

# Meta-analysis in financial stability topics

What do we know and what we have learnt

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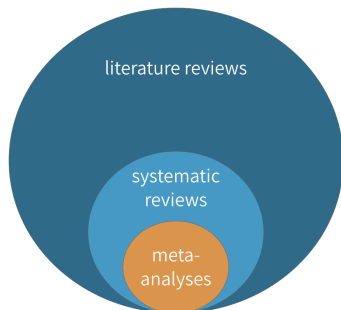
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# What is meta-analysis?

- Systematic review of the existing literature
- Not just an overview, but a quantitative evaluation
- Allows study publication bias problems
- Clarify inter-study differences
- Explain the differences across the primary estimates



Source: Global Health Research (2023)

# Origins of meta-analysis

- Developed in medicine to combine many small studies into a large one
- Goal was to increase the degrees of freedom; costly clinical trials
- Economic research is less expensive, but the degrees of freedom in macroeconomics are limited as well – so we hold the original purpose of meta-analysis
- One of the overviews of use of meta-analysis in economics is, for example, Moral-Benito (2015)
- Some prominent economic meta-analytical publications:
  - Andrews, I., & Kasy, M. (2019). Identification of and Correction for Publication Bias. *American Economic Review*, 109(8), 2766-94.
  - Anderson, R. G., & Kichkha, A. (2017). Replication, Meta-Analysis, and Research Synthesis in Economics. *American Economic Review*, 107(5), 56-59.
  - Card, D., & Krueger, A. B. (1995). Time-Series Minimum-Wage Studies: a Meta-Analysis. *American Economic Review*, 85(2), 238-243.

# Our motivation

- Rapidly **expanding literature** on, for example, the bank capital-lending relationship, regulation and credit, ir->credit, credit<->GDP...
- Increasingly **fragmented** literature
- **Changing** regulatory and economic **environment**
- Benchmark for policies
  - Stress tests settings
- **What is the true effect?**
  - The literature shows that the reported effects are often overestimated (Ioannidis et al., 2017)
  - We are interested in the effect beyond bias
- **What drives the heterogeneity?**
  - The literature usually reports a spectrum of results depending on different circumstances for the given phenomena
  - We are interested in the key drivers

# Overview of our work

- Works on the first meta-analysis by our team started in April 2019
- Till now 5 Journal publications, 1 WP, 4 close to finish
- Topics: Monetary policy, Macroprudential policy, International Finance, Financial Markets
- 6/47 CNB WP in last 4 years
- But the meta-analysis have in Czech National Bank a long history
  - Especially based on work of Tomas Havranek
  - 10 meta-analyses during the years 2010-2016
- Thus, Czech National Bank is very established in this area

## Selected Publications

- Malovaná, S., Hodula, M., Bajzík, J., & Gric, Z. (2023). Bank Capital, Lending and Regulation: A Meta-analysis. *Journal of Economic Surveys*, forthcoming.
- Ehrenbergerova, D., Bajzík, J., & Havranek, T. (2022). When Does Monetary Policy Sway House Prices? A Meta-Analysis. *IMF Economic Review*, 1-36.
- Gechert, S., Havranek, T., Irsova, Z., & Kolcunova, D. (2022). Measuring Capital-Labor Substitution: The Importance of Method Choices and Publication Bias. *Review of Economic Dynamics*, 45, 55-82.
- Bajzík, J., Havranek, T., Irsova, Z., & Schwarz, J. (2020). Estimating the Armington Elasticity: The Importance of Study Design and Publication Bias. *Journal of International Economics*, 127, 103383.
- Gric, Z., Bajzík, J., & Badura, O. (2023). Does Sentiment Affect Stock Returns?: A Meta-analysis Across Survey-based Measures. *International Review of Financial Analysis*, forthcoming.
- Malovaná, S., Hodula, M., Gric, Z., & Bajzík, J. (2022). Borrower-Based Macroprudential Measures and Credit Growth: How Biased is the Existing Literature?. CNB WP 8/2022.

# Policy implications

- Provide “instructions” on how to conduct future policy-relevant empirical research
  - E.g., how to estimate the effect of capital regulation on bank lending accurately
- Findings:
  - Overall: The effects exist but are exaggerated
  - The effect of borrower-based limits on bank lending grows stronger over time
  - Borrower-based measures are effective policy tools in terms of directly restricting (mortgage) credit growth.
  - One-percentage-point increase in the policy rate is associated with a decrease of 0.7% in house prices after two years.

