A MONTE CARLO ANALYSIS OF ALTERNATIVE META-ANALYSIS ESTIMATORS IN THE PRESENCE OF PUBLICATION BIAS

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2. Description of Estimators
3. Description of Experimental Designs
4. Results
5. Conclusion

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2) While random effects estimators are often more biased than other MA estimators, they sometimes are more efficient.

3) MA estimators perform poorly when there is substantial heterogeneity in true effects, and publication bias affects the most precise estimates.

4) Hypothesis testing about the mean true effect is generally unreliable for all MA estimators.

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BENCHMARK ESTIMATOR: Unadjusted (OLS)

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FIVE MA ESTIMATORS

A) Fixed Effects (VWLS)

$$\frac{\hat{\beta}_{i1}}{SE_i} = \alpha \cdot \left(\frac{1}{SE_i}\right) + \frac{v_i}{SE_i},\ \ i = 1,2,\ldots,M,$$

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$$\frac{\widehat{\beta}_{i1}}{\omega_i} = \alpha \cdot \left(\frac{1}{\omega_i}\right) + \frac{\nu_i}{\omega_i}, \quad i = 1,2,\ldots,M,$$

where $\omega_i = \sqrt{(SE_i)^2 + \tau^2}$.

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Only these last two estimators (the PET and PEESE) correct for publication bias.

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Because the samples in Step 1) have different error variances, some $\hat{\beta}$ values have smaller SE's than others

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Use these estimates to create a population of studies/estimates, $\hat{\beta}$

Fixed Effects:

Each study has one estimated effect, $\hat{\beta}$

One true effect across studies, α

Random Effects:

Each study has one estimated effect, $\hat{\beta}$

True effects differ across studies: $E(\alpha_i) = \alpha$

Panel Random Effects:

Each study has multiple estimated effects, $\hat{\beta}$

True effects differ both within and across studies

$E(\alpha_{ij}) = \alpha$

4) Apply selection rule to the population of studies/estimates above

Bias against statistical insignificance:
Keep if *t*-stat ≥ 2
Keep with prob = 0.10 if *t*-stat <2

Bias against wrong sign:
Keep if estimated effect ≥ 0
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Steps 1) through 4) simulate one MA study

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5) Repeat Steps 1) through 4) 1000 times
This produces 1000 simulated MA studies

CHOOSE SIMULATION PARAMETERS TO CREATE MA STUDIES WITH THE FOLLOWING CHARACTERISTICS

1) Produce a realistic range of *t*-values for the estimated effects in the population of studies

2) Produce realistic-looking funnel graphs

3) Cause the percent of studies that are eliminated through publication bias to range between 0 and 80 percent.

   For random effects:

4) Produce realistic values of "effect heterogeneity"

4. RESULTS

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(*FIXED EFFECTS*) The first set of results demonstrate that:

(i) the simulation parameters produce MA samples that "look like" real MA samples.

(ii) SE_i is endogenous

TABLE 1
Sample Characteristics for a Simulated Meta-Analysis Data Set: Fixed Effects ($\alpha = 1$)

Variable	*Median*	*Minimum*	*P5%*	*P95%*	*Maximum*
PRE-PUBLICATION BIAS (100 percent of estimates):					
Estimated effect	1.00	-5.74	-1.98	4.00	7.76
t-statistic	0.94	-2.31	-0.95	6.23	36.69
Precision (1/SE)	0.66	0.28	0.34	6.04	36.63
PUBLICATION BIAS AGAINST INSIGNIFICANCE (31.8 percent of estimates):					
Estimated effect	1.19	-5.01	-0.93	5.13	7.65
t-statistic	2.62	-2.15	-0.47	15.19	36.23
Precision (1/SE)	1.66	0.31	0.37	15.11	36.19
PUBLICATION BIAS AGAINST NEGATIVE EFFECTS (80.6 percent of estimates):					
Estimated effect	1.21	-3.10	0.12	4.25	7.72
t-statistic	1.27	-1.37	0.08	7.38	36.93
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4. RESULTS

(*FIXED EFFECTS*) The next set of results demonstrate that:

(i) much of the effectiveness of the PET and PEESE estimators comes from weighting by SE_i, as opposed to adding the variable SE_i as a "Heckman-type" selection correction

TABLE 2

Comparative Performance of Meta-Analysis Estimators: Fixed Effects/Publication Bias against Insignificance

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Mean Estimate of True Effect							
0.0	14.4	0.02	0.00	0.00	0.00	0.00	0.00
0.5	23.0	0.91	0.48	0.51	0.51	0.51	0.56
1.0	31.7	1.57	0.96	1.01	1.01	1.01	1.05
1.5	40.0	2.14	1.46	1.50	1.51	1.51	1.54
2.0	47.5	2.67	1.96	2.00	2.01	2.01	2.04
2.5	54.6	3.17	2.46	2.49	2.51	2.51	2.53
3.0	61.1	3.65	2.97	2.99	3.01	3.01	3.02
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1.0	31.7	1.57	0.96	1.01	1.01	1.01	1.05
1.5	40.0	2.14	1.46	1.50	1.51	1.51	1.54
2.0	47.5	2.67	1.96	2.00	2.01	2.01	2.04
2.5	54.6	3.17	2.46	2.49	2.51	2.51	2.53
3.0	61.1	3.65	2.97	2.99	3.01	3.01	3.02
3.5	66.9	4.12	3.47	3.49	3.51	3.51	3.52
4.0	72.4	4.57	3.97	3.99	4.01	4.01	4.01

TABLE 2
Comparative Performance of Meta-Analysis Estimators:
Fixed Effects/Publication Bias against Insignificance

