

Elasticity of Intertemporal Substitution

A Meta-Analysis

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Why Should We Care About the Elasticity?

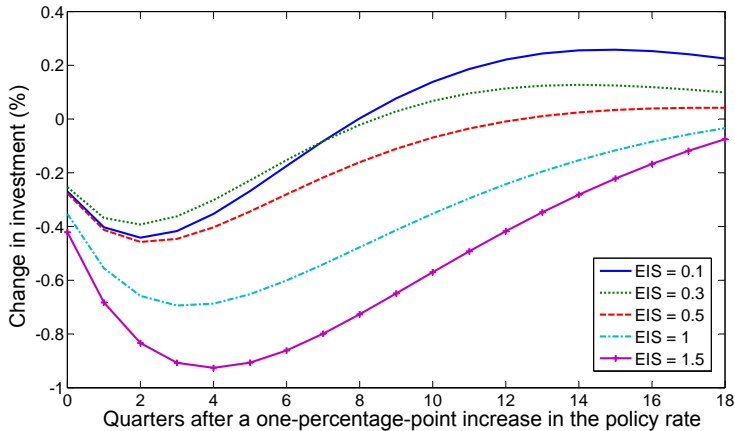
The EIS reflects households' willingness to substitute consumption between time periods in response to changes in the expected real interest rate.

$$u(c) = \frac{c^{1-\frac{1}{EIS}} - 1}{1 - \frac{1}{EIS}}; \quad \text{if } EIS = 1 \Rightarrow u(c) = \log c.$$

Crucial in models involving intertemporal choice:

- monetary policy,
- fiscal policy,
- portfolio choice,
- computing the social cost of carbon emissions, and more.

The Elasticity Matters.



Calibrations Vary.

Study	EIS	Outlet
House & Shapiro (2006)	0.2	American Economic Review
Piazzesi et al. (2007)	0.2	Journal of Financial Economics
Chari et al. (2003)	0.2	Review of Economic Studies
Trabandt & Uhlig (2011)	0.5	Journal of Monetary Economics
Jin (2012)	0.5	American Economic Review
Rudebusch & Swanson (2012)	0.5	American Economic Journal: Macro
Smets & Wouters (2007)	2/3	American Economic Review
Bansal & Yaron (2004)	1.5	Journal of Finance
Ai (2010)	2	Journal of Finance
Barro (2009)	2	American Economic Review
Colacito & Croce (2011)	2	Journal of Political Economy

Different Justifications

Study	EIS	Explanation
House & Shapiro (2006)	0.2	p. 1837: “Our calibration is roughly the average estimate in Hall (1988), Campbell and Mankiw (1989), and Barsky et al. (1997).”
Trabandt & Uhlig (2011)	0.5	p. 311: “For the intertemporal elasticity of substitution, a general consensus is followed for it to be close to 0.5.”
Smets & Wouters (2007)	2/3	p. 593: “These are all quite standard calibrations.”
Barro (2009)	2	p. 252: “Because of the shortcomings of the macroeconomic estimates, it is worthwhile to consider microeconomic evidence. The Gruber (2006) analysis is particularly attractive (...).”

Call for a Meta-Analysis

Empirical studies produce very different estimates of the EIS.

Browning & Lusardi (1996, p. 1833):

- “It is frustrating in the extreme that we have very little idea of what gives rise to the different findings.”
- “We still await a study which traces all of the sources of differences in conclusions to sample period; sample selection; functional form; variable definition; demographic controls; econometric technique; stochastic specification; instrument definition; etc.”

Estimating the Elasticity

Researchers usually follow Hall (1988) and use the log-linearized consumption Euler equation:

$$\Delta c_{t+1} = \alpha_i + EIS \cdot r_{i,t+1} + \epsilon_{i,t+1}.$$

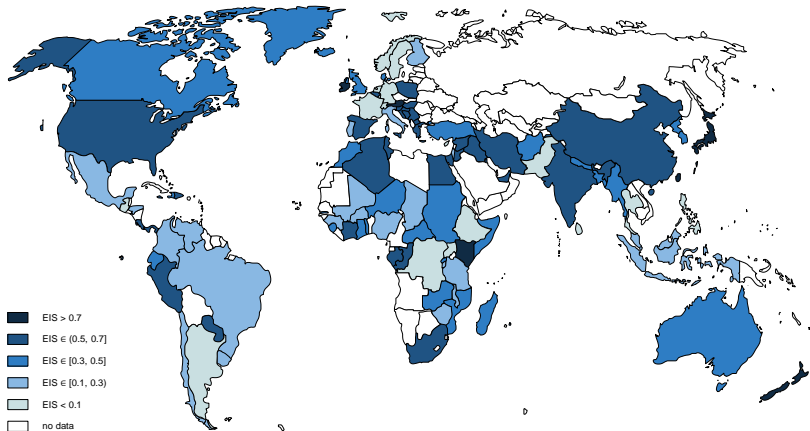
- Δc_{t+1} is consumption growth at time $t + 1$
- $r_{i,t+1}$ is the real return on asset i at time $t + 1$

Instruments for $r_{i,t+1}$ typically include the values of asset returns and consumption growth known at time t .

