Additional Results to "How Does Consumption Respond to Expected Income Changes? Evidence from 144 Studies"*

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September 10, 2018

Abstract

This online appendix provides the list of studies used in the meta-analysis along with three sets of additional results: Hedges's model of publication bias, BMA weighted by precision and the inverse of the number of estimates reported in each study, and detailed diagnostics of the BMA exercises.

1 Hedges's Model of Publication Bias

Hedges (1992) introduces a model which assumes that the probability of publication of estimates is determined by their statistical significance. The probability of publication changes only when a psychologically important p-value is reached: in economics these threshold values are 0.01, 0.05, and 0.1. When no publication bias is present, all estimates, significant and insignificant at the conventional levels, should have the same probability of being published. We estimate both the original model of Hedges (1992) and the augmented model of Ashenfelter *et al.* (1999), which allows for heterogeneity related to publication bias in the estimates of the underlying effect. The augmented log-likelihood function is (Ashenfelter *et al.*, 1999, p. 468)

$$L = c + \sum_{i=1}^{n} \log w_i(X_i, \omega) - \frac{1}{2} \sum_{i=1}^{n} \left(\frac{X_i - \mathbf{Z}_i \Delta}{\eta_i} \right)^2 - \sum_{i=1}^{n} \log(\eta_i) - \sum_{i=1}^{n} \log \Big[\sum_{j=1}^{4} \omega_j B_{ij}(\mathbf{Z}_i \Delta, \sigma) \Big], \quad (1)$$

where $X_i \sim N(\Delta, \eta_i)$ are the estimates of excess sensitivity. The parameter Δ is the average underlying excess sensitivity, and $\eta_i = \sigma_i^2 + \sigma^2$, where σ_i are the reported standard errors of the estimates and σ measures heterogeneity in the estimates. The probability of publication is determined by the weight function $w(X_i)$. In this model $w(X_i)$ is a step function associated with the p-values of the estimates. We choose four steps reflecting different levels of conventional statistical significance of the estimates: p-value < 0.01, $0.01 <$ p-value < 0.05, $0.05 <$ p-value

*The full paper, data, and code is available at `meta-analysis.cz/excess_sensitivity`.

Table 1: Hedges's test of publication bias

	Unrestricted model		Restricted ($\omega_j = 1$)	
	Coefficient	Standard error	Coefficient	Standard error
ω_2	-1.087	0.250		
ω_3	-0.426	0.213		
ω_4	0.377	0.087		
Constant	0.083	0.008	0.12	0.005
σ	0.129	0.005	0.13	0.005
Log likelihood	1259.0		1190.0	
Observations	1,224		1,224	
χ^2 (H_0: all estimates have the same probability of publication): 137.8, p-value < 0.001.				

Notes: In the absence of publication bias estimates with different statistical significance should have the same probability of being reported. ω_1, the weight associated with the probability of publication for estimates significant at the 1% level, is set to 1. ω_2, ω_3, and ω_4 show the relative probabilities for estimates significant only at the 5% level, estimates significant only at the 10% level, and insignificant estimates. σ is the estimated measure of heterogeneity (standard deviation) of the estimates of excess sensitivity.

Table 2: Hedges's test of publication bias, controlling for publication characteristics

	Unrestricted model		Restricted ($\omega_j = 1$)	
	Coefficient	Standard error	Coefficient	Standard error
ω_2	-0.814	0.217		
ω_3	-0.264	0.188		
ω_4	0.418	0.079		
Publication year	-0.0001	0.0007	-0.001	0.001
Citations	0.062	0.007	0.060	0.007
Top journal	-0.037	0.014	-0.037	0.013
Journal impact	-0.078	0.007	-0.078	0.021
Constant	0.087	0.021	0.142	0.004
σ	0.116	0.005	0.118	0.004
Log likelihood	1344.8		1285.6	
Observations	1,224		1,224	
χ^2 (H_0: all estimates have the same probability of publication): 118.5, p-value < 0.001.				

