Wild catch vs. Aquaculture: Preferences and predisposition to pay among residents of the coastal city of Shanghai

by Ting Meng, Wojciech J. Florkowski, and Chunxiao Wang

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Abstract (max 200)

Aquatic product demand has been rapidly increasing in the lesser developed countries. The wild catch is unable to meet demand and aquaculture production supplies more than one half of aquatic products consumed globally. This paper examines the readiness of urban consumers in a coastal megacity to pay a premium for wild catch and products originating from aquaculture using survey data collected in Shanghai, China. The study identifies factors influencing preferences for both types of products (wild catch and aquaculture), and the predisposition of consumers to pay a primum for either type. Those born in Shanghai or having small children prefer wild catch, whereas married consumers or those with knowledge of someone poisoned by eating seafood prefer aquaculture products. Those with preference for either product expressed readiness to pay a premium for it. When considering the predisposition to pay a premium, consumers with high income and brand preference are more likely to agree or strongly agree to pay. Those with brand preference would also agree to pay a premium for aquaculture product. Consumers having children or knowledge of someone poisoned eating seafood are less predisposed to pay a premium for both products.

Keywords: Wild catch, aquaculture, seafood consumption, product safety, certification, brand

JEL: Q22, Q13, Q29

Introduction

Global fish and aquatic product consumption has more than doubled in the past 50 years (Guillen et al. 2018). The depletion of seafood resources has encouraged the expansion of aquaculture as an alternative to support the growing demand for fish (López-Mas et al., 2021). The world's total production of aquaculture amounted to 110 million tons in 2016 and its growth rate outpaces other major food production sectors (FAO 2018). Aquaculture has become the primary source of fish and seafood across the world. The rapid expansion of aquaculture production results from the continuing growth in demand and the threat of depleting natural fish stock limiting the supply of wild-caught fish and seafood (Martin, 2017). Affinity for fresh fish and lessened budget constraint encourage increased aquatic product consumption in countries like China (Martin, 2017). In 2016, China produced 57.9% of the world's aquaculture fish (FAO 2020) indicating the uneven distribution of the growth in aquaculture. Moreover, China's share of the total wild capture is 15%, more than twice the summed shares of Indonesia and Peru (each 7%) placing it at the top of the world's rankings (FAO, 2020).

Wild catch has been preferred by some consumers (Cardoso et al., 2013; Maesano et al., 2020). Verbeke et al (2007) found that Belgian consumers favored wild catch for its perceived taste and nutritional value. Although some species are also available from aquaculture operations and outperformed the wild caught fish in blind tests, once the origin was revealed, consumers chose wild catch over aquaculture product (Claret et al., 2016).

This study examines the factors affecting the preferences of consumers for wild catch and aquaculture product, and identifies those factors that influence the decision to pay a premium for wild caught vs. aquaculture product and, separately, the inclination to agree to pay the premium. Knowledge of consumer personal characteristics, household attributes, and past experience in

eating seafood and aquaculture products shape preferences for the origin of the purchased product and relevant factors identified by this study provide insights for modifying strategies in aquaculture and wild catch product marketing. The geographical focus of this study is on China, the world's largest producer and consumer of fishery and aquaculture products (FAO, 2020) and within China, the Shanghai area has been a particularly large consumer of seafood and aquaculture products. Although the proportion of Chinese adults who consumed seafood increased from 27.4% in 1991 to 37.8% in 2011 (Wang, 2014) and per capita consumption reached 13.6 kg in 2019 (ref), per capita consumption in Shanghai exceeded the national average by 62.9 % in 2019 (National Bureau of Statistics, 2020). Therefore, results from this study of Shanghai consumers provide broad insights useful for the fishery industry, distributors, and retailers in other Chinese regions as well as countries with a high demand for fishery products.

Modeling approach

The empirical research to gain knowledge of factors that either encourage or discourage consumer decisions has been ongoing because of the need for practical solutions sought after by farmers, food processors, and distributors. The concept underlying an individual choice is the utility derived from the selected choice option. It is assumed that the consumer chooses to maximize her utility although the researcher cannot observe and measure it. However, the outcome of the decision can be observed and recorded. Each decision is a one-time occurring event and is commonly logged as a binary event taking the value of 1 for the choice decision, 0 otherwise.

