THE BANK CAPITAL CHANNEL OF MONETARY POLICY

Skander Van den Heuvel
Federal Reserve Board

The views presented are solely those of the author and do not necessarily represent those of the Federal Reserve Board or its staff.

Do bank capital and capital requirements matter for the transmission of monetary policy to bank lending?

Do bank capital and capital requirements matter for the transmission of monetary policy to bank lending?

- Traditional monetary theory has largely ignored bank equity and capital requirements.

Do bank capital and capital requirements matter for the transmission of monetary policy to bank lending?

- Traditional monetary theory has largely ignored bank equity and capital requirements.
- Increased importance of capital requirements (since the Basel Accords).

Do bank capital and capital requirements matter for the transmission of monetary policy to bank lending?

- Traditional monetary theory has largely ignored bank equity and capital requirements.
- Increased importance of capital requirements (since the Basel Accords).
- ‘Capital crunch’ during the 1990-91 and 2008-09 recessions. Banking crises associated with output declines.

Do bank capital and capital requirements matter for the transmission of monetary policy to bank lending?

- Traditional monetary theory has largely ignored bank equity and capital requirements.
- Increased importance of capital requirements (since the Basel Accords).
- ‘Capital crunch’ during the 1990-91 and 2008-09 recessions. Banking crises associated with output declines.
- Evidence that low bank capital increases cost of bank loans to firms (e.g. Hubbard, Kuttner and Palia).

Do bank capital and capital requirements matter for the transmission of monetary policy to bank lending?

- Traditional monetary theory has largely ignored bank equity and capital requirements.
- Increased importance of capital requirements (since the Basel Accords).
- ‘Capital crunch’ during the 1990-91 and 2008-09 recessions. Banking crises associated with output declines.
- Evidence that low bank capital increases cost of bank loans to firms (e.g. Hubbard, Kuttner and Palia).
- Evidence that low bank capital is associated with larger monetary policy effects on individual bank lending and on state level output.

Do bank capital and capital requirements matter for the transmission of monetary policy to bank lending?

This paper: **Yes**.

In the presence of financial frictions, capital requirements generate a mechanism whereby monetary policy changes bank loan supply through its effect on bank capital.

Outline

1. Regulatory background
2. Model
3. Calibration and quantitative results
4. Empirical test

Regulatory background for U.S.

Pre – Basle:

core capital ≥ 0.03 * total assets

higher requirement for all but "the most highly rated banks"

Basel I Accord (1988):

tier 1 capital ≥ 0.04 * risk-weighted assets

total capital ≥ 0.08 * risk-weighted assets

risk-weights: reflect credit risk of asset categories.

FDICIA (1991): Prompt Corrective Action

- prevent dividends that would leave the bank undercapitalized
- limits on assets growth and new lines of business for undercapitalized banks

Regulatory background

Basel II (never implemented in US)

Pillar1: More refined risk weights, based on ratings

- external
- internal

Pillar 2 incorporates some similar elements to the FDICIA

Basel III

- work in progress…

Model: Introduction

Dynamic bank asset and liability management model with:

1. Risk-based capital requirements
2. Imperfect market for bank equity
3. Maturity transformation by the bank

1 and 2 → bank lending depends on bank capital
3 → interest rate risk

Combined, this gives rise to a 'bank capital channel':

$$r_t \uparrow \rightarrow profits_{t+1} \downarrow \rightarrow E_{t+1} \downarrow \rightarrow L_{t+1} \downarrow$$

Strength of effect depends on initial balance sheet of the bank.

Model: Introduction

Model provides an alternative to the conventional bank lending channel

- No special role of reserves
- Bank lending channel requires financial frictions for *all* nonreservable bank liabilities

Model: Introduction

Main implications:

1. Bank lending depends on the bank's capital adequacy even when the regulatory constraint is not momentarily binding.
2. Shocks to bank profitability, such as loan defaults, have a persistent impact on lending.
3. The model generates a 'bank capital channel' of monetary policy.
4. The strength of this channel depends on the capital adequacy of the banking sector. Lending by banks with low capital has a delayed and then amplified reaction to interest rate shocks, relative to well-capitalized banks.

The Model

The bank's objective: maximization of shareholder value.

- Shareholders do not price the bank's risk
- Short market interest rate r_t exogenous process

$$V_t = \max_{\{N_{t+s}, D_{t+s}\}_{s=0}^{\infty}} \mathrm{E}_t \left[\sum_{s=0}^{\infty} \left(\prod_{u=0}^{s-1} (1 + r_{t+u})^{-1} \right) D_{t+s} \right]$$

Assets		**Liabilities**	
Loans	L_t	Debt (including deposits)	B_t
Securities	S_t	Equity	E_t
Total Assets	A_t		A_t

Assets		**Liabilities**	
Loans	L_t+N_t	Debt	$B_t+N_t+\Delta S_t+D_t$
Securities	$S_t+\Delta S_t$	Equity	$E_t - D_t$
Total Assets	$A_t+N_t+\Delta S_t$		$A_t+N_t+\Delta S_t$

Loans:

- Constant maturity structure of loan portfolio:
  - fraction $\bar{\delta}$ due each period.
  - Average maturity: $1/\bar{\delta} > 1$.
  - Actual repayments uncertain: δ_{t+1}

- Bad loans cause charge-offs.

$$L_{t+1} = (1 - \delta_{t+1} - \omega_{t+1})L_t + (1 - \delta_{t+1} - b_{t+1})N_t$$

- Downward sloping loan demand: higher N in given period implies lower contractual interest rate ρ and/or higher charge-offs**:**

$$b_{t+1} = \mathrm{b}(\underset{+}{N_t}, \omega_{t+1})$$

Bank debt and securities:

- All short (maturity transformation).
- Bank debt insured, securities risk-free → market interest rate r_t
- Abstracts from liquidity problems. No ‘bank lending channel’ in model.

Equity:

$$E_{t+1} = E_t - D_t + (1-\tau)\pi_{t+1}$$

- Corporate income tax generates tax advantage of debt finance, relative to equity.

Accounting profits:

$$\begin{aligned}\pi_{t+1} = \rho((1-\omega_{t+1})L_t + (1-b_{t+1})N_t) \\ -r_t(L_t - E_t + N_t + D_t) \\ -(\omega_{t+1}L_t + b_{t+1}N_t) + \pi^F\end{aligned}$$

Capital Regulation:

- Loans: 100% in risk weighted assets.
- Securities: zero risk weight.
- Regulations limit asset growth and dividends:

$$E_t \geq \gamma L_t \Rightarrow E_t - D_t \geq \gamma(L_t + N_t)$$

$$E_t < \gamma L_t \Rightarrow N_t = 0 \text{ and } D_t = 0$$

Financial Constraint:

$$D_t \geq 0$$

Risk:

1. Default risk, ω
2. Interest rate risk, r
3. 'Liquidity risk', δ

Markov in r

State variables: (E_t, L_t, r_t)

A useful benchmark: no financial friction

'Financially unconstrained bank':

- No financial constraint imposed; $D < 0$ without cost.

- Modigliani-Miller result for lending:
  $N^U(E_t, L_t, r_t) = \mathbf{N^U}(r_t)$ ('balance sheet does not matter')

- This bank always keeps capital at the regulatory minimum:
  $D^U(s_t) = E_t - \gamma(L_t + \mathbf{N^U}(r_t))$

Calibration

$$\mathrm{b}(N,\omega) = \alpha N^{\eta}\omega$$

Table 1.1. Parameters values (at annual rates):

