ASSESSING PROVINCIAL-LEVEL DEMAND FOR FOOD QUANTITY AND QUALITY IN CHINA: AN EASI DEMAND SYSTEM APPROACH

Sachintha Mendis
M.S. Student, Agricultural and Applied Economics, University of Wyoming
smendism@uwyo.edu

Dr. Vardges Hovhannisyan
Assistant Professor, Agricultural and Applied Economics, University of Wyoming
vhovhann@uwyo.edu

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Abstract: Food consumers in China have undergone significant changes in their food consumption patterns and have become more dependent on animal products for protein, while substituting fine grains for coarse grains. Considerable research effort has been devoted to this topic. A majority of these studies rely on the AIDS model, which has linear Engel and ignores unobserved consumer heterogeneity.

We study food demand in China using the Exact Affine Stone Index (EASI) system. The EASI model not only shares all of the desirable properties of the AIDS model but also provides additional benefits. Specifically, it is not subject to the rank three limitation of Gorman (1981) and allows the Engel curves to take arbitrary shapes. Further, the EASI accounts for unobserved consumer heterogeneity. This is especially important in welfare studies conducted on consumer-level since much of the demand variation is left unexplained.

Previous studies focus on changes in quantities, however we reveal that quality is also very important. Further, results confirm the prevalence of unobserved heterogeneity in consumer food preferences across provinces in China. By enhancing the findings of previous studies, this study elicits more realistic food preferences in China for agricultural policy, trade, and foreign direct investment decisions.

Keywords: Demand for food quality, EASI demand model, food demand in China.

JEL Code: D11, D12

Introduction

With nearly 20% of the total world population (Worldometers, 2016), China is the world's largest food consumer (Zhou et al., 2012). Food consumption in China has undergone structural changes driven by rising income urbanization and exposure to western food diet (Hovhannisyan and Gould, 2014; Dong and Fuller, 2007). According to Zhou et al. (2012), structural changes are reflected by higher demand for food, demand for more diverse food, demand for higher quality food, and the growth of away–from–home food.

Although numerous studies are conducted to identify consumer behavior and food demand in China majority of them address the quantity changes in diets, Marshallian demands and income and expenditure elasticities (Hovhannisyan and Shanoyan 2016, Hovhannisyan and Gould, 2014; Hovhannisyan and Gould, 2011; Zhuang and Abbott, 2006) based on unit values (obtained by dividing expenditure by the quantity consumed) as price data. Using unit values can bias empirical analyses because the unit values are not exogenous market prices; instead they reflect household food quality choices within each food product category (Deaton, 1988; Nelson, 1991). For instance, the choice of meat includes type of meat, cut, appearance, texture, tenderness, flavor, nutrient content, freshness, and ease of preparation. Thus, this study assesses the demand for food quality of heterogeneous consumers.

Yu and Abler (2015) addresses the issue of biasness in their study of Chinese rural food demand assuming similar consumption patterns across regions. Hiu et al. (2001) find there are prominent market segments in China with differences in consumers' decision–making styles. Cui and Liu (2000) also suggest differences in consumer preferences may be attributed to regional heterogeneity in terms of purchasing power, attitudes, lifestyles and consumption patterns. Hovhannisyan and Shanoyan (2016) studied the consumer preferences across Chinese provinces

and evident regional heterogeneity in provincial level. However, there are no studies identifying consumer decisions on a more disaggregated regional basis. Thus, this study fills that gap of estimating consumer demand for food quality and quantity in provincial level.

For studies on consumer demand, the Almost Ideal Demand System (AIDS) has been a workhorse demand model for nearly three decades (Deaton and Muellbauer, 1980). Lewbel and Pendakur (2009) offer a new model (EASI) that builds upon the AIDS demand, while addressing its key limitations: 1) unobserved consumer heterogeneity and, 2) non– linear Engel curves. Specifically, this more flexible framework of EASI model allows for an arbitrary shape of Engel Curves, while fully accounting for unobserved consumer heterogeneity. Thus, we analyze the demand for food quality in China based EASI model and Engel relationships.

To whom this is important?

