Monetary policy and the asset risk-taking channel

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Motivation

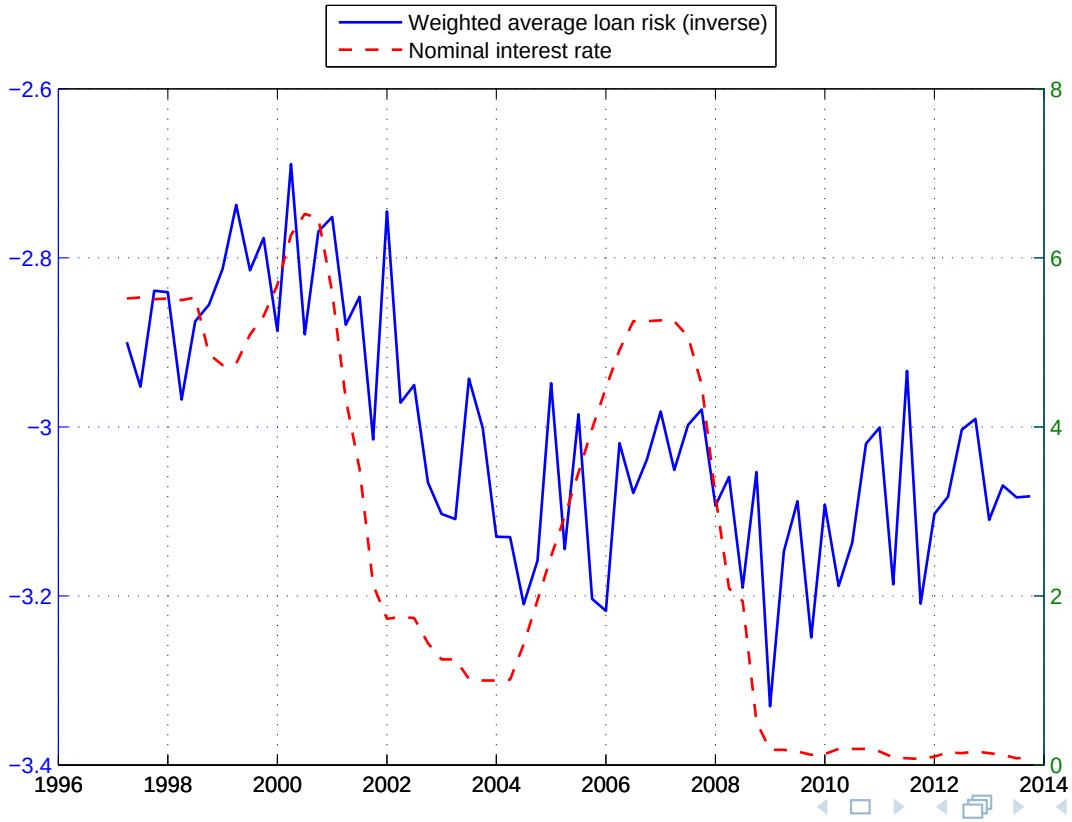
The Global Financial Crisis has reignited the debate on:

- The determinants of financial sector risk
- The influence of low interest rates on risk-taking behaviour
  - **Risk-taking channel of monetary policy**
    - Borio and Zhu (2008)
  - In the lead up to the crisis: low US interest rate and increasing measures of bank risk taking
  - Many empirical contributions on the topic using:
    - Loan level panel data: Jimenez et al. (ECMTA, 2014), Ioannidou et al. (Rev Financ, 2014)
    - Aggregate time series data: Buch et al. (JEDC, 2014)
  - **How important is the channel?**

