The Role of Information in Multidimensional, Buyer-Determined Auctions

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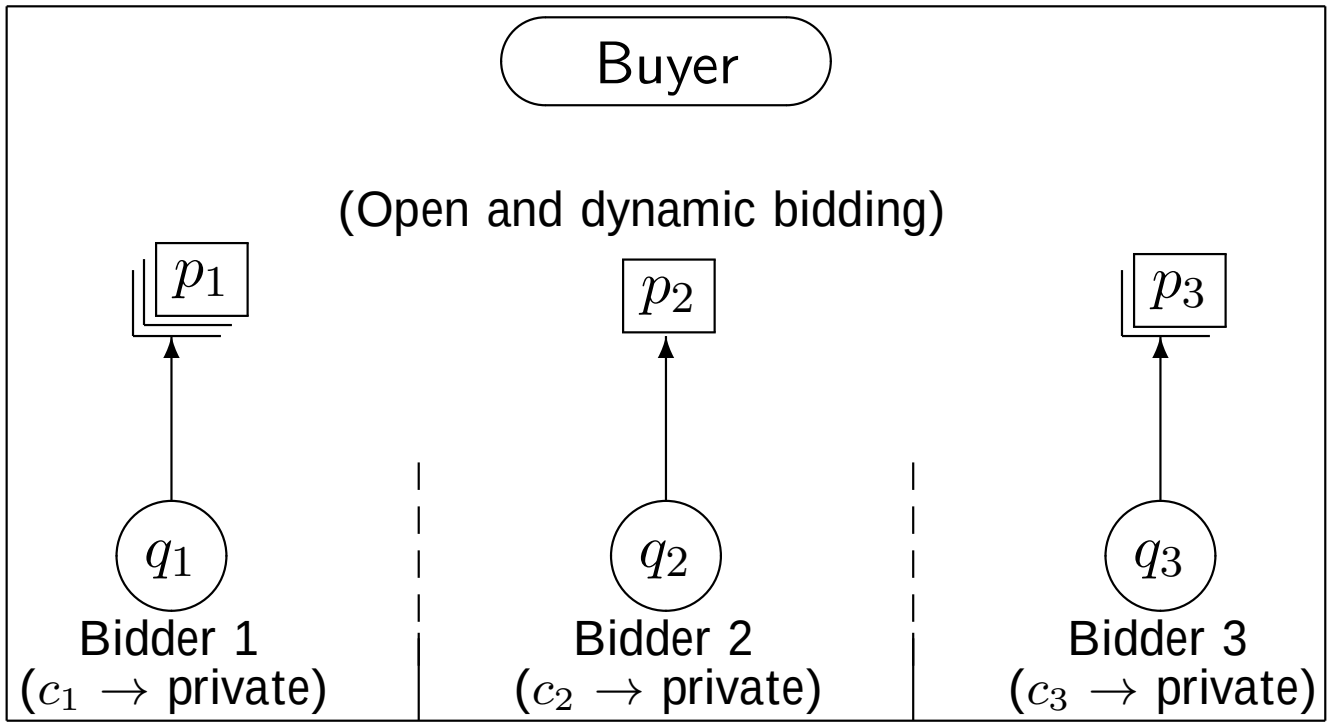
We analyze open non-binding procurement auctions with bidding on prices

($\rightarrow$ Very prominent in online procurement - e.g. FedBid: $4.1 billion in 2008)

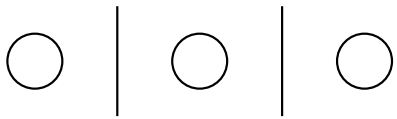
Setup on online procurement platform:



For example:

BMW

Quality information concealed



MyHammer

Quality information disclosed

Research Questions

Should the buyer in an open non-binding auction disclose or conceal information about bidders' relative qualities?
What are the consequences from a change in the information structure?

(A bidder's quality: Value of his non-price characteristics in the eyes of the buyer.)

