

# *Bank risk taking and liquidity creation following regulatory interventions and capital support*



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## Background

- During bank distress, authorities often intervene and/or provide capital support.
  - Main goal: reduce bank risk taking
    - ✦ *Dahl and Spivey (JBF 1995); Bhattacharya, Boot, and Thakor (JMCB 1998); Giannetti and Simonov (WP 2010); Hoshi and Kashyap (JFE 2010).*
  - Other benefits: avoid gridlock in payments system, restore financial market confidence, and enhance systemic stability.
- Unintended consequence may be reduction in bank liquidity creation.
  - Banks may make fewer loans, issue fewer commitments, and/or shift into liquid assets.
  - This may not be desirable, given that liquidity creation is one of banks' *raison d'être*.
    - ✦ *Diamond and Dybvig (JPE 1983); Boot, Greenbaum, and Thakor (AER 1993); Holmstrom and Tirole (JPE 1998); Kashyap, Rajan, and Stein (JF 2002).*
  - Reduced liquidity creation may have negative consequences for the macroeconomy.
    - ✦ *Bernanke (AER 1983); Ongena, Smith, and Michalsen (JFE 2003); Khwaja and Mian (AER 2008).*

**It is important to know whether regulatory interventions and capital support succeed in inducing banks to reduce risk taking and what the consequences are for bank liquidity creation.**

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## **Key research question**

What are the effects of regulatory interventions and capital support on bank risk taking and liquidity creation?

**We address this question using measures of risk taking and liquidity creation, exploiting a unique dataset from the Deutsche Bundesbank on all German banks for the period 1999 – 2009.**

- Dataset contains complete information on regulatory interventions and capital support.
- Authorities intervened in 17 percent of all banks, and provided capital support to 14 percent of all banks.

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## **Preview of main findings**

- **Short-run analysis:**
  - Regulatory interventions and capital support are generally associated with statistically significant reductions in risk taking and liquidity creation.
  - The effects of regulatory interventions are also economically significant, but the effects of capital support are generally not.
- **Long-run analysis:**
  - Most of the changes in risk taking and liquidity creation occur in the short run and remain in place in the long run (no reversal).
  - Importantly, regulatory interventions and capital support were not preceded by changes in risk taking and liquidity creation.

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## Data

- Annual data for all banks that operated in Germany between 1999 - 2009.
- Dataset is adjusted for mergers.
- 17,662 bank-year observations for 2,735 banks.

### Private banking pillar

- Large nationwide banks, regional banks, branches and subsidiaries of foreign banks
- 234 institutions

### Public banking pillar

- Savings banks and Landesbanks
- 591 institutions

### Cooperative banking pillar

- Cooperative banks and central credit cooperatives
- 1,910 institutions

## Representativeness

- Regulatory interventions and capital support are prevalent in many countries: U.S., Japan, and various European nations.
- Most German banks are small and medium-sized institutions as in the U.S.

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## **Regulatory Interventions**

- Supervision is the responsibility of the Federal Financial Supervisory Authority and the Bundesbank.
- May take actions after serious violations of Banking Act: e.g., dismissal of executives, fines, restrictions on profit distribution, deposit taking, and lending activities.
  - Dummy = 1 if one or more actions was taken in a year. (Robustness: subsets of actions.)

## **Capital Support**

- Government and bankers associations may provide capital support to prevent distressed banks from failing and stabilize the financial system.
  - The government did this during the recent financial crisis.
  - Three umbrella bankers associations (one for each pillar) and a number of regional bankers associations provided capital support over our entire sample period.
    - ✦ We combine capital support by the government and the bankers associations (our results are not driven by this combination).
  - Capital support variable: capital injection/Tier 1 capital.

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## Hypotheses about risk taking

- **H1. Regulatory Intervention Risk Reduction Hypothesis:**

*Regulatory interventions are associated with reductions in risk taking.*

- Restrictions on activities limit a bank's scope to undertake risk. Possibility of having the bank's charter revoked triggers portfolio adjustments and affects asset choices (*Mailath and Mester, JFI 1994*).

