

# A Tale of Different Capital Ratios: How To Correctly Assess The Impact of Capital Regulation on Lending

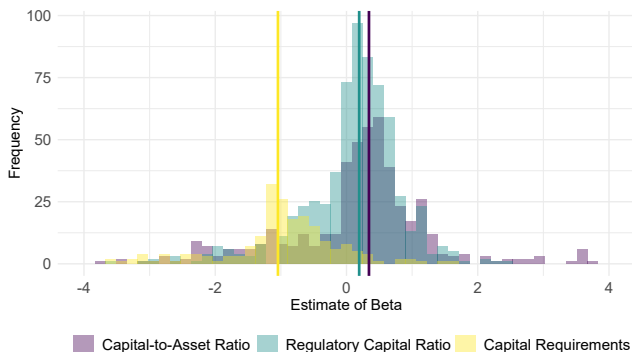
Simona Malovaná, Josej Bajžík, Zuzana Gric, and Martin Hodula

EEA-ESEM 2022, Bocconi University

August 23, 2022

# Introduction and motivation

- Rapidly **expanding literature** on the bank capital-lending relationship
- Increasingly **fragmented literature**
- **Changing** regulatory and economic **environment**
- What is the impact of capital and capital requirements on bank lending and what explains the heterogeneity?



*Note: The effect of 1 pp change in capital ratio on annual credit growth.*

# Roadmap of the paper

- Collection process and early view of fragmentation
- Publication bias
  - ▶ Is the reporting selective?
- Heterogeneity drivers
  - ▶ Why do estimates differ?
- Stylized (what if) elasticity
  - ▶ What the mean elasticity would look like if all studies used the same strategy as the one that we prefer?

# Selected papers and collected estimates

- Google Scholar search for all empirical studies with bank capital or capital requirements on the RHS and lending on the LHS

“bank capital regulation” OR “capital requirements” OR “bank capital” OR “capital surplus” OR “capital ratio” OR “macroprudential regulation” OR “macroprudential policy” AND “lending” OR “credit” OR “loans”

- Limited to studies published in 2010 and later (to capture changes to capital regulation since the GFC)
- 546 studies screened
  - ▶ 417 excluded based on abstract or title
  - ▶ 83 excluded due to lack of correspondence or data
  - ▶ 46 included (26 journal articles and 20 working papers)
- 1,639 estimates retrieved (app. 36 per study)

# Fragmentation

- 85% (1,395) of collected estimates use the same variable transformation, i.e. the semi-elasticities have the same interpretation
- We collect  $\hat{\beta}$  (generalized representation):

$$\text{credit growth}_{it} = \hat{\beta} \text{ capital ratio}_{it} + \hat{\gamma} \text{ other variables} + e_{it}$$

- $i$  can be country or bank
- **3 different capital ratios** in our sample:
  - ▶ Capital-to-asset ratio
  - ▶ Regulatory capital ratio (Tier 1 and Tier 2 over risk-weighted exposures)
  - ▶ Capital requirements (minimum, Pillar 2 add-ons and capital buffers)

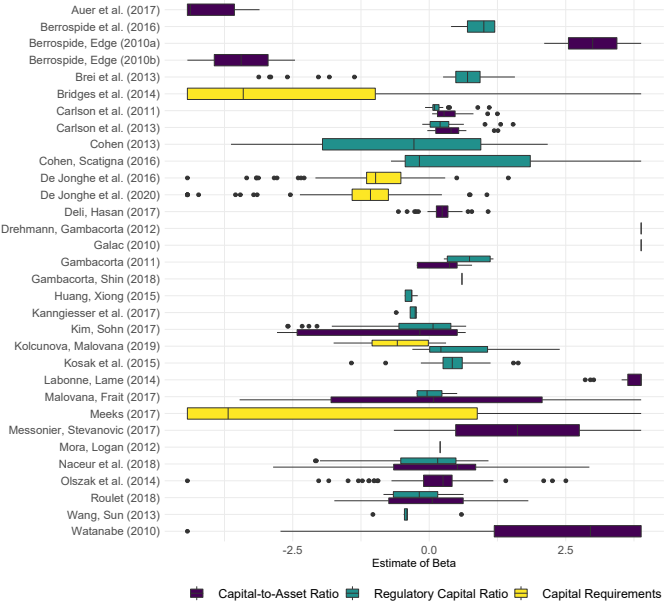
# Capital vs. capital requirements

- Some heterogeneity well explained by the type of capital ratio
- **Capital-to-asset ratio** associated with a **positive** effect on bank lending
- **Capital requirements** associated with a **negative** effect on bank lending
- **Regulatory capital ratio** is somewhere **in between** – positive mean elasticity, but negatively skewed
  - ▶ Capturing the effect of capital regulation?

