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EATING LIKE WHICH "JONESES?" AN ITERATIVE SOLUTION TO THE CHOICE OF A POVERTY LINE "REFERENCE GROUP"

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A standard method for calculating poverty lines (e.g. Ravallion, 1994) is not fully specified. The choice of the "reference population" for determining food baskets is left to the decision of the individual analyst. However, the poverty line can be quite sensitive to the real income of the reference group because the "quality" of the food basket—measured as the food expenditures per calorie—rises sharply with income. We propose that the reference group be centered on the poverty line. To address the obvious circularity problem in choosing a reference population at the poverty line to define the poverty line, we use an iterative approach. This iterative method provides a methodological anchor that fixes the reference group.

I. INTRODUCTION

Counting the poor is seemingly straightforward. A narrow definition of poverty is consumption below a certain predetermined level, the "poverty line." Measurement is then straightforward: those below the poverty line are "poor" and the rest, "non-poor." However, this simplicity is deceptive, as setting an absolute "poverty line" is complex. Even if one begins by accepting that the poverty line will be based on food expenditures necessary for nutritional adequacy and some allowance for "essential" non-food items, one still needs to answer many questions. What level of nutrition is "adequate"? What mix of food commodities are to be included in a food poverty basket to achieve adequacy? What level of non-food purchases are "essential"? Ultimately there are no correct answers to any of these questions as each is a social convention. But any proposed method for providing answers should be complete, internally consistent, and provide a credible case for its particular choice of social convention.

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Various ways to set poverty lines have been proposed in the literature—some more, some less, tied to nutritional standards. A popular one is the Food Energy Intake Method (for example, Greer and Thorbecke, 1986) which sets the poverty line at the level of consumption where a minimum nutritional standard is reached in expectation. Since this method does not have a basket of goods which forms the basis of the poverty line it is easy to implement and avoids the arbitrary choices that have to be made when selecting the items that enter into the basket. The method becomes problematic once one wishes to update the poverty line to allow for regional or intertemporal price variation. Since there is no basket of goods underlying the poverty line it is not obvious which price index to use. Applying the method separately by region or period does not guarantee that the poverty lines represent an equal real value. Differences across regions in tastes or relative prices of food vs. non-food items can also influence the outcome.[1] Others have gone as far as to abandon the link to a minimum nutritional intake altogether and to solicit the societal norms on what constitutes a minimum standard of living directly from survey data. An example of this approach is the Leyden poverty line (Groedhart *et al.*, 1977, Van Praag *et al.*, 1982) which is based on the Minimum Income Question.

In this paper we take as our starting point a method which is tied to a minimum nutritional intake but still yields a price deflator which can be used to calculate regional or inter-temporal poverty lines. This method, as developed by Ravallion (1994), has now become a standard procedure for setting a poverty line and with slight variations has been applied in World Bank "Poverty Assessments" and other studies in a large number of countries.[2] It uses a basket of goods yielding a minimum nutritional intake as the basis of the food poverty line and adds to this a non-food component based on the estimated Engel curve. The basket of goods is based on observed consumption patterns of a reference group.

We address the serious problem that this "standard method" for setting a poverty line is not complete. The standard method is incomplete as it does not have a method for specifying the "reference group," whose consumption choices determine the food basket used to create the food poverty line. Given this incompleteness there is no particular rationale for the choice of the reference group. We propose that the reference group be centered on the poverty line such that the consumption patterns used in defining the poverty line are of those at the poverty line. Centering the poverty line on the consumption patterns observed at the poverty line ensures that those who are at the poverty line on average indeed consume the minimum amount of calories set by the researcher. Also, when using the poverty line as a Laspeyres price index, it ensures that the poverty line represents the same standard of living in each region. We demonstrate an iterative method that produces a complete and consistent method for defining poverty.

The paper is organized as follows. In Section II we describe the "standard method" for setting the poverty line. Section III is devoted to demonstrating the importance of the reference group in setting the poverty line in the standard method. In Section IV we propose an iterative procedure which avoids having to

[1]See Ravallion (1998, pp. 11–12) for a detailed argument.

[2]Poverty assessments using this method have been produced in Cambodia (Prescott and Pradhan, 1997), Nepal, Vietnam, and Indonesia.

make arbitrary choices regarding the reference population. In Section V we apply the proposed method to Indonesia. Section VI concludes.

II. Description of the "Standard Method" for Setting the Poverty Line

In the "standard method" the poverty line (PL) has two elements: a food poverty line (FPL) and a non-food allowance (NFA).

The starting point for the food poverty line (FPL) is an intake requirement of N calories per person per day. The food poverty line (FPL) is the level of expenditures necessary to achieve this caloric intake. The caloric intake alone does not determine the FPL as the same intake could be achieved through a near infinite mix of foods. If a person in Indonesia were to only eat the cheapest possible source of calories, dried cassava flour, with a cost of 0.33 rupiah per calorie (see Table A1 in the Appendix), the FPL would be only 21,000 rupiah per person per month to achieve 2,100 calories per person per day.[3] A "rice only" diet at 0.73 rupiah per calorie would cost 46,000 rupiah per month. A diet of only "local chicken meat" at 4.34 rupiah per calorie would cost 273,420 rupiah per month—ten times the "cassava only" FPL. Obviously a diet of only rice or cassava flour is unrealistic and unpalatable and is not consumed, even by the very poor. People are quite willing to trade-off calories for variety and taste. In addition, calories are just a proxy for an overall nutritional adequacy, which requires proteins and micronutrients as well as calories, and hence a varied diet is important for other reasons.[4] While the total calories in the food poverty basket can be more or less fixed "technically," the *basket* and *quality* of those foods used to reach that level is purely a *social convention*.