The link between the concept of the unobservable utility and an empirical model proposed by MacFadden has been frequently applied in consumer decision research. The initial solution related the observed choice outcome coded as 0/1 to the latent dependent variable

specification estimated as the logit or probit equation. In the current study, the consumer choice distinguishes between the decision to agree to pay a premium for wild catch or a product from aquaculture depicted as 1=agree to pay premium and 0=does not agree to pay premium. The study then extends the analysis to examine the degree to which a consumer agrees to pay premium to differentiate among five levels included in the question that ranged from 1=strongly disagree to 5=strongly agree, where 3=neither agree nor disagree. Option 2 equals "agree" and option 4 equals "disagree".

The expressed consumer view to agree to pay any premium and the inclination to pay the premium for wild catch and aquaculture product are considered as two potentially related decisions because consumers may substitute wild catch for aquaculture product. Those products are displayed in the same section in supermarkets or indoor markets in China. The typical consumer has no access to infrequent open-air seafood markets scattered along the coast, but even there some vendors offer both wild catch and aquaculture products. The possible relationship between decisions pertaining to wild catch and aquaculture are recognized in the current study by the use of two different techniques, multivariate probit and bi-variate order probit, respectively. The next section describes details of the estimation techniques and stresses the practical relevance of converting the estimation results to measurable effects of individual explanatory variables on the probability of specific consumer choices regarding wild catch and aquaculture product.

Estimation techniques

Seemingly unrelated regression systems are applied in this study. The analysis involves two parts corresponding to two separate decisions. The first stage examines consumer preference towards seafood from wild catch or aquaculture and its affecting factors. The multivariate probit

model is employed. The dependent variables are preferences for wild catch seafood (Y1=1 if prefer wild catch; Y1=0, otherwise) or products from aquaculture (Y2=1 if prefer aquaculture; Y2=0, otherwise). In the second part, the consumer predisposition to pay a premium for seafood from wild catch (Y3) and aquaculture (Y4) are investigated. Y3 and Y4 are ordinal variables indicating the predisposition to pay a premium (1=strongly disagree, 2=disagree, 3=neither disagree nor agree, 4=agree, 5=strongly agree). That stage employs a bivariate ordered probit model.

Following the estimations at both stages, the estimated coefficients are converted into the percentage change in probability of selecting the specific decision (in the case of the multivariate model) or the selected option (in the case of the bi-variate probit). The calculated probability changes provide potentially useful insights for fisherman, farmers engaged in aquaculture, and food distributors as well as agencies striving for a balanced wild catch harvest. The explanatory variables include food purchase, safety of eating seafood, and socio-economic characteristics of consumers described in the next section.

Data

The study investigates whether consumers would agree to pay a premium for wild catch and aquaculture product and required the collection of data which are otherwise unavailable. The prepared structured questionnaire was used in a pilot study. A common technique in studies of consumers is the intercept method (Jin and Suh, 2005). The pilot was implemented in front of a supermarket in Shanghai, PuDong District. The intercepted consumers did not indicate any difficulties in understanding questions in the face-to-face interviews. The full-scale survey was conducted between July 1 and July 30, 2016 by 11 enumerators in three different locations and resulted in 394 fully completed questionnaires (out of the collected 419).

Among the surveyed consumers, 81% indicated that the wife was in charge of food purchases for the family. The role of gender is crucial in the ultimate food choices and the inclusion of aquatic products in the shopping and an earlier study suggested considering the influence of the main food purchaser in the household on the willingness-to-pay for certified fin-fish products in future studies (Cantillo et al., 2020). There was a strong preference for quality as reflected in the responses from 86% of respondents stating they would agree to pay a premium for quality aquatic product. However, those agreeing to pay a premium for a branded aquatic product accounted for 36% of respondents. It appears that those consumers may be particularly responsive to a marketing strategy focused on brand creation offering such opportunities to any party involved in aquatic product supply.