We show

theoretically: Answer depends on cost-quality relationship

Δc *high*, Δq *low*:	Disclosure
Δc *low*, Δq *high*:	Concealment

empirically on data from large European procurement platform:

Bidders are informed about their relative qualities

If concealed:	Platform turnovers	$-$ 30%
	Welfare buyers	$+$ 45%

(Turnover created in auctions on online platform analyzed in 2008: € 4.6 million)

Non-binding auctions in procurement:

Che (1993), Engelbrecht-Wiggans et al. (2007), Katok and Wambach (2011)

Information structure in non-binding auctions:

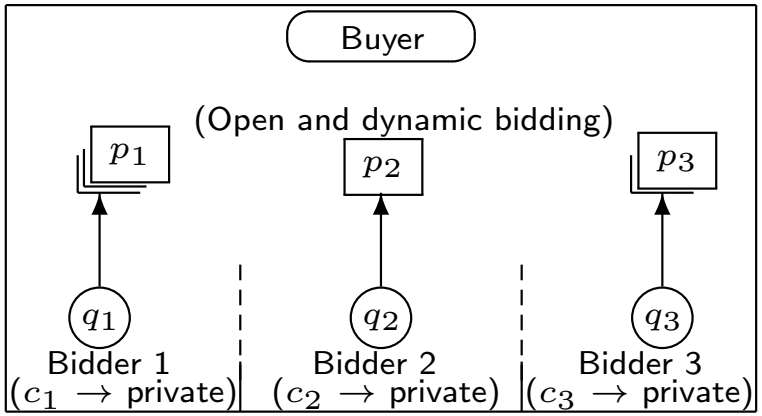
Gal-Or et al. (2007), Doni and Menicucci (2010), Colucci et al. (2011), Haruvy and Katok (2010)

Our contribution:

Theoretical analysis of the optimality of different information structures.

First to analyze open non-binding auctions on real world data; analysis of the effects of changes in the information structure.

Setup on online procurement platform:

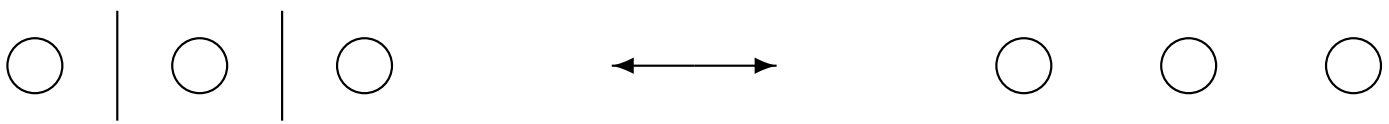


Buyer:

- Knows about both bidders' prices and qualities
- Decides for the bidder who gives him the highest overall utility

Bidders:

- Always know all their rivals' prices but only their own costs
- Maximize their (expected) profit
- Two cases w.r.t. information about relative quality:



No information ⟷ Information

Buyer's choice:

$$u_0 = c + \epsilon_0$$
$$u_1 = -p_1 + q_1 + \epsilon_1$$
$$\vdots$$
$$u_J = -p_J + q_J + \epsilon_J$$

Chooses $j = \underset{j}{\text{argmax}}\{u_j\}$

Bidders' equilibrium prices:

Information case

$$p_j = c_j + \frac{P_j}{|\partial P_j / \partial p_j|}$$

No information case

$(q_j \to 0,\ \epsilon_j \to 0)$

$$p_j = \begin{cases} c_{\text{2nd lowest}} & \text{if } c_j = \min\{c_k\}_k \\ c_j & \text{else} \end{cases}$$

$\hookrightarrow$ Buyers prefer ow prices/high price competition;

Price competition high if quality information

Δc *high*, Δq *low*:	disclosed (IC)
Δc *low*, Δq *high*:	concealed (NIC)

We collected data from auctions on

- painting and wallpapering jobs
- which were conducted during the second half of 2008.