- **H2a. Capital Support Risk Reduction Hypothesis:**

*Capital support is associated with reductions in risk taking.*

- Higher capital reduces moral hazard incentives → reduces risk taking (*Morrison and White, AER 2005*) or increases monitoring (*Holmstrom and Tirole, QJE 1997; Allen, Carletti, and Marquez, RFS forthcoming; Mehran and Thakor, RFS forthcoming*).

- **H2b. Capital Support Risk Increase Hypothesis:**

*Capital support is associated with increases in risk taking.*

- Higher capital may be accompanied by an increase in risk taking if banks react to higher capital by shifting into riskier portfolios and are not prevented from doing so by regulators (*Koehn and Santomero, JF 1980; Calomiris and Kahn, AER 1991*).

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## Hypotheses about liquidity creation

- **H3. Regulatory Discipline Hypothesis:**

*Regulatory interventions are associated with reductions in liquidity creation.*

- Interventions into bank operations likely impede the scale and scope of banks' activities, so we expect a negative effect on liquidity creation.

- **H4a. Capital Support Financial Fragility Hypothesis:**

*Capital support is associated with reductions in liquidity creation.*

- A fragile capital structure encourages monitoring, and hence allows loan originations. More capital makes it harder for the less-fragile bank to commit to monitoring → hampers bank's ability to create liquidity (*Diamond and Rajan JF 2000, JPE 2001*).

- **H4b. Capital Support Risk Absorption Hypothesis:**

*Capital support is associated with increases in liquidity creation.*

- Liquidity creation exposes banks to risk (*Allen and Santomero, JBF 1998; Allen and Gale, ECMT 2004*). Since higher capital improves banks' ability to absorb risk (*Bhattacharya and Thakor, JFI 1993; Repullo, JFI 2004; von Thadden, JFI 2004; Coval and Thakor, JFE 2005*), higher capital ratios may allow banks to create more liquidity.

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## Methodology for short-run analysis

We model changes in risk taking and liquidity creation as functions of regulatory interventions, capital support, and control variables.

- To ensure that our results are not driven by small changes in risk taking and liquidity creation, we use ordered logit models.
  - OLS approach could be dominated by small changes.
- We distinguish between sizeable changes in bank behavior and relatively constant behavior.
  - Specifically, the dependent variable takes on the value of:
    - ✦ 1 if risk taking or liquidity creation decreased (relative to t-1) by more than 3%.
    - ✦ 2 if risk taking or liquidity creation remained within a narrow band of +/- 3%.
    - ✦ 3 if risk taking or liquidity creation increased by more than 3%.

## Calculation of risk

- Our measure of risk is the Basel I risk-weighted assets divided by total assets ( $RWA / TA$ ) (see *Berger and Bouwman, WP 2011*).
  - This measure covers risk both on and off the balance sheet.

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## Calculation of liquidity creation

- We follow a three-step procedure (*Berger and Bouwman, RFS 2009*).
- Step 1: Classify bank activities as liquid, semi-liquid, or illiquid

### ASSETS

**Liquid assets**  
e.g., cash

**Semi-liquid assets**  
e.g., loans to credit institutions  
(maturity  $\leq 1$  yr)

**Illiquid assets**  
e.g., business loans (maturity  $> 1$  yr)

### LIABILITIES + EQUITY

**Liquid liabilities**  
e.g., transactions deposits

**Semi-liquid liabilities**  
e.g., time deposits

**Equity + illiquid liabilities**  
e.g., subordinated debt

### OFF-BALANCE SHEET

**Illiquid guarantees**  
e.g., loan commitments

**Liquid derivatives**

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## Calculation of liquidity creation (cont'd)

- Step 2: Assign weights:

<u>Weight</u>			<u>Weight</u>
- 0.5	<b>Liquid assets</b> e.g., cash	<b>Liquid liabilities</b> e.g., transactions deposits	+ 0.5
0	<b>Semi-liquid assets</b> e.g., loans to credit institutions (maturity ≤ 1 yr)	<b>Semi-liquid liabilities</b> e.g., time deposits	0
+ 0.5	<b>Illiquid assets</b> e.g., business loans (maturity > 1 yr)	<b>Equity + illiquid liabilities</b> e.g., subordinated debt	- 0.5
+ 0.5	<b>Illiquid guarantees</b> e.g., loan commitments	<b>Liquid derivatives</b>	- 0.5

- Step 3: Combine activities classified in Step 1 and weighted in Step 2:  

$$\text{€ liquidity creation} = \sum (\text{weight} * \text{€ activity})$$

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**Model: ordered logit**

Reported: odds ratios  
and t-tests of null that  
odds ratios equal 1.

