What Can We Learn from Benefit Transfer Errors? Evidence from 20 Years of Research on Convergent Validity

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Motivation

- U.S. Presidential Executive Order 12866 (1993) requires federal agencies to design ***"cost-effective"*** regulations, and assess ***"costs and benefits"*** based ***"on the best reasonably obtainable scientific, technical, economic, and other information."***
- The most common valuation method used to compute benefits and costs of environmental RIAs is a benefit transfer (U.S. EPA, 2010).
- An existing value estimate (or estimates) is transferred to a new policy application.

Benefit Transfer Validity Discussed for Two Decades

- **Benefit Transfers became a topic of academic interest in 1992 with a special issue of *Water Resources Research*.**
- **In 2005 U.S. EPA sponsored *"a forum for informed discussion regarding the practice of benefits transfer …"* Presenters were from Australia, Canada, France Spain, Singapore, United Kingdom and United States.**
- **In 2006 *Ecological Economics* published a special issue on benefit transfer.**

Validity of Benefit Transfer

- Tests of convergent validity:
  - Function transfers more accurate than value transfers (Kirchhoff, Colby and LaFrance, 1997)
  - Similar study and policy cases (Johnston, 2007)
- Still no overall consensus in the literature:

  "The size, complexity and relative disorganization of the literature may represent an obstacle to the use of updated methods by practitioners" Johnston and Rosenberger (2009).

Objectives

- Identify benefit-transfer practices that enhance or diminish the accuracy of benefit transfers using meta-analysis
- Review all benefit transfer validity studies conducted over the past 20 years
- Estimate meta-regression
  - Manski's (2007) "*bottom-up*" approach
  - Non-parametric regression - *robust*
  - Parametric regression – *specific predictions*

Conceptual Framework

- **Willingness to pay for improved quality:**

$$V_{ij}\left(p_j, x_j, q_j^1, M_i - wtp_{ij}; \alpha_i, d_i\right) = V_{ij}\left(p_j, x_j, q_j^0, M_i; \alpha_i, d_i\right)$$

- **Benefit transfer error:**

$$BTE = \hat{wtp}_{i,j}^{t} - \hat{wtp}_{i,j}^{p}$$

Study case "*t*"	**Policy case "*p*"**
Transferred value	**Original value**

Convergent Validity Error

- **Accuracy measurements:**

$$|\%\ \text{Transfer error}| = \left|\left(\frac{\hat{\text{wtp}}^{t}}{\hat{\text{wtp}}^{p}} - 1\right) \times 100\right|$$

- **Meta-analysis equation:**

$$y = m(x) + \varepsilon$$

y – |%Transfer Error|

x – Benefit-transfer variables (*q, α, d, v, t*)

Non-Parametric Analysis

- **Ouyang, Li and Racine (2009) - NP estimator for discrete regressors:**

$$\hat{f}(x) = \frac{\sum_{i=1}^{n} Y_i L(X_i, x, \lambda)}{\sum_{i=1}^{n} L(X_i, x, \lambda)}$$

L is the product kernel and λ are the bandwidths associated with regressors.