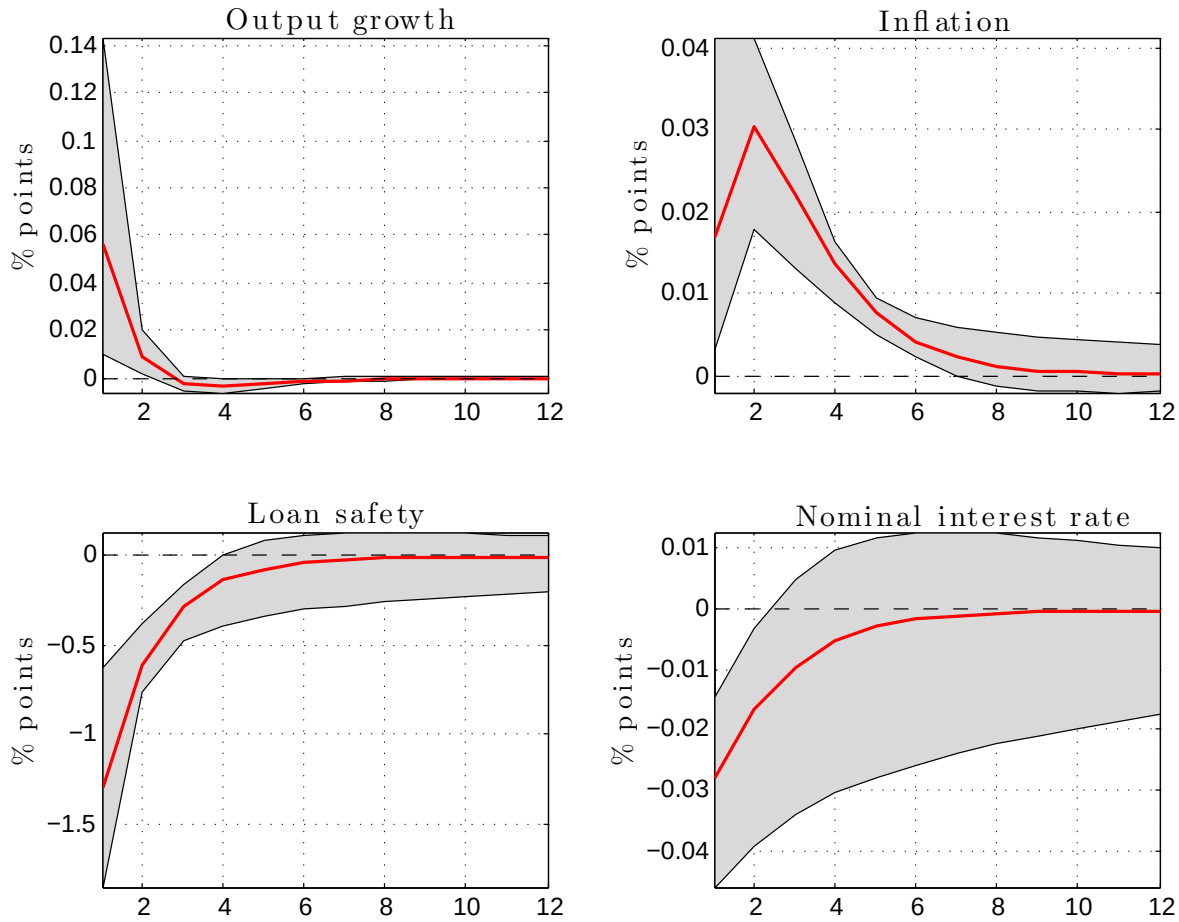
Ex-ante bank risk and the nominal interest rate

Average loan risk (from 1997Q2)

- Banks assign an internal risk rating to newly issued loans
- Construct a weighted average loan risk series, $\in [0, 5]$, $5 =$ max risk
- An increase in average risk could result from an active choice of the banks to extend credit to riskier borrowers



An expansionary monetary policy shock on US bank risk taking



Sample period: 1997q2-2009q4; IRFs over a 3-year horizon, identified through sign restrictions. Error bands shown correspond to a 90% confidence interval.

