An Alternative of Poverty Line Measurement: a Case Study of Indonesia

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Abstract

This paper discusses poverty lines in Indonesia. *Firstly*, the various poverty lines in Indonesia is discussed. The differences in methodologies and assumptions had created the central controversies in determining the poverty lines: kinds and quantities of goods. *Secondly*, an alternative poverty line measurement is the theoretically derived under Linear Expenditure System (LES). This poverty line might overcome the controversies. *Thirdly*, the poverty line measurement is then applied in case of Indonesia. This paper consludes that the economic crisis in 1997 had led to the increase of poverty lines in urban areas higher than in rural area.

Keyword: Poverty Line, Linear Expenditure System (LES), Seemingly Uncorrelated Regression (SUR).
JEL: D11, D60

I. Background

A simple question is sometime addressed: who is the poor? The answers to this question are still debatable. There are some definitions of poor people. Defining poverty is a matter of social convention (Pradhan 2000:2). An obviously and universally accepted definition of poverty, unlike the presence of its real problem, is somehow hard to define. There are a lot of definitions of poverty which can be used to different countries or regions and at all times, independent of the social structure and level of development (Meier, 1995:26). Some would go into a pragmatic conclusion by looking at poverty as merely contextual and can not be conceptualized since the notion of 'being poor' or 'feeling poor' can be very subjective (Widodo, 2002). However, for analytical and policy purposes, a rigorous definition is required.

There were at least three definitions of poverty line in most highly publicized research. The first one was the official measurement from the Indonesian Central Statistics Agency

(*Badan Pusat Statistik*, BPS). The second one was a measurement proposed by the International Labor Organization (ILO) and the United Nations Development Program (UNDP). The third measurement was published by the World Bank, SMERU – a non-governmental organization funded by the World Bank – and a joint study by RAND Graduate School and Demographic Institute, Faculty of Economics, University of Indonesia.

It can be argued that those immediate poverty measures might not be representing the real condition, since they were not based on the appropriate data. But it is reasonable, since the poverty alleviation policies were urgently needed, and it requires a quick estimation on poverty. The lesson is that in the future, there is a need for a method for poverty measurement that is justifiable, acceptable and applicable.

This paper aims to formulate an alternative measurements of poverty line which theoretically acceptable. The standard maximization utility in microeconomics will be applied to derive the alternative measurement of poverty line. And then, the alternative measurement derived is simulated by using Indonesian data. The rest of this paper is organized as follows. Part II presents literature study of poverty line. Part III exhibits the methodology applied in this research. This part mainly presents the derivation of poverty line under Linear Expenditure System (LES). Estimate and some simulations are presented in Part IV. Part V exhibits some conclusions..

II. Literature Study

Poverty is not the same with inequality. Where as poverty is related with the absolute standard of living of a part of society – the poor – inequality refers to relative living standard across the whole society. At maximum inequality, poverty is high. In contrast, minimum inequality is possible with zero poverty (where no one is poor) as well as with maximum poverty (where all are poor).

The perception of poverty has changed tremendously and evolved historically from culture to culture. Criteria for determining poor and non-poor tend to express particular national priorities and normative concepts of welfare and rights. It is common that as countries become wealthier, their perception of the acceptable poverty line changes.

What is poverty? A simple definition of poverty is the inability to attain a minimal standard of living (Meier 1995:26). Similarly, it is the inability of an individual or a family to command sufficient resources to satisfy basic needs (Fields 1994:88). It delivers a commonly shared idea of poverty as a state of deprivation. Despite giving a general idea, such definition also provides more issues to explore. This opens the room for some possible approaches in discussing poverty. Rein (1971) determines three approaches namely: (1) the biological approach, (2) the inequality approach, and (3) the externality approach.

The biological approach defines the poor as those who earnings are not enough to obtain the minimum necessities for maintaining physical efficiency. This approach was derived from the famous work of Rowntree (1901). Having nutritional standards on deriving the poverty line, malnutrition and starvation are clear symptom of the presence of poverty. This approach is subject to some vagueness and limitations. Sen (1981) noted several problems on implementing such approach. *Firs*t, there are significant variations related to physical features, climatic conditions and work habits. The survival ability may vary across societies and over different period of time. *Second*, translating the minimum nutritional requirement into minimum food requirement, which depends on the choice of (food) commodities and consumption habits of people. *Third*, difficulty may arise in determining non-food expenditure. A usual way to solve this problem is by assuming arbitrarily that a family or individual will spend a certain proportion of their income for food consumption. Subtracting this amount, we can calculate the non-food expenditure.

The second approach, *inequality approach*, covers a comparison of economic positions. It is often argued that inequality and poverty are two separated things. Although both concepts are associated to each other, basically they are not equivalent. However, both concern the same idea that poverty is the state of deprivation. (Meier, 1995:25). This approach focuses more on the nature and size of the difference between different groups in the society instead of focusing on the (absolute) poverty line. Townsend (1974, 1979) argues that poverty should be defined only in terms of relative deprivation. That is, not in *how wealthy* is an individual, but in *how less wealthy* he or she is compared to the other members of the society.

Accordingly, the need for a 'reference group' is an important implication of applying the concept in empirical analysis. The choice of it is in order to "define the style of living which is generally shared or approved in each society" (Townsend 1974:36). The other groups in society, which have less entitlement of resources, are compared to this reference group. Although the approach can eliminate the static characteristics of the first one, however it appears to be difficult to keep certain analysis to be value-free.

The third approach, the *externality approach,* is related with the "social consequences of poverty for the rest of society rather than in terms of the need of the poor" (Ariffin 1992:2). This view was originally introduced by Rein (1971). Presenting his argument he noted that the concept of poverty "must be seen in the context of society as a whole". He then quoted Smolensky (1966) that poverty line should serve as an "index of the disutility to the community of the persistence of poverty".

Poverty Line in Indonesia

There are various approaches had been used to derive the poverty line before the official poverty line in Indonesia was published by the BPS in 1984. Some well-quoted approaches are Sajogyo (1975), World Bank (1980), Booth (1981), Rao (1983) and a latter work by Esmara (1986). The official poverty line method adopted by the BPS since 1984 is a two-step method, combining the separate food and non-food poverty lines.

The first component, 'food poverty line' (FPL), is derived using the Food-Energy-Intake (FEI) method. This method considers the basic human needs for food as energy (calorie) fulfillment. A minimum calorie requirement is set up as 2,100 calories per day. The food poverty line is then defined, as the minimum expenditure needed to purchase such level of calories. For monthly per capita expenditure, the average price of calorie was computed by dividing the monthly expenditure for food by per capita calorie intake (Sutanto et al. 1999:3).

The second component, Non-Food Allowance (NFA), in addition to the FPL is more complex. The reason is that, unlike the presence of FEI assumption for FPL, there are no clear base for assigning the non-food basic needs. Also in many cases in developing countries, the price information availability for non-food commodities are difficult to get. Therefore the non-food expenditure should be estimated.

The method used by the BPS was applying a certain mark-up to the FPL as the estimation for NFA. The mark-up was based on several commodities, considered to be the basic non-food goods. The combination of FPL and its mark-up is the final poverty line. This method is, however, subject to the arbitrariness on choosing the goods. In 1993, the BPS introduced a new methodology on measuring the poverty line expenditure. The choice of commodity bundle is based on the living standard of a 'reference population'. The reference population is a class of population whose income is just above the expected poverty line.

Although the reference population method is slightly better than just arbitrarily determine the commodity bundle, the choice of the reference population itself is still based on subjectivity. In addition, it also seems to have circularity problem since to derive the exact poverty line, one has to have an 'expected value' of poverty line in his or her mind, in order to choose the reference population.

