

When Online Auction Meets Virtual Reality: An Empirical Investigation

A Joint Work with Zhongyun Zhou, Zhenbin Yan, Xingyao Guo, and Ziyue Jiang

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- VR can generate a simulated 3D visual reproduction of realistic settings
- Higher vividness and interactivity (Steuer, 1992)
- Online virtual games (Shin, 2009), healthcare (Smith et al., 2020), education (Radianti et al., 2020), and tourism (Bogicevic et al., 2019)
- Recently, real estate market, property sales, in online auctions



(a)



(b)



(c)



(d)

- Posted price sales: sellers set a fixed product price
- Online auctions (also known as Internet auctions): allow buyers to compete for an item by offering bids before the auction's closing time (Wang, 1993), selling the product the buyer of the highest bid (Chan et al., 2007)
- Suitable for transactions of rarely traded assets (such as art, cars, and real estate)
- Information asymmetry: high product uncertainty (Dimoka et al., 2012)

Auction success

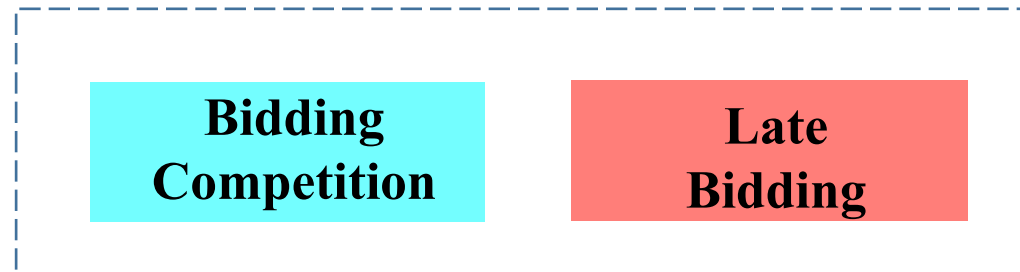
whether or not the item is finally sold in an auction.

Auction price

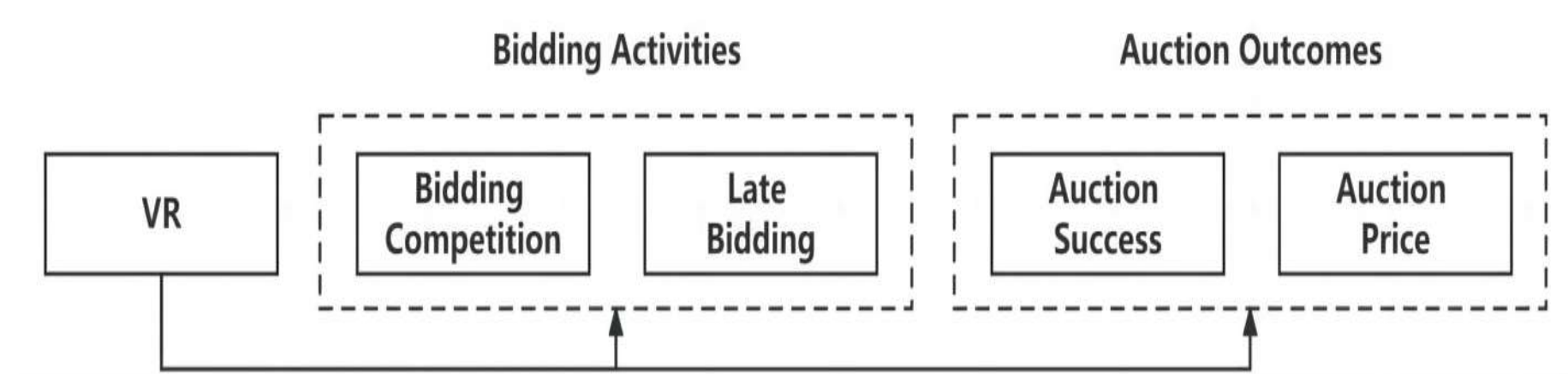
the seller's revenue from a successful auction.



- Bidding competition reflects buyers' participation intensity in the bidding process to compete for the product (Gregg & Walczak, 2008)
- Late bidding is proven to be an effective strategy for buyers to deprive the rival's time to respond, shed their private information about product value, and soften the fierce competition to avoid a bidding war (Roth & Ockenfels, 2002; Wintr, 2008)



- Examine the effects of VR on auction outcomes & bidding activities:
 1. What is the influence of VR on the outcomes (i.e., success and price) of Internet auctions?
 2. How does VR change bidding activities (i.e., bidding competition and late bidding) in Internet auctions?



