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FOOD DEMAND ESTIMATION AND ALTERNATIVE MEASUREMENT OF REGIONAL POVERTY LINE FROM HOUSEHOLD SURVEY DATA IN INDONESIA

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Abstract : Food Demand Estimation and Alternative Measurement of Regional Poverty Line from Household Survey Data in Indonesia. The purpose of this paper is to analyze food demand behaviour of Indonesian households and alternative measurement of regional poverty line using Linear Expenditure System (LES). This paper uses cross section data about household's expenditure from the 2007 Indonesian Life Family Survey (IFLS,2007), a nationwide survey conducted in 2007. The results show that the Indonesian households have the maximum marginal budget share on rice and the minimum one on fish. From this finding, Indonesian households could be called as "rice lovers" households. Furthermore, results also show that the highest poverty line is for Banten and the lowest poverty line is for East Kalimantan; the minimum average household expenditure is for Nusa Tenggara Barat and the maximum is for East Kalimantan.

Abstrak: Estimasi Permintaan Makanan dan Alternatif Pengukuran Garis Kemiskinan Daerah dari Data Survei Rumah tangga di Indonesia. Tujuan makalah ini adalah untuk menganalisis perilaku permintaan makanan rumah tangga Indonesia dan pengukuran alternatif garis kemiskinan daerah menggunakan Sistem Pengeluaran Linear (LES). Makalah ini menggunakan data *cross section* tentang pengeluaran rumah tangga dari Survei Kehidupan Keluarga Indonesia 2007 (IFLS, 2007), survei nasional dilakukan pada tahun 2007. Hasil penelitian menunjukkan bahwa rumah tangga Indonesia memiliki pangsa anggaran maksimum yang berlaku pada beras dan yang minimum pada ikan. Dari temuan ini, rumah tangga bahasa Indonesia bisa disebut sebagai rumah tangga "pecinta nasi". Selanjutnya, hasil penelitian juga menunjukkan bahwa garis kemiskinan tertinggi adalah untuk Banten dan garis kemiskinan terendah adalah Kalimantan Timur, pengeluaran rata-rata minimum rumah tangga adalah untuk Nusa Tenggara Barat dan maksimal adalah untuk Kalimantan Timur.

Kata kunci: Permintaan Makanan, Garis Kemiskinan Daerah, Sistem Pengeluaran Linear (LES), IFLS.

INTRODUCTION

Consumer demand theory is the oldest and one of the most fruitful research areas in economics. Theoretically, it is concerned about microeconomics foundation, in this case, allocation problems. In the other side, empirically, demand analysis provides important references for the policy makers to make a crucial decisions on welfare issues, such as poverty and inequality measurement. (Guo, 2000). The understanding of consumer demand analysis contributes to knowledge of the methodology of economic studies.

This paper estimates demand system specifications, namely, the LES (Linear Expenditure System) using the data of Indonesian household expenditure per year 2007. This study conduct to provide an empirical evidence of estimation of Indonesian household's food demands using LES model .

The LES model produces estimation that satisfy two important economic properties, adding-up and homogeneity, which are required for the analysis of household behaviour in a general equilibrium framework. The adding-up property requires that the expenditure share-weighted sum of expenditure elasticities, summed across all consumer goods, be equal to unity. The homogeneity property means homogeneity of zero degree in prices and expenditure, implying there is no demand change if

all money prices and the money value of expenditure change by the same proportion. This requires for each commodity demand function, the unweighted sum of the expenditure elasticity and all own and cross-price elasticities equal to zero.

LITERATURE REVIEW

The LES or Linear Expenditure System has been used extensively in the empirical studies by some authors. Stone (1954) applied Linear Expenditure System using the United Kingdom data over the year 1920 to 1938. Stone's LES model (1954b) consist of an empirical investigation of six groupss of commodities : 1). meat, fish and dairy, 2). fruit and vegetables, 3). drink and tobacco, 4). household operation, 5). durable goods and transport, and 6). Other expenditure. The result shows that the LES model fitted with the United Kingdom data.

Bakarezos and Georgiacodis applied the Linear Expenditure System to data on Greek exports and imports. The results show that the LES and the basic hypothesis on which it is, based, is empirically valid in the case of Greek imports and exports (1958 – 1987). It show that expenditure on imports and exports can be divided into a certain basic amount on imports and exports and into a remaining part that is reallocated on expenditure on imports and exports according to the estimated *bi*' s.