These structural changes and higher food consumption supported lower trade barriers have led to build up China an emerging massive market. China, as an emerging massive market has been luring many multinational corporations (Garten, 1998). For instance, food giants such as Danone, Coca–Cola, Mondelez and Nestle have their presence in China in large scale (Hoffmann, 2014). However, multinational corporations have achieved only a limited success in penetrating the massive markets (Prahalad and Lieberthal, 1998). The limited success is a result of the misconception that emerging massive market countries have homogenous consumer behavior in fact Hovhannisyan and Shanoyan (2016) confirm consumer heterogeneity by estimating variability of curvilinear Engel curves of different products. This study extends to observe that heterogeneity in consumer demand in terms of food quantity and fquality as well.

This improved assessment of consumer preferences would reduce difficulties in designing effective marketing strategies.

Not only the marketing strategies, but also the policy decisions can be improved by a more accurate consumer behavior assessment. China feeds over one–fifth of the world's population with only one–fifteenth of the world's arable land (FAO, 1998). China's future food security is therefore a growing concern for the Chinese government and global institutions, such as the World Health Organization, World Food Programme and Food and Agriculture Organization of the United Nations. The Chinese government designs food security policies to address three major issues: 1) significant fluctuations of food supply and prices, 2) low food security and inefficient access to food because of poverty, and 3) China's food supply availability (FAO, 1998). As food supply depends on demand identifying more accurate consumer demand may assist to formulate effective policies to improve food security.

Data

According to Gould and Villarreal (2006), quantifying issue of home-based food production in rural China is a major limitation when considering rural China's food consumption. Thus, this study is conducted based on the urban China. Out of the 31 provinces in China categorized as urban, inferences are made for 30 provinces except Tibet. Further, food consumption data of seven commodity groups in each province were analyzed. The commodity groups are meats (i.e. poultry, beef, lamb, pork and other meats), seafood, eggs, fat and oils, vegetables, fruits and grains. This study covers the period from 2003 to 2012 which constitutes the most recent and the longest provincial level panel data on Chinese consumer's food expenditure. The data were obtained from National Bureau of Statistics of China (NBSC) which have collected as a part of Chinese Urban Household Income and Expenditure Survey. The

method of data collections and aggregation is explained Dong and Fuller (2010) and Hovhannisyan and Bozic (2016).

Table 1 provides descriptive statistics of data for the period of 2003 to 2012. According to table one urban Chinese households' expenditure on meat is the highest among expenditures on food and it's 34% (810.7 Yuan per capita) of the food's budget share. Vegetables are identified as the second highest food which urban china allocates their budget (17.7%, 411.6 Yuan per capita). Grains and fruits looks somewhat equally important and the budget share for them are 14.9% (334.8 Yuan per capita) and 14.2% (330.9 Yuan per capita) respectively. Seafood can be identified as the next food category which urban China spends with a budget share of 9.8% (257.5 Yuan per capita). 5.5% of budget share (125.2 Yuan per capita) is spent on fats and oil while eggs alone get a 3.9% of the budget (86.8 Yuan per capita). Further, highest variation of expenditure was observed in seafood and meats.

For instance, if we consider food quantity purchase overtime in Beijing, meat and grain shows somewhat decreasing pattern while fruits show an increasing pattern (Figure 1). There are no clearly visible fluctuations in the quantity of fish purchased. However, the expenditures on each category have increased with time (Figure 2). Because the per capita income also increased, there may be reasons other than increase of prices which effect purchasing decision. For instance, meat quantity purchases have decreased, while the expenditure on meat has increased. This may due to people have purchased more pricy meat cut with increased income.