Parametric Analysis

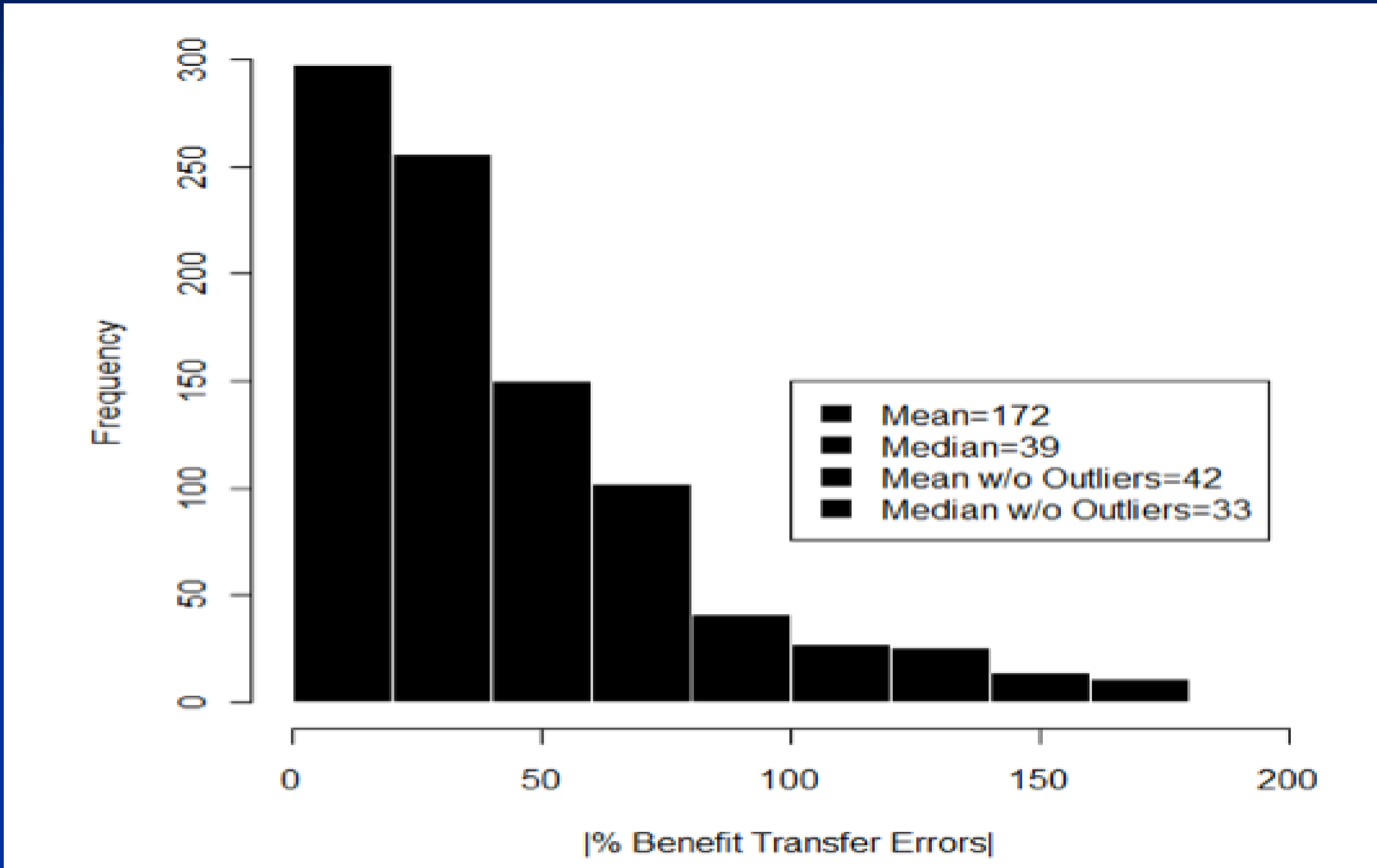
- **WLS – k_i where i=1,2,…,31 and is the number of observations from study i**
- **Outliers in *%TE* detected using Inter Quartile Range criterion**
- **IQR - x is an outlier if:**

$$Q_1 - 1.5 \times IQR > x > Q_3 + 1.5 \times IQR$$

Data

- Identified 40 BT validity studies (1990 – 2009).
  - 9 studies were excluded
  - non- peer reviewed (2), duplicate (1), could not code data (1), hedonic model (1), hedonic and could not code data (1), and missing data (3)
- Uniform protocol for coding BTE and modeling decisions. Coding by undergraduate and graduate research assistants
- Excluded flip error calculations
- N = 1071 N (w/out outliers) = 925

