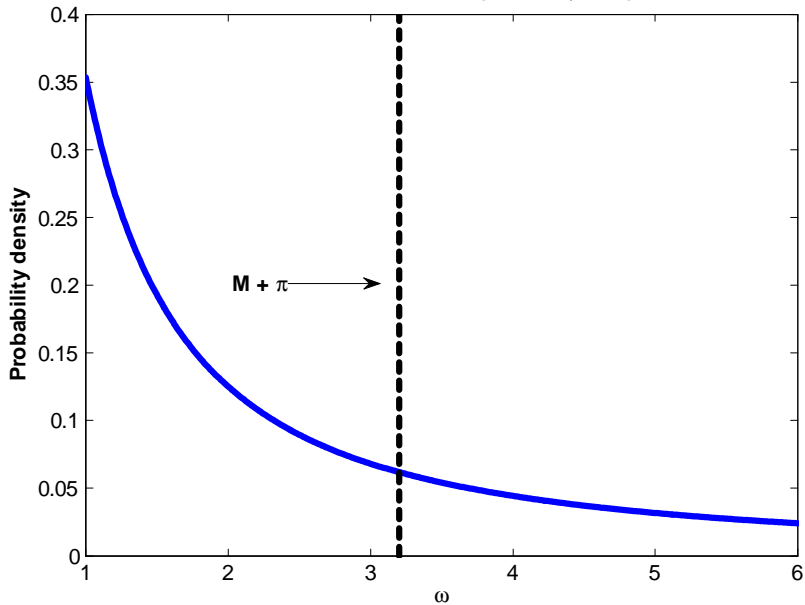
Distribution of Borrowers



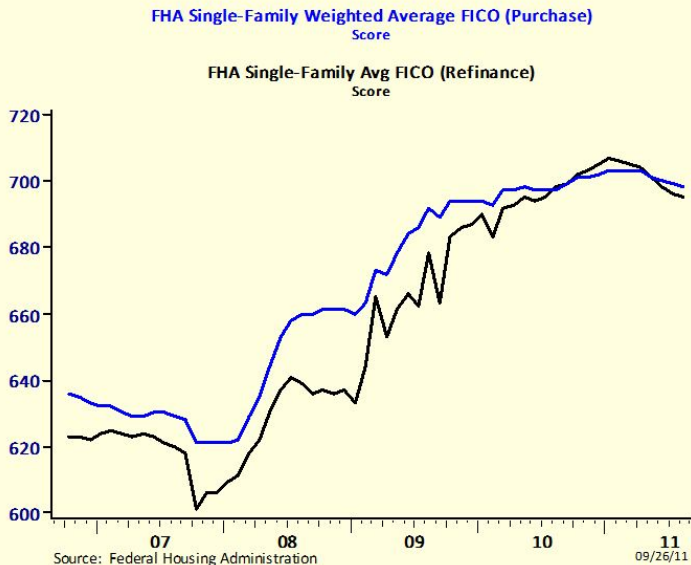
Banks

- ▶ Banks randomly meet borrowers but cannot observe ω
- ▶ Banks screen and adjust lending standards to weed out bad borrowers
- ▶ Set lending standards π so no borrower below $M+\pi$ gets credit (e.g. minimum FICO score)

Pareto Distribution ($M = 1, \mu = 2$)



What do we want to capture?



- ▶ Tighter standards means:
 1. Banks are pickier
 - ▶ Some borrowers that qualified for credit now do not qualify
 2. Probability of loan default falls
 3. More likely bank will not meet borrower good enough to lend (bank reserves will increase)

$$\frac{\partial \text{Prob Not lending}}{\partial \pi} = \frac{\mu M^\mu}{(M + \pi_t)^{\mu+1}} > 0$$

What determines lending standards?

