Unstable Individual Preferences and Stable Aggregate Demand: French Consumers' Willingness to Pay for Farmed and Wild Cod*

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Abstract: We use panel data from two experiments conducted five months a part to investigate the stability of individual preferences and aggregate demand for five types of fish. Even though the bids in the two experiments are positively correlated, they clearly suggest that the individual preferences are unstable. This may be explained by internal desire for variety or by external effects such as new relevant information, seasonality in preferences, changes in the quality of the fish, and changes in the market price of fish. However, the aggregate demand curves of the participants are stable when we control for changes in the perceived quality of the fish and price expectations of the participants. In other words, the stability is generated by aggregation rather than derived from stable individual preferences.

JEL: C91, D12, Q13

Key words: aggregation, consumer preferences, demand, experimental markets, food choices

1. Introduction

Consumers do not buy the same products on each trip to the food store. This has led to a large literature in marketing on variety seeking behavior focused on temporal changes in tastes from purchase occasion to purchase occasion (see e.g., McAlister and Pessemier 1982). Neoclassical theory of consumer demand, on the other hand, assumes the existence of stable preferences for goods. In the variety seeking literature, the observed changes in purchases are explained by

changes in external factor between the purchase occasions, or by internal factors such as desire for variety. Changes in external factors can be changes in the relative prices, changes in the household's storage of different goods, changes in the quality of products, new relevant information, or changes is usage situation due to time of day, seasonality, presence of other products, or presence of other people. Desire for variety means that consumers like to consume a variety of products, and therefore change their purchases from day to day. The desire for variety is explained by satiation after experiencing a product. Hence, after consuming one product, most consumers choose to consume a different product on the next occasion.

More recently the theory of coherent arbitrariness (Ariely, Loewenstein, and Prelec 2003) has been used to explain apparent random effects and unstable individual preferences. They show how peoples' willingness to pay (WTP) for products are affected by arbitrary anchors. However, they also find that consumers' relative valuation of different amounts of a good as well as different products appear coherent as if supported by demand curves from stable preferences. Changed anchors from one purchase opportunity to the next are likely to show up as instabilities in the WTP for the products, however, the bid differences between products are expected to be stable. Similar anchoring effects on consumers' WTP are also discussed in the paper on incidental pricing by Nunes and Boatwright (2004).

Individual preferences and WTP are more likely to be unstable than aggregate demand or WTP because individual specific effects are likely to cancel out during aggregation. This conclusion is supported by Mattei (2000) who studied decision making under certainty. He found that a significant number of individuals made choices among ordinary consumer goods that were inconsistent with the neoclassical model. The results led him to conclude that the heterogeneity

of preferences should make aggregate behavior more regular since individual errors will cancel out on average.

An early discussion about how unstable individual preferences may result in downward-sloping and stable aggregate demand curves is provided in Becker (1962). He showed how well-behaved downward-sloping aggregate demand curves could be derived for a wide class of behavior, including individuals who choose bundles of goods randomly from their budget set. Similar conclusions are drawn by Härdle and Kirman (1995) who found downward sloping demand curves at the aggregate level but not, in general, at the individual level using data from the Marseille fish market. They summarized their result as "sophisticated and complicated individual behavior may lead to simple aggregate properties".

We investigate the stability of individual preferences and aggregate demand over time using experimental data. One group of regular consumers participated in a market experiment for fish in December 2007 and May 2008 and we investigate the stability of their WTP for five types of fish in the two experiments. As discussed above, the participants' bids may be affected by many factors at the time of the experiment and, furthermore, these factors may change between the two experiments. The effect of the desire for variety is likely to cancel out during aggregation while systematic changes in external factors will not cancel out.

This paper distinguishes itself from the above sited literature in several ways. First, Härdle and Kirman (1995) study professional buyers in an actual market while we study consumers in a laboratory setting. Professional buyers are motivated by profit and not individual preferences, and changes in their purchases reflect changing beliefs about selling options. Second, Mattei (2000) studies inconsistencies in choices within one experiment while we look at instabilities across two experiments conducted five months apart. Third, desire for variety is not

likely to be a motivation factor in neither of these papers, but is likely to be an important motivation factor in consumers' choices for nonstorable fish products. Fourth, in the coherent arbitrariness literature, the effects of arbitrary anchors on the WTP or other measures of preferences are investigated. In this paper, we either keep the anchors constant or control for them in the statistical analysis. Finally, contrary to the variety seeking literature in marketing this paper uses WTP as a measure of preferences and looks on how unstable individual preferences affect the stability of aggregate demand.