Distribution w/o Outliers



Outliers = 14%

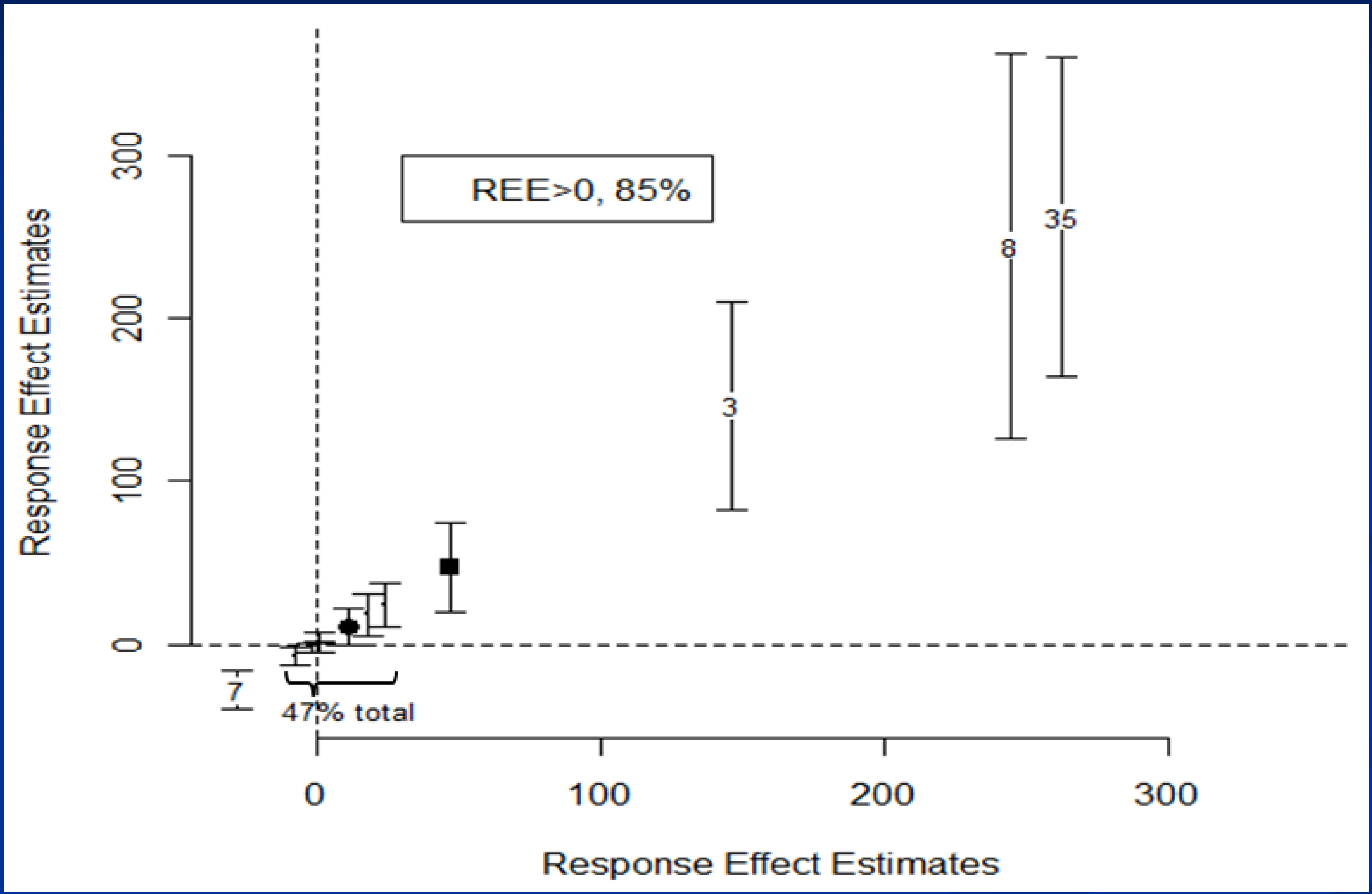
Independent Variables

	Variable	*Mean*
q variables	Policy Change	0.24
	Quality Change	0.51
	Use Value	0.66
d variables	Population	0.09
	Study Area	0.18
v variables	META (omitted)	0.17
	RUM	0.11
	TC	0.12
	CV	0.29
	CM	0.31
t variables	Value Transfer	0.38
	Multiple Study	0.27
	Mean Value	0.15