- ▶ Cost of equity (R_t^e)
- ▶ Interest on reserves (R_t^R)
- ▶ Expectations about the economy (s_{t+1})
- ▶ Recovery rate if borrower defaults
($\Psi(\omega, l_t, s_{t+1})$)
- ▶ Expected value of borrowers' assets ($\frac{q_{t+1}}{q_t}$)
- ▶ Costs of implementing the standards
($C(\pi_t)$)

What determines lending standards?

$$\max_{\{\pi_t, l_t\}_0^\infty} E \left\{ \frac{1}{R_t^e} \Pi_{t+1}^b - Equity \right\}$$

s.t.

$$\Pi_{t+1}^b = \left\{ \begin{array}{l} \int_M^{M+\pi_t} (R_t^R - R_t^d) d_t dG(\omega) + \\ + \int_{M+\pi_t}^{\tilde{\omega}_{t+1}} [\Psi(\omega, l_t, s_{t+1}) - R_t^d d_t] dG(\omega) + \\ + \int_{\tilde{\omega}_{t+1}}^\infty [R_t^L l_t - R_t^d d_t] dG(\omega) - C(\pi_t) \end{array} \right\}$$

$$Equity = \int_{M+\pi_t}^\infty \gamma l_t dG(\omega), \quad \underbrace{\Psi(\omega, l_t, s_{t+1}) = \frac{q_{t+1}}{q_t} l_t + s_{t+1} \omega^\alpha \left(\frac{l_t}{q_t} \right)^\phi}_{\text{Value of loan recovered if type } \omega \text{ defaults}}$$

Optimal Lending Standards Risk Neutral Bank:

if $R_t^R = R_t^D$ and capital requirement constraint binds:

$$\begin{aligned}
 & \underbrace{((1 - \gamma) R_t^d + \gamma R_t^e) l_t}_{\text{Cost of Funds}} = \\
 & = \underbrace{\frac{E[q_{t+1}]}{q_t} l_t}_{\text{Value Borrower Assets}} + \underbrace{E[s_{t+1}] (M + \pi_t)^\alpha \left(\frac{l_t}{q_t}\right)^\phi}_{\text{Value Borrower Income}} + \\
 & + \underbrace{C'(\pi_t)}_{\text{Cost Implementing Standards}} \underbrace{\left(\frac{(M + \pi_t)^{\mu+1}}{\mu M^\mu}\right)}_{\text{Inverse of } \frac{\partial \text{Prob Not lending}}{\partial \pi}}
 \end{aligned}$$

2. Banks under imperfect information

How do we model imperfect information?

- ▶ s_t is observable, but not its components

$$s_t = z_t + \eta_t$$

- ▶ z_t is persistent:

$z_t = \{z^H, z^L\}$ follows 2-state Markov process with transition matrix P

- ▶ η_t is not persistent:

η_t is *i.i.d.* Normal $\left(\frac{-\sigma_\eta^2}{2}, \sigma_\eta^2\right)$

Results due to imperfect info

- ▶ Model of lending standards under imperfect info can explain two facts:
 - a) Higher volatility of standards during the Great Moderation
 - b) Rational credit booms/busts driven by signal extraction problem after a sequence of good realizations

Example of Rational Overoptimism

"Spain's economic **success over the past years** has been most impressive...

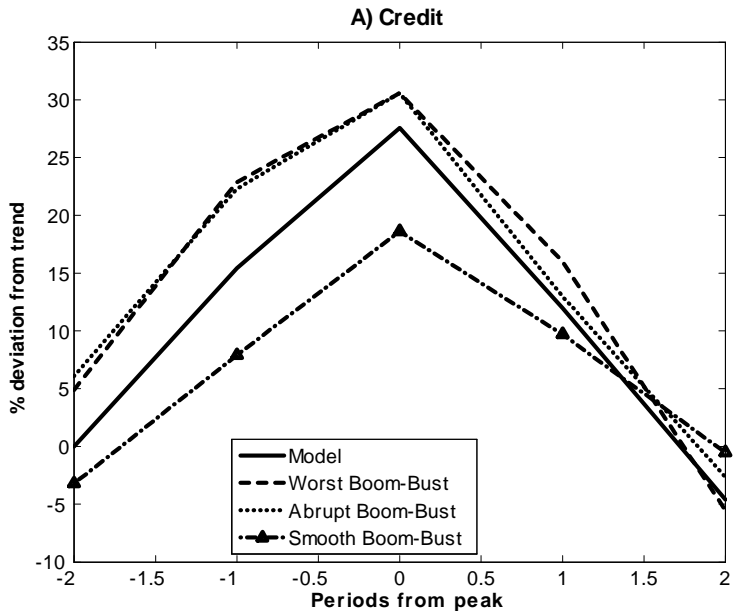
GDP growth is likely to remain above the euro-area average of just below 2% for several more years, allowing Spain to climb past Italy and Germany in the rankings of GDP per capita by 2020"