	Obs.	Articles	Mean	5%	95%	Skewness
<i>Total</i>	<i>1,395</i>	<i>32</i>	<i>-0.06</i>	<i>-2.61</i>	<i>1.68</i>	<i>-0.45</i>
Capital-to-asset ratio	514	17	0.30	-2.22	3.79	0.03
Regulatory capital ratio	652	18	0.13	-1.38	1.11	-0.23
Capital requirements	229	5	-1.40	-4.43	0.64	0.02

Note: The effect of 1 pp change in capital ratio on annual credit growth.

# Estimates vary within and across studies



# Publication bias

- Are only selected results published – statistically significant and/or with the “correct” sign?
- The best-published study in our data set admits that publication bias may be an issue:

*“The coefficient on the standard capital-to-asset ratio often has an **incorrect negative sign**, which casts some doubt on the role of this indicator in capturing the effect of a bank’s capital position on bank lending.” (Gambacorta and Marques-Ibanez, 2011; EP)*

- Other study clearly anticipates effect to be negative:

*“There is widespread agreement in the theoretical academic literature that the immediate effects of constraining capital standards are likely to be a **reduction in total lending**.” (VanHoose, 2007; JoBF)*

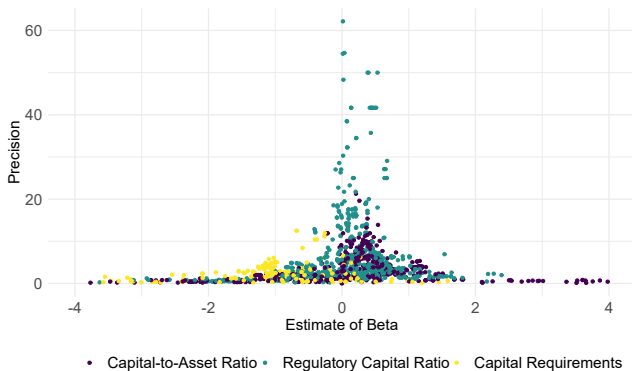
- Tools:

- ▶ Graphical inspection – funnel plot, distribution of t-statistics
- ▶ Empirically – a battery of linear and non-linear tests



# Publication bias – funnel plot

- Precision is calculated as an inverse of standard error
- In the absence of publication bias the funnel should be symmetrical around the most precise estimates
- As a whole, the funnel plot is symmetrical, **BUT** it is asymmetrical and visibly skewed towards positive or negative values for different subgroups



# Publication bias – empirical tests

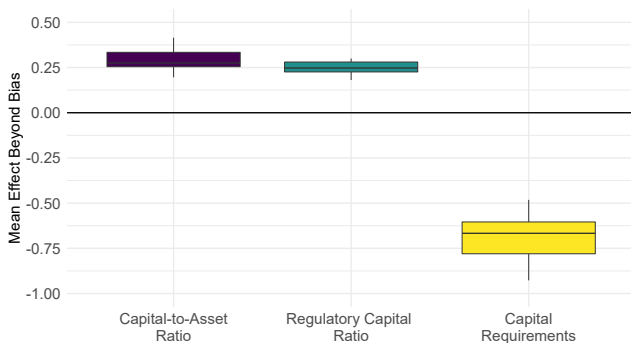
- Linear tests:

$$\hat{\beta} = \alpha + \gamma \text{ standard error}_{it} + e_{it}$$

- $\alpha$  – effect beyond bias (true effect)
- $\gamma$  – intensity of the publication bias
- Estimated by, for example, simple or weighted OLS, fixed-effects or random-effects regression
  
- Non-linear tests – based on various assumptions:
  - ▶ Optimizing trade-off between bias and variance (stem-based method)
  - ▶ Searching for a precision threshold above which publication bias is unlikely (kinked method)
  - ▶ Giving more weight to insignificant underreported estimates (selection method)

# Publication bias and true effect – results

- Publication bias:
  - ▶ No or limited for capital-to-assets ratio and regulatory capital ratio
  - ▶ Negative and significant for capital requirements
- Corrected effect:
  - ▶ 1 pp increase in capital-to-asset ratio and regulatory capital ratio leads to 0.3 pp and 0.2 pp increase in credit growth
  - ▶ 1 pp increase in capital requirements leads to decrease in credit growth between -0.5 to -2 pp (average app. -1 pp)



# Drivers of heterogeneity

- How do different **data and estimation methods** influence reported elasticity?
- Do also **publication characteristics** matter?
- What is the role of **structural characteristics** of the economy?
  
