A Study of Asian-American Rice Demand in Houston, Texas

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Responses to a product placement study of five long-grain rice varieties in 192 Asian-American households in Houston, Texas were utilized to estimate a quality-adjusted price model for rice demand. Quantity-dependent demand functions were estimated using actual price, quality-adjusted price, and no price scenarios. Results indicate that, although price was statistically significant, it explained very little of the variation in the quantity of rice demanded; further, income was not significant in determining rice demand for Asian Americans. Their demand appears to be driven primarily by ethnic and cultural considerations and household characteristics. Implications for retail marketing are discussed.

The number of Southeast Asian immigrants into the United States has increased considerably in recent years. The Asian segment of the U.S. population totaled 7.3 million in 1990 (U.S. Department of Commerce, Bureau of Census) and is projected to continue to grow. Annual Asian-American consumption of milled white rice exceeds 150 pounds per person (Tong), much higher than the 16.6 pounds average per person for the United States (Putnam and Allshouse). According to survey results in the Houston, Texas area (Goodwin *et al.*), many Asian-American ethnic groups' taste preferences are for a long-grain aromatic rice variety with medium-grain cooking qualities as opposed to conventional U.S. long grains.

Asian Americans' eating habits may change as they remain in the United States. Their demand for rice may not only differ substantially from that of the average American, but also from that of resident Asians. Previous studies on rice consumption (Ito *et al.*; Huang) focused primarily on rice demand patterns for Asians or for the United States on the average. No consideration has been directed towards identifying effects of special characteristics of Asian Americans on their rice demand. The price and income elasticities of Asian-Americans' demand for rice likely differ from Ito's and Huang's results.

The objectives of this paper are threefold: 1) to identify Asian-American household characteristics affecting rice demand using cross-sectional data; 2) to estimate a rice demand function for Asian Americans under three price scenarios--using unadjusted (actual) price, quality-adjusted price, and without price; and 3) to compute price and income elasticities for Asian Americans and compare them with those for Americans on the whole and for resident Asians.

Price/Quality Model

Underlying Theory

Prices in cross-sectional data are generally assumed to reflect "quality" effects which should be corrected for prior to estimation. Use of unadjusted cross-sectional prices may lead to potential distortions associated with quality effects, which increase with the heterogeneity of aggregated commodities. Failure to adequately specify cross-sectional price effects may result in biased and misleading demand elasticities (Polinsky; Cox and Wohlgenant). Hence, the factors which cause price variation must be identified in order to derive unbiased estimates of price coefficients in household budget data. Studies by Prais and Houthakker; Black; Theil; Houthakker; Cramer; and Cox and Wohlgenant have focused on possible sources and meaning of price variability. Prais

and Houthakker identified price variation due to region, price discrimination, services purchased, seasonal effects, and quality differences caused by heterogenous commodity aggregates. Black suggested the relationship between income and price is the result of differences in marketing services purchased. Higher-income households purchase more and better marketing services, in effect paying higher prices for the same basic commodities purchased by lower-income households. Both Theil and Cramer argued that commodity prices depend upon both income and household characteristics.

Cox and Wohlgenant found real deviations from mean prices to be associated with regional and cultural differences, reflecting quality effects induced by household characteristics. To remove the effects of these regional and ethnic differences, they regressed unadjusted price on these and other "quality" variables. The constant term from that regression plus the error term associated with each observation were used to represent the adjusted price, with the effects of the "quality" variables removed.

Quality Adjustment of Prices

The data used in this study were obtained from a 1991 household product placement survey conducted in 192 Asian-American households in Houston, Texas (Goodwin *et al.*). This survey was part of a larger Asian-American consumer preferences research project. The primary food preparers of each household, which were usually the primary household shoppers as well, were asked about the type(s) of rice typically consumed by the members of their households during a one-week period. Focus group interviews revealed that these households typically preferred rice packaged in 25-pound bags, and rice was purchased at least twice a month. There was some degree of brand loyalty, but there was no dominant brand of imported rice among those most prevalent in Houston.

Besides price, quality, and quantity information related to rice, general household socio-demographic characteristics were identified. Income, household size, the household head's education level, the number of years household shoppers have lived in the United States, the presence

of children, and ethnic group were used to represent household characteristics. Some respondents withheld information on household characteristics such as income and years of education. Subsequently, 140 useable observations were obtained from Vietnamese, Chinese, Taiwanese, Thai, Filipino, and Cambodian households.