Manrique (1998) estimated food demand of Indonesian urban households classified into different income groups. Food demand was classified into eight commodity groups. The study implemented AIDS and also incorporated demographic variables in the model. The study found that for high income household, rice was the least price responsive commodity and all food demand and expenditure elasticities less than unity. On the other hand, the low income urban households were more sensitive to the rice and fish price change. The significancy only occur for high income households.

Berges and Casellas (2002) conduct a research on a demand system analysis for food in Argentina's poor and non poor households. A complete system of demand equations, the Linear Expenditure System (LES), has been used due to its relative empirical advisability. The data provided by the mentioned National Survey (ENGHO) accounts with a sample size of 27,260 households. It include the money value, the quantities and type of food purchased by the households over a one-week period (March 96-April 97). The results showed that the parameter estimates change at different levels of income. Lower-income families choose to consume relatively more meat16, chicken and bread. This fact is according to argentine population preferences and their lower relative prices to satisfy basic food needs. Higher-income group has a more diversified diet and its share of ready to eat meals rises. The marginal budget shares differ significantly between both groups. Poor households expends more of its supernumerary income at meat, bread and vegetables than non poor households.

Skoufias (2003) explore the price and income effect on food and calorie demand. Using SUSENAS data of 1996 and 1999, this study aimed to examined the change of consumers behaviour of consumption after economic crisis. Nonparametric methods had apllied to observed the different in elasticity estimates of poor and non-poor households. The empirical findings revealed the income elasticity for calorie demand is mildly higher in 1999 (post economic crisis period) compared to 1996 (pre crisis period). This figure indicate the calorie-income elasticity is not sensitive to price changes even when the price is very volatile in the crisis time. The households smooth their consumption in the time of crisis, as shown in this study, through the increase of cereals calorie-income elasticity while the calorie-income elasticity for other food decreased.

Fabiosa et al. (2005) estimated nine

groups of food use the data of 1996 SUSENAS. An incomplete demand system (LinQuad) is implemented. In the case of vegetables and cereals, it has pointed out that Indonesian households mostly respond to changes in income through the change of the quantity demanded. Fruits, eggs and milk showed to had the lowest price elasticity while the highest price elasticity among nine groups of food is meat and fish.

Widodo (2006) estimated household demand function and welfare measurement using Linear Expenditure System (LES) in the case of Japan and Indonesia. His studies obtain some conclusions. *First*, for food consumptions, Indonesian households have maximum marginal budget shares on meat and the minimum marginal budget shares on fruits. Meanwhile, Japanese households have theirs maximum marginal budget shares on fish and shellfish, and their maximum buget shares on dairy products and eggs. *Second*, Indonesian households have smaller gap beetwen minimum food consumption (subsistence level) and average food consumption than Japanese households have. *Third*, with the same level of prices increase on foods, the simulation shows that in nominal term (Yen) Japanese households get greater welfare decrease than Indonesian households. However, in the percentage of total expenditure, Indonesian households get greater welfare decrease than Japanese households.

Pangaribowo and Daniel Tsegai (2011) analyzed the demand responses of Indonesian households to food prices, income changes and other socioeconomic factors. They use the Indonesian Family Life Survey data and employed an extended form of the Quadratic Almost Ideal Demand System model which includes demographic and regional factors. Results revealed the well known pattern that food demand behavior varies significatively between urban and rural households similar to income groups. The poorest households consume relatively more staple food as well as alcohol and tobacco goods, while the richest households consume relatively more meat, snack and dried food. It is shown the poorest households expenditure elasticity on alcohol and tobacco is high implying that the poorest households transfer their extra resources on alcohol and tobacco instead of another nutritious food items. Results also showed that price and expenditure elasticities have different value across time (1997-2007). Price elasticities increased for most food items implying that people become much responsive due to the changes in food prices. Otherwise, the expenditure elasticity decreased for most food items (except for 'alcohol and tobacco goods'). That would imply improvement of welfare since the 1997 economic crisis.