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
			Mean Estimate of True Effect				
0.0	14.4	0.02	0.00	0.00	0.00	0.00	0.00
0.5	23.0	0.91	0.48	0.51	0.51	0.51	0.56
1.0	31.7	1.57	0.96	1.01	1.01	1.01	1.05
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2.5	54.6	3.17	2.46	2.49	2.51	2.51	2.53
3.0	61.1	3.65	2.97	2.99	3.01	3.01	3.02
3.5	66.9	4.12	3.47	3.49	3.51	3.51	3.52
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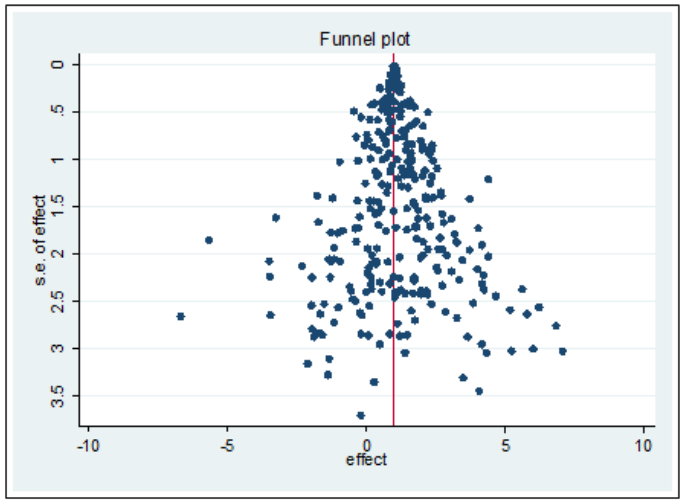
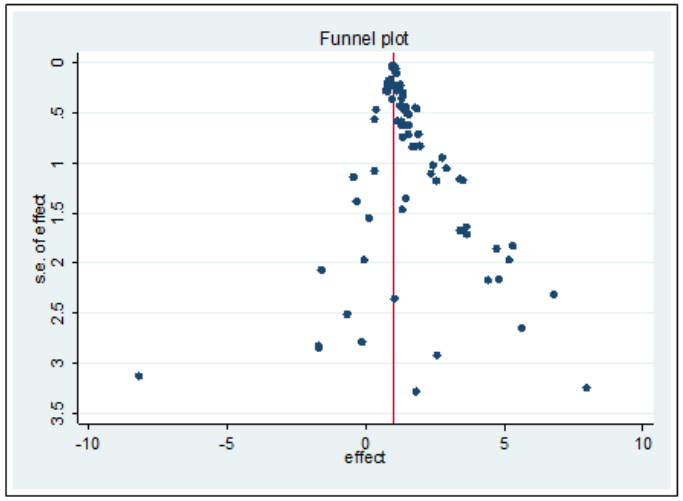
2.5	54.6	3.17	2.46	2.49	2.51	2.51	2.53
3.0	61.1	3.65	2.97	2.99	3.01	3.01	3.02
3.5	66.9	4.12	3.47	3.49	3.51	3.51	3.52
4.0	72.4	4.57	3.97	3.99	4.01	4.01	4.01

FIGURE 1
Example of Funnel Graphs for a Simulated Meta-Analysis Data Set: Fixed Effects

A. Pre-Publication Bias



B. Post-Publication Bias (against statistical insignificance)



4. RESULTS

(*RANDOM EFFECTS*) The next set of results demonstrate that:

(i) the simulation parameters produce MA samples that "look like" real MA samples.

TABLE 4
Sample Characteristics for a Simulated Meta-Analysis Data Set: Random Effects ($\alpha = 1$)

Variable	*Median*	*Minimum*	*P5%*	*P95%*	*Maximum*
PRE-PUBLICATION BIAS (100 percent of estimates):					
Estimated effect	1.00	-6.24	-2.38	4.37	8.25
t-statistic	0.79	-8.12	-1.48	5.98	31.79
Precision (1/SE)	0.65	0.28	0.33	5.06	17.66
I2	0.84	0.65	0.74	0.92	0.95
PUBLICATION BIAS AGAINST INSIGNIFICANCE (32.9 percent of estimates):					
Estimated effect	1.81	-5.90	-2.09	5.64	8.26
t-statistic	2.55	-8.15	-2.29	12.77	31.50
Precision (1/SE)	1.25	0.31	0.37	9.63	17.26
I2	0.93	0.72	0.87	0.97	0.99
PUBLICATION BIAS AGAINST NEGATIVE EFFECTS (74.7 percent of estimates):					
Estimated effect	1.55	-3.50	0.01	4.76	8.30
t-statistic	1.28	-2.93	0.01	7.40	31.57
Precision (1/SE)	0.70	0.28	0.34	5.57	17.03
I2	0.79	0.41	0.63	0.90	0.95

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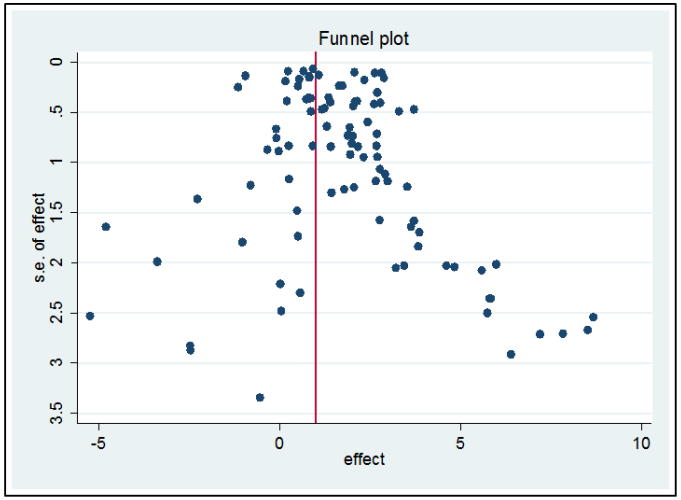
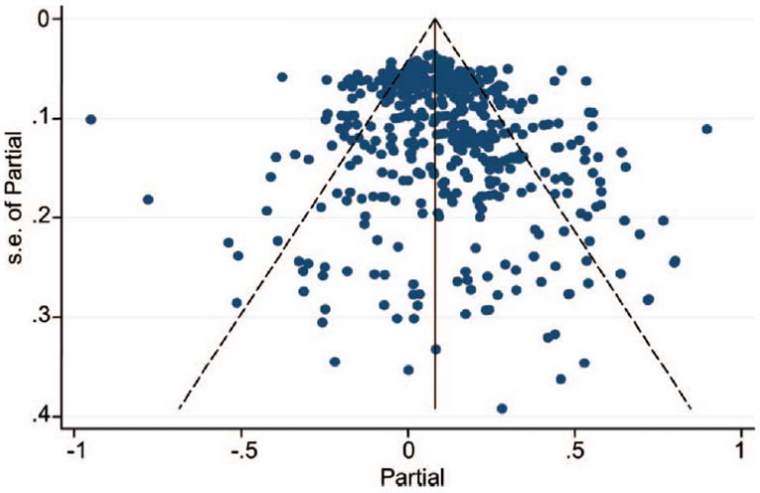
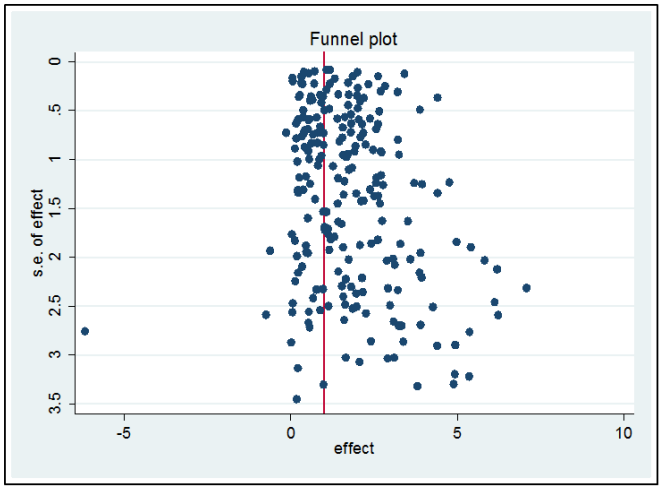
B. Post-Publication Bias (against statistical insignificance)