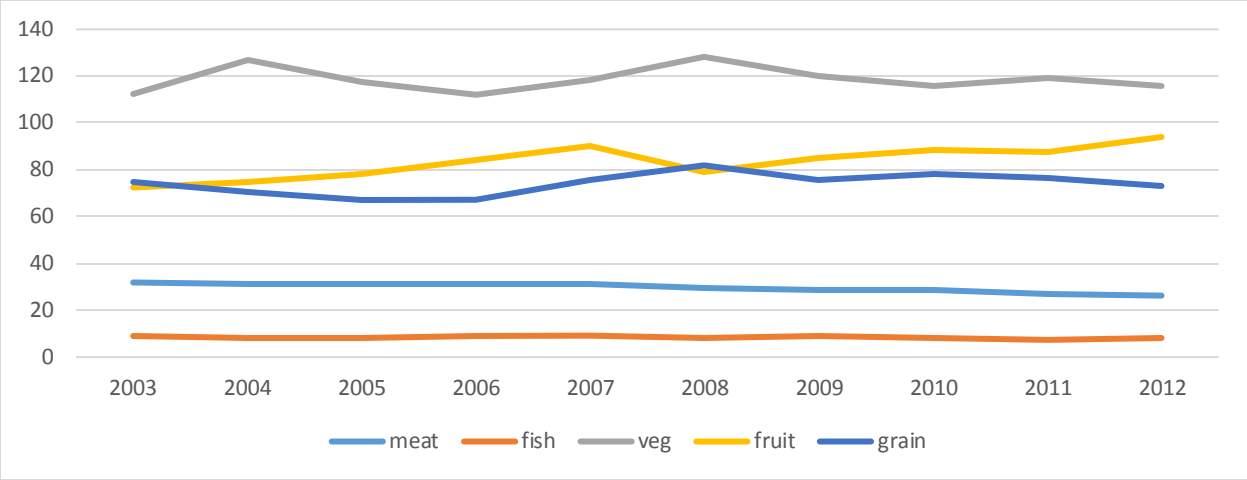

Figure 1: Food quantity purchased in Beijing

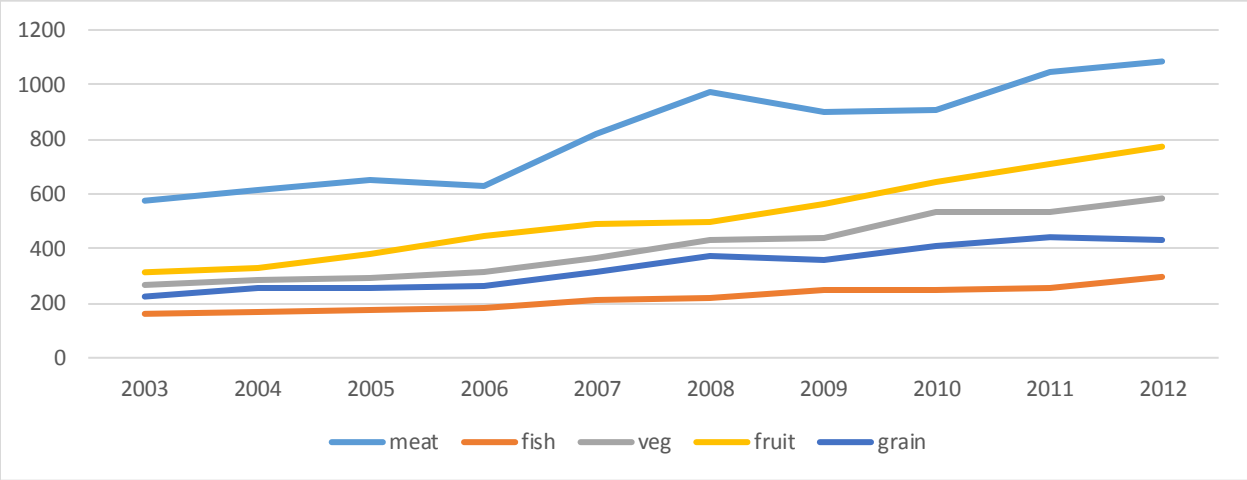

Figure 2: Total Expenditure in Beijing

A Structural Model for the Analysis of Demand for Food Quality

Income Elasticity of Food Quality

We follow the approach offered by Gale and Huang (2007) to evaluate consumer demand for food quality. Let e_i denote consumer expenditure on commodity i, y be consumer income, p_i and q_i represent the price and quantity of commodity i, respectively. Assuming prices are independent of

income, which characterizes a simple Engel relationship, changes in commodity expenditure e_i resulting from changes in income y are entirely reflective of quantity change:

(1) $$e_i(y) = p_i q_i(y)$$

Based on equation (1), income changes affect e_i and q_i in the same way, given that p_i is held fixed. In reality, though, changes in e_i may be brought not only by changes in q_i but also by fluctuations in p_i. When studying demand for commodity aggregates, p_i that reflects unit value of commodities, may be indicative of food quality, given that commodity composites comprise heterogeneous groups of food items that typically vary in quality, convenience, functionality, and other product features. To account for this possibility, Gale and Huang (2007) generalize equation (1) to allow for potential effects of income on food quality:

(2) $$e_i(y) = v_i(y) q_i(y)$$

where $v_i(y)$ captures the effect of income y on food quality. When consumers respond to rising incomes by purchasing products with higher unit values, $v_i(y) > 0$.