# Steps in the (meta-) analysis

- Data collection
  - Google scholar
  - Data set creation
- Publication bias tests
  - Visual tests
  - Linear tests
  - Non-linear tests
- Finding drivers of the heterogeneity
  - Standardization
  - BMA
- Robustness tests
- Implied elasticity



# Data collection

- Follow classical meta-analytical guidelines:
  - Havránek et al. (2020)
- Through calibrated string on Google Scholar
- Usually first 500 hits
- Forward and Backward snowballing
- Abstract reading, selection criteria
  - The standard error, t-statistics, or p-value needs to be included
  - Journal articles or working papers
- PRISMA diagram - Preferred Reporting Items for Systematic Reviews and Meta-Analyses

# Data-collection: Capital-based measures meta-analysis example

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

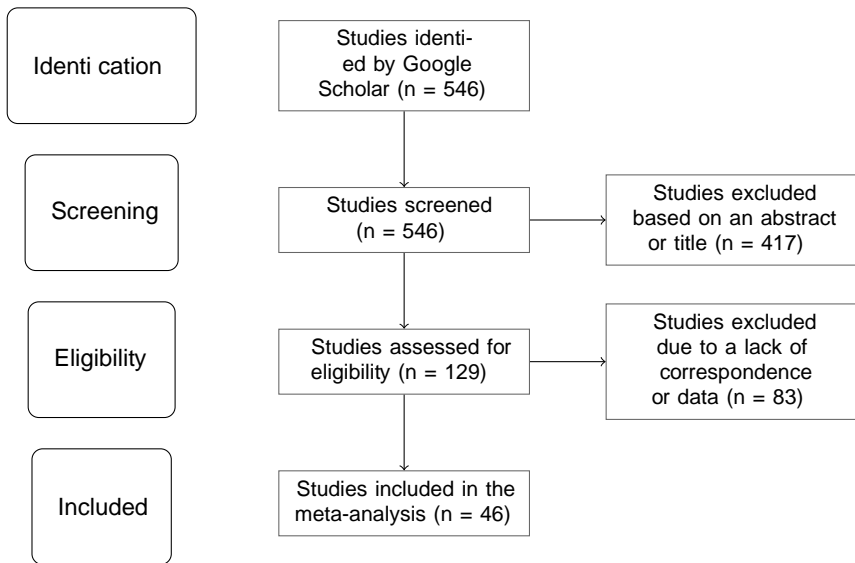
417 excluded based on abstract or title

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)

# Data-collection example of PRISMA



# 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)

Regarding borrower-based measures:

All have **the correct (negative) sign**, indicating that a policy tightening (coded as +1) reduces credit growth and a loosening (coded as -1) increases credit growth. (Kuttner and Shim, 2016; JFS)

Tools:

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

## Publication bias example of 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:

$$\hat{\beta}_i = \beta + \gamma \hat{SE}_{\hat{\beta}_i} + e_{it}$$

$\beta$  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

## Logic behind

Assumption I: Absent selectivity in publication, there is no association between the estimate ( $\hat{\beta}_i$ ) and its standard error ( $\hat{SE}_{\hat{\beta}_i}$ )

Assumption II: Potential publication selection bias has a linear association with the estimates' standard errors

If low and/or negative estimates that are imprecise are more likely to get discarded than equally imprecise high estimates then reported estimates that are high are more likely to have higher standard errors

# Publication bias empirical nonlinear tests

But the two assumptions might be violated

Tests that do not need to satisfy the criteria were created

**Non-linear tests** based on various assumptions:

- Based on the 10% of the most precise estimates (Top10 method)

- Based on the adequately powered estimate (WAAP method)

- 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 underreported intervals (selection method)

# 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?

**Explanatory variables** collected to understand the differences between studies better

LHS specifics: type of credit (households, NFCs...)