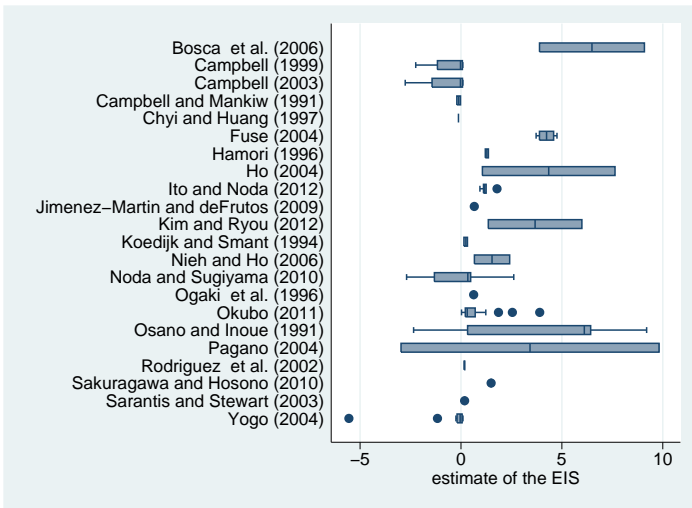
Data Collection

- I find 169 published studies that report estimates of the EIS.
- These studies provide in total 2735 estimates.
- I collect all estimates, their standard errors, and 30 aspects of methodology.
- **The average is 0.5** (0.8 for micro estimates; 0.9 for studies published in top journals).

The Elasticity Varies Across Countries.



The Elasticity Varies Across Methods.



Variables Coded (1)

Utility

Epstein-Zin	=1 if the estimation differentiates between the EIS and the coefficient of relative risk aversion.
Habits	=1 if habits in consumption are assumed.
Nonsep. durables	=1 if the model allows for nonseparability between durables and nondurables.
Nonsep. public	=1 if the model allows for nonseparability between private and public consumption.
Nonsep. tradables	=1 if the model allows for nonseparability between tradables and nontradables.

Data

No. of households	The logarithm of the number of cross-sectional units used in the estimation (households, cohorts, countries).
No. of years	The logarithm of the number of years of the data period used in the estimation.
Average year	The logarithm of the average year of the data period.
Micro data	=1 if the coefficient comes from a micro-level estimation.
Annual data	=1 if the data frequency is annual.
Monthly data	=1 if the data frequency is monthly.

Variables Coded (2)

Design

Quasipanel	=1 if quasipanel (synthetic cohort) data are used.
Inverse estimation	=1 if the rate of return is the dependent variable in the estimation.
Asset holders	=1 if the estimate is related to the rich or asset holders.
First lag instrument	=1 if the first lags of variables are included among instruments.
No year dummies	=1 if year dummies are omitted in micro studies using the Panel Study of Income Dynamics.
Income	=1 if income is included in the specification.
Taste shifters	The logarithm of the number of controls for taste shifters.

Variable definition

Total consumption	=1 if total consumption is used in the estimation.
Food	=1 if food is used as a proxy for nondurables.
Stock return	=1 if the rate of return is measured as stock return.
Capital return	=1 if the rate of return is measured as the return on capital.

Variables Coded (3)

Estimation

Exact Euler	=1 if the exact Euler equation is estimated.
ML	=1 if maximum likelihood methods are used for estimation.
TSLS	=1 if two-stage least squares are used for estimation.
OLS	=1 if ordinary least squares are used for estimation.

Publication

SE	The reported standard error of the estimate of the EIS.
Publication year	The logarithm of the year of publication of the study.
Citations	The logarithm of the number of per-year citations of the study in Google Scholar.
Top journal	=1 if the study was published in one of the top five journals in economics.
Impact	The recursive RePEc impact factor of the outlet.

Estimates Are Correlated with Standard Errors.