To derive the elasticity of demand for food quality in terms of income elasticity of demand and income elasticity of commodity expenditures, we logarithmically transform both sides of equation (2), and differentiate with respect to *lny*:

(3) $$\frac{d \ln e_i(y)}{d \ln y} = \frac{d \ln v_i(y)}{d \ln y} + \frac{d \ln q_i(y)}{d \ln y}$$

alternatively,

(4) $$\varepsilon_i = \theta_i + \eta_i$$

where ε_i – expenditure elasticity of income, θ_i – quality elasticity of income, and η_i – income elasticity of demand. From the relationship derived in equation (4), one can obtain quality elasticities as follows:

(5) $$\theta_i = \varepsilon_i - \eta_i$$

A Structural Model of Consumer Food Preferences

We employ a theory-based demand model to quantify ε_i and η_i, which are then used to evaluate quality effects of income change. Specifically, we adopt the EASI system offered by Lewbel and Pendakur (2009), which addresses two fundamental issues affecting previous workhorse demand models while retaining the desirable features thereof (Zhen et al. 2013).

Let w_{rit} denote the budget share of commodity i in province r in year t; p_{rjt} is the price of commodity j in province r in year t; y_{rt} is real food expenditures in province r in year t; L is the highest order of polynomial in real expenditures; D_r is a dummy variable for province r; N and R represent the number of commodities and provinces, respectively; u_{rit} denotes unobserved share determinants; and $\alpha_{i0}, \alpha_{ij}, \beta_{il}, \gamma_{ir}$ are parameters. The EASI model is then specified by the following functional form:

(6) $$w_{rit} = \alpha_{i0} + \sum_{r=1}^{R} \gamma_{ir} D_r + \sum_{l=1}^{L} \beta_{il} y_{rt}^{l} + \sum_{j=1}^{N} \alpha_{ij} \log\left(p_{rjt}\right) + u_{rit}, \quad \forall r = 1,\ldots,R;\ \ i = 1,\ldots,N; t = 1,\ \ldots,\ T.$$

The demand system in equation (6) satisfy the theoretical restrictions of aggregation and symmetry provided below:

(7) $$\sum_i \alpha_{i0} = 1, \sum_i \gamma_{ir} = 0\ \sum_i \beta_{il} = 0, \sum_i \alpha_{ij} = 0,\ \forall j = 1,\ldots,n, \quad \text{and} \quad \alpha_{ij} = \alpha_{ji},\ \forall j \neq i$$

Following Pendakur (2008) and Zhen et al. (2013), we specify y_{rt} as Stone price-deflated real expenditures given by: $y_{rt} = \log(x_{rt}) - \sum_{j=1}^{N} w_{rjt} \log(p_{rjt})$. This results in a linear approximate EASI model, the purpose of which is to simplify empirical analysis already complicated by the inclusion of a large number of provincial fixed-effects. Unlike the linear approximate AIDS model, where the Stone price index is only an approximation to the true expenditure deflator, by design, the Stone price is the correct deflator of food expenditures in the EASI model (Zhen et al 2013). Moreover, the linear EASI specification has been found to yield almost identical results to those of the nonlinear model (Lewbel and Pendakur 2009).

Expenditure, Price and Quality Elasticities

We derive expenditure elasticities from the EASI model in equation (6) following Banks et al. (1997) and Zhen et al. (2013) as provided below:

(8) $$E = \left(diag\left(W\right)\right)^{-1}\left[\left(I_N + BP'\right)^{-1} B\right] + 1_N,$$

where E is the (N x 1) expenditure elasticity vector, W is represents the (N x 1) vector of observed commodity budget shares, B is a (N x 1) vector with its ith element represented by $\sum_{l=1}^{L} \beta_{il} ly^{l-1}$, P is the (N x 1) vector of log prices, and 1_N is a (N x 1) vector of ones.

Further, the Hicksian elasticity of demand for commodity i with respect to price of commodity j $\left(e_{ij}^{H}\right)$ is developed from the approximate EASI model as follows:

(9) $$e_{ij}^{H} = \frac{\alpha_{ij}}{w_i} + w_j - \delta_{ij}, \ \forall i, j = 1, \ldots, 7,$$

where δ_{ij} is the Kronecker delta equaling 1 if $i = j$, and 0 otherwise.