NP & Parametric Results

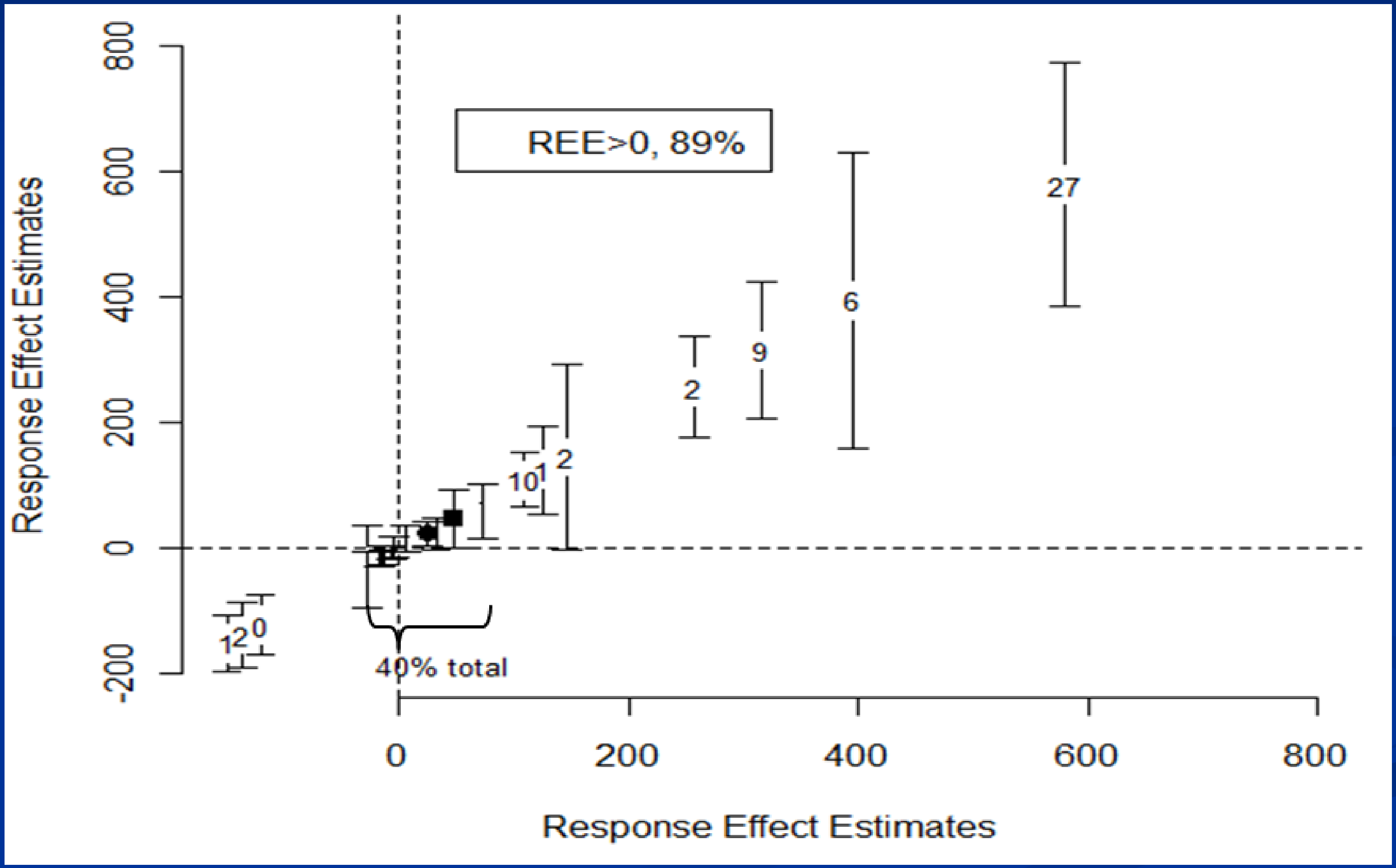
	Band Width w/o Outliers	NP Mean	WLS w/o Outliers
Intercept	NA	NA	74.5
Policy Change (-)	0.11	258.5	-3.19
Quality Change (+)	0.00	233.2	24.50
Use Value (-)	1.00	0.0	9.93
Population (-)	0.96	-0.1	19.80
Study Area (-)	0.05	62.1	-11.45
RUM (?)	1.00	0.0	-56.05
TC (?)	0.00	13.5	-74.05
CV (?)	0.95	-0.4	-66.97
CM (?)	0.04	220.5	-26.35
Value Transfer (+)	0.34	115.3	11.21
Multiple Study (-)	0.01	-0.7	-13.28
Mean Value (0)	0.02	0.9	-10.61