The BPS defined two poverty line in the its first publication of poverty figures: first, *batas miskin* (the 'poverty line' that is referred to as the 'overall poverty line', OPL); second, *batas sangat miskin* (the 'very poor line', henceforth referred to as the 'food poverty line, FPL). The latter appeals the level of income needed to cover expenditure on the food component of the expenditure basket reflected in OPL. Since 1984, the BPS has not reported figures for 'food poverty line' (meaning food components of the overall poverty line).

There are some changes in calculating the poverty line therefore some problems arise. The 1998 poverty line were derived using a much smaller sample survey (10,000 household) than the usual Susenas[1], whose sample size is aroud 65,000 households. It does not allow to derive the poverty line by province. The 1998 poverty line derived by the BPS result in a ratio of urban to rural overall poverty lines of 1.33 and of the urban to rural food poverty lines of 1.25 (Asra 1999:53). The food basket method used to develop the poverty lines allows for different food patterns (i.e. consumption of different quantities of food items) in urban and rural areas, where as the methodology applied until 1993 allowed for different calorie consumption patterns. The reason for applying different sets of quantity weights for urban and

[1] Survei Sosial Ekonomi Nasional (National Social-Economic Survey).

rural areas is to reflect the specific characteristics of each area, so that the poverty line is 'location specific' (Asra 1999:53) .

Table 1. The Criteria and Poverty Line

Research	Criteria	Poverty Line		
		Urban	Rural	Urban+Rural
Esmara (1969/1970) a)	Consumption of rice per capita per year (kg)	-	-	125
Sayogya a) 1971	Expenditure level of rice equivalence per capita per year: - Poor - Very poor - Poorest	 480 360 270	 320 240 180	 - - -
Ginneken a) 1969	Minimum of nutrition need per capita per day - Calorie - Protein (gram)	 - -	 - -	 2,000 50
Anne Both a) 1969/1970	Minimum of nutrition need per capita per day - Calorie - Protein (gram)	 - -	 - -	 2,000 40
Gupta a) 1973	Minimum of nutrition need per capita per year (Rp)	-	-	24,000
Hasan a) 1975	Minimum income per capita per year (US $)	125	95	-
BPS b) 1984	1. Calorie per capita per day 2. Expenditure per capita per day (Rp)	- 13,731	- 7,746	2,100 -
Sayogya b) 1984	Expenditure per capita per day (Rp)	8,240	6,585	-
World Bank b) 1984	Expenditure per capita per day (Rp)	6,719	4,479	-
International Poverty lines 1. Interim report 1976 b) 2. Ahluwalia 1975 c)	 Income per capita per year: - value US $ 1970 - purchasing power parity US $ Level of income per capita per year (US $)	 - - -	 - - -	 75 200 50 75

Note:

a) Esmara, H., 1986. *Perencanaan dan Pembangunan di Indonesia*. PT Gramedia, Jakarta: 312-316 (Table 9.2)

b) Kompas, Monday, 9 May 1988

c) Ahluwalia, M.S., 1975. "Income inequality: some dimension of the problem". In Hollis Chenery. 1974. *Redistribution with Growth*. London University Press.

Source: Widodo, S.T. 1990. *Indikator Ekonomi: Dasar Perhitungan Perekonomian Indonesia*.Penerbit Kanisius, Yogyakarta.

The problem arising is that whether focused on food or calorie consumption, the approach applied by the BPS results in a loss of comparability across areas as the independently derived urban and rural poverty reflect different food consumption pattern. In defining poverty lines for urban and rural areas, one should ensure that they take into account differences in the cost of living across these areas, i.e. ratios of urban to rural prices. Recent studies find that estimates of poverty levels are heavily dependent upon the inflation rates used (Frankenberg, Thomas and Beegle 1999:15).

There are also several poverty lines which have been put forward by Indonesian scholars. *First*, the well known scholar Profesor Sajogyo who defines originally the 'poor' in Indonesia as those with annual income less than the monetary equivalent of 240 kilograms of rice in rural areas and 36- kilogram of rice in urban areas. Subsequently, this definition has been used to define the 'very poor' while the 'poor' are those with annual incomes, in rice equivalents, of less than 360 kilogram in rural areas and 480 kilograms in urban areas. The measure can be criticized virtually on the grounds that it is relied on entirely on one price, and while rice continues to be an important staple for most Indonesians, its share in the budget of even poorer section of society in has been falling sharply (Booth 1992:344). Additionally, the price of rice has not been increasing as sharply as the various price indexes published by the BPS, therefore, the poverty line has been increasing sharply than these indexes, and less sharply than the official BPS poverty line.

Second, Professor Hendra Asmara has made an urban and rural poverty line in terms of actual expenditure on a basket of essential goods and services, as revealed in successive rounds of Susenas (Esmara in Booth 1992:345). It is easy to understand that because it covers both effects of inflation and the impact of higher real incomes on the quantity of essential good consumed, this poverty measure increases rather more sharply than either the official BPS or the previous one.

Third, Asra (1989) notes that different expenditure classes have experienced different rate of inflation. Based on Susenas data, constructs a further set of poverty lines for Java and the Outer Island separately. The actual poverty line were as follows:

Table 2. The Actual Poverty Line (rupiah per capita per month)

	Jawa		Outer Island	
Year	Urban	Rural	Urban	Rural
1969/70	1,260	850	1,540	1,030
1976	3,800	2,941	4,178	2,905
1981	7,019	5,100	9,034	6,448
1987	11,048	9,893	1,4220	11,491

Source: Booth (1992:359)

The actual poverty lines then were adjusted to 1976 and 1981 prices using the indexes given in Asra (1989: Table 3). The result of adjustment is represented in table 3.

Table 3. The Adjusted Poverty Line (rupiah per capita per month)

	Jawa		Outer Island	
Year	Urban	Rural	Urban	Rural
1969/70	3,600	3,000	4,320	3,600
1976	10,857	9,210	11,719	7,848
1981	20,052	18,632	25,358	17,697
1987	31,562	29,327	39,913	31,536

Source: Booth 1992:359

There are still several poverty lines summarized in Table 1. Basically, they can be divided into two groups i.e. poverty lines based on 'sufficient calorie/good' and i.e. poverty lines based on income/expenditure.

Urban-Rural Poverty Line

It is commonly believed that the living cost in urban area is higher than in rural area. To take account the spatial difference in cost of living index, urban and rural poverty lines are set separately. Therefore, to meet the same level of utility, urban people would need higher expenditure than rural people. Some practical weaknesses still exist on setting different regional poverty lines. This occurs due to the lack of adequate index for spatial cost of living comparisons in many countries. In many cases, regional poverty lines should be based only on the FEI approximation. But if the urban-rural cost-of-living difference is large, then the FEI approximation is a very misleading indicator.

According to Ravallion and Bidani (1994), there are several reasons why FEI can not be a appropriate indicator for poverty comparisons. *First*, it is because the urban-rural prices differ not only in nominal, but also in real terms. To that extent, the demand behaviors at given real expenditure levels are also different. For example, the prices of some non-food goods are lower (relative to foods) in urban areas. The food demand and FEI will then be lower in the urban areas.

Second, the activities in typical urban jobs (e.g. factory works) tend to require fewer calories than do rural activities (e.g. agricultural works). *Finally*, since tastes may differ, urban households may have more expensive food tastes, but relatively lower calorie intake. These three cases will result in less calorie expenditure for urban households. But clearly this should not be taken as evidences of poverty.

Problems on measurement poverty line can also take place when there is mobility across the groups being considered in the poverty line, such as migration from rural to urban areas (see Ravallion 1992). Suppose someone who is just above the poverty line from the rural area migrates to the urban area. If this person earns income gain (the income from working in urban minus income in rural area) less than the difference in the urban-rural poverty lines, then there will be an increase in poverty statistics. This may happen although the person is actually better off in terms of living standards being used. In that case, an economic development process that generates urban area enlargement may results in an increase of poverty, despite no poor are being worse off.