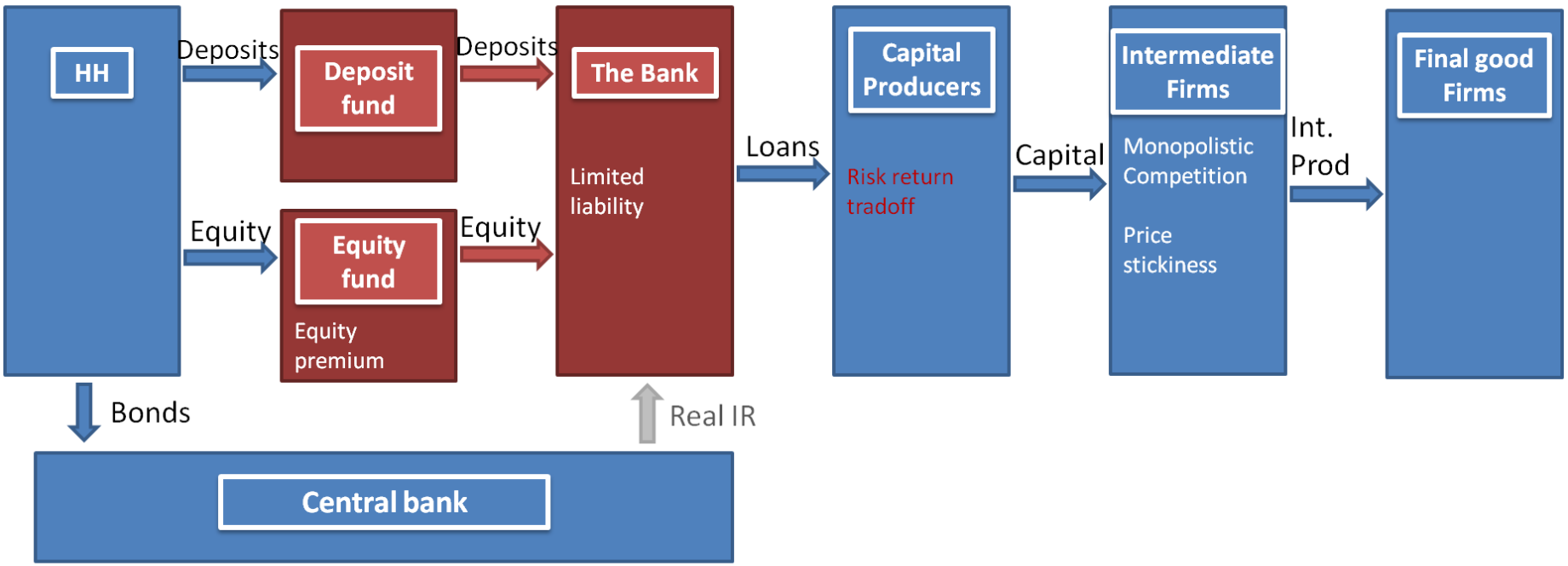
Contributions:

1. **Develop a dynamic New Keynesian model with a risk-taking channel**, by extending Dell'Ariccia *et al.* (JET, 2014)
   - Lower risk-free rate $\Rightarrow$ banks grant loans to riskier borrowers
   - This level of risk is not optimal
   - 1^{st} and 2^{nd} order effects on consumer welfare
   - Main differences from other models of financial frictions:
     - Asset risk vs funding risk
     - Pro-cyclical leverage dynamics

2. **How important is the risk-taking channel?**
   - Estimate the model on US data
   - How does the channel affect the trade-off faced by the monetary policy authority?

Literature review

Overview of the model



The supply of deposits and equity: Households

Choose consumption and labour, and save through government bonds (s_t), bank deposits (d_t), and bank equity (e_t)

1. If a bank defaults, e_t pay 0 and d_t pay the (limited) deposit insurance
2. Real cost of holding equity ξ (premium over the risk free rate)

$\Rightarrow$ Equity is more costly for banks than deposits

- Each bank defaults with probability $1-q$, but HH perfectly diversify among a continuum of banks
- In equilibrium, the no-arbitrage conditions must hold:

$$E\left[u_c(c_{t+1})\left(q_t r_{d,t} + (1-q_t)\frac{\psi}{(1-k_t)}\right)\right] = E\left[u_c(c_{t+1})R_t\right]$$

$$E\left[u_c(c_{t+1})\left(r_{e,t+1}q_t - \xi\right)\right] = E\left[u_c(c_{t+1})R_t\right]$$

Banks: Introduction

Continuum of identical banks facing a 2-stage problem:

Stage 1: Raise deposits and equity from households

Stage 2: Invest in projects with a specific risk-return trade off

Assumptions:

1. Equity (residual claimant) is more costly for banks than deposits
2. Bank managers/equity are protected by limited liability
3. Depositors cannot observe the risk choice made in Stage 2

Implications:

- Equity is more costly, but deposits entail an agency problem:

$\Rightarrow$ The less equity the bank has, the higher the incentives for risk taking

- In equilibrium excessive risk choice is chosen
- The lower the real risk free rate, the higher is the risk chosen

Banks: Asset side and Objective function

In the 2^{nd} stage banks choose asset riskiness, given the capital structure and the cost of deposits, to maximise equity's profits

- buys capital projects of type q_t with a specific risk-return trade off
- the riskier the project, the higher the net return in case of success
- with probability q_t, the project is successful: capital is produced in $t+1$ and rented to firms; banks get paid the rental rate
- with probability $1-q_t$ the project defaults: the bank/equity get 0 while depositors get the deposit insurance

$\Rightarrow$ Bank's objective function is:

$$E_t\left\{\Lambda_{t+1} q_t \left[\underbrace{(\omega_1 - \omega_2/2q_t) r_{k,t+1}}_{\text{per-unit real revenue}} - \underbrace{r_{d,t}(1-k_t) - r_{e,t+1} k_t}_{\text{funding costs}}\right]\right\}$$

Note that, because of limited liability, banks are protected by the downside risk of their investment

The risk-taking channel

Bank problem is solved backwards:

2. Choose q_t, taking the deposit rate and capital structure as given
   - by assumptions, depositors cannot contract on the choice of q_t
1. Choose the optimal capital structure $k_t \equiv \frac{e_t}{(d_t+e_t)}$, anticipating the risk choice made in Stage 2

In equilibrium, a lower risk-free rate makes banks increase leverage:

- Equity premium becomes relatively more important
- Substitute equity for deposits
- Internalise less the consequences of risk (limited liability)
- Choose a portfolio with higher risk
  (but a higher net return in case of repayment)

Steady state and dynamic implications of excessive risk taking

Bank risk choice vs choice made under no banking frictions:

- **Bank risk choice is excessive** in the steady state
  - inefficient capital production technology in the steady state $\Rightarrow$ bank economy is under-capitalized $\Rightarrow$ inefficiently low levels of output, consumption and welfare
- **Risk taking gets more excessive as the real interest rate falls**

To compare dynamics, we **define a benchmark model**:

- risk choice and equity ratio are parameters set to the steady state values of the bank model
- corresponds to a standard New Keynesian model with a small markup in capital markets

The full macro model

We embed the risk-taking channel in a medium-scale model similar to Smets and Wouters (AER 07):

- internal habits, investment adjustment costs and imperfect competition and wage stickiness in the labor market

This serves two purposes:

1. perform a sound monetary policy evaluation through a quantitative model that can replicate key empirical moments of the data
2. assess whether our channel is quantitatively important compared to other monetary and real frictions