	Risk ( $\Delta$ RWA/TA)
Regulatory interventions	0.7819***
Capital support	0.9818***
$\Delta$ Log total assets	1.0518***
$\Delta$ Return on equity	0.9885***
$\Delta$ Loan portfolio concentration	0.9954
$\Delta$ Bank branches	1.0226**
$\Delta$ Interest rate spread	2.2491***
Public bank dummy	1.4290***
Cooperative bank dummy	1.1508*
$\alpha_1$	1.4235***
$\alpha_2$	10.8454***
Observations	17,662
Pseudo R-squared	0.039

## Short-run risk taking results

- Regulatory interventions are associated with statistically significant decreases in risk.
  - Also economically significant: odds ratio implies interventions are associated with a 21.81% increase in the likelihood of a drop in risk.
  - Consistent with the *Regulatory Intervention Risk Reduction Hypothesis (H1)*.
- Capital support statistically significant.
  - Not economically significant: odds ratio suggests that mean capital support (18% of Tier 1 capital) is associated with only a 0.33% increase in the likelihood of a drop in risk.
  - Suggests: effects of the *Capital Support Risk Reduction Hypothesis (H2a)* and the *Capital Support Risk Increase Hypothesis (H2b)* are weak or approximately offset each other.

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**Model: ordered logit**

Reported: odds ratios  
and t-tests of null that  
odds ratios equal 1.

	Liquidity creation ( $\Delta$ LC)
Regulatory interventions	0.6398***
Capital support	0.9839***
$\Delta$ Log total assets	1.0365***
$\Delta$ Return on equity	1.0015
$\Delta$ Loan portfolio concentration	1.0041
$\Delta$ Bank branches	1.0357***
$\Delta$ Interest rate spread	1.3606***
Public bank dummy	1.5082***
Cooperative dummy	1.3452***
$\alpha$ 1	0.9125
$\alpha$ 2	1.8456***
Observations	17,662
Pseudo R-squared	0.011

## Short-run liquidity creation results

- Regulatory interventions are associated with statistically significant decreases in liquidity creation.
  - Also economically significant: odds ratio suggests interventions are associated with a 36.02% increase in the likelihood of a drop in liquidity creation.
  - Consistent with the *Regulatory Discipline Hypothesis (H3)*.
- Capital support statistically significant.
  - Not economically significant: mean support of 18% associated with only a 0.29% increase in likelihood of a drop in liquidity creation.
  - Suggests: effects of *Capital Support Financial Fragility Hypothesis (H4a)* and *Capital Support Risk Absorption Hypothesis (H4b)* are weak or net each other out.

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## **Extensions: Subsamples**

- Banking pillars (private, public, and cooperative banks)
- Small vs. large banks (below vs. above median bank size of € 329 m)
- Poorly- vs. better-capitalized banks (cutoff: median bank's capital ratio of 8.73%)
- Crisis years (2001, 2007 - 2009) vs. non-crisis years (1999 - 2000, 2002 - 2006)
- Decomposition of interventions in less and more strong types of interventions, and into interventions affecting assets, liabilities and management.

## **Subsample findings**

- Regulatory interventions result in reduced risk taking in only some of the subsamples – cooperative banks, small banks, poorly-capitalized banks, and banks during non-crisis years.
- Regulatory interventions tend to reduce liquidity creation for all subsamples (except private banks).
- Capital support generally has a statistically but not economically significant effect on risk taking and liquidity creation for most of the subsamples (as for the full sample).
- Decomposition of interventions does not fundamentally alter the inferences.

