Economic, Socio-Demographic and Psychographic Determinants of Milkfish Consumer Demand, Iloilo Province, Philippines

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Abstract

This paper attempts to identify the factors that affect the demand for milkfish in Iloilo Province and consequently suggest improvement in the overall competitiveness of the local milkfish industry. Knowing the determinants of demand will guide economic agents to deliver products consistent with specifications desired by consumers. The paper is based on a research conducted in the Province of Iloilo, Philippines using primary data gathered through personal interview of 378 purchase–decision makers. Employing the two-stage least squares method, endogeneity in the model was corrected using an instrumental variable approach. Per capita consumption of milkfish was estimated for the parameters of hypothesized determinants including economic, socio-demographic, and psychographic/behavioral characteristics relating to consumption trends. Demand determinants that were found significant are prices of beef and tilapia; educational attainment, gender and age of the purchase decision-maker, and household size; and psychographics relating to food safety and product traceability. It is recommended that adjustments in production and marketing operations be made to improve the overall competitiveness of the milkfish industry. These are: 1) improvement in production efficiency to reduce cost and be able to sell milkfish at competitive price, 2) adoption of proper postharvest handling practices that preserve the good quality of milkfish, 3) value addition by transforming milkfish into deboned and other processed products, and (4) product labeling to communicate Iloilo origin or product traceability to consumers

Keywords: *hedonic price, consumer demand, instrumental variable, economic, socio-demographics, psychographics*

Introduction

Milkfish is the most important fish species being farmed in the Philippines with the Province of Iloilo as a major producer. While demand for fish and other fishery products is increasing, production in the province is dwindling (Figure 1). This may imply that the milkfish industry in Iloilo is losing its competitiveness vis-à-vis other milkfish-producing provinces.

The literature is rich in both the theoretical and empirical studies on consumer demand for various commodities. Current approaches in demand modeling, however, are constrained by their inability to capture a holistic view of the various factors affecting overall demand. Oftentimes, studies capture only economic and socio-demographic variables but ignore equally important factors such as consumer psychographics.

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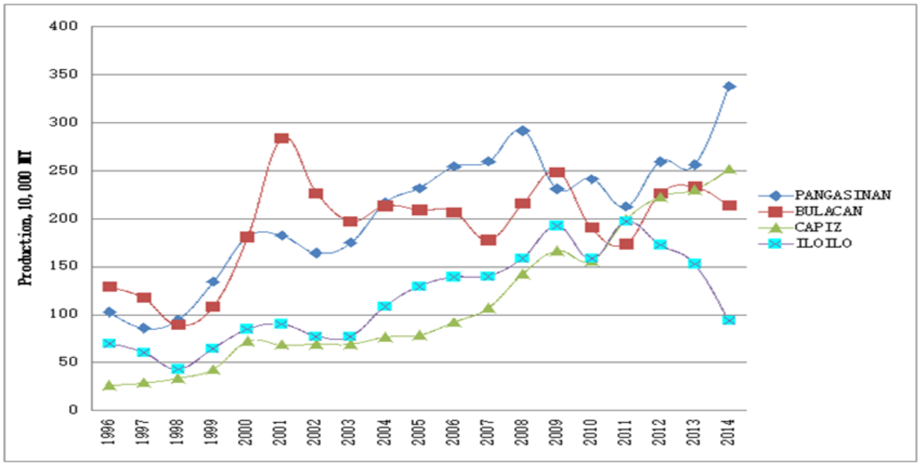

Figure 1. Milkfish production of top producing provinces, Philippines, 1996-2014

Results of such studies are thus insufficient to formulate market-driven strategies or production plan structuring. The introduction of missed variables in the demand model will make possible the analysis of the unexplored areas of decision-making process typical of a 'new critical consumer" (Arcidiacono 2011).

Among the available literature on demand for fish and fishery products are the works of Angrist, Graddy and Imbens (1995), Burton (1992), Wellman (1992), and Dey (2000). However, literature characterizing the consumer demand for milkfish in the Philippines, more so for the Province of Iloilo, is scarce. For the Philippines, notable are the works of Tan et al. (2017) and Garcia, Dey and Navarez (2005). These studies, however, fail to consider all the necessary elements such as economic, socio-cultural, and psychographic factors. The inclusion of these factors in one unified study could capture the dimensions of cognitive economics and other behavioral perspectives in analyzing the rationality in milkfish consumption. The key question is, "To what extent do economic, socio-demographic, and psychographic variables affect milkfish demand particularly in the Province of Iloilo". The information generated will be valuable in devising market-oriented policies through re-orientation of production and marketing decisions.

Conceptual Framework

The study is founded on the idea that a more holistic study of demand incorporates the economic, socio-demographic, and the psychographic characteristics of consumers. The socio-demographic perspective considers the effect of social and cultural influences on one's consumption choice. Psychographic influences capture the individual peculiarities such as value system, lifestyles, opinions, personalities, and interests. Economic factors include price and income variables. Own price of milkfish, referred to as hedonic price, is assumed to be a function of its physical quality attributes. The three key variable groups are depicted in Figure 2.