The respondents answered two questions pertaining to the perceived and real safety of consuming seafood. More than one half (52%) admitted hearing about individuals suffering food poisoning as a result of eating seafood (Table 1). Such news could affect the consumption of aquatic products although there is a lack of real data about the following dips in seafood purchases. As many as 13% of respondents answered that a family member got sick after eating seafood. The share of respondents is substantial although it only reflects the perceived cause and ignores the severity of the incident. However, perceptions shape food purchase and consumption and cannot be ignored, especially if the food, like aquatic products, is a relatively expensive category.

Overall, the sample represents consumers in Shanghai, a major Chinese urban center and a consumption and life-style trend-setter in the most populous country in the world. Observing the choices there provides insights about tendencies that will likely follow in other urban areas in

China and other populous countries in south-east Asia, with a possible extension to urban areas in other lesser developed economies.

Results

Choosing to pay a premium for wild catch and aquaculture product

Estimation results of the respondents' preference for wild catch and aquaculture product are shown in Table 2. Marginal effects quantifying the changes in the probability of the consumer decision are included because the coefficients are not directly interpretable.

Regarding the consumer preference toward wild catch, results indicate that older respondents prefer wild catch more than younger consumers, though the effect is small. A ten-year increase in age increases the likelihood of preferring wild-catch by 5.4%. It is interesting to find that households having children prefer wild catch, and are characterized by a 10% higher likelihood than households without a child. This may due to the child's special nutrition needs or because children have to develop taste for aquatic products. Respondents born in Shanghai prefer wild catch, and their likelihood is 14.5% higher than respondents born in other places. Earlier studies reported regional preferences in aquatic product consumption (Cordoso et al., 2013). White-collar consumers have nearly 4% higher likelihood of preferring wild catch than respondents with other job types. Consumers with preference for high-quality food have a substantial 20.5% higher likelihood of preferring wild catch as compared to respondents not expressing such a desire. Such a large marginal effect suggests that consumers view wild catch as being of superior high-quality, a result that coincides with earlier studies (Bronnmann and Asche, 2017).

In contrast, the estimation results of preferences toward farmed aquatic products differ from those in the wild catch equation (Table 2). College-educated consumers are almost 15%

more likely to prefer aquaculture product than those with a lower educational attainment level. Compared with respondents having other jobs, those with white-collar jobs are more than 11% more likely to prefer products from aquaculture. Respondents from households with a previous seafood poisoning experience are almost 30% more likely to choose aquaculture product. Food safety seems a major factor in determining aquaculture product preferences. Similarly, consumers from households liking high-quality foods are about 20% more likely to prefer aquaculture products.

The varying inclination to agree to pay a premium for wild catch and aquaculture product

The estimation results of the bi-variate ordered probit of the inclination to agree to premium payment for wild catch and aquaculture product are presented in Tables 3 and 5. Although several factors influence the agreeing to pay a premium for either type of product, the directional effects of monthly income differ. Respondents from households with high income are more likely to agree to pay a premium for wild catch, but unwilling to pay it for an aquaculture product.

Regarding the preferences, results indicate that consumers who had experienced seafood poisoning, as well as those with a preference for high quality food, were more likely to prefer seafood from both wild catch and aquaculture. It is interesting to find that households having children preferred wild catch, while white-collar consumers and consumers with a college degree were more likely to prefer aquaculture. Also, respondents born in Shanghai preferred wild catch. Regional preferences were found to influence the choice of seafood (Cardoso et al., 2013).

Results for household predisposition to pay for seafood from wild catch vs. aquaculture were not quite consistent with the results for consumer preference discussed above. Results indicate that households aware of food poisoning incidents after eating seafood in the year

preceding the survey were less likely to pay more for wild catch. Households with a high-income or preferring certified brand food were more likely to pay a premium for wild catch. Interestingly, households having children and those born in Shanghai were less likely to pay more for wild catch. All other statistically significant variables lowered the likelihood of agreeing to pay a premium, except for brand preference, for either product type. Food safety-related variables lowered the likelihood of agreeing to pay for wild catch (Table 3), but paying for aquaculture product was not affected by having a sick family member after eating seafood in the past (Table 5).