III. Methodology

The Linear Expenditure System (LES)

In this paper, it is assumed that the rural and urban people have a utility function following the more general Cobb-Douglas. Stone (1954) made the first attempt to estimate a system equation explicitly incorporating the budget constraint, namely the Linear Expenditure System (LES).

Formally the individual household's preferences defined on n goods are characterized by a utility function of the Cobb-Douglas form. Klein and Rubin (1948) formulated the LES as the most general linear formulation in prices and income satisfying the budget constraint, homogeneity and Slutsky symmetry. Basically, Samuelson (1948) and Geary (1950), derived that the LES representing the utility function:

$$U(x_1 \dots\dots\dots x_n) = \left(x_1 - x_1^o\right)^{\alpha_1}\left(x_2 - x_2^o\right)^{\alpha_2}\left(x_3 - x_3^o\right)^{\alpha_3} \dots\dots\dots \left(x_n - x_n^o\right)^{\alpha_n} \quad \dots\dots\dots\dots(1)$$

The individual household's problem is to choose x_i that can maximize its utility $U(x_i)$ subject to its budget constraint. Therefore, the optimal choice of x_i is obtained as a solution to the constrained optimization problem as follows:

$$\underset{x_i}{\text{Max}} \quad U(x_i) = \prod_{i=1}^{n}\left(x_i - x_i^o\right)^{\alpha_i}$$

Subject to:

$$PX \leq M$$

Solving the utility maximization problem, we can find the Marshallian (uncompensated) demand function for each commodity x_i as follows:

$$x_i = x_i^o + \frac{\alpha_i\left(M - \sum_{j=1}^{n} p_j x_j^o\right)}{p_i \sum_{i=1}^{n} \alpha_i} \quad \text{for all i and j} \quad \dots\dots\dots\dots\dots\dots\dots\dots(2)$$

Where: $i \in (1,2,\ldots\ldots n)$
$j \in (1,2,\ldots\ldots n)$

Since a restriction that the sum of parameters α_i equals to one, $\sum_{i=1}^{n} \alpha_i = 1$, is imposed equation (2) becomes:

$$x_i = x_i^o + \frac{\alpha_i \left(M - \sum_{j=1}^{n} p_j x_j^o \right)}{p_i} \quad \text{for all i and j} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Equation (2) can be also reflected as the Linear Expenditure System as follows:

$$p_i x_i = p_i x_i^o + \alpha_i \left(M - \sum_{j=1}^{n} p_j x_j^o \right) \quad \text{for all i and j} \quad \ldots\ldots\ldots\ldots\ldots\ldots(4)$$

This equation system (4) can be interpreted as stating that expenditure on good i , given as $p_i x_i$, can be broken down into two components. The first part is the expenditure on a certain base amount x_i^o of good i , which is the minimum expenditure to which the consumer is committed (*subsistence expenditure*), $p_i x_i^o$ (Stone 1954). Samuelson (1948) interpreted x_i^o as a necessary set of goods resulting in an informal convention of viewing x_i^o as non-negative quantity. The restriction of x_i^o to be non-negative values however is unnecessarily strict. The utility function is still defined whenever: $x_i - x_i^o > 0$. Thus the interpretation of x_i^o as a *necessary level of consumption* is misleading (Pollak, 1968). The x_i^o allowed to be negative provides additional flexibility in allowing price-elastic goods. The usefulness of this generality in price elasticity depends on the level of aggregation at which the system is treated. The broader the category of goods, the more probable it is that the category would be price elastic. Solari (in Howe 1954:13) interprets negativity of x_i^o as *superior* or *deluxe* commodities.

In order to preserve the committed quantity interpretation of the x_i^o's when some x_i^o are negative, Solari (1971) redefines the quantity $\sum_{j=1}^{n} p_j x_j^o$ as 'augmented supernumerary income' (in contrast to the usual interpretation as supernumerary income, regardless of the signs of the x_i^o). Then, defining n* such that all goods with $i \le n^*$ have positive x_i^o and goods for $i > n^*$ are superior with negative x_i^o, Solari interprets $\sum_{j=1}^{n^*} p_j x_j^o$ as *supernumerary income* and $\sum_{j=n^*+1}^{n} p_j x_j^o$ as *fictitious income*. The sum of 'Solary-supernumerary income' and fictitious income equals augmented supernumerary income. Although somewhat convoluted, these redefinition allow the interpretation of 'Solari-supernumerary income' as expenditure in excess of the necessary to cover committed quantities.

The second part is a fraction α_i of the *supernumerary income*, defined as the income above the 'subsistence income' $\sum_{j=1}^{n} p_j x_j^o$ needed to purchase a base amount of all goods. The α_i are scaled to sum to one to simplify the demand functions. The α_i is referred to as the *marginal budget share*, $\alpha_i / \sum \alpha_i$. It indicates the proportion in which the incremental income is allocated.

The household's food poverty line (FPL) for specific region j can be found by summing up the minimum expenditure to which the consumer is committed (*subsistence expenditure*). And then, the household poverty line (PL) for specific region j can be derived (ω_j is the contribution of FPL on PL for region j).

$$FPL_j = \sum_{i=1}^{n} p_{ij} x_{ij}^o \qquad \forall x^o_{ij} > 0 \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$
$$PL_j = (2 - \omega_j) \sum_{i=1}^{n} p_{ij} x_{ij}^o$$

The estimated Engel curve is estimated using all households i for each region j is presented as:

$$\omega_{ij} = \omega_j + \alpha_j \log\left(\frac{e_{ij}}{FPL_j}\right) + u_{ij} \qquad \text{……………………..……………(6)}$$

Where ω_{ij} is the food share of total expenditure
e_{ij} is total expenditure
FPL_j is the food poverty line for region j
PL_j is the poverty line for region j
ω_j and α_j are parameter to estimated

IV. Data, Estimation, Result and Simulation

Data

This paper uses the secondary pooled data (time series and cross section data) about individual household's expenditure from *Statistik Harga Pedesaan* (Rural Price Statistics) and *Survey Biaya Hidup* (Survey of Living Cost) published by the Central Bureau of Statistics (*Badan Pusat Statistik*, BPS) Indonesia 1980, 1981, 1984, 1987, 1990, 1993 and 1996. The data used are consumption on foods, prices of foods[2], income (total expenditure) of household by rural and urban households by provinces. This paper is based on ten food commodity-groups: Cereals (X1), Tubers (X2), Fish (X3), Meat(X4), Eggs and Milk (X5), Vegetables (X6), Nuts (X7), Fruits (X8), Prepared Foods (X9), Tobacco / Cigarette (X10). Computer program Shazam version 8 is applied for estimating the parameters.

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2 We will use the average of the price of commodity group: $p_k = \frac{\sum_{i=1}^{n} p_{ki}}{n}$ Where p_k is price of commodity group k, p_{ki} is the price of commodity i in group commodity k and n is the number of commodities in the commodity group k.

The 26 provinces of Indonesia are grouped into 5 groups of region based on the geography i.e. Java and Bali; Sumatra; Kalimantan; Sulawesi; and the rest of Indonesia. Some problems faced about availability of prices data are overcome by interpolation.

Estimation

The estimation of a linear expenditure system (LES) shows certain complications because, while it is linear in the variables, it is non-linear in the parameters, involving the products of α_i and x_i^o in equation systems (2) and (3). There are several approaches to estimation of the system (see Intriligator, Baskin, Hsaio 1996). This paper applies one of the approaches: selecting α_i and x_i^o simultaneously by setting up a grid of possible values for the 2n-1 parameters (the –1 based on the fact that the α_i sum tends to unity, $\sum_{i=1}^{n} \alpha_i = 1$) and obtaining that point on the grid where the total sum of squares over all goods and all observations is minimized.

The reason is that when estimating a system of equation seemingly unrelated regression (SUR), 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 estimate a new variance-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 reached. When the random errors follows a multivariate normal distribution these estimators will be the maximum likelihood estimators (Judge et al 1982:324).