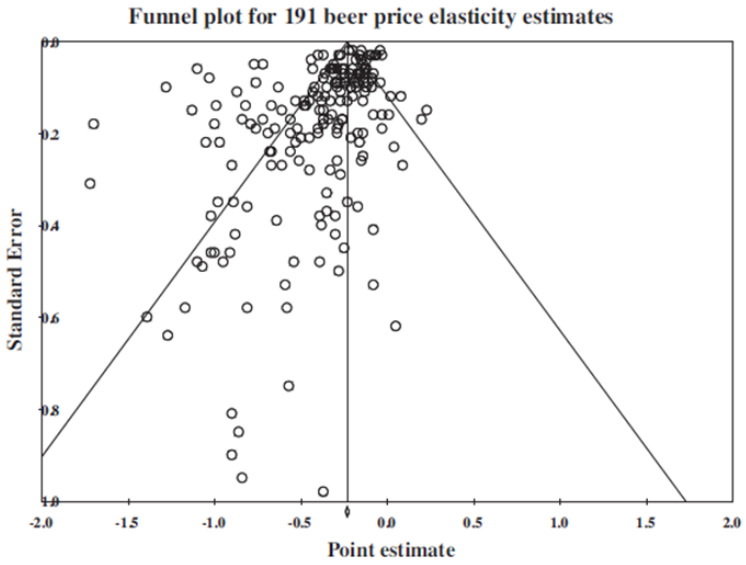
A. Mekasha and Tarp (2013, Figure 1, page 571)



C. Post-Publication Bias (against wrong-signed estimates)



C. Nelson (2014, Figure 1, page 184)



4. RESULTS

(*RANDOM EFFECTS*) The next set of results demonstrate that:

(i) MA estimators that correct for publication bias sometimes perform worse than those that do not.

TABLE 5
Comparative Performance of Meta-Analysis Estimators:
Random Effects/Publication Bias against Insignificance

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Mean Squared Error							
0.0	27.1	0.0871	0.1749	0.1089	0.1032	0.1032	0.0437
0.5	28.8	0.3272	0.1840	0.1230	0.1192	0.1192	0.1822
1.0	33.2	0.7382	0.1649	0.1220	0.1232	0.1232	0.3522
1.5	39.2	0.9210	0.1366	0.0990	0.1027	0.1027	0.3605
2.0	46.0	0.9117	0.1343	0.0811	0.0806	0.0806	0.2916
2.5	52.7	0.8252	0.1375	0.0787	0.0750	0.0750	0.2187
3.0	59.1	0.7246	0.1357	0.0807	0.0753	0.0753	0.1649
3.5	65.1	0.6272	0.1420	0.0851	0.0780	0.0780	0.1298
4.0	70.4	0.5222	0.1164	0.0733	0.0682	0.0682	0.0944

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Comparative Performance of Meta-Analysis Estimators: Random Effects/Publication Bias against Insignificance

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4.0	70.4	0.5222	0.1164	0.0733	0.0682	0.0682	0.0944

4. RESULTS

(*RANDOM EFFECTS*) The next set of results demonstrate that:

(i) While random effects estimators are often more biased than other MA estimators, they sometimes are more efficient.

TABLE 6

Comparative Performance of Meta-Analysis Estimators: Random Effects/Publication Bias against Wrong Sign

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
			Mean Estimate of True Effect				
0.0	55.1	1.26	0.60	0.66	0.69	0.69	0.90
0.5	65.5	1.53	0.89	0.94	0.97	0.97	1.18
1.0	74.5	1.81	1.21	1.26	1.29	1.29	1.49
1.5	82.0	2.12	1.58	1.62	1.64	1.64	1.84
2.0	87.5	2.48	2.01	2.04	2.06	2.06	2.23
2.5	91.3	2.86	2.49	2.51	2.53	2.53	2.66
3.0	93.9	3.27	2.96	2.99	3.00	3.00	3.11
3.5	95.9	3.70	3.49	3.50	3.51	3.51	3.58
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α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Mean Estimate of True Effect							
0.0	55.1	1.26	0.60	0.66	0.69	0.69	0.90
0.5	65.5	1.53	0.89	0.94	0.97	0.97	1.18
1.0	74.5	1.81	1.21	1.26	1.29	1.29	1.49
1.5	82.0	2.12	1.58	1.62	1.64	1.64	1.84
2.0	87.5	2.48	2.01	2.04	2.06	2.06	2.23
2.5	91.3	2.86	2.49	2.51	2.53	2.53	2.66
3.0	93.9	3.27	2.96	2.99	3.00	3.00	3.11
3.5	95.9	3.70	3.49	3.50	3.51	3.51	3.58
4.0	97.2	4.15	3.98	3.99	4.00	4.00	4.05

