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Unstable Individual Bids and Stable Market Demand[1]

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Abstract: We explore preference stability at the individual and market level. We examine individual bidding behavior among 116 French consumers who participated in experimental auctions conducted seven months apart for five types of fish. We reject preference stability at the individual level, but not at the aggregate market level.

JEL: C91, D12, Q13

Key words: aggregation, consumer preferences, demand, experimental auctions, food choice

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1. Introduction

Stable market demand arising from stable individual preferences remains a classic assumption in neoclassical demand theory (e.g., Varian 1982; Ariely et al. 2003). But stable individual preferences is a sufficient not a necessary condition for a stable market demand curve.[1] For example, Härdle and Kirman (1995) report stabile market demand created through aggregation in their field study of professional buyers in the Marseilles fish market. They found downward sloping demand curves at the aggregate level but not at the individual level and concluded that: "sophisticated and complicated individual behaviour may lead to simple aggregate properties" (p. 228).

We use a controlled experimental auction setting to explore preference stability at the individual and market level. We test for preference stability using a panel of 116 French consumers who participated in two experimental auctions conducted seven months apart for five types of fish. We measure stability based on bids elicited by using the Becker-DeGroot-Marschak (1964) mechanism (BDM), and reject the hypothesis that individual bids are stable. However, we find that the market demand curves are stable indicating that stable market preferences are due to the market's aggregation properties across consumers. This supports the broader notion that stability in economic behavior should be defined as a social construct, not an individual one (Arrow 1987; Smith 1993).

2. Repeated Experimental Auctions: Sample and Design

We conducted the experiments in the sensory laboratory of l'institut national de la recherche agronomique (INRA) in Dijon. Based on INRA's consumer panel, we created a panel of 116 typical French consumers who participated in two experimental auctions conducted in

[1] Becker (1962) showed how well-behaved downward sloping aggregate demand curves can be derived for a wide class of behavior, including random choices within the budget set.

May and December 2008. The sample consisted of 63 women and 53 men, age ranging from 23 to 70 years old, with an average of 48 years. All the participants said they eat fish at least once a month and purchase fish at least every second month.

Participants were paid €25 per session. Each participant evaluated salmon, wild cod, farmed cod, monk, and pangasius. Each session had two parts and a survey. The first part was a sensory evaluation. After a professional chef cooked the fish, each participant was served 50 grams of each fish in rotational order to avoid any ordering effects. Before tasting, the participants were told what fish they were served. After tasting, the participants gave their hedonic scores.[2]

The second part elicited preferences for the fish. Stable individual preferences would imply stable bidding behavior in the experimental auctions conducted at different times. We used a BDM mechanism, in which each bidder's weakly dominant strategy is to bid the amount that leaves him indifferent between obtaining the product or not. While demand revealing in theory, such mechanisms frequently require some initial training (e.g., Lusk and Shogren 2007: 63). We first explained the BDM and then the participants practiced bidding on orange juice or champagne.

3. Results

Table 1 shows the descriptive statistics for the bids. The median bids remained stable from May to December for all fish types except farmed cod. For farmed cod, the median bid increased from €8.00 to €9.25. The mean bid for farmed cod increased from €7.82 to €8.71 while the mean bids fell slightly for the other fish types.

[2] We do not discuss the results of the sensory evaluations, however, the individual hedonic scores are also unstable.

3.1. Stability results

Two main results with respect to stability emerge from our experiments.

Result 1. Individual preferences are unstable across the two sessions.

Support. In Row 1 of Table 2, we present the number of participants with constant bids (mostly 0 in both experiments). Rows 2 through 4 shows the number of participants who changed bids by less than half a standard deviation; by one-half to one standard deviation; and by more than one standard deviation. As seen in Table 1, the standard deviations being in range of €3.74 to €6.91 for the different fishes. More than 50 participants changed their bids by more than half a standard deviation for each fish type.

Many participants also changed their ranking of the five fish types. Only 11 participants had a constant ranking of the bids. Furthermore, as shown by the last row of table 2, only 53 of 116 participants ranked salmon identically according to the bids in May and December. The corresponding numbers for wild cod, farmed cod, monk, and pangasius are 47, 43, 61, and 69.

Table 3 shows the Pearson correlation coefficients between the bids in May and December and the associated 95% confidence intervals. Zero correlation suggests independent valuations in the two experiments, i.e., random bidding, while a correlation factor of one implies constant bidding. All the correlation coefficients are significantly different from zero and one, suggesting that the individual bids are positively correlated between the two experiments; however, they do not come from a group of individuals with stable preferences.

Result 2. Aggregate market demand curves are stable across the two sessions.

Support. Define each individual's demand curve by

$$x_{ijt} = \begin{cases} 0 \text{ if } p_{jt} > Bid_{ijt} \\ 1 \text{ if } p_{jt} \le Bid_{ijt} \end{cases} \tag{1}$$

where x_{ijt} is the quantity demanded of product j by individual i at time t, p_{jt} is the price of the good, and Bid_{ijt} is the bid.[3] Let participant 1 be the highest bidder, participant 2 the second-highest bidder, and so on; n participants are willing to pay at least the same as participant n's bid. The market demand curves, X_{jt} is defined by

$$X_{jt} = \sum_{i=1}^{I} x_{ijt}(p_{jt}) \tag{2}$$

We constructed the market demand curves for May using equation (2), i.e., by ranking the individual participant's bid from the highest to the lowest. The market demand curves for salmon and wild cod are shown by the solid lines in Panels A and B of Figure 1. In these panels, the December bids using the same ordering of the participants as in May are plotted as the dots.