Notes: In the absence of publication bias estimates with different statistical significance should have the same probability of being reported. ω_1, the weight associated with the probability of publication for estimates significant at the 1% level, is set to 1. ω_2, ω_3, and ω_4 show the relative probabilities for estimates significant only at the 5% level, estimates significant only at the 10% level, and insignificant estimates. σ is the estimated measure of heterogeneity (standard deviation) of the estimates of excess sensitivity.

< 0.1, and p-value > 0.1. $B_{ij}(\Delta, \sigma)$ represents the probability that an estimate X_i will be assigned weight ω_i. For the first step, p-value < 0.01, we normalize ω to 1 and evaluate whether the remaining three weights differ from this value. Z_i is a vector of the characteristics of estimate X_i; here we opt to include publication characteristics of the estimate (publication year, number of citations, publication in a top journal, and impact factor of the journal where the study was published) which might potentially be related to publication bias. We include only micro estimates in the model.

Table 1 shows the estimation results of the model where Z includes only a constant (that is, no heterogeneity in the estimates of excess sensitivity is explicitly modeled). The table includes two models, an unrestricted model and a restricted model with restriction $\omega_2 = \omega_3 = \omega_4 = 1$. The unrestricted model assumes publication bias, while the restricted model assumes no bias (in other words, all coefficients have the same probability of being published, their different statistical significance notwithstanding). The restriction is rejected, which suggests publication bias: estimates significant at the 1% level are much more likely to get published than all other estimates (the differences among the three remaining groups are not statistically significant). The results are similar when we allow for heterogeneity in the estimates of excess sensitivity that might potentially be related to publication bias (Table 2).

2 Weighted BMA

The tables on the following two pages show the results of the baseline BMA exercise when observations are weighted, respectively, by precision and by the number of estimates reported per study.

Table 3: Why do estimates of excess sensitivity differ? (precision weights)

Response variable:	Bayesian model averaging			Frequentist check (OLS)		
Estimate of ES	Post. mean	Post. SD	PIP	Coef.	Std. er.	p-value
Data characteristics						
No. of obs.	-0.020	0.002	1.000	-0.019	0.007	0.008
Midyear of data	0.004	0.001	1.000	0.003	0.002	0.054
Micro	-0.337	0.024	1.000	-0.333	0.057	0.000
Micro x SE (bias)	0.703	0.077	1.000	0.891	0.163	0.000
Panel	0.119	0.019	1.000	0.110	0.055	0.047
Synthetic cohort	-0.008	0.021	0.151			
Annual frequency	0.015	0.020	0.400			
Monthly frequency	0.000	0.003	0.016			
Liquidity constraints						
Liquidity unconstr.	0.000	0.000	0.018			
Decrease in income	0.069	0.012	1.000	0.068	0.027	0.013
Liquidity constr.	0.010	0.007	0.768	0.015	0.002	0.000
Increase in income	0.000	0.001	0.007			
Utility function						
Habits	-0.083	0.011	1.000	-0.094	0.031	0.002
Nonsep. public	0.000	0.002	0.009			
Nonsep. labor	-0.069	0.011	1.000	-0.065	0.021	0.002
Interest rate	0.055	0.015	0.998	0.035	0.031	0.257
Consumption measure						
Total consumption	0.000	0.002	0.023			
Food	0.000	0.000	0.018			
Indiv. category	-0.017	0.005	0.986	-0.016	0.006	0.008
Income measure						
Outside income	-0.126	0.023	1.000	-0.123	0.035	0.000
Current income	-0.025	0.032	0.428			
Lagged income	-0.201	0.029	1.000	-0.200	0.039	0.000
GDP proxy	0.281	0.016	1.000	0.280	0.049	0.000
Instruments signif.	0.010	0.018	0.261			
Signif. not reported	-0.003	0.010	0.111			
Consumption instr.	0.002	0.008	0.066			
Income instr.	-0.017	0.023	0.392			
Difference instr.	0.000	0.002	0.010			
Nominal IR instr.	0.062	0.024	0.935	0.071	0.043	0.097
Inflation instr.	0.082	0.025	0.981	0.078	0.054	0.144
Real IR instr.	-0.021	0.024	0.477			
Other instr.	0.000	0.001	0.009			
Specification						
Exact Euler	-0.005	0.018	0.091			
Estimated in levels	0.000	0.001	0.008			
Second order	-0.094	0.019	1.000	-0.100	0.033	0.003
Short run	0.000	0.001	0.008			
Cumulative	0.016	0.013	0.676	0.017	0.010	0.093
Time shift	0.000	0.004	0.009			
No year dummies	0.031	0.033	0.529			
Time aggregation	0.046	0.014	0.977	0.044	0.035	0.213
Technique						
ML	0.000	0.004	0.019			
TSLS	-0.101	0.012	1.000	-0.097	0.025	0.000
OLS	-0.007	0.015	0.199			
Switching regr.	0.003	0.014	0.056			
Publication						
Publication year	0.006	0.001	1.000	0.006	0.002	0.001
Citations	0.017	0.006	0.956	0.014	0.010	0.173
Top journal	0.055	0.013	0.998	0.047	0.024	0.046
Journal impact	-0.035	0.005	1.000	-0.041	0.011	0.000
Constant	0.115	NA	1.000	0.128	0.081	0.116
Observations	3,127			3,127		