It was concluded from focus group interviews that immigrants from Southeast Asia, such as Thais, Vietnamese, and Cambodians, consume primarily jasmine-type rice, which is generally more expensive than other types of rice. Rice consumption of the Chinese, Taiwanese, and Filipino groups is more diverse and may include long-grain and parboiled rice. Very limited use of non-jasmine rice for flour and noodles was observed for Thais, Vietnamese, and Cambodians, but table use was almost exclusively jasmine-type. Non-jasmine long grain rice is sometimes used by Chinese and Filipinos, although jasmine is typically preferred. Taiwanese generally consume non-jasmine rice. The educational level, family size, and household incomes of the Thai, Vietnamese, and Cambodian households were very similar. Average household income of Southeast Asian immigrants was about $32,000, which was notably lower than the income of the Chinese, Taiwanese, and Filipino ethnic groups (around $45,000).

Real deviations from regional/seasonal mean price (RDMP), assumed to reflect the quality effects induced by household characteristics, are specified by Cox and Wohlgenant as follows:

$$RDMP_i = PRICE_i - \alpha_i = \Sigma_j (\delta_{ij} \beta_{ij}) + e_i,$$

where: $PRICE_i$ is the theoretical price paid for rice by household i; α_i is the regional/seasonal mean price for rice; β_{ij}'s are the characteristics of household i; and e_i is the residual for household i in the regression. By econometric analysis, the effects of these household characteristics upon price can be estimated and then subtracted to give the quality-adjusted price. This is particularly important in the present case due to known differences in rice type and quality consumption patterns tied to ethnicity, as alluded to previously. To adjust prices for quality effects induced by household characteristics such as ethnicity (Cox and Wohlgenant, Park *et al.*) in this analysis, the fol-

lowing equations were estimated:

$$PRICE_i = \alpha_I + \delta_1 INCOME_i + \delta_2 HHLD_i$$
$$+ \delta_3 YRSED_i + \delta_4 CHILD_i$$
$$+ \delta_5 SHOPAGE_i + \delta_6 SHOPUS_i$$
$$+ \delta_7 EFILI_i + \delta_8 ETAIWAN_i$$
$$+ \delta_9 ESEASIAN + e_i$$

and

$$PBAR_i = \hat{\alpha} + e_i,$$

where: $PRICE_i$ is rice price in cents per pound derived by dividing the package price for rice (DPRICE) by its package weight (PKGWT); $INCOME_i$ is annual household income; $HHLD_i$ represents the number of persons per household; $YRSED_i$ represents the household head's education level in years; $CHILD_i$ is a binary dummy variable representing the existence of children under 18 in the household, with no children as the base; $SHOPAGE_i$ is the age of the primary household shopper; $SHOPUS_i$ is the number of years the shopper has lived in the United States; and $EFILI_i$, $ETAIWAN_i$, and $ESEASIAN_i$ are binary dummy variables representing Filipino, Taiwanese, and Southeast-Asian ethnic groups (Thais, Cambodians and Vietnamese were combined based upon their aforementioned similarities), respectively. $PBAR_i$ is the quality-adjusted rice price in cents per pound, $\hat{\alpha}$ is the estimate of α, and e_i corresponds to the residuals of the regression. A summary of descriptive statistics for these data is shown in Table 1.

Cox and Wohlgenant used 1977-78 Nation-wide Food Consumption Survey (NFCS) data to analyze the effects of quality characteristics on price. Because the NFCS includes data from households of diverse socio-demographic classifications, Cox and Wohlgenant used the dummy variable approach outlined by Suits (1984) to create regional, quality-adjusted prices. The Suits method provides for the use of several sets of categorical (dummy) variables without requiring that an awkwardly-interpreted, narrowly-defined, base group be specified to avoid the dummy variable trap and still estimate a constant term. The data used in this paper come from households located in one specific, urbanized region. The only category specifications requiring the use of dummy variables in this analysis pertain to ethnicity and the presence of children in the household. Therefore, the Suits method was not used and a base of Chinese households, which constituted roughly 32% of the responding households, with no children was set to avoid the dummy variable trap.

Analysis was first performed using OLS regression. OLS estimation indicated heteroskedasticity as identified by the White test (White 1980), so White's heteroskedastic-consistent covariance matrix was used to correct for the unknown form of heteroskedasticity. Results of the quality adjustment for rice price are shown in Table 2. The value of the t-ratio for income (2.507) showed income to have a positive effect on rice price. In other words, households

Table 1. Descriptive Statistics for Independent Variables.