There are two ways to fix a basket—expert choice or using the actual observed basket of some group. The "expert choice" method typically relies on either some "least cost" calculation or relies on some group of nutritionists/economists to decide on the appropriate basket. The standard method is more defensible as it uses a basket of foods actually consumed by a "reference population" to determine the *mix* of foods. The *total* of each food item is then determined by scaling the mix of foods proportionately to achieve the level of N calories. More formally, let $\bar{q}_k$ denote the average quantities consumed of commodity k by the reference population. The food basket is defined as $q_k = \theta \bar{q}_k, k =$

[3]Setting N to 2100 calories per person per day has become a convention (Ravallion, 1994) stemming from work by nutrition experts with FAO and WHO in setting minimal energy and protein intake guidelines (FAO, 1973). Of course "necessary" caloric intake for any given individual varies across a variety of factors, including body mass, individual metabolism, types of activities, climate, age, gender, underlying disease conditions, etc. While some use "equivalence scales" to allow for different nutritional "requirements" of persons of different ages and genders, this practice is controversial as it implies women need less money than men to attain the same level of welfare. For these and other methodological reasons the exact scaling factors remain controversial and we use the single per person amounts. The same methodological difficulties in this paper would apply if N were any other number.

[4]Focusing on calories only is nutritionally unrealistic as there are other dietary requirements, such as proteins and micronutrients (e.g. iron and vitamin A). If one were attempting to specify technically a least cost nutritionally adequate diet, these additional constraints would need to be imposed.

$1, \ldots, K$, where $\theta = N/\sum_{k=1}^{K} \bar{q}_k c_k$ and c_k is the unit calorie value of commodity k. Once the q_k are fixed we need to mind the prices, "p's."

Putting the two together, the food poverty line (FPL) for region j using a reference population with total per capita expenditures $\tilde{e}$, is defined as:

$$\text{(1)} \qquad \text{FPL}_j = \sum_{k=1}^{K} \bar{q}_k(\tilde{e}) \times \hat{p}_{kj}(\tilde{e}) \times \left(\frac{N}{\sum_{k=1}^{K} \bar{q}_k(\tilde{e}) \times c_k} \right).$$

The poverty line (PL) is this food poverty line (FPL) plus a non-food allowance. The rationale for choosing the non-food allowance in the standard method is that the non-food amount that is "essential" to avoid poverty is that amount actually chosen by those households who are in poverty (Ravallion, 1994). The *low* estimate uses the non-food expenditures of those households whose *total* expenditures are equal to the food poverty line. This non-food component of the poverty line is calculated by estimating an Engel curve for food consumption. This non-food allowance is what households deem essential, as they choose to spend on these non-food items rather than achieve the 2100 calorie level. The Engel curve, estimated using all household (i) for each region j is specified as:

$$\text{(2)} \qquad \omega_{i,j} = \omega_j + \beta \log(e_{i,j}/\text{FPL}_j) + \varepsilon_{i,j}.$$

A "lower bound" for the NFA is derived by taking the predicted value of non-food expenditures where $e = \text{FPL}$. Since $\ln(\text{FPL}/\text{FPL}) = 0$, $\text{NFA}_j = (1 - \omega_j)\text{FPL}_j$.

The lower bound poverty line (PL) for region j equals the FPL plus the non-food allowance (NFA) so:

$$\text{(3)} \qquad \text{PL}_j = \text{FPL}_j + \text{NFA}_j = \text{FPL}_j + (1 - \omega_j) \times \text{FPL}_j = \text{FPL}_j \times (2 - \omega_j).$$

III. The (Unexpected) Importance of the Reference Group

An arbitrary but, as it turns out, crucial decision in implementing the standard method is the choice of the reference population. The consumption pattern of this group determines the composition of the food basket that forms the basis of the food poverty line. The attractiveness of using a reference group is that it reflects the consumption patterns actually chosen by some group. This makes it a plausible case for a "social convention." However, this does not resolve the question of *which* group. Should the poor achieve calorie adequacy at the consumption patterns of the *average* consumer? The typical (*median*) consumer? Consumers at the 10th? 20th? 40th percentile?

Most researchers therefore start off with a prior belief about the level of poverty and use a range of percentiles (e.g. 20th–30th or 30th–40th) as the reference group. This method could lead to two researchers working on the *same* country with exactly the *same* data and using exactly the *same* standard method, but simply having different *prior* beliefs about the level of poverty to get different poverty results. The one who believes poverty is high will choose a higher range of percentiles, hence a wealthier reference population. This richer reference group will consume a higher quality food basket, with higher cost per calorie, so the cost of obtaining a fixed amount of calories will be higher. This will make the PL higher because of the direct effect and the indirect effect of a higher FPL on moving along an Engel curve to a higher non-food share:

$$\frac{d\,\mathrm{PL}}{d\,\mathrm{FPL}} = (2-\omega) - \mathrm{FPL}\frac{\partial \omega}{\partial\,\mathrm{FPL}}. \quad (4)$$

Consequently, the researcher with higher prior will get a higher estimated head-count poverty compared to the researcher with a low prior. This means that the standard poverty methodology is incomplete. Without a procedure for fixing the reference group, the standard method applied to the same country with the same data can produce different outcomes.

In the case of Indonesia, the difference is not a minor theoretical *curiousem* but is empirically important. Suppose one researcher believed the poverty rate was 15 percent and hence began with a reference group of the 15th percentile, while another believed poverty was 30 percent. They both then estimate the head-count poverty rate without iterating. Table 1 shows that the resulting poverty rates from the two researchers, using exactly the same *method* on exactly the same *data* and differing only in their prior (and not unreasonable) beliefs about the appropriate reference group, would produce estimates of the poverty rate that differed by 6.7 percentage points (more than 30 percent).