Using the Hicksian $\left(e_{ij}^{H}\right)$ and expenditure elasticity estimates $\left(e_i\right)$, the Marshallian price elasticities $\left(e_{ij}^{M}\right)$ can be obtained from the Slutsky equation: $e_{ij}^{M} = e_{ij}^{H} - w_j \, \mathrm{e}_i$.

To derive ε_i and η_i, we supplement the EASI demand system (6) by a system of expenditure equations, which express log expenditures for each food commodity in terms of log income:

(10) $$\ln e_i = \delta_{i0} + \delta_{i1} \ln y + \zeta_i, \ \forall = 1, \ldots, N$$

where $\delta_{i1} = \dfrac{d \ln e_i}{d \ln y}$ represents the expenditure elasticity of income for commodity aggregate *i*.

Finally, we follow Dhar, Chavas, and Gould (2003) to account for total expenditure endogeneity:

(11) $$\ln X = \phi_0 + \phi_1 \ln y + \phi_2 trend + \sum_{r=1}^{N-1} \varphi_r D_r + \zeta$$

The empirical appeal of this approach is the ease of deriving income elasticity of total expenditure $\dfrac{d \ln X}{d \ln y}$, which can be used to derive income elasticity of demand η_i from the relationship $\eta_i = \dfrac{d \ln q_i}{d \ln X} \dfrac{d \ln X}{d \ln y}$, where $\dfrac{d \ln q_i}{d \ln X}$ is the expenditure elasticity of demand as provided in equation (8).

Empirical Analysis

Our empirical analysis builds upon the structural framework that incorporates the EASI demand model (6), the individual commodity expenditure equations (10), and the total expenditure equation (11). This structural framework is estimated via a Full Information Maximum Likelihood (FIML) procedure that takes account of theoretical demand restrictions and one demand equation is dropped to avoid singularity. An important benefit of the FIML is its ability to account for the true simultaneity of expenditure budget shares and total expenditures on food commodities in question (Hayashi 2000).

Several EASI specifications are estimated via the GAUSSX programming module of the GAUSS software system with allowance being made for contemporaneous correlation across the stochastic terms of the system of equations (GAUSS optimization algorithm is utilized for the model estimations, and heteroskedasticity-consistent standard errors are obtained via the ROBUST option). Specifically, to determine the proper specification for the EASI system, the full system comprising equations (6), (**Error! Reference source not found.**), and (**Error! Reference source not found.**) is estimated with the demand system allowing for different polynomial structures. The degree of polynomial function is increased one at a time starting at L=1, and the Bewley likelihood ratio (B_{LR}) test procedure is adopted to evaluate the incremental change in the explanatory power of these more general models.[1] The results indicate that at L=4 the EASI system provides the best fit of the data, and adding one more degree of income polynomial does not considerably enhance the explanatory power of the model (the respective p-value associated with the B_{LR} test statistic is 0.27).[2] Interestingly, many previous

[1] The B_{LR} test statistic is measured as: $B_{LR} = 2(LL^U - LL^R)\left[(E*N^S - N^U)/E*N^S\right]$, where $LL^{U,R}$ is the optimal log-likelihood value from the unrestricted/restricted model, E denotes the number of equations, N^S - sample size, and N^U - number of parameters in the unrestricted model (Bewley 1986). Asymptotically, $B_{LR} \sim \chi^2(g)$, where degrees of freedom (g) equals the difference in the number of estimated parameters under the restricted vs. unrestricted specification.

[2] It deserves noting that L should be less R, i.e., the number of demand equations, from the convergence perspective (Pendakur 2008).

studies find that L=5 offers the most optimal polynomial structure in the EASI model (see for example, Lewbel and Pendakur 2009; Zhen et al. 2013). Based on the statistical evidence from the Durbin-Wu-Hausman test, food prices and expenditures are found to be endogenous (LaFrance 1993). Further evidence from a first stage F-test confirms that the set of price instruments used in the analysis are relevant (the associated p-value<0.00). Finally, the B_{LR} test for the joint significance of the province fixed-effects indicates that the unobserved provincial heterogeneity significantly enhances the explanatory power of the EASI system.

