

Bidding Behavior given Point and Interval Values in a Second-price Auction

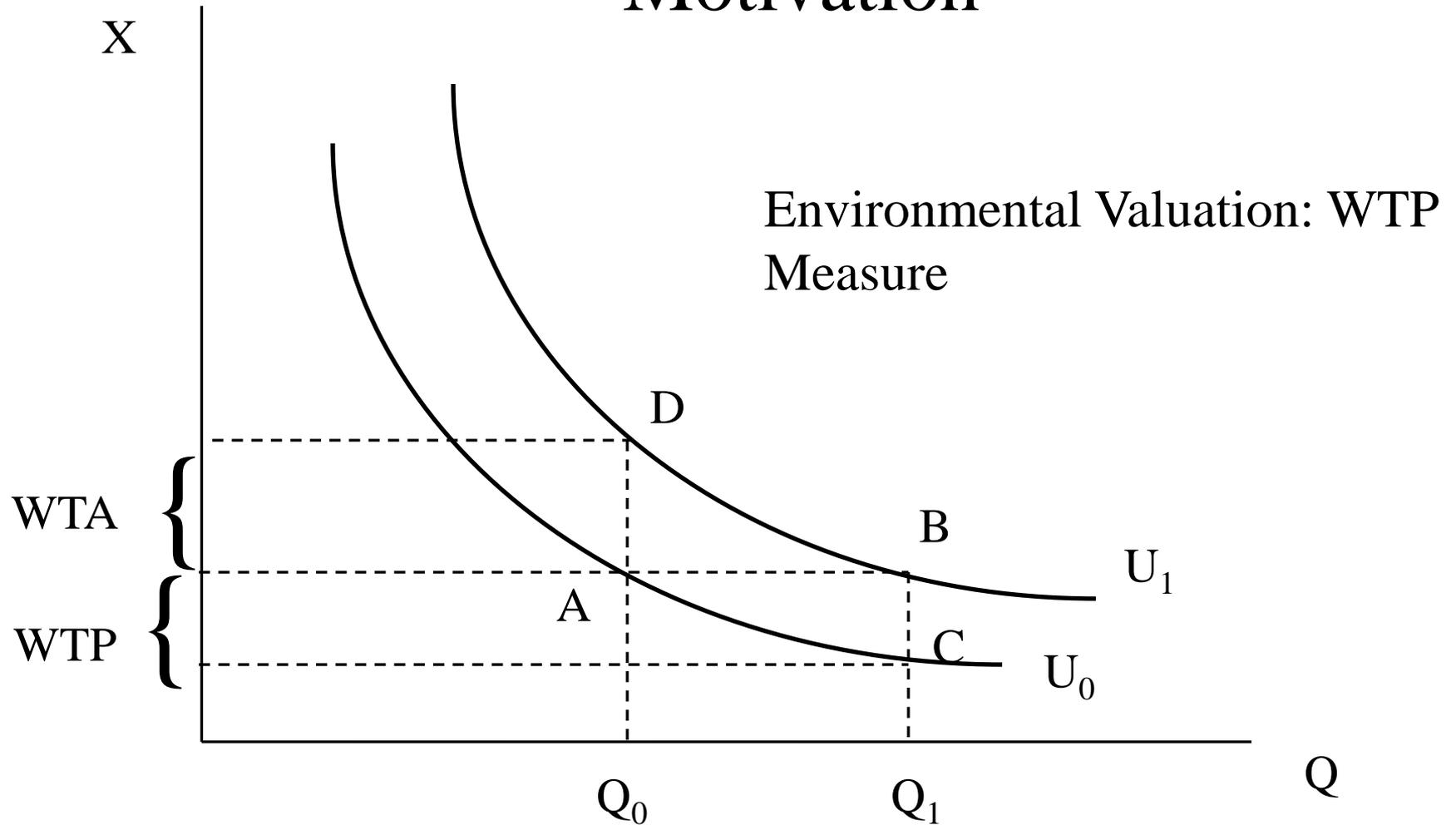
Prasenjit Banerjee and Jason F. Shogren

International Workshop on Mechanism Design and the Environment
Edinburgh
9 May 2013

Open Question

Is it incentive compatible to elicit preference in a point given value uncertainty (or, interval values)

Motivation



Rational choice theory: a **point** estimate of WTP for a good/ service (Marshall, 1890; Ciriacy-Wantrup, 1947; Bateman and Willis, 1999)

