RETAIL PRICING IN JAKARTA - AN EXPLORATION

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INTRODUCTION

The availability of food to Indonesian households is a continuing public concern. Major changes in food consumption patterns have occurred in the past decade. There have been substantial increases in the consumption of rice, poultry products, fats and oils. The changing socioeconomic and demographic structure of the Indonesian population has been an important determinant of changes in the pattern of food consumption. However, some of the changes may also reflect increased public awareness of the role of diet in health. Analysis of the effects of nutrients in food and additives to food on the demand for food products are of increasing interest.

According to traditional theory goods (retail products) are the direct objects of utility and the theory provides no guide to effects on demand of specified change in the characteristics of goods. Only lately has there been an attempt to take into account the characteristics or quality of goods. Analysis of the prices of products should, it is argued here, take into account characteristics of the product in order to understand price formation in retail markets where quality is important. The objective of this study is the development and testing of hypotheses about the components of the retail price of food. This study is a first step towards developing a comprehensive framework for the study of hedonic prices in retail food markets in Indonesia.

ECONOMIC BACKGROUND

In dealing with any large system, there are benefits to be gained from starting with the simplest model and working toward the more complex. Markets in the real world seldom reflect basic economic theory which views them as competitive or of monopolistic structure trading in homogeneous products. Rather, markets are much more complex with varying structures, in which retailers engage in price discrimination, product differentiation and amalgams of both. The price and non-price offers of retailers are as complex as the variety of products they sell, the market segments they face, and the composition of each product in their range.

The theory underlying the model draws on the household production function framework of Becker (1965) and Muth (1966), and the product characteristics approach of Lancaster (1966). Becker and Muth present the idea that households are both consumers and producers of goods. Consumers buy foods from outside sources to create a finished meal by combining time, human capital, household appliances, and food items. The idea presented by Lancaster involves examination of the characteristics or properties of goods as they affect consumers' preferences instead of consideration of the good itself. This suggests that the characteristics of food such as odor, appearance, texture, and nutrient content are the reasons that food is consumed.

The Muth and Becker model assumes non-joint individual production functions,

(1) $$z_i = f^i\,(x_{(i)}, t_i\,, C_{(i)}),\ i = 1,\ldots,m,$$

where z_i is the quantity of the i^{th} commodity produced by the sub-sector of market goods $x_{(i)}$, and t_i units of household time, and $C_{(i)}$ is a vector of production function parameters representing technology and the households environment. In the Lancaster model it is assumed that each market good possesses a vector of characteristics (or qualities) that are objectively defined, measured by all producers and consumers, and provide utility directly to consumers. Consumers purchase and consume combinations of goods and the level of utility is derived from the sum of characteristics belonging to these goods.

According to Lancaster the household production function has the linear form,

(2) $$z_i = \sum_j C_{ij} x_j,$$

with C_{ij} being defined as the quantity of the i^{th} characteristic contained in one unit of the j^{th} market good. Lancaster writes the individual's utility function as,

(3) $$U = U(z_1, \ldots, z_j)$$

where z_j is the total amount of characteristics j obtained by the consumer. The consumer chooses quantities of continuously variable commodities to maximise utility subject to the consumption technology and the budget constraint.

(4) $$\begin{aligned} \text{Max} \quad & U(z) \\ \text{S.T.} \quad & z = Cx \\ & y \geq Px \\ & z, x \geq 0 \end{aligned}$$

where z is the vector (z_j)

C is the matrix (C_{ij})

y is the consumer's income

P is a vector of commodity prices (P_i)

x is the vector (x_i)

This program has a solution for the optimal bundle of characteristics (z^*). Lancaster suggests that the most efficient way of obtaining any given bundle of characterstics, such as z^*. This is given by the solution to the problem:

(5) $$\text{Min. } Px$$
$$\text{S.T. } Cx \geq z^*$$
$$x \geq o$$

The dual of (5) is

$$\text{Max } \rho z^*$$
$$\text{S.T. } \rho C < P$$

where ρ are the shadow prices of the characteristics. For those constraints which are binding in the solution of above problem

(6) $$P^a = \rho C^a$$

where P^a is the solution subvector of P;
C^a is the solution sub matrix of C.