Rewriting equation (4) to accommodate a sample t=1,2,3,…..T and 10 goods yields the following econometric non-linear system:

$$p_{1t}x_{1t} = p_{1t}x^{o}_{1t} + \alpha_1\left(M - \sum_{j=1}^{10} p_j x^{o}_j\right) + e_{1t}$$

$$p_{2t}x_{2t} = p_{2t}x^{o}_{2t} + \alpha_2\left(M - \sum_{j=1}^{10} p_j x^{o}_j\right) + e_{2t} \qquad \text{for all i and j} \quad \ldots\ldots\ldots\ldots\ldots\ldots(7)$$

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$$p_{10t}x_{10t} = p_{10t}x^{o}_{10t} + \alpha_{10}\left(M - \sum_{j=1}^{10} p_j x^{o}_j\right) + e_{10t}$$

Where: e_{it} is error term equation (good) i at time t.

Given that the covariance matrix $E[e_t e_t'] = \xi$ where $e_t' = (e_{1t}, e_{2t}, \ldots\ldots\ldots\ldots e_{10t})$ and ξ is not diagonal matrix, this system can be viewed as a set of non-linear seemingly unrelated regression (SUR) equations. There is an added complication, however. Because $\sum_{i=1}^{10} p_{it}x_{it} = M$ the sum of the dependent variables is equal to one of the explanatory variables for all t, it can be shown that $(e_{1t} + e_{2t} + \ldots\ldots\ldots\ldots + e_{10t}) = 0$ and hence ξ is singular, leading to a breakdown in both estimation procedures. The problem is overcome by estimating only 9 of the ten equations, say the first nine, and using the constraint that $\sum_{i=1}^{10} \alpha_i = 1$, to obtain an estimate of the remaining coefficient α_{10} (Barten, 1977).

The first nine equations were estimated using the data and the maximum likelihood estimation procedure. The nature of the model provides some guide as to what might be good starting values for an iterative algorithm[3]. Since the constraint the minimum observation of expenditure on good i at time t (x_{it}) greater than the minimum expenditure x^{o}_{i} should be satisfied, the minimum x_{it} observation seems a reasonable starting value for x^{o}_{i} in iteration process. Also the average budget share, $T^{-1}\sum_{t=1}^{T}\left(p_{it}x_{it} / M_t\right)$, is likely to be a good starting value for α_i in the iterating process (Griffith et al, 1982). It is because the estimates of the budget share

[3] For a detailed explanation about iterative algorithms, see Griffith *et al* 1982.

α_i will not much differ with the average budget share. The estimate and statistical analysis is presented in the Appendix.

Result

Table 4 represents the estimated parameters from linear expenditure equation system (7). The parameters have both negative and positive signs. The negative value of x_i^o seems to break the restriction that x_i^o should be positive because it reflects the minimum expenditure to which consumer is committed (*subsistence expenditure*), $P_i x_i^o$ (Stone 1954). In the same sense, Samuelson (1948) defines x_i^o as a necessary set of goods resulting in an informal convention of viewing x_i^o as a non-negative quantity. However, the restriction of x_i^o to be non-negative values, is unnecessarily strict because the utility function is still theoretically defined whenever $x_i - x_i^o > 0$ (Howe 1954:13). Thus the interpretation of x_i^o as a necessary level of consumption as being to some extent misleading (Pollak, 1968). The x_i^o is allowed to be negative provides additional flexibility in allowing price-elastic good[4].

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[4] The expression for own-price elasticity: $\varepsilon_i = \frac{x_i^o}{x_i}(1-\alpha_i)-1$. When x_i^o is positive $\frac{x_i^o}{x_i} < 1$ by the requirement $(xi- x_i^o)>0$. Since $\alpha_i > 0$ and $\sum_{i=1}^{10}\alpha_i = 1$ elasticity is less than one in absolute value. Only if x_i^o is negative, elasticity exceeds one in absolute value. Negative x_i^o also has consequences for price elasticities. With positive x_i^o the cross elasticity: $\varepsilon_{ij} = \frac{\partial x_i / x_i}{\partial p_j / p_j} = -\frac{\alpha_i x_j^o}{x_i}\frac{p_j}{p_i}$ is a negative (complement). With negative x_i^o , the elasticity is positive (substitute).

Table 4. The Coefficients of Estimate Demand

	Indonesia		Java+Bali		Sumatra		Kalimantan		Sulawesi		Rest	
Coeff.	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
x_1^o	6.4476	8.7832	9.4896	9.919	9.334	6.4451	6.292	7.7184	10.311	12	7.8023	6.0646
x_2^o	12.1800	12.4510	10.064	11.65	1.506	12.7470	7.044	2.4665	6.306	14.576	13.111	1.3003
x_3^o	0.3976	0.8447	1.2227	0.423	0.374	0.2475	0.336	0.4104	0.635	-1.669	0.268	1.5955
x_4^o	0.8382	0.8240	0.4932	0.202	0.85	1.0505	2.303	1.9606	1.31	0.773	1.068	1.2870
x_5^o	0.3293	0.1487	0.3354	0.149	0.25	0.1087	0.189	0.1319	0.247	0.128	0.372	0.2475
x_6^o	1.8147	1.0872	1.9147	0.833	2.772	1.0393	4.564	1.3389	2.292	0.9799	1.64	0.6281
x_7^o	1.1915	1.1464	1.0681	1.068	0.213	1.5027	0.885	0.4953	1.0233	0.835	1.269	1.1527
x_8^o	0.7531	0.5635	1.1469	0.692	0.595	0.2335	0.333	0.2203	0.3509	0.253	1.024	0.4671
x_9^o	0.9827	1.4060	1.3183	1.386	0.378	1.7398	2.167	1.6802	1.245	1.243	1.425	2.8246
x_{10}^o	-3.3644	-0.6972	-2.2745	-2.215	-0.186	-1.7062	-0.301	-0.3854	-1.967	-1.139	-1.349	-1.8863
α_1	-0.1909	-0.2477	-0.2281	-0.238	-1.363	-0.3199	-0.24	-1.0263	-0.7228	-0.2473	-0.355	-1.0631
α_2	0.1086	-0.0651	-0.0778	-0.068	-3.3	-0.1529	-0.209	-2.2502	-0.89	0.0157	0.0083	-0.1160
α_3	-0.0259	-0.0466	-0.0053	-0.042	-0.16	-0.0495	-0.031	-0.0809	-0.035	-0.171	-0.059	-1.4542
α_4	-0.0072	0.0010	-0.0016	-0.0088	-0.00034	0.0001	0.0004	0.0084	-0.00012	-0.0031	0.00004	0.1013
α_5	0.0040	-0.0005	-0.0012	-0.0013	0.003	-0.0007	-0.0035	-0.0252	-0.0026	-0.002	0.0017	0.2422
α_6	-0.0157	-0.0016	-0.0017	0.364	-0.00005	-0.0002	0.002	-0.0557	-0.00022	0.00131	-0.00047	-0.7270
α_7	-0.0061	-0.0087	-0.0184	-0.0096	-0.686	-0.0032	-0.0026	-0.1169	-0.016	0.00418	-0.019	-0.7815
α_8	0.0092	0.0135	0.0254	-0.0086	0.026	-0.0066	-0.017	-0.0040	-0.0099	0.00786	0.034	-0.0250
α_9	-0.0218	0.0017	0.0039	0.0187	-0.31	0.0098	-0.0078	-0.0746	0.011	0.00568	0.0025	-1.2157
α_{10}	1.1458	1.3542	1.3049	1.354	6.79	1.5232	1.509	4.6254	2.666	1.396	1.387	6.0391

Source: *Statistik Harga Pedesaan* (Rural Price Statistic) and *Survey Biaya Hidup* (Survey of Living Cost), BPS, *calculated*.
Note: Statistical analysis is provided in Appendix C

The level of commodity aggregation could cause negative x_i^o. Solary (in Howe 1954:13) interprets negativity of x_i^o as superior or deluxe commodities. Superior commodities can be ranked hierarchically with regard to $\frac{p_i|x_i^o|}{\alpha_i}$. When total expenditure increase, superior goods enter the consumption pattern in order of increasing $\frac{p_i|x_i^o|}{\alpha_i}$.

