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Spatial Differences in the Cost of Living

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A method is described for constructing spatial indices of the cost of a basket of basic "requirements" of food and nonfood categories. The proposed index for nonfood items is built up from household expenditure, since their prices are unavailable in most developing countries. Using Peru as a case study, it is shown that the cost differences have significant implications for measures of real income and poverty across regions and between urban and rural areas.

Spatial differences in living costs have implications for estimates of income and measures of poverty within a country. Nevertheless, it is common to use money income in comparing living standards and a single money income threshold in measuring poverty across locations. These procedures, however, give a misleading picture of the benefits and costs of locating in various parts of a country. Exactly how misleading depends on cost-of-living differentials.

This paper describes a method for representing income and poverty differences within a country more accurately than those based on money income measures. Focusing on the cost of basic requirements of food and nonfood categories, a cost index of a basket typically consumed by the poor is built up. To bring out the importance of doing so, the index is used to deflate money estimates into real estimates. The cost-of-living index is also combined with income estimates to obtain measures of regional differences in poverty which are more accurate than those based on money income estimates. The country studied is Peru.

The empirical analysis is based on a countrywide budget survey called ENCA conducted by Peru's Ministry of Agriculture in 1971-1972 but published after 1975 [9]. Using information given by this survey, per

¹This paper is part of a larger study I did at the World Bank [14] in cooperation with Peru's Ministry of Economics and Finance. The study would not have been possible without the advice and support of Carlos Amat y Leon Chavez and his research group at the Ministry, and Douglas Keare, John English, and Elkin Chaparro at the World Bank. I acknowledge assistance from Nelson Valverde, John I ask, and Joni Shaio, and helpful comments from Enrique Lerdau, George Tolley, and R.T. Hard Webb. The views expressed are those of the author and not necessarily those of the World Bank Group.

²The data given in this paper were obtained from the ENCA tapes by the kind courtesy of the Ministry of Economics and Finance and are given in a World Bank Working Paper, No. 108.
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capita income and expenditure are derived. In general, reported income (adjusted for income in kind) is lower than expenditure, especially for low-income groups in rural areas. This divergence perhaps reflects the failure of the sampling method to fully record seasonal fluctuations in income. Given this drawback, the paper relies on data on consumption expenditures rather than income. Expenditure data on food are broken down into specific categories and indicate both price and quantity. Data are also provided on consumption of home-produced food and it is therefore possible to estimate the money value of this element of income. Expenditure data on the main nonfood categories are available; however, they are not broken down into prices and quantities.

ENCA classifies Peru into nine subregions. For ease of exposition, the regional comparisons reported in this paper will be confined to a four-region classification consisting of Lima, Coast (excluding Lima), Sierra, and Selva containing, respectively, 23, 22, 45, and 10% of the country’s population. To highlight the urban/rural differences, the paper also focuses on three distinct areas, differing in degree of urbanization. These areas are (i) Lima, the largest urban center, (ii) Urban Coast, the relatively built-up urban centers in the Coast except Lima (9% of the national population), and (iii) Rural Sierra, representing about the most rural situation in Peru (29% of the national population).

1. SPATIAL DIFFERENCES IN LIVING COSTS

To correct money expenditures for spatial price differences and provide measures of actual consumption levels, regional consumer price indices are required. The price index for any region $j$ may be written as follows (Meesook [6]):

$$P_j = \frac{\sum_{i=1}^{n} X_{im}P_{ij}}{\sum_{i=1}^{n} X_{im}P_{im}} \cdot 100,$$

where $X$ and $P$ are quantities and prices, respectively, $i$ are commodities, and $m$ defines a region whose characteristics represent the national average. The above price index rewritten in terms of relative prices, using