Among other factors, married respondents were significantly less likely to pay a price premium for products from aquaculture (Table 5). Households where the wife was in charge of seafood purchasing were less likely to pay more for products from aquaculture. Having children under 18 years of age lowered the likelihood of agreeing to pay more for aquaculture product. Households showing preferences for branded aquatic products were found to have a higher likelihood of agreeing to pay more for aquaculture products.

Probability changes in varying agreement to pay a premium for wild catch and aquaculture product

Tables 4 and 6 show the changes in probability associated with each option describing the inclination to pay a premium for the two products in response to a unit change in the explanatory variable. The following presentation is sequential and describes the results referring to wild catch (Table 4) before discussing those applicable to aquaculture products (Table 6).

Among the largest changes in probability to agree to pay for wild catch is the variable representing the monthly income (Table 4). Those with high income appear quite ready to agree or strongly agree to pay a premium for wild catch as the probability increases by 38% and 30%,

respectively. Not surprisingly, the presence of children in the family lowers the probability to agree or strongly agree to pay a premium although the decrease is not large, about 5% and 4%, respectively. Furthermore, those from households with children are more likely to disagree to pay or remain neutral on the issue.

Consumers born in Shanghai expect access to wild catch without the need to agree to the premium payment. The native Shanghainese have a lower probability to agree (nearly 8%) or strongly agree (8.5%) to pay a premium (Table 4). Raised in a coastal city, the respondents are used to the supply of wild caught seafood and may take its availability for granted. Those residents have a higher probability of falling into the neutral category (about 11%) or those who disagree with the premium payment (5% higher probability).

The inclination to pay a premium for wild catch decreases if a respondent is aware of poisonings resulting from seafood consumption. The probability to agree to a pay a premium decreases by more than 5% and 4%, respectively, while the probability of choosing a neutral option or disagreeing to pay increases by nearly 6% and about4%, respectively (Table 4). The changes in the corresponding probabilities are of the same direction although slightly smaller in the case of a respondent having a family member who fell sick due to seafood poisoning.

Branding wild catch seems to be important to consumers. Those preferring a branded wild catch have an 8% higher probability to agree and more than 7% higher probability to strongly agree to pay a premium (Table 4). At the same time, those respondents have a nearly 10% lower probability of choosing a neutral stand on branding or disagreeing to the premium payment (about 5%). The preference for branding may be associated with developments not directly examined in this study such as the mislabeling of seafood in retail outlets (ref).

Probability changes associated with the inclination to agree to a premium payment for aquaculture products decrease as the monthly income of respondents' household increases (Table 6). The probability that a consumer "agrees" or "strongly agrees" to pay a premium for aquaculture product decreases by about 12% and nearly 5%, and the probability that the same consumer "strongly disagrees" to pay increases by just over 20%. Two demographic characteristics also decrease the inclination to pay a premium for aquaculture products. Having a child in a household decreases the probability of agreeing to pay a premium and increases the probability that a respondent disagrees to pay it, but the changes are smaller than those associated with the variable indicating the marital status (Table 6). Knowledge about people being poisoned by eating seafood lowered the probability of agreeing to pay a premium by nearly 9% and by more than 3% in the case of choosing to "strongly agree" to pay the premium. However, the largest challenge faced by marketers of aquaculture products is to convince wives who do most of the food shopping. That group of respondents has a more than 6% lower probability of agreeing and almost 3% lower probability of strongly agreeing to pay a premium, while the probability that a wife "strongly disagrees" to pay a premium increases by about 86% (Table 6). It appears that wives who shop are unwilling to consider any premium payment. Interestingly, this characteristic was not statistically significant in the case of agreeing to pay a premium for wild catch.

The positive message to the aquaculture suppliers is the increase in the probability to "agree' and "strongly agree" to pay a premium for an aquaculture product by about 8% and 3%, respectively. Although branding of aquaculture products requires substantial resources and a sustained consumer education as branded products become available, these results show the importance of such efforts. Even certification standards have been sporadically adopted due to

the cost of compliance (Xuan, 2021), but branding and quality labels have been found important in fish product purchase (Castillo et al., 2021). While sustained sales are conditional upon producing consistent, quality products, efforts undertaken by aquaculture producers or a major retailer to brand products can nevertheless differentiate the supplier among the aquaculture product vendors.