Response Effect Estimates Value Transfer



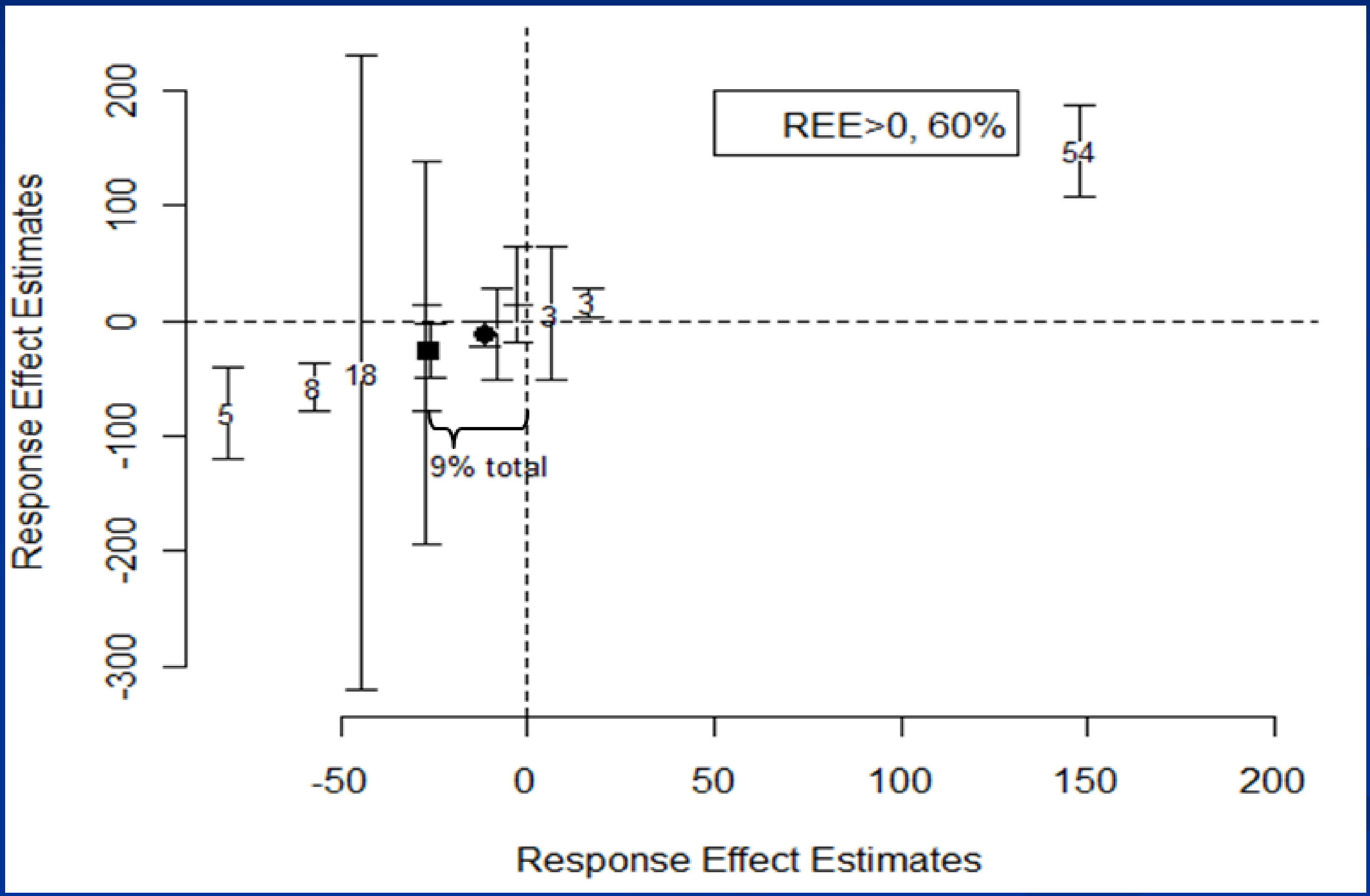
- ■ WLS w Outliers
- ● WLS w/o Outliers

QualityΔ