273. The basic information has now been published by the Ministry of Agriculture and the Ministry of Economics and Finance.
expenditure weights instead of quantity weights, is given below:

\[ P_j = \frac{\sum_{i=1}^{n} X_{im} P_{im} \left( \frac{P_{ij}}{P_{im}} \right)}{\sum_{i=1}^{n} X_{im} P_{im}} \cdot 100 \]

\[ = \frac{\sum_{i=1}^{n} X_{im} P_{im} \left( \frac{P_{ij}}{P_{im}} \right)}{\sum_{i=1}^{n} X_{im} P_{im}} \cdot 100. \] (2)

Using data on prices and average shares of the various commodities in total expenditure, an overall price index for each region of Peru is calculated. First, the absolute prices of major food categories, taken from the ENCA survey, are converted into relative prices with national average prices taken as 100 for each commodity. The relative prices of the various food commodities are weighted according to the importance of the commodities in the budget to give a price index of food items. For simplicity, the national average expenditure weights are assumed for all regions. Next, a nonfood price index, again with national average prices taken as 100, is calculated based on data on nonfood expenditure. Finally, using the shares of food and nonfood in the budget of the national average family, the two price indices for food and nonfood are combined into an overall price index for each region. The use of national expenditure weights as opposed to regional weights simplifies the procedure tremendously, while not affecting the results significantly.

Ideally, consumer price indices should allow us to compare regional differences in the cost of achieving a certain level of utility. If people and locations were identical, a given basket of goods and services could be assumed to provide the same level of utility. Realistically, however, people’s needs and tastes, as well as the quality of goods and services, vary from place to place, and it is thus difficult to define baskets of goods and services that are appropriate across a whole country, or to argue that such baskets provide the same level of utility.

**A Food Price Index**

Some of these problems may not arise in the case of food, since nutrition levels can be defined in terms of calories and proteins. One can calculate a food price index that reflects differences in the cost of achieving a certain level of nutrition recommended for each location. Of course, a variety of food baskets differing in their compositions, and hence prices and perhaps in utility, can provide the recommended level of nutrition. Ideally, perhaps,
a separate basket should be priced for each location that represents the revealed preferences of the poor in that location.

In this paper, however, the same food basket is used for all locations. This basket consists of the items consumed by Rural Sierra’s people at the 20th percentile in the income range. The quantity of food in the basket is adjusted to meet the nutritional levels recommended for each location by Peru’s National Planning Institute [12]. A different food basket representing the preferences of the poor for each location was not used, because data were available only for Lima, Urban Coast, and Rural Sierra. To the extent that the particular basket used is not revealed as preferred uniformly across locations, the cost differences derived on its basis will be exaggerated.

A Nonfood Price Index

Measuring and pricing the consumption of services and commodities other than food raises problems that will be met in most attempts to compare living standards within countries. Data on nonfood expenditures are frequently available from household budget surveys for a number of locations, but the quantities consumed may not be reported, or the commodity specifications may be poor, or inconsistent with the available price data. Even if some quantity estimates are available, “minimum requirements” of nonfood items are hard to define and measure, and as a result, regional variation in needs is difficult to assess. Quality differences of nonfood items are similarly hard to account for. If price data are available for at least some of the main nonfood categories like housing, clothing, and transportation, one may attempt to define “comparable” quantity units and build a nonfood price index directly on this basis. Peruvian data on nonfood prices do not permit this.

Given these difficulties, a nonfood price index may be calculated using some relationships of the Slutsky equation as presented by McCloskey [5] from data on nonfood expenditure. A detailed derivation is given in the Appendix. In the approach used, it is assumed that regional expenditure data refer to equivalent baskets of goods and services. In reality, however, considerable quality differences exist; because of this, it would have been better, had the data permitted, to construct the price indices on the basis of expenditure data for groups at similar positions in the income distribution. The approach used in this paper is to think of differences in mean expenditures in any location from the country’s average expenditures as the product of a price difference and quantity difference. The quantity difference is then explained in terms of a price difference and an income difference in a location compared to the national average.