Table 4 also shows that there are some negative value of α_i . The negative α_i means that when there is an increase in income such that supernumerary income is negative $\left(M-\sum_{j=1}^{10} p_j x_j^0 \langle 0\right)$ the demand for good i will decrease. Also, if there is an increase in income such that supernumerary income is positive $\left(M-\sum_{j=1}^{10} p_j x_j^0 \rangle 0\right)$ the demand for good i will decrease. The negative value of α_i indicates that if there is an increase of income, the demand for good i will decrease (inferior good). Good i is an inferior good. Two properties of LES are that inferior and complementary are disallowed. Evaluation of the expression $\frac{\partial x_i}{\partial M} = \frac{\alpha_i}{p_i}$ reveals that, in the LES, the income elasticity is always positive, inferior goods are not allowed. Cross substitution matrix are positive with LES. However, at the high the level of aggregation employed in this study, this limitation is not restrictive. It would be possibly to find the negative α_i, when a research is related with the aggregation data. In fact, the goods could be normal or inferior good. Therefore, when we aggregate those goods the nature of the goods (normal or inferior) will appear in the aggregate data. The higher level of aggregation, the less likely it is that consumption of any given category would decline with an increase in income, negative α_i (Howe 1974:18).

Based on these α_i and x_i^o interpretations, in general tobacco/cigarette (x_{10}) is *superior* or *deluxe* (price-elastic) commodity in both rural and urban Indonesia, whereas the other commodity groups are price-inelastic goods, except fish (x3) that is also a price-elastic good for rural households in Sulawesi. It is shown by negative x_{10}^o for all regions and negative x_3^o for rural Sulawesi respectively. Since food is a basic good (basic needs or necessity good), it is theoretically believed that food would be inelastic. A household's demand for food would be not very responsive to the change in food prices. Tobacco/cigarette has a positive *marginal budget share*, estimate α_{10} positive. It clearly means that when a household's income increases the demand for tobacco/cigarette (x_{10}) also increases. The strange result is found in rural Sulawesi where fish (x_3) is a price-elastic good but has a negative marginal budget share. It means that fish (x_3) is a price-elastic and inferior good for rural household Sulawesi.

From the structure of food consumption, in general a rural household's minimum consumption of cereals (x1), tubers (x2), fish (x3) is relatively much more than urban household's one. In contrast, urban household's minimum consumption of meat (x4), egg and milk (x5), vegetables (x6) and prepared foods (x9) is relatively higher than for a rural household. However, the urban and rural households have relatively the same minimum consumption of nuts (x7) and fruits (x8).

Why do some of these coefficients differ from staples across region ad rural-urban areas? The deep research is needed to answer this question. Some general factors could be addressed in explaining the difference (Widodo, 2000). Elaine (1999) notes that there are 5 factors affecting food decisions made by individual consumers i.e. food availability, cultural factors, psychological factors, lifestyle factors and food trends.

First, food availability is the crucial factor in determining food consumption. It is obvious that households will consume relatively more a kind of food that is abundant in that area. *Second*, food habits are culture factors that make an important contribution to the food decisions consumers make. Although some view and food habits as unchanging and static, it is now known that they are continually changing as they assimilate to immigration, travel and socio-economic environment (Jerome, 1982; Lowenberg et al., 1974: Senauer et al., 1991; Kittler and Sucher, 1995). However, there are certain elements of food habits that might be difficult to change, such as the concept of meals, meal patterns, the number of meals eaten in a day, when to eat what during the day, how food is acquire and prepared, the etiquette of eating and what is considered edible as food (Elaine, H. 1999:288).

Third, psychological factors consist of food preferences, food likes and dislikes and response to sensory attributes. Food preferences play a key role in food selection because they give an indication of the amount of satisfaction an individual anticipates from eating a food. Food preference is a result of physiological and psychological development and social experiences, and is related to degree of liking a food (Elaine, H. 1999:289). Liked foods are those that are familiar, considered pleasant, and are usually the ones eaten, thus food preference predict consumption. In contrast, disliked foods are rejected either because they are considered unpleasant or they are unfamiliar foods that have never been tasted.

Fourth, lifestyle factors. Lifestyles describe how people seek to express their identity in many areas, including food selection. Fifth, food trends. Several established and emerging food trends identified by Sloan (1994, 1996, and 1998) affect the food decisions individual make. These include foods that are fresh; quick to cook; ethnic with distinctive ingredients, favour and spices; fusion foods (the combine ethnic cuisines); less meat; more vegetarian meals; labelled natural organic; available in a variety of places; health promote; and physical performance-enhancing energy foods.

Simulation

The economic crisis happened since 1996 has caused some increases in price of foods and decrease in income. This paper utilizes some figures from the previous other researches and surveys. Two settings based on those can be withdrawn. The increase of prices (inflation) from the BPS and also the inflation level suggested by IFLS (Indonesia Family Life Survey) will be used i.e. inflation per province inflated from the BPS by 14% for urban and 16% for rural. This paper assumes that the inflation rate per province reflects the food inflation rate in that province. This assumption is taken because the data of inflation rate of each commodity groups per province is unavailable. Therefore, the shortcoming of this assumption is that all commodity groups are treated to have same inflation rate. However, this shortcoming can be avoided if the data inflation rate of each commodity group per province can be reached. It gives opportunities to other researchers to do some simulation based on the available data.

Table 5 represents the calculated unweighted average food inflation rate in each considered region[5]. The second column consists of the average inflation rate for each region calculated from taking the average of inflation in all provinces published by the BPS. For example, according to BPS the food prices increase by 76.04% during 1996-1998 period. Unfortunately, the BPS does not distinguish the inflation rate in urban and rural areas. Therefore, it is assumed that rural and urban areas have the same inflation rate in this study in one part. In fact, urban and rural have obviously different rates of inflation.

Table 5. The Average Food Inflation Rate (% per annum), 1996-1998

Region	BPS	IFLS-Urban	IFLS-Rural
Indonesia	76.04	90.04	92.04
Java+Bali	72.34	86.34	88.34
Sumatra	81.31	95.31	97.31
Kalimantan	71.00	85.00	87.00
Sulawesi	75.60	89.60	91.60
Rest	79.93	93.93	95.93

Source: Frankenberg, Thomas and Beegle 1999, calculated (average groups)

The IFLS data suggests that inflation between the rounds of the survey has been about 15% higher than the rate estimated from BPS data (Frankenberg, Thomas, Beegle 1999:14) and therefore IFLS suggests to inflate the BPS inflation by 14% for urban and 16% for rural household. The third and fourth columns of Table 5 represent urban and rural average inflation rates respectively suggested by the IFLS for each region. These inflation rates (we

[5] The unweighted average inflation rate per province is calculated by applying formula as follows: $\pi_i = \frac{\sum_{j=1}^{n} \mu_j}{n}$ where π_i is the unweighted average inflation in region i, μ_i is inflation in province j and n is the number of provinces in region i.

call as BPS scenario and IFLS adjusted scenario) will be used to inflate the prices, therefore the prices pre-crisis and post-crisis can be withdrawn.

a. Households' Food Poverty Line (FPL)

The *subsistence* (minimum) expenditure can virtually be used to derive the food poverty line (FPL). Therefore, by applying equation 5 and some scenarios about prices explained above, the household poverty lines can be calculated. Table 6 shows the food poverty line (FPL) defined from this paper for 1980-1998. These figures are derived from summing up of the multiplication of estimated minimum consumption (x_i^o) (from Table 4) and their respective prices, so that we get the total minimum (*subsistence*) expenditure for food as the food poverty line.