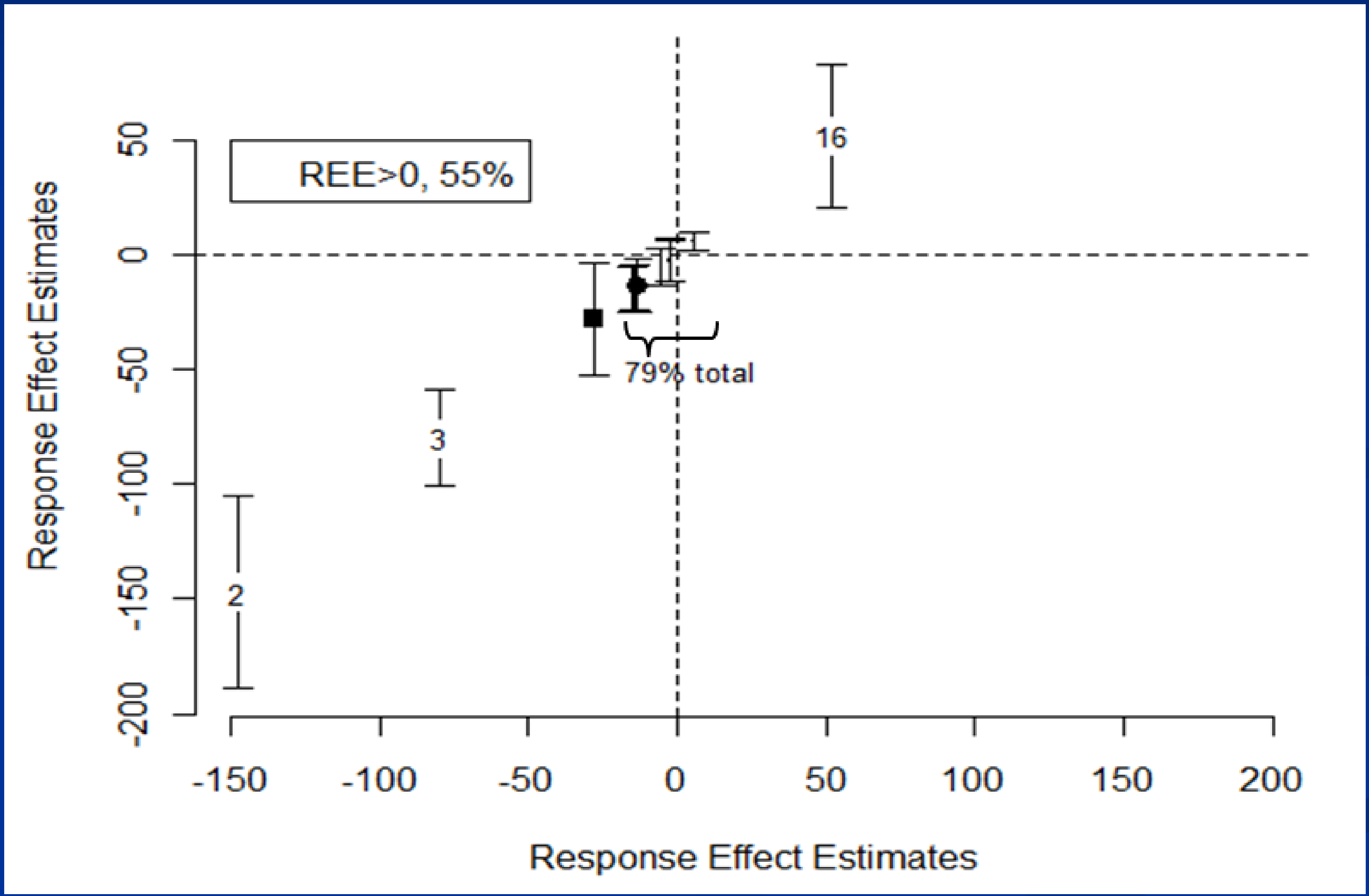
REE>0, 89%
27
6
9
2
2
10
1
1
2
0
40% total
800
600
400
200
0
-200
0
200
400
600
800
Response Effect Estimates
Response Effect Estimates