The index for any region \(j\) is constructed with region \(m\), whose per capita nonfood expenditure represents the national average, as a base. Any
divergence in the nonfood expenditure of region \(j\) from the national average arises from both a price difference and a quantity difference for a uniform basket of nonfood items. \(N\) denotes the nonfood items; \(P\) and \(X\) again denote price and quantity, respectively. Let \(P^N_j\) be the average price of nonfood items in region \(j\), weighted according to the proportions of the different items in regional nonfood expenditures, and let \(X^N_j\) be the average quantity of nonfood items consumed in region \(j\). The ratio between the average annual per capita expenditure on nonfood items \(Z_j\) in any region \(j\), and the national average, \(Z_m\), is then given by

\[
\frac{Z_j}{Z_m} = \frac{P^N_j X^N_j}{P^N_m X^N_m}.
\]

Assuming that all regions have common price and income elasticities and common proportions of food and nonfood in total expenditure, any quantity difference between region \(j\)'s nonfood consumption, \(X^N_j\), and the national average, \(X^N_m\), can be attributed to interregional differences in income, \(Y\), and in the weighted average nonfood prices, \(P^N\), between \(m\) and any \(j\). Thus

\[
X^N_j = X^N_m + \frac{dX^N_m}{dY_m} \Delta Y + \frac{dX^N_m}{dP^N_m} \Delta P^N,
\]

where \(\Delta Y = Y_j - Y_m\), and \(\Delta P^N = P^N_j - P^N_m\). \(dX^N_m / dY_m\), the change in the average equilibrium quantity of nonfood consumption divided by the change in mean income, given prices, can be rewritten as

\[
\frac{dX^N_m}{dY_m} = \eta_Y \frac{X^N_m}{Y_m},
\]

where \(\eta_Y\) is the income elasticity of the quantity of nonfood consumption. Similarly, \(dX^N_m / dP^N_m\) is the change in the equilibrium quantity of nonfood consumption divided by the change in the price of nonfood, given mean income. It can be rewritten as

\[
\frac{dX^N_m}{dP^N_m} = \eta_p \frac{X^N_m}{P^N_m},
\]

where \(\eta_p\) is the own-price elasticity of the quantity of nonfood consump-
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Thus, the difference in quantity of nonfood consumption between regions \( j \) and \( m \) can be expressed according to (i) the interregional difference in income multiplied by the national average income elasticity of expenditures on nonfood, and (ii) the interregional difference in price (this is to be solved for) multiplied by the national average nonfood price elasticity.

The income elasticity of nonfood consumption, \( \eta_Y \) in Eq. (5) and the own-price elasticity of nonfood consumption, \( \eta_p \) in Eq. (6) cannot be estimated from nonfood expenditure data. However, certain known relationships exist between the nonfood elasticities and the corresponding elasticities for food items as shown by McCloskey [5]. The latter may be calculated from data on average income, and quantities and prices of food. Using these relationships, (5) and (6) may be substituted into (4), giving the equation

\[
X_j^N = X_m^N + \frac{X_m^N}{Y_m} \left( 1 - S_m^F \sigma_Y \right) \frac{1}{S_m^N} \Delta Y \\
+ \frac{X_m^N}{P_m^N} \left[ - S_m^N - S_m^F \left( \sigma_p - S_m^F \sigma_Y \right) - S_m^N \sigma_Y \right] \frac{1}{S_m^N} \Delta P, \tag{7}
\]

where \( S^F \) and \( S^N \) are the shares of food and nonfood in total expenditure, and \( \sigma_Y \) and \( \sigma_p \) are national average income and own-price elasticities of the quantity of food for the nation. Substituting (7) into (3), an expression may be derived for \( P_j^N \):

\[
P_j^N = Z_j + \left[ X_m^N + \frac{X_m^N}{Y_m} \left( 1 - S_m^F \sigma_Y \right) \frac{1}{S_m^N} \Delta Y \\
+ \frac{X_m^N}{P_m^N} \left[ - S_m^N - S_m^F \left( \sigma_p - S_m^F \sigma_Y \right) - S_m^N \sigma_Y \right] \frac{1}{S_m^N} \Delta P \right]. \tag{8}
\]