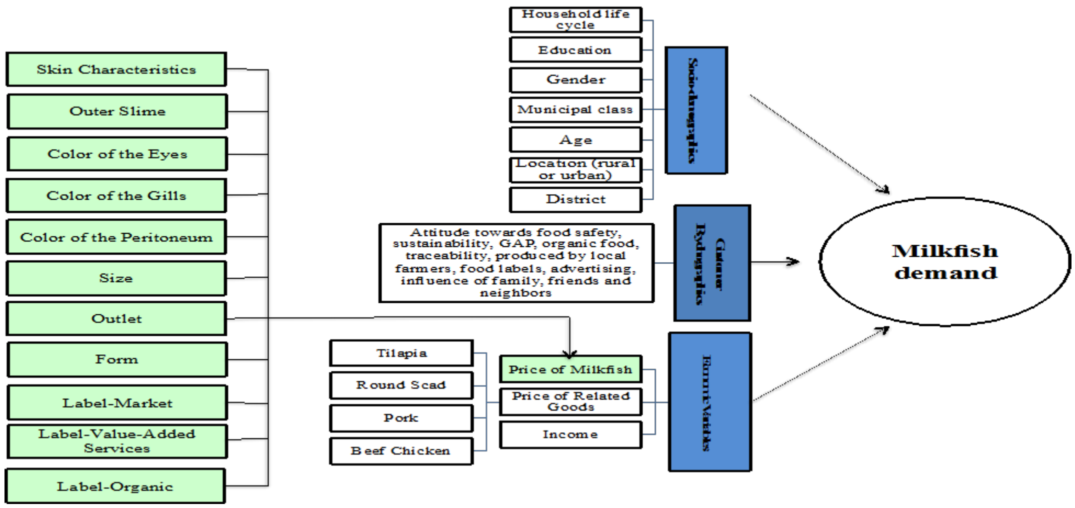

Figure 2. Conceptual framework incorporating economic, socio-demographic and psychographic variables in the analysis of the demand for milkfish in the Province of Iloilo, Philippines

Methodology

The research was conducted in the Province of Iloilo. It is in the central part of Philippine archipelago and stands as a gateway to Southern Philippines. The largest province in Panay Island of the Western Visayas Region, Iloilo is divided into 42 municipalities with 1,721 barangays and one component city, Iloilo City.

The study used primary data that were collected using a structured interview schedule. Data consist of information about the quality attributes of milkfish used in the hedonic price model and household characteristics used in the final demand model. Milkfish quality attributes include skin and outer slime characteristics, color of the eyes, gill color, characteristics of the peritoneum, size, location where the product is marketed, product form, place of origin label, provision of value-added services, and organic label. Quality was determined based on the respondent's recall of the characteristics of their last milkfish purchase. Hedonic prices for these attributes were determined in Tan et al. (2017).

The respondents consist of household purchase decision makers. They were selected using multi-stage stratified random sampling with degree of urbanization (rural and urban) and congressional district as basis of stratification in the first and second stages, respectively. Half of the respondents are from urban area whereas the other half are from the rural area. Five municipalities representing each of the five congressional districts were selected as rural and the lone district (Iloilo City) as urban.

The sampling frame was developed from the list of households obtained from identified target areas. The total number of respondents is 378. Sample size per area was determined by proportional allocation. Distribution of sample size per municipality including a description of the chosen municipality is shown in Table 1.

Table 1. Profile of sample municipalities and sample size per municipality

Item	Iloilo City	Miagao	Leganes	Mina	Barotac Nuevo	Concepcion
Land area (sq.km)	78.34	56.8	32.2	3.4	94.49	86.12
Congressional district	Lone District	1	2	3	4	5
Income class	1^{st}	1^{st}	4^{th}	5^{th}	2^{nd}	3^{rd}
Distance from the center (km)	0	40	11	38	27.5	105.6
Population	424,619	64,545	29,438	21,785	51,867	39,617
Milkfish production	Deficit	Deficit	Surplus	Deficit	Surplus	Deficit
No. of respondents	189	59	27	20	47	36

Source: Province of Iloilo (2016)

Regression was specified using the log-linear form and estimated by instrumental variable estimator (IV) with robust option for estimating standard errors by the Hubert-White sandwich estimators. Also known as two-stage least squares (2SLS), this is used to address important threats to internal validity, namely, 1) omitted variable bias from a variable that is correlated with X but is unobserved, so cannot be included in the regression; 2) simultaneous causality bias; and 3) error in the variables bias.

Baum, Schaffer and Stillman (2003) presented a theoretical underpinning of the method of instrumental variables. From their work, the general model for IV in matrix notation is

$$y = X\beta + u, \qquad E(uu') = \Omega$$

with typical row, where X is an n x K matrix, n is the number of observations, u is the error term distributed with a mean of zero and is the covariance matrix defined as n x n. Three special cases for Ω considered by Baum et al. (2003) are:

Homoskedasticity: $\Omega = \sigma^2 I$

Heteroskedasticity: $\Omega = \begin{pmatrix} \sigma_1^2 & & & & 0 \\ & \ddots & & & \\ & & \sigma_1^2 & & \\ & & & \ddots & \\ 0 & & & & \sigma_1^2 \end{pmatrix}$

$$\text{Clustering: } \Omega = \begin{pmatrix} \Sigma_1 & & & & 0 \\ & \ddots & & & \\ & & \Sigma_1 & & \\ & & & \ddots & \\ 0 & & & & \Sigma_1 \end{pmatrix}$$

Σ_m indicates the intra-cluster covariance matrix where it is t x t in cluster m with t observations. A zero covariance between observations in M different clusters gives the covariance matrix a block-diagonal form.

In cases where regressors are endogenous characterized by $E(X_i \; u_i) \neq 0$, regressors are partitioned into sets of $[X_1 \; X_2]$, with K_1 regressors X_1 assumed under the null to be endogenous, and the $(K\text{-}K_1)$ remaining regressors assumed to be endogenous.

Further, the set of instrumental variables is Z and is n x L, a full set of exogenous variables. Instruments are partitioned into $[Z_1 \; Z_2]$ where the L_1 instruments Z_1 are excluded instruments, and the remaining $(L\text{-}L_1)$ instruments are the included exogenous regressors:

$$\text{Regressors } X = [X_1 \; X_2] = [X_1 \; Z_2] = [\text{Endogenous Exogenous}]$$
$$\text{Intruments } Z = [Z_1 \; Z_2] = [\text{Excluded Included}]$$

Included instruments are S_w, E_o, E_g, G_p, SZ_M, FW_P, V_s, and O_{FP}, corresponding to skin-waxy, eye color-opaque, eye color-grey pupil and opaque cornea, gill color-red to pink, size-medium, form-processed, value-added services are available, and outlet - Iloilo fishing port (Table 4, column 1).

Order of condition for identification of the identity is $L \geq K$. This implies that there must be at least as many instruments as there are regressors. If L= K, the equation is said to be 'exactly identified'; if L>K, the equation is said to be 'over identified.'