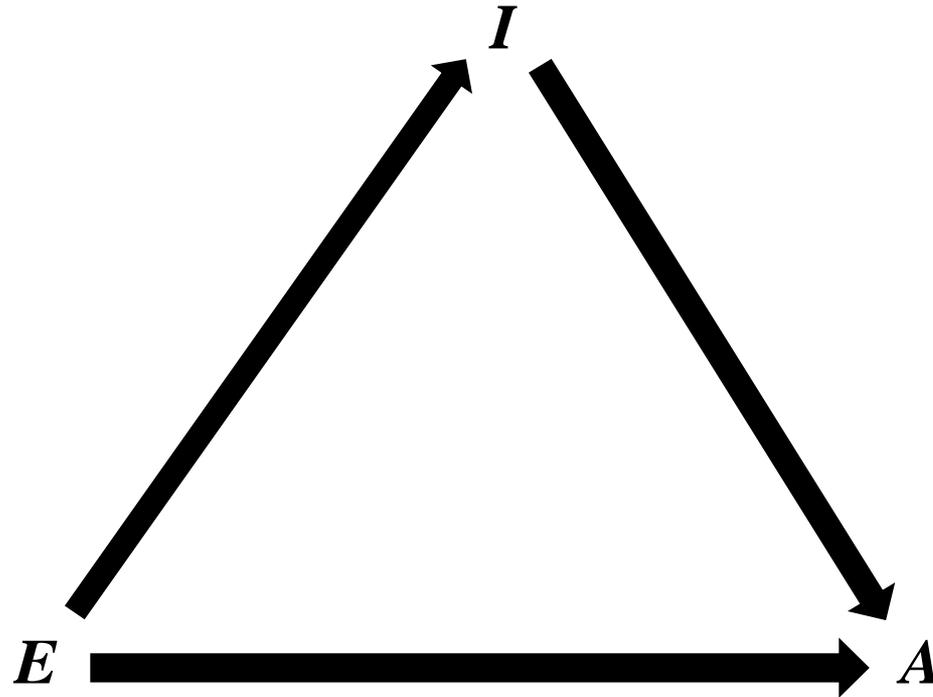
Motivation

- **Coherent arbitrariness:** consumers' absolute valuation is arbitrary, and consumers' *relative* valuations of different amounts of the good appear orderly
 - a **range** of acceptable WTP values
 - an elicited point estimate **biased** to anchoring on arbitrary cue (Ariely et al., 2003; Kahneman and Sugden, 2005; Manski and Molinari, 2010)
 - possible to map value uncertainty into a point estimate of expected WTP ?

Motivation

- anticipated satisfaction from a good hard to capture (Marshall, 1890; Pigou, 1903)
- individuals have interval values in mind, but round it up in one single value while reporting WTP (Manski and Molinari, 2010; Belyeav and Kristrom, 2010)
- unknown “anchors” may be used guide us to value the good in such instances (Kahneman and Sugden ,2005)
- CVM adapting to the value uncertainty—fuzzy number approach to represent the vagueness of preference (Kooten, Kckmar, and Bulte, 2001); or adding a random number in the utility function (Haneman and Kristrom, 1995); multiple bounded a discrete choice questionnaire format (see, e.g., Welsh and Poe, 1998, Broberg and Brannlund, 2008), and so on.
- Empirical validity of these two polar viewpoints – people **prefer** to express WTP in **interval** (Hanley et al., 2009)

Design



Lab experiment to control for preferences using an induced value design for sincere bidding by using Vickrey second-price auction

Vickrey Second-price Auction (Vickrey, 1961)

- Bidders has a private value for a good and submit bid to buy it
- Private values independently drawn from a uniform distribution
- Rank bids from highest to lowest and
- Highest bidder buys the good and pays market price (i.e., 2nd highest bid)
- Profit = value – market price
- Dominant strategy: bid private value (Milgrom and Weber 1982)
 - since overbidding risks paying too much and underbidding risks missing out on a profitable opportunity

Treatments

BID

POINT

INTERVAL

VALUE

POINT

(POINT, POINT)

(POINT,
INTERVAL)

INTERVAL

(INTERVAL,
POINT)

(INTERVAL,
INTERVAL)

	POINT	(POINT, POINT)	(POINT, INTERVAL)
INTERVAL		(INTERVAL, POINT)	(INTERVAL, INTERVAL)

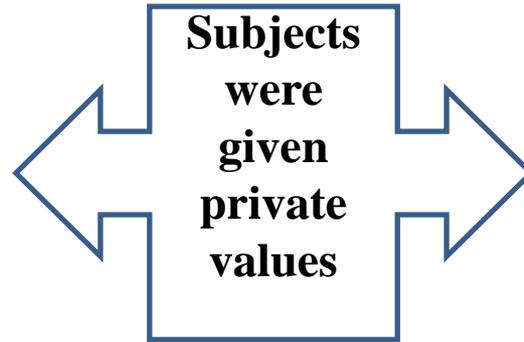
- 70 UW undergrad & grad students participated in 7 sessions of auction
- Monitor read instruction; bidders answered a quiz and no verbal communication
- \$5 for participation
- Each treatment: 2 sessions with 10 bidders/session (except treat 0)
- Bidders played 10 rounds in each session and 5 practice rounds.
- Each round, one hypothetical good was in auction
- Given private values, bidders submitted bid in a sealed envelope simultaneously
- Highest bidder won & paid 2nd highest bid and experimenter bought back the good. Payoff: difference between the private value and 2nd highest bid
- Next round, different values from a uniform distribution
- After 10 rounds, total surplus converted into monetary units and paid in cash

Research Questions

- These point versus interval results suggest three questions about preference elicitation
 - (1) How do people bid if they have a point value but are asked to state an interval bid (could be a point, e.g., \$40-\$40)?
 - (2) How do people bid if they have a value interval but are asked to state a point estimate?
 - (3) How do they bid if they have an interval value and they state an interval bid?