\( \sigma_Y \) and \( \sigma_p \) may be computed by regressing logs of average quantities of food consumption on prices of food items and mean income levels. In order to calculate the \( P_j \)'s, Eq. (1) is normalized assuming that \( P_m^N = 100 \) and \( X_m^N = Z_m / 100 \). The required regional nonfood price indices will then be given by the ratios \( P_j^N / P_m^N \).

**Results**

The typical diet of the poor in Rural Sierra is much more expensive in urban areas: 3943 soles per capita per year in Lima, and 3470 soles in Urban Coast, as opposed to 2650 soles in Rural Sierra. Among the three regions, the Coast shows the highest cost for this food basket: 3344 soles,
compared to 2745 in the Sierra and 3060 in the Selva. The national average cost is 3155 soles per capita per year. Table 1 presents these cost estimates in the form of a price index for a "typical" food basket.

To calculate the costs of items other than food, using Eq. (8), the income and price elasticities of food items ($\sigma_Y$ and $\sigma_p$) were calculated from the ENCA data, at 0.7 and -0.4, respectively. The results are not very sensitive to alternative values of these elasticities (Weisskoff [17]). Food and nonfood items each accounts for about half the total budget in the country as a whole so that 0.5 was used for $S^F_m$ and $S^N_m$. Alternative values for the share of food were also tried, based on expenditure patterns at the 20th percentile: 0.8 as in Rural Sierra, and 0.65 as in Urban Coast. These do not alter the results greatly. The use of national expenditure weights as opposed to regional weights simplifies the procedure tremendously while not affecting the results significantly.

The use of a national average income elasticity indicates the quantities that would be consumed in a hypothetical "average" location, at various levels of income. It will not fully identify differences in the quantity consumed in a particular place that arise due to location-specific needs. The procedure used in this paper, for instance, will not fully reflect that part of urban people's higher consumption arising purely due to their being city dwellers—for example, the larger quantities consumed of transportation, clothing, and safety devices. Such quantity differences, beyond those in the "average" location, will instead become part of the price differences. This feature of our method is reasonable insofar as this type of quantity differences does not enhance welfare (e.g., urban dwellers are not better off because they travel more). If, on the contrary, it contributes to welfare, the price index as calculated in this paper for urban areas will be biased upwards.

The nonfood price index shown in Table 1 varies systematically among the Coast, the Sierra, and the Selva. Prices are highest in Lima and the Coast, followed by the Selva and the Sierra. They increase with the degree of urbanization: nonfood prices in Lima appear to be over 25% higher

| Table 1 |
|---|---|---|---|---|---|---|
| **Estimated Spatial Price Indices—Peru (1971)** |
| **Food: a typical diet** | Peru | Lima | Coast | Sierra | Selva | Urban Coast | Rural Sierra |
| | 100 | 125 | 106 | 87 | 97 | 110 | 84 |
| **Nonfood: Based on Eq. (8)** | 100 | 157 | 102 | 72 | 97 | 125 | 56 |
| **Overall: Weighted average of food and nonfood** | 100 | 141 | 103 | 79 | 97 | 118 | 70 |
| **Based on minimum wage** | 100 | 140 | 106 | 79 | 99 | 104 | 72 |
than in other big cities in the Coast and about three times those in the
villages of the Sierra.

The overall price index in Table 1 is a weighted average of the first two
lines in the same table, as expressed in Eq. (2). The weights are the shares
of food and nonfood in national expenditure. There exist considerable
price differences between the Coast, the Sierra, and the Selva, and, not
surprisingly, the urban areas in general seem to be more expensive to live
in. (Izraeli [4]).