- Context: Ali Auction, the largest online auction platform in China
- Independent variables: product characteristics, product presentation, auction features

Table 1. Variable Description and Summary Statistics

Variable	Description	N	Mean	Min	Max
AuctionSuccess	Whether an auction is successful.	36240	.558	0	1
AuctionPrice	The final selling price (in CNY).	20232	2245419.2	6200	1.029e+08
NumBids	The number of bids in an auction.	20232	49.319	1	695
NumBidders	The number of bidders in an auction.	20232	4.961	1	37
BidsLast60Min	The number of bids in the last 60 minutes.	20232	25.988	0	410
NumExtensions	The number of extensions before closing.	20232	38.282	0	610
VR	Whether VR supports (1) or not (0).	36240	.211	0	1
Size	The area of a house (in m^2).	36240	265.179	2.1	3000125.5
StartingPrice	The number of opening bid price.	36240	1613245	1	2.537e+08
Deposit	The number of deposits of an auction.	36240	240859.51	1000	47000000
Valuation	The valuation price of the product.	36240	2221761.9	89	3.358e+08
Increment	The minimum bidding increments.	36240	7597.534	1	1200000
Guarantee	Whether money-back guarantee supports.	36240	.387	0	1
Video	Whether supports video (1) or not (0).	36240	.395	0	1
NumPictures	The number of pictures.	36240	11.952	2	21
NumText	The number of word descriptions.	36240	5162.219	263	12173

- Model
 - Auction Success:
$$\text{probit}(\text{AuctionSuccess}_i) = \beta_0 + \beta_1 \text{VR}_i + \beta_c \text{Controls}_i + \varepsilon_i, (1)$$
 - Auction Price:
$$\ln(\text{AuctionPrice}_i) = \beta_0 + \beta_1 \text{VR}_i + \beta_c \text{Controls}_i + \varepsilon_i, (2)$$
 - **Controls_i**: *Size_i, StartingPrice_i, Deposit_i, Valuation_i, Increment_i, Gurantee_i, Video_i, NumPictures_i and NumText_i*; City and Month Fixed effects
- Identification
 - Propensity score matching (PSM): mitigate the selection bias from observables
 - Instrumental variable (IV) approach:
 - *ClosedVRRate*: VR adoption rate of former closed auctions in the same city
 - Relevance: VR services are similar in the same city
 - Exclusion: Former closed auctions may not affect latter auctions

➤ VR on Auction Outcomes

- Auction Success:**

VR can increase the possibility of asset liquidation

- Auction Price:**

VR can increase the final price of an auction item

Table 2. The Effect of VR on Auction Outcomes

	(1) Auction Success	(2) Auction Price
VR	2.265*** (0.009)	0.241*** (0.090)
Size	0.000 (0.000)	-0.000*** (0.000)
Starting Price	-0.000*** (0.000)	0.000*** (0.000)
Deposit	-0.000*** (0.000)	0.000*** (0.000)
Valuation	0.000*** (0.000)	-0.000*** (0.000)
Increment	0.000 (0.000)	0.000 (0.000)
Guarantee	-0.665*** (0.042)	0.023 (0.040)
Video	-0.098*** (0.020)	-0.080*** (0.014)
Num Pictures	0.010 (0.006)	0.042*** (0.006)
Num Text	-0.000*** (0.000)	-0.000* (0.000)
Constant	-0.433*** (0.082)	13.161*** (0.077)
City, Month FE	Yes	Yes
Observations	22,577	15,190

- **Bidding Competition:**

(1) **NumBidders**: the number of bidders

(2) **NumBids**: the number of bids

Generally, more participants joining the bidding process may increase competition. Besides, bidders place more bids to improve their chances of winning the auction, whereas more bids also suggest a higher level of competition.

$$\ln(BiddingCompetition_i) = \beta_0 + \beta_1 VR_i + \beta_c \mathbf{Controls}_i + \varepsilon_i, (3)$$