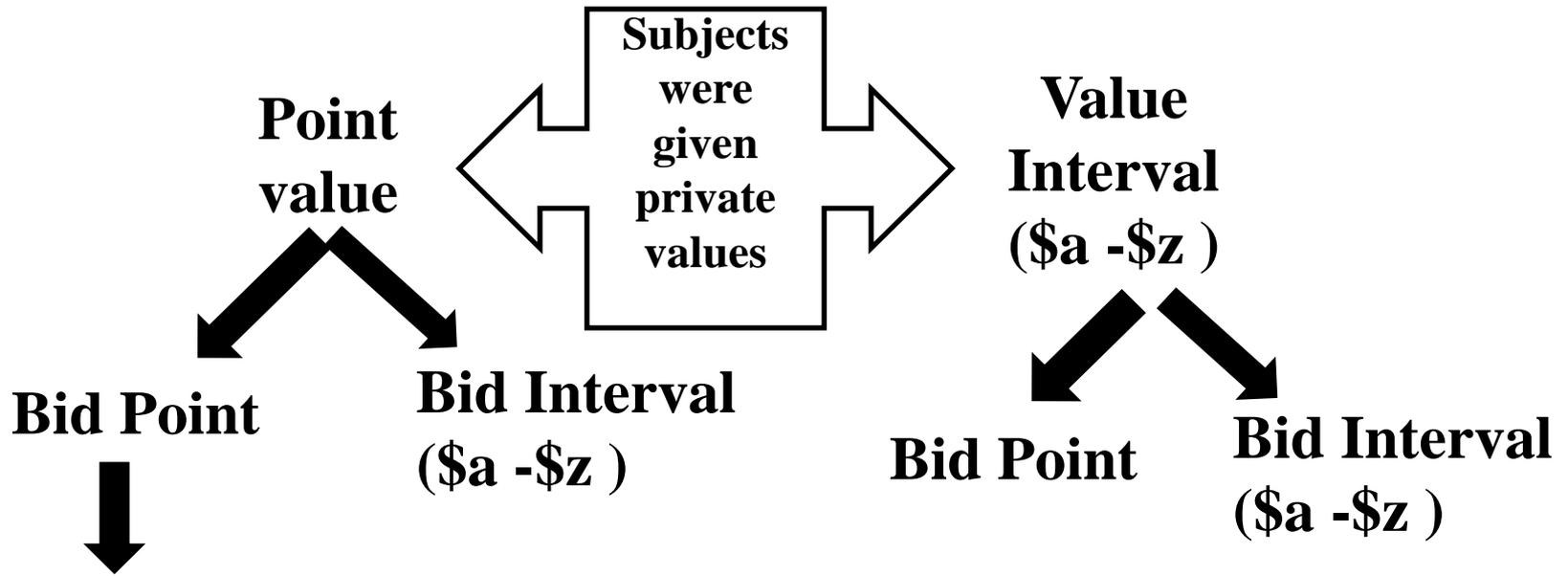
drawn from a
uniform
distribution of
[\$0.10, \$10] in
\$0.10

**Point
value**



**Value
Interval
(\$a -\$z)**

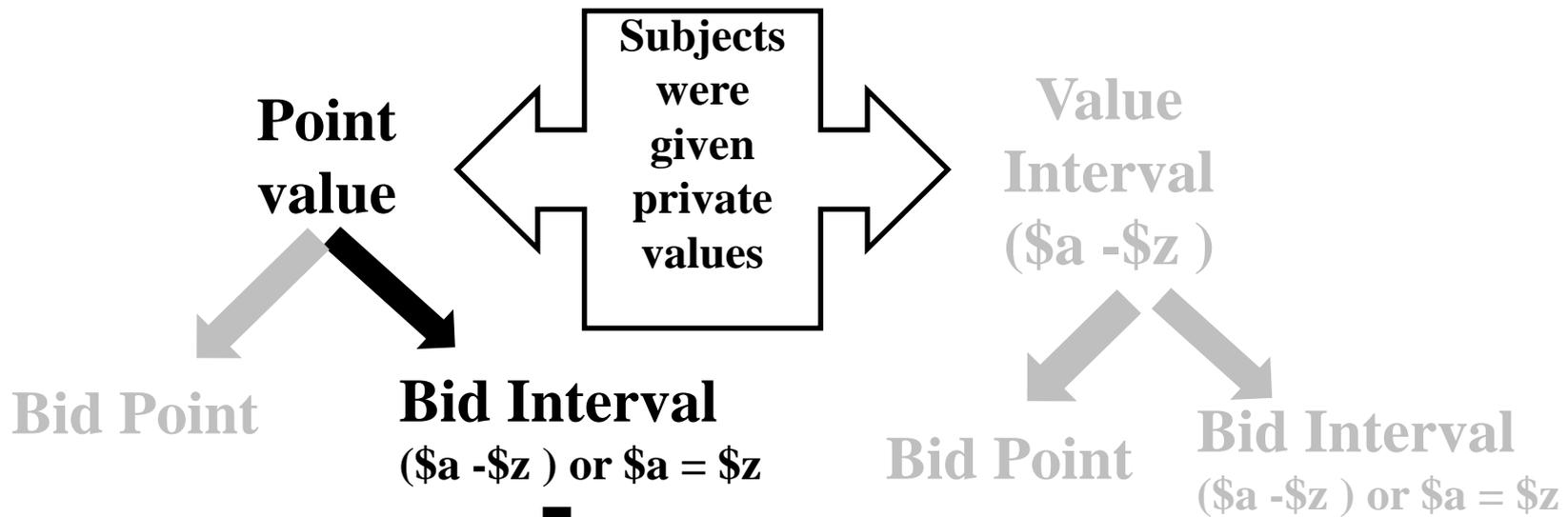
drawn from a
uniform
distribution of
[\$0.10, \$10] –
[{\$0.10, \$0.40},
....{\$7.60, \$8.40}]



Standard Vickrey Auction

Prediction: Bid the Values

Result: No surprise



**Ranked bids based on one
random drawn from interval.**

Profit = resale value – market price (or, 2nd highest bid)

**Concern: new bias by asking
interval bid when well-formed
preferences (i.e., point value)**

**Dominant strategy:
Bid the Point Value**

Result II

- Our bidders choose not to bid a point estimate
 - constructed a bid interval
 - formed interval bid by using the induced point value as the mean of the interval.

Summary Statistics

Mean Point Value	Mean Interval Bid	Interval Bid	Over Bid	Under Bid	Exact Point Bid
5.31(2.52)	5.89 (4.83)	56%	20.5%	18.5%	22.5%