TABLE 6
Comparative Performance of Meta-Analysis Estimators:
Random Effects/Publication Bias against Wrong Sign

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Mean Estimate of True Effect							
0.0	55.1	1.26	0.60	0.66	0.69	0.69	0.90
0.5	65.5	1.53	0.89	0.94	0.97	0.97	1.18
1.0	74.5	1.81	1.21	1.26	1.29	1.29	1.49
1.5	82.0	2.12	1.58	1.62	1.64	1.64	1.84
2.0	87.5	2.48	2.01	2.04	2.06	2.06	2.23
2.5	91.3	2.86	2.49	2.51	2.53	2.53	2.66
3.0	93.9	3.27	2.96	2.99	3.00	3.00	3.11
3.5	95.9	3.70	3.49	3.50	3.51	3.51	3.58
4.0	97.2	4.15	3.98	3.99	4.00	4.00	4.05

TABLE 6
Comparative Performance of Meta-Analysis Estimators:
Random Effects/Publication Bias against Wrong Sign

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
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0.0	55.1	1.26	0.60	0.66	0.69	0.69	0.90
0.5	65.5	1.53	0.89	0.94	0.97	0.97	1.18
1.0	74.5	1.81	1.21	1.26	1.29	1.29	1.49
1.5	82.0	2.12	1.58	1.62	1.64	1.64	1.84
2.0	87.5	2.48	2.01	2.04	2.06	2.06	2.23
2.5	91.3	2.86	2.49	2.51	2.53	2.53	2.66
3.0	93.9	3.27	2.96	2.99	3.00	3.00	3.11
3.5	95.9	3.70	3.49	3.50	3.51	3.51	3.58
4.0	97.2	4.15	3.98	3.99	4.00	4.00	4.05

TABLE 6
Comparative Performance of Meta-Analysis Estimators:
Random Effects/Publication Bias against Wrong Sign

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Mean Estimate of True Effect							
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0.5	65.5	1.53	0.89	0.94	0.97	0.97	1.18
1.0	74.5	1.81	1.21	1.26	1.29	1.29	1.49
1.5	82.0	2.12	1.58	1.62	1.64	1.64	1.84
2.0	87.5	2.48	2.01	2.04	2.06	2.06	2.23
2.5	91.3	2.86	2.49	2.51	2.53	2.53	2.66
3.0	93.9	3.27	2.96	2.99	3.00	3.00	3.11
3.5	95.9	3.70	3.49	3.50	3.51	3.51	3.58
4.0	97.2	4.15	3.98	3.99	4.00	4.00	4.05

TABLE 6
Comparative Performance of Meta-Analysis Estimators:
Random Effects/Publication Bias against Wrong Sign

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Mean Estimate of True Effect							
0.0	55.1	1.26	0.60	0.66	0.69	0.69	0.90
0.5	65.5	1.53	0.89	0.94	0.97	0.97	1.18
1.0	74.5	1.81	1.21	1.26	1.29	1.29	1.49
1.5	82.0	2.12	1.58	1.62	1.64	1.64	1.84
2.0	87.5	2.48	2.01	2.04	2.06	2.06	2.23
2.5	91.3	2.86	2.49	2.51	2.53	2.53	2.66
3.0	93.9	3.27	2.96	2.99	3.00	3.00	3.11
3.5	95.9	3.70	3.49	3.50	3.51	3.51	3.58
4.0	97.2	4.15	3.98	3.99	4.00	4.00	4.05

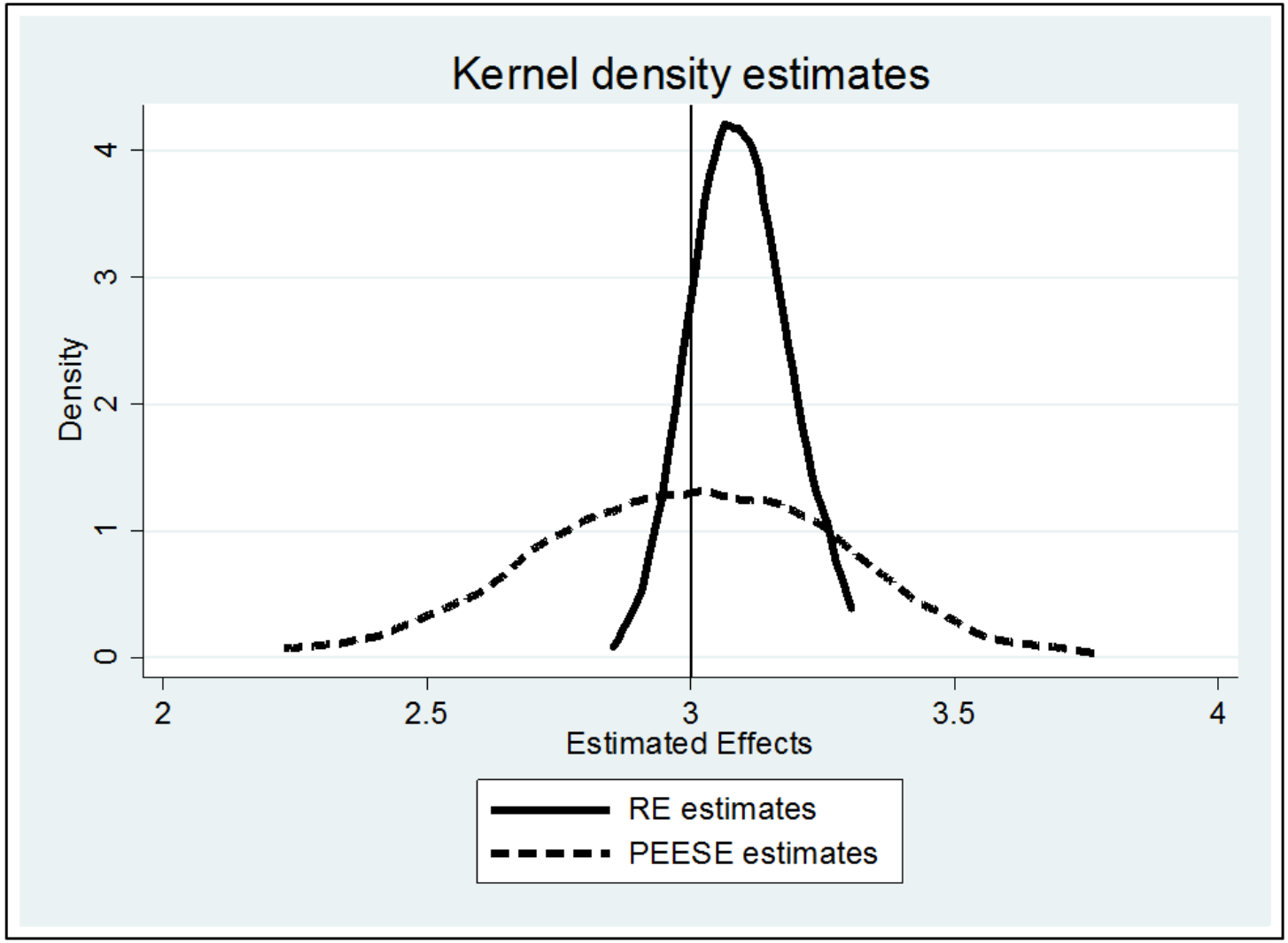
TABLE 6
Comparative Performance of Meta-Analysis Estimators:
Random Effects/Publication Bias against Wrong Sign