TABLE 1

Illustration of the Sensitivity of the Estimated Poverty Rate to Assumptions About the Reference Group

Assumption	Mid Point of Reference (Rp/month)	Poverty Line (Rp/month)	Poverty Rate (%)
Reference group centered on 15th percentile	69,645	77,265	21.78
Reference group centered on 30th percentile	86,159	84,550	28.48

Since by equation (3) an increase in the FPL line increases the PL more than proportionally, the key is the sensitivity of the FPL to the expenditures of the chosen reference group. Since higher expenditures affect all three terms of the FPL (prices per unit, mix of units consumed amongst various food items, and total caloric value), the derivative of FPL with respect to expenditures is complex. The most intuitive way of expressing the derivative is:

$$\frac{\partial \mathrm{FPL}}{\partial e} = \left(\frac{N}{\mathrm{TC}}\right) \times \left[\sum_{k=1}^{K} \varepsilon_k \times \sigma_k + (\bar{\kappa}) \sum_{k=1}^{K} \sum_{l=1}^{l<k} (\kappa_k - \kappa_l) \times (\eta_k - \eta_l)\right], \quad (5)$$

where, for each commodity, the

ε's are the "elasticities of price with respect to total expenditures"; this is the increase in within commodity group quality as expenditures rise

σ's are the shares in expenditure of each commodity

η's are the usual (Marshallian) income elasticities, which determine the income expansion paths

κ's are the rupiah per calorie of each commodity

N is the target calories and TC is the actual calories of the basket.

This expression for the derivative breaks into two parts. The first term is an increase in price for a fixed commodity basket as, for a given mix of goods, consumers move to higher qualities. This is simply the expenditure weighted sum of the "quality" elasticities. Using the data from Table A1, this is 0.10 in the Indonesian data.

The second term is the "quality upgrading across commodities" and is also quite intuitive, particularly using a simple example of two goods, say rice and eggs. The rupiah per calorie of rice is 0.73 while the income elasticity is also low, only 0.063 (see Table A1). In contrast, the rupiah per calorie of eggs is 6.07 and the income elasticity is a high 0.582. Therefore, as the expenditure of the reference group increases, consumers shift to a basket of proportionally more eggs, which are a higher cost source of calories, with the contribution to increasing the poverty line in this case of $(0.73-6.07)\times(0.063-0.582)=2.77$. Since there is a general tendency for higher income elasticities to be associated with higher rupiah per calorie as the expenditures of the reference group increases (the rank correlation is 0.34), the FPL increases because the rupiah per calorie of the mix of commodities chosen by the group increases.

The estimated relationship between rupiah per calories and expenditures is shown in Figure 1 in two ways—either as semi-log (rupiah per calorie on natural log expenditures) or using a flexible functional form (a quartic). In either case the relationship is quite steep. For instance in moving the 15th percentile to the 30th percentile of expenditures, the predicted rupiah per calorie increase from 1.86 to 2.20—almost a 20 percent increase. This accounts for the sensitivity of the poverty rate to the choice of reference group.

Note that changes in the total calories in the basket of commodities with respect to expenditure, which are shown in Figure 2, play no role at all in setting