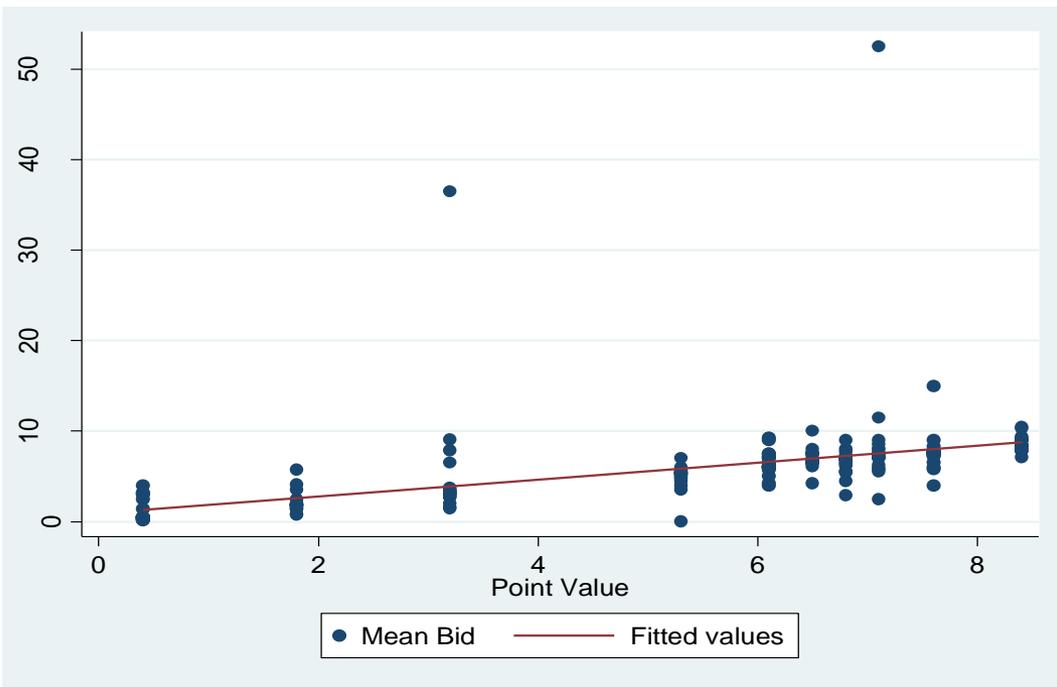
Result II (Contd.)

Difference between Lower, upper, and mean of interval bid and

point value	Lower bound Bid – Point Value	Upper bound Bid – Point Value	Mean of bid – Point Value
Mean	-0.48 (3.44)	1.64 (6.16)	0.58 (4.20)
t - statistic	-1.97	3.76	1.94

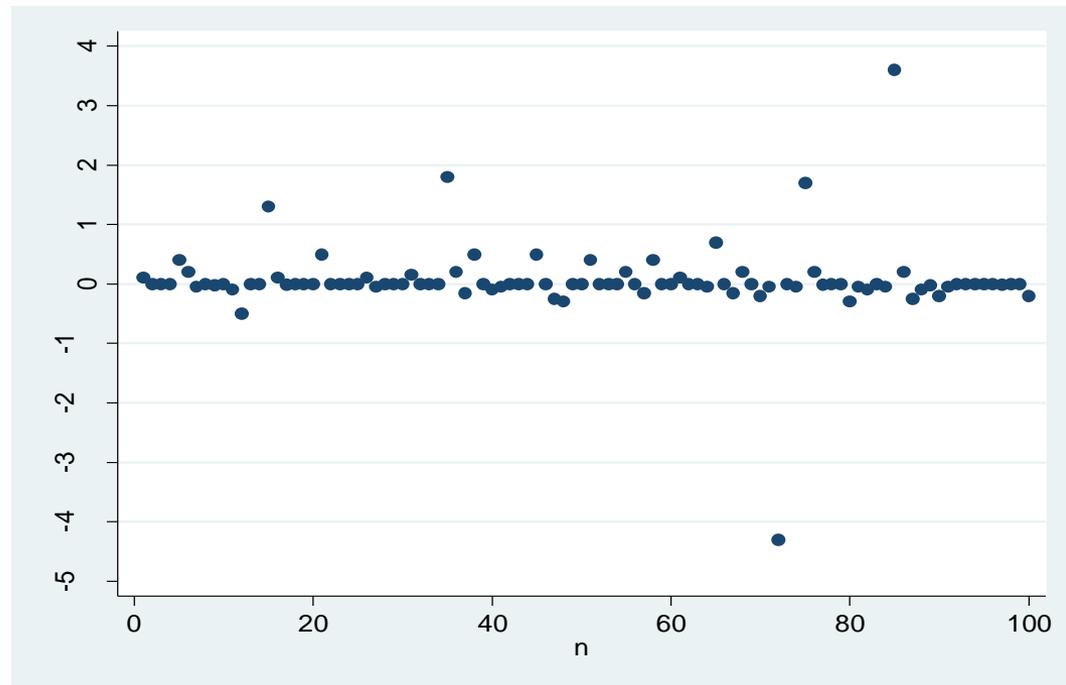
Two way Random Effect Model of Mean of Interval Bid