We have available data on

- cost elements of the jobs offered by the buyers,
- bidders' prices and non-price characteristics,
- the buyers' decisions.

	Mean	SD	Median
No. of auctions	1,928		
No. of bidders	2,670		
No. of buyers	1,907		
No. of bidders per auction	7.83	4.38	7
Bid amount	559.33	514.03	400
Startprice	508.30	386.65	400
Auction participations per bidder	3.73	9.04	1
Auctions per buyer	1.01	0.10	1
Auction duration (days)	8.47	6.85	5.98
Last bid placement (hours)	24.28	55.50	3.98

Estimation of buyers' preferences w.r.t. the bidders' characteristics:

Covariates in buyer's utility fct.	**Average marginal effects**
Bid amount (EUR)	-.0009***
	(.00006)
No. of positive ratings	.0013***
	(.0001)
No. of negative ratings	-.0086***
	(.0012)
Controls	X
No. of observations	17,028
No. of auctions	1,928

(Standard errors are given in parentheses.)

Controls: All bidder information available online!

Econometric model of bidders' pricing behavior:

(For all but lowest-cost bidders)

$$p_{nj} = \boldsymbol{\xi}\mathbf{K}_{nj} + \beta S_{nj} + (oc_j + s_j) + \epsilon_{nj}$$

S_{nj}: Dummy indicating "quality shock";
here: Appearance of bidder with ratings difference > 90 points

Hypothesis:

If bidders are aware of their relative quality: $\beta < 0$

If bidders are agnostic about their relative quality: $\beta = 0$

Identification strategy:

FE estimation of pricing equation.

FE estimation of $p_{nj} = \boldsymbol{\xi}\mathbf{K}_{nj} + \beta S_{nj} + \tilde{a}_j + \epsilon_{nj}$:

Dependent variable: Bid amount of bidder j in auction n	(1)	(2)	(3)	(4)
Strong rival (dummy)	-88.86***	-97.34***	-97.81***	-60.57***
	(16.62)	(19.86)	(19.66)	(14.00)
Controls for				
Nbr. of bidders		X	X	X
Region		X	X	X
Bidder composition			X	
Startprice interval				X
Cost Controls	X	X	X	X
Bidder FE's	X	X	X	X
R^2	0.295	0.298	0.340	0.501
N		8,353		
Nbr. of bidders		936		

Derivation of cost estimates from model for factual case:

FOCs:

$$p_{nj} + \frac{P_{nj}}{\partial P_{nj}/\partial p_{nj}} - c_{nj} = 0 \quad \xrightarrow[P_{nj} \text{ from preference estimates}]{p_{nj} \text{ observed,}} \quad \hat{c}_{nj}$$

Computation of price estimates from model for counterfactual case:

$$\rightarrow \hat{p}_{nj} = \begin{cases} b_{\text{2nd lowest}} & \text{if } b_{nj} = \min\{b_{nk}\}_k \\ b_{nj} & \text{else} \end{cases}$$

	Mean	*SD*	*Median*
Actual bidamounts (p_{nj})	559.33	514.03	400
Estimated costs ($\hat{c}_{nj}$)	449.60 (10.41)	517.66	304.30
Counterfactual bidamounts ($\hat{p}_{nj}$)	460.89 (10.51)	518.73	307.88

All figures are in €; bootstrapped standard errors are given in parentheses.

From computed counterfactual bidamounts:

Counterfactual aggregate utility of buyers and counterfactual turnover on platform if quality information was concealed from the bidders.

	Actual in expectation (Information case)		**Counterfactual** in expectation (No information case)
All auctions in 2nd half of 2008 (7,725 auctions)			
Aggr. utility buyers	0	$\xrightarrow{+871{,}932}$	871,932 (36,396)
Platform turnover	1,912,901	$\xrightarrow{-576{,}466}$	1,336,435 (31,216)

All figures are in €; bootstrapped standard errors are given in parentheses.

Results are robust under varying assumptions about bidders' behavior!