This result is a linear specification of the hedonic price function.

The Lancaster model suffers from a number of limitations. It is possible that some characteristics have negative marginal utilities. The consumption technology relating goods to characteristics may not be linear. Utility may depend on the distribution of characteristics among products. These issues have been addressed by Hendler (1975), and Lucas (1975). Another limitation of the Lancaster model is that it is formulated in objectively measurable characteristics. Sociopsychological aspects of food, which sometimes have no direct relationship with the physical characteristics, are not taken into account.

Household production theory is an attempt to integrate the neoclassical theory of the consumer with that of the firm (Deaton and Muelbauer, 1980). This approach advances conventional consumer choice theory because it permits the analysis of several issues not dealt with directly in the neoclassical theory. Some of these issues are time as a constraining factor in economic choice, quality changes among goods, purchasing choices for durable goods, and consumer reaction to new market goods.

Related to the household production function theory are the several approaches to measuring the effects of quality differences on market behaviour. Quality differences among market goods have been of some interst to economist at least since the work of Waugh (1928) on vegetable prices. The hedonic price function approach appears to have its beginning in the simultaneous papers of Houthakker (1952) and Theil (1952), where market prices were specified as linear functions of a scalar level of quality, which was assumed to be available on the market in a continuum. Gorman (1980) developed the present form of the linear characteristics model discussed extensively by Lancaster (1966, 1971). These studies stimulated considerable interest in the question of how the quality of goods affects market prices.

THE MODEL

According to Lucas (1975) a general form of the hedonic price function can be written:

$$P_i = P(C_{i1}, \ldots, C_{ij}; e_i) \quad i = 1, \ldots, I; \quad j = 1, \ldots, J. \tag{7}$$

where,

P_i is the market price of the i^{th} commodity

C_{ij} is the amount of the j^{th} characteristics per unit of the i^{th} commodity

e_i is the disturbance term

The regression coefficients provide information about the consumer's marginal evaluation of quality improvement with respect to each individual characteristics.

Price may be regarded as a bundle of characteristics of a product which identifies for the consumer a stable market value which typifies products with a known characteristics mix. It may be argued that the consumer's primary concern is finding a desirable characteristics mix which determines his willingness to pay for all the features of the price maker's offer and concern for prices is thereby truncated.

Suppose that there are two sources of calories, protein and fat, in calorie intake and that the relationship of interest is that betwee... ·ail price and a single characteristic of the product (source of calorie). For this situation the relationship might be written for protein as,

(8) $$\frac{P_1}{R_1} = \alpha_1 + \beta_1 C$$

where α_1 and β_1 are parameters relating P_1, the price per unit of protein in the calorie intake, to the characteristic which for simplicity is assumed to be a metric variable.

The relationship for fat may be written as,

(9) $$\frac{P_2}{R_2} = \alpha_2 + \beta_1 C$$

if it is assumed that the coefficient (β_1) of the characteristic variable (C) are identical and R_2 is the unit of fat in the calorie intake. When the proportion of the total units of the calorie which is protein defined as: $\pi = R_1/R = R_1/(R_1 + R_2)$ so that $R_2/R = 1 - \pi$. The two price functions can then be written as:

(10) $$\frac{P_1}{\pi R} = \alpha_1 + \beta_1 C$$

$$\frac{P_2}{(1-\pi)R} = \alpha_2 + \beta_1 C$$

Although P_1 and P_2 are not directly observable data can be obtained on the other variables. If one denotes the price of a unit calorie as $P/R = P_1/R_1 + P_2/R_2$ by rearrangement and addition of the two equations one obtains,

(11) $$\frac{P}{R} = \alpha_2 + (\alpha_1 - \alpha_2)\pi + \beta_1 C$$

If the assumption that β_1 is the same for both sources of calories is relaxed, defining slope parameters β_1 for protein and β_2 for fat, one may then derive an alternative estimating equation:

(12) $$\frac{P}{R} = \alpha_2 + (\alpha_1 - \alpha_2)\pi + (\beta_1 - \beta_2)\pi C + \beta_2 C$$

The analysis may be extended to n groups of interest from the point of view of implicit pricing of various sources of calories and type of retailer so that the set of implicit price functions may be written as:

(13) $$\frac{P_1}{R_1} = \frac{P_1}{\pi_1 R} = \alpha_1 + \sum_{k=1}^{m-1} \beta_{1k} Z_k$$

$$\frac{P_2}{R_2} = \frac{P_2}{\pi_2 R} = \alpha_2 + \sum_{k=1}^{m-1} \beta_{2k} Z_k$$

$$\frac{P_n}{R_n} = \frac{P_n}{(1 - \sum_{k=1}^{n-1} \pi_i)R} = \alpha_n + \sum_{k=1}^{m-1} \beta_{nk} Z_k$$

Summation of the above equations yields:

(14) $$\frac{P_c}{R_c} = \alpha_n + \sum_{i=1}^{n-1} (\alpha_i - \alpha_n)\,\pi_i + \sum_{k=1}^{m-1} \beta_k Z_k$$

$$+ \sum_{i=1}^{n-1} \sum_{k=1}^{m-1} (\beta_{1k} - \beta_{nk})\,\pi_i Z_k$$

The variables in this equation are all directly observable and estimation makes it possible to derive the parameters of the set of non-observable variables in equation (13).

A list of continuous and the dichotomous (dummy) variables designed to capture the effects of the process of consumers' valuation of the calorie is provided in Table l.

In empirical form the estimated equation was,

(15) $$Pc = \alpha + \sum_{i=1}^{m-1} \lambda_i \pi_i + \sum_{c=1}^{l-1} \beta_c S_c + \sum_{k=1}^{n-1} \gamma_k T_k + \varepsilon_c$$

where,

i is l, 2, .., m(=3) source of calorie by food composition.

c is l, 2, .., l, (= 7) type of calorie by product origin (plant or animal).

k is l, 2, .., n(=4) type of retailer.

S_c are dummy variable associated with source of the calorie which take the value 1 for the c^{th} characteristics and zero otherwise.

T_k are dummy variables associated with type of retailer which take the value l for the k^{th} characteristic and zero otherwise.

the α, λ, β and γ are coefficients to be estimated. ε_c are random errors associated with the estimation of the equation.

Table l. List of the Variables

VARIABLE		EXPLANATION
	P_c	Retail price in R_p per kilo calorie
π_i	SOURCE OF CALORIE	
	CARB*	Proportion of calories in the form of carbohydrate
	PROT	Proportion of calories in the form of protein
	FAT	Proportion of calories in the form of fat
S_c	TYPE OF CALORIE	
	PLAN	Calories from plant origin
	ANIM*	Calories from animal origin
T_k	TYPE OF RETAILER	
	MARM	Retailer in a regional market complex
	MALM	Retailer in a local market complex
	MASU*	Supermarket
	MALO	Retailer as an individual outlet (not in a market complex)

*Base class

The empirical model was estimated using ordinary-least-square (OLS) and data from a cross sectional sample from 28 retail shops in Jakarta. All retail prices of commodities being converted into calories according to the Food Balance Sheet in Indonesia l983. The commodities are rice, "palawija" (soybean, mungbean, peanut, corn), dry fish, and cooking oils.

THE RESULT

As a first step, price was regressed on the source of calorie variables (π_i). The results are displayed as Model 1 in Table 2. All these continuous variables have a statistically significant (at 5 per cent level) effect on the price of the product. The prime position amongst source of calorie is taken by protein. When the model accounts for other characteristics these results change slightly. It is apparent that the model cannot be regarded as exhaustive since the source of calories is not the only characteristic contributing to the value of a calorie. The proportion of protein as source of calories is shown to be a significant factor contributing to the value of a calorie, and as being valued more highly by consumers than fat or carbohydrate.