The paper proceeds as follows. Section 2 gives some background on the fish products included in the study. Section 3 presents the experiment, and section 4 presents the sensory and bidding results. Section 5 presents the main results of the paper on unstable individual preferences and aggregate demand, and section 6 concludes.

2. Background on the fish

The most important whitefish species from wild fisheries are Alaskan pollack, hake, and cod. The annual catch of North-Atlantic cod is estimated to 770,000 tons in 2008. (Norwegian Seafood Export Council 2008). Furthermore, cod is a highly priced species and cod prices have been increasing over the last decade. Because of the high cod prices, cod has a large potential as an aquaculture product.

Experimental trials on cod farming started in Norway late in the 1970s, however, the production did not reach 10,000 tons before 2006. This is a small volume as compared with farmed whitefish species such as tilapia and pangasius with estimated production levels of more than 2 and 1 million tons, respectively (Norwegian Seafood Export Council 2008). However, some participants within the emerging cod farming industry believe that cod farming may be

equally successful as salmon farming. Norwegian salmon farms produced around 10,000 tons annually in the mid 1980s, however, the current production is around 700,000 tons. One critical factor for the growth possibilities of cod farming is the market potential for farmed cod in countries with a tradition of eating fresh cod.

To investigate the market potential for fresh farmed cod in France, we have used experimental markets to eliciting French consumers' valuations of five types of fish: farmed salmon, wild cod, farmed cod, wild monk, and farmed pangasius. Wild monk and farmed pangasius are included as expensive and inexpensive substitutes to cod, respectively. All fish types originated from the typical origin in the French market, i.e., Norwegian farmed salmon, North-Atlantic wild cod, Norwegian farmed cod, North-Atlantic wild monk, and Vietnamese farmed pangasius. We only include cod and salmon in this paper, however, the results for monk and pangasius are consistent with the presented results.

3. Experiment

The experiments were conducted at a sensory laboratory in Dijon, which is a medium size city (150.000 inhabitants), situated 300 km south-east of Paris. It is located in the heart of a habitat and employment basin of over 350 000 people. Dijon belongs to the Burgundy region (Centre-East of France), which is fully representative in terms of households' disposable income (99% of France mean disposable income). The socio-demographic composition of the Burgundy region is also close to the mean. Fresh fish consumption in the region is slightly under the mean of France, but representative of the non-coastal regions.

The data we use is a panel of 94 regular consumers who took part in two rounds of experiments. The first round was conducted in December 2007 and the second was conducted in

May 2008. The sample consisted of 56 women and 38 men, age ranging from 22 to 70 years old, with an average of 48 years.

The experiments consisted of three parts. The first part was a sensory evaluation. The fish was prepared by a professional chef, and the participants were served 50 grams of each fish type. For each type of fish, the participants marked on a linear unstructured scale with anchors *Do not like at all* (=0) and *Like very much* (=10) on a computer screen. The ordering of the fish types was rotated between the sessions to alleviate any ordering effects.

The second part of the experiments was a valuation experiment using the Becker-DeGroot-Marschak (BDM) mechanism (Becker, DeGroot, and Marschak 1964), which is one of the three commonly used sealed-bid mechanisms to elicit private values. The Vickrey auctions (Vickrey, 1961) and the uniform-price sealed-bid auctions with single-unit buyers (Vickrey, 1961) being the other two. The weakly dominant strategy is to bid the amount at which the bidder would be indifferent to whether he or she obtains the product or not, i.e., to bid the WTP for the product. As discussed by Alfnes (forthcoming), a straightforward implication of this strategy is that bidders should bid so that they obtain at least the same surplus from winning the auction as they would from buying a close substitute elsewhere. Hence, price changes in the outside market may affect the bids in the experiment. The biddings were conducted on a computer screen that also showed the tasting scores.

The third part of the experiment was a survey including demographic, attitude, and beliefs questions. Most of the questions were asked only in December, however, a few questions were repeated in May. The question: "*What is your <u>best guess</u> at the average market price for one kilogram of fresh salmon, cod, monk, and pangasius fillets this week?"* is of particular interest for this paper, and was asked both in December and May. Systematic changes in the

price beliefs due to changes in market prices will likely systematically affect the bids, and not cancel out in the aggregation.