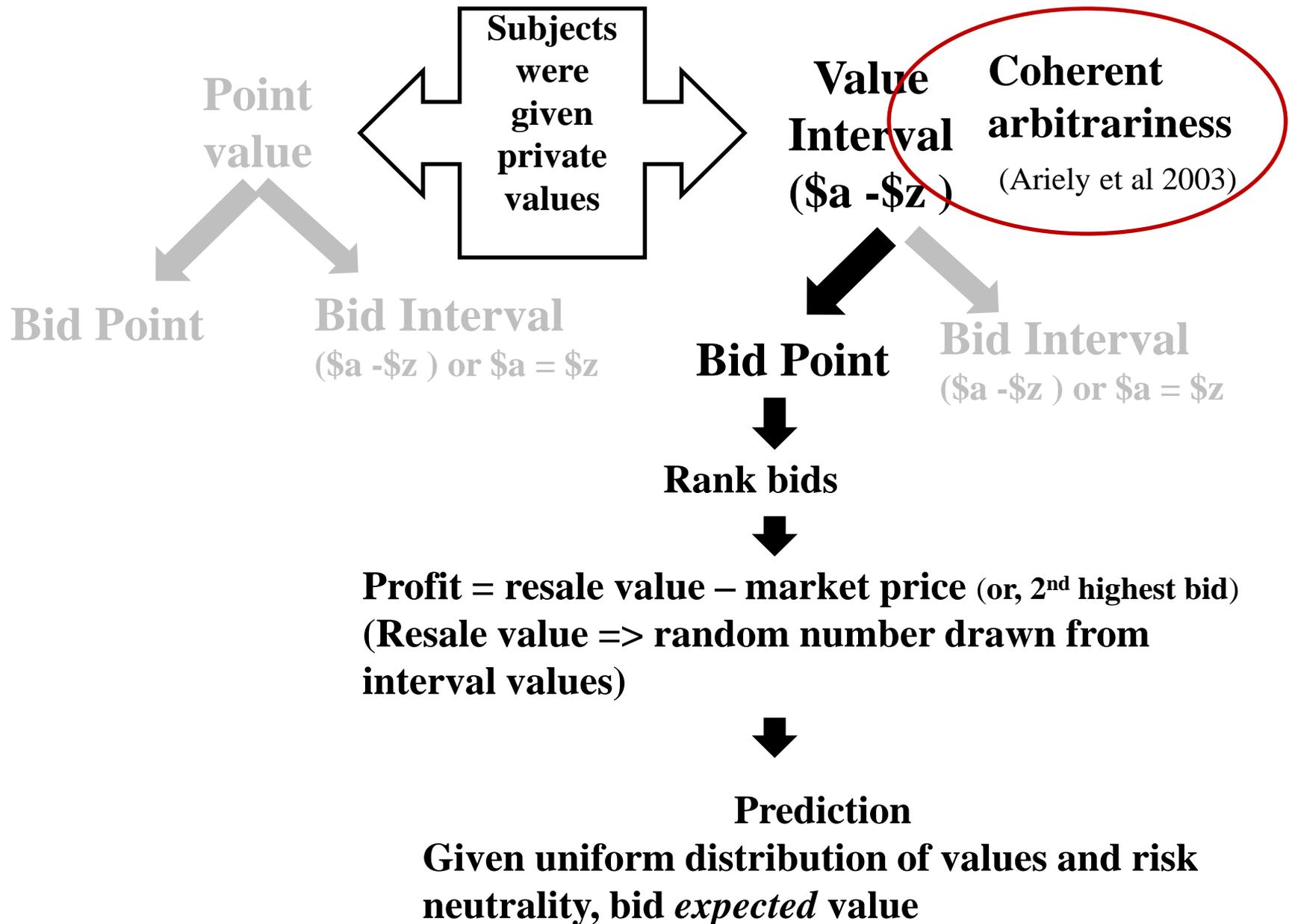
	Coefficient	Std. Error
Point Value	0.94*	0.11
Constant	0.26	0.67



Scatter Plots with an overlay of the regression line

Scatter Plots of difference between Mean of Interval Bids and Point Values





Result II

- Our results suggest bidders bid their expected value from the interval.
 - Given interval values, bidders bid expected values.

Summary Statistics

Mean Interval Value	Mean Point Bid	Over Bid	Under Bid	Exact Point Bid (= expected value)
4.90 (2.60)	5.04 (2.99)	19.5%	13%	67.5%

Note: 48% of bids within \$0.05 of mean interval values

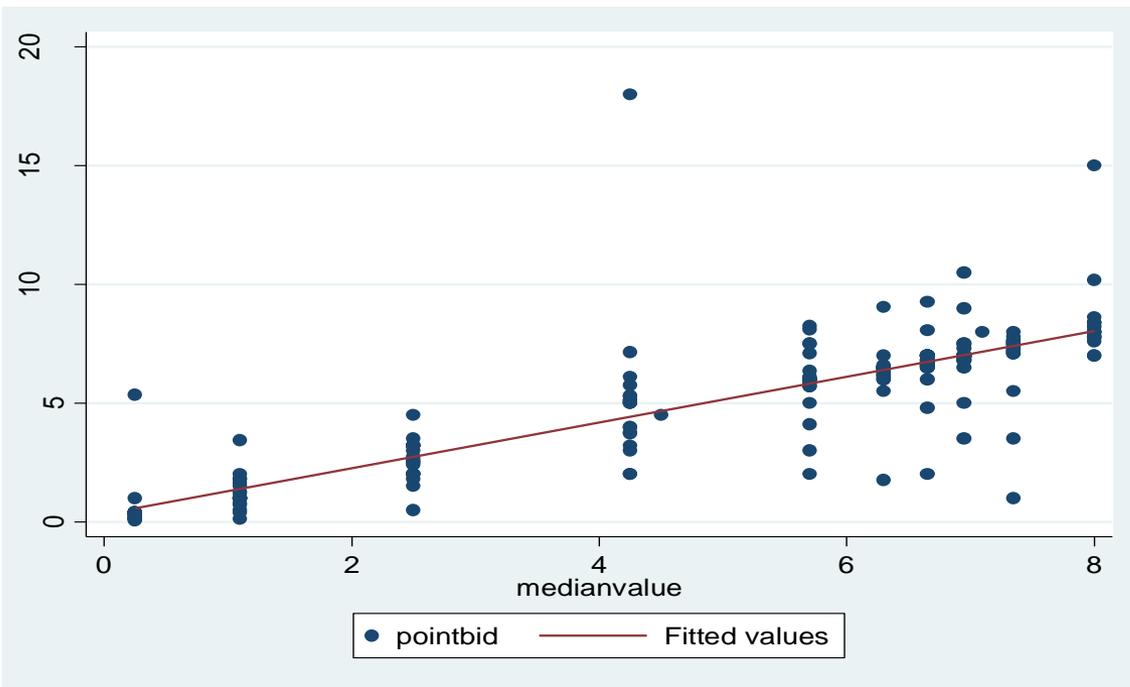
Result II (Contd.)