Variable	Units	N	Mean	Variance	Minimum	Maximum
HHLD	no.	140	4.014	2.964	1.000	12.000
YRSL18*	no.	140	1.407	1.941	0.000	8.000
YRSED	yrs.	140	13.779	22.318	0.000	25.000
SHOPUS	yrs.	140	10.289	39.367	0.500	35.000
LBSWK	lbs.	140	8.946	37.684	0.250	30.000
PKGWT	lbs.	140	29.843	396.64	20.000	110.000
DPRICE	$/pkg.	140	8.978	12.360	1.250	25.000
INCOME	$/yr.	140	34,786	.546E+09	5,000	80,000
PRICE	$/lb.	140	0.337	0.018	0.057	1.000

Source: Asian-American Household Panel, Houston, TX; Texas A&M University Aromatic Rice Project, 1992.
*YRSL18 is the number of household members under the age of 18. The variable CHILD used in the regressions is a dummy variable that represents the presence of household members under the age of 18. Roughly 69% of the households surveyed had children under age 18.

with higher income levels were inclined to purchase more expensive rice. Southeast Asian ethnic groups (Thais, Vietnamese, and Cambodians) were also significantly associated with higher prices for imported aromatic rice. The number of years the primary household food shopper has lived in the U.S. (SHOPUS) also had a negative effect on the price paid for rice. This could suggest that a household's sensitivity to rice quality lessens as the members of the household become more involved in Western culture and deviate from the cultural trends of their ethnic backgrounds.

Table 2. Cox-Wohlgenant Quality-Adjustment Coefficient Estimates for Rice Price.

Variable Name	Units	Without Income Slope Shifters
INCOME	$/yr.	0.123E-05*
		(2.507)
HHLD	no.	-0.002
		(-0.322)
YRSED	yrs.	-0.634E-03
		(-0.246)
SHOPAGE	yrs.	0.018
		(1.494)
SHOPUS	yrs.	-0.003*
		(-2.028)
CHILD	binary	-0.012
		(-0.464)
EFILI	binary	0.013
		(0.579)
ETAIWAN	binary	-0.003
		(-0.113)
ESEASIAN	binary	0.116*
		(4.041)
CONSTANT		0.232*
		(3.901)
Adjusted R^2		0.092
F-Value		2.561
(P-Value)		(0.010)
D-W Statistic		2.491

t-statistics reported in parantheses (d.f. = 130).
* indicates statistical significance at α=.05.

Surprisingly, household size (HHLD) did not significantly affect the price paid for rice. Typically, one would expect larger households to take advantage of price savings associated with "deals" or "better values." Likewise, the presence

of children under the age of 18 (CHILD) did not significantly affect the price households generally paid for rice. The age of the primary shopper (SHOPAGE), while not statistically significant from zero even at the 90 percent confidence interval, was positively associated with higher rice prices. This could relate to the fact that older shoppers have stronger cultural ties that would result in the purchase of imported Asian rice.

The adjusted R^2 for the quality-adjusted rice price model was 0.0918; the F-value for the equation indicated a significance level of greater than .01. This R^2 is a relatively low value even for household survey data, indicating there is a large portion of variation in the price which remains unexplained after adjusting for quality effects associated with differing household characteristics. According to Cox and Wohlgenant, the reason may be that the data on physical characteristics reflecting commodity quality were not utilized in the model, i.e., the residual variation reflects non-systematic, supply-related factors. In other words, adjusting prices for quality accounted for the differing preferences of heterogeneous consumers, not for the levels of "quality" characteristics in the rice. It may also be that consumers did not differentiate among the different types of rice based upon price. We may infer that, due to the significance of ethnic group parameters, rice is differentiated based upon ethnicity and preference for certain rice characteristics rather than price or income. This further supports the appropriateness of the household characteristics approach.

The Demand Functions

Model Specification

Cross-sectional demand functions for rice were estimated using: 1) unadjusted (actual) prices, 2) quality-adjusted prices, and 3) no prices. Using the three different approaches allowed for investigating the effects of including (excluding) quality in (from) the demand. The demand functions were specified as follows:

Q = f (PRICE, INCOME, HHLD, YRSED, CHILD, SHOPAGE, SHOPUS, EFILI, ETAIWAN, ESEASIAN)

where PRICE represents either actual prices for the unadjusted price model (PRICE) or quality adjusted prices estimated in the first stage of this study (PBAR). The other variables are the same as the ones used in adjusting the prices for quality effect.

The third model, which does not include price as an explanatory variable, was reported simply for comparison with the model using quality-adjusted prices. Theoretically, the parameter estimates for variables in the "no price" model should match the parameter estimates for the same variables in the model using quality-adjusted prices, representing the effectiveness of the quality-adjustment process in accounting for the impacts of household characteristics on price.