The three parts of the experiment give us three sets of variables: tasting scores, bids, and price beliefs. All three sets of variables were elicited in May and December for the 94 participants included in the analysis.

4. Tasting and bidding results

The first data elicited in the experiments where the taste scores. In December the tasting was done with only information about the species of the fish, i.e., salmon and cod. In May the tasting was done with full information, i.e., Norwegian farmed salmon, North-Atlantic cod and Norwegian farmed cod. From table 1, we can see that the mean tasting scores for salmon were 7.55 and 7.60 in December and May, respectively. For wild cod the mean scores were 5.53 and 6.53 and for farmed cod they were 6.29 and 5.58 in December and May, respectively. Salmon has been sold as farmed salmon for many years and the taste scores were not significantly affected by telling the participants that the salmon was Norwegian and farmed. The taste scores for cod were, however, significantly affected by the information that there were two types of cod, i.e., North-Atlantic cod and Norwegian farmed cod.

Farmed cod and wild salmon are almost non-existent in the French market, and we asked the participants about their best guess of the average market price for one kilogram of fresh salmon and cod fillets without distinguishing between farmed and wild fish. As shown in table 1, the mean guesses of the market price for salmon were €14.65 and €14.38 in December and May. The corresponding guesses for cod were €13.56 and €15.23. The difference between December and May were insignificant for salmon and significant for cod.

Table 1 shows the descriptive statistics for the bids for farmed salmon, wild cod, and farmed cod in December and May. The mean bids for salmon were €10.01 and €10.14 in December and May. The corresponding bids for wild and farmed cod were €6.51 and € 9.15 and €6.89 and €7.37 in December and May, respectively. However, the bid difference between December and May is only significant for wild cod.

To quantify the effects of taste scores and price beliefs on the bids, we estimated the following models

(1) $$Bid_{ijt} = \alpha_0 + \alpha_1 Taste_{ijt} + \alpha_2 Price_{ijt} + u_{ijt}$$

(2) $$\Delta Bid_{ijt} = \gamma_0 + \gamma_1 \Delta Taste_{ijt} + \gamma_2 \Delta Price_{ijt} + u_{ijt}$$

where Bid_{ijt} is individual *i*'s bid for product *j* at time *t*. $Taste_{ijt}$ is the corresponding taste score and $Price_{ijt}$ is the corresponding market price belief. The constant term in the first-difference model γ_0 capture any systematic changes in the bids not related to changes in $Taste_{ijt}$ or $Price_{ijt}$. The results are presented in table 2. The first two columns present the results for the December data, the two subsequent columns present the results for the May data, and the last column present the results from the model on first-difference form. Tasting and price beliefs affect the bids significantly in all the three models. For example, in the December experiment, a one-point increase in the taste score resulted in bids that increased between €0.73 and €1.37. Furthermore, a one-Euro increase in the price beliefs resulted in bids that increased between €0.18 and €0.50.

We also used equation (1) to predict changes in the bids for wild cod from December to May. We used the participants' taste scores and price beliefs from May, inserted them into the model estimated for the December data, and found the bid predictions. Table 3 presents the results for the three fish types. First, we note that the model successfully predicted a significant bid increase for wild cod from December to May, and the prediction is within the 95%

confidence interval for the May mean. Second, the model predicts slightly lower mean bids than the observed bids for all the fish types. Third, for farmed cod and salmon the predictions are within the 95% confidence intervals of both the December and May means.

5. Individual preferences and aggregate demand

For an individual having stable preferences, only changes in relative prices, income, and quality of the fish would induce changes in the bids from December to May. Given moderate changes in these demand shifters, one would expect very high correlations between the individual bids in December and May. Comparing the individual bids in December and May, we can see that they are positively correlated, however, the correlation coefficients suggest that the bids are unlikely to come from individuals with stable preferences. The Pearson correlation coefficient between the bids for salmon in December and May is only $\rho_S = 0.47,$ and for wild and farmed cod the corresponding correlations are even lower, $\rho_{WC} = 0.38$ and $\rho_{FC} = 0.36$. Even though the correlations are lower than expected, we can reject that they are zero ($p < 0.01$ for all three) which would imply random bidding.