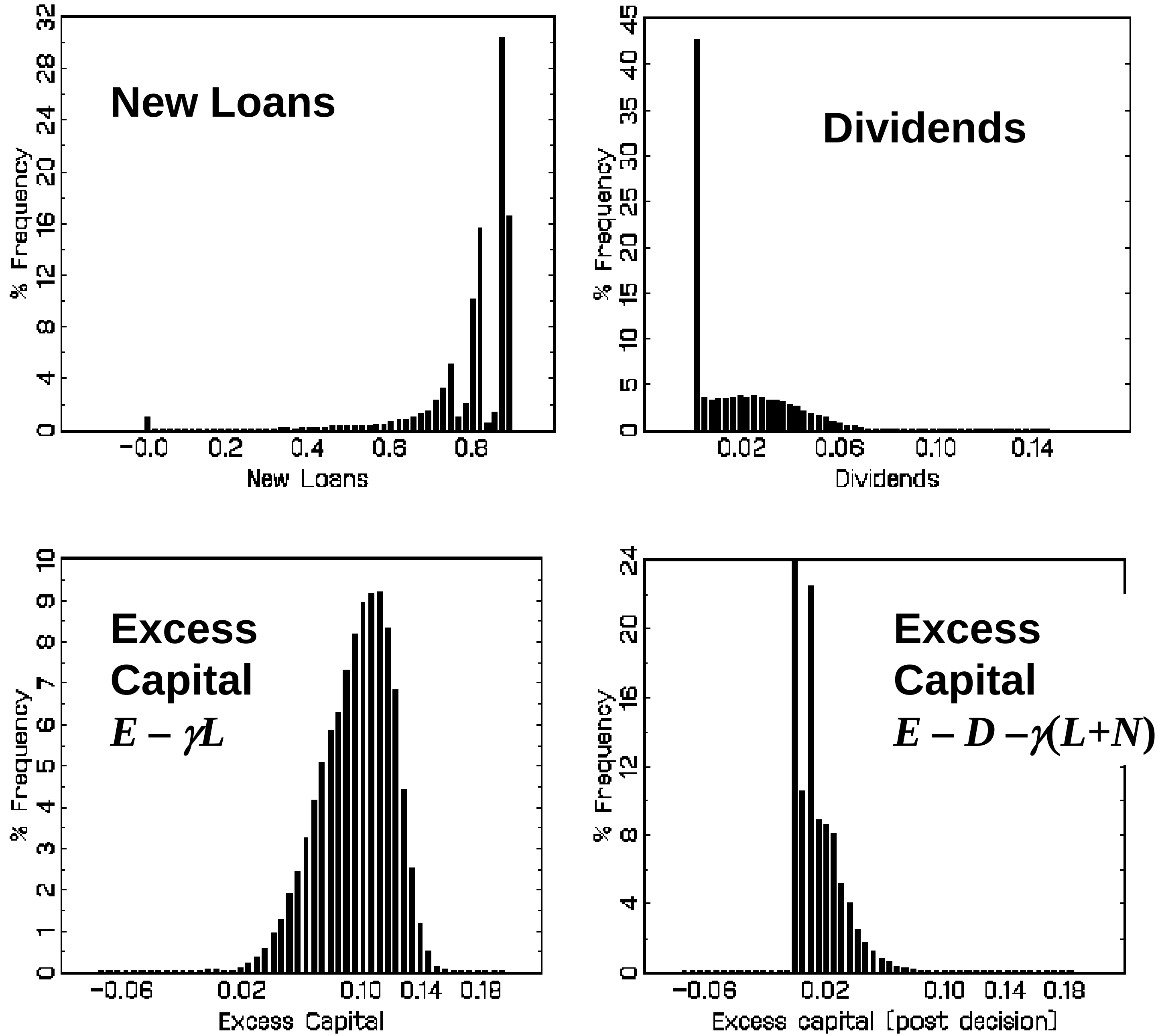
γ	0.08
τ	0.40
ρ^{0}	0.08
α	4.00
η	8.00
π^{F}	- 0.094

Distr. Of:	*Min:*	*Mode:*	*Max:*
ω	- 0.005	0.005	0.040
δ	0.200	0.250	0.300

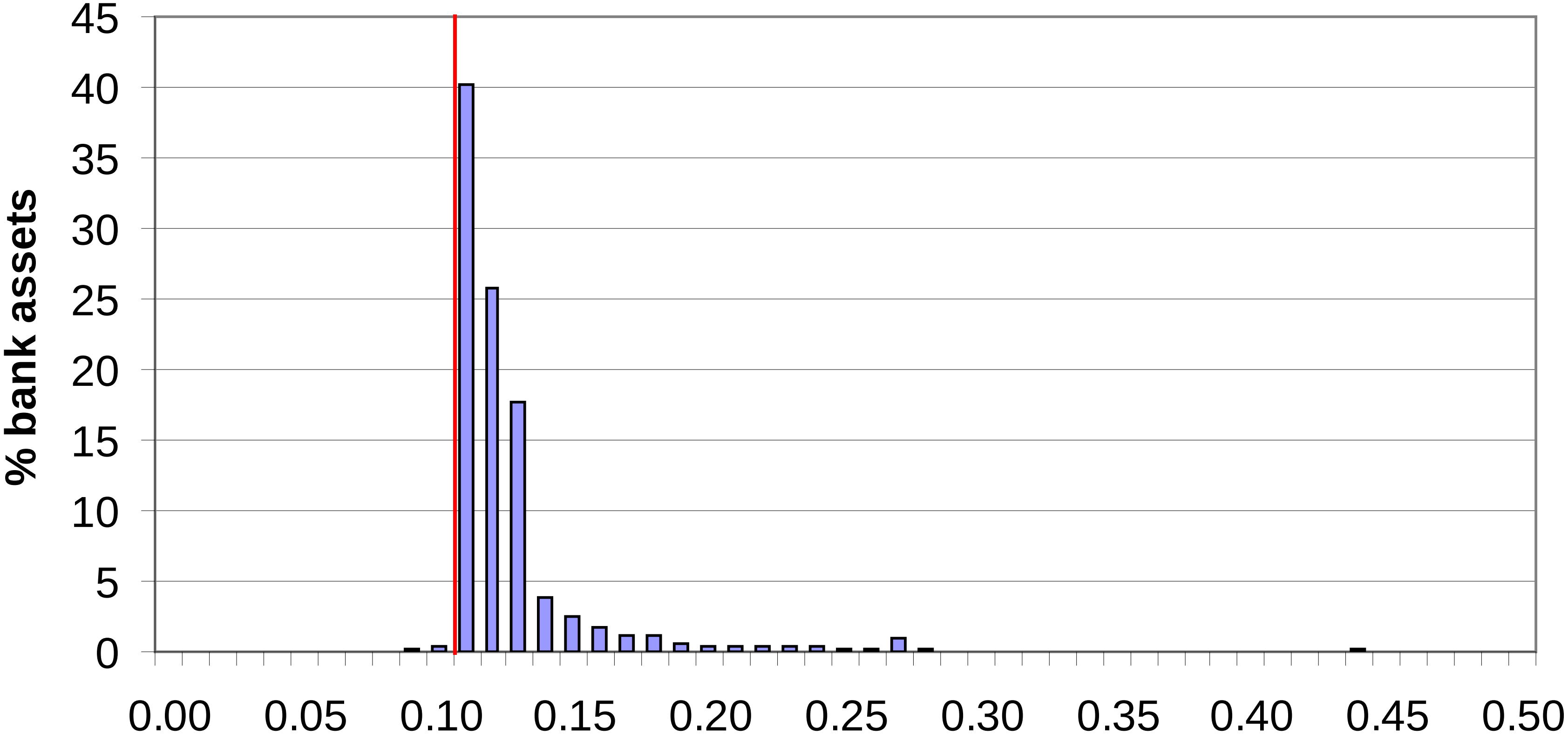
- ω and δ i.i.d., triangular densities

Results

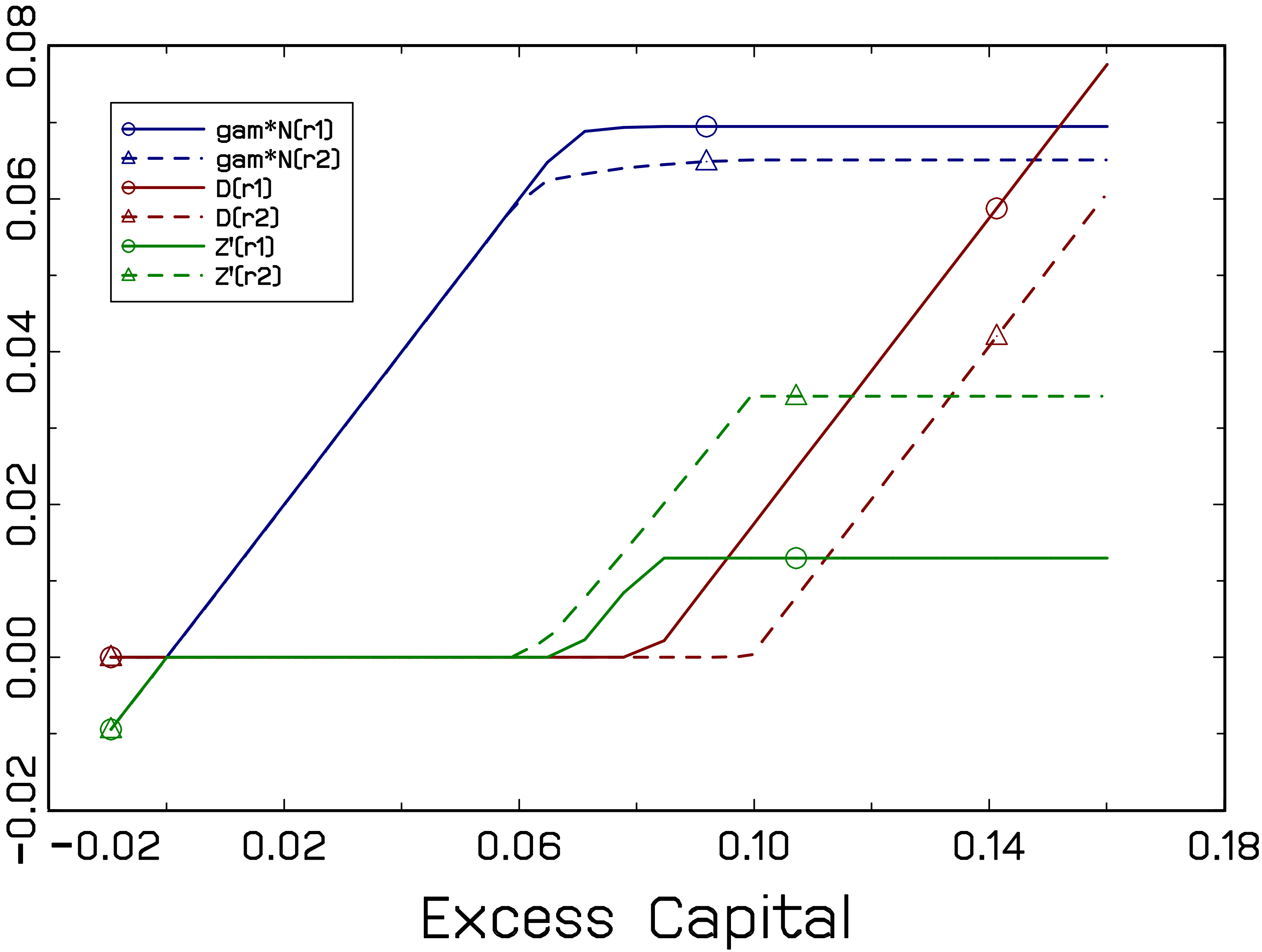
Capital requirement slack: $E - D - \gamma(L+N) > 0$	**81 %**	$\partial N / \partial E = 0$ **60 %** $\partial N / \partial E > 0$ **40 %**
Capital requirement binding: $E - D - \gamma(L+N) = 0$	**19 %**	$\partial N / \partial E = 1/\gamma$
Capital Inadequacy: $E - \gamma L < 0$	**0.43 %**	$\partial N / \partial E = 0$
Bankruptcy: $E \leq 0$	**0.02 %**	Exit