Research Department of **Deutsche Bank (2007)**

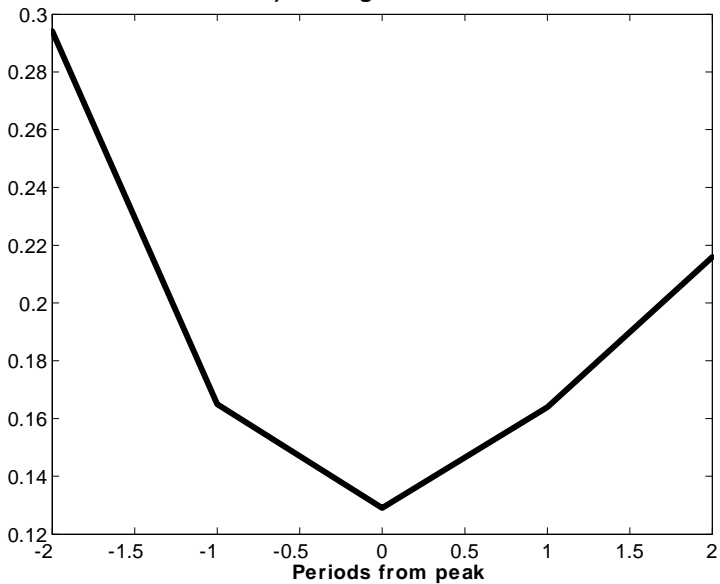
Booms/Busts

- ▶ Fluctuations in beliefs \Rightarrow fluctuations in lending standards
- ▶ Expect higher aggregate productivity \Rightarrow lower screening intensity
- ▶ Problem: banks may be reacting to i.i.d. shocks