We analyzed information structures in open and non-binding auctions

→ Whether it is optimal to disclose or conceal non-price information depends on bidders' cost-quality relationship:

	Price competition spurred by
Δc *high*, Δq *low*:	Disclosure
Δc *low*, Δq *high*:	Concealment

→ Examined consequences of change in information structure on real world data

Bidders are informed about their relative qualities;
If concealment of non-price information:

Platform turnovers	− 30%
Aggr. utility buyers	+ 45%

(Turnover created in auctions on online platform analyzed in 2008: € 4.6 million)

Thank You!

Che, Y.-K. (1993). Design competition through multidimensional auctions. *RAND Journal of Economics 24*, 668–680.

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Gal-Or, E., M. Gal-Or, and A. Dukes (2007). Optimal information revelation in procurement schemes. *RAND Journal of Economics 38*, 400–418.

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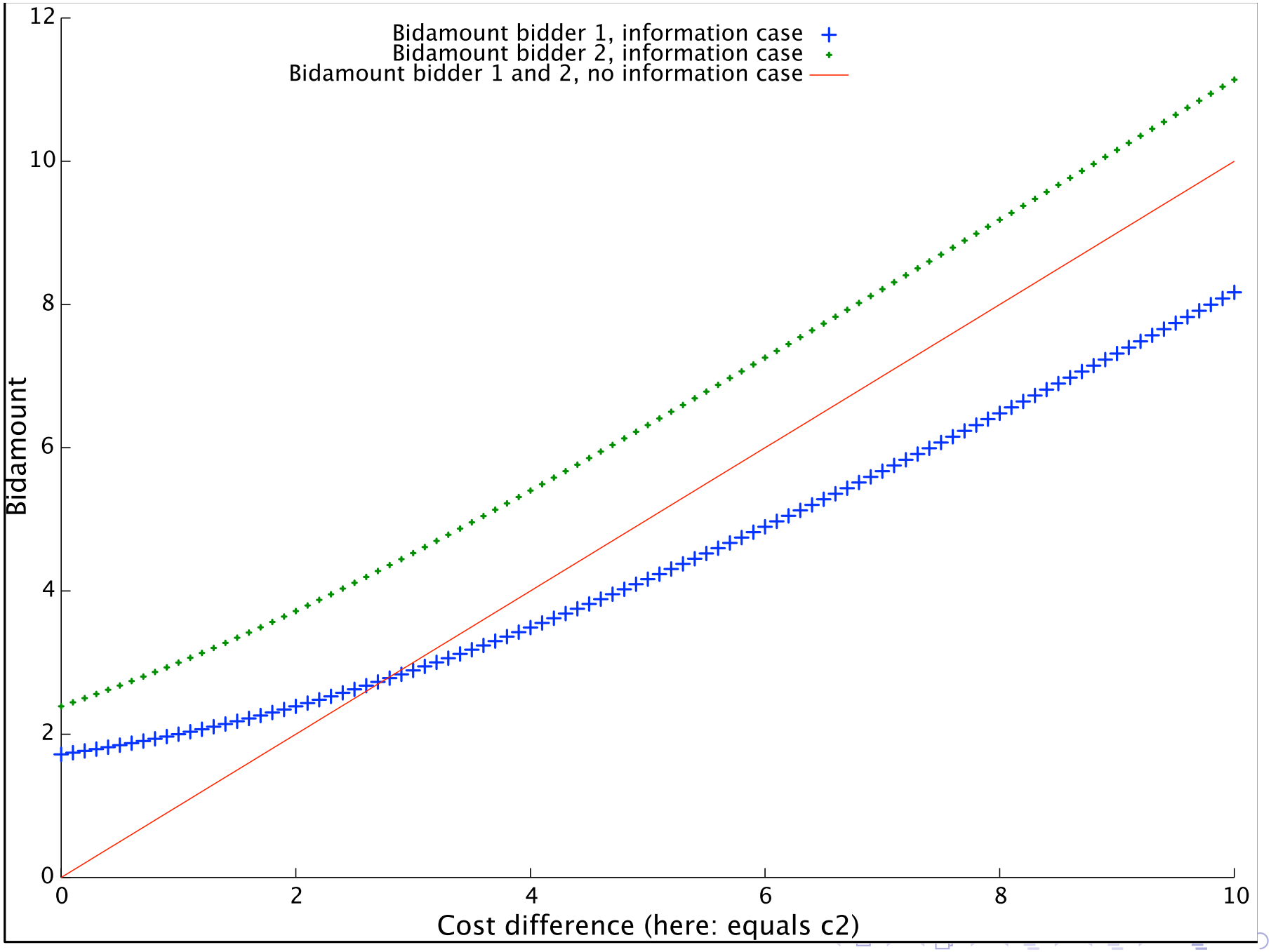
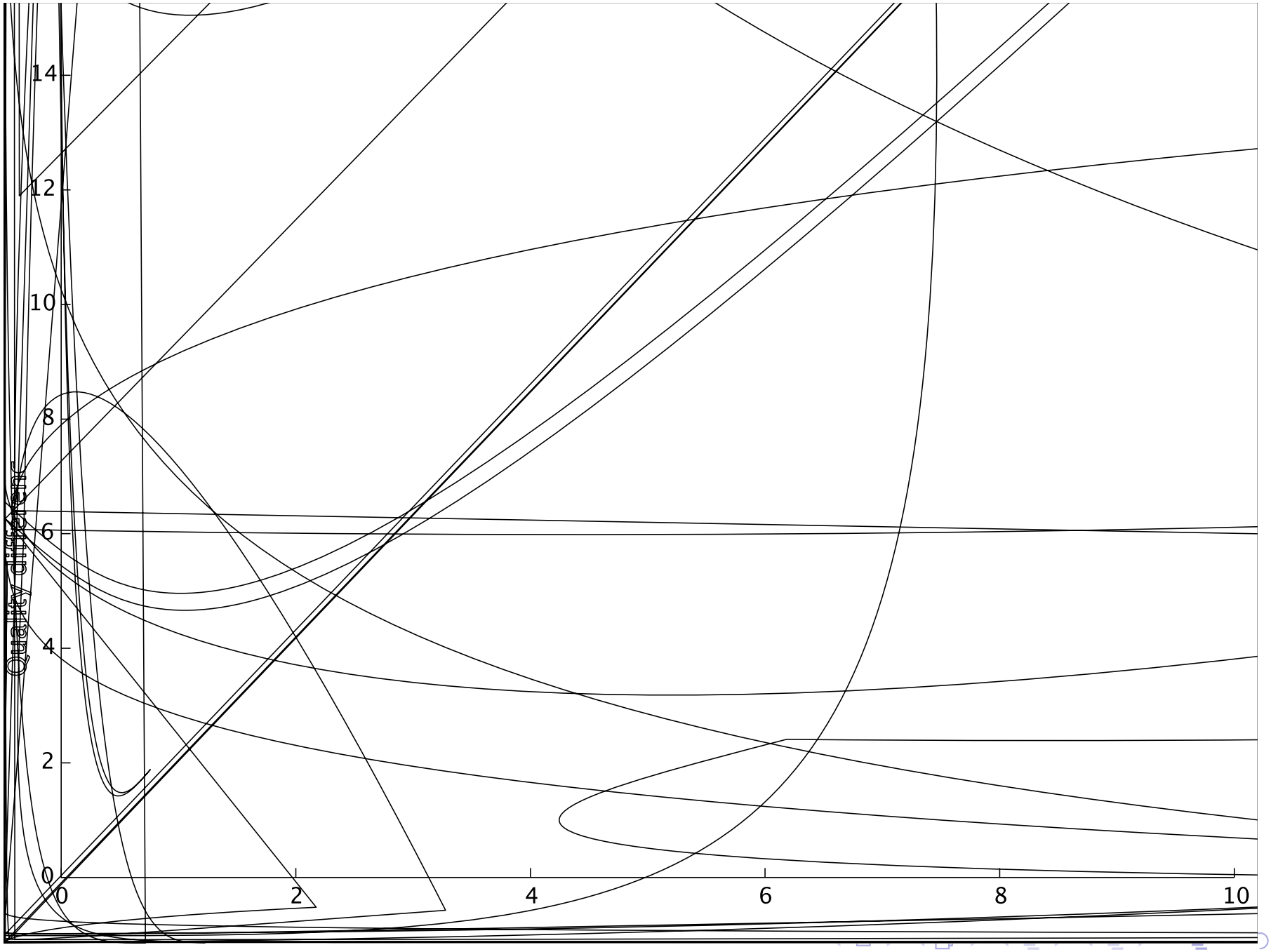