Difference between Point bid and lower, upper, and mean interval value

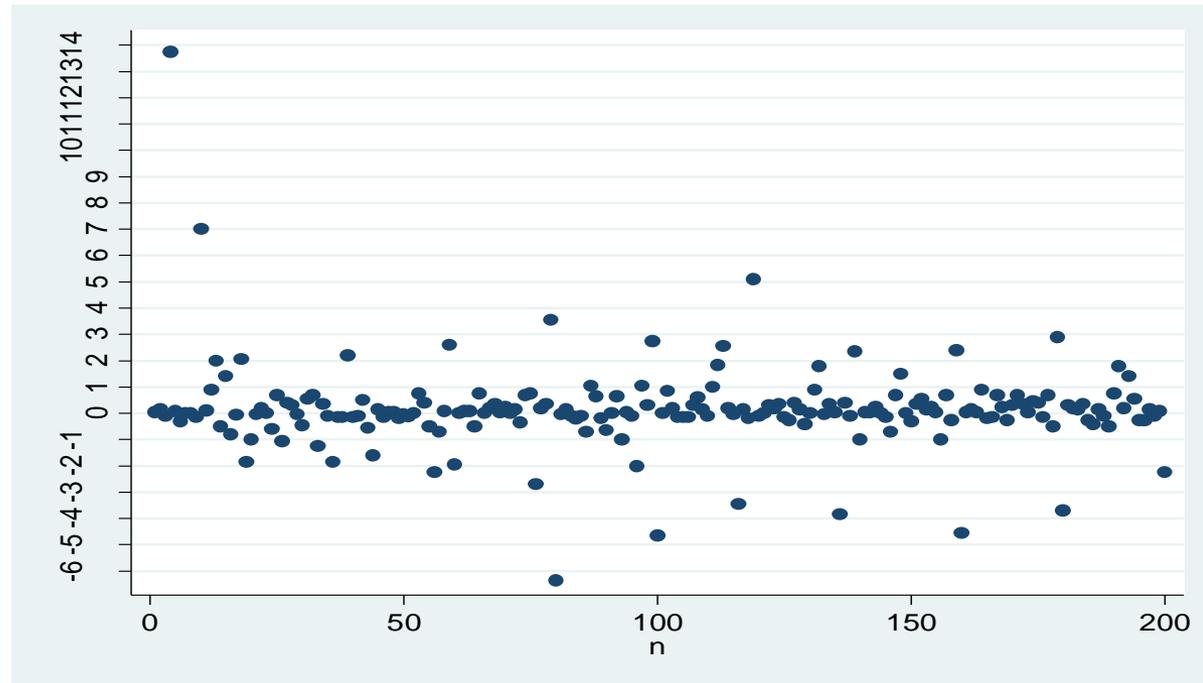
	Point Bid – Lower bound Value	Point Bid –Upper bound Value	Point bid –Mean of Value
Mean	0.55 (1.69)	-0.27 (1.62)	0.14 (1.63)
t - statistic	4.63	-2.38	1.22

Two way Random Effect Model of Point Bid

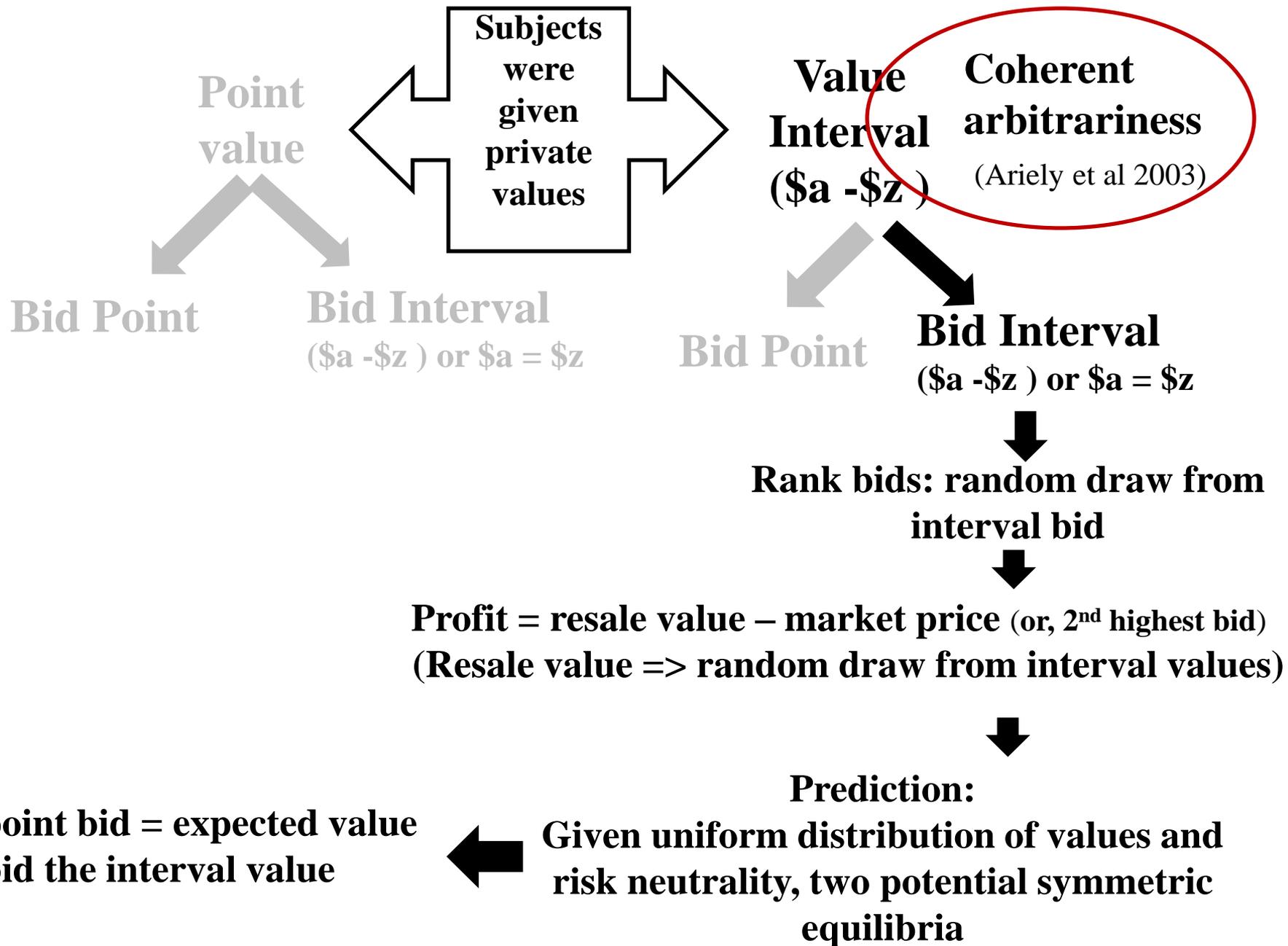
	Coefficient	Std. Error
Mean of Interval Value	0.96*	0.03
Constant	0.071	0.35



