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# Robust Poverty and Inequality Measurement in Egypt: Correcting for Spatial-price Variation and Sample Design Effects

*Dean Jolliffe, Gaurav Datt, and Manohar Sharma**

## Abstract

The paper estimates inequality and absolute poverty in Egypt for 1997 with measures that are robust to sample design effects and corrected for spatial variation in price levels. Standard errors for inequality indices are calculated using a bootstrap approach which replicates the sample design. Standard errors for poverty indices are corrected for the design effects resulting from sample stratification and clustering. The authors use data from the Egypt Integrated Household Survey and follow the cost-of-basic-needs methodology to construct region-specific poverty lines. It is found that 15.7 million people were poor in Egypt in 1997, or 26.5% of the population. The estimates indicate a sharp sectoral difference with rural areas being significantly poorer, but significant differences in poverty were not found between Upper and Lower Egypt. This finding differs substantially from the conventional wisdom that Upper Egypt is poorer than Lower Egypt and results from the correction for spatial-price variation.

## 1. Introduction

In 1990, the World Bank asserted that poverty reduction was the fundamental objective of economic development. This emphasis on poverty reduction continues, and the World Bank (2000a) recently stated that fighting poverty is at the center of all work that they do. Before policies can be designed and implemented for poverty reduction, it is first necessary to identify who is poor. The aim of this paper is to identify the poor and measure the level of inequality in Egypt in 1997. The source of data for this analysis is the 1997 Egypt Integrated Household Survey (EIHS) and the key measure of individual welfare is total consumption per person.

Poverty lines are constructed following a cost-of-basic-needs methodology for five regions of Egypt, and the regional variation in these lines is used as a spatial-price index. There are significant differences in the cost of living across regions of Egypt and we illustrate the importance of correcting for spatial-price variation when measuring poverty. An important characteristic of the EIHS, as with most nationally representative household surveys, is that the sample was not collected in a simple random draw (or, in other words, a single-stage random draw as considered in most introductory statistics textbooks), but rather in a multistage draw from the population. The implication of this is that conventional standard errors for poverty indices can significantly

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* Jolliffe: Economic Research Service, US Department of Agriculture, 1800 M Street NW, Washington, DC 20036, USA. Tel: 202-694-5430; Fax: 202-694-5642; E-mail: jolliffe@ers.usda.gov. Datt: The World Bank, Level 18, 14 Martin Pl., Sydney NSW 2000, Australia. Tel: (61-2) 9235-6533; Fax: (61-2) 9223-2533; E-mail: gdatt@worldbank.org. Sharma: International Food Policy Research Institute, 2033 K Street NW, Washington, DC 20006, USA. Tel: 202-862-8142; Fax: 202-467-4439; E-mail: m.sharma@cgiar.org. We wish to thank Akhter Ahmed, Dowoud Al-Husseini, Heba El-Laithy, Fatma El-Zanaty, Lehman Fletcher, Lawrence Haddad, Akila Hamza, Amina Hegazy, Nelly Shaheen, Ayman Tawfik, and Maged El Wakkad. The authors are solely responsible for any errors. Work for this paper was partially funded by USAID grant 263-G-00-96-00030-00. The views and opinions expressed in this paper do not necessarily reflect the views of the Economic Research Service of the US Department of Agriculture.

understate the true sampling variance. We provide robust measures of sampling error for the poverty estimates which allow us to assess whether observed differences in estimated levels of poverty and inequality are statistically significant, or are artifacts of the sampling procedure.

## 2. Data and the Measure of Individual Welfare

*Egypt Integrated Household Survey*

The EIHS is a nationwide, multiple-topic household survey carried out by the International Food Policy Research Institute in coordination with the Ministry of Agriculture and Land Reclamation (MALR) and the Ministry of Trade and Supply (MOTS). Fieldwork began during the first week of March 1997 and concluded in the third week of May 1997. The questionnaire consisted of 18 sections on a series of topics which integrated monetary and nonmonetary measures of household welfare and a variety of household behavioral characteristics.

The questionnaire was administered to 2,500 households from 20 governorates using a two-stage, stratified selection process. In the first-stage of the selection process, 125 primary sampling units (PSUs) were randomly selected with probability proportional to size. The second stage of the process then entailed randomly selecting 20 households from each PSU. The design also stratified selection on the following five regions of Egypt: Metropolitan, Lower urban, Lower rural, Upper urban, and Upper rural.

The advantage of a two-stage process relative to a simple random selection process is that it dramatically reduces the scope of fieldwork and therefore reduces the cost of the survey. The disadvantage is that standard errors resulting from two-stage samples tend to be significantly larger than those resulting from simple random samples. For more information on the EIHS, including details on the field work, sample frame, list of the selected PSUs, and derivation of the weighting factors, see Datt et al. (1998).