Study Area



REE>0, 60%
54
5
8
18
3
3
9% total
Response Effect Estimates
200
100
0
-100
-200
-300
-50
0
50
100
150
200
Response Effect Estimates

Multiple Study



Conclusions

- ***Existing stylized facts:***
  - **Function transfers outperform value transfers**
  - **Geographical similarity improves accuracy of value transfers**
- ***New stylized facts:***
  - **Quality changes less accurate than quantity changes**
  - **Data from multiple studies improves function transfers**
- ***Novel approach to Meta-analysis***
  - **parametric point estimates desirable but investigate robustness using NP methodology**

Comparisons

- *Comparisons to stated-preference errors:*

	Stated Preferences (Murphy et al., 2005)	Benefit Transfer	Benefit Transfers w/out outliers
Median	35%	39%	33%
Mean	160%	172%	42%
Maximum	240%	7496%	172%

- *Comparison to market data errors:*
  - **Single price change, Marshallian elasticities - error is 3% for compensating variation and 32 % for deadweight loss (Hausman, 1981).**
  - **Average commercial real estate appraisal error is 11% (90% → 0-25%) (Fisher, Miles and Webb, 1999).**

Benefit transfers are not as challenging as trying to make a silk purse from a sow's ear, but there is still room for much improvement in methodological procedures and documentation to support benefit-cost calculations.

Future BT Validity Studies

- Credibility of future BTs – Data Validation!!
- Documentation protocol
  - Transfer procedures
  - Criteria for selecting policy and study cases
  - Uniform standard for reporting errors
- Beyond reporting errors – investigate why some errors are so large?