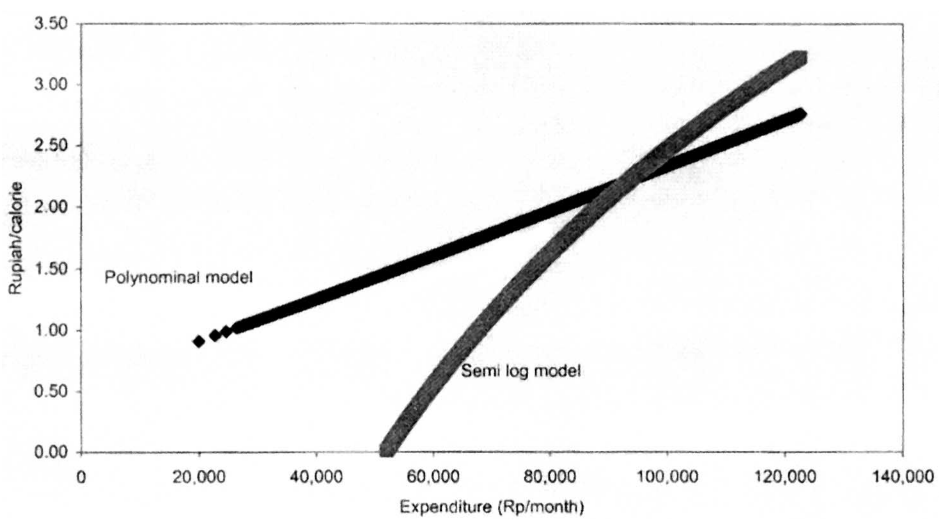

Figure 1. Relationship between Prices of Calories Consumed and Expenditures

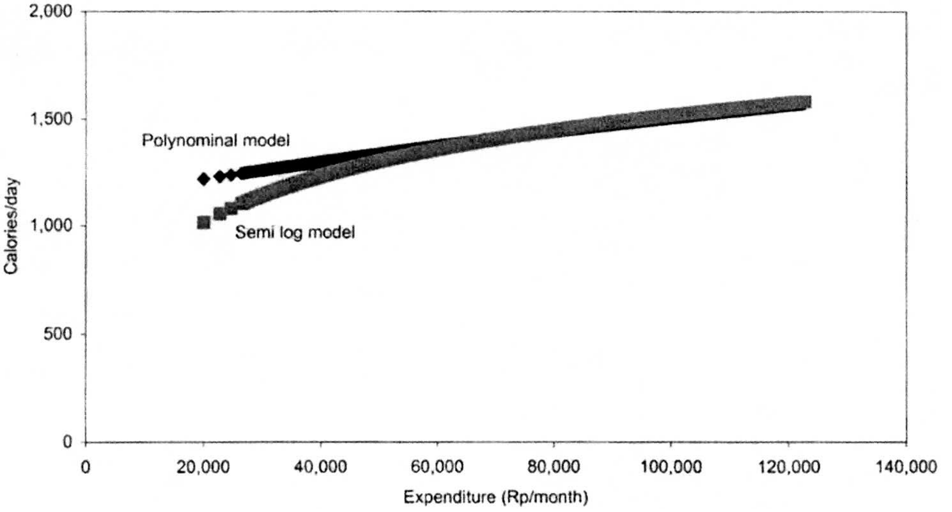

Figure 2. Relationship between Calories Consumed and Expenditures

the FPL.[5] Since by formula in equation (1), calories are re-scaled up (or down) to remain constant, all that matters is the rupiah per calorie.

IV. An Iterative Method

To overcome the circularity between determining the reference population and the resulting headcount poverty rate, we use an iterative method. This method estimates the poverty line using an initial reference group. The poverty line that emerged from these initial steps is used as the center of the reference group for the next step. The iteration converges when the reference group yields a poverty line that is the same as the midpoint of the reference group. This point corresponds to the intersections of the PL(e) and the 45° line in Figure 3.[6]

The method is an iterative version of the standard method with some adjustments. Since we center the reference group at the poverty line, and do not work with a reference group, the bundle of goods entering into the poverty line is estimated using regression methods. The quantity consumed of good k by household i (q_{ik}) is regressed on per capita consumption e_i:

(6) $$q_{ik} = \alpha_{0k} + \alpha_{1k}\, e_i + \varepsilon_{ik}.$$

The relative weights of the different food items is obtained by predicting the quantity at the prior poverty line.

[5]The calculations in this figure are based on the 52 commodities in the poverty basket only. The average caloric intake from these 52 commodities is 1,513 calories per person per day, while the average total caloric intake is 1,850 calories per person per day.

[6]The figure also provides an empirical explanation for the positive income elasticity of the (self-reported) Minimum Income as used in the Leyden method. Possibly, poor people do not adjust their food patterns when answering what income they need to make ends meet. As a result poorer people will report a lower income needed to reach a minimum nutritional standard than rich people.

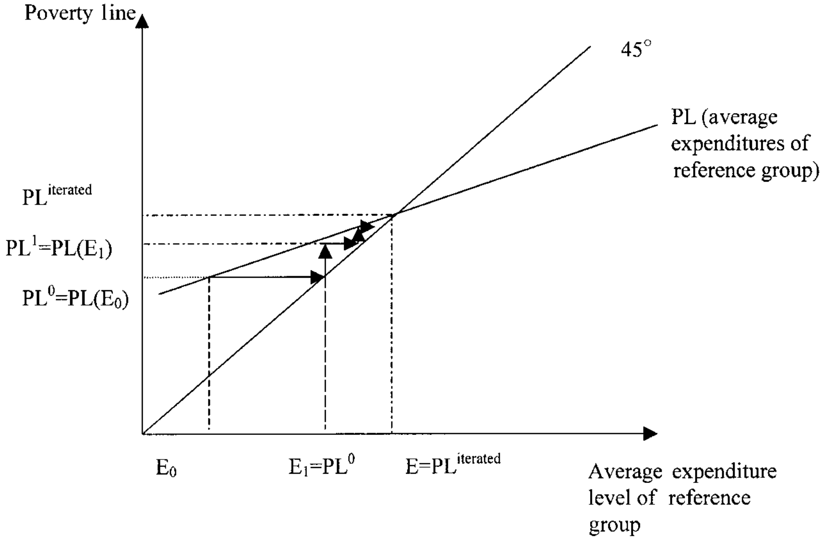

Figure 3. Expenditure Level of Reference Group and Poverty Line and the Iterated Poverty Line

A similar adjustment is made for prices. In the application we will use unit values obtained from dividing expenditures by reported quantities for prices.[7] The main advantage of using unit price estimates is that typically they can be derived from the same consumption survey. Especially in a period of high inflation, it is important that the price and expenditure data correspond to the same reference time. A disadvantage of unit values is that products may not be homogeneous within a commodity category as wealthier households may consume more luxurious varieties of a commodity. We correct for the product heterogeneity problems by regressing unit values on expenditures.[8] If households indeed switch to more luxurious varieties as they get richer, this would result in a positive significant estimate of per capita consumption in the unit price regression. We use the predicted price at the poverty line, which should reflect prices relevant for the poor.

Applying the standard method, a new poverty line is obtained which then serves as the prior in the next iteration. The different steps involved, and how we deal with regional variation, are detailed in the Appendix.

This method will converge to a unique equilibrium as long as the FPL(e) has a positive intercept (which it must), is monotonic, and eventually has a slope less than one ($(\partial \mathrm{FPL}/\partial e) < 1$ from equation (5)). These conditions are plausible since $\partial \mathrm{FPL}/\partial e$ should be less than the food expenditure response, $\partial \mathrm{FE}/\partial e$, and the income elasticity of food expenditure is typically less than one. While there is no guarantee this is always true, the method appeared robust with respect to the

[7]Bidani and Ravallion (1993) and Ravallion and Bidani (1994) use separately collected price data. Deaton and Tarozzi (1999) use weighted median unit values by region in an analysis of Indian poverty.