Funnel asymmetry test:

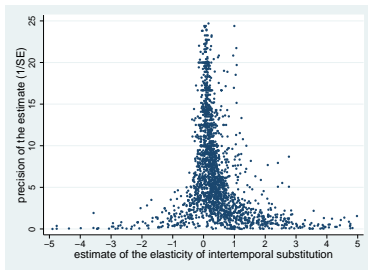
$$EIS_i = \underbrace{\beta}_{\text{true effect}} + \underbrace{\beta_0 SE_i}_{\text{publication bias}}$$

	FE	BE	Median	IV	Micro	Top	Country
SE	2.115*** (0.205)	3.020*** (0.573)	2.719*** (0.397)	1.659* (0.850)	1.496** (0.717)	1.466* (0.825)	2.117*** (0.216)
Constant	0.0145 (0.00881)	0.0303*** (0.00656)	0.0322*** (0.00893)	0.0340 (0.0363)	0.174*** (0.0554)	0.171* (0.0887)	0.0144 (0.00928)
Observations	2,735	2,735	2,735	2,735	512	566	2,735
Studies	169	169	169	169	42	33	169

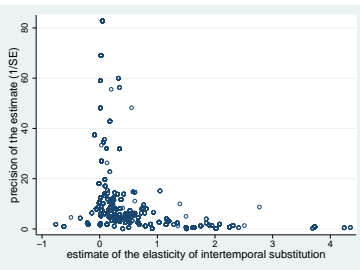
Negative Estimates Are Underreported.

Negative estimates are published less often than positive estimates with the same precision.

(a) All estimates



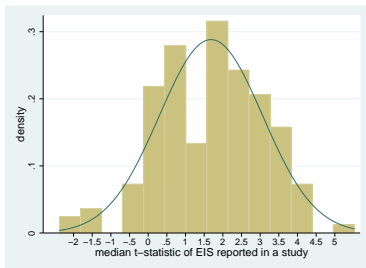
(b) Median estimates



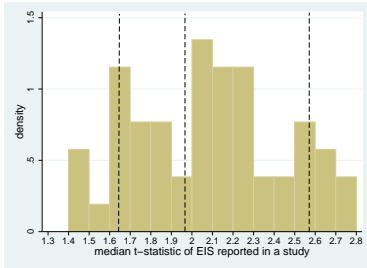
Marginally Insignificant Estimates Are Underreported.

The probability of reporting increases when the estimate gets another significance star.

(c) Median t-statistics



(d) Median t-statistics around $t = 2$



Some Alleged Mistakes in Measurement

- first lags as instruments (time aggregation)
- food as proxy for nondurables (nonseparability)
- omission of time dummies in micro studies (identification would come from time-series variation correlated with consumption)
- assumption of separability between durables and nondurables (nonseparability)
- use of aggregated data (omitted demographic variables)
- log-linearization (endogeneity of higher-order terms)
- use of the rate of return as the dependent variable (weak instruments)
- including non-asset holders (Euler eq. not valid)

Micro Estimates Are Larger than Macro Estimates.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SE	2.465*** (0.394)	1.926*** (0.251)	1.864*** (0.243)	2.109*** (0.268)	1.975*** (0.261)	1.961*** (0.262)	1.809*** (0.248)
Micro data	0.200*** (0.0250)	0.209*** (0.0308)	0.269*** (0.0495)	0.350*** (0.0986)	0.476*** (0.0854)	0.502*** (0.0865)	0.430*** (0.106)
Asset holders	0.136*** (0.0303)	0.174*** (0.0365)	0.195*** (0.0626)	0.189*** (0.0565)	0.228*** (0.0482)	0.236*** (0.0460)	0.316*** (0.0586)
Constant	0.0237** (0.0109)	0.00512 (0.00322)	-27.52 (21.42)	-37.61* (21.97)	-26.33 (18.44)	-32.58 (22.45)	-43.89 (43.05)
Utility		Included	Included	Included	Included	Included	Included
Data			Included	Included	Included	Included	Included
Design				Included	Included	Included	Included
Variable def.					Included	Included	Included
Estimation						Included	Included
Publication							Included

So How Should One Calibrate the EIS?

Best-practice estimate

I compute a mean estimate conditional on a huge data set, best possible publication characteristics, and lack of major mistakes in measurement.

- Plugging the values to the estimated meta-regression yields $EIS = 1/3$.
- The upper confidence bound is $0.8 \Rightarrow$ calibration of the EIS larger than 0.8 is not consistent with the bulk of the empirical evidence.

Summary

Main Findings

- 1 People often discard negative or insignificant estimates of the EIS, which drastically biases the mean published estimate upwards.
- 2 Rule of thumb: use $EIS = 1/3$ for calibrations.
- 3 But: EIS varies a lot across countries.

Project Website

www.meta-analysis.cz

For Further Reading

-  Stanley, T. D. & C. Doucouliagos (2012): *Meta-Regression Analysis in Economics and Business*.
Routledge, 1st. edition.
-  Havranek, T. (2015): *Measuring Intertemporal Substitution: The Importance of Method Choices and Selective Reporting*.
Journal of the European Economic Association, in press.
-  Havranek, T., R. Horvath, Z. Irsova, & M. Rusnak (2015): *Cross-Country Heterogeneity in Intertemporal Substitution*.
Journal of International Economics: **96(1)**: pp. 100–118.

Reading list on RePEc: Google “meta-analysis in economics.”