Initial Endowment Effects
in Multi-Unit Vickrey Auctions

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Abstract

We report the result of experiments designed to assess the effect of initial endowments on willingness to pay values elicited from multi-unit Vickrey auctions. Comparing bids from an "endow and upgrade" approach with the "full bidding" approach, we find that the direction of the endowment effect generally depends on the number of endowed units of the conventional product that subjects are willing to give up in exchange for units of the upgraded product. The endowment effect is "reverse" when the number of units that participants are willing to give up is lower or equal to the number of remaining endowed units. However, we generally find an endowment effect when the number of units a participant is willing to give up is higher than the number of remaining endowed units.

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1   Introduction

In experimental auctions, researchers interested in eliciting people's valuation for a new product or product attribute routinely endow subjects with a conventional good and ask them their willingness to pay (WTP) to exchange the endowed conventional good with an upgraded   good with the attribute of interest. Many of the researchers that used this approach cite the seminal paper by Shogren et al. (1994) where they used this "endow-upgrade" approach to examine possible reasons for the disparity between WTP and willingness to accept (WTA) values. Some of the studies that have used this approach include Buhr et al. (1993) ; Fox et al. (1995) ; Lusk et al. (2000) ; Hayes, Fox and Shogren (2002) ; Fox, Hayes and Shogren (2002); and Alfnes and Rickertsen (2003).

While this approach has a number of advantages (e.g., related to outside market influences, option values) as discussed by Lusk and Shogren (2007) and Corrigan and Rousu (2006), the initial endowment can also introduce a bias in the form of endowment effect, consistent with loss aversion effects gained from Kahneman and Tversky's (1979) prospect theory which implied that people value a good more if it is already in their possession. Lusk, Feldkamp and Schroeder (2004) examined the effect of endowment by comparing differences in bids obtained from an "endow and upgrade" approach to the "full bidding" approach, where people bid on both the conventional and upgraded goods simultaneously. They found that the sign and magnitude of the endowment effect depend on the auction mechanism used. Corrigan and Rousu (2006) also examined the endowment effect by comparing the differences in subjects' WTP for one unit and two units for the same product to subjects' WTP to upgrade from one endowed unit to another unit of the same product. Their results suggest that endowing subjects with a good significantly affects WTP values even in the absence of loss aversion. They postulated two possible explanations: top dog effect (i.e., subjects derive some utility from being declared the winner or top dog) and reciprocal obligation effect (i.e., participants want to repay the experimenter for endowing them with the product). Lusk and Shogren (2007) argue that if there are perfect field substitutes to products offered in a full bidding approach, then the bids for each of the products will be censored at the market price of the products and the differences in optimal bids might differ from the measure of real interest, the differences in value. As a result, they recommended the use of the endow-upgrade approach, since bids cannot be affected by such bias. However, Alfnes (2009) showed that the full bidding method is better than the endow-upgrade method when the products in the auction have the same field substitutes.

These studies that evaluated initial endowment effects in experimental auctions used single unit auction mechanisms. While these are useful, it is generally not known if these effects are present in multi-unit auction settings. Hence, we deviate from previous studies that used single unit auctions by examining the effect of initial endowments on value estimates from multi-unit experimental auctions. In multi-unit auctions, multiple units of the same product

are auctioned and the bidder(s) can bid for more than one unit (Krishna 2002). Admittedly, the use of multi-unit auctions in applications related to product marketing and pricing is still rare in the agricultural economics literature. However, consumers can be interested as well in purchasing not just one but multiple units of a product. Also, due to increasing time constraints, many consumers are becoming increasingly concerned about optimizing shopping efficiency by purchasing multiple units of products to save several trips to the store. While extensively studied in the literature, the WTP values obtained from single-unit auctions are only applicable for the first unit a consumer is willing to buy. Therefore, single-unit auctions are useful if one assumes that people are interested in purchasing one unit during the auction but these auctions cannot provide information on consumers' WTP for subsequent units of the product beyond the first unit. The use of multi-unit auctions also allows the derivation of demand curve for the product being auctioned for each individual and the market. Hence, demand elasticities and consumer surplus measures can be derived, which can then be used, among others, in evaluating consumer demand and welfare implications of policy interventions (e.g., product taxes, price ceilings, price floors). Consequently, we suspect that the use of multi-unit auctions for applications related to product pricing, adoption, and policy will increase in the near future.