Table 6. The Food Poverty Line (Rp/household/month)

Region	Indonesia	Java+Bali	Sumatra	Kalimantan	Sulawesi	Rest
URBAN						
1980	11,625	6,639	13,223	17,513	8,540	8,243
1981	12,246	7,293	13,586	19,005	9,004	8,781
1984	14,322	9,434	14,938	23,311	11,008	10,406
1987	17,212	12,408	16,710	29,288	13,921	12,516
1990	21,105	16,172	19,243	36,895	18,002	15,463
1993	25,939	20,162	21,736	48,899	23,034	20,210
(before crisis) 1996	31,884	24,561	26,632	65,657	32,207	28,730
(after crisis IFLS adj) 1998	60,495	45,767	52,014	121,466	61,064	55,716
(after crisis BPS) 1998	56,032	42,329	48,286	112,274	56,555	51,694
RURAL						
1980	10,305	4,179	12,494	15,327	6,096	7,161
1981	10,839	4,567	12,852	16,518	6,515	7,629
1984	12,648	5,896	14,025	20,522	7,974	9,181
1987	15,169	7,784	15,548	26,000	10,110	11,232
1990	18,588	10,288	17,784	32,848	13,213	13,950
1993	22,708	12,664	19,999	43,862	17,016	18,399
(before crisis) 1996	26,656	15,219	22,958	56,601	23,488	26,392
(after crisis IFLS adj) 1998	51,110	28,664	45,299	105,844	45,003	51,710
(after crisis BPS) 1998	46,845	26,229	41,626	96,788	41,245	47,488

Source: *Statistik Harga Pedesaan* (Rural Price Statistic) *Survey Biaya Hidup* (Survey of Living Cost), BPS, calculated.

In general, the poverty lines in urban areas are greater than in rural areas. In Indonesian urban areas, before crisis (1996) it was Rp 31,884 per month, and then, (1998) it became Rp 60,495 per month under IFLS adjusted scenario or Rp 56,032 per month under BPS scenario after crisis. Meanwhile in Indonesian urban areas, before crisis (1996) it was Rp 26,656 per month, and then, (1998) it became Rp 51,110 per month under IFLS adjusted scenario or Rp 48,845 per month under BPS scenario after crisis.

Both urban and rural poverty lines in Kalimantan is higher than in other regions. It could be caused by two virtual reasons. *First*, the food poverty line extremely depends on the level of prices. In fact, the levels of prices in Kalimantan are relatively higher than the other regions. *Second*, the food habits in term of kinds of food consumed are also effect on the food poverty line. Determining the kind and amount of food included in the food poverty lines calculation are difficult. This paper has advantage in determining the amount of each food consumed (as presented in Table 4). The Kalimantan households eat relatively more expensive food (such as meat (x_4^o) and prepared food (x_9^o)).

b. Poverty Line

People consume food and non-food. Therefore, the food poverty line is only one part of poverty line. The second one is non-food poverty line. Determining the non-food poverty line is more complex than the food poverty line. Establishing the allowance made for the non-food expenditure is more difficult, because there is no equivalent of a nutritional standard to provide even a weak anchor to the amount (Pradhan 2000):6). In this paper, the non-food component of the poverty line is calculated by estimating an Engel curve for food consumption (equation 6). The non-food component of the poverty line is set at the expected non-food consumption for those whose total consumption equals the food poverty line.

Table 7. The estimate of Parameter ω_j

Regions (j)	Urban	Rural
Indonesia	0.552 * (0.006)	0.611* (0.005)
Java+Bali	0.574* (0.021)	0.602* (0.035)
Sumatra	0.565* (0.11)	0.612* (0.009)
Kalimantan	0.539* (0.009)	0.567* (0.012)
Sulawesi	0.615* (0.025)	0.651* (0.015)
Rest of Indonesia	0.543* (0.017)	0.657* (0.014)

Note: Standard error in parentheses (). * significant at 1% level of significance

Table 7 shows the estimate parameters in equation 6. Statistically, they are significant at 1% level of significance. The food share of total expenditure in every region is greater than 50 percent. It means that more than half of total expenditure is spent for food consumption. As commonly believed, the urban food share of total expenditure in every region is smaller than the rural one. It implies that urban households spend their total expenditure in the smaller proportion on food than rural households do.

Table 8 presents the poverty line derived. It is easy to understand that the method used to derive such households' poverty lines is extremely depends on the food poverty lines and the food share derived above. Regions whose have higher food poverty line and smaller proportion of food tend to have higher poverty line. In contrast, regions whose have lower food poverty line and higher proportion of food tend to have lower poverty line. Therefore, all factors effecting the food poverty line and the food share (such as food habits, religion, culture, belief, climate, and season) have brought some differences in the poverty line across regions. The urban poverty lines are higher than the rural households' poverty lines.

Table 8. The Households' Poverty Line (Rp/household/month)

Region	Indonesia	Java+Bali	Sumatra	Kalimantan	Sulawesi	Rest
URBAN						
1980	16,833	9,467	18,975	25,586	11,828	12,010
1981	17,732	10,400	19,496	27,766	12,471	12,794
1984	20,738	13,453	21,436	34,057	15,246	15,162
1987	24,923	17,694	23,979	42,790	19,281	18,236
1990	30,560	23,061	27,614	53,904	24,933	22,530
1993	37,560	28,751	31,191	71,441	31,902	29,446
(before crisis) 1996	46,168	35,024	38,217	95,925	44,607	41,860
(after crisis IFLS adj) 1998	87,597	65,264	74,640	177,462	84,574	81,178
(after crisis BPS) 1998	81,134	60,361	69,290	164,032	78,329	75,318
RURAL						
1980	14,314	5,842	17,342	21,964	8,224	9,617
1981	15,055	6,385	17,839	23,670	8,789	10,246
1984	17,568	8,243	19,467	29,408	10,757	12,330
1987	21,070	10,882	21,581	37,258	13,638	15,085
1990	25,819	14,383	24,684	47,071	17,824	18,735
1993	31,541	17,704	27,759	62,854	22,955	24,710
(before crisis) 1996	37,025	21,276	31,866	81,109	31,685	35,444
(after crisis IFLS adj) 1998	70,992	40,072	62,875	151,674	60,709	69,447
(after crisis BPS) 1998	65,068	36,668	57,777	138,697	55,640	63,776

Source: *Statistik Harga Pedesaan* (Rural Price Statistic) *Survey Biaya Hidup* (Survey of Living Cost), BPS, calculated.

V. Conclusion

Increase in food prices due to economic crisis has increased the minimum (*subsistence*) food expenditure defined as the food poverty line (FPL) of both urban and rural people. During 1996-1998, the increase in the *subsistence* food expenditure was averagely more than doubled. Therefore, it is clear that the share of food expenditure on the total expenditure of urban and rural household increased drastically.

The alternative measurement of food poverty line can also be derived from the consumption theory namely Linear Expenditure System (LES). This method has more advantage in determining the amount of good consumed that is core problem in establishing poverty lines as far. By applying the alternative measurement of poverty line, this research conclude that the economic crisis has effected the urban poverty line increasing sharper than the rural one.

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Appendix: Statistical Analysis

1. Testing for Contemporaneous correlation

If there contemporaneous correlation does not exist, the least square (OLS) rule separately to each equation is fully efficient an the there is no need to apply the seemingly unrelated regression (SUR) (Griffiths 1993:561). Therefore, if there is uncertainty concerning this proposition, it is useful to test whether the contemporaneous covariance are zero.

