Meta-Analysis Instrumental Variable Estimator (MAIVE)

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14 September 2024

MAER-Net Colloquium, University of Augsburg

Example: meta-analyzing the education premium

True model:

$$Earnings_j = \gamma Education_j + \delta Ability_j + v_j,$$

Ability not observed.

Primary studies:

1. ignore ability $\rightarrow \hat{\gamma}$ too large, SE($\hat{\gamma}$) likely too small (ability matters for education).
2. include a proxy $\rightarrow \hat{\gamma}$ smaller, SE($\hat{\gamma}$) likely larger (more collinearity).
3. quasi-experiment $\rightarrow$ if done well (e.g., good instrument), $\hat{\gamma}$ even smaller, SE($\hat{\gamma}$) likely even larger.

Example: meta-analyzing the education premium

Omitted variable:

$$Earnings_j = \gamma Education_j + w_j,$$

Ability not observed.

Primary studies:

1. ignore ability $\rightarrow \hat{\gamma}$ too large, SE($\hat{\gamma}$) likely too small (ability matters for education).
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Example: meta-analyzing the education premium

Proxy:

$$Earnings_j = \gamma Education_j + \omega IQ_j + x_j,$$

Ability not observed.

Primary studies:

1. ignore ability $\rightarrow \hat{\gamma}$ too large, SE($\hat{\gamma}$) likely too small (ability matters for education).
2. include a proxy $\rightarrow \hat{\gamma}$ smaller, SE($\hat{\gamma}$) likely larger (more collinearity).
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Example: meta-analyzing the education premium

Instrument:

$$Earnings_j = \gamma\, Education_j + z_j, \quad Distance_j$$

Ability not observed.

Primary studies:

1. ignore ability $\rightarrow \hat{\gamma}$ too large, SE($\hat{\gamma}$) likely too small (ability matters for education).
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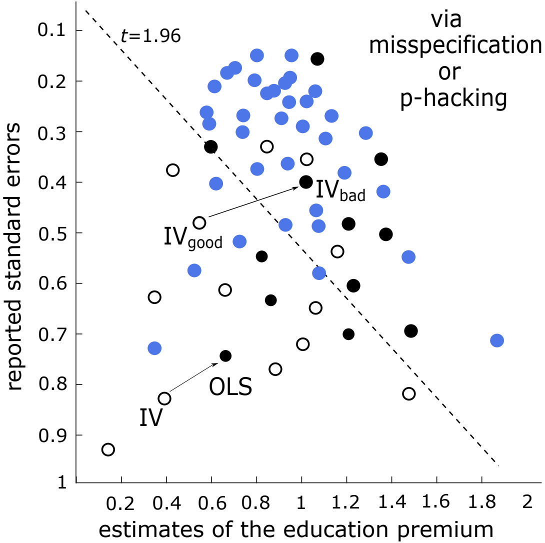
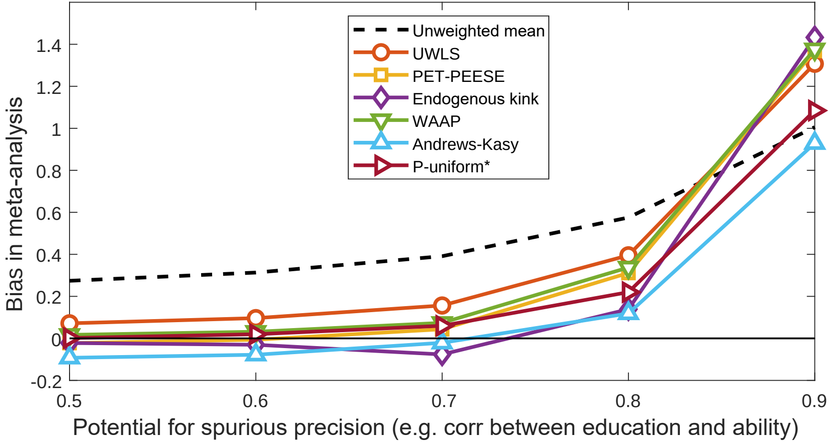
3. quasi-experiment $\rightarrow$ if done well (e.g., good instrument), $\hat{\gamma}$ even smaller, SE($\hat{\gamma}$) likely even larger.

Some estimates both spuriously large & precise



Simulation: all meta estimators biased upwards



Reason: key meta assumption broken

Methods or p-hacking

PEESE:

$$\hat{E}_i = E_0 + \beta SE(\hat{E})_i^2 + u_i,$$

Methods or p-hacking

corr$(SE, u) \neq 0 \Rightarrow \hat{\beta}$ and $\hat{E}_0$ biased. Problem in all meta estimators (funnel-based, selection models, simple random effects). All of them use SE as a regressor, identification threshold, or weight.

Natural solution: N instrumenting $SE(\hat{E})_i^2 \rightarrow$ MAIVE.

Options for the meta-analyst

1. Use only quasi-experimental studies (ignore those that can be spuriously precise). Is quality binary?
2. Include controls in meta-regression (dummies for OLS, DID, . . .). Are we sure we are not missing some?