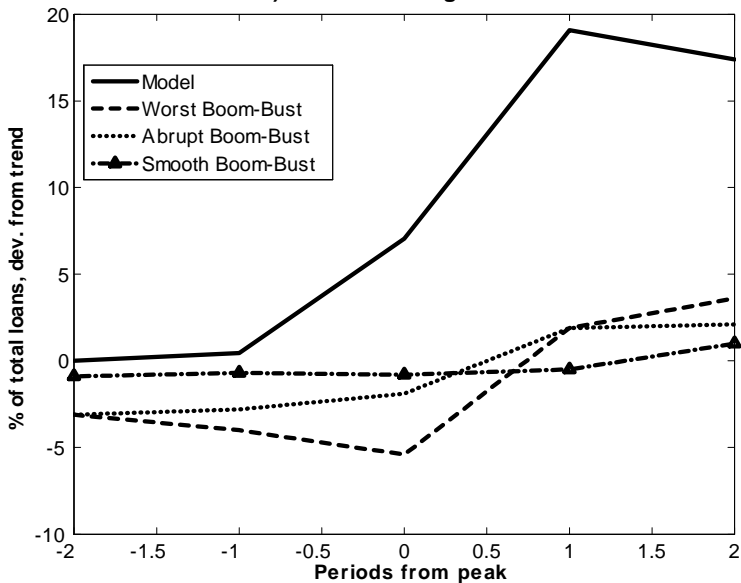
Data and model



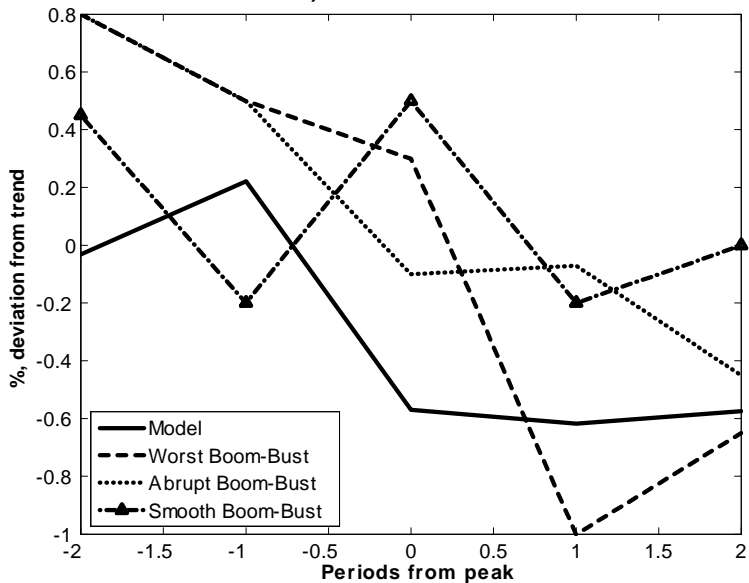
C) Lending Standards



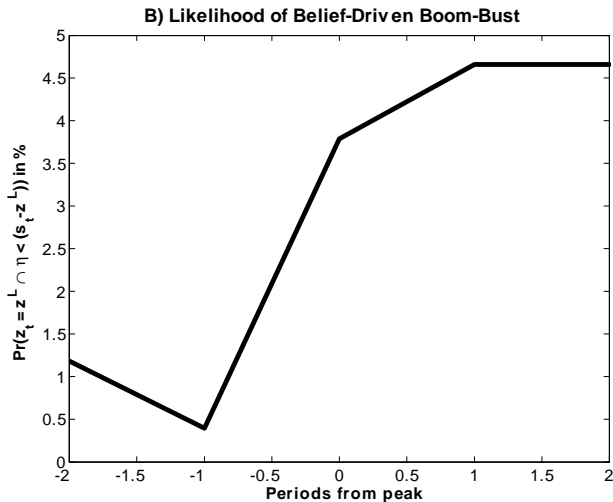
D) Non-Performing Loans



E) Return on Assets

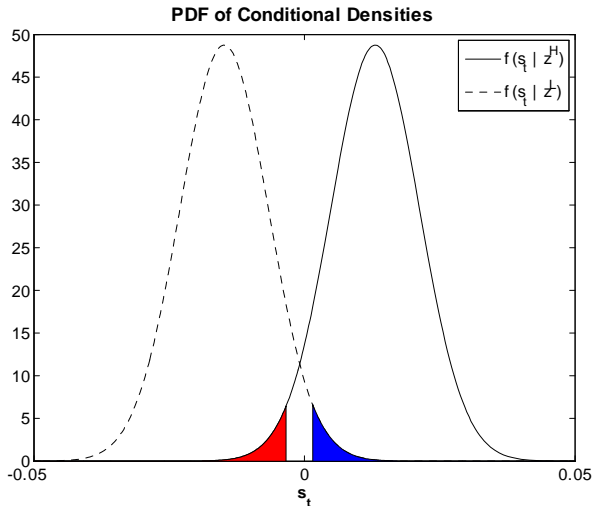


Likelihood of booms/busts driven by wrong beliefs



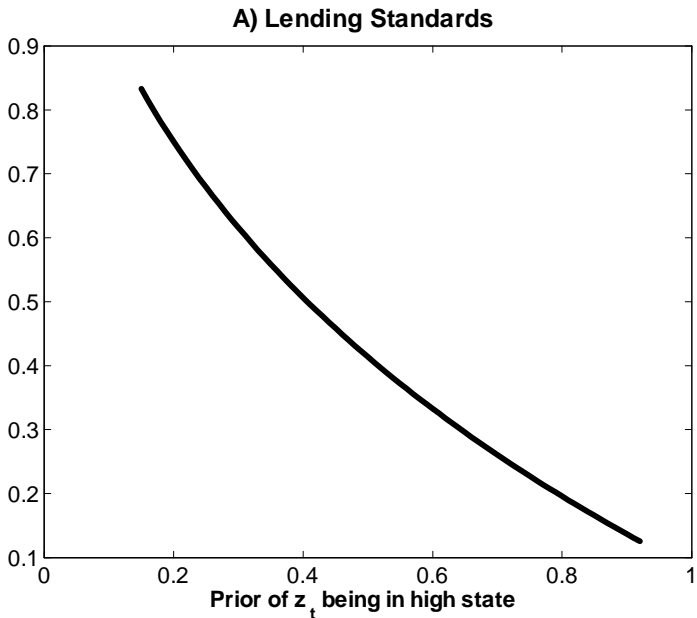
3. Macroprudential Policy

- ▶ With imperfect information, iid shocks matter next period
- ▶ Two possible errors:



- ▶ Regulator does not have superior info relative to banks
- ▶ But Regulator faces unlimited liability: pay for losses above bank's capital
- ▶ Regulator is more conservative with lending standards