Projection matrix is denoted by P_z whereas the instrumental variable estimator β is

$$\beta_{IV} = \{X'Z(Z'Z)^{-1}Z'X\}^{-1}X'Z(Z'Z)^{-1}Z'y = (x'^{P_z}X)^{-1}X'P_z y$$

Standard tests for multicollinearity and heteroscedasticity were performed to ensure that the sign and magnitude of the coefficients of the various independent variables were appropriately captured. In addition, relevance of instruments was tested by the following: 1) Kleibergen-Paap rk LM statistic for underidentification, 2) Kleibergen-Paap rk Wald F statistic for weak identification, 3) Hansen J statistic for overidentification test of all instruments, 4) endogeneity tests for all regressors, and 5) partial R^2 to test intercorrelations among instruments as proposed by Shea (1997) in Baum, Schaffer and Stillman's Instrumental Variables and Generalized Method of Moments: Estimation and Testing (2003).

The Empirical Model

Consumer per capita demand for milkfish is modeled as a function of economic, socio-demographic, and psychographic variables. The functional relationship between per capita demand and the hypothesized variables is described in the following form:

$$Q_i^D = \alpha_0 + \alpha_i E + \beta_i S + \gamma_i P + u_i$$

where Q^D, E, S and P are per capita milkfish demand, economic variables, socio-demographic variables, and psychographic variables, respectively, and the error term μ is assumed to be normally distributed.

The expanded empirical equation is given by:

$$\begin{aligned} Q_D^M = \alpha_0 &+ \alpha_1 P + \alpha_2 PTLAPIA + \alpha_3 PRSCAD + \alpha_4 PPORK + \alpha_5 PBEEF \\ &+ \alpha_6 PCHICK + \alpha_7 INCOME + \beta_1 LCN + \beta_2 LCC + \beta_3 LCMWC \\ &+ \beta_4 LCMC + \beta_5 LCT + \beta_6 LCM + \beta_7 EDUE + \beta_8 EDUH + \beta_9 EDUC \\ &+ \beta_{10} EDUP + \beta_{11} EDUV + \beta_{12} GEND + \beta_{13} MC2 + \beta_{14} MC3 \\ &+ \beta_{15} MC4 + \beta_{16} MC5 + \beta_{17} AGE + \beta_{18} LOC + \beta_{19} LC1 + \beta_{20} LC2 \\ &+ \beta_{21} LC3 + \beta_{22} LC4 + \beta_{23} LC5 + \gamma_1 FST + \gamma_2 SUS + \gamma_3 GAP \\ &+ \gamma_4 ORF + \gamma_5 TRAC + \gamma_6 LPR + \gamma_7 SLF + \gamma_8 LAB + \gamma_9 ADV \\ &+ \gamma_{10} FFN + u_i \end{aligned}$$

where $P = \propto_0 + \delta_1 S_w + \delta_2 M_m + \delta_3 E_o + \delta_4 E_g + \delta_5 G_p + \delta_6 P_s + \delta_7 SZ_M + \delta_8 SZ_L + \delta_9 O_{TC} + \delta_{10} O_{MM} + \delta_{11} O_{PS} + \delta_{12} O_{FP} + \delta_{13} F_s + \delta_{14} F_p + \delta_{15} I_L + \delta_{16} V_S + \delta_{17} OR_L + \nu_i$

α_0, α_i, β, γ_i and δ_i correspond to the constant term, the coefficients of the economic variables, the coefficients of the socio-demographic variables, the coefficients of the psychographic variables, and the coefficients of the price variables, respectively. All variables are presented and defined in Table 2.

Table 2. Variables in the analysis of factors affecting per capita consumption of milkfish, Iloilo, 2015

Variable Name	Variable Code	Variable Definition
Economic Variables		
Price of milkfish	Pmfish	Nominal retail price of milkfish (PhP/kg)
Household per capita income	Income	Nominal household per capita income (PhP/month)
Price of tilapia	PTLAPIA	Nominal retail price of tilapia (PhP/kg)
Price of roundscad	PRSCAD	Nominal retail price of roundscad (PhP/kg)
Price of pork	PPORK	Nominal retail price of pork (PhP/kg)
Price of beef	PBEEF	Nominal retail price of beef (PhP/kg)
Price of chicken	PCHICK	Nominal retail price of chicken (PhP/kg)
Milkfish Characteristics		
Outer slime	M_t (base category)	Outer slime transparent; water white
	M_m	1 if outer slime milky; 0 otherwise
Color of the eyes	E_b (base category)	Black pupil translucent and water white
	E_o	1 if eyes slightly opaque pupil; slightly opalescent cornea; 0 otherwise
	E_g	1 if grey pupil and opaque cornea; 0 if otherwise
Color of the gills	G_r (base category)	Bright red or dark red; mucus translucent
	G_p	1 if red or pink; mucus slightly opaque; 0 otherwise