The individual demand curves in our experiment are given as

$$x_{ijt} = \begin{matrix} 0 \text{ if } p_{jt} > Bid_{ijt} \\ 1 \text{ if } p_{jt} \le Bid_{ijt} \end{matrix} \quad (3)$$

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 individual bid. To investigate the stability of the individual bids as compared with the aggregate demand, we have constructed the aggregate demand curves, X_{jt} as

$$X_{jt} = \sum_{i=1}^{I} x_{ijt}(p_{jt}) \quad (4)$$

Without loss of generality, we assume that individual 1 is the one with the highest bid, individual 2 is the one with the second-highest bid, and so on. Hence, *n* persons are willing to pay at least the same as individual *n*'s bid. The demand curve for December was constructed by using equation (4) on the December bids, i.e., by ranking the individual bids from the highest to the lowest.

First, we superimposed the May bids on the aggregated demand curve from December, keeping the individual numbering from the December data. Figure 1 presents the results for salmon, figure 2 for wild cod, and figure 3 for farmed cod. On the horizontal axis is the individual numbering from December used, so at the far left are the individuals with the highest bids in December and at the far right are the individuals with the lowest bids in December. As suggested by the relatively low correlations between the bids in December and May, many of the individual bids have changed in quite erratic ways suggesting unstable individual preferences. For example, figure 1 shows that six individuals that bid positive amounts for the salmon in December bid zero in May and four individuals that bid zero in December bid positive amounts in May. Furthermore, the highest bidder in May, who bid €25, was only the eleventh highest bidder in December, and the second highest bidder in May, who bid €22, was only the 49th highest bidder in December. Only ten out of the 94 participants gave the same bid for salmon in December and May, and 54 of the 94 participants gave bids that differed €5 or more.