Banks lower standards when optimistic

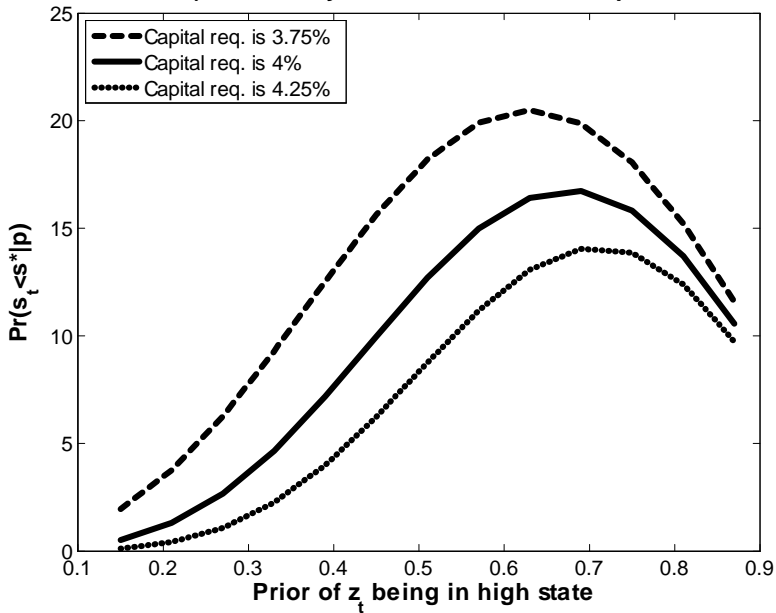


- ▶ Policymaker chooses capital requirements following Value at Risk: Keep size of loss in a certain probability
- ▶ Macroprudential tools should lean against banks' beliefs
 - ▶ When optimism, tighten policy

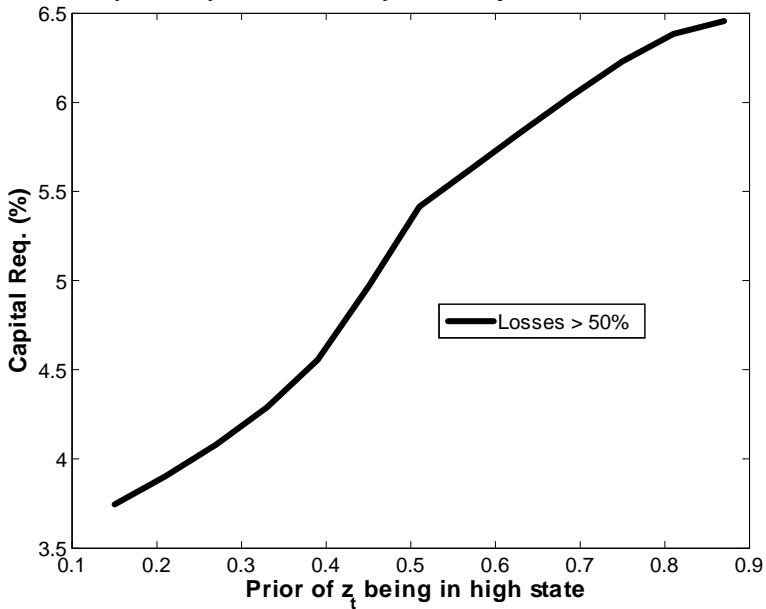
Raising capital requirements:

1. Increases the weight of equity, which is more expensive than debt
 - ▶ Bank needs to be pickier to ensure breakeven
2. Lower leverage implies smaller loans and less reward to high lending standards

A) Probability banks lose > 50% of capital

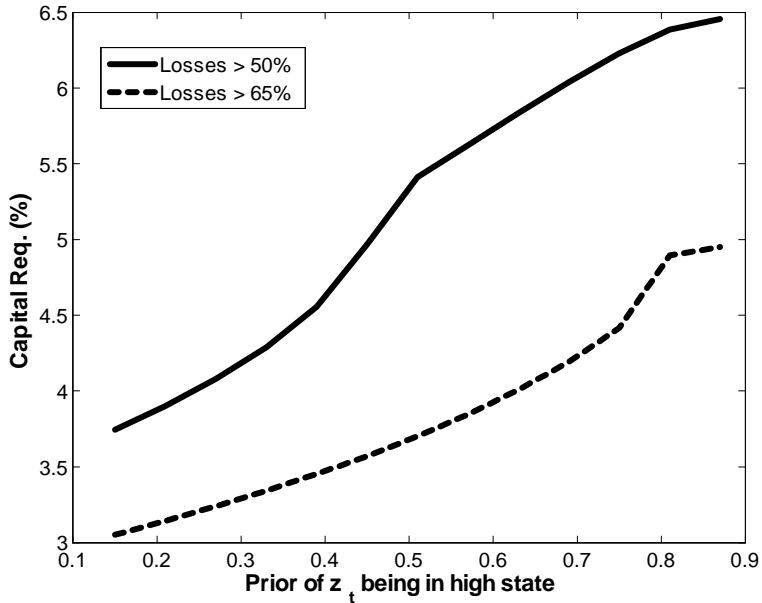


Capital requirements s.t. probability of bank losses is 2%



- ▶ Higher capital requirements increase lending standards and reduce potential losses
- ▶ Large losses happen less often, thus a VaR framework demands lower capital requirements as loss tolerance rises