Color of the peritoneum	Pg (base category)	Glossy; brilliant; difficult to tear from flesh
	Ps	1 if slightly dull; difficult to tear from flesh; 0 otherwise
Size	SZ_s (base category)	Size is small
	SZ_m	1 if size medium; 0 otherwise
	SZ_l	1 if size large; 0 otherwise
Outlet	O_m (base category)	Outlet is from mall-based supermarket
	O_{tc}	1 if outlet is from trade center; 0 if otherwise
	O_{mm}	1 if municipal market; 0 if otherwise
	O_{ps}	1 if source is peddled on street; 0 if otherwise
	O_{fp}	1 if outlet is from Iloilo fish port complex; 0 otherwise
Form	F_w (base category)	Product form is whole
	F_s	1 if product form is sliced; 0 if otherwise
	F_p	1 if product form is processed; 0 if otherwise
Label-Market	I_l	1 if labeled/marketed as produced in Iloilo; 0 otherwise
Label-Value-Added Services	V_s	1 if value-added services are available; 0 otherwise
Label-Organic	O_l	1 if labeled/marketed as organic; 0 otherwise
Socio-demographic Variables		
Life-cycle stage of the household (young singles is base category)		
Newlyweds	LCN	1 for newlyweds; 0 otherwise
Young couples without children	LCC	1 for young couple without children; 0 otherwise
Married couples without children	LCMWC	1 for married couple without children; 0 otherwise
Married couples with young children	LCMC	1 for married couple with young children; 0 otherwise
Household with teen-agers	LCT	1 for household with teenagers; 0 otherwise
Mature couples	LCM	1 for mature couple; 0 otherwise
Educational level of the household purchase decision maker (HPDM) (no education is base category)		
Elementary	EDUE	1 if HPDM graduated elementary; 0 otherwise
High school	EDUH	1 if HPDM graduated high school; 0 otherwise
College	EDUC	1 if HPDM graduated college; 0 otherwise
Post-graduate	EDUP	1 if HPDM has a post-graduate degree, 0 otherwise
Vocational	EDUV	1 if HPDM has a vocational degree; 0 otherwise
Gender of household purchase decision maker (female is base category)	GEND	1 if HPDM is male; 0 otherwise

Municipal class (1st class municipality is base category)		
2nd class municipality	MC2	1 if household resides in a 2nd class municipality; 0 otherwise
3rd class municipality	MC3	1 if household resides in a 3rd class municipality; 0 otherwise
4th class municipality	MC4	1 if household resides in a 4th class municipality; 0 otherwise
5th class municipality	MC5	1 if household resides in a 5th class municipality; 0 otherwise
Age of the household purchase decision-maker	AGE	Age of HPDM in years
Location Variables		
Loc (rural is base category)	LOC	1 if HH is an urban area; 0 otherwise
Congressional district (lone district is base category)		
C1	LC1	1 if HH is in 1st Congressional district; 0 otherwise
C2	LC2	1 if HH is in 2nd Congressional district; 0 otherwise
C3	LC3	1 if HH is in 3rd Congressional district; 0 otherwise
C4	LC4	1 if HH is in 4th Congressional district; 0 otherwise
C5	LC5	1 if HH is in 5th Congressional district; 0 otherwise
Psychographic Variables		
Food safety	FST	Scale ranking from 1 (not important) to 5 (extremely important)
Sustainability	SUS	Scale ranking from 1 (not important) to 5 (extremely important)
Good agricultural practices	GAP	Scale ranking from 1 (not important) to 5 (extremely important)
Organic food	ORF	Scale ranking from 1 (not important) to 5 (extremely important)
Traceability	TRAC	Scale ranking from 1 (not important) to 5 (extremely important)
Locally-produced	LPR	Scale ranking from 1 (not important) to 5 (extremely important)
Support for local farmers	SLF	Scale ranking from 1 (not important) to 5 (extremely important)
Food label	LAB	Scale ranking from 1 (not important) to 5 (extremely important)
Availability of advertising and promotional events	ADV	Scale ranking from 1 (not important) to 5 (extremely important)
Influence of family, friends, and neighbors	FFN	Scale ranking from 1 (not important) to 5 (extremely important)

Since the model is expressed in log-linear form, each of the estimated coefficients measures the marginal effect. It gives the percentage change in the dependent variable resulting from a 1% change in the explanatory variable, *ceteris paribus*.

It is expected that an increase in price of milkfish will result in a reduction in quantity of milkfish demanded, so $\alpha_1 < 0$. Tilapia, roundscad, pork, beef, and chicken are assumed to be milkfish substitutes, thus an increase in price of these commodities will result in an increase in per capita consumption of milkfish, thus, α_2, α_3, α_4,α_5, and $\alpha_6 > 0$. Per capita consumption of milkfish is expected to increase with income, thus, $\alpha_7 > 0$. Households are more likely to consume milkfish as income increases because of the many preparations, often specialty products, from milkfish. Examples include *surimi* and *surimi*-based fish balls, fish burger patties, and flavored smoked milkfish.

Life-cycle stage refers to life stages of individuals in a given household that affect consumption choices. In this paper, the various household life stage segments are young singles (base category), newlyweds, young couples without children, married couples with children, households with teenagers, and mature couples. Young singles are between 18 to 24 years old and living with roommates. Newlyweds are couples who have been married for a year or less. Young couples without children are those with age 30 to 39 years, married, and without kids. In contrast, married couples with children is a household segment of the same age bracket as young couples without children but this segment is differentiated by the presence of kids. Households with teenagers are couples with children age 13-20 years old. Finally, mature couples are households with age 40 years old up, living on their own or with grown up children living with them. It is expected that household lifecycle stage characterized by absence of children below 18 will result in increased consumption of milkfish, thus β_1,β_2, and $\beta_3 < 0$ and β_4, β_5, and $\beta_6 > 0$. Milkfish by nature is generally a bony fish such that parents with young kids reduce their consumption because it may be unsafe for them. Also, consumption of milkfish among households with young children may be time consuming as parents will have to debone prior to serving. The options of buying the relatively more expensive deboned or processed milkfish will result in the reduction of the household budget for food and/or other necessities.

The increase in level of education of the homemaker is expected to increase per capita demand for milkfish. With no education as the base category, it is expected that β_7, β_8, β_9, β_{10}, and $\beta_{11} > 0$. This is based on a premise that highly educated individuals are knowledgeable about the health-related and other benefits associated with fish consumption. In addition, education, together with technology removes the basic assumption of information asymmetry and as such, highly educated individuals will tend to limit food choices that will optimize well being.

Existing literature, for example, Wennberg et al. (2012), supports the premise that fish consumption does not differ between men and women. However, this paper tests the cultural premise that women are more health conscious vis-à-vis men, thus exhibit higher milkfish consumption. With female as base category, $\beta_{12} < 0$.

Municipalities are categorized from 1st class to 6th class depending upon their income with 1st class municipalities having the highest income at PhP 55,000,000.00 per annum or more (the base category) and 6th class municipalities having the least income at PhP 15,000,000.00 or less. It is hypothesized that as income class increases, preference for and thus per capita consumption of milkfish increases. Thus, β_{13}, β_{14}, β_{15}, and $\beta_{16} < 0$.