Scatter Plots of Point Bids and Mean of Interval values



Scatter Plots of difference between Point Bids and Mean of Interval values



Result III

- Our bidders bid sincerely again
 - as measured by equality in the expected values of the bid and value intervals.

Summary Statistics

Mean Interval Value	Mean Point Bid	Interval Bid	Over Bid	Under Bid	Exact Interval Bid
4.90 (2.60)	6.44 (9.97)	77%	22%	15%	4.5%

Result III (Contd.)

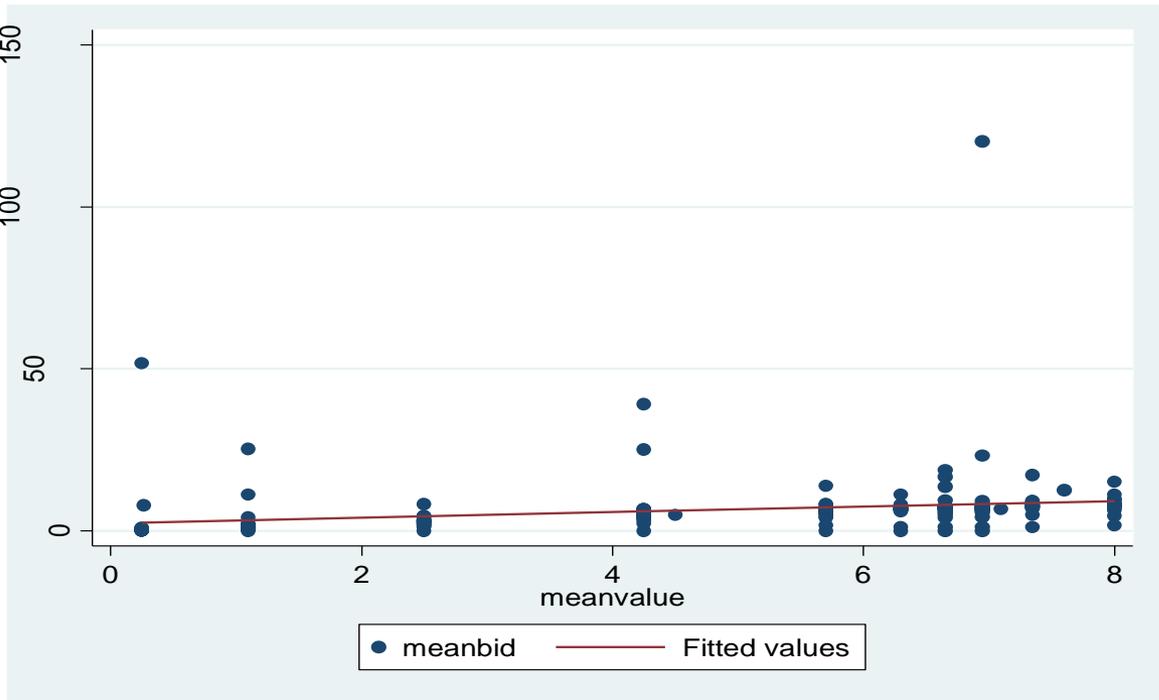
Difference between lower, upper, and mean of interval bid and value

	Lower bound Bid – Lower bound Value	Upper bound Bid – Upper bound Value	Mean of bid – Mean of Value
Mean	0.97 (9.09)	2.12 (11.40)	1.54 (9.71)
t - statistic	1.51	2.63	2.25

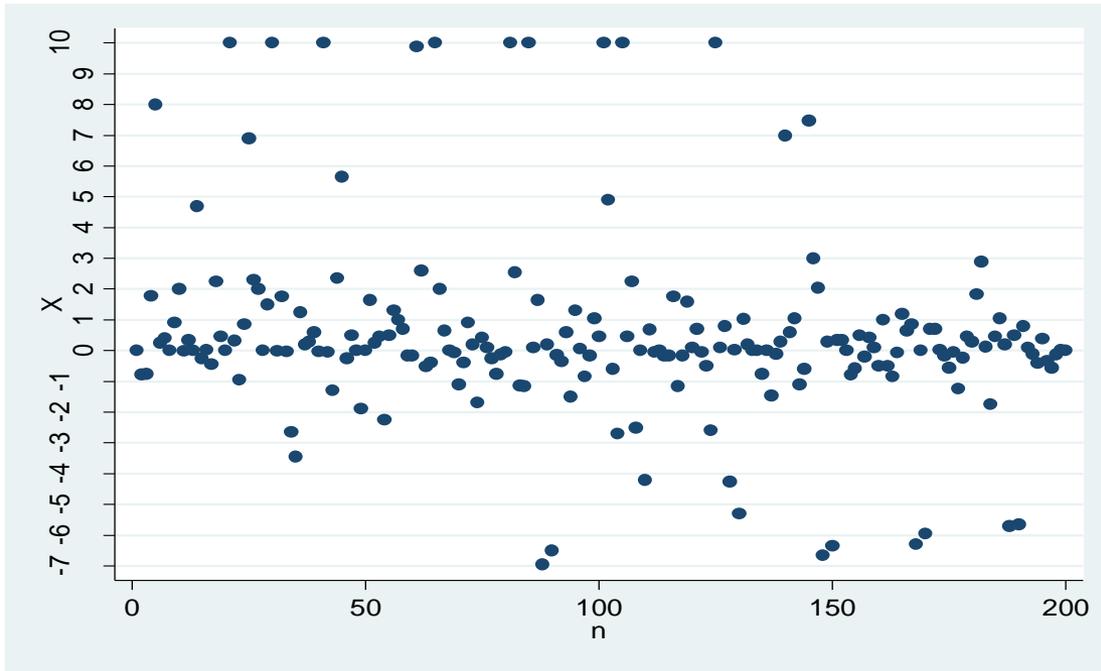
Two way Random Effect Model of Mean of Interval Bid