Capital requirements s.t. probability of bank losses is 2%



Conclusions

- ▶ Wm. McC. Martin, Jr. (1955):
"The job of the Federal Reserve is to take away the punch bowl just as the party gets going"
- ▶ Our version:
One job of the macro regulator is to curb enthusiasm when banks think times are good

Appendix

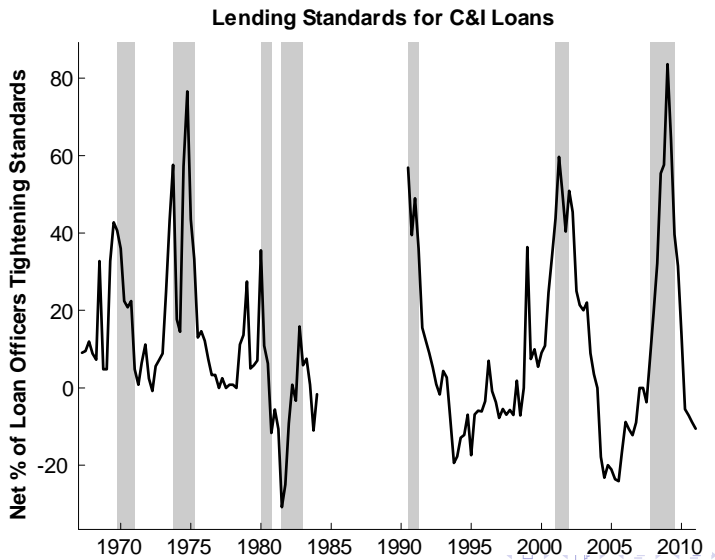
Imperfect Info and Volatility

- ▶ Dynamics of lending standards depend on information content of economic news σ_{η}^2
- ▶ In noisy times, smaller changes
- ▶ Model prediction matches new fact: larger volatility in lending standards since Great Moderation

A new fact:

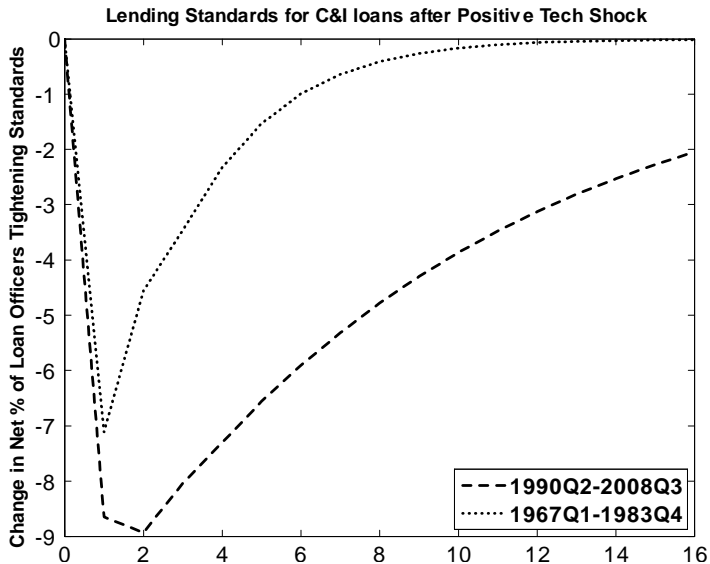
Std. Dev.: 1967-1983: 16.25

Std. Dev. 1990-2011: 23.28



- ▶ Data for lending standards:
1967Q1-1983Q4 and 1990Q2-2008Q3
- ▶ 1990Q2-2008Q3 is less noisy (estimated two state Markov switching model à la Hamilton 1989)
- ▶ Identify technology shock using long run restrictions in VAR (Blanchard-Quah)
 - ▶ only tech shocks have permanent effect on the level of output

In data: higher reaction in less noisy times



Model IRs to TFP shock for different amounts of noise