Notes: Weighted by precision. PIP = posterior inclusion probability. SD = standard deviation. In the frequentist check we include only explanatory variables with PIP > 0.5. The standard errors in the frequentist check are clustered at both the study and data set level.

Table 4: Why do estimates of excess sensitivity differ? (study weights)

Response variable:	Bayesian model averaging			Frequentist check (OLS)		
Estimate of ES	Post. mean	Post. SD	PIP	Coef.	Std. er.	*p*-value
Data characteristics						
No. of obs.	0.000	0.002	0.037			
Midyear of data	0.003	0.001	0.998	-0.002	0.003	0.426
Micro	-0.322	0.044	1.000	-0.291	0.048	0.000
Micro x SE (bias)	0.454	0.048	1.000	0.437	0.124	0.000
Panel	-0.025	0.039	0.341			
Synthetic cohort	0.000	0.005	0.012			
Annual frequency	0.145	0.018	1.000	0.108	0.042	0.011
Monthly frequency	-0.157	0.031	1.000	-0.157	0.064	0.014
Liquidity constraints						
Liquidity unconstr.	0.000	0.002	0.009			
Decrease in income	0.321	0.036	1.000	0.337	0.134	0.012
Liquidity constr.	0.000	0.003	0.009			
Increase in income	-0.005	0.018	0.090			
Utility function						
Habits	-0.162	0.023	1.000	-0.149	0.063	0.019
Nonsep. public	0.000	0.005	0.014			
Nonsep. labor	-0.123	0.026	1.000	-0.112	0.046	0.014
Interest rate	0.147	0.019	1.000	0.141	0.081	0.083
Consumption measure						
Total consumption	0.019	0.026	0.396			
Food	-0.004	0.016	0.070			
Indiv. category	0.000	0.004	0.013			
Income measure						
Outside income	-0.001	0.006	0.019			
Current income	-0.269	0.029	1.000	-0.274	0.124	0.027
Lagged income	-0.298	0.036	1.000	-0.316	0.077	0.000
GDP proxy	0.309	0.028	1.000	0.325	0.099	0.001
Instruments signif.	0.001	0.010	0.027			
Signif. not reported	0.010	0.023	0.220			
Consumption instr.	0.000	0.003	0.013			
Income instr.	-0.001	0.008	0.042			
Difference instr.	-0.001	0.007	0.032			
Nominal IR instr.	0.062	0.039	0.779	0.061	0.045	0.176
Inflation instr.	-0.001	0.007	0.025			
Real IR instr.	-0.112	0.021	1.000	-0.123	0.081	0.128
Other instr.	-0.003	0.011	0.070			
Specification						
Exact Euler	-0.310	0.039	1.000	-0.329	0.093	0.000
Estimated in levels	-0.020	0.029	0.381			
Second order	-0.153	0.027	1.000	-0.134	0.060	0.025
Short run	0.178	0.025	1.000	0.161	0.133	0.226
Cumulative	0.001	0.007	0.017			
Time shift	0.010	0.032	0.106			
No year dummies	0.026	0.043	0.310			
Time aggregation	0.013	0.024	0.258			
Technique						
ML	0.001	0.007	0.020			
TSLS	-0.126	0.016	1.000	-0.141	0.042	0.001
OLS	0.000	0.004	0.014			
Switching regr.	0.222	0.042	1.000	0.247	0.111	0.027
Publication						
Publication year	0.009	0.001	1.000	0.011	0.005	0.024
Citations	0.034	0.011	0.983	0.028	0.021	0.190
Top journal	0.093	0.030	0.978	0.096	0.042	0.022
Journal impact	-0.022	0.020	0.612	-0.038	0.025	0.132
Constant	-0.005	NA	1.000	0.351	0.150	0.019
Observations	3,127			3,127		