Estimation details

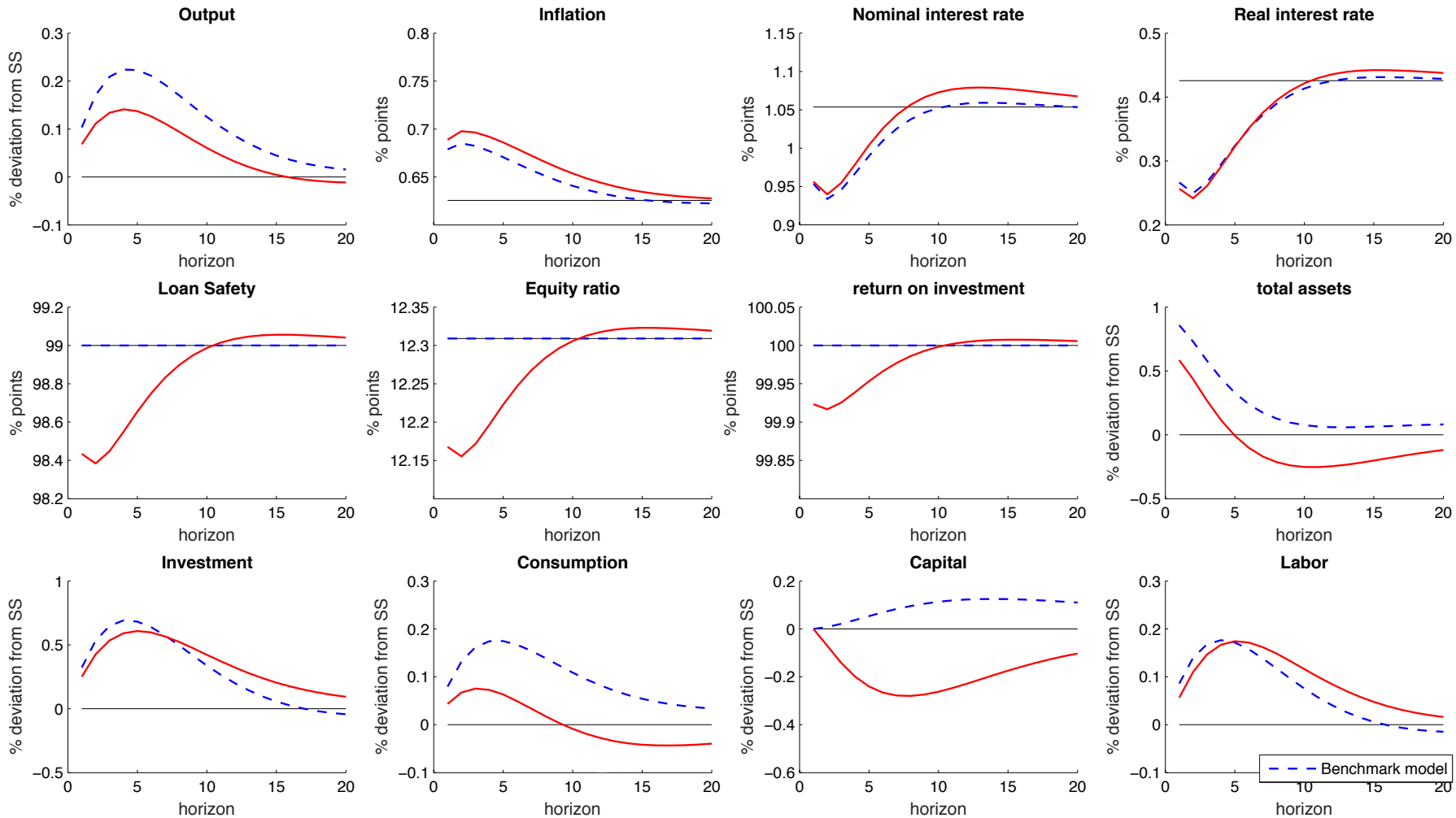
The model is estimated with Bayesian techniques using 8 US series from 1984q1 to 2007q3:

- federal funds rate, hours, inflation, and growth rates in real wage, per-capita real GDP, consumption and investment
- bank equity ratio (FDIC data)