- **Late bidding**

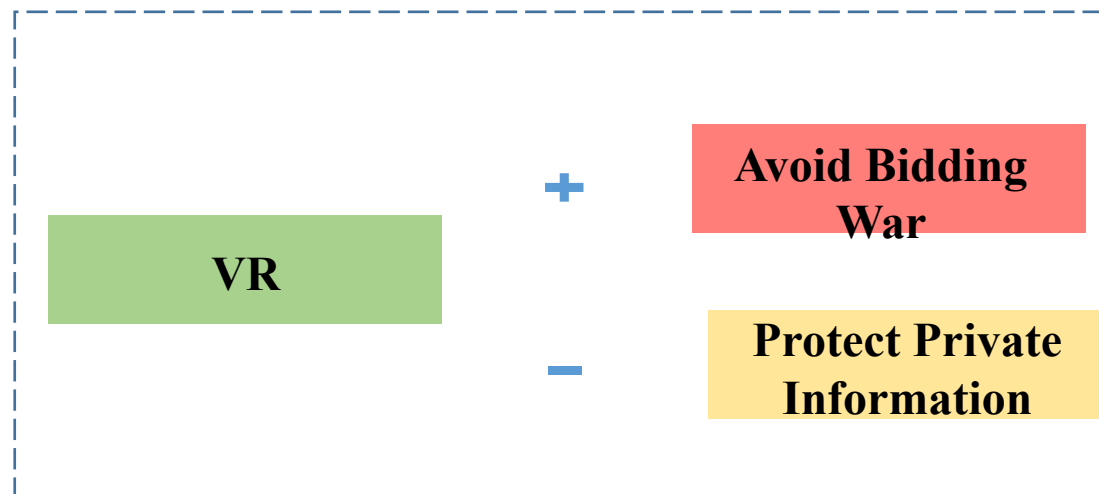
(1) **BidsLast60Min**

(2) **NumExtensions**

$$\ln(\text{LateBidding}_i) = \beta_0 + \beta_1 \text{VR}_i + \beta_c \text{Controls}_i + \varepsilon_i, (4)$$

- **(+) Avoiding a bidding war:**
Bid late to avoid the “bidding war” & the “winners’ curse”

- **(-) Protecting private information:**
Protecting private information becomes less important



Part 4 Model and Result

Table 3. The Effect of VR on Bidding Activities

	(3)NumBids	(4)NumBidders	(5)BidsLast60Min	(6)NumExtensions
VR	2.147***(0.274)	0.631***(0.107)	2.061***(0.252)	2.542***(0.310)
Size	-0.000(0.000)	-0.000***(0.000)	-0.000(0.000)	-0.000(0.000)
StartingPrice	-0.000*(0.000)	-0.000***(0.000)	-0.000*(0.000)	-0.000(0.000)
Deposit	0.000(0.000)	0.000(0.000)	0.000(0.000)	0.000(0.000)
Valuation	0.000***(0.000)	0.000***(0.000)	0.000***(0.000)	0.000***(0.000)
Increment	-0.000***(0.000)	-0.000***(0.000)	-0.000***(0.000)	-0.000***(0.000)
Guarantee	0.444***(0.081)	0.148***(0.033)	0.342***(0.077)	0.425***(0.095)
Video	-0.021(0.036)	-0.006(0.014)	-0.033(0.032)	-0.045(0.040)
NumPictures	0.006(0.011)	0.004(0.004)	0.004(0.010)	0.011(0.012)
NumText	-0.000***(0.000)	-0.000***(0.000)	-0.000***(0.147)	-0.000***(0.000)
Constant	2.443***(0.157)	1.320***(0.060)	2.041***(0.147)	1.911***(0.178)
City, Month FE	Yes	Yes	Yes	Yes
Observations	15,190	15,190	15,190	15,190

NumBids ↑
NumBidders ↑

VR can bring a competitive effect, which contributes to an improved final auction price.

BidsLast60Min ↑
NumExtensions ↑

VR can enhance the late bidding, which supports the “avoiding the bidding war” hypothesis.

- **Theoretical contributions:**
- Explains VR's effects in online auctions:
 - VR improves auction effectiveness, increasing **auction success** and **price**
- Reveals VR's effects in buyers' bidding behaviors:
 - VR leads to a **competitive effect** and a **late-bidding effect**
- **Practical implication:**
 - This study also provides managerial implications for auction platforms and sellers

Q&A

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