It is expected that rice quantities demanded by a household are negatively related to rice price. However, the coefficient of income may be negative, since previous studies (Ito; Huang) found rice to be an inferior good when income reaches a certain level. Household size was hypothesized to be a positive factor influencing rice consumption, i.e., the larger the household, the more rice consumed by the household. No *a priori* assertions were made relating to ethnic groups.

Empirical Estimation Results

Ordinary least squares regression using a linear functional form was first used as the estimating procedure. Once again, because the White test indicated the existence of heteroskedasticity, White's heteroskedastic-consistent covariance matrix was employed. The results of the models with unadjusted price, adjusted price, and no price are presented in Table 3.

The adjusted R^2's for three models were 0.236, 0.236, and 0.224, respectively, indicating that all the three approaches explained demand variation equally well, with price information offering only marginal improvement in the statistical measures employed. Both the adjusted and unadjusted price coefficients were statistically significant ($\alpha=.10$) and had a similarly negative effect on quantity of rice demanded, but explained very little of the variation in the quantity of rice consumed. F-tests employed to compare the unrestricted models (utilizing unadjusted price

or quality-adjusted price) to the restricted model (no price) failed to reject the hypothesis that price had no effect on the quantity of rice consumed. The statistically significant coefficients for household characteristics, as determined by Student's t-statistic, had the same sign and similar magnitude in all three approaches.

Table 3. Estimates of Quantity-Dependent Rice Demand Functions for Asian Americans.

	With Unadjusted Price	With Adjusted Price	With No Price[†]
PRICE	-6.353*	---	---
	(-1.737)*		
PBAR	---	-6.353*	---
		(-1.737)	
INCOME	-0.613E -0	-0.139E -0	-0.139E -0
	(-0.280)	(-0.634)	(-0.641)
HHLD	1.341**	1.355**	1.356**
	(2.449)	(2.470)	(2.467)
YRSED	-0.174	-0.170	-0.170
	(-1.577)	(-1.545)	(-1.472)
CHILD	-1.061*	-0.986*	-0.986*
	(-0.837)	(-0.780)	(-0.767)
SHOPAGE	0.686*	0.572	0.572
	(1.764)	(1.463)	(1.470)
SHOPUS	-0.077	-0.057	-0.057
	(-0.801)	(-0.592)	(-0.582)
EFILI	1.561	1.479	1.479
	(1.203)	(1.139)	(1.161)
ETAIWAN	-1.120	-1.099*	-1.099*
	(-1.025)	(-1.006)	(-0.925)
ESEASIAN	2.690**	1.955*	1.955*
	(2.349)	(1.796)	(1.794)
CONSTANT	5.849**	5.849**	4.374
	(2.107)	(2.107)	(1.618)
Adjusted-R^2	0.236	0.236	0.224
F-value	5.286	5.286	5.456
(P-value)	(0.000)	(0.000)	(0.000)
D-W Statistic	1.887	1.887	1.928

t-statistics in parentheses underneath.
* indicates statistical significance at $\alpha=.10$.
** indicates statistical significance at $\alpha=.05$.
[†]Restricted F-tests with both the unadjusted and adjusted price models = $2.96 < F_{1,130,\alpha=.05} = 3.84$.

While most coefficient values vary between the models using unadjusted prices or quality-adjusted prices, the parameter estimates for the model using quality-adjusted price and the model using no price are exactly the same, except for the constant term. This is representative of the usefulness of the quality-adjustment process in ac-

counting for the effects of household characteristics on price. The quality-adjusted price represents the "pure" price paid for rice, unfettered by correlations with household and socio-demographic characteristics. The use of quality-adjusted price (therefore) does not alter the influence of the household characteristics on the quantity of rice consumed in the demand equation.

Household size was found to be statistically significant ($\alpha=.05$) in each of the three equations. As household size increases, the quantity of rice demanded increases. However, the coefficient for income was not statistically significant in any model. This suggests that the level of household income has no effect on rice demand. Further, rice may be viewed as an independent good in relation to income for this Asian-American sample population. The results also indicated that Southeast-Asian households consume more rice than Chinese households. Taiwanese and Filipino rice consumption was not found to be significantly different from that of Chinese households.

Own-Price and Income Elasticities

The own-price elasticities computed at mean values for the three price approaches are presented in Table 4. Own-price elasticities were statistically significant at the .10 significance level; the own-price elasticity of the unadjusted model was greater in absolute magnitude than that of the unadjusted model. Since the coefficients for income in all three models were not statistically significant, no income elasticities are shown. These results suggest that household characteristics had a noticeable impact on price elas-

ticities computed at the means, but not on income elasticities computed at the means.