Prior to the estimation of the complete model (15) for the examination of the role of source of calories, type of calorie and type of retailer in setting the retail price of calorie, two partial regressions were carried out to facilitate statistical testing of the complete model and the contribution of sets of variables to an explanation of the price of calorie.

The influence of type of calorie and type of retailer was tested in two steps which required estimation of three successive models. First the effect of type of calorie (PLAN) was tested that is, price was seen as a function of source of calories and type of calorie (Model 2, Table 2). Then variables for the type of retailer (MARM, MALO, MALM) were added to the model, and the complete model was estimated where price was seen as a function of source of calorie, type of calorie, and type of retailer (Model 3, Table 2).

Table 2. Parameter Estimates and t- values for Price of Calories, A Linear Model

Variable	Model 1		Model 2		Model 3	
	Estimate	t-value	Estimate	t-value	Estimate	t-value
INTERCEPT	164.91	2.16	2300.94	12.50	2482.71	13.51
PROT	2439.80	13.16	440.05	2.08	431.17	2.11
FAT	-222.48	2.08	-102.24	1.33	-102.14	1.38
PLAN			-1965.54	12.15	-1984.89	12.72
MARM					-231.79	3.38
MALO					-236.51	3.17
MALM					-177.34	2.57
R^2	0.55		0.77		0.79	
F-value	94.90		173.90		96.11	
N	154		154		154	

Based on these models the impact of type of calorie and type of retailer on price was tested. The Null hypothesis H_o: $\beta_c = \gamma_k = o$ (where c = 1 and k = 3) was tested against an alternative hypothesis H_1: $\beta c = \gamma_k \neq 0$. The following F statistic was applied (Doran and Guise, 1984):

(16) $$F_{M,n-k-1} = \frac{(RSS_0 - RSS_1)/M}{(RSS_1/(n-k-l)}$$

where,

RSS_0 is sum of squares of the residuals from the constrained model where, the coefficient of the variables the effect of which is tested are set to zero.

RSS_1 is the sum of squares of the residuals from the unconstrained model,

M is the number of constrained variables

n is the number of observations

k is the number of regressors.

Table 3. F-test for the Type of Calorie and Type of Retailer on Price

Variable	Constrained RSS_0	Unconstrained RSS_1	M	n-k-1	F-stat*	Critical value**	H_0 rejected
Type of calorie	29966843.76	15103071.61	2	150	73.81	3.07	* *
Type of retailer	15103071.61	13737884.03	3	147	4.86	2.68	* *

* calculated from the F-stastic formula (eg 16)
** at the 5 per cent level of significance

Using the corresponding RSS_S from the estimated model (Table 2) the F-statistics were calculated and compared with the critical values for the $F_{M,m-k-1}$ degrees of freedom at the 5 per cent level of significance. The results are displayed in Table 3.

Based on the F-test statistic the null hypothesis that the type of calories and type of retailers have no impact on the level of retail price was rejected at the 5 per cent level of significance. These findings suggest that consumers ascribe significantly different values to similar products purchased at different types of retailer.

The type of retailer appears to be an important factor in the evaluation of price by consumers. The negative signs of the coefficients of type of retailer are to be interpreted relative to the supermarket retailer which is the base. It can be said that a ranking of type of retailers established by consumers according to these data is supermarket, retailer in local market, retailer in regional market, and individual outlet. It appears that consumers do differentiate among apparently similar commodities on the basis of type of retailer. This perception seems to be related to the belief that some retailers offer better quality than others.

CONCLUSION

Preliminary analysis of a small survey of sales of selected foods in four type of foods outlet in Jakarta suggests that the consumers attach different money value to different sources of calorie. They also assign different values to similar products purchased at different types of retailers.

The theory and estimation procedures employed in this study have more general applicability. Refinement and extensions of the empirical procedures require a more complete data set on several key variables than were available for this study. The analysis could be sharpened were it possible to obtain the physical characteristics like the presence of broken grain or defects, dirt or foreign matter, and the type of packaging, for each commodity at different retailers. Data of this kind was not available for this study.

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