- **40 additional variables** collected to better understand the differences between studies
  - ▶ Type of credit, region, data time span and frequency, data confidentiality
  - ▶ Estimation method, model specification, lags, control variables,
  - ▶ Journal, impact factor, citations, publication year
  - ▶ External variables capturing cross-country or cross-regional differences (macro-financial variables, e.g., interest rates, financial development, credit and house price growth, LIRE)
  
- **Bayesian model averaging** (baseline), frequentist model averaging and simple OLS (robustness checks)

# Which factors drive the heterogeneity?

- **Capital-to-asset ratio and regulatory capital ratio** BMA CA BMA CRWE
  - ▶ Higher positive estimates: single-country studies with longer time span using confidential data, corporate credit
  - ▶ Lower positive or negative estimates: studies shielding against omitted variable bias (FE estimator, control variables included) with more favorable publication characteristics
  - ▶ CA – significant role of a number of structural factors (e.g. LIRE)
  - ▶ CRWE – limited role of structural factors
- **Capital requirements** BMA CReq
  - ▶ Publication bias confirmed
  - ▶ Longer time span used in the estimation weakens the negative effect

# Elasticity implied by significant heterogeneity drivers

- Corrected effect accounting for significant heterogeneity drivers is
  - ▶ **Positive** for the capital-to-asset ratio and
  - ▶ **Negative** for the regulatory capital ratio
- **Prolonged period of low interest rates** – the bank capital-lending relationship changes to negative

	Capital-to-Asset Ratio		Regulatory Capital Ratio	
	Estim.	68% CI	Estim.	68% CI
Baseline ("best practice")	1.78	(1.12, 2.52)	-0.74	(-1.00, -0.16)
Corporate credit	1.93	(1.29, 2.67)	-0.78	(-1.03, -0.19)
Household credit	1.71	(1.06, 2.45)	-0.75	(-1.00, -0.17)
Public data & annual frequency	1.62	(0.94, 2.39)	-1.03	(-1.30, -0.47)
Multi-country, public data & annual frequency	0.32	(-0.45, 0.95)	-2.05	(-2.41, -1.55)
Inferior empirical approach	1.55	(0.89, 2.27)	-0.67	(-0.92, 0.00)
Prolonged period of low interest rates*	-1.22	(-1.98, -0.57)	-0.98	(-1.10, -0.22)

# Concluding remarks

- We synthesise the empirical literature on the relationship between banks capital, capital requirements, and lending – **more than 1,600 estimates from 36 studies**
- We collected additional 40 variables to explain the heterogeneity of collected estimates
- The literature is **fragmented** in terms of the magnitude and direction of the effect
- The fragmentation is well explained by
  - ▶ capital ratio used in the primary study,
  - ▶ publication bias, and
  - ▶ primary study characteristics, such as model specification, estimation method, and data characteristics
- **Corrected mean effects** of 1 pp increase in capital ratio on annual credit growth:
  - ▶ Capital-to-asset ratio: 0.3 pp (1.8 pp)
  - ▶ Regulatory capital ratio: 0.2 pp (-0.7 pp)
  - ▶ Capital requirements: -0.5 to -2.0 pp