In an alternative attempt to construct a price index, information on the
minimum wage established by Peru's Ministry of Labor was used. The last
row in Table 1 presents the minimum-wage estimates in the form of an
index with a national average of 100 as a base. This index shows dif-
fferences between Lima and Rural Sierra, and between the Coast, the
Sierra, and the Selva, which are remarkably similar to the previous results.
To the extent that minimum wage differentials accurately reflect the
income levels required to achieve comparable levels of living across loca-
tions, they strengthen our earlier results.

II. MONEY MEASURES VERSUS REAL MEASURES

To bring out the significance of the cost-of-living differentials estimated
in the previous section, two types of comparisons are made. First, money
expenditures are deflated by the price indices to obtain more accurate
measures of well-being across locations in Peru. Second, a national poverty
threshold is deflated by the price indices to provide a better basis for
measuring spatial differences in poverty.

Money and Real Expenditure

Annual per capita money expenditures and their breakdown between
food and nonfood are given in Table 2. Mean expenditure differs consid-
erably across locations within Peru. They vary systematically with respect
to the degree of urbanization. The average consumption expenditure in
Lima is nearly twice and in Rural Sierra is about half as much as the
national average. Within total expenditure, nonfood items account for
much more of the spatial differences than food items. Average total
expenditure per capita in Urban Coast is 2.28 times as high as that in
Rural Sierra, but food accounts for only 47% of this expenditure in Urban
Coast compared with 65% in Rural Sierra. As a result, the average nonfood
expenditure in Urban Coast is 3.5 times as high as that in Rural Sierra,
whereas the differential for food expenditures is only 1.64. Housing and
transportation expenditures account for much of this differential. Expendi-
tures on these location-specific items are proportionately higher in the
more urbanized locations (Tolley [15]). Together, they make up 29% of the
TABLE 2
Annual per Capita Expenditure (Soles) — Peru (1971)

<table>
<thead>
<tr>
<th>Region</th>
<th>Peru</th>
<th>Lima</th>
<th>Coast</th>
<th>Sierra</th>
<th>Selva</th>
<th>Urban Coast</th>
<th>Rural Sierra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>8558</td>
<td>16462</td>
<td>8412</td>
<td>5228</td>
<td>7041</td>
<td>10023</td>
<td>4404</td>
</tr>
<tr>
<td>Percentage in total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>48</td>
<td>35</td>
<td>55</td>
<td>60</td>
<td>54</td>
<td>47</td>
<td>65</td>
</tr>
<tr>
<td>Nonfood</td>
<td>52</td>
<td>65</td>
<td>45</td>
<td>40</td>
<td>46</td>
<td>53</td>
<td>35</td>
</tr>
<tr>
<td>Housing</td>
<td></td>
<td>17</td>
<td>10</td>
<td>6</td>
<td>7</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
<td>12</td>
<td>4.5</td>
<td>4.1</td>
<td>5.6</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Ratio of NF/F expenditures</td>
<td>1.1</td>
<td>1.9</td>
<td>0.82</td>
<td>0.66</td>
<td>0.85</td>
<td>1.1</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Source: Calculated from ENCA 1971.

The price indices estimated in Section I may be used to deflate the money expenditures to obtain estimates of real expenditures. Table 3 shows the results of so doing, and compares the real expenditures with the money expenditures. Measured in this way, the interregional differences in consumption appear much smaller and the rural parts of the country appear less disadvantaged. Compared to a differential of 3.74:1 in money expenditures, the ratio of deflated per capita total expenditure in Lima to that in Rural Sierra is 1.93:1. Similarly, a differential of 3.15:1 in money expenditures in Lima, compared to 19% in Urban Coast and only 8% in Rural Sierra.