It is noted that ageing shifts consumption towards healthy food choices, that is, more fish and considerable reduction of starch-based staples like rice, thus, $\beta_{17} > 0$. It is hypothesized that urban areas will consume lesser amount of fish as consumption is more skewed towards processed and ready-made food. Also, urban consumption tends to favor food rich in fats and sugar as a result of advertising. With rural as base category, $\beta_{18} > 0$.

Local culture, proxied by legislative district, determines fish consumption as well. A legislative district is composed of contiguous, compact, and adjacent territory having a population of at least 250,000. It is hypothesized that dietary patterns across the different districts in the province of Iloilo would vary, that is, consumption will be relatively less in land-locked areas compared to coastal districts. With the lone congressional district as the base, it is premised that land-locked districts (Districts 2 and 3) have more access to fresh water finfishes, hence, β_{20} and $\beta_{21} < 0$. Coastal congressional districts (Districts 1, 4, and 5) will have more access to other finfishes, hence, β_{19}, β_{22}, and $\beta_{23} < 0$.

Consumer's personal belief system comprising the psychographic variables is hypothesized to affect consumption. These include behavior towards food safety, sustainability, good agricultural practices, organic food, traceability, locally-produced products, support to local farmers, and food labels. They capture the behavioral characteristics of consumers with respect to current issues and thus affect consumption behavior. Because milkfish sold in Iloilo is traditionally known to be safe, produced using extensive production technologies, locally-produced, and produced by local farmers, γ_1, γ_2, γ_6, and $\gamma_7 > 0$. On the other hand, absence of certification as proof of GAP and being organically-produced, place of origin label, and food safety labels renders γ_3, γ_4, γ_5, and $\gamma_8 < 0$. Finally, consumers are hypothesized to be affected by the social media as well as their surrounding family, friends, and neighbors, thus, γ_9 and $\gamma_{10} > 0$.

Results and Discussion

Descriptive Statistics for Variables Used in the Regression Model

Table 3 presents the descriptive statistics for all the variables used in the regression model. For continuous variables, their respective means and standard deviations are presented. On the other hand, frequency was used to describe the dummy variables in the model.

Table 3. Descriptive statistics for the variables used in the study, 2015

Description	Frequency	Percent	Mean	Standard Deviation
Dependent Variable				
Ln Per Capita Consumption			0.723	0.070
Independent Variables				
Economic variables				
Ln price of milkfish			4. 945	0.162
Ln per capita income			7. 638	0.896
Ln price of tilapia			4.953	0.125
Ln price of roundscad			4.894	0.145
Ln price of pork			5.200	0.018
Ln price of beef			5.413	0.095
Ln price of chicken			4.955	0.110
Milkfish characteristics				
Characteristics of the skin				
Bright and shining	359	94.97		
Waxy, slight loss of bloom	19	5.03		
Outer Slime				
Slime transparent; water white	360	95.24		
Outer slime milky	18	4.76		
Color of the eyes				
Black pupil translucent and water white	363	96.03		
Eyes slightly opaque pupil; slightly opalescent cornea	12	3.17		
Grey pupil and opaque cornea	3	0.79		
Color of the gills				
Bright red or dark red; mucus translucent	356	94.18		
Red or pink; mucus slightly opaque	22	5.82		
Color of the peritoneum				
Glossy; brilliant; difficult to tear from flesh	363	96.03		
Slightly dull; difficult to tear from flesh	15	3.97		
Size				
Small	31	8.20		
Medium	267	70.63		
Large	80	21.16		
Outlet				
Mall-based supermarket	47	12.43		
Trade center	54	14.29		
Municipal markets	217	57.41		
Peddled on street	58	15.34		
Iloilo fish port complex	2	0.53		
Form				
Whole	305	80.69		
Sliced	60	15.87		
Processed	13	3.44		

Description	Frequency	Percent	Mean	Standard Deviation
Place of origin labeling				
Labeled/marketed as produced in Iloilo	179	47.35		
Not labeled produced in Iloilo	199	52.65		
Label-value-added services				
Value added services	189	50.00		
Without value-added services	189	50.00		
Labeled organic				
Labeled/marketed as organic	81	21.43		
Not labeled as organic	297	78.57		
Socio-demographic characteristics				
Ln age			3.802	0.317
Ln per capita income			7.638	0.896
Ln household size			1.490	0.484
Behavior characteristics towards food consumption trends				
Food safety			5.516	
Sustainability in production			4.211	
Good agricultural practices			4.582	
Organically-produced			4.616	
Traceability			4.307	
Labeled-produced in Iloilo			4.669	
Support local farmers			4.696	
Product labeling			4.399	
Advertisement			4.032	
Influence of family and friends			4.844	

Result of the Diagnostic Tests

Three procedures were used to check for the presence of highly influential or unusual data. These are 1) leverage statistic, h; 2) the Cook's distance, D; and 3) dfFit. Identification of these outliers may affect validity of regression results and must be considered in interpreting the results. Result for the three procedures indicated absence of any usual or influential data. In the test for leverage statistics, only 2 of the 378 observations reported h-values = 0.5. Using Cook's distance test to determine existence of influential data, 32 data points were known to have exceeded minimally the cut-off point of 4/n= 0.01058. No large Cook's D stat was noted. Finally, existence of outliers was determined using the dfFit Test. No data point from the 378 samples was noted to influence the observation.

The following OLS assumptions were checked: 1) normality, 2) linearity, 3) homogeneity, 4) independence, and 5) errors in the variables.

Normality assumption. Figure 3 shows the kernel density plot of the residuals overlaid against the normal density plot. Small variations between the two plots were noted. To validate the kernel density plot output, a Shapiro-Wilk W Test was performed. The p-value for the test is based on the assumption that the distribution is normal. The result which is p = 0.153 implies that r is normally distributed at alpha = 0.1 cannot be rejected.