Notes: Weighted by the inverse of the number of estimates reported per study. PIP = posterior inclusion probability. SD = standard deviation. In the frequentist check we include only explanatory variables with PIP > 0.5. The standard errors in the frequentist check are clustered at both the study and data set level.

3 Diagnostics of BMA

Table 5: Summary of BMA estimation, baseline specification

Mean no. regressors 19.5920	*Draws* $1 \cdot 10^8$	*Burn-ins* $5 \cdot 10^7$	*Time* 3.70969 hours
No. models visited 16, 157, 481	*Modelspace* $2.8 \cdot 10^{14}$	*Visited* $5.7 \cdot 10^{-7}\%$	*Topmodels* 81%
Corr PMP 1.0000	*No. Obs.* 3, 127	*Model Prior* uniform	*g-Prior* UIP
Shrinkage-Stats Av= 0.9997			

Notes: No weights are used. In this specification we employ the priors suggested by Eicher *et al.* (2011) based on predictive performance: the uniform model prior (each model has the same prior probability) and the unit information prior (the prior provides the same amount of information as one observation of data).

Figure 1: Model size and convergence, baseline specification

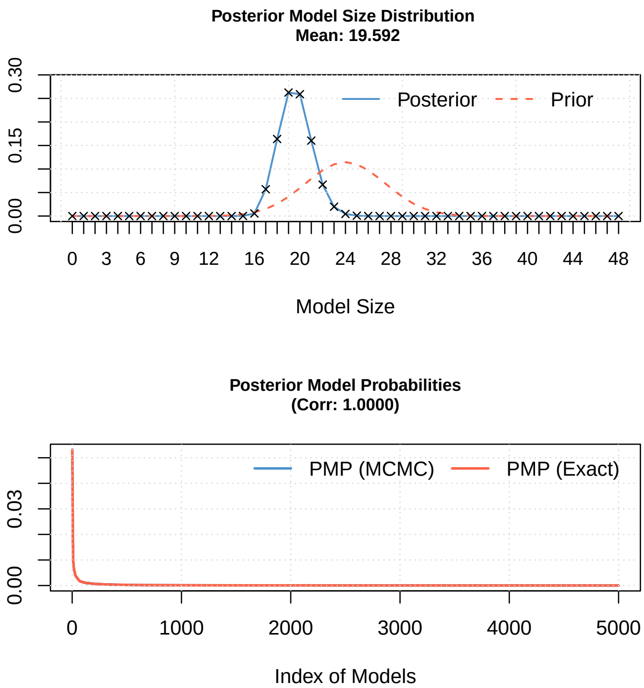


Table 6: Summary of BMA estimation, precision weights

Mean no. regressors 26.8321	*Draws* $1 \cdot 10^8$	*Burn-ins* $5 \cdot 10^7$	*Time* 2.73489 hours
No. models visited $19,363,590$	*Modelspace* $2.8 \cdot 10^{14}$	*Visited* $6.9 \cdot 10^{-6}\%$	*Topmodels* 75%
Corr PMP 0.9999	*No. Obs.* $3,127$	*Model Prior* uniform	*g-Prior* UIP
Shrinkage-Stats Av= 0.9997			

Notes: The inverse of the reported estimate's standard error is used as the weight. In this specification we employ the priors suggested by Eicher *et al.* (2011) based on predictive performance: the uniform model prior (each model has the same prior probability) and the unit information prior (the prior provides the same amount of information as one observation of data).