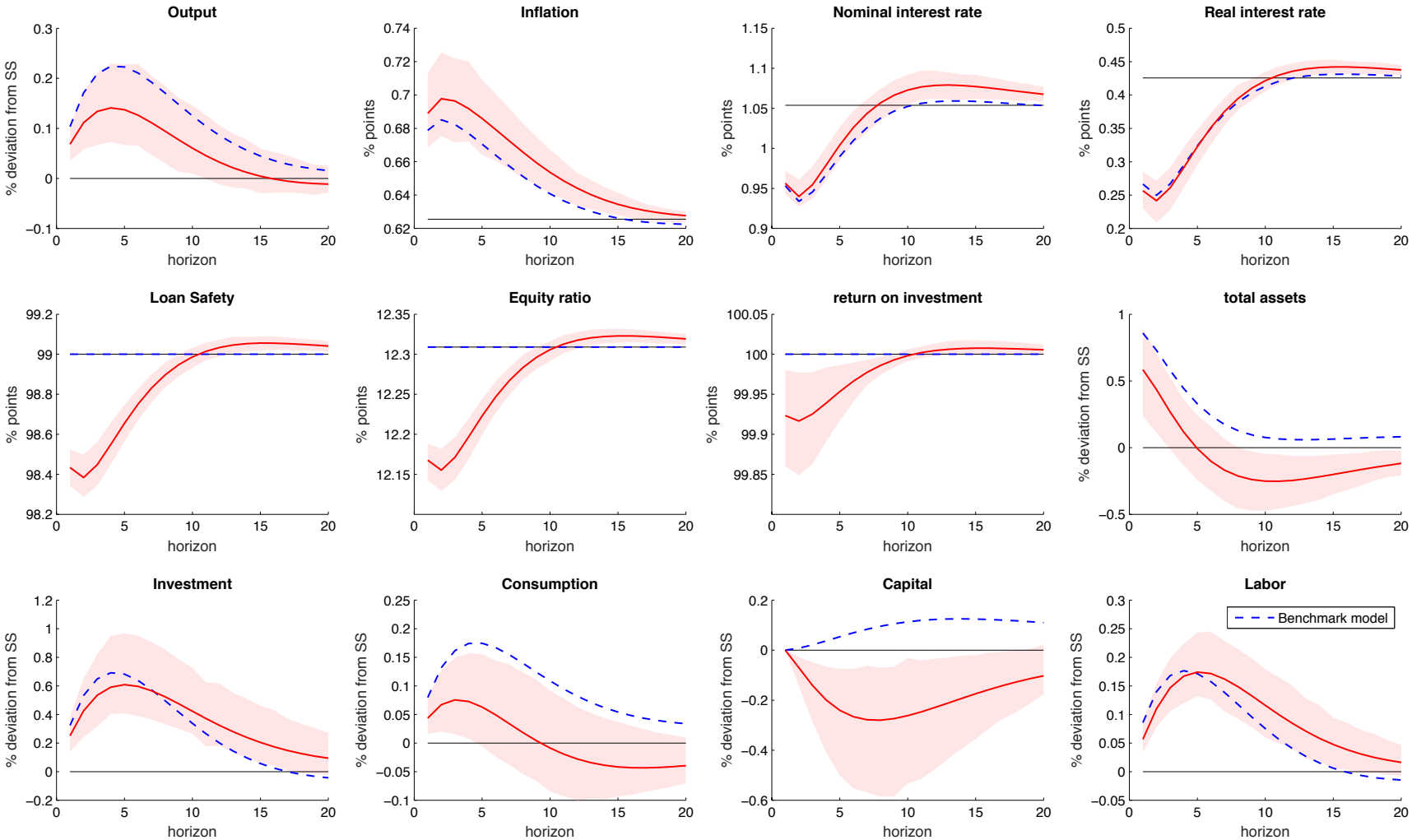
Three block of parameters:

1. a set of calibrated parameters
2. a set of standard parameters: priors as in Smets and Wouters (07)
3. a set of banking parameters:
   - rewrite deposit insurance and investment efficiency as a function of the steady state equity ratio and default rate
   - mean equity ratio of 11% and mean annual default rate of 4%
   - recovery rate takes values $\in [0.3, 0.7]$ with 95% probability

Model responses to an expansionary monetary policy shock in the bank and benchmark models



Model responses to an expansionary monetary policy shock in the bank and benchmark models - 90% credible sets



The effects of a monetary policy expansion

An unexpected cut in the risk-free rate causes:

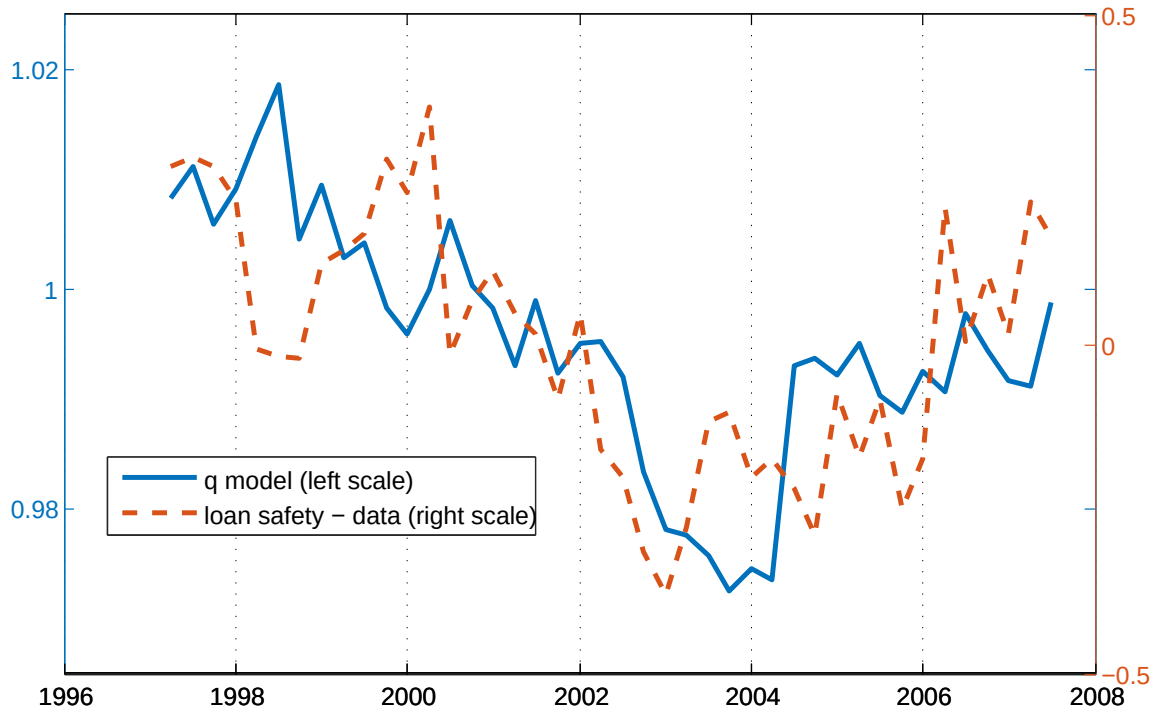
- **standard effects**: $c \uparrow$, $y \uparrow$, $\pi \uparrow$
- **risk-taking effects**:

  Banks substitute equity for deposits, and choose a riskier investment
  - less efficient capital production
  - expected return on aggregate investment drops
  - investment and consumption rise less then in the benchmark case and capital stock declines considerably

A cut in the risk-free rate is less expansionary if the risk-taking channel is present, because it creates financial sector distortions

The risk-taking channel model - estimation

- Data favours the model with the risk-taking channel (seven-variable comparison)
- The inclusion of banking sector leverage identifies the key friction parameters
- We are matching the dynamics of loan risk taking



Implications for monetary policy (1/2)

Is the risk-taking channel quantitatively significant for monetary policy?

- Determine the optimal simple monetary policy rules in the bank and in the benchmark models:

$$R_t - \bar{R} = \phi_\pi \hat{\pi}_t + \phi_y \hat{y}_t + \rho \left(R_{t-1} - \bar{R} \right)$$

  - the hat denotes % deviations from the steady state

- Compute the welfare costs of implementing the optimal benchmark policy in the bank model
  - expressed in % of the consumption stream, based on the 2^{nd} order approx. of household's welfare

Implications for monetary policy (2/2)

	benchmark model			*bank model*			
rule	ρ	ϕ_{π_t}	ϕ_{y_t}	ρ	ϕ_{π_t}	ϕ_{y_t}	Ω
$\rho = 0$	**0**	7.20	0.11	**0**	3.11	0.12	0.50
$\rho \neq 0$	0	7.201	0.12	1	0.10	0.01	0.89

- Bank model: ϕ_y and ϕ_π are smaller and full smoothing is optimal
  - optimal rule is close to a stable real interest rate rule
  - reduce the volatility of the real interest rate $\Rightarrow$ reduce the volatility in banking sector risk and increase mean efficiency of the banking sector