*Total Household Consumption*

In this paper, per capita consumption is used as the measure of individual welfare. While this measure fails to incorporate some important aspects of welfare, such as consumption of publicly provided goods (including schools, health services, and public sewage), it is a useful aggregate money metric of welfare which reflects individual preferences conditional on prices and incomes.

The decision to use total expenditure rather than income as the measure of individual welfare is motivated by the following considerations. First, Atkinson (1993) notes that income can be interpreted as a measure of welfare opportunity while consumption is interpretable as a measure of welfare achievement. Since all income is not consumed, nor is all consumption financed out of income, consumption is arguably a more appropriate indicator if we are concerned with realized rather than potential welfare. Second, individuals can use savings and credit to smooth fluctuations in income, so consumption may provide a more accurate measure of an individual's welfare over time. Third, some researchers and policymakers hold the belief that survey respondents are more willing to reveal their consumption patterns than they are willing to reveal their income. Finally, in developing countries, consumption is also better measured than income because of the difficulties in defining and measuring income for the self-employed who tend to form a relatively larger proportion of the workforce in developing countries.

The measure of total consumption used in this paper draws upon several sections of the household survey. In brief, consumption is measured as the sum of total food consumption, total nonfood nondurable good expenses, estimated use-value of durable goods, and an actual or imputed rental value of housing. Below is a brief description of each of these items.

To estimate total food consumption, the survey respondent is asked a series of questions on how much the household has consumed of 123 food products over the past seven days. For each of the food items, the respondent is asked to state how much of the item consumed came from purchases, then whether the household both grew and consumed any of the food items, and then finally whether the household had received any of the food items from other sources, such as gifts. The sum of the responses to these three questions for each of the 123 food items is the primary component of food consumption. Food consumption, though, also includes the estimated value of all meals eaten away from the home by all household members over the past seven days.

Nonfood and nondurable consumption is the sum of expenditures on 45 nonfood items, including expenditures on fuel, clothing, schooling, health, cleaning items, and several miscellaneous items. For these items the respondent states how much was spent during the last month or year on the item, depending on the typical frequency of purchase.

An important component of total consumption, which is sometimes excluded from more limited definitions of consumption, is the use-value of durable goods. The survey respondents are asked a series of questions about 22 durable goods, and an estimated use-value of these goods is constructed by first estimating the current value of the item. Most respondents provided estimated current values for their durable goods as well as the value when obtained, but some people were able to provide only the value of the item when they purchased it. Using the responses from those individuals who answered both the current and initial value, as well as the age of the item, it is possible to estimate an average rate of depreciation for each durable good. This estimate of item-specific depreciation rates is used with the information on the age of the item to predict a current value of durable goods for those who couldn't provide these estimates.

Responses from a section of the survey on credit and savings are used to estimate a nominal rate of interest which is the final piece of information needed to estimate a use-value of durables. The interest rate used for this purpose is the modal rate for all loans obtained from commercial banks. For urban areas the rate of interest used is 15% and for rural areas the rate is 14%. The use-value for household $j$ of durable good $i$ is then estimated by the following formula:

$$Use\text{-}value_{ij} = Current\ value_{ij} * (r + \delta_i)/(1 - \delta_i), \tag{1}$$

where $r$ is the nominal rate of interest and $\delta_i$ is the average rate of depreciation for good $i$.

To estimate the rental value of housing, we use self-reported estimates of rent or rental value when provided, and for others we impute a value based on their housing characteristics. More precisely, for tenants we use the reported actual rent and for owners we use their self-imputed estimates of rental value. This results in a reported rental estimate for 2,264 out of a total sample of 2,500 households. For the remaining households we impute rents derived from a hedonic model of dwelling rentals. Because we want to predict rental value for a small fraction of both owner-occupied and rented dwellings, we use both actual and self-imputed rents. We then model rental value as

$$\ln R_i = \alpha + \beta'(Urban)_i + \gamma'(Gov)_i + \delta(Tenant)_i + \eta' X_i + \theta'(Tenant * X)_i + \varepsilon_i, \quad (2)$$

where $R_i$ is monthly rent (actual or self-imputed) for household $i$, $Urban_i$ is a dummy variable for urban areas, $Gov_i$ is a vector of dummy variables for individual governorates, $Tenant_i$ is a dummy variable with a value of 1 if the rent observation is reported by a tenant, and 0 if self-imputed by the owner, and $X_i$ is a vector of dwelling characteristics, including number of rooms, categorical variables identifying the type of walls, floor, roof, toilet, and source of water. The regression results are presented in Datt et al. (1998).