Data characteristics: time span and frequency, confidentiality, region

Methodology: estimation method, model specification, lags (VAR models), control variables

Publication characteristics: journal, impact factor, citations, publication year

External variables: cross-country or cross-regional differences (macro-financial variables, e.g., interest rates, financial development, credit and house price growth, LIRE)



# Drivers of heterogeneity - estimation

**Bayesian model averaging** (baseline + robustness checks), simple C  
(robustness checks)

Objective

The most influential factors across models  
Contend with heterogeneity

Model averaging techniques solve:

Omitted variable problem  
Parsimony problem  
Best model choice

Comparison with previous findings

# BMA results meta-analysis example

# Implied elasticity

What would be the effect based on:

Current knowledge

Corrected for publication bias

The best econometrical approaches

Recommendations

Guidelines for future research

Useful in calibration for different countries etc.

	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 freq.	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)

# The effect of capital-based measures on lending: meta-analysis

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

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

# The effect of borrower-based measures on lending: meta-analysis

We synthesize the empirical literature on the effects of borrower-based measures on bank lending **more than 700 estimates from 34 studies**

The literature is **fragmented** in terms of the magnitude and direction of the effect

The uncorrected mean effect is 1.69 **strong negative publication bias**

**Two sources of publication bias:**

- Researchers over-report negative and significant estimates, and positive and not significant estimates

- The corrected mean is about half the size of the uncorrected mean ( $-0.9$ ).

**Model specification, estimation method and data characteristics** also explain a large part of the variation in estimates

# The effect of monetary policy on house prices: meta-analysis

We review and synthesize 31 studies estimating the effect of monetary policy (short-term interest rate) on house price levels, covering 27 countries, 220 graphical IRFs and more than 1400 point estimates

Increase in the interest rate by 1 pp causes a mean decrease of house price of **0.9%** for one-year horizon and **1.2%** for two-year horizon

We examine the extent of **publication bias** and find it is **significant**

We identify the most prominent **drivers of heterogeneity**

The largest implied effect, attained at the medium-term horizon, is **0.7%**, and varies across countries up to **1.8%** as a response to 1pp change in interest rates

# Capital-Labour substitution: meta-analysis

Large elasticity of substitution between capital and labour estimated in the literature on average, 0.9 is explained by:

- publication bias

- cross-country variation

- omission of the first-order condition for capital

The mean elasticity conditional on the absence of these issues is 0.

3,186 estimates, 121 studies, 71 control variables coded

BMA and FMA used, nonlinear techniques for publication bias

The weight of evidence accumulated in the empirical literature emphatically rejects the Cobb-Douglas specification

# Armington elasticity: meta-analysis

Wide **application** of Armington elasticity in international economics

**Vary** systematically across countries

Results exaggerated by **publication bias**

Depending on method and **data characteristics**

Elasticities are larger **in peer-reviewed** and highly cited studies

Mean **Armington elasticity** implied by the literature, corrected for publication bias and potential misspecification, is 3.8 (median)



# The effect of sentiment on returns: meta-analysis

We conducted the **first meta-analysis of sentiment return relationship** using **1311** estimates from 30 primary studies

We proved presence of negative **publication bias** in most of the specifications

We show that the **true effect** of sentiment is **negative but in some specifications not different from zero**

We examine additional 47 variables as potential drivers of heterogeneity:

- More negative** estimates for individual sentiment and US region or higher data frequency

- Less negative (or positive)** estimates for contemporaneous effect horizon and more financially developed countries

We proposed implied estimates:

- 1SD increase in sentiment **decreases returns by 0.198 SDs**

# Short- and Long-run effects of shareholder activism: meta-analysis (preliminary)

Short-run - 1973 Estimates from 67 studies

Long-run - 1186 Estimates from 49 studies

Studying not only geographical aspects but even **institutional settings**

Focus on **activism sponsors**, their objectives and approaches + other characteristics

**Substantial publication bias** revealed

**Institutional settings** explain most of the variability across the estimates

Long-run - **benchmark setting** is important

Valuable **insights to regulators**

# Conclusion

Meta-analysis originates in medicine, but has its place even in the economics

It is not just a summary of the literature, but the quantitative evaluation

Allows for determining the seminal drivers of heterogeneity,

Controls for publication bias

Suggests the implied estimates

Benchmark for policies

In Czech National Bank since 2010, 15+ publications

Current topics: monetary and macroprudential policy, business and financial cycles

Thank you!

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