However, the usefulness of multi-unit auction, as a non-hypothetical value elicitation method, to measure consumers' WTP for new products in a multi-unit setting can be limited by the possible existence of endowment/reverse endowment effects. Hence, in this paper we attempt to assess the sensitivity of multi-unit auction to the endowment effect and determine which experimental approach (i.e., endow-upgrade vs. full bidding) practitioners should use when using multi-unit auctions to estimate consumers' WTP for multiple units of a product. To our knowledge, our paper is the first to attempt to study the effect of initial endowments on values elicited from multi-unit Vickrey auctions. Specifically, we wish to examine: (1) whether endowing participants with multiple units in multi-unit auctions will generate an "endowment effect" or "reverse endowment effect"; (2) whether the sign and magnitude of the endowment effect change from one auctioned unit to another; and (3) whether the number of units that a participant is willing to buy is correlated with the sign and magnitude of the endowment effect.

Our paper is structured into five sections. In the next section, we describe how the multi-unit auction mechanism works, followed by our experimental design. We then discuss the results in the fourth section and then draw some concluding remarks in the last section of the paper.

2   Multi-unit Vickrey auction

In our experiment, we used an incentive compatible multi-unit auction

mechanism, the so called multi-unit Vickrey auction. Multi-unit Vickrey auction is a generalization of the second price auction. Each participant is asked to bid on multiple units of the same product and the winner pays an amount corresponding to the sum of the bids (excluding his or her own bids) that are displaced by his or her successful bids (Krishna 2010). For a better understanding of the auction mechanism, consider three bidders and three identical units of the same product to be auctioned. Each bidder reports a bid of three values (i.e. one value for each unit). Let's say that bidder 1's bid is (14, 9, 3), bidder 2's bid is (12, 7, 2) and bidder 3 bids (10, 5, 0). If we rank the nine values, we obtain (14, 12, 10, 9, 7, 5, 3, 2, 0). The pricing rule dictates that the owner(s) of the three highest bids is (are) declared the winner(s). In this particular example, the owners of the bids 14, 12 and 10 (i.e. bidder 3, bidder 1 and bidder 2) are the winners.

The price that each winner has to pay (i.e. clearing price) is determined as follows. First, the common set of rejected values (i.e. the values that do not make their owners winners of the auctioned product) is determined. In our example the common set of rejected values is {9, 7, 5, 3, 2, 0}. Second, for each winner an individual set of rejected values, consisting of the common set of rejected values without the winner's own values, is determined. In our particular example, the individual set of rejected values for bidder 1, bidder 2 and bidder 3 are {7, 5, 2, 0}, {9, 5, 3, 0} and {9, 7, 3, 2}, respectively. Third, if the winner wins one unit, he/she pays a price equal to the first highest value in his/her individual set of rejected values. If the winner wins two units, he/she pays a price equal to the sum of the first and the second highest value in his/her individual set of rejected values and so on. In our particular example, bidder 1, bidder 2 and bidder 3 each pays a price equal to 7, 9 and 9, respectively.

In multi-unit Vickrey auction, a participant can win more than one unit. For example, suppose that bidder 3 provided a bid equal to (15, 13, 8) so the ranking of values is now (15, 14, 13, 12, 9, 8, 7, 3, 2). Hence, bidder 1 wins one unit, bidder 2 does not win any unit and bidder 3 wins two units. The individual set of rejected values for bidder 1 and bidder 3 are {12, 8, 7, 2} and {12, 9, 7, 3, 2}, respectively. So, bidder 1 pays 12 and bidder 3 pays 12 for the first unit and 9 for the second unit. Since the price that the winner has to pay is not based on the winner's bid but on the bids of the other participants, bidding truthfully is a dominant strategy in the multi-unit Vickrey auction (Engelbrecht-Wiggans and Kahn, 1998).