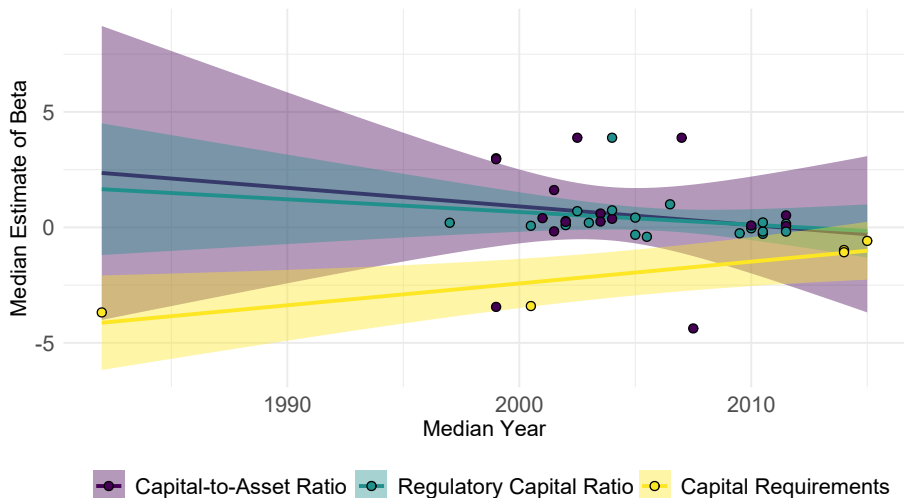
Thank you for your attention!



# Back-up slides

# Estimates change over time – median elasticity per study

- Studies on recent data report estimates closer to zero.



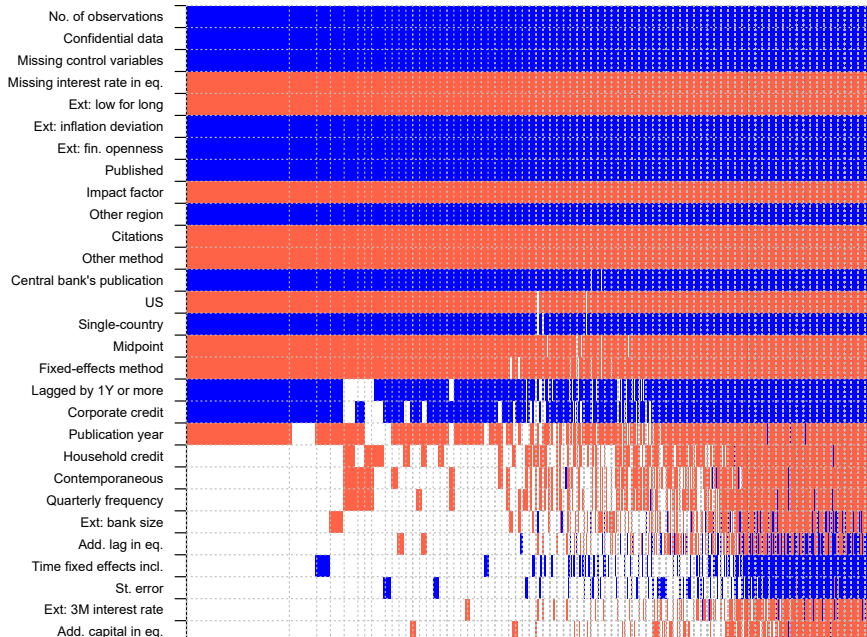
# Publication bias – linear techniques

	Capital-to-Asset Ratio	Regulatory Capital Ratio	Capital Requirements
Simple OLS			
<i>Constant (effect beyond bias)</i>	0.311 (0.197)	0.091 (0.091)	-0.871* (0.330)
<i>SE (publication bias)</i>	0.027 (0.022)	0.097 (0.136)	-0.569 (0.370)
Weighted OLS (by the inverse of the standard error)			
<i>Constant (effect beyond bias)</i>	0.350*** (0.102)	0.255*** (0.083)	-0.593** (0.137)
<i>SE (publication bias)</i>	-0.004 (0.232)	-0.238 (0.328)	-0.752** (0.239)
Study-level fixed effects			
<i>Constant (effect beyond bias)</i>	0.415* (0.213)	0.289*** (0.104)	-0.927*** (0.307)
<i>SE (publication bias)</i>	-0.057*** (0.017)	-0.307 (0.289)	-0.533 (0.343)
Study-level random effects			
<i>Constant (effect beyond bias)</i>	0.580 (0.386)	0.300*** (0.115)	-0.683*** (0.196)
<i>SE (publication bias)</i>	0.006 (0.032)	0.011 (0.174)	-0.531 (0.348)