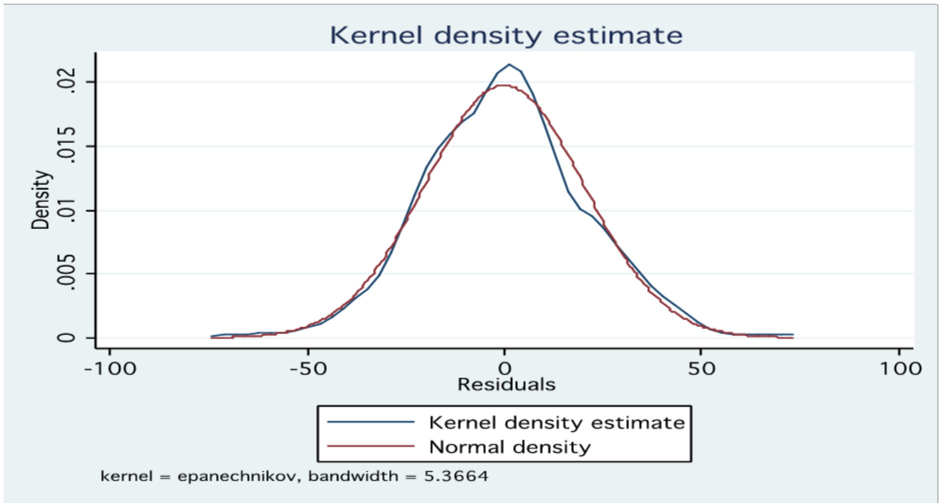

Figure 3. The kernel density plot of the residuals overlaid against the normal density plot

Homoscedasticity. One of the OLS assumptions is the homogeneity of the variance of the residuals. To test this, two quantitative methods were used: 1) information matrix (IM) test and 2) the Breausch-Pagan/ Cook Weisberg test for heteroscedasticity.

The IM test performs the information matrix test for the regression model including the orthogonal decomposition into tests for heteroskedasticity, non-normal skewness, and the non-normal kurtosis from the works of Cameron and Trivedi (1990) and Long and Trivedi (1993) as cited in Stata Corp. (1996). The IM test statistic is asymptotically $\chi 2$ with ½k(k+3) degrees of freedom.

The p-values equal to 0.043 and 0.009 corresponding to the IM test and Breaush-Pagan/ Cook Weisberg tests, respectively, are less than 0.1, hence the hypothesis is rejected and the alternative hypothesis that the variance is not homogenous is accepted.

Collinearity. This refers to a phenomenon when two or more predictor variables in a regression model are highly correlated. As the level of collinearity increases, the coefficients become unstable and the standard errors of the coefficients become inflated. No variance inflation factor (VIF) value is greater than 10, hence no variable merits further investigation concerning collinearity assumption.

Regression Result Without Correcting for Endogeneity

Table 4 shows the regression results. Column 1 shows OLS for per capita consumption per annum without correcting for endogeneity, column 2 shows the OLS for the price of milkfish (equivalent to first stage of the TSLS), and column 3 shows the IV regression for per capita consumption of milkfish (equivalent to the second stage of the TSLS).

Table 4. Regression results for OLS without correcting for endogeneity and regression results using the instrumental variable approach, Iloilo, Philippines, 2016

Variable	OLS Estimates Without Correcting For Endogeneity			First Stage Regression Ln Milkfish Price			Instrumental Variable Estimates		
	Coefficient		p-value	Coefficient		p-value	Coefficient		p-value
Ln milkfish price	0.18039		0.618				-1.47619		0.175
Candidate for instrumental variables									
Sw	0.24299		0.542	0.09659	**	0.034			
M_M	-0.08759		0.839	-0.01807		0.715			
Eo	0.41407		0.366	-0.10990	**	0.026			
E_G	-0.89867		0.162	-0.29441	***	0.000			
G_P	-0.23251		0.46	0.06065	*	0.075			
P_S	-0.28348		0.525	0.01154		0.835			
SZ_M	0.00168		0.995	-0.00007	***	0.999			
SZ_L	-0.18495		0.535	0.05510		0.342			
FW_S	0.15992		0.34	-0.00520		0.838			
FW_P	-0.14158		0.669	0.17221	***	0.000			
I_L	0.02608		0.843	-0.00586		0.745			
V_S	0.07820		0.547	0.03633	*	0.057			
O_L	0.15273		0.373	-0.00189		0.945			
O_{TC}	-0.05524		0.945	-0.03598		0.524			
O_{MM}	0.06490		0.935	-0.04655		0.381			
O_{PS}	0.32253		0.688	-0.06244		0.262			
O_{FP}	2.41938	**	0.025	-0.35355	***	0.000			
Prices of related goods									
PPORK				5.59849	*	0.094	5.61586		0.778
PBEEF	-4.19239		0.376	-1.17089	**	0.015	-4.33387	*	0.100
PCHICK	8.97644		0.566	-1.38291		0.636	4.81213		0.765
PRSCAD	-2.36284		0.297	0.10706		0.769	-2.12281		0.259
PTLAPIA	1.12712		0.122	0.02797		0.557	1.07240	***	0.000
Socio-demographic variables									
LCN	-0.69700	*	0.075	0.09495	*	0.061	-0.32003		0.333
LCC	-0.27167		0.415	0.04605		0.279	-0.21972		0.436
LCWMC	-0.32028		0.122	0.02476		0.373	-0.20511		0.286
LCMC	-0.10544		0.58	0.04036	*	0.1	0.03112		0.850
LCT	0.03382		0.879	0.02911		0.336	0.16605		0.366
LCM	0.19098		0.855	0.15376	***	0	0.50510		0.111
EDUE	0.58562		0.464	-0.03843		0.5	0.46754		0.264
EDUH	0.78299		0.322	-0.04874		0.359	0.61718		0.150
EDUC	0.97672		0.217	-0.00907		0.868	0.88251	**	0.038
EDUP	1.27057		0.127	0.00326		0.961	1.18914	***	0.010
EDUV	0.32356		0.739	0.02974		0.654	0.18910		0.719
GEND	0.22258	*	0.056	0.00827		0.655	0.19494	*	0.068
LOC	2.54393		0.579	-0.16081		0.815	1.60746		0.673
LN AGE	0.39753	*	0.074	0.00629		0.845	0.39738	**	0.047
LM PCINC	-0.00907		0.912	0.01124		0.336	0.03252		0.696
LN HLDSZ	-1.69752	***	0	0.01084		0.593	-1.66021	***	0.000
MC2	2.76415		0.532	-0.21211		0.745	1.84725		0.613
MC3	1.80272		0.549	-0.14726		0.73	1.29459		0.590
MC4	0.81328		0.424	0.21928	*	0.055	0.91807		0.132
MC5	0.04207		0.974	dropped					