TABLE 3
Actual and Deflated Expenditure — Peru (1971)*

<table>
<thead>
<tr>
<th>Region</th>
<th>Peru</th>
<th>Lima</th>
<th>Coast</th>
<th>Sierra</th>
<th>Selva</th>
<th>Urban Coast</th>
<th>Rural Sierra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>4129</td>
<td>5735</td>
<td>4627</td>
<td>3137</td>
<td>3802</td>
<td>4713</td>
<td>2880</td>
</tr>
<tr>
<td>Nonfood</td>
<td>4429</td>
<td>10727</td>
<td>3785</td>
<td>2091</td>
<td>3239</td>
<td>5310</td>
<td>1524</td>
</tr>
<tr>
<td>Total</td>
<td>8558</td>
<td>16462</td>
<td>8412</td>
<td>5228</td>
<td>7041</td>
<td>10023</td>
<td>4404</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region</th>
<th>Peru</th>
<th>Lima</th>
<th>Coast</th>
<th>Sierra</th>
<th>Selva</th>
<th>Urban Coast</th>
<th>Rural Sierra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflated***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>4129</td>
<td>4588</td>
<td>4365</td>
<td>3564</td>
<td>3920</td>
<td>4285</td>
<td>3190</td>
</tr>
<tr>
<td>Nonfood</td>
<td>4429</td>
<td>6832</td>
<td>3711</td>
<td>2904</td>
<td>3339</td>
<td>4248</td>
<td>2721</td>
</tr>
<tr>
<td>Total</td>
<td>8558</td>
<td>11420</td>
<td>8076</td>
<td>6468</td>
<td>7259</td>
<td>8533</td>
<td>5911</td>
</tr>
</tbody>
</table>

*In soles per capita/year.
**From ENCA Survey (1971).
***Actual expenditures on Food, Nonfood and the Total divided by, respectively, the first, second, and third rows in, Table 1.
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expenditure between Lima and the Sierra as whole implies only a differential of 1.77:1 in real terms.

The differentials in the expenditure on food in real terms is considerably less than those indicated by the expenditures in money terms. Table 4 presents these differentials in the form of indices with the national average as a base. While the money measures suggest that people in Lima consume 39% more and the Sierra 24% less food that the national average, the real expenditure measures tell a different story: those in Lima consume 11% more and those in the Sierra 14% less food than the national average. The latter estimates in real terms are much closer to measures of nutritional levels achieved in these regions. For instance, people in Lima on the average satisfy 11% higher and those in the Sierra 6% lower caloric needs compared to the national average. These measures underline the importance of applying spatial price differences to food consumption expenditure data to obtain real differentials.

Compared to food, the differentials in nonfood consumption are reduced even more by going from a money measure to a real measure. The ratio of money expenditure on nonfood between Lima and Urban Coast and between Lima and Rural Sierra are, respectively, 2:1 and 7:1; the same in real terms are, respectively, only 1.6:1 and 2.5:1. It is clear that a significant part of the urban expenditure in Peru should be attributed to the higher price of nonfood categories. Judging from the breakdown of nonfood expenditure in Table 2, it appears that the urban dwellers, compared to the rural people, spend much more on location-specific items like housing and transportation. Typically, the prices of these items rise with the increase in the degree of urbanization. Unless these price differences are corrected for, urban people would appear to be better off than they really are.

It may be concluded that although Lima and the coastal region show a higher mean assumption in general than the rest of the country, these

<table>
<thead>
<tr>
<th>Table 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indices of Food Consumption—Peru (1971)</td>
</tr>
<tr>
<td>Region</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Peru</td>
</tr>
<tr>
<td>Money expenditure</td>
</tr>
<tr>
<td>Real expenditure</td>
</tr>
<tr>
<td>Calories</td>
</tr>
</tbody>
</table>

*aMoney Expenditure divided by row 1, Table 1.
*bFrom Thomas [14, p. 29].
differences are less than are implied by differentials in money expenditures. Only a part of the spatial differences shown in Table 1 is due to quantity differences; the remaining part is simply due to differences in living costs.