3   Experimental design

In our experiments we used a six-pack product to examine the endowment effect in multi-unit auctions. "Six-pack" is the packaging form popularly used in Spain for products such as soda, juice, water, beer, and milk, which are products that consumers are used to buying in multiple units in the same shopping trip. While a "six-pack" consists of 6 identical units of the same product together in a

bundle, consumers in retail stores are not forced to buy the entire bundle – that is they can purchase less than 6 units by just opening the package and take the number of units they want to buy. In our experiment we used a six-pack of organic milk. Each unit contains one liter of organic milk. Organic milk is a relatively new product in Spain. We opted to use a new product to avoid any censoring of bids by participants above the market price of the auctioned product. It is important to note that Spanish milk is Ultra Pasteurized (using UHT method) which extends its shelf life and allows the milk to be stored unrefrigerated because of the longer lasting sterilization effect.

We conducted two experiments using multi-unit Vickrey auctions of organic milk in Barcelona, Spain. In the first experiment (i.e., "endow-upgrade experiment"), we endowed each participant with six units of conventional milk and asked them their WTP to upgrade from the endowed product to each unit of the auctioned product (organic milk). In the second experiment (i.e., full bidding experiment), we did not endow participants with conventional milk and asked them their WTP for the auctioned products. In contrast to previous studies on endowment effect, we did not ask participants in the full bidding experiment to report their WTP for the conventional milk and then determine the premium price for the organic milk by subtracting the WTP for the conventional milk from the WTP for the organic milk. However, we informed all participants in both experiments about the market price of the conventional milk considered in the experiment (0.90€)[4]. Therefore, in the full bidding experiment, we asked subjects to report their WTP for the organic milk knowing that the price of the conventional milk is 0.90€ and that their price premium for organic milk is nothing more than their WTP for organic milk minus 0.90€ In the endow-upgrade experiment, we asked subjects their WTP to upgrade from the conventional milk to the organic milk knowing that the price of the endowed milk is 0.90€/unit.

There are a number of reasons why we did not auction the conventional milk in the full bidding experiment and instead, informed participants in both experiments about the reference market price of the conventional milk. First, since all the participants are regular consumers of milk, we expected their WTP for the conventional milk to be censored at above the market price and not reflecting their true WTP. Second, we did not auction the conventional milk to avoid making the participants think that it may be more profitable to get the conventional milk in the lab than in supermarkets, which can then bias their bids for the products. In fact, allowing participants to bid for the conventional milk in the full bidding experiment may result in decreasing WTP through units of the product (i.e. consequently the price that the winner has to pay for the nth unit is lower than the price s/he has to pay for the $(n-1)^{th}$ unit). However, since conventional milk is generally sold with a constant price per unit in Spanish

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[4] 0.90€is the average of the prices of the different brands of conventional milk available in the market.

supermarkets, a participant may then get an incentive to get the product in the lab not only because s/he wants it but also because it might be more profitable to buy units beyond the first one in the experiment than in the supermarket[5]. Finally, by providing participants in both experiments the reference market price of conventional milk, we tried to guarantee that the endowment of the conventional product is the unique difference between the endow-upgrade experiment and the full bidding experiment. Hence, with this design, differences in participants' behavior would more likely be due to the endowment effect and not due to other factors such as field substitute's bias and option value bias.

To rule out the windfall effect[6], which is a principal cause of the reciprocal obligation effect, we reduced the participation fee (i.e., roughly the equivalent value of 6 units of conventional milk) of the subjects in the first experiment since they were endowed with the conventional milk. Hence, while participants in the second experiment received 15€, participants in the first experiment received 10€ plus the six units of conventional milk.

3.1   Endow-upgrade Experiment

Eighty randomly selected subjects participated in the endow-upgrade experiment[7]. These subjects were randomly assigned to 8 sessions with 10 participants per session. The auctioned product was six identical items of organic milk. The experiment was performed in a room equipped with computers. We used the z-tree software (Fischbacher 2007) to collect bids and to determine the winner and the clearing price. Participants also had to complete a questionnaire eliciting socio-demographic and economic information. Each subject was given 10€ as participation fee. We also endowed participants with six items of one-liter of conventional milk (with the same brand and fat content as organic milk being auctioned) and informed them that the milk and the cash endowments are payment they receive for participating in the experiment. To avoid brand effects, we covered all the milk items with white paper.