Variable	OLS Estimates Without Correcting For Endogeneity			First Stage Regression Ln Milkfish Price			Instrumental Variable Estimates		
	Coefficient		p-value	Coefficient		p-value	Coefficient		p-value
Behavioral characteristics on food consumption trends									
FST	-0.12232	**	0.022	0.01311	*	0.083	-0.11191	**	0.014
SUS	-0.05702		0.263	-0.00920		0.182	-0.05911		0.197
GAP	0.04686		0.41	-0.00515		0.518	0.02140		0.677
ORG	-0.05266		0.356	-0.00182		0.818	-0.04332		0.423
TRAC	0.08854	*	0.084	-0.00589		0.422	0.08634	**	0.039
LPR	0.03162		0.586	-0.00784		0.337	0.02462		0.681
SLF	0.01237		0.842	0.00863		0.28	0.01397		0.854
LAB	0.02996		0.526	-0.00555		0.392	0.01659		0.677
ADV	-0.03575		0.376	0.00274		0.623	-0.01208		0.755
FFN	0.00653		0.882	0.00712		0.282	0.02323		0.570
_Cons	-17.39869		0.786	-11.66032		0.126	-17.55487		0.629

***, **, * Significant at 1%, 5% and 10% probability levels, respectively
Centered $R2 = 0.4897$, $F (35, 342) = 20.49$, $Prob > F = 0.0000$

Without correcting for endogeneity, the estimated effect of price of milkfish on per capita consumption is -0.18039 (p = 0.618). This coefficient may be biased in the presence of endogeneity. A test of endogeneity was conducted using the Durbin-Wu-Hausman test. The null hypothesis is that *ln* of milkfish price is exogenous. Hypothesis is not rejected implying the exogeneity of *ln* of milkfish price in the model, χ^2 (1,291)=1.68789, $p =$ 0.1949. Endogeneity of price in modeling per capita consumption of milkfish is addressed by employing the IV approach. *Ln* price is modeled as the hedonic price of the different quality attributes. Failure to correct for endogeneity may have had resulted in errors in magnitude and sign switching in estimates. Case in point is variable O_{FP} corresponding to place of purchase (Iloilo fish port). Based on OLS without correcting for endogeneity output, its coefficient of 2.419 is the ratio of the geometric mean for O_{FP} over the geometric mean of O_M. In this case, exp (γ_6) = exp (2.419) = 11.238. It implies that milkfish bought at Iloilo Fishport Complex will be 1023% more expensive than milkfish bought at the base case which is mall-based supermarkets. This contradicts priori expectation that price in Iloilo Fish Port is lower being the main trading center. Moreover, the price difference between these two channels is unexpectedly large.

Result of the First Stage Regression

The second column of Table 4 presents the first stage regression of TSLS. The *ln* price per kilo of milkfish was regressed vis-à-vis all the other explanatory variables including the candidates for instrumental variables. Chosen as candidate instrumental variables were characteristic of the skin, condition of the slime, color of the eyes, color of the gills, condition of the peritoneum, size, product form, labeled as organic, labeled as produced in Iloilo, provision of value-added services, and the place of purchase. Except for organic labeling, place of origin, size, and place of purchase, specification for all other potential instrumental variables exhibit significant relationship with the *ln* milkfish price. This satisfies the partial correlation requirement for instrumental variables to be valid.

In the first stage regression analysis, milkfish price rises with increase in price of pork implying that they are substitutes. However, price of milkfish in the first stage regression exhibits a negative relationship with the price of beef. This connotes that milkfish and beef are complements. It is invariant to changes in the prices of chicken, tilapia, and roundscad.

Price of milkfish is affected by dominance of specific household lifecycle groups. Increasing population of newlyweds and households composed of mature couples tends to increase milkfish price, *ceteris paribus*. This may be attributed to increase in purchasing power and minimal cost of maintaining a household for both household lifecycle groups. Also, milkfish price was found to be positively correlated with income.

Except for behavioral patterns towards food safety, the hypothesized behavioral patterns do not affect milkfish price. As consumers exhibit certain behavior consistent with food safety rules, price of milkfish declines. This may indicate that price of milkfish decreases as consumers are becoming more food safety conscious.

Not surprisingly, quality attributes affect the price of milkfish. Price of milkfish decreases as the index in the qualities of the skin, slime, color of the eyes, and condition of the peritoneum deteriorates away from the qualities of newly caught/ fresh milkfish.

Provision of value added services has a positive relationship with milkfish price. In addition, milkfish price tends to respond positively with size, product form, and place where milkfish is purchased. Milkfish price increases as size increases. On the other hand, processing increases price of milkfish as well. Expectedly, milkfish bought from outlets other than Iloilo Fishing Port complex is priced higher. Also, milkfish bought from mall-based supermarkets is priced the highest.

Result of the Second Stage Regression: Factors Affecting Demand for Milkfish

The factors affecting the demand for milkfish are shown as column 3 in Table 4. After controlling for endogeneity, it should be noted that the coefficient of *ln* price of milkfish changed from 0.18039 ($p = 0.618$) to -1.47619 ($p = 0.175$). Though the parameter estimate remains insignificant at 10% probability level, there is a significant improvement in the probability level. Likewise, the price coefficient exhibits a correct (negative) sign. The result indicates that elimination of the endogeneity-induced bias improved the estimated result. The coefficient implies that a 1% increase (decrease) in price of milkfish will result in -1.47% decrease (increase) in per capita consumption. This result is indicative of demand for milkfish being responsive to change in its own price, which is consistent with the result of Lee (1993).