Figure 1. Bids for salmon in December and May. Ranked by December bids

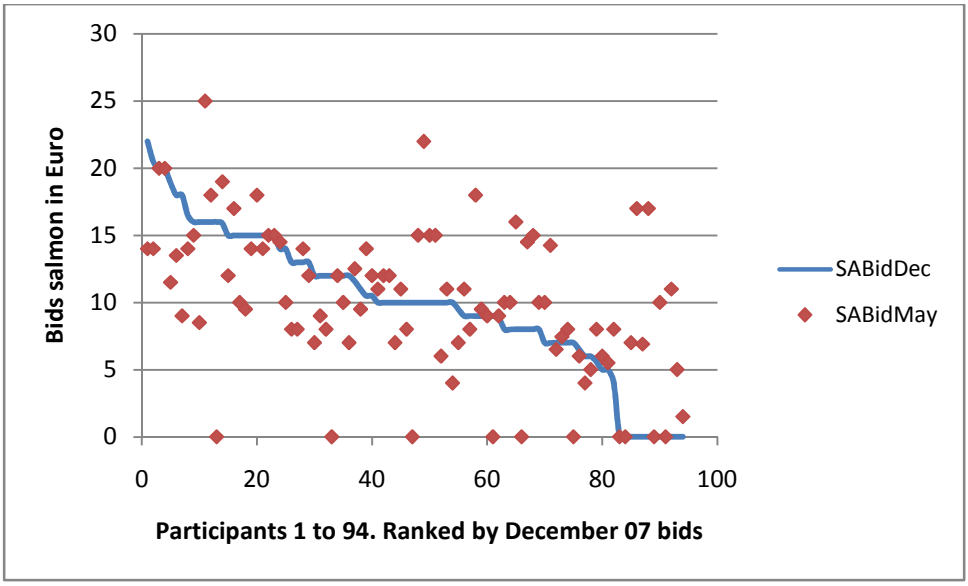


Figure 2. Bids for wild cod in December and May. Ranked by December bids

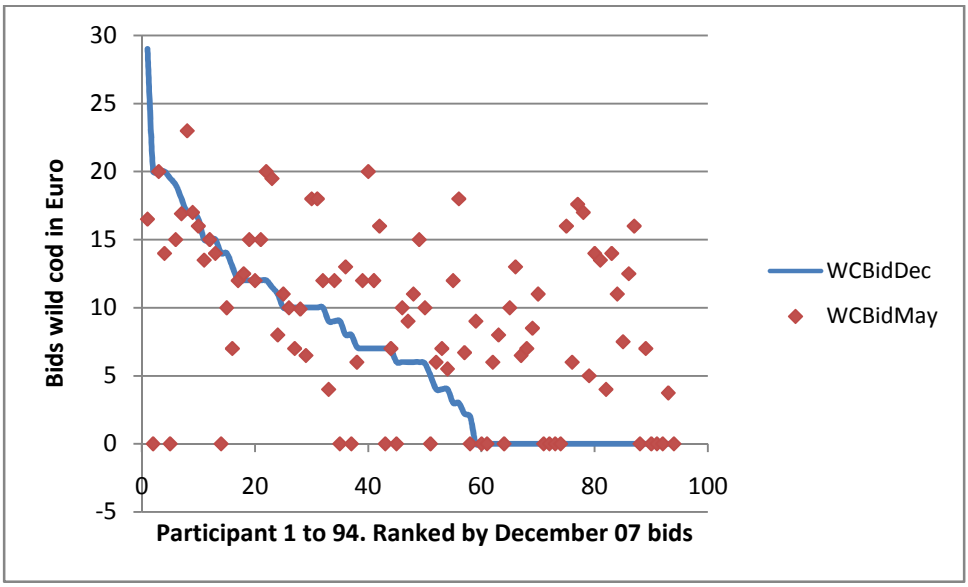
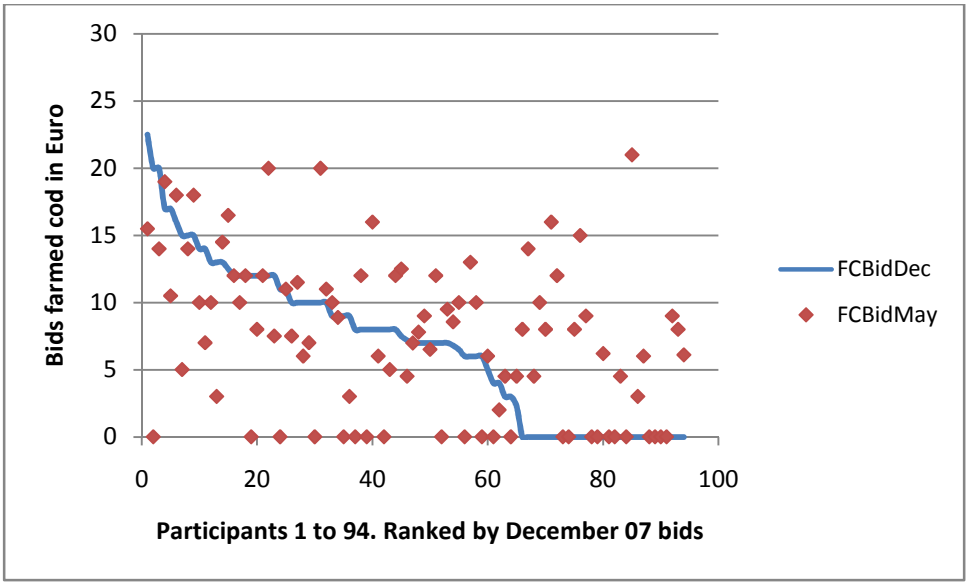


Figure 3. Bids for farmed cod in December and May. Ranked by December bids



Second, we constructed the aggregate demand curves in May the same way as we did in December, i.e., by ranking the individual bids from the highest to the lowest bid. Figure 4 presents the results for salmon, figure 5 for wild cod, and figure 6 for farmed cod. For salmon the aggregated demand curve from May is almost identical to the aggregate demand curve from December. For wild cod, there is a positive shift in the demand curve, as was predicted above, as a result of the significantly higher tasting scores and price beliefs in May than in December. For farmed cod, the aggregate demand curves for December and May are almost identical, except for four additional zero bids in May suggesting that the positive price effect has canceled out the negative tasting effect. The analysis suggests that aggregation causes stability even when the individual preferences are unstable.