Table 2 displays the demand estimates from the full model accounting for provincial heterogeneity as well as the price and expenditure endogeneity. The majority of coefficients are statistically significant at standard significance-levels and have expected signs. Table 3 presents the Marshallian price elasticity estimates (ε^M), expenditure, income, and quality elasticity estimates (e_i) evaluated at sample mean values. All own-price elasticity estimates appear to be consistent with theory and are statistically significant. Further, own price elasticities are less than unitary elastic for all commodities except for seafood (-1.13) and fats/oils (-1.21). This may be reflective of consumer price reaction to changing composition of seafood consumption in China with more luxury seafood finding its way into household consumption (Fabinyi 2012). In the same vein, China has been increasing imports of fats and oils that are refined into consumer oil products, which tend to be more expensive than their domestically produced counterparts (Gale et al. 2015). More importantly, quality elasticities are estimated to be positive for all commodities except for seafood.

Conclusions

We study food demand in China using the Exact Affine Stone Index (EASI) system. The EASI model not only shares all of the desirable properties of the AIDS model but also provides

additional benefits. Specifically, it is not subject to the rank three limitation of Gorman (1981) and allows the Engel curves to take arbitrary shapes. Further, the EASI accounts for unobserved consumer heterogeneity. This is especially important in welfare studies conducted on consumer-level since much of the demand variation is left unexplained.

Previous studies focus on changes in quantities, however we reveal that quality is also very important. Further, results confirm the prevalence of unobserved heterogeneity in consumer food preferences across provinces in China. By enhancing the findings of previous studies, this study elicits more realistic food preferences in China for agricultural policy, trade, and foreign direct investment decisions.

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Table 1. Descriptive Statistics for Food Expenditures, Prices, and Budget Shares

Variable	Mean	STD	Min	Max	CV (%)
Expenditure (Yuan/Capita)					
Meats	745.7	331.0	251.8	2,086.7	44
Seafood	239.6	224.6	36.4	1,220.0	94
Vegetables	377.6	135.9	156.0	797.0	36
Fruits	301.1	129.8	111.5	772.9	43
Grains	311.2	94.5	157.3	699.8	30
Eggs	81.6	28.8	25.8	195.9	35
Fats and oils	116.6	39.6	43.5	266.6	34
Agricultural Commodity Price					
Meats	22.8	6.6	11.5	41.3	29
Seafood	19.1	8.2	8.8	57.5	43
Vegetables	3.1	1.1	1.4	7.3	35
Fruit	4.7	1.6	2.2	9.9	33
Grains	3.7	0.9	2.0	6.4	24
Eggs	8.5	2.3	4.4	15.8	27
Fats and oils	10.9	2.5	6.4	17.0	23
Budget Share (%)					
Meats	33.9	5.3	24.9	48.4	16

Seafood	9.9	6.4	3.1	29.1	65
Vegetables	17.6	2.4	12.6	24.4	14
Fruit	14.0	3.1	7.5	22.3	22
Grains	15.1	3.5	7.4	24.5	23
Eggs	4.0	1.3	1.4	6.9	32
Fats and oils	5.6	1.4	2.6	10.7	26
Income (1,000 Yuan/Capita)	14.3	6.6	0.0	40.2	46

Note: CV represents the coefficient of variation and is calculated as a ratio of the standard deviations to the respective mean.

Source: Chinese Urban Household Income and Expenditure Survey, China Statistical Yearbooks, 2003–2012.