H_o: $\sigma_{21} = \sigma_{31} = \sigma_{32} = \ldots\ldots\ldots\ldots = \sigma_{98} = 0$ (or $\sigma_{ij}=0$ for all $i \neq j$)

H1: at least one covariance is non-zero

The appropriate test statistic, under the normal linear model, is given by:

$$\lambda = T\left(r_{21}^2 + r_{31}^2 + r_{32}^2 + \ldots\ldots\ldots\ldots\ldots\ldots + r_{98}^2\right)$$

where is the squared correlation $r_{ij}^2 = \frac{\hat{\sigma}_{ij}^2}{\hat{\sigma}_{ii}\hat{\sigma}_{jj}}$ and $\hat{\sigma}_{ij} = (y_i - x_i b_i)(y_j - x_j b_j) / T$.

Table A.1. Contemporaneous Test for the 'Average' and 'Poorest' Households

No	Regions	λ	Decisions
	Average Household		
1	Urban Indonesia	1.215E+07	Reject H_o and conclude there is Contemporaneous
2	Rural Indonesia	2.442E+07	Reject H_o and conclude there is Contemporaneous
3	Urban Java+Bali	2.503E+06	Reject H_o and conclude there is Contemporaneous
4	Rural Java+Bali	4.076E+06	Reject H_o and conclude there is Contemporaneous
5	Urban Sumatra	2.205E+07	Reject H_o and conclude there is Contemporaneous
6	Rural Sumatra	4.447E+06	Reject H_o and conclude there is Contemporaneous
7	Urban Kalimantan	1.655E+07	Reject H_o and conclude there is Contemporaneous
8	Rural Kalimantan	2.653E+07	Reject H_o and conclude there is Contemporaneous
9	Urban Sulawesi	1.763E+07	Reject H_o and conclude there is Contemporaneous
10	Rural Sulawesi	4.664E+06	Reject H_o and conclude there is Contemporaneous
11	Urban Rest	7.449E+06	Reject H_o and conclude there is Contemporaneous
12	Rural Rest	1.297E+09	Reject H_o and conclude there is Contemporaneous

Under H_o, the test statistic λ has an asymptotic χ^2-distribution with N(N-1)/2 (in our case 9(9-1)/2=36) degree of freedom, where N is the number of equations and the estimated error correlation are used in the computation of λ. The null hypothesis is rejected if λ is greater than the critical value for a $\chi^2_{(36)}$-distribution at pre-specified significance level. At significance levels α=1%, α=5% and α=10% the critical values $\chi^2_{(36)}$ are about 63.6907; 55.7585 and 51.8050 respectively. The calculated λ and the decision about the contemporaneous correlation test for each region are presented in Table A.3.

2. Testing for significance of the coefficient estimate:

When error term e is not normally distributed, or independent variable X is random, we have to refer to large sample distributions. We assume that X'X/T converges to a finite non-singular matrix $\sum_{xx}$, and that X, if it is random, is at least contemporaneously uncorrelated with error term e (Griffiths 1993:453). The estimate b_k will be normally distributed.

$$\frac{b_k - \beta_k}{\sqrt{\hat{\operatorname{var}}(b_k)}} \approx N(0,1)$$

The large sample theory suggests that normal distribution not the t-distribution should be used. The appropriate test is:

H_o: β_k=0

H_1: $\beta_k \neq 0$

The calculated t-statistic is:

$$t = \frac{b_k - 0}{\sqrt{\hat{\operatorname{var}}(b_k)}} \approx N(0,1)$$

The null hypothesis is rejected if t-statistic is greater than the critical value for a N(0,1) distribution at pre-specified significance level. At significance levels α=1%, α=5%, α=10%, α=15% and α=20%, the critical values N(0,1) are about 2.57; 1.96; 1.65; 1.44 and 1.28 respectively. Tables below represent the significance test of each estimate parameters for each region:

* significant at level of significance, α=1%,
** significant at α=5%,
*** significant at α=10%,
**** significant at α=15%,
***** significant at α=20%.

	INDONESIA						JAVA+BALI					
	URBAN			RURAL			URBAN			RURAL		
Parameters	Coeff.	Std. Error	t-ratio	Coeff.	Std. Error	t-ratio	Coeff.	Std. Error	t-ratio	Coeff.	Std. Error	t-ratio
x_1^o	6.4476*	1.0000	6.4475	8.7832*	1.0754	8.1676	9.4896*	1.0526	9.0153	9.9191*	1.0007	9.9117
x_2^o	12.1800*	0.6914	17.6150	12.4510*	0.6384	19.5030	10.0640*	0.6313	15.9430	11.6500*	0.6457	18.0420
x_3^o	0.3976**	0.1905	2.0869	0.8447**	0.4342	1.9454	1.2227*	0.1480	8.2599	0.4230	0.2590	1.6333
x_4^o	0.8382*	0.0626	13.3880	0.8240*	0.0613	13.4430	0.4932*	0.0446	11.0590	0.2018*	0.0550	3.6705
x_5^o	0.3293*	0.0218	15.1300	0.1487*	0.0137	10.8460	0.3354*	0.0318	10.5400	0.1493*	0.0197	7.5981
x_6^o	1.8147*	0.0986	18.4050	1.0872*	0.0781	13.9220	1.9147*	0.0727	26.3460	0.8332*	0.0782	10.6570
x_7^o	1.1915*	0.1074	11.0940	1.1464*	0.0833	13.7620	1.0681*	0.0985	10.8480	1.0684*	0.0671	15.9320
x_8^o	0.7531*	0.0595	12.6600	0.5635*	0.0555	10.1510	1.1469*	0.0821	13.9770	0.6922*	0.0958	7.2262
x_9^o	0.9827*	0.0716	13.7230	1.4060*	0.0639	21.9910	1.3183*	0.0952	13.8470	1.3864*	0.1170	11.8460
x_{10}^o	-3.3644*	0.2841	-11.8420	-0.7*****	0.5341	-1.3054	-2.2745**	1.0868	-2.0928	-2.2148*	0.2862	-7.7393
α_1	-0.1909*	0.0612	-3.1168	-0.2477*	0.0346	-7.1632	-0.2281*	0.0408	-5.5943	-0.2382*	0.0622	-3.8276
α_2	0.1086***	0.0685	1.5842	-0.0651	0.0613	-1.0614	-0.08****	0.0521	-1.4920	-0.0679	0.0613	-1.1074
α_3	-0.0259**	0.0112	-2.3053	-0.0466**	0.0232	-2.0090	-0.005****	0.0035	-1.5049	-0.0421*	0.0067	-6.2481
α_4	-0.0072	0.0096	-0.7492	0.0010	0.0054	0.1823	-0.0016	0.0050	-0.3195	-0.0088	0.0080	-1.0990
α_5	0.0040	0.0037	1.0760	-0.0005	0.0022	-0.2465	-0.0012	0.0037	-0.3288	-0.0013	0.0021	-0.6240
α_6	-0.0157	0.0132	-1.1919	-0.0016	0.0049	-0.3259	-0.0017	0.0058	-0.2985	0.0036	0.0060	0.6042
α_7	-0.0061	0.0213	-0.2856	-0.0087	0.0143	-0.6096	-0.018****	0.0116	-1.5855	-0.0096	0.0104	-0.9251
α_8	0.0092	0.0126	0.7267	0.0135**	0.0058	2.3085	0.0254**	0.0104	2.4366	-0.0086	0.0141	-0.6074
α_9	-0.0218	0.0231	-0.9423	0.0017	0.0088	0.1887	0.0039	0.0118	0.3297	0.0187	0.0193	0.9714
α_{10}	1.1458*	0.1368	8.3745	1.3542*	0.0826	16.3943	1.3049*	0.0784	16.6501	1.354*	0.0870	15.5634
Log likelihood: : -9278.571				Log likelihood: -9362.236			Log likelihood: -1654.984			Log likelihood: : -1660.010		