Figure 4. Bids for salmon in December and May. Ranked independently

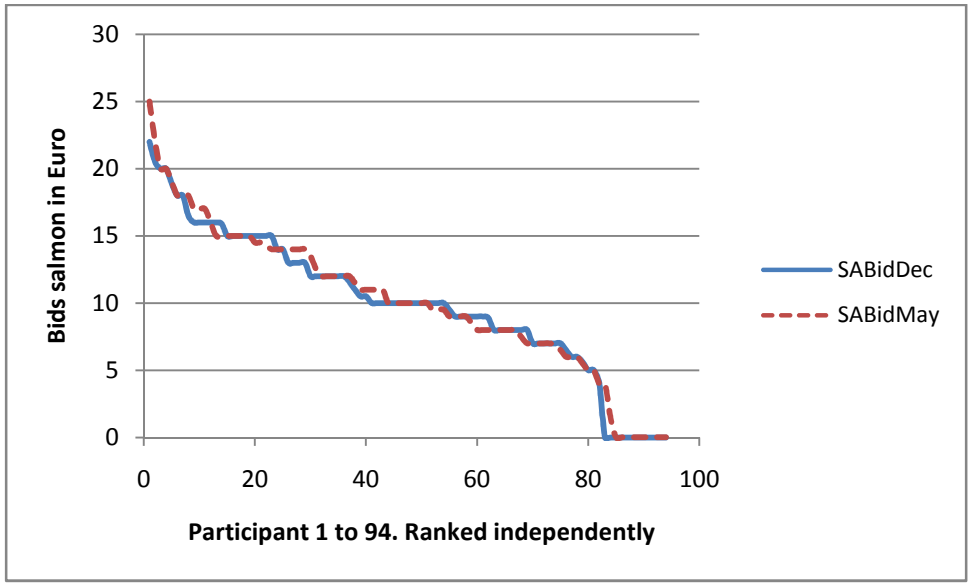


Figure 5. Bids for wild cod in December and May. Ranked independently

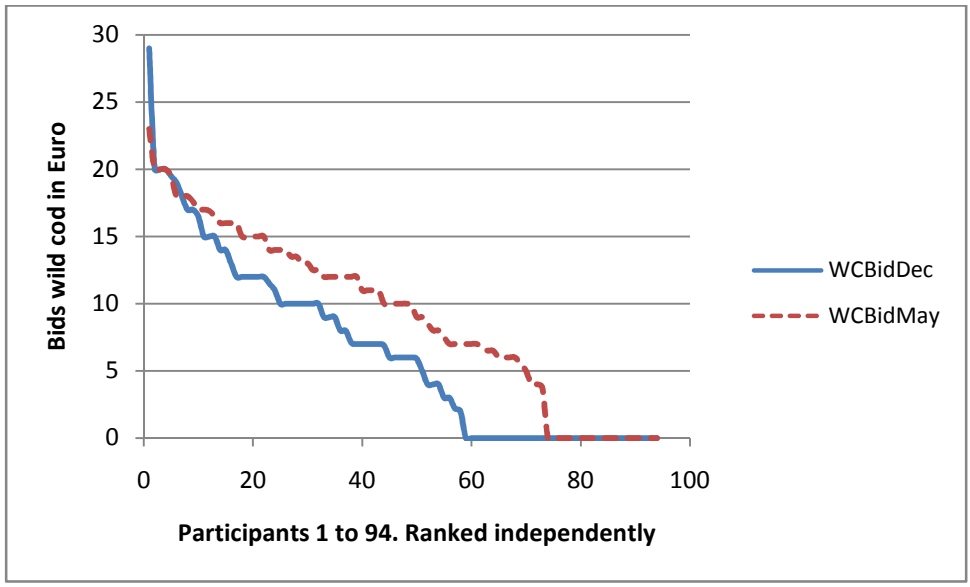
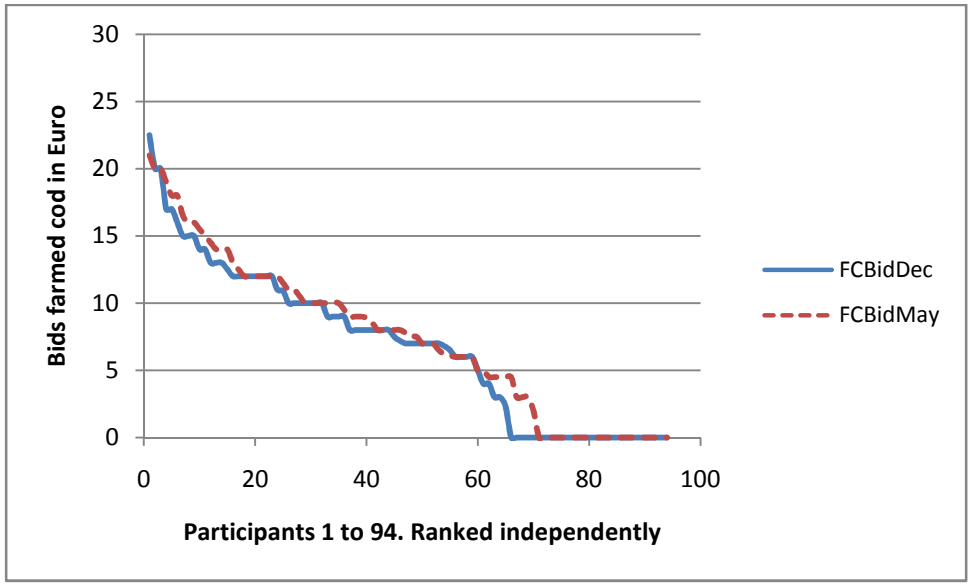