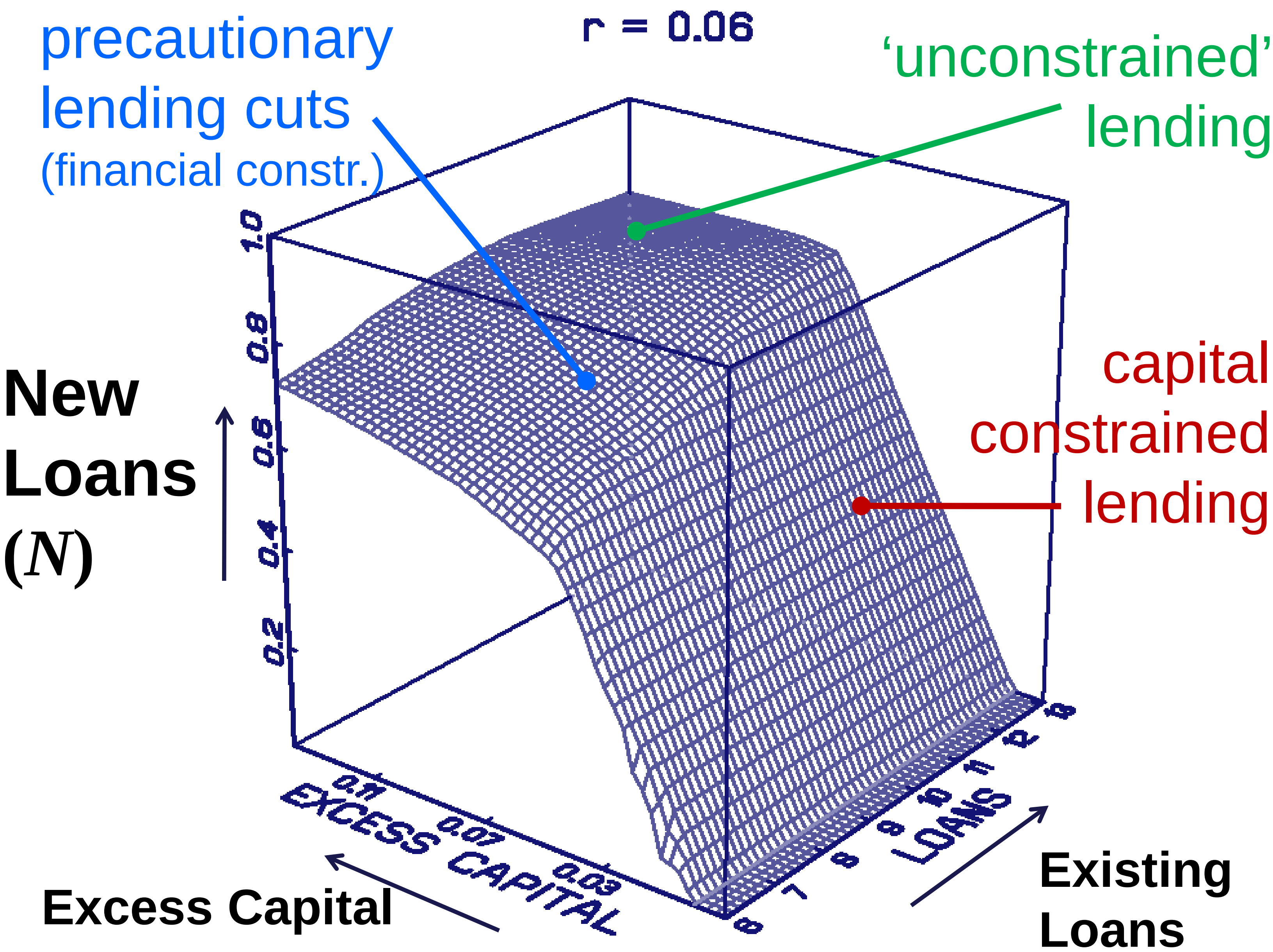

New Loans
% Frequency
New Loans
Dividends
% Frequency
Dividends
Excess
Capital
$E - \gamma L$
% Frequency
Excess Capital
Excess
Capital
$E - D - \gamma (L+N)$
% Frequency
Excess capital (post decision)