THEORETICAL FRAMEWORK

The Linear Expenditure System (LES) is originated in the Stone-Geary direct utility function which takes the form (Pollack and Wales, 1992) :

$$U(q) = \sum_{1}^{n} {}_i \ln(q_i - \bar{q}_i) \quad \text{.....} \quad (1)$$

Where $\bar{q}_i$ is a constant, $\beta_i > 0$, $(q_i - \bar{q}_i) > 0$, and $\sum_i {}_i = 1$. The consumer maximizes the Stone-Geary utility function subject to the budget constraint:

$$\sum_i p_i q_i = y \text{ .....(2)}$$

The first-order conditions are:

$$\frac{i}{q_i - \bar{q}_i} = {}^{a}p_i \quad \text{.....(3)}$$

$$y = \sum_i p_i q_i \quad \text{.....(4)}$$

where λ is the Lagrange multiplier. The equation (3) can be rewritten as $\beta_i = \lambda p_i (q_i - \bar{q}_i)$, hence:

$$\sum_i \beta_i = \sum_i \lambda p_i (q_i - \bar{q}_i) = \lambda \left(y - \sum_i p_i \bar{q}_i \right) = 1$$

λ can be derived as:

$$^{a} = \frac{1}{y - \sum_{1} p_i \bar{q}_i} \quad \text{.....(5)}$$

Subtitute equation (5) into equation (3), to get:

$$q_i - \bar{q}_i = \left(\frac{\beta_i}{p_i}\right)\left(y - \Sigma_i p_j \bar{q}_j\right) \quad \text{.....(6)}$$

or

$$p_i q_i = p_i \bar{q}_i + \beta_i \left(y - \sum p_j \bar{q}_j\right) \quad \text{.....(7)}$$

which is the excatly the linear expenditure function. In the case of n groups of goods, the system is such that:

$$p_1 q_1 = p_1 \bar{q}_1 + \beta_1 \left(y - (p_1 \bar{q}_1 + p_2 \bar{q}_2 + p_3 \bar{q}_3 + \ldots . + p_n \bar{q}_n\right)$$

$$p_2 q_2 = p_2 \bar{q}_2 + \beta_2 \left(y - (p_1 \bar{q}_1 + p_2 \bar{q}_2 + p_3 \bar{q}_3 + \ldots . + p_n \bar{q}_n\right)$$

.....

$$p_n q_2 = p_n \bar{q}_n + \beta_n \left(y - (p_1 \bar{q}_1 + p_2 \bar{q}_2 + p_3 \bar{q}_3 + \ldots . + p_n \bar{q}_n\right) \quad \text{.....(8)}$$

ESTIMATION STRATEGY

This paper estimates food demand of Indonesian households, and then use the estimation to analize the regional poverty line in each provinces that covered in the 2007 Indonesian Familiy Life Survey. Follow the Marshalian demand function, the household demand for goods and services is a function of prices and income.

The estimation of the complete demand system is important in identifying the interdependence among goods, and specifically the effect of changes in one particular good price on the demand for the other goods. One of the widely used functional forms is derived from maximization of the utility function under budget constraint is the Linear Expenditure System (LES) (Intriligator, 1996). The system also developed by Uri (1981) that estimated from the data on quantities (q_i) and prices (p_i) of the n goods and data on income or total expenditure. The parameters that are estimated are the n *base quantities* $q_1, q_2, \ldots . q_n$ and the marginal budget share $\beta_1, \beta_2, \ldots . \beta_n$. The model can be written as:

$$p_i q_i = p_i \bar{q}_i + \beta_i \left(y - \sum p_j \bar{q}_j\right) \qquad i = 1, 2, \ldots, n \quad (1)$$

and

$$\beta_i > 0, (q_i - \bar{q}_i) > 0, \text{ and } \sum_i \; _i = 1$$

which is stated above as equation (7).

This system can be interpreted as stating that expenditure on good *i*, given as $p_i q_i$, can be decomposed into two components. The first is the expenditure on a certain "base amount" $\bar{q}_i$ of good *i*, which is the minimum expenditure to which the consumer is committed. The second is a fraction β_i of the *supernumerary income* defined as the income above the "subsistence income" ($\sum p_j \bar{q}_j$) needed to purchase the base amount of all goods. Since $\beta_i > 0$, this system does not allow for inferior goods and all of them behave as gross complementary goods.

The estimation of the LES is difficult due to nonlinearity in the coefficients β and $\bar{q}$, which enter in a multiplicative form. In this study applies seemingly unrelated regression (SUR) equation to overcome this difficulty. The reason is when estimating a system of seemingly unrelated regression, the estimation may be iterated. In this case, the initial estimation is done to estimate variance.

A new set of residuals is generated and used to estimates a new covariance matrix. The matrix is then used to compute a new set of parameter estimator. The iteration proceeds until the parameters converge, or until the maximum number of iteration is reached. When the random error follows a multivariate normal distribution these estimators will be the maximum likelihood estimators (Widodo,2006).