Figure 6. Bids for farmed cod in December and May. Ranked independently



6. Conclusion

The individual preferences elicited in our experimental markets were not stable between experiments. This is consistent with the variety-seeking literature in marketing, but not consistent with traditional neoclassic theory, which assumes stable preferences. This is not surprising, but the level of the instability is surprisingly high.

Even though the individual preferences are unstable, the aggregated demand curves are well-behaved. They are stable between experimental sessions when we control for significant changes in prices of close substitutes (same product sold in the market) or change in the perceived quality of the product. Furthermore, we are able to predict shifts in the demand curves from changes in price beliefs and perceived quality by extrapolating estimation results from one experiment over to another.

Further research will look into how stable tasting scores and price beliefs are between experiments, and how stable rankings of alternatives and segmentation results are between

experiments. Do people give the same tasting score and bid differently between experiments, or do they bid differently because the tasting score has changed? Do they keep the ranking, as suggested by the arbitrary coherent literature, or do they change the ranking as suggested by the variety seeking literature? These questions will be investigated in an expanded version of this paper.

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Table 1. Summary Statistics bids, taste scores, and outside price assumption

	Mean	Median	StD	Min	Max	N	Zeros
Salmon							
TasteDec	7.55	8.05	2.10	0.00	10.00	94	1
TasteMay	7.60	8.10	2.10	0.20	10.00	94	0
PriceDec	14.65	15.00	4.00	6.00	24.00	93	0
PriceMay	14.38	15.00	4.21	3.00	30.00	92	0
BidDec	10.01	10.00	5.37	0.00	22.00	94	12
BidMay	10.14	10.00	5.48	0.00	25.00	94	10
Wild cod							
TasteDec	5.53	5.75	2.63	0.00	10.00	94	2
TasteMay	6.53	6.70	2.16	0.60	10.00	94	0
PriceDec	13.56	12.00	5.24	3.00	33.00	94	0
PriceMay	15.23	15.00	4.79	3.00	24.00	92	0
BidDec	6.51	6.00	6.69	0.00	29.00	94	36
BidMay	9.15	10.00	6.37	0.00	23.00	94	21
Farmed cod							
TasteDec	6.29	6.30	2.34	0.00	10.00	94	1
TasteMay	5.68	5.80	2.38	0.00	9.90	94	1
PriceDec	13.56	12.00	5.24	3.00	33.00	94	0
PriceMay	15.23	15.00	4.79	3.00	24.00	92	0
BidDec	6.89	7.00	5.78	0.00	22.50	94	29
BidMay	7.37	7.65	5.90	0.00	21.00	94	25

Table 2. Effect of tasting and price assumptions on bids

	Model 1 Dec		Model 1 May		Model 2	
	Para	St.err	Para	St.err	Para	St.err
Salmon						
Constant	-2.90	2.29	-2.72	2.37	0.32	0.52
Taste	0.73***	0.24	0.95***	0.24	0.70***	0.24
Price	0.50***	0.13	0.39***	0.12	0.51***	0.11
Wild Cod						
Constant	-6.50***	1.65	-5.07**	2.16	0.92	0.67
Taste	1.37***	0.20	1.11***	0.26	1.42***	0.22
Price	0.40***	0.10	0.47***	0.12	0.27**	0.13
Farmed cod						
Constant	-2.27	1.90	-3.34*	2.01	1.45**	0.61
Taste	1.07***	0.23	1.15***	0.22	1.39***	0.20
Price	0.18*	0.10	0.28**	0.11	-0.30	0.12

Note: Significant levels at 1%, 5% and 10% are denoted by ***, ** and *, respectively.

Table 3. Observed and predicted mean bids

	Salmon	**Wild cod**	**Farmed cod**
Observed Dec	10.14	6.65	6.89
Observed May	10.14	9.15	7.37
Predicted May	9.85	8.59	6.50