[8]A similar procedure in the construction of poverty line in Indonesia is used by Alatas (1997). A quintile regression using the results to median is the same as the LAD (Least Absolute Deviations) estimate. Since a regression is performed for each commodity in each region, sample sizes are small. Hence, we use quintile (median) regression methods because they are less sensitive to outliners.

choice of the initial value of the poverty line. As noted above, convergence can be quite slow (especially if median regressions are used), so beginning from a reasonable starting point is helpful.

IV. Application to Indonesia

We use the Susenas February 1999 data with the 65,000 households and the detailed expenditures module. Susenas is the National Socio-Economic Survey, conducted by Statistics Indonesia (BPS). The detailed consumption module of this survey is conducted every three years. The questionnaire in this detailed consumption module has a total of 229 food and 110 non-food items.

Estimated food poverty lines can be rather sensitive to the choice of the commodity basket, especially if the national basket excluded some locally important calorie sources. Chesher (1998) shows a large difference in some regions between using 31 commodities (as in Bidani and Ravallion, 1993) and the 52 food items used by BPS. In order to make our estimates as directly comparable as possible to the "official" poverty estimated by BPS, we use their 52 commodity items (BPS and UNDP, 1999). The list of these 52 commodities, their unit caloric value, and their "rupiahs per calorie" are given in Table A1 in the Appendix. Following BPS, we use a 2,100 calorie requirement per person per day.

Our approach for the inter-regional comparison has been to keep the quantities in the food basket constant. Theoretically, we want the poverty line to represent the same level of utility. This approach guarantees that the poverty line suffices to purchase this national basket in each region. A disadvantage is that the applied basket is not necessarily optimal for every region. In a region with a very different set of relative prices compared to the national average, the same welfare (in utility terms) can generally be reached with a lower total expenditure than the poverty line would imply. This is the argument in favor of using region specific food bundles.[9] Chesher (1998) finds that moving to a regional poverty basket increases the extremes in measured poverty, raising provinces that are already high and lowering provinces that are already low.

The resulting regional poverty rates from our iterative method are presented in Table 2, while the associated poverty lines are presented in Table A2 in the Appendix and the number of poor people are in Table A3. For comparison, Table 2 also shows the regional poverty rates according to BPS's conventional approach. Our finding of a poverty rate of 27.13 percent in February 1999 is modestly higher than the BPS poverty rate of 23.55 percent.[10] The ranking of provinces from least to most poor by our iterative method and BPS's method are quite consistent with a Spearman rank correlation of 0.92. The poverty rate of 27.13 percent in Indonesia implies around 55.8 million poor people.

While at the national level the difference in poverty rates between the two methods is less than 4 percentage points, the two methods differ wildly in the range of differences in poverty rates across urban and rural areas. The rank correlation is also lower at 0.84 for urban areas and 0.88 for rural areas. The BPS

[9]There are a number of compelling arguments against, which are discussed in length in Ravallion and Bidani (1994) or Ravallion (1994).

[10]See Sutanto and Irawan (2000).

TABLE 2

REGIONAL POVERTY INCIDENCE (%) AND RANK IN FEBRUARY 1999

	Iterative Method						BPS Conventional Method					
	Urban		Rural		Total		Urban		Rural		Total	
Province	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank
Jakarta	2.82	1	–	–	2.82	1	6.59	1	–	–	6.59	1
Bali	10.67	11	15.61	5	13.62	6	9.80	3	9.89	1	9.85	2
Riau	8.53	7	9.62	1	9.21	2	11.43	4	14.98	2	13.65	3
Aceh	5.43	3	15.41	4	12.89	5	13.76	6	17.38	5	16.47	4
West Sumatera	8.78	9	9.74	2	9.47	3	17.43	12	16.48	3	16.75	5
Central Kalimantan	5.00	2	13.43	3	11.15	4	7.16	2	20.41	6	16.83	6
East Kalimantan	8.74	8	35.06	15	21.67	10	12.65	5	22.83	9	17.65	8
North Sumatera	10.81	12	18.91	6	15.27	7	17.50	13	16.64	4	17.03	7
North Sulawesi	11.70	13	26.83	11	22.47	12	14.23	7	24.60	13	21.61	9
West Java	20.82	22	31.87	13	26.60	15	20.96	17	22.32	8	21.67	10
South Sulawesi	17.42	18	24.94	8	22.63	13	20.50	16	22.20	7	21.68	11
South Kalimantan	7.99	6	26.38	10	20.64	9	16.37	11	25.03	15	22.33	12
Yogyakarta	22.12	23	36.78	16	26.95	16	20.13	15	27.68	18	22.62	13
Bengkulu	10.41	10	24.55	7	20.44	8	20.02	14	24.55	12	23.23	14
West Nusa Tenggara	30.17	27	44.71	22	41.78	23	25.94	23	23.42	10	23.93	15
Jambi	15.41	16	25.25	9	22.18	11	23.27	21	24.63	14	24.24	16
South Sumatera	14.47	15	27.93	12	23.81	14	24.77	22	24.27	11	24.42	17
Central Sulawesi	16.72	17	32.69	14	28.52	17	21.69	20	25.87	16	24.78	18
Southeast Sulawesi	13.74	14	44.44	21	36.61	21	14.28	8	29.34	20	25.50	19
East Java	19.51	20	40.87	20	33.31	20	21.55	19	28.80	19	26.24	20
Central Java	23.72	25	37.76	17	32.78	19	26.06	24	27.52	17	27.01	21
West Kalimantan	6.17	5	38.04	18	30.76	18	14.43	10	34.25	22	29.72	22
Lampung	19.90	21	40.57	19	36.80	22	21.14	18	32.92	21	30.77	23
Maluku	18.64	19	59.90	24	48.40	24	28.52	25	41.50	23	37.88	24
East Timor	23.37	24	59.38	23	55.49	26	39.35	27	44.07	24	43.56	25
East Nusa Tenggara	28.67	26	66.11	25	61.18	27	30.43	26	47.15	25	44.95	26
Papua	6.07	4	72.19	26	54.89	25	14.31	9	59.30	26	47.53	27
Indonesia	16.34		34.10		27.13		19.98		25.85		23.55	

Note: Sorted by average provincial poverty by BPS method.

conventional method implies less than 6 percentage points in the difference between urban and rural poverty rates. The iterative method, meanwhile, has a much, much, wider difference of almost 18 percentage points (16 vs. 34 percent). Table 3 demonstrates the reason for this.