Results of selected studies in which own-price and income elasticities for rice were determined are also summarized in Table 4. The calculated own-price elasticities for Asian Americans from both the unadjusted price model and the adjusted price model were higher in absolute magnitude than those of all the regions selected for comparison as well as the United States in general. Results from previous studies indicate that income elasticities range from the highest of 0.243 for the Philippines to -0.346 for the U.S. Negative income elasticities for Thailand and Taiwan, as well as the U.S. population in general and the Asian-Americans subset of the U.S. population, indicate that rice is an inferior good for these countries/ethnic groups. The income elasticities for Asian Americans as identified in this study, although statistically insignificant, were -0.02 to -0.05, which is substantially greater (closer to zero) than that of the U.S. in general or most of the regions selected for comparison. These elasticities support the hypothesis that rice is viewed more as an income-independent good or a necessity for Asian Americans, as opposed to the status of inferior good given to rice by the general U.S. population.

Summary, Conclusions, and Implications

Data on quantities and prices of rice purchased, along with various household characteristics, were gathered from several Vietnamese, Chinese, Taiwanese, Thai, Filipino, and Cambodian households. Examination of the data showed close income and rice consumption similarities

Table 4. Price and Income Elasticities of Rice.

	THIS STUDY			OTHER STUDIES				
	Unadjusted Price	Adjusted Price	No Price	Thailand	Taiwan	China	Philippines	United States
Price	-0.239[a]	-0.165[a]	--------	--------	-0.074[b]	-0.005[b]	-0.170[b]	-0.1467[c]
Income	--------[e]	--------[e]	--------[e]	-0.131[b]	-0.081[b]	--------	0.243[b]	-0.3364[d]

[a] Statistically significant at the .10 level.
[b] From Rice Outlook and Situation Report, March 1985.
[c] From Huang.
[d] Expenditure elasticity, from Huang.
[e] Income coefficients were not statistically significant from zero at $\alpha=.10$.

among households of Southeast Asian ethnic backgrounds (Vietnamese, Thai, and Cambodian) which was not evident among Chinese, Filipino, and Taiwanese households in the surveyed area.

A quality-adjusted price model was estimated using ethnic origin and other household characteristics as independent variables. This quality-adjusted price estimation had an extremely low R^2, and only three statistically significant coefficients (excluding the constant) were observed. Southeast Asian ethnicity and income were found to positively impact the price per pound paid for rice by households at the .05 significance level, while the number of years spent in the U.S. had a negative impact on the price per pound of rice paid at the .05 significance level. Household size and the presence of children did not significantly affect the price paid for rice. Taken together, this implies that households affiliated with Southeast Asia and Asian-American households with higher income levels desire jasmine-type rices, which are priced higher than typical U.S. long grain varieties. The longer the household members have been in the U.S. the less inclined they are to purchase expensive specialty rices, possibly because they have become "Westernized" in their eating and preference patterns.

With quality-adjusted prices estimated, quantity-dependent rice demand functions were estimated using three price scenarios: unadjusted (actual) price, quality-adjusted price, and no price at all. Own-price elasticities were then calculated for comparison with a few previous studies on rice demand. The three quantity-dependent rice demand models all had similar results, regardless of price scenario. The coefficients for unadjusted and quality-adjusted price, although statistically significant in their respective equations, indicate that price explains very little of the variation in household consumption. The coefficient for income, although consistently negative, was not statistically different from zero in any one of the three scenarios. Therefore, rice may be considered as a necessity for Asian Americans, a product for which both price and income effects are vastly outweighed by cultural and dietary preferences/patterns.

The coefficients for household size were positive and statistically significant for all three

scenarios. Also, statistically significant coefficients for the dummy variables associated with ethnic origin suggest that Southeast-Asian households consume larger quantities of rice than Chinese households. Rice consumption in Filipino and Taiwanese households was not statistically different from that of Chinese households. These results suggest that ethnicity, culture, and possibly the perceived quality of imported specialty rices play a larger role in Asian-American rice demand than do price and income.

Several implications for rice marketing to Asian Americans can be drawn from these results. Attempts to acquire the Asian-American market share for rice should possibly be focused on adult members of the household and on jasmine-type rice. Younger Asian-American shoppers, due to the influence of Western culture, may be less demanding with respect to jasmine-type rices and probably consume less rice per capita than their adult counterparts. For this group, a market-penetration pricing strategy would probably be ineffective, based upon the relative unimportance of price in determining rice demand. Communicating positively to adult Asian-Americans and drawing on cultural/ethnic mannerisms should be considerations for product positioning strategists. Given the conclusions of this analysis and these implications, development of a competitively-priced, close substitute to Thai jasmine rice is likely to find a niche market with Asian-American consumers.

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