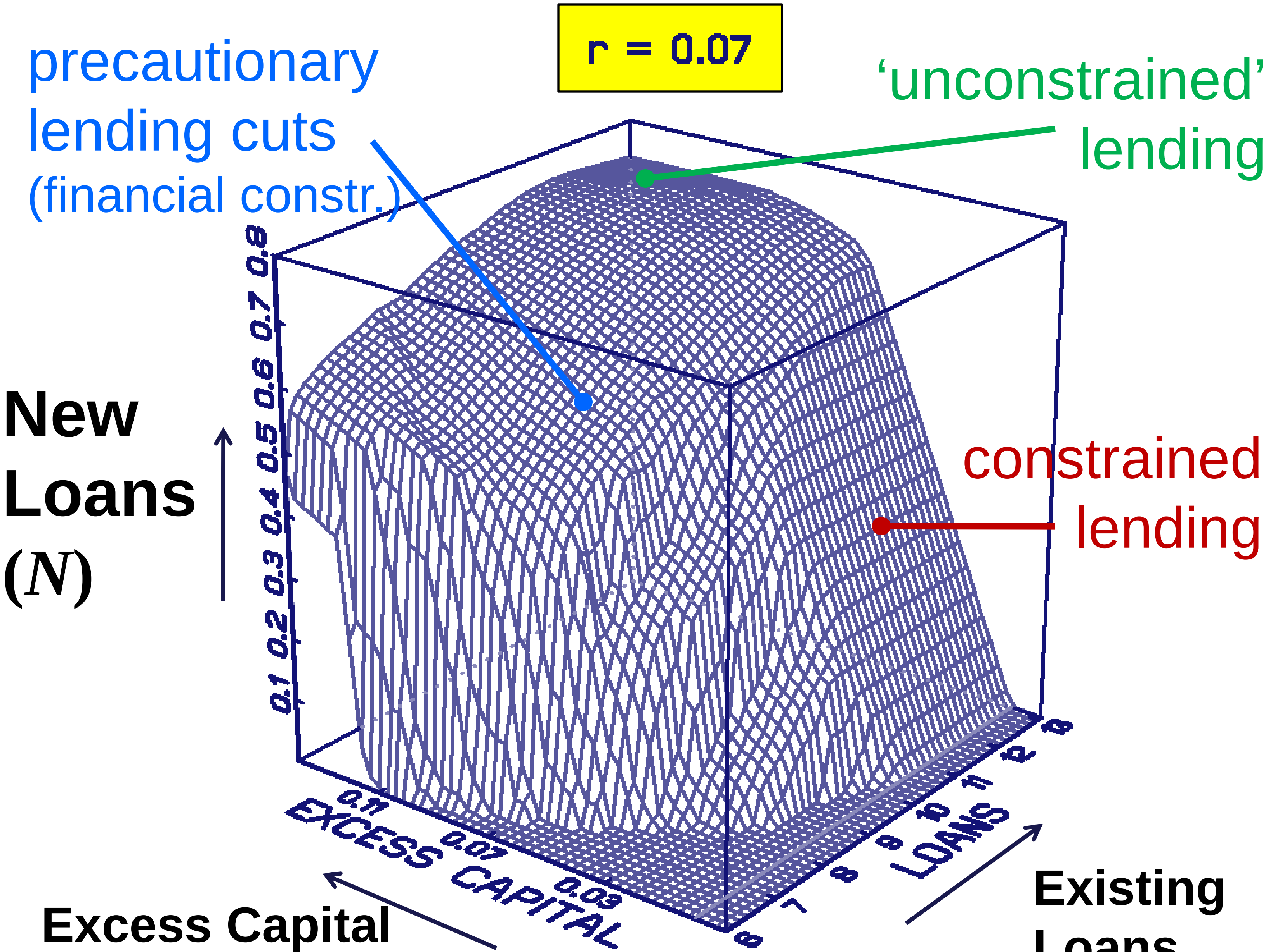
Risk based total capital ratios



Optimal policy as a function of excess capital for r1 = 0.05 and r2 = 0.06

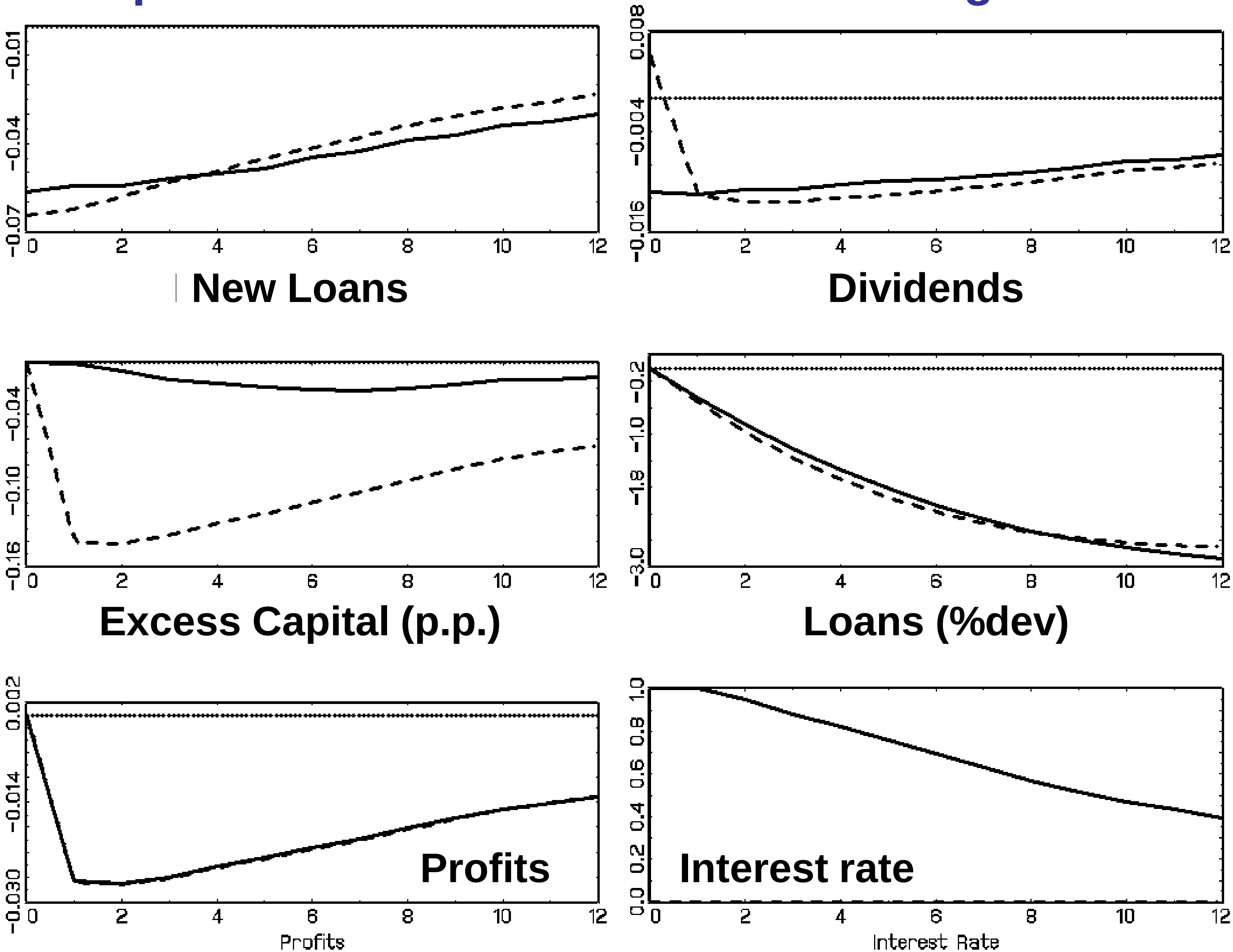



r = 0.06
precautionary
lending cuts
(financial constr.)
'unconstrained'
lending
capital
constrained
lending
New
Loans
(N)
1.0
0.8
0.6
0.4
0.2
EXCESS CAPITAL
0.11
0.07
0.03
LOANS
6
7
8
9
10
11
12
13
Excess Capital
Existing
Loans

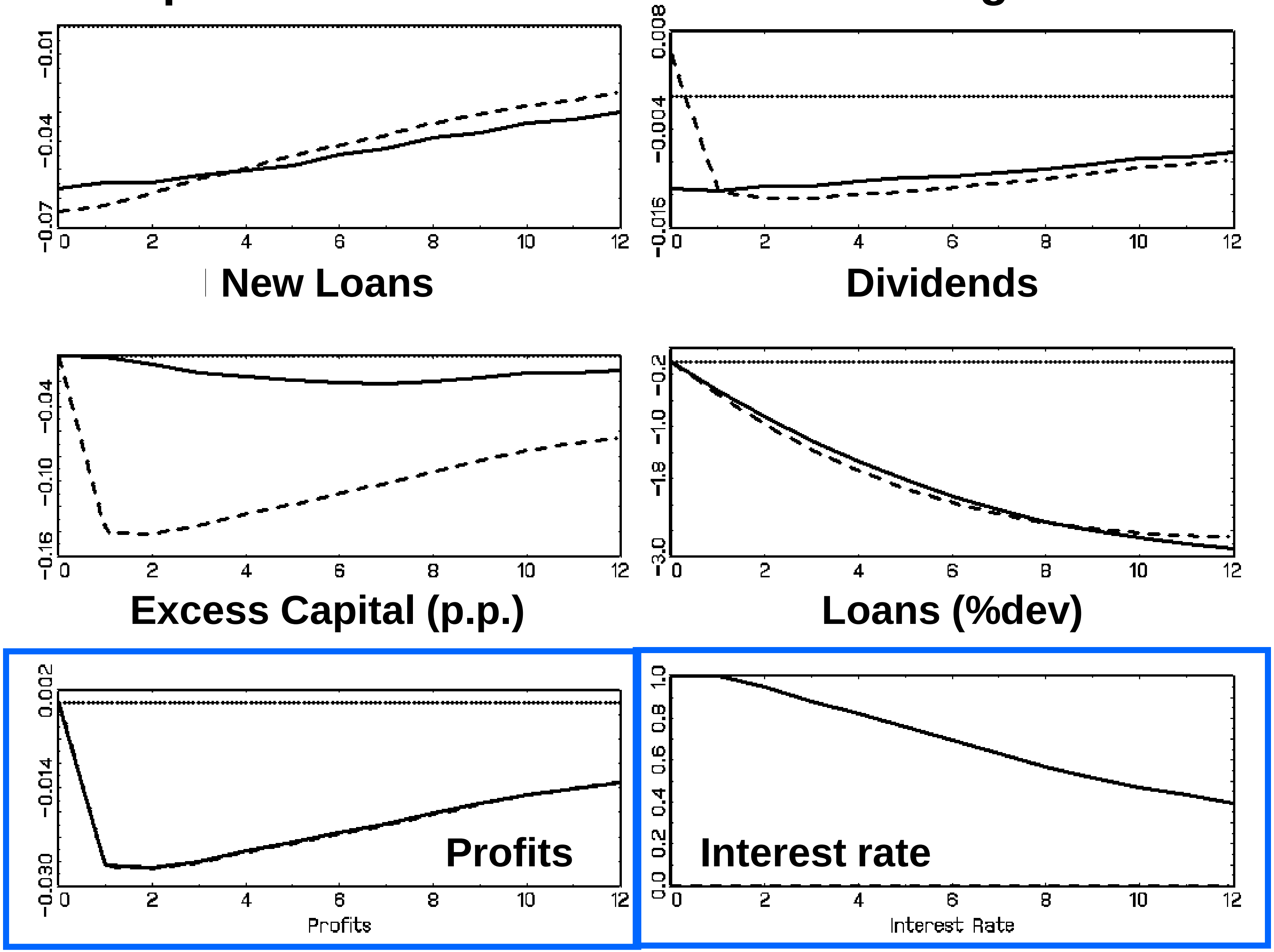


r = 0.07
precautionary lending cuts (financial constr.)
'unconstrained' lending
constrained lending
New Loans (N)
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
EXCESS CAPITAL
0.11
0.07
0.03
LOANS
6
7
8
9
10
11
12
Excess Capital
Existing Loans