## 3. Poverty Lines and Measures

This paper follows the cost-of-basic-needs methodology described in Ravallion (1998) and Ravallion and Bidani (1994) to construct region-specific poverty lines. Using this approach, the total poverty line ($z$) is constructed as the sum of a food ($z^F$) and a nonfood poverty line ($z^N$). The reference poverty line varies for each of the five regions: Metropolitan, Lower urban, Lower rural, Upper urban, and Upper rural. Differences in the poverty lines reflect variations in the food and nonfood prices across the five regions. They also incorporate regional differences in the size and age composition of the relatively poor households, and their food and nonfood consumption preferences. The following details the derivation of a region-specific poverty line.

### *Minimum Caloric Requirements*

An initial step in defining the food poverty line is the construction of a minimum food basket, which can be anchored to some normative nutritional requirements. We first estimate minimum caloric requirements for different types of individuals. Using tables from the World Health Organization (WHO, 1985), caloric needs are separately specified for urban and rural individuals, by sex and 13 age categories. For individuals over 18 years of age, WHO's recommended daily allowances are differentiated by weight and activity levels. The estimates used in this paper assume the average weight of men over 18 years of age is 70 kilograms and for women it is assumed to be 60 kilograms. Urban individuals are assumed to need 1.8 times the average basal metabolic rate (BMR) and rural individuals are assumed to need 2.0 times the average BMR. These assumptions appeared reasonable for the Egyptian context. See Datt et al. (1998, Table 1) for a list of the specific caloric needs used to generate the minimum food basket used in the definition of the poverty line.

With the caloric requirements defined for the various age and sex categories, the next step is to estimate the average composition of households within each stratum. For the bottom 50% of the households in the entire sample (ranked by nominal per capita consumption), average household composition is constructed for each of the five regions. In other words, the EIHS data are used to estimate the number of people within each age–sex category for the average *relatively poor* household from each of the five regions, and the relatively poor are defined as those households with consumption levels less than the sample median. These average household characteristics for each region are then mapped to the caloric needs for each age–sex category which results in the region-specific minimum requirements for the typical relatively poor household. The estimated minimum per capita caloric needs thus build in differential requirements for different age–sex categories and also reflect differences in household composition across regions. The minimum per capita caloric requirements used to estimate the poverty lines are: 2,430 for Metropolitan; 2,360 for Lower urban; 2,499 for Lower rural; 2,380 Upper urban; and 2,431 for Upper rural.

### *Typical Food Bundle of Relatively Poor Households*

Once the minimum caloric needs have been estimated, the next step is to determine how costly it is to obtain this level of calories. We determine the cost of the calories using EIHS data on how they are obtained on average by poor households, rather than by pricing out the cheapest way of obtaining the calories or following a recommended diet. Within each region, the average consumption level for each of the 123 food items is estimated for those households with total expenditure less than the sample median. Datt et al. (1998) list in detail the grams, calories, and cost of these five region-specific food bundles, which reflect average consumption levels of the relatively poor households.

These average food bundles may contain more or less calories than the normative requirements for each of the five regions determined above. The food poverty lines are then derived by the following equation:

$$z^f = \frac{\text{Minimum caloric requirement}}{\text{Calories in average food bundle of poor households}} * \begin{array}{c}\text{Cost of the average}\\ \text{food bundle.}\end{array} \tag{3}$$

In other words, the food poverty line is the product of the minimum caloric requirement and the average cost of a calorie in the average food bundle of the relatively poor person. The region-specific estimates are listed in Table 1. These food poverty lines reflect average differences in prices, household composition, and consumption preferences across the five regions.

### *Minimum Nonfood Consumption of Relatively Poor Households*

While the cost of the minimum food bundle is derived from estimated physiological needs, there is no equivalent methodology for determining the minimum nonfood bundle. In this paper we follow two methods for determining the nonfood bundle, one of which is used for our reference poverty line and the other we use for a more extreme poverty line. For the reference poverty line, the cost of basic nonfood consumption is defined as the amount of nonfood spending by the typical household whose per capita expenditure on *food* is just equal to the food poverty line. Thus, if $x^N$ is per capita

*Table 1. Reference and Extreme Poverty Lines*

| | *Average cost of calorie* | *Food poverty line* | *Reference poverty line* | *Extreme poverty line* | *Relative price index* |
|---|---|---|---|---|---|
| Metropolitan | 0.678 | 50.18 | 129.19 | 75.36 | 1.000 |
| Lower urban | 0.639 | 45.94 | 101.72 | 67.52 | 0.787 |
| Lower rural | 0.582 | 44.29 | 85.38 | 64.76 | 0.661 |
| Upper urban | 0.624 | 45.19 | 101.36 | 67.51 | 0.785 |
| Upper rural | 0.545 | 40.36 | 82.81 | 53.37 | 0.641 |