The experiment was performed in three steps. In step 1, each subject sat in a

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[5] However, we informed participants in both experiments that they can report a decreasing WTP for the units of organic milk.

[6] Participants endowed with a product may feel somewhat wealthier and try to be kind to the experimenter by bidding high values for the auctioned product (Lusk and Shogren 2007).

[7] In both experiments subjects were randomly drawn from a list of people who are responsible for food shopping in their household and who are regular consumers of milk.

table separated from the rest to minimize any possible interactions and allow anonymous bidding. After taking a seat, each subject was provided an identification number (to be held in secret during the process) and a questionnaire. We then asked participants to complete the questionnaire.

In step 2, once the questionnaire was completed, the actual experiment began. One of the main determinants of success in experimental auctions is a good understanding by the participants of the operating procedures used in the auction mechanism. To achieve this goal, we gave each participant a printed material that included an explanation of how the specific auction works and some examples to illustrate the auction. After reading and discussing the instructions, participants were given the opportunity to ask questions to dissipate any doubts about the process. Given the importance of this step, we informed participants that it is very important that they fully understand the auction mechanism. We also demonstrated to them how they can lose money if they deviate from their true valuations. We moved to the next step only after being sure that all participants fully understood how the auction mechanism worked. Finally, to permit a better understanding of the auction mechanism and a good familiarity with the software, we carried out a training session, auctioning six identical items of organic milk and informed participants that no actual economic exchange will take place at the end of the training session. In this session, we asked participants to bid the amount they are willing to pay to exchange each item of their conventional milk (with a reference price of 0.90€) with a unit of organic milk. We informed the participants that the only difference between the milk they already have and the product to be auctioned was the organic attribute. Once all participants reported their bids through the computer, the identification number of winner(s) is displayed in the screen of the computer.

In step 3, once the participants became familiar with the procedure, we announced the start of the real auction of organic milk. Each participant had to submit, again through the computer, how much he or she was willing-to-pay to exchange each unit of conventional milk with a unit of organic milk. Once all participants finished reporting their bids, the software determined whether the participant was the winner or not and the price that he/she had to pay for each unit won. Once the results were announced, the experiment ended by handing the product to the winner(s) who had to pay the corresponding market-clearing price.

3.2   Full bidding Experiment

We randomly selected 90 subjects to participate in the full bidding experiment. Sessions were conducted in groups of 10 subjects. In this experiment, subjects were not endowed with conventional milk but received 15€ each for participating in the experiment. We conducted the full bidding experiment using the same three steps as in the first experiment, except that subjects were asked their WTP for the organic milk items rather than their marginal WTP to exchange

conventional milk with organic milk. As previously discussed, we provided subjects a reference price of 0.90€ for the conventional milk. Therefore, the price premium they are willing to pay for the organic attribute is computed by subtracting 0.90€ from their WTP for the organic milk.

4   Results

Considering the whole sample, we first test the significance (t-test) of the difference between the mean of the price premium for the organic attribute obtained using the endow-upgrade method and the price premium for the organic attribute obtained using the full bidding method. We then report the results of six Tobit models designed to test the effect of initial endowment of six units of conventional milk on subjects' valuations. We then conducted an analysis for different subsamples based on the number of the auctioned product the participant is willing to buy.
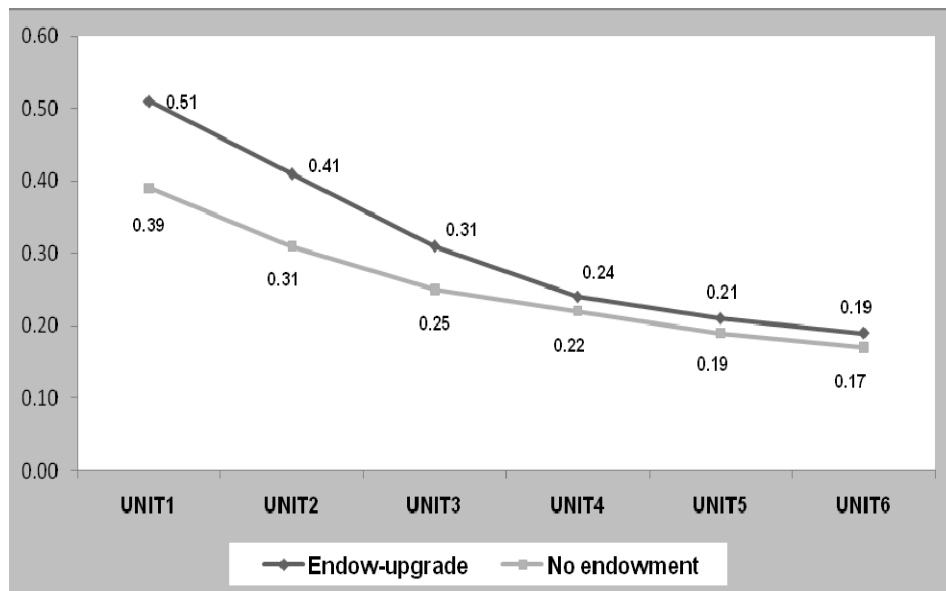