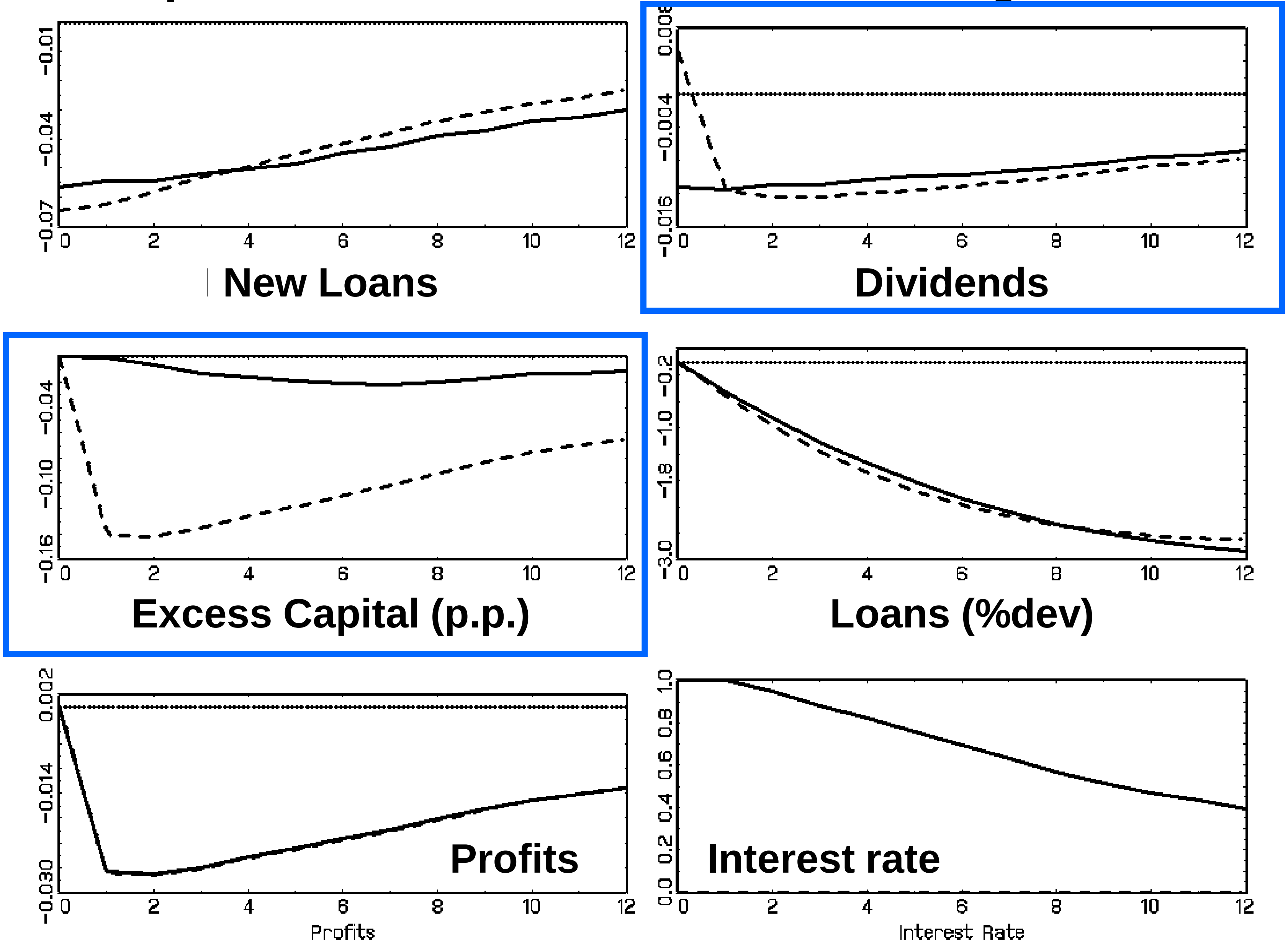
Response to interest rate shock: ‘average’ bank



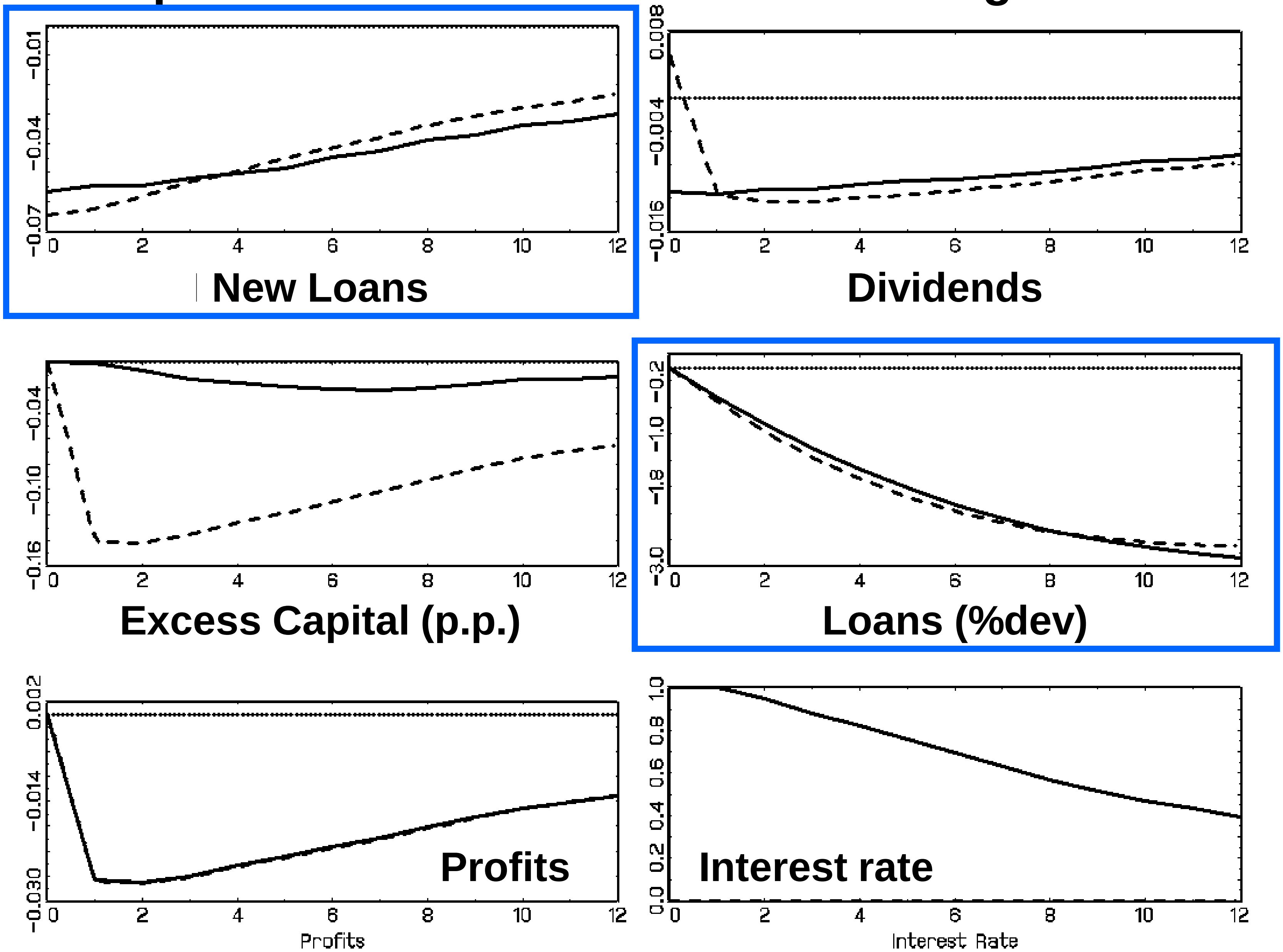
Response to interest rate shock: ‘average’ bank



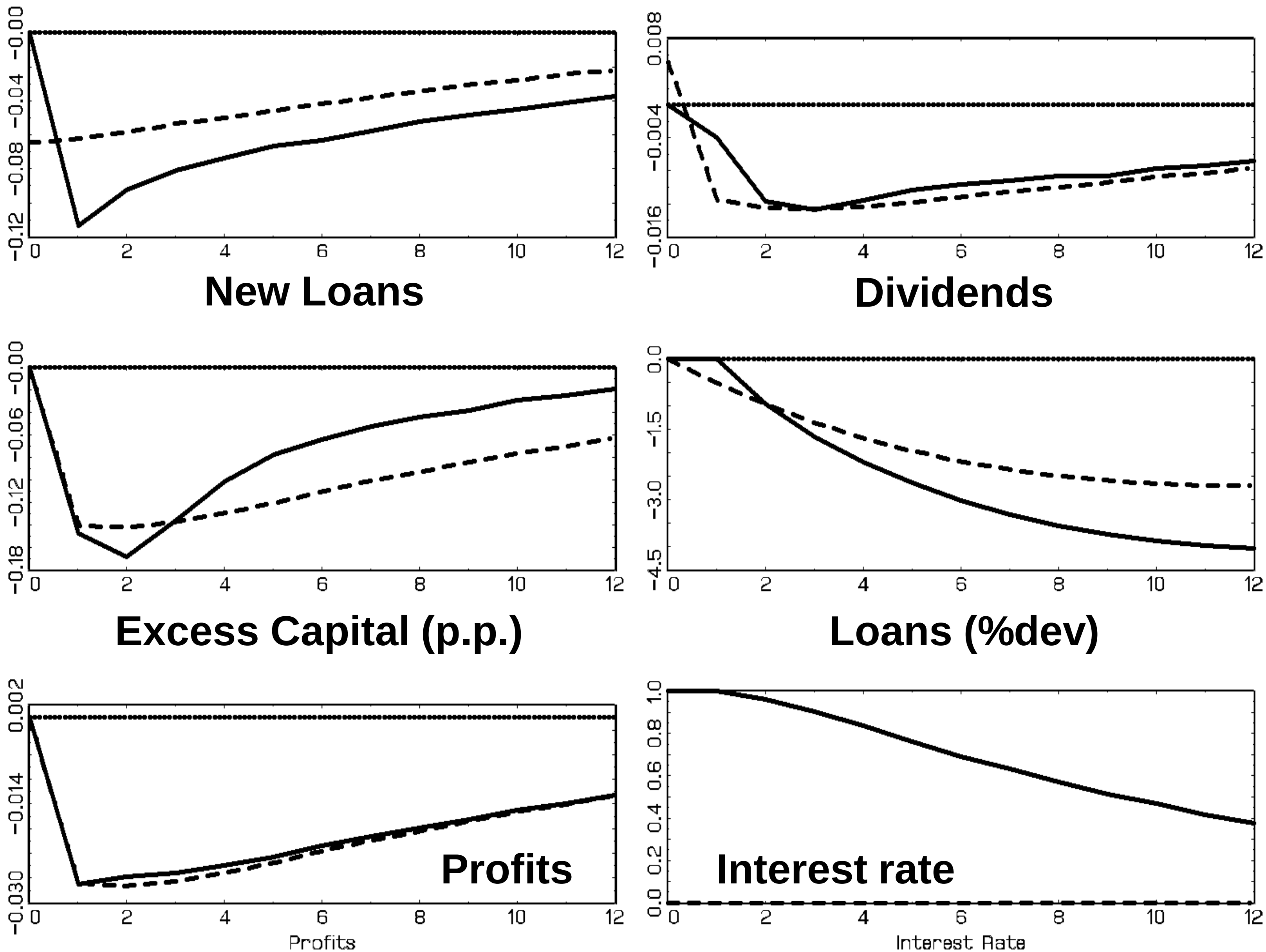
Response to interest rate shock: ‘average’ bank