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
			Mean Squared Error				
0.0	55.1	1.6156	0.4676	0.5072	0.5436	0.5436	0.8234
0.5	65.5	1.0664	0.2415	0.2583	0.2795	0.2795	0.4696
1.0	74.5	0.6631	0.1304	0.1272	0.1367	0.1367	0.2499
1.5	82.0	0.3915	0.0959	0.0749	0.0758	0.0758	0.1215
2.0	87.5	0.2375	0.1081	0.0749	0.0709	0.0709	0.0635
2.5	91.3	0.1400	0.1064	0.0721	0.0665	0.0665	0.0347
3.0	93.9	0.0852	0.1099	0.0736	0.0668	0.0668	0.0211
3.5	95.9	0.0518	0.1127	0.0763	0.0692	0.0692	0.0138
4.0	97.2	0.0370	0.1075	0.0735	0.0668	0.0668	0.0116

TABLE 6
Comparative Performance of Meta-Analysis Estimators:
Random Effects/Publication Bias against Wrong Sign

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
			Mean Squared Error				
0.0	55.1	1.6156	0.4676	0.5072	0.5436	0.5436	0.8234
0.5	65.5	1.0664	0.2415	0.2583	0.2795	0.2795	0.4696
1.0	74.5	0.6631	0.1304	0.1272	0.1367	0.1367	0.2499
1.5	82.0	0.3915	0.0959	0.0749	0.0758	0.0758	0.1215
2.0	87.5	0.2375	0.1081	0.0749	0.0709	0.0709	0.0635
2.5	91.3	0.1400	0.1064	0.0721	0.0665	0.0665	0.0347
3.0	93.9	0.0852	0.1099	0.0736	0.0668	0.0668	0.0211
3.5	95.9	0.0518	0.1127	0.0763	0.0692	0.0692	0.0138
4.0	97.2	0.0370	0.1075	0.0735	0.0668	0.0668	0.0116

FIGURE 3
Distribution of RE and PEESE Estimates in the RE Case, α=3, Publication Bias against Wrong Sign



4. RESULTS

(*PANEL RANDOM EFFECTS*) The next set of results demonstrate that:

(i) MA estimators perform poorly when there is substantial heterogeneity in true effects, and publication bias affects the most precise estimates.

TABLE 9

Comparative Performance of Meta-Analysis Estimators: Panel Random Effects /Publication Bias against Wrong Sign

α	*N*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Mean Estimate of True Effect							
0.0	37.5	2.02	1.72	1.73	1.77	1.77	1.86
0.5	47.9	2.19	1.89	1.90	1.94	1.94	2.04
1.0	56.8	2.41	2.16	2.16	2.17	2.17	2.29
1.5	65.6	2.64	2.41	2.42	2.43	2.43	2.53
2.0	73.7	2.90	2.63	2.64	2.66	2.66	2.79
2.5	80.7	3.17	3.00	3.00	3.00	3.00	3.09
3.0	86.0	3.51	3.30	3.30	3.31	3.31	3.43
3.5	90.4	3.88	3.74	3.73	3.74	3.74	3.82
4.0	93.5	4.27	4.13	4.13	4.14	4.14	4.22

TABLE 9
Comparative Performance of Meta-Analysis Estimators:
Panel Random Effects /Publication Bias against Wrong Sign

α	*N*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
			Mean Estimate of True Effect				
0.0	37.5	2.02	1.72	1.73	1.77	1.77	1.86
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1.0	56.8	2.41	2.16	2.16	2.17	2.17	2.29
1.5	65.6	2.64	2.41	2.42	2.43	2.43	2.53
2.0	73.7	2.90	2.63	2.64	2.66	2.66	2.79
2.5	80.7	3.17	3.00	3.00	3.00	3.00	3.09
3.0	86.0	3.51	3.30	3.30	3.31	3.31	3.43
3.5	90.4	3.88	3.74	3.73	3.74	3.74	3.82
4.0	93.5	4.27	4.13	4.13	4.14	4.14	4.22

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2.0	73.7	2.90	2.63	2.64	2.66	2.66	2.79
2.5	80.7	3.17	3.00	3.00	3.00	3.00	3.09
3.0	86.0	3.51	3.30	3.30	3.31	3.31	3.43
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2.5	80.7	3.17	3.00	3.00	3.00	3.00	3.09
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Comparative Performance of Meta-Analysis Estimators:
Panel Random Effects /Publication Bias against Wrong Sign