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## **Robustness tests:**

- Alternative cut-offs (1% and 5% instead of 3%)
  - Main findings are not affected.
- Subsamples of merged and non-merged banks
  - Main findings are not affected.
- Alternative dependent variables
  - Insolvency risk ( $\Delta$  Tier 1 capital/RWA):
    - ✦ Main findings not affected.
  - Liquidity creation components:
    - ✦ Regulatory interventions affect assets and off-balance sheet activities, but not liabilities.
- Ordered probit models
  - Main findings not affected.
    - ✦ Prefer to present main results ordered logit models because the odds ratio has a natural interpretation.

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## Robustness tests: Instrumental variable (IV) analysis

- Endogeneity concern: bank distress may result in both regulatory interventions and capital support on the one hand, and reductions in risk taking and liquidity creation on the other hand → IV ordered probit estimators.

### *Instruments used in both first-stage regressions:*

- Capital support at the county level
  - Interventions and capital support more likely if other local banks are weak.
- Levels of bank risk
  - Interventions and capital support more likely when risk is high.
    - ✦ Capital adequacy ratio (Tier 1/RWA), loan loss provisions/customer loans, and RWA/TA.

### *Instruments used only in capital support first-stage regressions:*

- Shares of conservative, liberal, and green party voters per county
  - Less likely to observe capital support if located in counties with more conservative, liberal, and green party voters, reflecting their strong belief in market forces.
- Bankers associations dummies (32)
  - May be differences in willingness to provide capital support.

## IV results support the main results

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## **Long-run effects of regulatory interventions and capital support on risk taking and liquidity creation**

- We use OLS regressions which include five leads and lags of the regulatory intervention and capital support dummies as well as bank and year dummies, to analyze the long-run time patterns of the effects.
  - We follow the methodology of Beck, Levine, and Levkov (JF 2010).
- The dependent variables are the change in the credit risk variable, RWA/TA, and the change in the natural log of liquidity creation.
  - Since these are OLS regressions instead of logit equations, we examine whether the coefficients are positive or negative, rather than whether the log odds are above or below 1.

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Long-run effects	Regulatory interventions		Capital support	
	Risk taking	Liquidity creation	Risk taking	Liquidity creation
	( $\Delta$ RWA/TA)	( $\Delta$ LC, ln)	( $\Delta$ RWA/TA)	( $\Delta$ LC, ln)
t-5	0.0544	-0.3309	-1.0144	0.3076
t-4	-0.004	1.1546	-0.1589	1.6102
t-3	-0.3356	2.5347	0.7513	2.3106
t-2	0.3634	1.4919	-0.3947	0.1127
t-1	-0.3692	-0.4837	0.1091	-1.5015
t+1	-0.7550***	-2.7957***	-0.9037***	-2.8206**
t+2	-0.5718**	0.3736	-0.157	-0.2582
t+3	-0.1304	-0.0224	-0.364	0.2686
t+4	-0.4114*	-0.7844	0.2674	0.5288
t+5	-0.2993	-0.3576	-0.0978	-0.4828
Bank and year dummies	Yes	Yes	Yes	Yes
Observations	17,662	17,662	17,662	17,662
R-squared	0.499	0.045	0.499	0.045

- Most changes in risk taking and liquidity creation occur in short run and remain in place in long run (no reversal). Except: effect of regulatory intervention on risk taking takes longer.
- Importantly, the five lags are not significant. I.e., the changes in risk taking and liquidity creation did not precede the policy actions.

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## **Summary of main findings**

- **Short-run analysis:**
  - Regulatory interventions and capital support are generally associated with statistically significant reductions in risk taking and liquidity creation.
  - The effects of regulatory interventions are also economically significant, but the effects of capital support are generally not.
- **Long-run analysis:**
  - Most of the changes in risk taking and liquidity creation occur in the short run and remain in place in the long run (no reversal).
  - Importantly, regulatory interventions and capital support were not preceded by changes in risk taking and liquidity creation.

## **Policy implications**

- **Results suggest: regulatory interventions and capital support have intended and unintended consequences.**
  - Policies may be effective in reducing bank risk taking, but may have adverse effects on the macroeconomy through reductions in bank liquidity creation.