   In observational research
   we never know the true model!

3. Remove "bad" variation from SE $\rightarrow$ MAIVE.

Meta-analysis instrumental variable estimator

MAIVE intuition:

Definition of SE

$$\hat{E}_i = E_0 + \beta SE(\hat{E})_i^2 + u_i. \quad 1/N_i$$

- MAIVE + PEESE = classical IV.
- Can add controls in the 2nd stage (dummies for OLS, DID, …).
- You can plug MAIVE-adjusted SEs into other estimators (e.g., do simple random effects with adjusted SEs).

Meta-analysis instrumental variable estimator

MAIVE first stage:

$$SE(\hat{E})_i^2 = \alpha_0 + \alpha_1 \left(1/N_i\right) + \pi_i. \qquad \text{hacking or misspecifications}$$

- MAIVE + PEESE = classical IV.
- Can add controls in the 2nd stage (dummies for OLS, DID, . . .).
- You can plug MAIVE-adjusted SEs into other estimators (e.g., do simple random effects with adjusted SEs).

Meta-analysis instrumental variable estimator

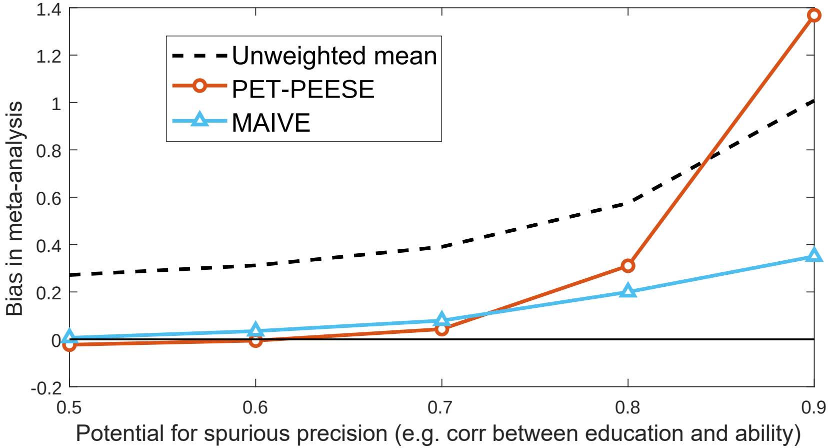
MAIVE adjustment:

$$SE(\hat{E})^2_{adj,i} = \hat{\alpha}_0 + \hat{\alpha}_1\,(1/N_i) + \cancel{\pi_i}.$$

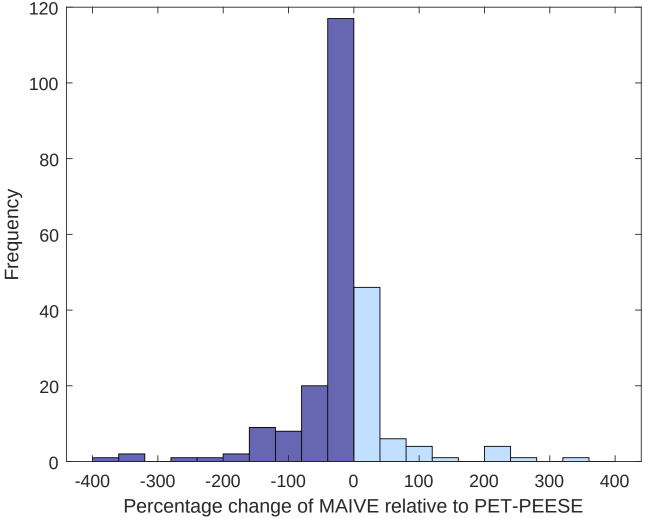
~~hacking~~ or ~~misspecifications~~

- MAIVE + PEESE = classical IV.
- Can add controls in the 2nd stage (dummies for OLS, DID, . . .).
- You can plug MAIVE-adjusted SEs into other estimators (e.g., do simple random effects with adjusted SEs).

Simulation: MAIVE alleviates the bias



MAIVE reduces PET-PEESE in most econ metas



Practical issues for a meta-analyst

Main consideration

- Can methods or p-hacking influence both $\hat{E}$ and SE? Or could there be another relationship between $\hat{E}$ and SE beyond publication bias (e.g. because you use a standardized effect size)?
- Yes $\rightarrow$ MAIVE helps.
- No $\rightarrow$ MAIVE doesn't hurt much (but makes the meta estimate less precise).

Project Website

meta-analysis.cz/maive

Papers using MAIVE

- Irsova Z., P. Bom, T. Havranek, & H. Rachinger (2024): Spurious Precision in Meta-Analysis of Observational Research.
  Nature Human Behaviour, 2nd revision.
- Opatrny M., T. Havranek, Z. Irsova, & M. Scasny (2024): Publication Bias and Model Uncertainty in Measuring the Effect of Class Size on Achievement.
  Journal of Labor Economics, revise and resubmit.
- Havranek T., Z. Irsova, & O. Zeynalova (2024): Publication and Attenuation Biases in Measuring Skill Substitution.
  Review of Economics and Statistics 106(5): 1187-1200.