Bidamount bidder 1, information case
Bidamount bidder 2, information case
Bidamount bidder 1 and 2, no information case
Bidamount
Cost difference (here: equals c2)
0
2
4
6
8
10
12


Quality difference
0
2
4
6
8
10
12
14
0
2
4
6
8
10

Covariates in buyer's utility fct.	**Coefficient estimates**	**Average marginal effects**
Bid amount (EUR)	-.011***	-.0009***
	(.0004)	(.00006)
Nbr. of positive ratings	.016***	.0013***
	(.001)	(.0001)
Nbr. of negative ratings	-.108***	-.0086***
	(.014)	(.0012)
Controls:		
Distance (km)	-.006***	-.0005***
Trade License	.298***	.0238***
In craftsmen register	.293***	.0234***
Registered at platform	-.066	-.0053
Master craftsman company	.136	.0108
Senior journeyman company	.073	.0058
Engineer	-.118	-.0094
Technician	1.042	.0830
Other certifications	.025	.0020
Nbr. of employees	-.012	-.0009
Nbr. of observations	17,028	
Nbr. of auctions	1,928	

Theory:

For all but lowest-cost bidder:

$$p_{nj} = c_{nj} + m_{nj}; \qquad m_{nj} = \begin{cases} \frac{P_{nj}}{|@P_{nj}=@p_{nj}|} > 0 & \text{if IC} \\ 0 & \text{if NIC} \end{cases}$$

Econometric model:

S_{nj}: Dummy indicating "quality shock"

$$p_{nj} = a_j + \boldsymbol{\xi}\mathbf{K}_{nj} + \nu_{nj} + \mu_j + \beta S_{nj} + \vartheta_{nj}$$

$$= \boldsymbol{\xi}\mathbf{K}_{nj} + \beta S_{nj} + \tilde{a}_j + \epsilon_{nj}$$

Dependent variable: **Bid amount of bidder j in auction n**	(1)	(2)	(3)	(4)
Strong rival (dummy)	-88.86***	-93.29***	-92.77***	-97.34***
	(16.62)	(19.61)	(16.72)	(19.86)
Controls:				
Area to paint (m^2)	1.80***	1.82***	1.79***	1.82***
Area to paper (m^2)	1.53***	1.40***	1.54***	1.40***
Paper removal (m^2)	2.72***	2.84***	2.80***	2.92***
Cleaning (dummy)	85.23***	65.64**	92.35***	71.90**
Reparation (dummy)	36.77***	53.36***	36.95***	53.42***
Priming (dummy)	129.89***	132.48***	129.84***	131.87***
Nbr. of windows	9.40	9.57	10.06	10.27
Nbr. of window frames	36.52	33.58	34.84	31.78
Nbr. of doors	51.20***	50.36***	52.28***	51.41***
Nbr. of door frames	19.13***	20.55***	18.46***	19.95***
Nbr. of radiators	91.50***	91.95***	91.48***	91.83***
Paint by contractor (dummy)	25.10**	13.58	25.57**	14.19
Varnish by contractor (dummy)	128.58	117.43	129.17	117.35
Distance (km)	1.19***	1.14***	1.25***	1.20***
Dummies for nbr. of bidders		X		X
Dummies for region			X	X
Dummies for startprice interval				
Bidder FE's	X	X	X	X
R^2	0.295	0.303	0.289	0.298
N	8,353	8,353	8,353	8,353