Transfers of Economic Information are Common Practice

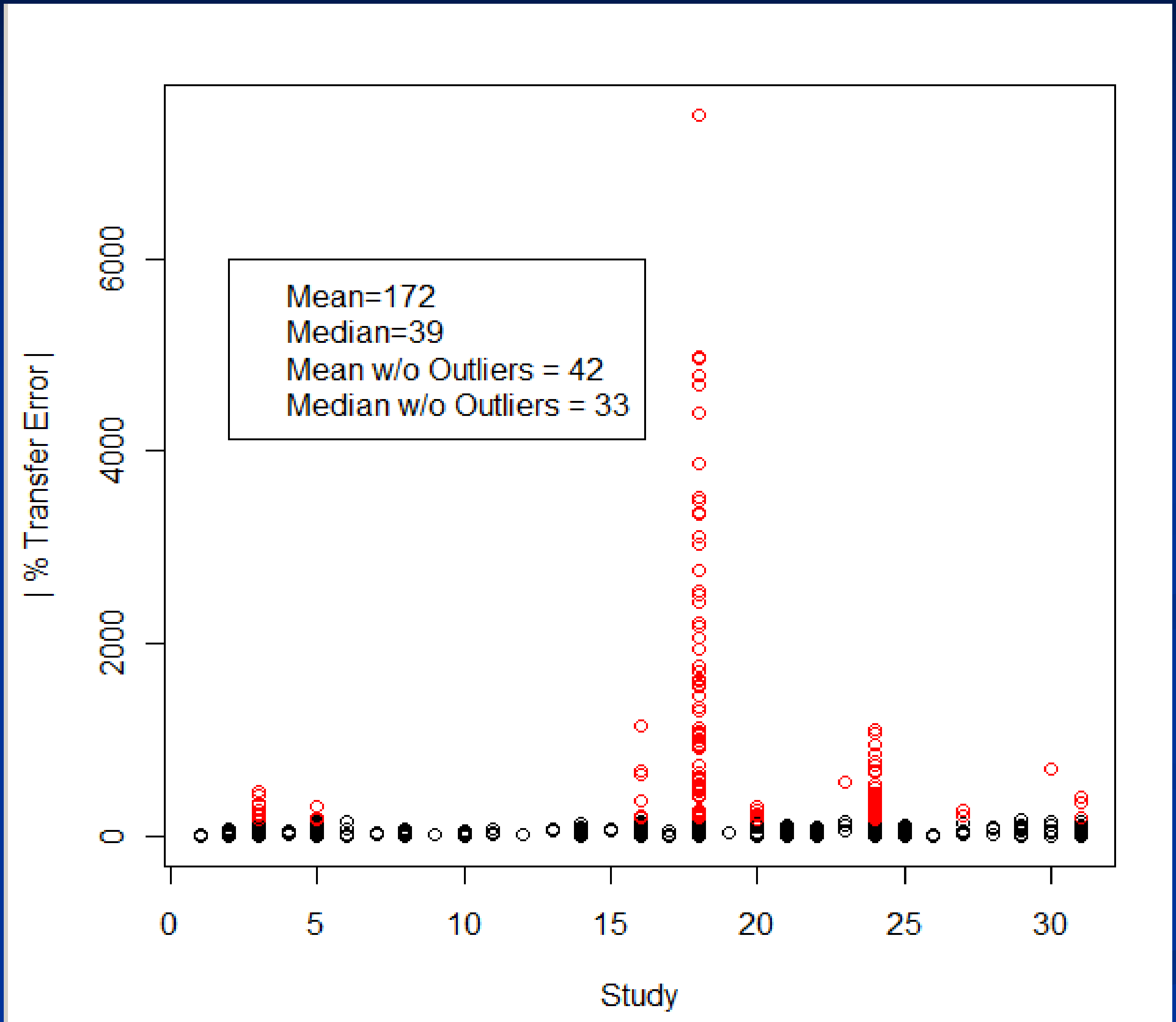
- Hines (1999) notes that "… to quantify the economic costs of (taxes, regulations, externalities, monopolistic practices, etc.) … it is standard practice – and has been since the 1960s – to use a small number of assumptions and selected elasticities to estimate areas of the relevant 'Harberger triangles'" (p. 167).
- The Economic Report of the President (2009) includes net benefits of federal policies to improve air quality based on benefit-transfer estimates (e.g., U.S. EPA, 2005, p. 4-48, Table 4-11).

U.S. EPA *Guidelines for Preparing Economic Analyses* (2010)

- Study case(s) → Policy Case
- Steps:
  - Describe the policy case,
  - Select study cases,
  - Transfer values, and
  - Report the results.
- Implementation:
  - Direct value transfer, or
  - Function transfer.

How Accurate are Benefit Transfers? … but more, what can we learn?

Outliers



146 outliers detected using IQR criterion.

Nonparametric Results

	Band Width	NP Mean
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