Figure 1: Mean of the Price Premium for the Organic Attribute Obtained in the Endow-upgrade and the Full Bidding Experiment

As exhibited in Figure 1, the mean of the price premium in the endow-upgrade experiment is higher than that obtained in the full bidding experiment but the differences are only significant in the first, second and the third

unit[8]. This result is also evident in the Tobit model for each unit of the auctioned product. The independent variables, consisting of a dummy variable for type of experiment/approach and other control variables, used in the Tobit models are listed and described in Table 1[9].

Table 1: The Independent Variables Used in the Model

Label of independent Variables	Name	Description
Endowment	ENDOWMENT	Dummy variable that takes the value 1 if the subject participated in the endow-upgrade experiment; and 0 otherwise
Frequency of purchasing milk	WEEKLY	Dummy variable that takes the value 1 if the subject used to buy milk once a week; and 0 otherwise
Quantity of milk purchased per week	QUANTITY	continuous variable: the quantity of conventional milk purchased by week; and 0 otherwise
Household size	HOUSEHOLD	Dummy variable that takes the value 1 if participants lives in a household composed of more than 2 members; and 0 otherwise
Gender	GENDER	Dummy variable that takes the value 1 if the participant is male; and 0 otherwise
Age	AGE	Continuous variable: age of the participant
Subjects who have children	CHILDREN	Dummy variable that takes the value 1 if the participant has children; and 0 otherwise
High income	INCOME	Dummy variable that takes the value 1 if the participant's income is more than 2500€/month; and 0 otherwise

[8] Both demand curves show that the organic milk is a normal good, since participants' WTP decreases as the number of unit increases.

[9] Since inventory effects can be an important issue that could potentially influence WTP, we asked our subjects questions related to the number of units (similar unit we used in our experiment) of milk they normally buy every week (QUANTITY), frequency of buying milk (DAILY, WEEKLY or MONTHLY), and size of their household (HOUSEHOLD). These questions tend to provide less measurement errors than questions that directly ask people the amount of inventory they have at home (Raphael 1987; Coughlin 1990 and Koriat 1993). In addition to these variables, we also include a number of demographic factors as control variables in the models.

As shown by the coefficients of the "endowment" variable in the Tobit models (Table 2), results for the first unit, second unit and the third unit suggest a reverse endowment effect. Corrigan and Rousu (2006) found the same results using single-unit auction and proposed the presence of "reciprocal obligation effect" (windfall effect) as a likely explanation. We take out this effect in our experiment, however, by informing participants in the endow-upgrade experiment that the units of conventional milk they received are part of their participation fee. The amount of cash money that the participant has to pay if s/he is declared the winner is probably the cause of this disparity. For example, in the endow-upgrade experiment, the winner just has to pay the price premium declared as the clearing price, while in the full bidding experiment; the winner of the auctioned product has to pay the whole price. Consequently, participants who are endowed with the conventional milk may have greater incentive to pay more for the auctioned product and to buy more units of organic milk vis-à-vis the participants in the full bidding experiment.