In this paper, equation (8) is rewrited to accomodate a sample t = 1,2,... 6 goods, that yield the following econometric non-linear system:

$$p_1 q_1 = p_1 \bar{q}_1 + \beta_1 \left(y - (p_1 \bar{q}_1 + p_2 \bar{q}_2 + p_3 \bar{q}_3 + \ldots + p_6 \bar{q}_6\right)$$

$$p_2 q_2 = p_2 \bar{q}_2 + \beta_2 \left(y - (p_1 \bar{q}_1 + p_2 \bar{q}_2 + p_3 \bar{q}_3 + \ldots + p_6 \bar{q}_6\right)$$

....

$$p_6 q_6 = p_6 \bar{q}_6 + \beta_6 \left(y - (p_1 \bar{q}_1 + p_2 \bar{q}_2 + p_3 \bar{q}_3 + \ldots + p_6 \bar{q}_6\right) \quad (8)$$

DATA

Estimation of the LES model requires data on prices, quantities and incomes. This paper uses cross section data about household's expenditure from a nationwide survey conducted in 2007 named Indonesian Life Family Survey (2007 IFLS) by RAND, in conjunction with Lembaga Demografi at the University of Indonesia, the IFLS consists of a national household survey and matched community survey.

The survey presents some of the findings that suggests by descriptive analyses of population, health, and education data; highlights important policy issues and suggests areas where more rigorous, multivariate analyses are needed.

The household survey contains 21 provinces it represent approximately 87 percent of the Indonesian population. The community surveys have within it data on the availability, prices, and

quality of health, family planning, and school facilities in the household respondents' immediate communities. Several features of the IFLS according to Serrato and Melnick (1995), make it unique among surveys in Indonesia as well as many other developing countries. First, it is a multipurpose survey, collecting a broad array of detailed demographic, health, education, and economic information on individuals, households, and communities. Second, the IFLS contains information on individuals of all ages, including current as well as retrospective data. Third, the matched household and community surveys enable researchers to integrate individual, household, and community data, so they can better understand how surrounding conditions influence family behavior and can more readily assess the effects of existing and potential public policies and programs.

IFLS provides a rich dataset of household expenditure on both food and non food expenditure. The IFLS 2007 provides data on prices, quantities of goods demanded by housheholds and incomes. There are 9 groups of foods in the 2007 IFLS survey, but because the lack of the data, 3 groups had to be excluded in this analysis. The aggregate food groups are: 1) Rice; 2) Meat; 3) Chicken; 4) Fish; 5) Cooking Oil, and 6) Kerosene.

The samples of this analysis include 700 households in 18 provinces, that is, the whole survey with complete information for each households. The provinces that are covered in this analysis are.

Table 1.
Sample Provinces

No.	Code	Province
1	12	North Sumatera
2	13	West Sumatera
3	14	Riau
4	16	South Sumatera
5	18	Lampung
6	19	Kepulauan Bangka Belitung
7	21	Kepulauan Riau
8	31	DKI Jakarta
9	32	West Java
10	33	Central Java
11	34	DI. Yogyakarta
12	35	East Java
13	36	Banten
14	51	Bali
15	52	West Nusa Tenggara
16	63	South Kalimantan
17	64	East Kalimantan
18	76	West Sulawesi

Source: author's calculation

RESULTS

Food Demand

Household tries to determine the optimal level of each goods consumed. Theoritically, the optimal level of goods

depends on the prices of goods and household's income, *ceteris paribus*. Other factors that influences household's demand, such as preferences, prices of subtitution and complementary goods, number of consumers and producers in the market, taste, demographic characteristics, etc, are assumed to remain unchanged. Under LES specification, it is assumed that demand for a spesific good is determined by its price, other goods prices and income.

Table 1 show the estimated parameters of equation in the LES model (equation 7)

Table 2.
Estimation of the Parameter in the LES Model

No.	Food Items	Minimum Consumption (X_i)	Marginal Budget Share (β_i)
1	Rice	2.130582*	0.428081*
2	Meat	0.458982*	0.137543*
3	Chicken	0.759555*	0.103550*
4	Fish	0.778052*	0.074975*
5	Cooking oil	0.363874*	0.103840*
6	Kerosene	1.382370*	0.152009*

Source: author's calculations
Note: * significant at level of significance 1%.