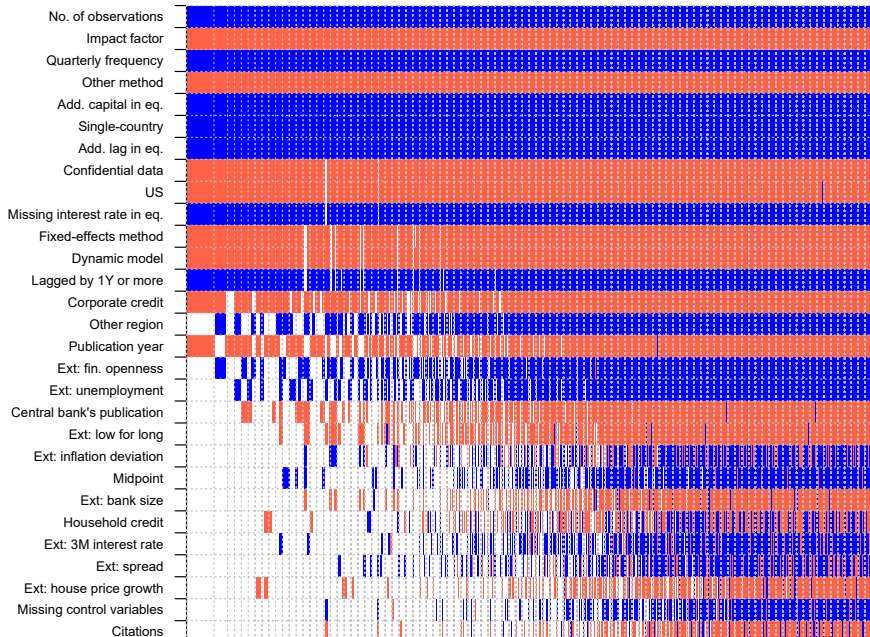
# Publication bias – non-linear techniques

	Capital-to-Asset Ratio	Regulatory Capital Ratio	Capital Requirements
Top 10 method (Stanley <i>et al.</i> , 2010) <i>Effect beyond bias</i>	0.252*** (0.026)	0.221*** (0.028)	-0.608*** (0.094)
WAAP (Ioannidis <i>et al.</i> , 2017) <i>Effect beyond bias</i>	0.263*** (0.037)	0.181*** (0.023)	-0.750*** (0.076)
Stem-based method (Furukawa, 2019) <i>Effect beyond bias</i>	0.196* (0.107)	0.021 (0.187)	-0.651*** (0.082)
Kinked method (Bom & Rachinger, 2019) <i>Effect beyond bias</i>	0.287*** (0.023)	0.240*** (0.013)	-0.482*** (0.043)

# BMA results – capital-to-assets ratio

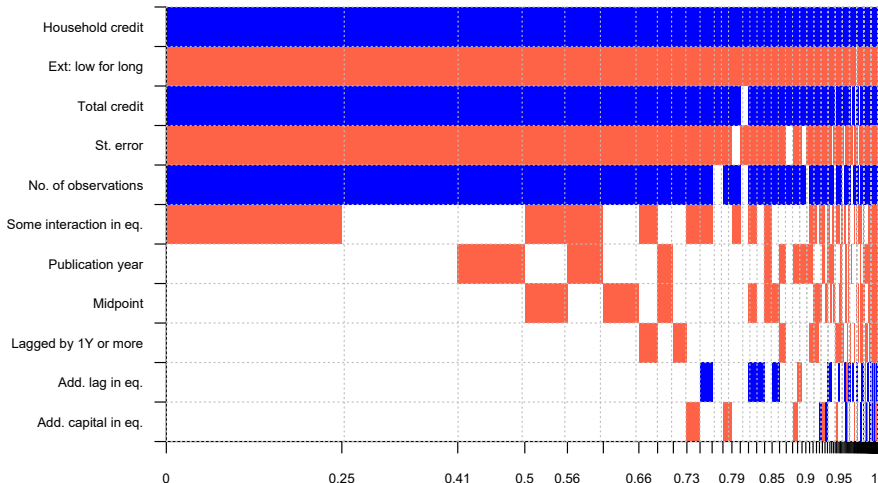
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# BMA results – regulatory capital ratio

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# BMA results – capital requirements

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# Elasticity implied by significant heterogeneity drivers

- “Best practice” – what the mean elasticity would look like if all studies used the same strategy as the one that we prefer
  - ▶ Single-country studies performed on confidential data samples with higher frequency
  - ▶ Dynamic model specification with lagged effect of capital on lending including both bank-level (supply-side) and macroeconomic (demand-side) control variables and estimated with unit fixed effects
  - ▶ More favorable publication characteristics
  - ▶ Selected structural variables
- Economic significance of key variables – type of credit, data and methodology, a prolonged period of low interest rates



# Bibliography

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