	SUMATRA						KALIMANTAN					
	URBAN			RURAL			URBAN			RURAL		
Parameters	Coeff.	Std. Error	t-ratio	Coeff.	Std. Error	t-ratio	Coeff.	Std. Error	t-ratio	Coeff.	Std. Error	t-ratio
x_1^o	9.3346*	1.2128	7.6968	6.4451*	1.0024	6.4297	6.2924*	1.0000	6.2925	7.7184*	0.9999	7.7188
x_2^o	1.5059*	0.2539	5.9303	12.7470*	0.6584	19.3600	7.0438*	0.6822	10.3260	2.4665*	0.3331	7.4042
x_3^o	0.3745***	0.1973	1.8979	0.25*****	0.1894	1.3069	0.3362	0.0817	4.1165	0.4104*	0.0634	6.4749
x_4^o	0.8502*	0.1641	5.1805	1.0505*	0.0005	2020.6	2.3003*	0.0041	555.3400	1.9606*	0.0054	363.2100
x_5^o	0.2510*	0.0203	12.3700	0.1087*	0.0077	14.0570	0.1893*	0.0151	12.5010	0.1319*	0.0252	5.2320
x_6^o	2.7723*	0.2836	9.7759	1.0393*	0.0038	272.010	4.5638*	0.0105	433.62	1.3389*	0.0374	35.7570
x_7^o	0.2125*	0.0859	2.4750	1.5027*	0.1342	11.1990	0.8851*	0.0955	9.2705	0.4953*	0.0454	10.9130
x_8^o	0.5948*	0.0535	11.1210	0.2335*	0.0363	6.4238	0.3326*	0.0366	9.0918	0.2203*	0.0253	8.6981
x_9^o	0.3784*	0.0700	5.4071	1.7398*	0.1225	14.2040	2.1668*	0.0074	292.79	1.6802*	0.0242	69.3110
x_{10}^o	-0.1862*	0.0798	-2.3348	-1.7062*	0.2562	-6.6592	-0.3****	0.2064	-1.4588	-0.3854*	0.1019	-3.7808
α_1	-1.3632*	0.2316	-5.8860	-0.3199*	0.0670	-4.7737	-0.2406*	0.0926	-2.5986	-1.0*****	0.7843	-1.3086
α_2	-3.3010*	0.3438	-9.6004	-0.1529**	0.0650	-2.3516	-0.209***	0.1270	-1.6450	-2.2502*	0.8935	-2.5184
α_3	-0.1613*	0.0312	-5.1697	-0.0495*	0.0093	-5.3545	-0.0307*	0.0057	-5.3567	-0.0809	0.0671	-1.2056
α_4	-0.0003	0.0003	-1.0992	0.0001**	0.0000	2.3965	0.0004**	0.0002	2.2230	0.008****	0.0057	1.4766
α_5	0.0030	0.0130	0.2305	-0.0007	0.0013	-0.5358	-0.0035	0.0036	-0.9721	-0.0252	0.0348	-0.7243
α_6	-0.0001	0.0014	-0.0370	-0.0002*	0.0001	-2.8942	0.0021*	0.0006	3.7280	-0.06*****	0.0401	-1.3916
α_7	-0.6861*	0.1351	-5.0799	-0.0032	0.0286	-0.1110	-0.0026	0.0179	-0.1428	-0.1169****	0.0791	-1.4780
α_8	0.0264	0.0257	1.0250	-0.007***	0.0041	-1.6244	-0.0173*	0.0068	-2.5600	-0.0040	0.0299	-0.1342
α_9	-0.3108*	0.1163	-2.6727	0.0098	0.0178	0.5513	-0.0078*	0.0018	-4.3179	-0.075*****	0.0533	-1.3980
α_{10}	6.7934*	0.59952	11.3314	1.5232*	0.1127	13.5143	1.5089*	0.21144	7.1363	4.6254*	1.2902	3.5850
Log likelihood: : -2415.311				Log likelihood: -2285.101			Log likelihood: -1110.235			Log likelihood: -1190.913		

	SULAWESI						REST					
	URBAN			RURAL			URBAN			RURAL		
Parameters	Coeff.	Std. Error	t-ratio	Coeff.	Std. Error	t-ratio	Coeff.	Std. Error	t-ratio	Coeff.	Std. Error	t-ratio
x_1^o	10.3110*	1.0011	10.3000	12.0000*	1.0497	11.4320	7.8023*	0.9999	7.8032	6.0646*	1.0000	6.0647
x_2^o	6.3059*	0.5994	10.5210	14.5760*	1.5139	9.6281	13.1110*	1.4711	8.9125	1.3*****	0.9992	1.3014
x_3^o	0.6345*	0.1324	4.7922	-1.6691**	0.6600	-2.5290	0.2677	0.4236	0.6319	1.66****	1.0122	1.5763
x_4^o	1.3099*	0.0004	3434.40	0.7725*	0.0655	11.7990	1.0681*	0.1425	7.4945	1.2870*	0.0459	28.0310
x_5^o	0.2471*	0.0245	10.0670	0.1285*	0.0201	6.3793	0.3719*	0.0392	9.4916	0.248****	0.1629	1.5194
x_6^o	2.2915*	0.0020	1132.0	0.9799*	0.0352	27.8780	1.6414*	0.4470	3.6720	0.63*****	0.4716	1.3319
x_7^o	1.0233*	0.0669	15.3060	0.8346*	0.1125	7.4212	1.2687*	0.1309	9.6942	1.1527*	0.3504	3.2895
x_8^o	0.3509*	0.0346	10.1440	0.2528*	0.0434	5.8315	1.0235*	0.0762	13.4260	0.4671*	0.1380	3.3847
x_9^o	1.2448*	0.0560	22.2130	1.2431*	0.1000	12.4300	1.4246*	0.1508	9.4494	2.8246*	0.6221	4.5405
x_{10}^o	-1.9672*	0.2560	-7.6832	-1.1392*	0.3526	-3.2312	-1.3493*	0.3915	-3.4463	-1.8863**	0.8370	-2.2538
α_1	-0.7228*	0.1638	-4.4123	-0.2473*	0.0515	-4.7986	-0.3551*	0.0955	-3.7203	-1.0631	0.9908	-1.0730
α_2	-0.8903*	0.1591	-5.5949	0.0157	0.1038	0.1508	0.0083	0.1107	0.0746	-0.1160	0.8788	-0.1320
α_3	-0.0349**	0.0174	-1.9999	-0.1710*	0.0320	-5.3415	-0.0589**	0.0207	-2.8393	-1.454***	0.8369	-1.7376
α_4	-0.0001**	0.0000	-2.3506	-0.0031	0.0077	-0.4019	0.0000	0.0001	0.6039	0.1013*	0.0208	4.8624
α_5	-0.0026	0.0076	-0.3446	-0.0020	0.0029	-0.7017	0.0017	0.0046	0.3745	0.2422*	0.0532	4.5524
α_6	-0.0002*****	0.0002	-1.3496	0.0013	0.0028	0.4751	-0.0005****	0.0003	-1.5639	-0.7270*	0.1402	-5.1858
α_7	-0.0158	0.0210	-0.7546	0.0042	0.0176	0.2379	-0.0192	0.0215	-0.8941	-0.7815**	0.3266	-2.3932
α_8	-0.0099	0.0091	-1.0905	0.0008	0.0062	0.1277	0.0340*	0.0096	3.5602	-0.0250	0.0471	-0.5308
α_9	0.0109	0.0214	0.5115	0.0057	0.0181	0.3133	0.0025	0.0274	0.0901	-1.2157*	0.4387	-2.7710
α_{10}	2.6657*	0.28694	9.2901	1.3958*	0.13365	10.4437	1.3872*	0.16042	8.6473	6.0391*	1.3196	4.5765
Log likelihood-1077.666				Log likelihood: : -1307.368			Log likelihood: :-1182.565			Log likelihood: -1196.189		