Implications for Poverty Measures

Spatial differences in living costs have serious implications for the measurement of the extent and location of poverty. An "absolute" measure of poverty level is the cost of buying a basket of "minimum" requirements of food and nonfood categories (see Chiswick [2], Faber and Musgrove [3], Orshansky [7], [8]). USHEW [16]). One approach to measuring poverty is to compare such a poverty threshold to actual income (or expenditure) distributions across locations to obtain the percentage of population that fall below the poverty line.

In the absence of spatial price indices, a single countrywide poverty line is usually used to measure poverty. By so doing, one tends to give a misleading picture of poverty by overstating spatial differences, in general overestimating rural and underestimating urban poverty. Row 1 in Table 5 presents one estimate of an "absolute" poverty level, built up from the cost at the national mean of buying certain "basic requirements" of food and nonfood items (for details see Thomas [14]). By comparing with the income distribution data for Peru [10, 11], the percentage of people below that poverty line is obtained (row 2). Spatial differences in poverty on this basis are sharp; while only about 4% of Lima's population are poor according to this estimate, more than 50% in Rural Sierra fall in that category.

In contrast to the countrywide poverty line, row 3 in Table 5 shows location-specific poverty lines obtained using price indices for food and

| TABLE 5 |
|---|---|---|---|---|---|---|
| Regions | Peru | Lima | Coast | Sierra | Selva | Urban Coast | Rural Sierra |
| 1. National poverty line | 4575 | 4575 | 4575 | 4575 | 4575 | 4575 | 4575 |
| 2. Percentage below | 28.0 | 3.8 | 19.2 | 42.5 | 29.4 | 9.6 | 53.4 |
| 3. Location-specific poverty line | 4575 | 6172 | 4792 | 3767 | 4437 | 5245 | 3445 |
| 4. Percentage below | 28.0 | 8.1 | 20.5 | 35.8 | 28.6 | 12.3 | 41.4 |
| 5. Minimum wage | 4767 | 6658 | 5100 | 3765 | 4753 | 4956 | 3445 |
| 6. Percentage below | 28.5 | 9.8 | 22.4 | 35.8 | 30.5 | 10.7 | 41.4 |

*(Soles per capita/year)*
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nonfood. On this basis the spatial differences in the percentage of population below the poverty line are much less (row 4 compared to row 2). For instance, 8% of people in Lima are now classified as poor while people in that category in Rural Sierra decline to 41%. Table 5 also shows the minimum wage figures provided by Peru’s Ministry of Labor (see Table I also). The percentage of population below the minimum wage in each location is remarkably similar to that under the location-specific poverty line. To the extent that the minimum wage reflects the cost of purchasing a basket of basic requirements in each location, the results based on it support the use of the spatial price indices, as developed in this paper, to measure poverty.

The poverty measure defined as the percentage of population below the poverty line does not fully reflect the extent of poverty. A better measure combines the percentage of poor with the magnitude by which they, on the average, fall short of the poverty line. Sen [13] has developed such an index of poverty and Anand [1] has further clarified its use. Thomas [14] applies such an index of poverty, first using the single nationwide poverty line and then the location-specific ones. The wide differences in the incidence of poverty based on a single poverty threshold are once again significantly reduced by the use of location-specific poverty lines. Consequently, the implied benefits of locating in Lima and the Coast, in contrast to the other regions and rural areas, are reduced.

APPENDIX: A NONFOOD PRICE INDEX

A more detailed derivation of the nonfood price index than that in the text is presented here. The following notations are used:

\[ P \] weighted average price of nonfood
\[ X \] average quantity of nonfood
\[ Z \] average nonfood expenditure

\[ I = N_p / N \times (Y^* - Y_P / Y^*) \]

where \( N \) is the total population, \( N_p \) the number of people below the poverty line, \( Y^* \) the poverty line, and \( Y_P \) the mean income of the poor.