Price of beef negatively affects per capita consumption of milkfish. Thus, beef and milkfish are complementary products. A 1% increase in price of beef decreases per capita consumption of milkfish by 4.33% ($p = 0.10$).

Price of tilapia positively affects per capita consumption of milkfish. From Table 4, a 1% increase in price of tilapia increases per capita consumption of milkfish by 1.027% (p = 0.000). The positive sign for tilapia price coefficient implies that milkfish and tilapia are substitute products. Education level has a positive and statistically significant coefficient vis-à-vis the base case which is no education. Table 4 shows that purchase decision makers who have finished college consume 88.251% (p = 0.038) more milkfish than purchase decision makers without any education. Purchase decision makers who have post-graduate degrees, on the other hand, consume more milkfish than those without education. This supports the earlier findings of Arcidiacono (2011) that education, together with technology, tends to remove the basic assumption of information asymmetry and thus tends to make choices based on reason. For example, educated individuals are more likely to be holistic in their choices, favoring products not only based on the benefits they can bring but also on the intangible values behind the product. Purchase decision-makers in Iloilo are more likely to consider intangible product values such as food safety, support to local farmers, being locally-produced, and being produced using organic-production technologies. This result affirms Silverstein's contention about the new consumer being characterized as adopting emotional intelligence like choosing goods based on their symbolic meanings.

Among behavioral factors relating to key food consumption trends, affinity towards food safety and traceability yielded significant relationship with milkfish per capita consumption. As the self-rated behavior on espousing food safety increases, per capita consumption of milkfish decreases by 0.112 (p = 0.014). This implies that respondents who espouse food safety in food selection view milkfish as a relatively unsafe product. Use of animal manure in the production of natural feeds for milkfish and use of commercial feeds in intensive cultures may have created a negative perception such that their continuous use may reduce the safety level of milkfish. Likewise, there is perception that some fish culture occurs in poor quality water environment. In addition, consumption of milkfish is oftentimes restricted among children because of its many bones. On the other hand, as respondents behave to support food traceability, consumption of milkfish increases by 0.086343 (p = 0.039). Iloilo is one of the country's top milkfish producing provinces such that the belief that milkfish being sold is produced in Iloilo may explain the increase in one's consumption as behavior towards traceability (product origin) increases.

Other purchase decision makers' demographics that affect per capita consumption are age and household size. Age has a positive effect on per capita consumption as, on the average, per capita consumption increases by 0.397% as age increases by 1% (p = 0.047), *ceteris paribus*. Household size has a negative effect on milkfish per capita consumption. As household size increases by 1%, per capita consumption, on the average, decreases by 1.66%, holding other things constant (p = 0.000). This indicates that bigger households will have lesser propensity to consume more milkfish.

Consistent with the findings of Verbeke et al. (2007), high perceived importance towards food consumption trends such as sustainability in production and ethics related to fish are not translated into increases in consumption.

Conclusions and Recommendations

This study was designed to analyze how the economic, socio-demographic, and consumer psychographic factors affect the demand for milkfish by *Ilonggo* milkfish consumers. After controlling for endogeneity by the use of instrumental variables, the results generally show consistency of parameter estimates in terms of magnitude and signs vis-à-vis a priori expectations. Specifically, the milkfish price coefficient exhibited correct (negative) sign and the significance level improved from $p = 0.618$ without correcting for endogeneity to $p = 0.175$ after the use of instrumental variables in controlling for endogeneity. Other variables found to significantly affect milkfish demand including their effect (positive or negative) are as follows: price of beef (-), price of tilapia (+), educational attainment of the purchase decision-maker (+), gender of the purchase decision-maker (+), age of the purchase decision-maker (+), and household size of the purchase-decision maker (-). Among the behavioral characteristics related to consumption trends, behavior towards food safety and traceability exhibited negative and positive signs, respectively, and significant relationship with milkfish consumption. The perception that the use of chicken manure in natural food production and milkfish being produced in poor quality water environment could give rise to the belief that milkfish is unsafe to eat. This leads to lower consumption, thus a decrease in consumption as behavior towards food safety increases. On the other hand, consumers who believe that the origin of milkfish is Iloilo (traceability) have generally higher consumption.

Based on the results, the following recommendations are given attention, namely, 1) making production efficient so as to make its price competitive with substitute product, 2) observing proper post harvest handling to maintain its fresh quality up to the consumer's level and producing the right size of fish preferred by consumers, 3) adding value by processing such as deboning and producing milkfish-based products, and 4) ensuring the Iloilo traceability label possibly through branding and avoiding the unsafe image of milkfish associated with increasing use of commercial feeds in intensive production, use of animal manure in natural feeds, and culture in poor water quality environment.

Despite the relatively low significance level of the price coefficient, the elastic demand for milkfish implies the need for efficient production system to reduce cost significantly in order to avoid raising its price. Otherwise, a given price increase would lead to a more than proportional decrease in demand that would reduce revenue of producers. To increase revenue, there is a need for milkfish to be competitive with substitute products like tilapia. Result also shows considerable price discount as milkfish quality deteriorates, hence, the delivery of the desired milkfish quality through better postharvest handling (e.g., proper icing and packing to preserve the preferred physical characteristics of the skin, eye color, and gill color) is important in improving the industry's competitiveness. On the other hand, there is a price premium associated with medium size milkfish which implies the need for optimal harvesting practices. The aspect of food safety needs to be incorporated in the marketing strategy not only to ensure public safety but also to address the negative image of culture system in poor water quality environment and use of commercial and animal manure-based feeds. Iloilo should take advantage of the favorable image of milkfish coming from the province. A good label for the product will benefit the milkfish industry and will be consistent with the current marketing trend that addresses traceability issues for food products.

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