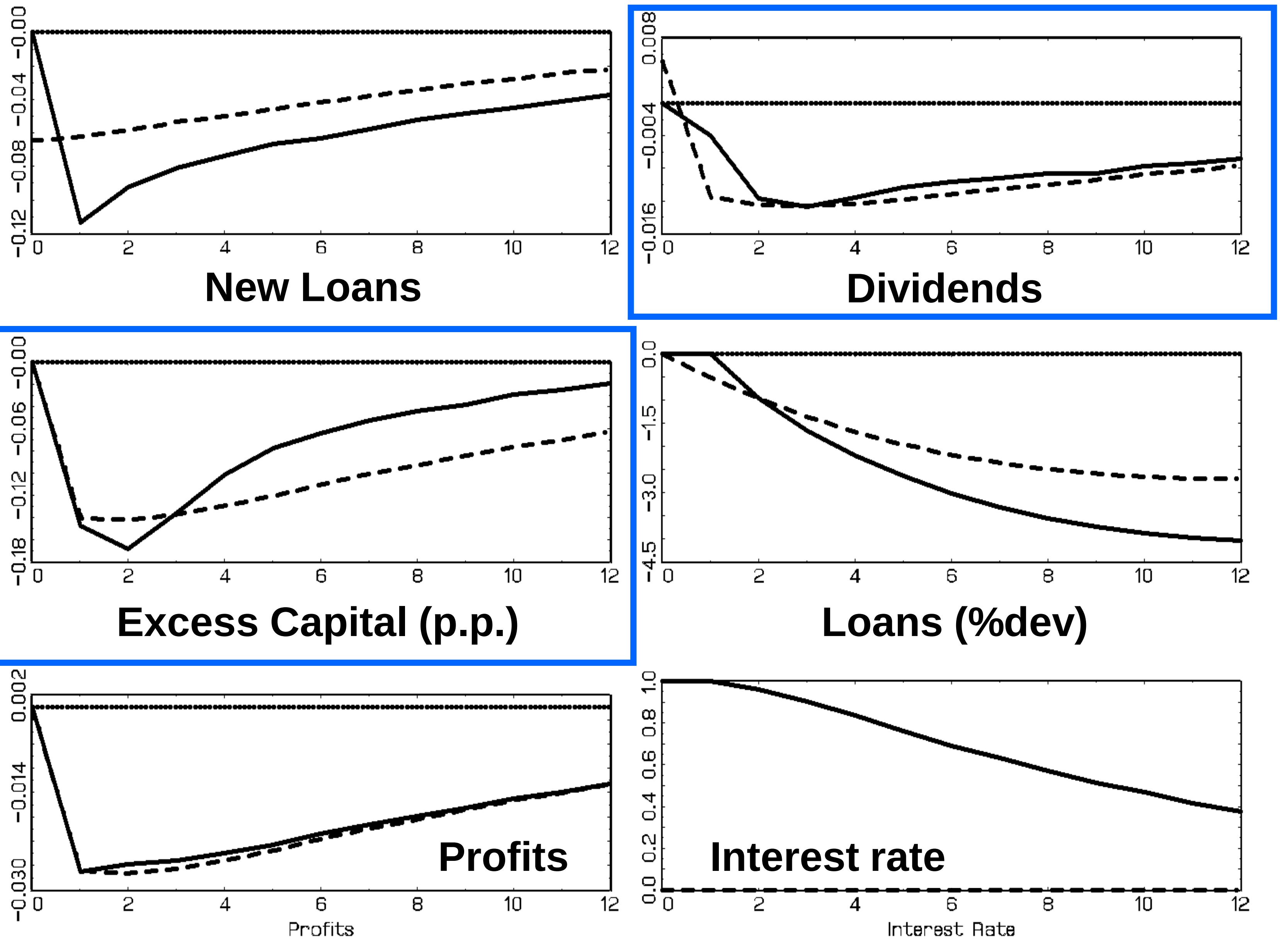
Response to interest rate shock: ‘average’ bank



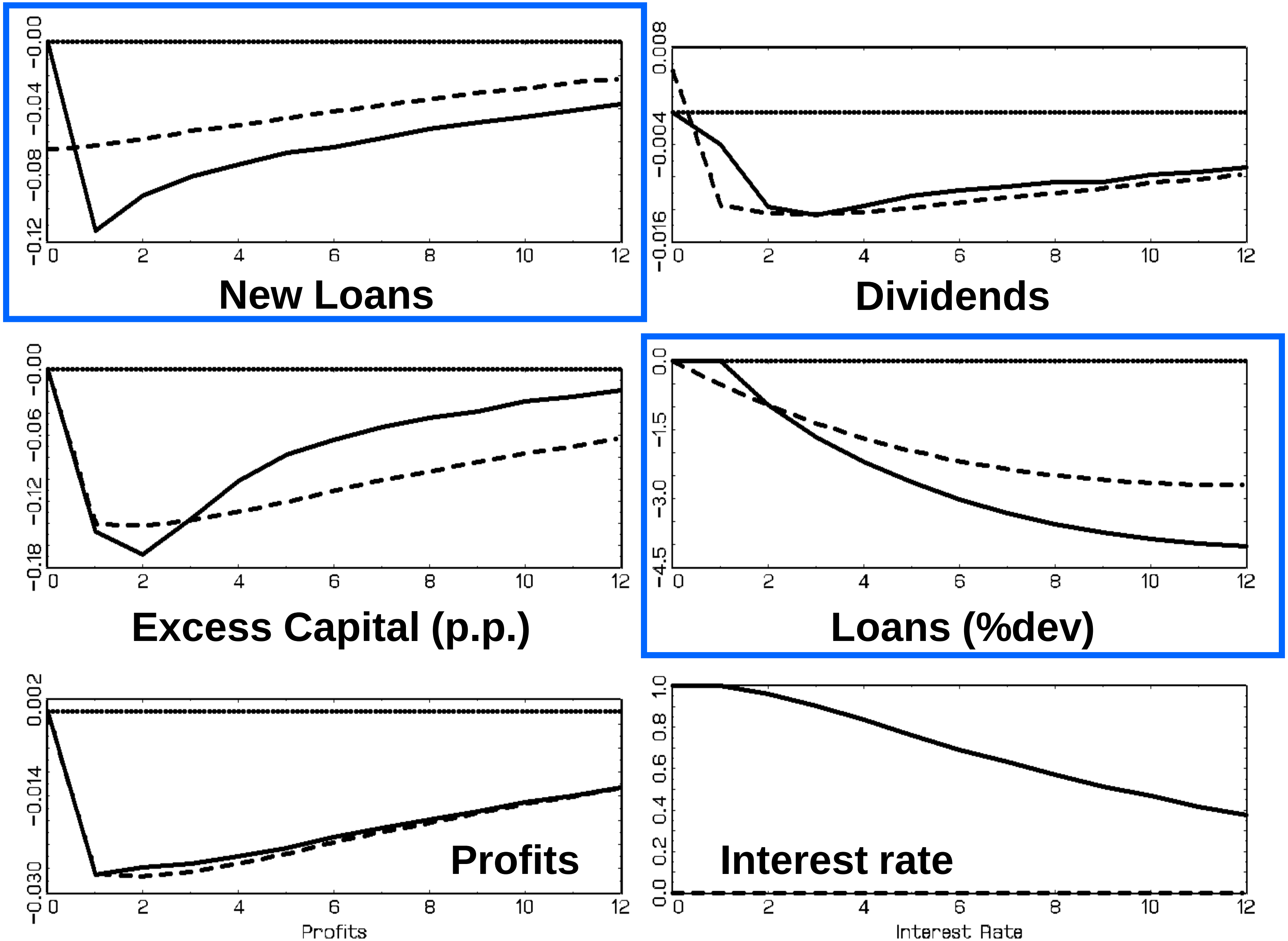
Response to Interest Rate Shock: Capital Requirement Binding