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1.0	56.8	2.41	2.16	2.16	2.17	2.17	2.29
1.5	65.6	2.64	2.41	2.42	2.43	2.43	2.53
2.0	73.7	2.90	2.63	2.64	2.66	2.66	2.79
2.5	80.7	3.17	3.00	3.00	3.00	3.00	3.09
3.0	86.0	3.51	3.30	3.30	3.31	3.31	3.43
3.5	90.4	3.88	3.74	3.73	3.74	3.74	3.82
4.0	93.5	4.27	4.13	4.13	4.14	4.14	4.22

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Comparative Performance of Meta-Analysis Estimators:
Panel Random Effects /Publication Bias against Wrong Sign

α	*N*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Mean Estimate of True Effect							
0.0	37.5	2.02	1.72	1.73	1.77	1.77	1.86
0.5	47.9	2.19	1.89	1.90	1.94	1.94	2.04
1.0	56.8	2.41	2.16	2.16	2.17	2.17	2.29
1.5	65.6	2.64	2.41	2.42	2.43	2.43	2.53
2.0	73.7	2.90	2.63	2.64	2.66	2.66	2.79
2.5	80.7	3.17	3.00	3.00	3.00	3.00	3.09
3.0	86.0	3.51	3.30	3.30	3.31	3.31	3.43
3.5	90.4	3.88	3.74	3.73	3.74	3.74	3.82
4.0	93.5	4.27	4.13	4.13	4.14	4.14	4.22

FIGURE 7
Distribution of All Estimators:
Panel RE Case, α=1, Publication Bias against Wrong Sign

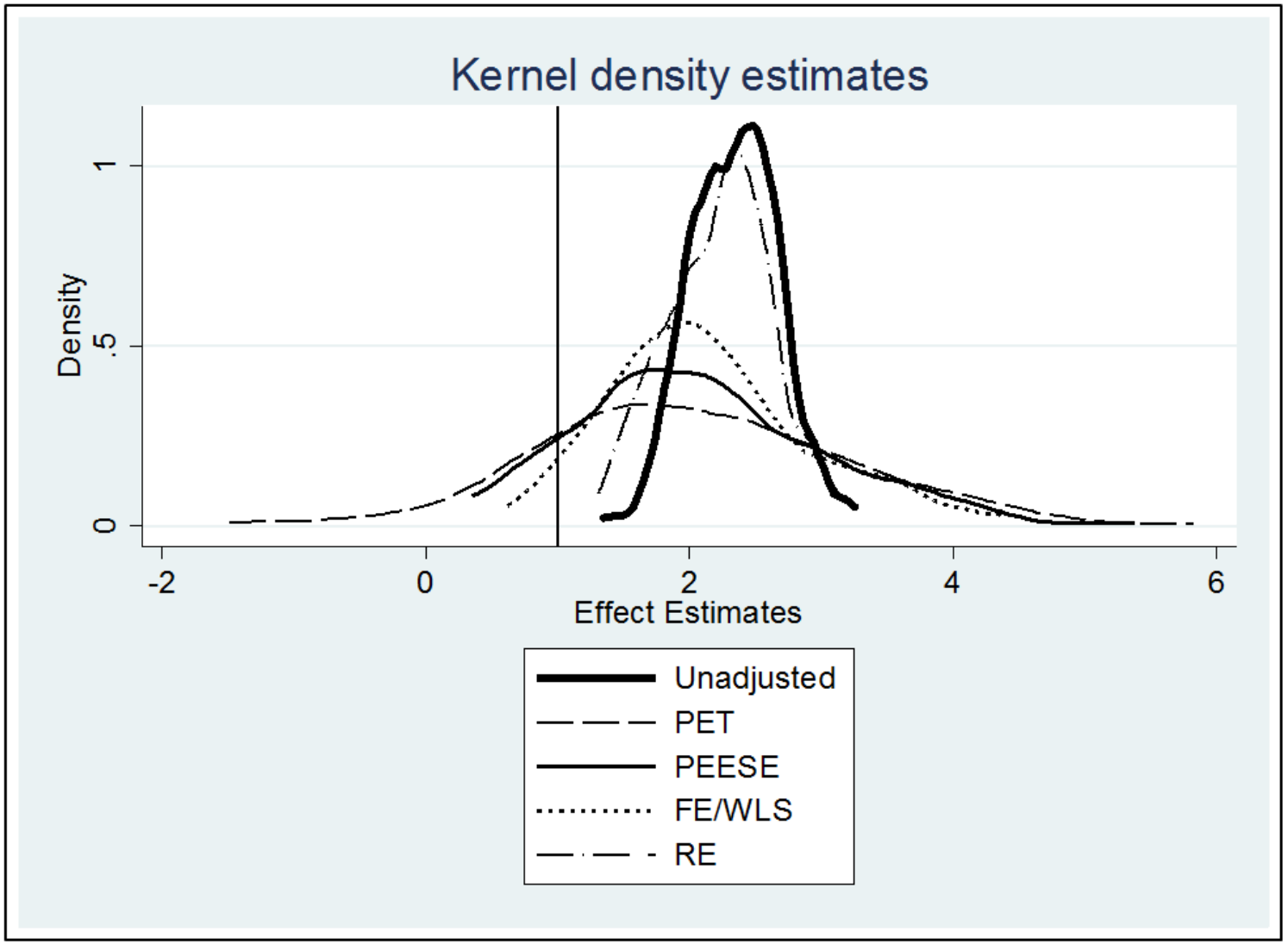
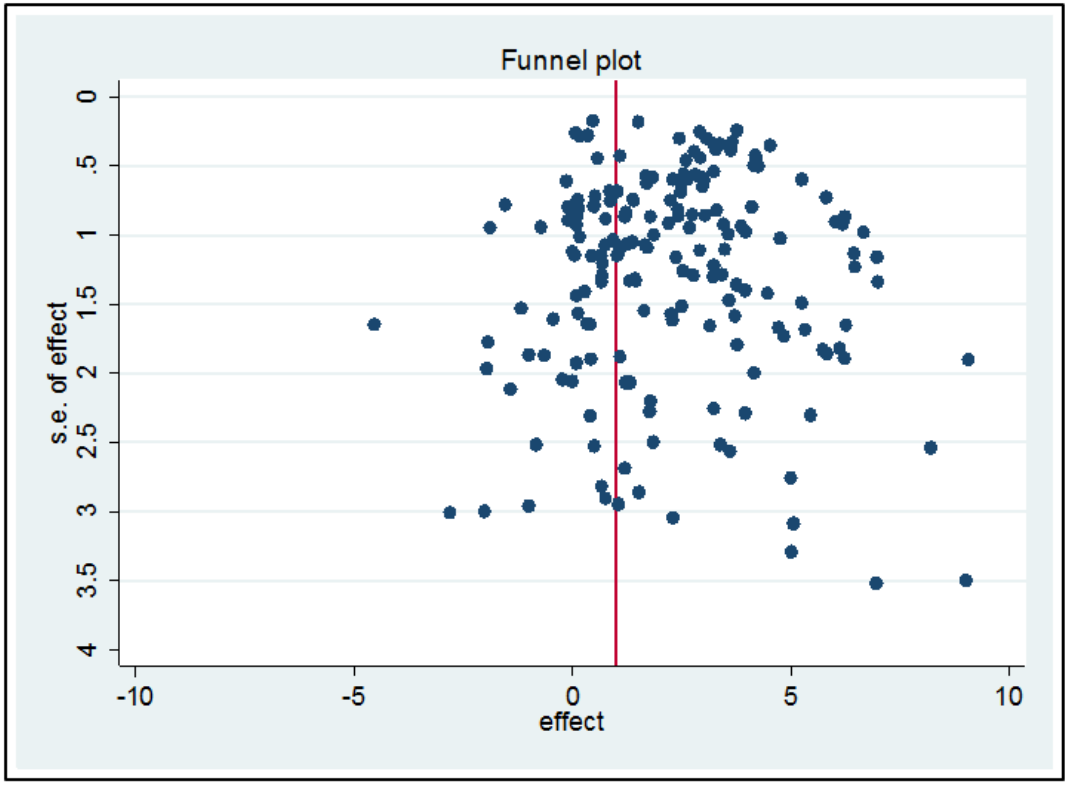