Table 2. Parameter Estimates from the EASI Budget Share Equations

Parameter	Meats	Seafood	Vegetables	Fruit	Grains	Eggs	Fats
Intercept (β_{i0})	**0.241**	**0.248**	**0.225**	**0.144**	**0.081**	**0.014**	**0.047**
	0.011	*0.007*	*0.005*	*0.008*	*0.006*	*0.003*	*0.005*
Real income (β_{i1})	**-0.088**	**0.080**	**0.067**	0.064	**-0.150**	-0.010	**-0.037**
	0.046	*0.029*	*0.032*	*0.060*	*0.059*	*0.021*	*0.014*
Real income (β_{i2})	-0.010	**-0.054**	-0.007	**-0.039**	0.035	**0.035**	**0.039**
	0.035	*0.018*	*0.015*	*0.021*	*0.019*	*0.006*	*0.005*
Real income (β_{i3})	**0.254**	0.015	**0.078**	**-0.177**	**-0.103**	-0.022	**-0.045**
	0.044	*0.038*	*0.047*	*0.040*	*0.032*	*0.015*	*0.023*
Real income (β_{i4})	**0.666**	**-0.237**	0.072	**-0.258**	-0.132	**-0.074**	**-0.136**
	0.271	*0.104*	*0.065*	*0.143*	*0.132*	*0.018*	*0.026*
Price (α_{1i}) meats	0.027	-0.005	**0.143**	-0.078	**-0.109**	**-0.044**	0.066
	0.035	*0.023*	*0.029*	*0.054*	*0.052*	*0.011*	*0.061*
Price (α_{2i}) seafood		-0.004	**-0.075**	**-0.024**	**0.071**	0.009	0.028
		0.018	*0.018*	*0.013*	*0.028*	*0.015*	*0.030*
Price (α_{3i}) veg			**0.117**	-0.035	0.013	0.020	**-0.083**
			0.055	*0.055*	*0.036*	*0.017*	*0.049*
Price (α_{4i}) fruits				0.039	**0.156**	-0.012	0.054
				0.066	*0.045*	*0.022*	*0.058*
Price (α_{5i}) grains					0.013	-0.011	-0.033
					0.071	*0.015*	*0.067*
Price (α_{6i}) eggs						0.002	**0.037**
						0.016	*0.015*
Price (α_{7i}) fats/oils							-0.070
							0.081
Province fixed-effects					Yes		
Price and expenditure endogeneity accounted for					Yes		

Note: The italicized numbers are the estimated parameter standard errors. Values in bold identify elasticity estimates that are statistically different from 0 at or below the 0.05 significance level.

Table 3. Marshallian Price, Expenditure, Income and Quality Elasticity Estimates

Commodity	Meats	Seaf.	Veg.	Fruits	Grains	Eggs	Fats	Exp.	Income	Quality
Meats	**-0.83**	0.01	**0.47**	**-0.19**	**-0.28**	**-0.12**	**0.21**	**0.97**	**0.28**	**0.03**
	0.04	*0.02*	*0.02*	*0.02*	*0.03*	*0.01*	*0.03*	*0.03*	*0.03*	*0.03*
Seafood	**-0.35**	**-1.13**	**-0.91**	**-0.37**	**0.59**	**0.06**	**0.24**	**0.98**	**0.28**	**-0.05**
	0.08	*0.09*	*0.05*	*0.06*	*0.07*	*0.03*	*0.12*	*0.07*	*0.02*	*0.02*
Vegetables	**0.74**	**-0.45**	**-0.95**	**-0.23**	0.04	**0.11**	**-0.48**	**1.01**	**0.29**	**0.12**
	0.05	*0.04*	*0.05*	*0.04*	*0.03*	*0.01*	*0.07*	*0.05*	*0.02*	*0.02*
Fruit	**-0.72**	**-0.22**	**-0.34**	**-0.79**	**0.33**	**-0.11**	**0.36**	**0.98**	**0.28**	**0.06**
	0.06	*0.05*	*0.05*	*0.06*	*0.05*	*0.02*	*0.09*	*0.05*	*0.04*	*0.04*
Grains	**-0.60**	**0.51**	**0.15**	**0.42**	**-0.86**	**-0.06**	**-0.20**	**1.02**	**0.30**	**0.16**
	0.05	*0.05*	*0.04*	*0.04*	*0.07*	*0.03*	*0.05*	*0.05*	*0.01*	*0.01*
Eggs	**-0.72**	**0.26**	**0.56**	**-0.27**	**-0.25**	**-0.95**	**0.95**	**1.10**	**0.32**	**0.00**
	0.01	*0.08*	*0.06*	*0.07*	*0.09*	*0.01*	*0.19*	*0.06*	*0.02*	*0.02*
Fats/oils	**0.42**	**0.57**	-0.35	0.07	**-0.49**	**0.69**	**-1.21**	**1.02**	**0.30**	**0.05**
	0.16	*0.21*	*0.21*	*0.21*	*0.13*	*0.13*	*0.01*	*0.09*	*0.03*	*0.03*

Note: Values in bold identify elasticity estimates that are statistically different from 0 at or below the 0.05 significance level. The first column represents commodities with price change.