Figure 2: Model size and convergence, precision weights

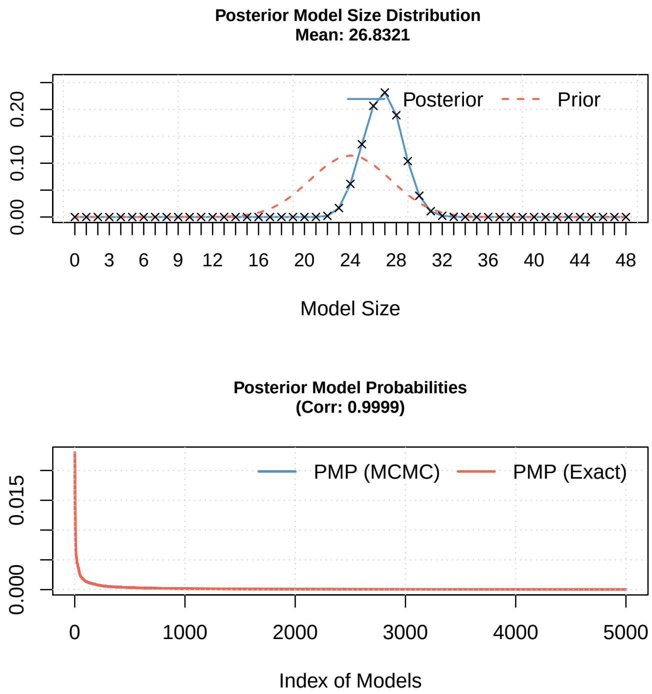
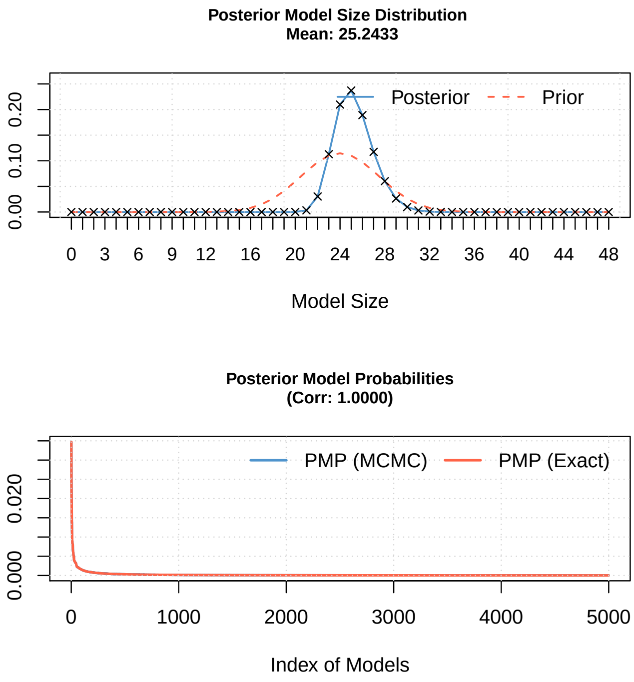


Table 7: Summary of BMA estimation, weights based on the number of estimates per study

Mean no. regressors	*Draws*	*Burn-ins*	*Time*
25.2433	$1 \cdot 10^8$	$5 \cdot 10^7$	2.790386 hours
No. models visited	*Modelspace*	*Visited*	*Topmodels*
$18,909,766$	$2.8 \cdot 10^{14}$	$6.7 \cdot 10^{-6}\%$	82%
Corr PMP	*No. Obs.*	*Model Prior*	*g-Prior*
1.0000	$3,127$	uniform	UIP
Shrinkage-Stats			
Av= 0.9997			

Notes: The inverse of the number of estimates reported per study is used as the weight. In this specification we employ the priors suggested by Eicher *et al.* (2011) based on predictive performance: the uniform model prior (each model has the same prior probability) and the unit information prior (the prior provides the same amount of information as one observation of data).

Figure 3: Model size and convergence, weights based on the number of estimates per study



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