From table 2 we know that the minimum consumption of Indonesian household for each goods are: 2,13 kg for rice; 0,46 kg of meat; 0,76 kg of fish; 0,36 litre of cooking oil and 1,38 litre of kerosene.

The marginal budget shares (β_i) indicated the share of additional expenditure going to good *i*. The positif value of β_i means that if there is an increase in *supernumerary income* $(y - \sum p_j \bar{q}_j)$, will lead to an increase the demand for good *i* (normal goods). The results show that if there is an increase in *supernumerary income*, 42,8 percent of it will be allocated for rice expenditure; 15,2 percent will be allocated for kerosene expenditure; 13, 75 percent for meat expenditure; 10,38 for cooking oil expenditure; 10,35 for chicken expenditure, and 7,49 percent will be allocated for fish expenditure. From this finding, Indonesian households can be called "rice lovers" households.

Poverty Line

Estimation of the LES model can be used as alternative measurement of poverty line since the minimum consumption (X_i) of spesific expenditure is a minimum quantity of goods in the spesific category consumed by individual household in a month. Minimum expenditure of living expenditure item (*i*) can be calculated by using formula P_iX_i . The sum up of the minimum expenditure (i) refers to the poor household's expenditure which can be used as a measurement of poverty line. So, the poverty line under LES model is $\sum p_j \bar{q}_j$.

This study calculates the poverty line for each province that are covered in the sample. Table 3 exhibits the estimated regional poverty line using LES model. From table 3, we know that national poverty line (for six commodities) is Rp. 69.607. Table 3 also represents regional poverty line in each province. The highest poverty line is for Banten and the lowest poverty line is for East Kalimantan, *ie*. Rp. 132.088,7 and Rp. 38.656,8 respectively.

The average household expenditure per month in each province can also be seen in table 3. The minimum average household expenditure is for West Nusa

Tenggara and the maximum is for East Kalimantan, *ie*. Rp. 102.768 and Rp. 3.083.744, respectively.

Table 3.
Estimation of the Regional Poverty Line in the LES Model

Code	Province	Line[1]	Poverty line[2]	Expenditure[3]	Size[4]	Poor[5]
12	North Sumatera	69.607,79	70.055,35	247.026,7	864	3
13	West Sumatera	69.607,79	71.135,05	388.024,4	602	4
14	Riau	69.607,79	68.191,82	285.875	99	0
16	South Sumatera	69.607,79	67.816,56	228.013	553	3
18	Lampung	69.607,79	69.194,73	201.359,1	499	0
19	Bangka Belitung	69.607,79	75.605,09	234.125	70	0
21	Kepulauan Riau	69.607,79	73.044,08	203.375	32	0
31	DKI Jakarta	69.607,79	69.244,77	549.216,7	920	4
32	West Java	69.607,79	65.252,04	186.052,1	2.088	10
33	Central Java	69.607,79	97.856,45	199.189,3	1.537	9
34	DI. Yogyakarta	69.607,79	57.981,86	186.736,7	690	7
35	East Java	69.607,79	58.134,3	123.272,2	1.858	59
36	Banten	69.607,79	132.088,7	192.000	475	1
51	Bali	69.607,79	81.037,09	151.603	616	4
52	West Nusa Tenggara	69.607,79	72.909,29	102.768	803	40
63	South Kalimantan	69.607,79	87.059,28	422.119,5	603	4
64	East Kalimantan	69.607,79	38.656,8	3.083.744	31	0
76	West Sulawesi	69.607,79	64.753,62	630.142,9	594	0

Source: author's calculations

[1] Line is average national minimum expenditure, that is X_i multiply with its average national price. So, we called national poverty line (for six commodities)

[2] Poverty line is average province minimum expenditure, that is X_i multiply with its average province price. (regional/province poverty line for six commodities)

[3] Expenditure shows an average expenditures of households per month in each province.

[4] Size indicated the number of household surveyed in each province.

[5] Poor indicated the number of poor household in each province. By construction of LES, a poorest householdsis the household which consume in the minimum amount of goods (subsistence level).

CONCLUSION

This paper presents an analysis of food demand behaviour of Indonesian households and alternative measurement of regional poverty line using IFLS 4. The results show that the Indonesian households have the maximum marginal budget share on rice and the minimum one on fish. From this finding, Indonesian households can be categorized as "rice lovers" households.

Furthermore, results also show that: 1) the highest poverty line is for Banten and the lowest poverty line is for East Kalimantan; 2) The minimum average household expenditure is for West Nusa Tenggara and the maximum is for East Kalimantan.

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