Dependent variable: **Bid amount of bidder j in auction n**	(1)	(2)
Strong rival (dummy)	-97.81***	-60.57***
	(19.66)	(14.00)
Controls:		
Area to paint (m^2)	1.69***	.63***
Area to paper (m^2)	1.41***	.13
Paper removal (m^2)	2.54***	1.37***
Cleaning (dummy)	62.98*	-48.90
Reparation (dummy)	37.65***	31.37***
Priming (dummy)	120.27***	25.59
Nbr. of windows	12.76	.92
Nbr. of window frames	27.73	-85.65***
Nbr. of doors	46.96***	38.14***
Nbr. of door frames	19.17***	14.60***
Nbr. of radiators	84.65***	30.77**
Paint by contractor (dummy)	17.70	28.91***
Varnish by contractor (dummy)	104.87	137.02
Distance (km)	.78***	.57***
Dummies for nbr. of bidders	X	X
Dummies for region	X	X
Controls for bidder composition	X	
Dummies for startprice interval		X
Bidder FE's	X	X
R^2	0.340	0.501
N	8,353	8,353

	Platform turnover (in expectation)	**Aggregate utility buyers** (in expectation; monetary equivalent, normalized)	**Mean bidamount**
Set of auctions for which cost information is available: (1,928 auctions)			
Actual values (Information case)	820,778	0	559.3 (Avg. costs: 449.6)
Counterfactual values (No information case; given are changes relative to information case)			
Price only	− 170,581	+ 177,029	460.9
Price dominant, $\hat{\rho} \times 10$	− 268,350	+ 274,701	461.7
Price dominant, $\hat{\rho} \times 100$	− 315,646	+ 322,357	450.5

	Subset of auctions with cost information available (1,928 auctions)		**Whole set of auctions** (7,725 auctions)	
	Platform turnover (in expectation)	**Aggregate utility buyers** (in expectation; monetary equivalent, normalized)	**Platform turnover** (in expectation)	**Aggregate utility buyers** (in expectation; monetary equivalent, normalized)
Actual values (Information case)	820,778	0	1,912,901	0
Counterfactual values (No information case; given are changes relative to information case)				
$(\hat{\rho}, \hat{\ }) \times 1$	− 170,581	+ 177,029	− 576,466	+ 871,932
$(\hat{\rho}, \hat{\ }) \times 2$	− 173,379	+ 173,973	− 517,807	+ 788,827
$(\hat{\rho}, \hat{\ }) \times 0.5$	− 163,151	+ 168,188	− 581,941	+ 911,354
$\hat{\rho} \times 2, \hat{\ } \times 0.5$	− 175,476	+ 170,284	− 525,101	+ 793,945
$\hat{\rho} \times 0.5, \hat{\ } \times 2$	− 165,226	+ 179,067	− 577,267	+ 912,212
$(\hat{\rho}, \hat{\ }) \times 10$	− 163,040	+ 163,740	− 480,357	+ 743,935
$(\hat{\rho}, \hat{\ }) \times 0.1$	− 157,717	+ 161,551	− 576,732	+ 915,750
$\hat{\rho} \times 10, \hat{\ } \times 0.1$	− 165,054	+ 157,805	− 480,242	+ 743,771
$\hat{\rho} \times 0.1, \hat{\ } \times 10$	− 184,764	+ 215,543	− 558,763	+ 925,352
$(\hat{\rho}, \hat{\ }) \times 100$	− 429,569	+ 309,945	− 578,340	+ 835,310
$(\hat{\rho}, \hat{\ }) \times 0.01$	− 156,007	+ 159,590	− 575,411	+ 913,539