	Coefficient	Std. Error
Mean of Interval Value	0.87*	0.22
Constant	0.05	1.31

Scatter Plots of Mean of Interval Bids and Values



Scatter Diagram of the deviations of mean bids from mean values



Result: Summary

We find bidders bid rationally:

Sincere bidding –
classic Vickrey
prediction

Bid

POINT

INTERVAL

POINT

(POINT,
POINT)

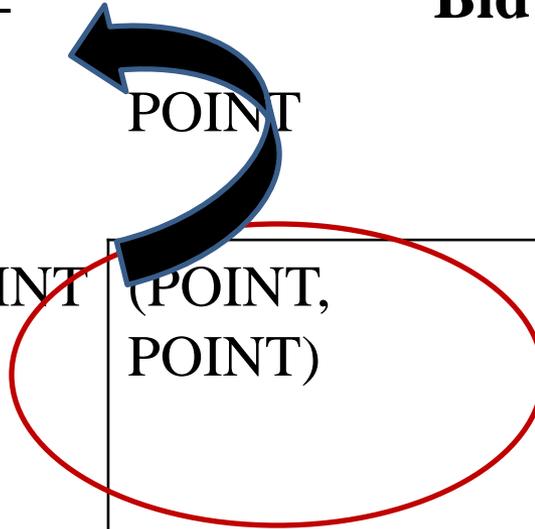
(POINT,
INTERVAL)

Value

INTERVAL

(INTERVAL,
POINT)

(INTERVAL,
INTERVAL)



Result: Summary

We find bidders bid rationally:

- (i) Prefer to bid in interval (Hanley et al. 2009)
- (ii) point value = mean of the interval

		Bid	
		POINT	INTERVAL
Value	POINT	(POINT, POINT)	(POINT, INTERVAL)
	INTERVAL	(INTERVAL, POINT)	(INTERVAL, INTERVAL)

Result: Summary

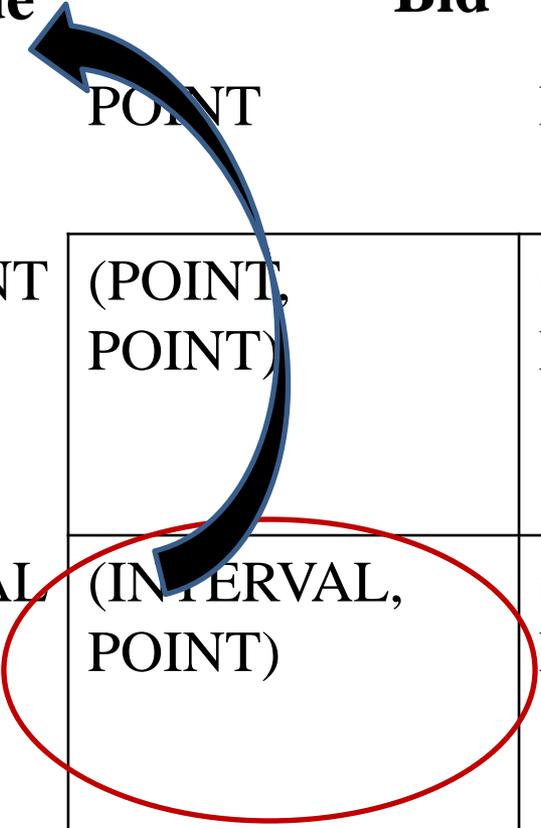
We find bidders bid rationally:

bid the expected value
from the interval

Bid

Value

	POINT	INTERVAL
POINT	(POINT, POINT)	(POINT, INTERVAL)
INTERVAL	(INTERVAL, POINT)	(INTERVAL, INTERVAL)



Result: Summary

We find bidders bid rationally:

		Bid	
		POINT	INTERVAL
Value	POINT	(POINT, POINT)	(POINT, INTERVAL)
	INTERVAL	(INTERVAL, POINT)	(INTERVAL, INTERVAL)

(i) Prefer to bid in interval (ii) mean of interval value = mean of the interval bid

Concluding Remark

- Our result supports the key presumption of coherent arbitrariness (Ariely et al. 2003) and the finding of Hanley et al. (2009) that people prefer to express their WTP in intervals, regardless of whether they were induced with point or interval values.
- Also, people constructed their bids based on expected values.

Concluding Remark

- Further exploration for stated preference methods:
 - (i) allowing people to state preferences as interval did not drastically alter rational incentives
 - (ii) mean of interval WTP could provide a reasonable estimate of true value for a good or service.
- Limitation
 - used mean/median as reference points given uniform distribution
 - In applying interval method, a variety of internal reference points to construct point estimates for homegrown values
 - Bohm (1979): as it is challenging to state a point estimate, bid design should promote both “controlled” over- and underbidding in point estimates such that an “average interval” is created