The iterative method, which chooses the reference groups to reflect equivalent *real* incomes of urban and rural groups in the reference basket, produces much lower differences in the poverty lines in urban vs. rural areas. The method fixes a poverty line only 11 percent higher in urban than rural areas. As a result, the poverty incidence in urban areas, which is 16.3 percent, is less than half of the poverty rate in rural areas, which is 34.1 percent.

The BPS conventional method, meanwhile, uses reference groups that are chosen reflecting an *assumption* of higher costs of living in urban than rural areas. They choose a reference group range that is non-overlapping (the lower limit of urban is Rp 80,000, which is the same as the upper limit of rural) and which is between 25 and 33 percent higher for urban areas. The result is a poverty line that

TABLE 3

Urban–Rural Differences in Iterative and BPS Methods, February 1999

	Reference Population (Rp/month)		Poverty Line (Rp/month)	Poverty Incidence (%)
	Lower limit	Upper limit		
Iterative method				
Urban	72,392	108,588	90,490	16.34
Rural	64,947	97,421	81,184	34.10
Ratio	1.11	1.11	1.11	0.48
BPS conventional method				
Urban	80,000	100,000	93,869	19.98
Rural	60,000	80,000	73,898	25.85
Ratio	1.33	1.25	1.27	0.77

is 27 percent higher in urban than in rural areas. Not surprisingly, the poverty rate in urban areas by this method, which is around 20 percent, is 77 percent of that in rural areas, which is 25.9 percent. So, in spite of much lower nominal expenditures, the cost of attaining the poverty basket is *assumed* to be much lower in rural areas. This implies that the differences in poverty rate between urban and rural areas are possibly as much an artifact of method and assumptions as they are a finding of "fact"—the poverty line is higher because it is assumed to be higher.[11] However, there is no double check within the BPS method on the initial assumptions about the appropriate reference groups.

VI. Conclusion

The standard method of poverty measurements leaves the choice of the reference group open. This, however, implies that when the quality of the food basket consumed, as measured by rupiahs spent per calories, is strongly responsive to the level of expenditures, then the standard method for setting poverty lines is not robust to arbitrary choices about reference groups. Only by iterating can the reference group and poverty line be consistent.

The conventional BPS method is typical of the standard method in relying on prior choices of reference groups, choosing a higher nominal level to define the reference group in urban than rural areas. As seen in the Indonesian example, regional comparisons should be based on an iterative methodology for setting the reference groups. Given the high sensitivity of regional poverty comparisons to reference groups, and given that these reference groups are often chosen without any methodological justification, this makes a substantial difference to the poverty profile.

Appendix

The steps involved in the iterative approach to calculating poverty lines are each somewhat complex, so a brief description is in order.[12] Since in the application

[11]Asra (1999) shows that headcount poverty estimates in Indonesia are sensitive to the choice of inflation rates and cost of living differences between urban and rural areas.

[12]The actual Stata program that implements this description is available from the authors on request.