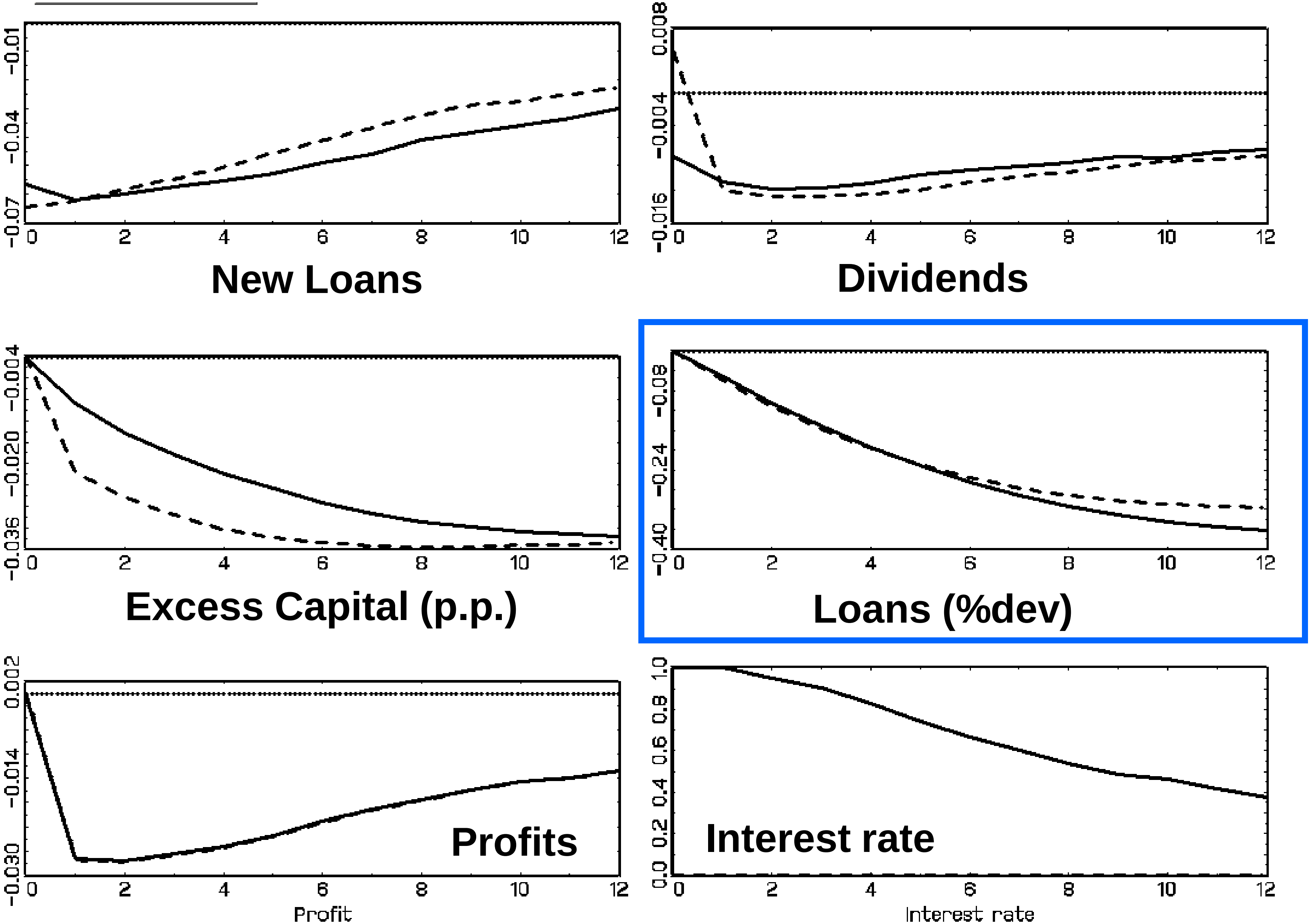
Response to Interest Rate Shock: Capital Requirement Binding



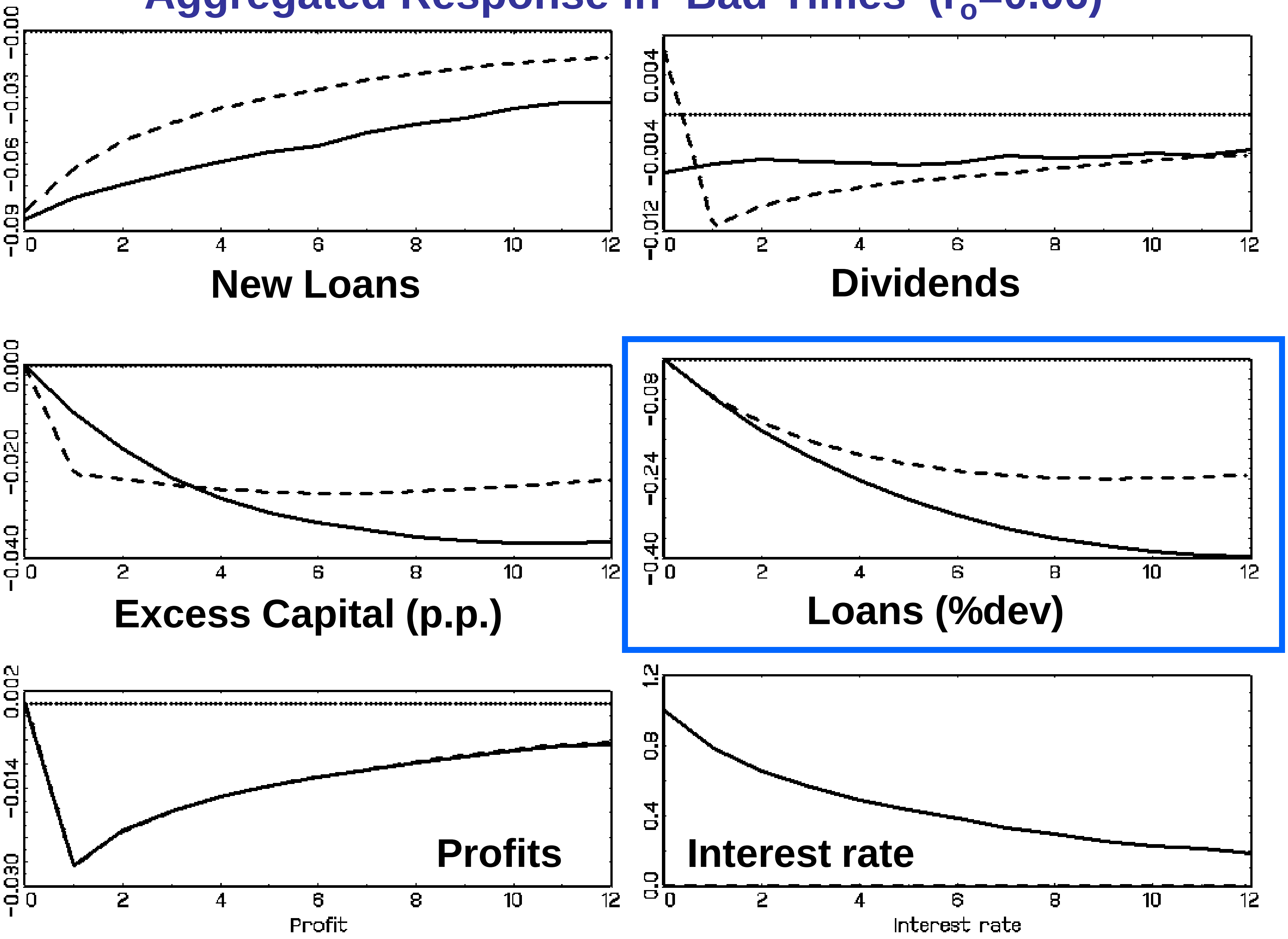
Response to Interest Rate Shock: Capital Requirement Binding