Conclusions

Food consumption, especially the variety of foods, is undergoing a rapid change in developing countries due to the growth of disposable income. Wild catch is preferred by some consumers, while aquaculture has become a major source of a variety of products. This study investigates the factors influencing consumer preference and predisposition to pay a premium for seafood from wild catch and aquaculture in the megacity of Shanghai.

Results suggest that household income significantly increases predisposition to pay a premium for wild catch but decreases predisposition to pay a premium for aquaculture products. It confirms that households' income influences their choice of food in terms of source. As age increases, participants report higher preference for seafood from both wild catch and aquaculture, possibly, due to health concerns. The changing demographic composition of aging societies, including China, can be expected to be associated with increased demand for aquaculture products. Households preferring high quality seafood report higher preference for seafood from both wild catch and aquaculture. It suggests that food quality is a crucial factor influencing seafood marketing. Households preferring certified branded products are predisposed to pay more for both wild catch and aquaculture products. Strengthening brands can be an efficient way to promote a price premium. Knowing about food poisoning incidents after eating seafood decreases predisposition to pay a premium for both wild catch and aquaculture products.

Therefore, farmers engaged in aquaculture and marketing aquaculture products need to consider safety, branding and quality as the top priority. Consumers with a college degree and white-collar consumers prefer aquaculture. Such a trend indicates that aquaculture farmers and marketers need to consider the particular tastes and specific characteristics of consumer groups.

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Table 1. Descriptive statistics of variables used in estimation.

Variable name	Definition	Mean	Std. deviation
Wildlike_d_both	=1 if like seafood from aquaculture	0.42	0.49
aqualike_d_both	=1 if like seafood from aquaculture	0.41	0.49
Age	Age in years	39.24	12.22
Child_d	=1 if children under 18 years of age	0.57	0.5
Birthsh_d	=1 if born in Shanghai	0.84	0.37
Month income	Monthly income in RMB	18964.14	15675.82
Married	= 1 if married	0.68	0.47
College	=1 if college degree	0.81	0.39
White collar	=1 if white collar job	0.55	0.50
Poison_d	=1 if heard about food poison after eating seafood	0.52	0.50
Sick	=1 if family members got sick after eating seafood	0.13	0.33
Wife_d	=1 if wife be in charge of buying seafood	0.81	0.39
Quality_pre_d	=1 if willing to pay more for quality	0.86	0.35
Brand_pre_d	=1 if willing to pay more for brand	0.36	0.48

Table 2. Probit estimation results of preferences for wild catch and aquaculture product among residents of Shanghai, China.

Variable name	Caught wild		Aquaculture	
	Coef.	Marginal effects		Marginal effects
Intercept	-2.2579	-	-2.5836	-
	(0.4327)		(0.4465)	
Monthincome	-0.0165	-	0.0533	-
(10,000)	(0.0464)		(0.0451)	
Age	0.0146**	0.0054	0.0177***	0.0066
	(0.0078)		(0.0081)	
Child_d	0.2718**	0.0989	0.1526	-
	(0.1575)		(0.1606)	
Birthsh_d	0.3653**	0.1455	0.0541	-
	(0.2048)		(0.2069)	
Married	-0.1516	-	-0.1343	-
	(0.2107)		(0.2149)	
College	0.3477	-	0.4686***	0.1449
	(0.2184)		(0.2266)	
Whitecollar	0.5923***	0.0385	0.7699***	0.1130
	(0.1601)		(0.1622)	
Poison_d	-0.0096	-	0.7699***	0.2950
	(0.1429)		(0.1452)	
Sick	-0.0096	-	-0.0880	-
	(0.2027)		(0.2046)	
Wife_d	0.0596	-	0.2246	-
	(0.1790)		(0.1839)	
Quality_pre_d	0.5682***	0.2051	0.5321***	0.2034
	(0.2125)		(0.2139)	
Brand_pre_d	-0.1688	-	-0.1566	-
	(0.1524)		(0.1553)	

Note: Standard errors in parentheses. Only the marginal effects of significant variables are reported.

**Significant at 0.05.

***Significant at 0.01.

Table 3. Results of the ordered probit equations on agreeing to pay premium for certified wild catch seafood.