TABLE A1

VARIOUS PARAMETERS OF FOOD ITEMS IN POVERTY BASKET

No.	Commodity	Unit	Quantity Expansion of Income	Price Expansion of Income	Calories per Quantity	Rupiah per Calorie	Expenditure Share
1	Dried cassava flour	Kg	–0.701	0.076	3,630	0.33	0.001
2	Dried cassava	Kg	–0.174	0.129	3,380	0.37	0.001
3	Dryshelled corn	Kg	–0.694	0.163	3,200	0.45	0.010
4	Cassava	Kg	–0.040	0.246	1,309	0.48	0.009
5	Sweet potatoes	Kg	–0.037	0.235	1,252	0.63	0.003
5	Coconut/cooking oil	Litre	0.590	–0.010	6,960	0.64	0.024
7	Rice	Kg	0.063	0.103	3,622	0.73	0.435
8	Brown sugar	Ounce	0.234	0.099	377	0.84	0.005
9	Glutinous rice	Kg	–0.065	0.236	3,605	0.94	0.001
10	Cane sugar	Ounce	0.415	–0.013	364	1.00	0.045
11	Wheat flour	Kg	0.370	–0.006	3,330	1.04	0.003
Average rupiah/calorie of poverty basket						**1.08**	
12	Coconut	Unit	0.213	0.164	1,335	1.28	0.021
13	Candle-nut	Ounce	0.310	0.049	636	1.38	0.004
14	Peanuts without shell	Kg	0.356	0.062	4,520	1.64	0.003
15	Crisps	Ounce	0.335	0.147	453	1.72	0.006
16	Cassava leaf	Kg	0.020	0.147	635	1.80	0.007
17	Boil or steam cake	Unit	0.434	0.332	138	1.80	0.012
18	Zalacca	Kg	0.541	0.260	1,351	1.96	0.003
19	Fermented soybean cake	Kg	0.281	0.018	1,430	2.17	0.029
20	Instant noodle	80 gr	0.688	0.019	356	2.18	0.019
21	Cookies	Ounce	0.682	0.131	426	2.48	0.005
22	Ambon banana	Kg	0.335	0.168	644	2.93	0.006
23	Sweet canned liquid milk	397 gr	0.376	–0.001	1,334	3.02	0.007
24	Young jack-fruit	Kg	0.159	0.219	408	3.11	0.002
25	Papaya	Kg	0.328	0.186	345	3.25	0.005
26	Pork	Kg	0.285	0.264	4,165	3.37	0.003
27	Other bread	Unit	0.583	0.252	162	3.47	0.008
28	Tofu, soybean curd	Kg	0.344	0.037	800	3.49	0.022
29	Fish paste	Ounce	0.114	0.029	250	4.02	0.005
30	Broiler meat	Kg	0.590	0.023	3,020	4.09	0.016
31	Local chicken meat	Kg	0.437	0.071	3,020	4.34	0.008
32	Powdered coffee	Ounce	0.320	0.156	352	4.85	0.017
33	Canned powder milk	Kg	0.497	0.063	5,090	5.23	0.006
34	Duck egg	Unit	0.570	0.104	125	5.54	0.003
35	Broiler egg	Kg	0.582	0.021	1,371	6.07	0.031
36	String bean	Kg	0.143	0.144	276	7.85	0.009
37	Beans	Kg	0.021	0.227	306	7.89	0.002
38	Mango	Kg	0.373	0.450	365	7.93	0.001
39	Anchovies	Kg	0.348	0.090	740	8.35	0.004
40	Eastern tuna/skipjack tuna	Kg	0.214	0.274	904	8.94	0.012
41	Milk fish	Kg	0.333	0.124	1,032	8.96	0.007
42	Indian mackerel	Kg	0.183	0.224	824	9.07	0.012
43	Trimmings	Kg	0.410	0.074	1,280	9.79	0.001
44	Tea	Ounce	0.306	0.080	132	9.90	0.009
45	Beef	Kg	0.513	0.126	2,070	10.55	0.010
46	Spinach	Kg	0.246	0.117	114	13.53	0.008
47	Tomato	Ounce	0.421	0.043	19	18.52	0.005
48	Cayenne pepper	Ounce	0.243	0.097	88	19.21	0.022
49	Onion	Ounce	0.553	0.037	35	31.94	0.023
50	Chillies	Ounce	0.500	0.132	26	71.51	0.021
51	Salt	Ounce	0.112	0.120	0	–	0.006
52	Cigarettes	Unit	0.712	0.199	0	–	0.069

TABLE A2

Poverty Lines in February 1999, in Rp/month (Results of Iterative Method)

Province	Urban	Rural	Total
Aceh	74,087	70,199	71,008
North Sumatera	83,462	74,460	78,186
West Sumatera	85,361	78,499	80,227
Riau	92,643	82,033	85,693
Jambi	85,216	77,004	79,260
South Sumatera	85,579	79,962	81,667
Bengkulu	86,026	77,966	80,056
Lampung	88,877	78,637	80,265
Jakarta	102,814	–	102,814
West Java	94,405	86,024	89,635
Central Java	85,009	78,461	80,566
Yogyakarta	92,644	83,304	87,933
East Java	85,024	80,020	81,637
Bali	97,794	94,405	95,580
West Nusa Tenggara	87,783	84,718	85,296
East Nusa Tenggara	84,144	77,856	78,739
East Timor	97,017	90,621	91,235
West Kalimantan	93,380	87,982	89,155
Central Kalimantan	95,514	85,587	87,842
South Kalimantan	86,921	82,932	84,139
East Kalimantan	96,070	92,977	94,533
North Sulawesi	87,474	82,179	83,581
Central Sulawesi	81,251	76,802	77,784
South Sulawesi	84,561	74,376	77,274
Southeast Sulawesi	86,630	80,279	81,718
Maluku	102,797	100,169	100,821
Papua	88,486	97,129	94,906
Indonesia	90,490	81,184	84,537

for Indonesia regional differences were important, we outline the method, assuming multiple regional poverty lines are being set.

1. Start with a prior on the poverty line in region j. Denote this by PL_j^{n-1}.
2. Calculate "real" per capita consumption for household i in region j by dividing nominal per capita consumption by the poverty line, $e_{ij}^n = C_{ij}/PL_j^{n-1}$. This gives expenditures as a fraction of that necessary to purchase the poverty line basket.
3. Regress for each product k in the food basket the per capita quantity consumed on real per capita expenditures, $q_{ijk} = \alpha_{0k} + \alpha_{1k} e_{ij}^n + \varepsilon_{ik}$.[13] Only use households near the poverty line for this regression. We used only households for which $0.8PL_j^{n-1} < e_{ij}^n < 1.2PL_j^{n-1}$.[14]
4. Predict the quantity consumed for each product at the poverty line, $\bar{q}_k = \alpha_{0k} + \alpha_{1k}$ (since $e_{ij}^n = 1$ at the prior poverty line).

[13]If the sample is not nationally random (e.g. stratified), then sampling weights should be used in this regression.

[14]We experimented with expanding the range to $0.7PL_j^{n-1} < e_{ij}^n < 1.3PL_j^{n-1}$ which had a marginal effect on the results. Expanding the range resulted in an increase of the headcount from 27.13 to 27.20 percent.