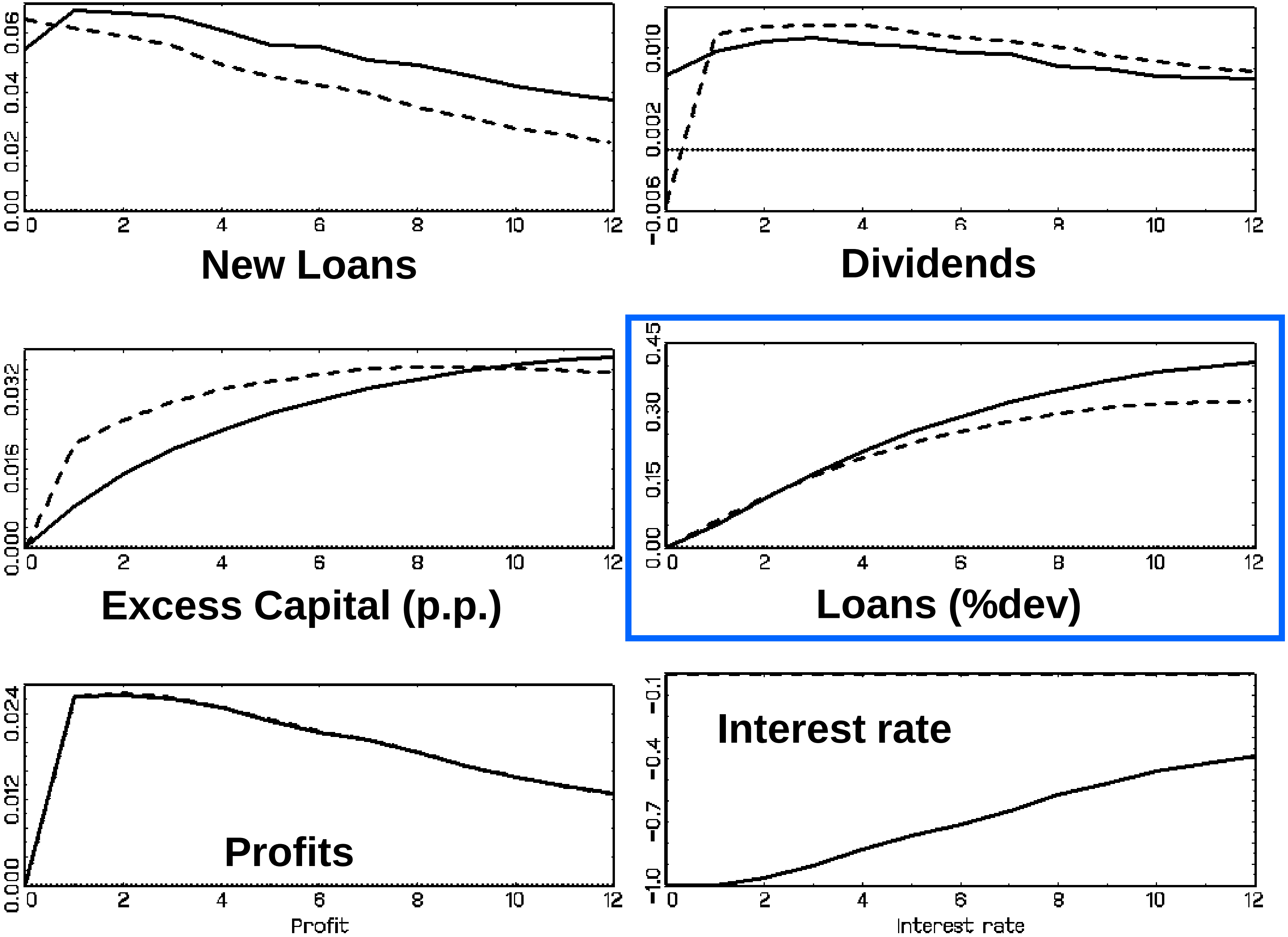
Aggregated Response in ‘Good Times’ (r_o=0.05)



Aggregated Response in ‘Bad Times’ (r_o=0.06)



Aggregated Response to Interest Rate Cut in 'Bad Times' (r_o=0.06)



A Look at the Data:

"Do Monetary Policy Effects on Bank Lending Depend on Bank Capitalization?"

Model predicts a negative lending response to a monetary policy induced rise in the interest rate:

$$\frac{\partial \,\mathrm{E}_t[\Delta L_{t+s} \,|\, (E_t, L_t, r_t)]}{\partial r_t} \leq 0, \quad \text{for } s \geq 0$$

which is more pronounced for *low* capital banks:

$$\frac{\partial^2 \,\mathrm{E}_t[\Delta L_{t+s} \,|\, (E_t, L_t, r_t)]}{\partial r_t \partial E_t} \geq 0, \quad \text{for } s > 0$$

Empirical Method:

Idea:

$$\Delta L_{it} = \alpha(C_{it-1}) + \gamma(C_{it-1})\Delta r_t + ... + \varepsilon_{it}$$

L_{it} Log of Total Loans of bank *i* at the end of quarter *t*

C_{it} Capital Asset Ratio of bank *i* at the end of quarter *t*

Δr_t Identified monetary policy shock,
Christiano, Eichenbaum, Evans (1994)

Expect $\dfrac{\partial \gamma(C_{it-1})}{\partial C_{it-1}} \geq 0$

$$\Delta L_{it} = \alpha^{[it]} + B^{[it]}(L)\Delta L_{it-1} + \Gamma^{[it]}(L)\Delta r_t + ... + \varepsilon_{it}$$

where

$[it] = lo$ if $C_{it\text{-}5} < 0.06$

$[it] = mid$ if $0.06 < C_{it\text{-}5} < 0.09$

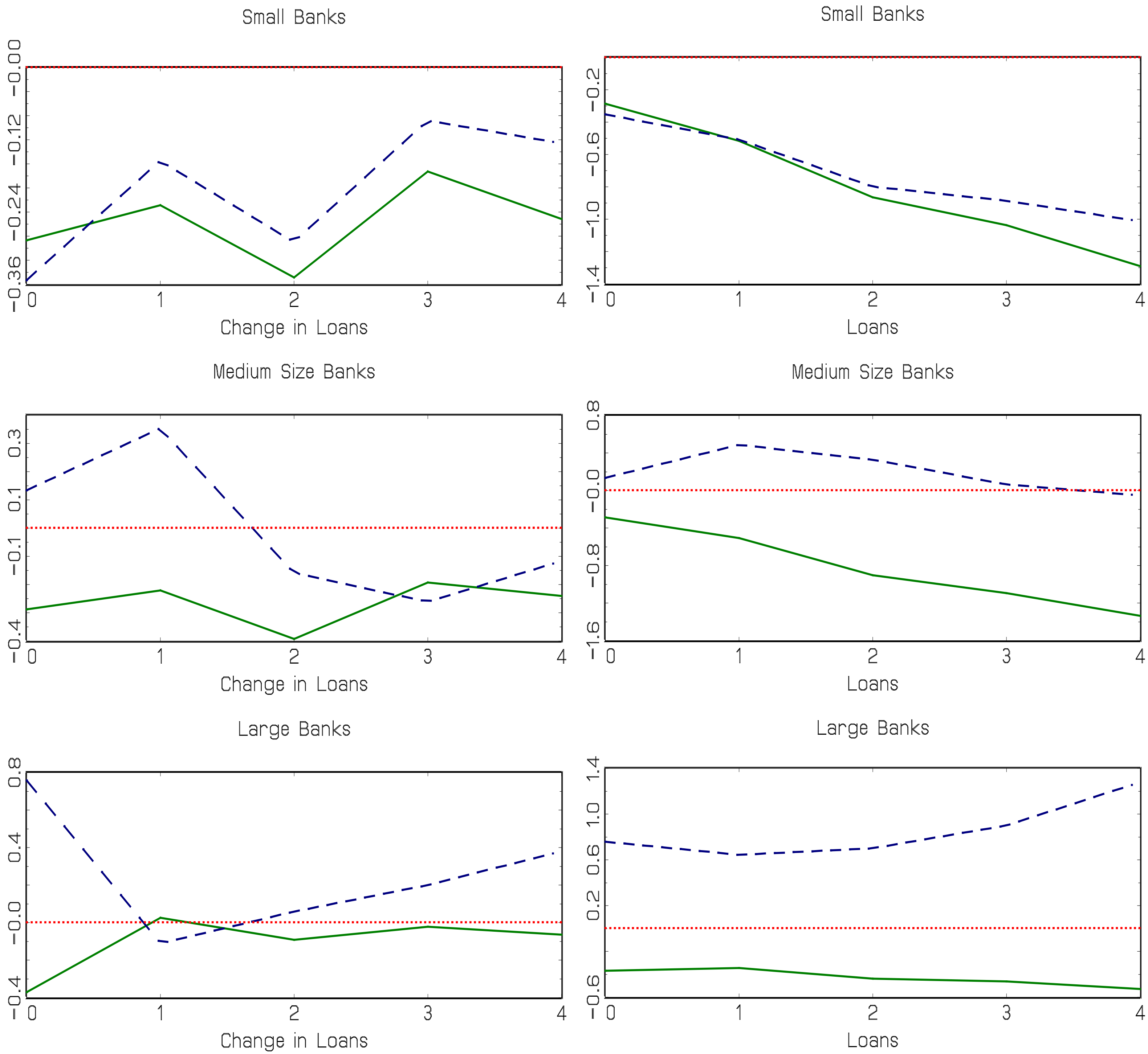
$[it] = hi$ if $C_{it\text{-}5} > 0.09$

Estimated separately for three different size classes:

	Percentiles in size distr.	Perc. of assets	*lo*	*mid*	*hi*
Small	0 – 90	20 %	0.08	0.52	0.40
Medium	90 – 98	20 %	0.21	0.55	0.24
Large	98 - 100	60 %	0.45	0.32	0.23

Larger Banks:

- May have better access to stock market and better hedging → smaller bank capital channel
- Tend to have a more diversified loan portfolio than small banks (lower charge-off risk), so they tend to hold a smaller buffer stock of equity. If maturity mismatch is the same as small banks → larger bank capital channel


Small Banks
−0.36
−0.24
−0.12
−0.00
0
1
2
3
4
Change in Loans
Small Banks
−1.4
−1.0
−0.6
−0.2
0
1
2
3
4
Loans
Medium Size Banks
−0.4
−0.1
0.1
0.3
0
1
2
3
4
Change in Loans
Medium Size Banks
−1.6
−0.8
−0.0
0.8
0
1
2
3
4
Loans
Large Banks
−0.4
−0.0
0.4
0.8
0
1
2
3
4
Change in Loans
Large Banks
−0.6
0.2
0.6
1.0
1.4
0
1
2
3
4
Loans