Table 2: Tobit Models

Variables	Model 1 unit1	Model 2 unit2	Model 3 unit3	Model 4 unit4	Model 5 unit5	Model 6 unit6
CONSTANT	0.437***	0.270	0.194	0.074	-0.015	-0.064
ENDOWMENT	0.179***	0.160**	0.128*	0.121	0.142	0.142
WEEKLY	0.072	0.105	0.054	0.017	-0.034	-0.050
QUANTITY	-0.015	-0.009	-0.010	-0.016	-0.012	-0.010
HOUSEHOLD	0.048	0.051	0.006	0.102	0.124	0.117
GENDER	0.056	0.107	0.138*	0.145*	0.154*	0.153*
AGE	0.000	-0.001	0.000	0.001	0.000	0.000
CHILDREN	-0.153**	-0.150**	-0.213***	-0.228***	-0.209**	-0.220***
INCOME	-0.113	-0.058	0.015	0.007	0.060	0.080
Loglikelihood	-105.35	-107.37	-106.66	-111.97	-110.00	-110.00
Wald chi2	15.90	13.76	15.76	13.19	13.19	11.79
Prob > chi2	0.04	0.08	0.04	0.05	0.16	0.16

*** (**) (*) Statistically significant at 1%, 5% and 10% level

Results above generally suggest that the differences in WTP values between the endow-upgrade and the full bidding experiments tend to become insignificant as the number of units of the auctioned product increases. A first intuition of these results is that in the endow-upgrade experiment, an increase in the number of units

that the participant is willing to buy is accompanied by a proportional increase in the number of units of conventional milk that s/he is willing to give up or to exchange for units of organic milk (i.e. since the auction rule indicates that the winner gets the auctioned product and gives the auctioneer the conventional product and an amount of money equal to the clearing price, then the number of units of conventional milk the winner has to exchange is equal to the number of units of organic milk s/he wins. For example, if the winner wins four units of organic milk, s/he has to give up four units of conventional milk and keeps the other two units). Consequently, the increasing effect of loss aversion seems to inhibit the incentives of participants to bid high for the last three units.

To test this intuition, we divided the subjects in the two experiments based on the number of units of organic milk they are willing to buy: buyers of one unit, buyers of two units, buyers of three units, buyers of four units, buyers of five units and buyers of six units (i.e. participant is considered a buyer of a unit if for that unit s/he reported a positive premium price). We assumed that a positive price premium is a sign of the participant's willingness to exchange the conventional milk with organic milk. We then compared the effect of the endowment by testing the sign and the significance of the difference in the mean of the price premium in the endow-upgrade experiment and the mean of the price premium in full bidding experiment in each of the subsamples and through the various units auctioned. Results in Table 3 exhibit an interesting pattern[10].

Table 3: Difference in Premium Prices Obtained from Endow-upgrade Experiment and Full Bidding Experiment: Buyers of Different Units by Auctioned Unit

	Buyers 1 unit	Buyers 2 units	Buyers 3 units	Buyers 4 units	Buyers 5 units	Buyers 6 units
UNIT1	0.13	0.19	0.10	-0.05	-0.15	-0.10
UNIT 2	-	0.21	0.12	-0.10	-0.11	-0.08
UNIT 3	-	-	0.12*	-0.14	-0.08	-0.08
UNIT 4	-	-	-	-0.21*	-0.08	-0.09*
UNIT 5	-	-	-	-	-0.05	-0.11**
UNIT 6	-	-	-	-	-	-0.11**
Number of Bidders	18	18	16	10	5	76

** (*) Statistically significant at 5% and 10% level

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[10] For a simpler reading of the table we only report the difference between the mean of the price premium in the endow-upgrade experiment and the mean of the price premium in full bidding experiment.