  $\Rightarrow$ tradeoff between inflation and financial market volatility

  (moments)
- The costs Ω of applying in the bank model the rule that is optimal for the benchmark model are always significant
- The additional welfare gains of reacting to leverage are small

Differences in moments (in %) associated to different rules

For example, under rule-type 1, risk is on average 0.12% lower and 44.55% less volatile if the optimal bank policy rule is applied

	Standard deviation				
rule	q	R^r	π	y	c
$\phi_k, \rho = 0$	-44.546	-48.511	52.957	-0.807	-4.190
$\phi_k = 0$	-69.401	-78.915	66.990	-7.404	-9.775
$\rho = 0$	-42.464	-47.820	53.641	-0.739	-3.897

	Mean				
rule	q	R^r	π	y	c
$\phi_k, \rho = 0$	0.154	0.002	-0.057	0.321	0.517
$\phi_k = 0$	0.219	0.007	-0.081	0.440	0.709
$\rho = 0$	0.205	0.010	-0.083	0.437	0.695

Conclusions

- Low risk-free rates lead banks to make riskier investments
  - Excessive risk taking and inefficient capital production in SS
  - Monetary policy expansion dampened by financial frictions
- Optimal monetary stabilizes the the real interest rate path
  - accept more inflation volatility to reduce welfare detrimental fluctuations in risk taking

Open questions (Trinity-related)

- Can macropudential policy do a better job?
- We analyse *one aspect of risk*
  - different financial frictions imply different transmission mechanisms, and (possibly) different policy prescriptions
  - which financial friction is most relevant for the data?

Literature review

Theoretical contributions on banking sector risk

- Funding risk: Gertler, Kiyotaki and Queralto (JME, 2012), Angeloni, Faia (JME, 2013)
- Asset risk: Dell'Ariccia, Laeven and Marquez (JET, 2014)

Empirical contributions on the **asset** risk-taking channel

- Loan level panel data: Jimenez et al. (ECMTA, 2014), Ioannidou et al. (Rev Financ, 2014)
- Aggregate time series data: Buch et al. (JEDC, 2014)

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Data

SYMBOL	SERIES	MNEMONIC	UNIT	SOURCE
Y	GREAL GROSS DOMESTIC PRODUCT	GDPC96	BN. USD	FRED / BEA
P	GDP DEFLATOR	GDPDEF	INDEX	FRED / BEA
R	EFFECTIVE FEDERAL FUNDS RATE	FEDFUNDS	%	FRED
C	PERSONAL CONSUMPTION EXPENDITURE	PCEC	BN. USD	FRED / BEA
I	FIXED PRIVATE INVESTMENT	FPI	BN. USD	FRED / BEA
H_1	CIVILIAN EMPLOYMENT	CE16OV	THOUSANDS	FRED / BLS
H_2	NONFARM BUSINESS (..) HOURS	INDEX	PRS85006023	DPT OF LABOR
W_1	NONFARM BUSINESS (..) HOURLY COMPENSATION	INDEX	PRS85006103	DPT OF LABOR
N	CIVILIAN POPULATION	CE16OV	LNS10000000	BLS
q	AVERAGE WEIGHTED LOAN RISK		%	BOARD OF GOV.
E	EQUITY CAPITAL OVER LIABILITIES		%	FDIC

Equity capital is defined as equity plus reserves plus subordinated debt, while total liabilities are equity plus deposits.

Back

Loan demand: Capital producers

Continuum of capital producers (competitive):

- Use loans to purchase capital projects o_t
- o_t is used to produced capital in the next period, leased to firms
- Each produce has access to a continuum of technologies $q_t \in [0, 1]$:

$$K_{t+1} = \begin{cases} \left(\omega_1 - \frac{\omega_2}{2} q_t\right) o_t & \text{with probablity } q_t \\ \theta o_t & \text{else} \end{cases}$$

- The safer the technology, the lower the output in case of success.

The bank orders the capital projects with a given technology q_t.
Since we are working with a continuum of representative agents, we can derive the law of motion of capital as:

$$K_{t+1} = q_t \left(\omega_1 - \frac{\omega_2}{2} q_t\right) o_t + (1 - q_t) s_t \theta_t \ .$$

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