It should be pointed out that the spatial price indices given in this paper do not reflect the differences in the availability of items that are not purchased, for instance, some public goods and services. There exist considerable disparities in the availability of public services in Peru. The rural areas in comparison to the urban centers lack these amenities. If one were to construct an index of availability of these items, the implied differences in their “cost” would probably be substantial, the rural areas displaying a higher “cost” than the urban centers. Depending on the imputed share of public services in total expenditure, therefore, some of the spatial differences in the living costs as presented in this paper would be reduced, and, as a result, the differentials in our earlier measures of real income and poverty between urban and rural areas increased accordingly.
$Y$ mean money income
$E$ mean expenditure
$\eta_Y$ income elasticity of nonfood
$\eta_p, \eta_p^1$ uncompensated own price elasticity and cross price elasticity of nonfood
$\sigma_Y$ income elasticity of food
$\sigma_p, \sigma_p^1$ uncompensated own price elasticity and cross price elasticity of food
$\epsilon_p, \epsilon_p^1$ compensated own price elasticity and cross price elasticity of food
$S^F$ share of food in total expenditure
$S^N$ share of nonfood in total expenditure

$m$ refers to a national average, $j$ refers to a region, and $\Delta$ indicates a differential between $j$ and $m$. $F$ and $N$ indicate food and nonfood, respectively.

\[
\frac{Z_j}{Z_m} = \frac{P_j^N X_j^N}{P_m^N X_m^N}, \quad (i)
\]

\[
X_j^N = X_m^N + \frac{dX_m^N}{dY_m} \Delta Y + \frac{dX_m^N}{dP_m^N} \Delta P_m^N, \quad (ii)
\]

\[
\frac{dX_m^N}{dY_m} = \eta_Y \frac{X_m^N}{Y_m}, \quad (iii)
\]

\[
\frac{dX_m^N}{dP_m^N} = \eta_p \frac{X_m^N}{P_m^N}. \quad (iv)
\]

In converting $\eta_Y$ and $\eta_p$ into their corresponding $\sigma_Y$ and $\sigma_p$, the following steps are used. The budget constraint for a two-good world of food and nonfood is

\[
E = P^FX^F + P^NX^N. \quad (v)
\]

Differentiating (v) with respect to $E$, holding prices constant,

\[
\frac{dE}{dE} = P^FX^F + P^NX^N. \quad (vi)
\]

This can be rewritten as

\[
1 = S^F \sigma_Y + S^N \eta_Y, \quad (vii)
\]
hence

\[ \eta_y = \left(1 - S^F \sigma_y \right) \frac{1}{S^N}. \]  

(viii)

Similarly, differentiating (v) with respect to \( P^N \), holding \( P^F \) and \( E \) constant,

\[ \frac{dE}{dP^N} = X^F \frac{dP^F}{dP^N} + P^F \frac{dX^F}{dP^N} + X^N \frac{dP^N}{dP^N} + P^N \frac{dX^N}{dP^N}. \]  

(ix)

Multiplying both sides of (ix) by \( P^N/E \) and rearranging terms,

\[ \eta_p = \left( -S^N - S^F \sigma_1 \right) \frac{1}{S^N}. \]  

(x)

But

\[ \sigma^1_p = \epsilon^1_p - S^N \sigma_y. \]  

(xi)

Further,

\[ \epsilon_p = -\epsilon^1_p. \]  

(xii)

And

\[ \epsilon_p = \sigma_p + S^F \sigma_y. \]  

(xiii)

Substituting (xiii) and (xi) into (x)

\[ \eta_p = \left[ -S^N - S^F \left( -\sigma_p - S^F \sigma_y \right) - S^N \right] \frac{1}{S^N}. \]  

(xiv)

Substituting (viii) and (xiv) into (iii) and (iv), and into (ii), Eqs. (7) and (8) in the text are derived.

REFERENCES

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