FIGURE 6
Example of Funnel Graphs for a Simulated Meta-Analysis Data Set: Panel Random Effects

C. Post-Publication Bias (against wrong-signed estimates)



4. RESULTS

(*RANDOM EFFECTS/PANEL RANDOM EFFECTS*) The last set of results demonstrate that:

(i) hypothesis testing about the mean true effect is generally unreliable for all MA estimators.

TABLE 5
Comparative Performance of Meta-Analysis Estimators:
Random Effects/Publication Bias against Insignificance

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Type I Error Rates							
0.0	27.1	0.04	0.12	0.10	0.88	0.44	0.04
0.5	28.8	0.43	0.16	0.15	0.88	0.51	0.49
1.0	33.2	0.92	0.15	0.17	0.88	0.58	0.93
1.5	39.2	1.00	0.14	0.14	0.89	0.59	0.99
2.0	46.0	1.00	0.15	0.12	0.87	0.57	1.00
2.5	52.7	1.00	0.14	0.11	0.86	0.58	0.98
3.0	59.1	1.00	0.15	0.12	0.86	0.60	0.96
3.5	65.1	1.00	0.14	0.12	0.89	0.62	0.92
4.0	70.4	1.00	0.12	0.10	0.86	0.60	0.83

TABLE 5

Comparative Performance of Meta-Analysis Estimators: Random Effects/Publication Bias against Insignificance

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Type I Error Rates							
0.0	27.1	0.04	0.12	0.10	0.88	0.44	0.04
0.5	28.8	0.43	0.16	0.15	0.88	0.51	0.49
1.0	33.2	0.92	0.15	0.17	0.88	0.58	0.93
1.5	39.2	1.00	0.14	0.14	0.89	0.59	0.99
2.0	46.0	1.00	0.15	0.12	0.87	0.57	1.00
2.5	52.7	1.00	0.14	0.11	0.86	0.58	0.98
3.0	59.1	1.00	0.15	0.12	0.86	0.60	0.96
3.5	65.1	1.00	0.14	0.12	0.89	0.62	0.92
4.0	70.4	1.00	0.12	0.10	0.86	0.60	0.83

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Comparative Performance of Meta-Analysis Estimators:
Random Effects/Publication Bias against Insignificance

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
			Type I Error Rates				
0.0	27.1	0.04	0.12	0.10	0.88	0.44	0.04
0.5	28.8	0.43	0.16	0.15	0.88	0.51	0.49
1.0	33.2	0.92	0.15	0.17	0.88	0.58	0.93
1.5	39.2	1.00	0.14	0.14	0.89	0.59	0.99
2.0	46.0	1.00	0.15	0.12	0.87	0.57	1.00
2.5	52.7	1.00	0.14	0.11	0.86	0.58	0.98
3.0	59.1	1.00	0.15	0.12	0.86	0.60	0.96
3.5	65.1	1.00	0.14	0.12	0.89	0.62	0.92
4.0	70.4	1.00	0.12	0.10	0.86	0.60	0.83

TABLE 5
Comparative Performance of Meta-Analysis Estimators: Random Effects/Publication Bias against Insignificance

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Type I Error Rates							
0.0	27.1	0.04	0.12	0.10	0.88	0.44	0.04
0.5	28.8	0.43	0.16	0.15	0.88	0.51	0.49
1.0	33.2	0.92	0.15	0.17	0.88	0.58	0.93
1.5	39.2	1.00	0.14	0.14	0.89	0.59	0.99
2.0	46.0	1.00	0.15	0.12	0.87	0.57	1.00
2.5	52.7	1.00	0.14	0.11	0.86	0.58	0.98
3.0	59.1	1.00	0.15	0.12	0.86	0.60	0.96
3.5	65.1	1.00	0.14	0.12	0.89	0.62	0.92
4.0	70.4	1.00	0.12	0.10	0.86	0.60	0.83

TABLE 6

Comparative Performance of Meta-Analysis Estimators: Random Effects/Publication Bias against Wrong Sign