As discussed above, the individual bids change in erratic ways. For example, Panel A shows 11 participants who bid a positive amount for salmon in May bid zero in December; 10 participants who bid zero in December bid a positive amount in May. The second highest bidder for wild cod in May, who bid €20, was only the 56th highest bidder in December with €10, and the third highest bidder in December, who bid €19.90, was only the 29th highest bidder in December with €14. Of the 11 participants who bid a positive amount for wild cod in May, but not in December, 9 bid a positive amount for salmon in December. This result shows even though these participants did not want to buy wild cod, they still wanted to buy fish.

[3] Each package of fish weighted about 300 grams, which may be insufficient for a meal in a household consisting of more than two persons. To avoid that the package size caused zero bids, we let each participant choose if he wanted to purchase 1, 2, 3, 4, or 5 packages of fish before the bidding. Since this procedure was implemented for practical reasons, we count the individual demand in equation (1) as 1 rather than the requested number of packages.

To investigate the stability of market demand, we constructed the market demand curves in December as in May, i.e., by ranking the participants bids from the highest to the lowest bid. Panels C and D present the results for salmon and wild cod. As shown in the figures, none of the market demand curves shift substantially.[4]

Several statistical tests were implemented to test for the stability of the market demand curves. We use a Wilcoxon signed rank test (W) to test for identical median bids, a Brown-Forsythe test (B-F) to test for identical variances of bids, and a Kolmogorov-Smirnov test (K-S) to test for identical probability distribution functions for bids in the two experiments (Hollander and Wolfe 1999). Table 3 presents the test values and the associated *p* values of the tests. The median bid for farmed cod increased significantly. This increase may be explained by a improved quality as reflected by a significant increase in the median hedonic score. The median bids for the other fish types did not change. Finally, we do not reject identical variance or identical distribution functions for any of the bids in May and December.

4. Conclusions

Our results suggest that individual preferences were unstable over experimental sessions for French consumers. Even though the individual preferences are unstable, aggregation across participants creates stable market demand curves. Our results further supports the general notion that random day-to-day variations in individual preferences have minor effects on the stability of the market demand. This is good news since food producers and retailers are primarily interested in the market demand and not the preferences of the individual consumer.

[4] Figures for farmed cod, monk, and pangasius show similar patterns but are not presented here.

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Table 1. Descriptive Statistics for the Bids

	Mean	Median	St Dev	Min	Max	N	Zeros
Salmon							
May	10.16	10.00	5.70	0.00	25.00	116	15
December	10.01	10.00	5.10	0.00	18.00	116	13
Wild cod							
May	9.87	10.00	5.59	0.00	23.00	116	16
December	9.81	10.00	5.66	0.00	20.00	116	18
Farmed cod							
May	7.82	8.00	5.50	0.00	21.00	116	25
December	8.71	9.25	5.79	0.00	22.00	116	23
Monk							
May	11.40	12.00	6.60	0.00	25.00	116	20
December	10.75	12.00	6.91	0.00	24.00	116	24
Pangasius							
May	2.28	0.00	4.06	0.00	18.00	116	82
December	1.96	0.00	3.74	0.00	17.00	116	87

Table 2. Stability of Individual Bids

	Salmon	Wild Cod	Farmed Cod	Monk	Pangasius	Total
Constant bid	21	17	17	22	79	
$0 < \text{Change} < 0.5 \cdot SD$	44	31	37	40	10	
$0.5 \cdot SD \leq \text{Change} \leq 1.0 \cdot SD$	31	29	26	24	9	
$\text{Change} > 1.0 \cdot SD$	20	39	36	30	18	
Constant ranking	53	47	43	61	69	11

Table 3. Test Results for Stability

	P[a]	95% CI[b]	W[c]	p-value	B-F[d]	p-value	K-S[e]	p-value
Salmon	0.63	0.50-0.73	0.16	0.87	1.20	0.28	0.08	0.88
Wild cod	0.46	0.31-0.59	-0.07	0.95	0.01	0.94	0.03	1.00
Farmed cod	0.51	0.36-0.63	-2.12	0.03	0.55	0.46	0.12	0.37
Monk	0.53	0.39-0.65	0.62	0.53	1.03	0.31	0.09	0.57
Pangasius	0.65	0.54-0.75	0.33	0.74	1.18	0.37	0.40	0.53

Notes:
[a] Pearson correlation coefficient as estimated by STATA corrci command.
[b] 95 % confidence interval for Pearson correlation coefficient estimated by STATA corrci command using the Fisher transformation.
[c] Wilcoxon signed-rank test as estimated by STATA signrank command.
[d] Brown-Forsythe test of equal variance as estimated by STATA robvar command.
[e] Kolmogorov–Smirnov test as estimated by STATA ksmirnov command.

Figure 1. Bids for salmon and wild cod in May and December