Variables	Coefficient	Std. error	t-value	PR(>|t|)
Monthincome	1.7650	4.9521	3.56	0.00
Age	7.5702	6.2037	1.22	0.22
Child_d	-2.4344	1.3028	-1.87	0.06
Birthsh_d	-4.1328	1.6371	-2.52	0.01
Married	-1.4289	1.7012	-0.84	0.40
College	1.7258	1.7733	0.10	0.92
White collar	-1.2761	1.3320	-0.10	0.92
Poison_d	-2.4793	1.2213	-2.03	0.04
Sick	-4.3881	1.7337	-2.53	0.01
Wife_d	2.3193	1.4701	0.16	0.87
Wild ike_d_both	4.0167	1.2055	0.33	0.74
Quality_pre_d	2.1723	1.6855	1.29	0.20
Brand_pre_d	3.9052	1.2880	3.03	0.00
Threshold parameters				
Threshold(1->2)	-2.4710	0.3997	-6.18	6.30
Threshold(2->3)	-1.1304	0.3352	-3.37	0.00
Threshold (3->4)	0.4359	0.3291	1.32	0.19
Threshold (4->5)	1.5274	0.3358	4.55	5.40

Table 4. Statically significant marginal effects of variables in the ordered probit equation on agreeing to pay premium for certified wild catch seafood.

Variables	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Monthincome[a]		-0.2605***	-0.4107***	0.3857***	0.3038***
Child_d		0.0353*	0.0547*	-0.0523*	-0.0428*
Birthsh_d		0.0506***	0.1098**	-0.0784***	-0.0850**
Poison_d		0.0364**	0.0578**	-0.0536**	-0.0431**
Sick		0.0784**	0.0768***	-0.0102**	-0.0609***
Brand_pre_d		-0.0538***	-0.0956***	0.0808***	0.0723***

[a] Scaled by 10,000.

* Significant at 0.1.

** Significant at 0.05.

*** Significant at 0.01.

Table 5. Results of the ordered probit equation on agreeing to pay a premium for certified aquaculture products.

Variable	Estimate	Std. error	t-value	Pr(>|t|)
Monthincome	-8.1785	3.7225	-2.20	0.03
Age	-9.0456	6.2892	-1.44	0.15
Child_d	-3.0969	1.2947	-2.39	0.02
Birthsh_d	6.7769	1.6808	0.40	0.69
Married	-3.9657	1.7199	-2.31	0.02
College	-2.3353	1.7780	-1.31	0.19
White collar	-1.2354	1.3478	-0.92	0.36
Poison_d	-5.8928	1.2657	-4.66	3.23
Sick	1.3458	1.7292	0.78	0.44
Wife_d	-3.9208	1.4665	-2.67	0.01
aqualike_d_both	-1.1688	1.2784	-0.09	0.93
Quality_pre_d	-2.1349	1.7137	-0.01	0.99
Brand_pre_d	4.9782	1.2970	3.84	0.00
Threshold Parameters				
Threshold(1->2)	-2.5744	0.3519	-7.32	2.57
Threshold(2->3)	-2.0010	0.3418	-5.85	4.81
Threshold(3->4)	-0.4483	0.3332	-1.35	0.18
Threshold(4->5)	0.3818	0.3444	1.11	0.27

Table 6. Marginal effects of statistically significant variables in the ordered probit equation on agreeing to pay a premium for certified aquaculture products.

Variables	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Monthincome[a]	0.2027**	0.0982**	-0.1326**	-0.1224**	-0.0459**
Child_d	0.0752**	0.0374**	-0.0473**	-0.0470**	-0.0183**
Married	0.0910**	0.0449**	-0.0515***	-0.0627**	-0.0262*
Poison_d	0.1440***	0.0669***	-0.0892***	-0.0884***	-0.0354***
Wife_d	0.8584***	0.0499**	-0.0437***	-0.0639**	-0.0282**
Brand_pre_d	-0.1149**	-0.0612***	0.0650***	0.0782***	0.0330***

[a] Scaled by 10,000.

* Significant at 0.1.

** Significant at 0.05.

*** Significant at 0.01.