We found that when the number of units of the endowed product that the participant is willing to give up is lower or equal to the number of remaining endowed units (e.g., in the case of buyers of two units, the number of units of the conventional product that participants are willing to exchange for organic milk is two, which is lower than the remaining four units), the endowment effect is reverse (i.e., the difference between the premium price obtained in the endow-upgrade experiment and in the full bidding experiment is positive). However, when the number of units that the subject is willing to give up is higher than the number of remaining units (e.g. buyers of four units are willing to exchange four units of conventional milk with four units of organic milk and the remaining number of endowed product is two units), we find a positive endowment effect. Hence, our results seem to suggest that when the number of units of the endowed product that participants are willing to give up is higher than the number of remaining units, participants feel that they are losing more than they are winning and a loss aversion effect arises. This finding implies that the endowment effect in multi-unit Vickrey auctions depends on the number of units of the endowed or conventional product that the participant is willing to give up.

To further support this finding, we graph the price premiums for each auctioned unit and type of buyer in Figure 2. While the price premium for the organic milk in the full bidding experiment is weakly increasing in the type of buyer, it is generally decreasing in the endow-upgrade experiment where participants have to give up more units of the endowed conventional milk if they want to buy more units of the auctioned organic milk. While some results are not statistically significant due the low number of participants in some sub-samples (e.g. buyers of 5 units), they are nonetheless significant in economic terms. For example, the differences between the price premium in the endow-upgrade experiment and the price premium in the full bidding experiment range from 0.05€ to 0.21€, which is equivalent to a range of 12.5% to 52.5% of the mean of price premium for organic milk in the market.

5   Discussion and Concluding Remarks

Endowing subjects with goods have been found in previous experimental auction studies (e.g., Lusk, Feldkamp and Schroeder (2004); Corrigan and Rousu (2006)) to significantly influence valuations in single-unit auctions. This issue is important since questions may be raised about the accuracy and validity of the results from many valuation studies that used the "endow-upgrade" approach (Corrigan and Rousu 2006; Alfnes 2009). The studies, however, that evaluated initial endowment effects in experimental auctions used single unit auction mechanisms. While these are useful, it is generally not known if these effects are present in multi-unit auction settings. Hence, in this paper, we further examine the effect of initial endowments in experimental auctions but instead of using single-unit auctions as in previous studies, we study the issue in a multi-unit

setting using an increasingly useful valuation tool, multi-unit auctions. We suspect that the use of multi-unit auctions for applications related to product pricing, marketing, and policy will increase in the near future due to some of its advantages over single-unit auctions. For example, multi-unit auctions allow the derivation of demand curve for the product being auctioned for each individual and the market. Hence, demand elasticities and consumer surplus measures can be derived, which can then be used, among others, in evaluating consumer demand and welfare implications of policy interventions (e.g., product taxes, price ceilings, price floors). Using a six-unit Vickrey auction, we found a "reverse" endowment effect in the first three units and observed that the direction of the endowment effect is related to the number of units that subjects are willing to give up. Specifically, we found a reverse endowment effect when the number of units that subjects are willing to give up is lower or equal to the number of remaining endowed units. However, we found a positive endowment effect when the number of units that subjects are willing to give up is higher than the number of remaining endowed units.

Our results generally suggest that subjects tend to decrease their WTP as the number of units of the endowed product they have to give up increases. When the number of units of the endowed product that subjects have to give up is higher than the number of the remaining units, the loss aversion effect (caused by the tendency of subjects to value the products more when they own it) becomes high enough to counterbalance the "reverse" endowment effect. Since our results show more sensitivity of the endow-upgrade approach to the endowment effect, it would be generally better to use the full bidding approach when eliciting consumers' willingness to pay values for multiple units of a new product or product attribute.

Some researchers have tried to take out loss aversion effects by decreasing the ownership of the endowed product. For example, Corrigan and Rousu (2006) informed their participants that they will receive the endowed good at the end of the experiment. Plott and Zeiler (2007), on the other hand, informed their subjects that it will be by pure chance (flipping a coin) that they will receive a product (i.e., either mugs or pens) and that the subjects in the next door will receive the alternative good. Hence, it might be interesting in future studies to test the effect of decreasing the ownership of the endowed products on loss aversion effects in multi-unit auctions. In addition, we utilized a constant reference price across units of the conventional product in our experiments to avoid influencing subjects' bids for units of the upgrade product. Since reference prices can potentially influence bidding behavior in experimental auctions (Drichoutis, Lazaridis and Nayga 2008), future studies could test the robustness of our findings with varying reference prices of the conventional products.

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