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Type I Error Rates							
0.0	55.1	1.00	0.75	0.85	1.00	0.98	1.00
0.5	65.5	1.00	0.42	0.60	0.98	0.95	1.00
1.0	74.5	1.00	0.21	0.31	0.93	0.82	1.00
1.5	82.0	1.00	0.14	0.15	0.84	0.66	0.96
2.0	87.5	1.00	0.13	0.12	0.86	0.65	0.74
2.5	91.3	0.93	0.12	0.11	0.86	0.67	0.44
3.0	93.9	0.73	0.12	0.10	0.86	0.65	0.24
3.5	95.9	0.45	0.13	0.12	0.85	0.65	0.13
4.0	97.2	0.28	0.13	0.11	0.86	0.63	0.09

TABLE 6
Comparative Performance of Meta-Analysis Estimators:
Random Effects/Publication Bias against Wrong Sign

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Type I Error Rates							
0.0	55.1	1.00	0.75	0.85	1.00	0.98	1.00
0.5	65.5	1.00	0.42	0.60	0.98	0.95	1.00
1.0	74.5	1.00	0.21	0.31	0.93	0.82	1.00
1.5	82.0	1.00	0.14	0.15	0.84	0.66	0.96
2.0	87.5	1.00	0.13	0.12	0.86	0.65	0.74
2.5	91.3	0.93	0.12	0.11	0.86	0.67	0.44
3.0	93.9	0.73	0.12	0.10	0.86	0.65	0.24
3.5	95.9	0.45	0.13	0.12	0.85	0.65	0.13
4.0	97.2	0.28	0.13	0.11	0.86	0.63	0.09

TABLE 8

Comparative Performance of Meta-Analysis Estimators: Panel Random Effects/Publication Bias against Insignificance

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Type I Error Rates							
0.0	19.4	0.55	0.38	0.40	0.96	0.76	0.56
0.5	19.5	0.62	0.36	0.38	0.95	0.77	0.61
1.0	22.0	0.69	0.40	0.41	0.96	0.79	0.66
1.5	25.3	0.81	0.41	0.42	0.95	0.79	0.78
2.0	29.7	0.88	0.41	0.43	0.96	0.81	0.83
2.5	34.1	0.92	0.42	0.43	0.94	0.81	0.86
3.0	40.4	0.93	0.41	0.41	0.95	0.81	0.87
3.5	46.4	0.95	0.39	0.40	0.96	0.82	0.85
4.0	52.7	0.94	0.39	0.39	0.93	0.79	0.83

TABLE 8
Comparative Performance of Meta-Analysis Estimators:
Panel Random Effects/Publication Bias against Insignificance

α	*Percent*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Type I Error Rates							
0.0	19.4	0.55	0.38	0.40	0.96	0.76	0.56
0.5	19.5	0.62	0.36	0.38	0.95	0.77	0.61
1.0	22.0	0.69	0.40	0.41	0.96	0.79	0.66
1.5	25.3	0.81	0.41	0.42	0.95	0.79	0.78
2.0	29.7	0.88	0.41	0.43	0.96	0.81	0.83
2.5	34.1	0.92	0.42	0.43	0.94	0.81	0.86
3.0	40.4	0.93	0.41	0.41	0.95	0.81	0.87
3.5	46.4	0.95	0.39	0.40	0.96	0.82	0.85
4.0	52.7	0.94	0.39	0.39	0.93	0.79	0.83

TABLE 9

Comparative Performance of Meta-Analysis Estimators: Panel Random Effects /Publication Bias against Wrong Sign

α	*N*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Type I Error Rates							
0.0	37.5	1.00	0.61	0.77	1.00	1.00	1.00
0.5	47.9	1.00	0.54	0.66	0.99	0.99	1.00
1.0	56.8	1.00	0.52	0.60	0.97	0.93	1.00
1.5	65.6	1.00	0.48	0.50	0.96	0.90	0.98
2.0	73.7	0.97	0.47	0.48	0.95	0.85	0.92
2.5	80.7	0.88	0.46	0.48	0.94	0.85	0.82
3.0	86.0	0.75	0.41	0.41	0.94	0.84	0.71
3.5	90.4	0.61	0.38	0.40	0.93	0.85	0.59
4.0	93.5	0.51	0.39	0.40	0.93	0.83	0.55

TABLE 9
Comparative Performance of Meta-Analysis Estimators:
Panel Random Effects /Publication Bias against Wrong Sign

α	*N*	*Unadjusted*	*PET*	*PEESE*	*FE*	*WLS*	*RE*
Type I Error Rates							
0.0	37.5	1.00	0.61	0.77	1.00	1.00	1.00
0.5	47.9	1.00	0.54	0.66	0.99	0.99	1.00
1.0	56.8	1.00	0.52	0.60	0.97	0.93	1.00
1.5	65.6	1.00	0.48	0.50	0.96	0.90	0.98
2.0	73.7	0.97	0.47	0.48	0.95	0.85	0.92
2.5	80.7	0.88	0.46	0.48	0.94	0.85	0.82
3.0	86.0	0.75	0.41	0.41	0.94	0.84	0.71
3.5	90.4	0.61	0.38	0.40	0.93	0.85	0.59
4.0	93.5	0.51	0.39	0.40	0.93	0.83	0.55

5. CONCLUSION

- ✓ MA estimators that correct for publication bias sometimes perform worse than those that do not
- ✓ While random effects estimators are often more biased than other MA estimators, they sometimes are more efficient.
- ✓ MA estimators perform poorly when there is substantial heterogeneity in true effects, and publication bias affects the most precise estimates.
- ✓ Hypothesis testing about the mean true effect is generally unreliable for all MA estimators.

While previous research has identified specific settings in which one or more MA estimators have been shown to be superior, our results demonstrate that these conclusions do not generalize to all settings.

While previous research has identified specific settings in which one or more MA estimators have been shown to be superior, our results demonstrate that these conclusions do not generalize to all settings.

APPENDIX:
Stata .do files to produce all tables and figures in the paper

Note #1: These .do files are included to make it possible for readers to confirm this study's findings, and investigate alternative DGP specifications. Many of the programs perform 1000 simulations and take several hours to run. However, the running time can be decreased without substantially affecting the results by reducing the number of replications to 100.

Note #2: Some programs consist of two parts. Part A should be run first.

THANK YOU!