TABLE A3

NUMBER OF POOR PEOPLE IN FEBRUARY 1999
(RESULTS OF ITERATIVE METHOD)

Province	Urban	Rural	Total
Aceh	55,983	470,401	526,384
North Sumatera	572,722	1,225,916	1,798,638
West Sumatera	114,432	315,504	429,936
Riau	134,446	253,719	388,165
Jambi	122,013	441,684	563,697
South Sumatera	341,459	1,493,688	1,835,147
Bengkulu	46,209	266,087	312,296
Lampung	254,381	2,321,018	2,575,399
Jakarta	268,179	–	268,179
West Java	4,210,930	7,075,401	11,286,331
Central Java	2,586,788	7,496,727	10,083,515
Yogyakarta	448,455	366,091	814,546
East Java	2,408,028	9,218,412	11,626,440
Bali	129,632	281,861	411,493
West Nusa Tenggara	235,570	1,383,319	1,618,889
East Nusa Tenggara	143,674	2,185,343	2,329,017
East Timor	22,766	478,403	501,169
West Kalimantan	54,711	1,139,976	1,194,687
Central Kalimantan	23,486	170,420	193,906
South Kalimantan	76,310	556,054	632,364
East Kalimantan	112,374	434,927	547,301
North Sulawesi	93,416	530,185	623,601
Central Sulawesi	91,204	504,834	596,038
South Sulawesi	426,454	1,379,038	1,805,492
Southeast Sulawesi	59,972	566,337	626,309
Maluku	114,182	949,300	1,063,482
Papua	33,296	1,118,298	1,151,594
Indonesia	13,181,072	42,622,943	55,804,015

5. Calculate the calorie content of this basket $\mathrm{TC} = \sum_k \bar{q}_k c_k$, where c_k is the unit calorie content of product k.
6. Scale the quantities in the basket so that the basket yields N calories. $\hat{q}_k = \bar{q}_k (N/\mathrm{TC})$. This is the food basket for the poverty line.
7. For each region j and for each product k, do a regression of unit prices on real per capita consumption.[15] $p_{ijk} = \beta_{0jk} + \beta_{1jk} e_{ij}^{n} + \upsilon_{ij}$ where p_{ijk} is the unit price paid by household i in region j for product k. Since unit price data can be plagued by large outliers reporting and coding errors, we prepared to use quintile (median) regression at this stage. However, since this involves running $j \times k$ regressions (in our case over 2,500) in each iteration, using quintile regressions slows the procedure considerably. We would recommend using OLS until the process converges, then switch to median regressions for the final iterations.
8. Calculate the predicted unit price paid for product k in region j at the poverty line. $\hat{p}_{jk} = \beta_{0jk} + \beta_{1jk}$.
9. Calculate the cost of the N calorie food basket, this is the food poverty line $\mathrm{FPL}_j^n = \sum_j \hat{q}_k \hat{p}_{jk}$.

[15]Since this is done region by region, do not apply weights in this regression.

10. Estimate an Engel curve for the food share in each region:

$$\omega_{ij} = \omega_j + \beta_j \log\left(e_{ij}^{\,n} \times \left(\frac{\mathrm{PL}_j^n}{\mathrm{FPL}_j^n}\right)\right) + \nu_j$$

and get the intercept, $\hat{\omega}_j^n$ for each region.

11. The poverty line at the *n*th iteration is $\mathrm{PL}_j^n = \mathrm{FPL}_j^n(2 - \hat{\omega}_j^n)$.
12. Start at step 1 using the poverty line at the *n*-th iteration for the new $n + 1$st iteration.

References

Alatas, V., *How Robust is Indonesia's Poverty Profile*? Department of Economics, Princeton University, Mimeo, 1997.

Asra, A., "Urban–Rural Differences in Costs of Living and Their Impact on Poverty Measures," *Bulletin of Indonesian Economic Studies*, 35, 51–69, 1999.

Bidani, B. and M. Ravallion, "A Regional Poverty Profile for Indonesia," *Bulletin of Indonesian Economic Studies*, 29, 37–68, 1993.

BPS and UNDP, *Crisis, Poverty, and Human Development in Indonesia, 1998*, Badan Pusat Statistik, Jakarta, 1999.

Chesher, A., *Local Poverty Lines and Poverty Measures for Indonesia*, Report prepared for the World Bank, Department of Economics, University of Bristol, 1998.

Deaton, A. and A. Tarozzi, *Prices and Poverty in India*, Research Program in Development Studies, Princeton University, Mimeo, 1999.

FAO (Joint FAO/WHO *ad hoc* Expert Committee on Energy and Protein Requirements), *Energy and Protein Requirements: Report of a Joint FAO/WHO ad hoc Expert Committee,* FAO Nutrition Meetings Report Series, No. 52, Rome, 1973.

Greer, J. and E. Thorbecke, "A Methodology for Measuring Food Poverty Applied to Kenya," *Journal of Development Economics*, 24(1), 59–74, 1986.

Groedhart, T., V. Halberstadt, A. Kapteyn, and B. van Praag, "The Poverty Line: Concept and Measurement," *Journal of Human Resources*, 12, 503–20, 1997.

Prescott, N. and M. Pradhan, *A Poverty Profile of Cambodia*, Discussion Paper No. 373, World Bank, Washington DC, 1997.

Ravallion, M., *Poverty Comparisons*, Fundamentals of Pure and Applied Economics, Volume 56, Harwood Academic Press, Chur, Switzerland, 1994.

———, "Poverty Lines in Theory and Practice," LSMS Working Paper No. 133, World Bank, Washington DC, 1998.

Ravallion, M. and B. Bidani, "How Robust is a Poverty Profile," *The World Bank Economic Review*, 8, 75–102, 1994.

Sutanto, A. and P. B. Irawan, "Regional Dimensions of Poverty: Some Findings on the Nature of Poverty," Paper presented at International Conference on Poverty Measurement in Indonesia, May 16, 1999, Jakarta, 2000.

Van Praag, B. M. S., A. J. M. Hagenaars, A. Van Weeren, and H. Van Weeran, "Poverty in Europe," *Review of Income and Wealth*, 28(3), 345–59, 1982.