*Notes*: Average calorie cost is Egyptian pounds per 1,000 calories. Poverty lines are monthly, per capita figures in Egyptian pounds. The Metropolitan poverty line is used as a base line to create the relative price index, which is the ratio of each region's reference poverty line to the base line.

expenditure on nonfood, $x^F$ is per capita expenditure on food, and $x$ is total per capita expenditure, then the nonfood poverty line can be considered as

$$z^N = E\{x^N | x^F = z^F\}. \tag{4}$$

There may well be no individual household whose per capita food expenditure is exactly equal to the food poverty line, and even if such a household were to exist, the nonfood poverty line should not be based solely on a single household's preferences for nonfood consumption. Thus, instead of using the expenditure data of a household whose food expenditure just equals $z^F$, we examine the expenditure patterns of all households whose food expenditures are in the neighborhood of the food poverty line. Using these households, the cost of the minimum nonfood bundle, $z^N$, is then estimated nonparametrically as the weighted average nonfood expenditure. In constructing the average, observations closer to $z^F$ are given a higher weight. The weighting scheme follows a kernel with triangular weights.

For the second method, the cost of basic nonfood consumption is defined as the amount of nonfood spending by the typical household whose *total* expenditure is just equal to the food poverty line. Thus, the nonfood poverty line can be determined as

$$z^N = E\{x^N | x = z^F\}. \tag{5}$$

The poverty line which results from using this definition of minimum nonfood consumption is considered in this paper to be an extreme poverty line. As with the first method, this definition of minimum nonfood expenditures is the average nonfood expenditures of those individuals whose total expenditures are in the neighborhood of the food poverty line and it is estimated using the triangular kernal method.[1] It is notable that the reference and the extreme poverty lines differ only in their allowance for basic nonfood consumption; the reference line permits a more generous allowance for nonfood consumption.

Table 1 lists by region the food poverty line, the reference and extreme poverty lines, as well as the implicit spatial-price indices. By definition, the differences observed in the poverty lines reflect different costs of obtaining minimum consumption bundles in the five regions, and thus the ratio of poverty lines reflects spatial-price differences. In this paper the poverty line for the Metropolitan region is treated as a baseline and the spatial-price index is the ratio of each region's poverty line to the poverty line for the Metropolitan region.

### *Poverty and Inequality Indices*

To examine poverty, we use three poverty measures:

(a) the headcount index ($P_0$), given by the percentage of the population in households with a consumption per capita less than the poverty line;
(b) the poverty-gap index ($P_1$), defined as the mean distance below the poverty line stated as a proportion of that line, where the mean is formed over the entire population, counting the nonpoor as having zero poverty gap;
(c) the squared poverty-gap index ($P_2$), introduced by Foster et al. (1984), and defined as the mean of the squared, proportionate poverty gaps.

While the headcount index measures the incidence of poverty, the poverty-gap index reflects the depth of poverty, as well as its incidence. The squared poverty-gap index, unlike the poverty-gap index, reflects the severity of poverty, in that it will be sensitive to the distribution of welfare among the poor. For example, a transfer from a poor person to a poorer person will not change either the headcount or poverty-gap index, but it will decrease the squared poverty-gap index.

All three poverty measures are members of the Foster–Greer–Thorbecke (FGT) class of poverty indices and can be represented as

$$p_{\alpha,i} = [\max((1 - x_i/z), 0)]^{\alpha}, \alpha \geq 0 \tag{6}$$

where $P_{\alpha,i}$ is the poverty index for individual $i$, $x_i$ is consumption level of the $i$th person in a population of size $n$, $z$ denotes the poverty line, and $\alpha$ is a nonnegative parameter. Aggregate poverty is then the mean of this measure across all persons, giving

$$P_{\alpha} = \sum_{i=1}^{n} p_{\alpha,i}/n. \tag{7}$$

The headcount index is obtained when $\alpha = 0$, the poverty-gap index is obtained when $\alpha = 1$, and the squared poverty-gap index has $\alpha = 2$.

In order to answer questions of whether poverty is worse in certain regions, estimates of the sampling variance for the indices are required. The Kakwani (1993) formula for the variance of $P_0$, the headcount index, is $P_0(1 - P_0)/(n - 1)$, where $n$ is the sample size. The formula for all other variance estimates of the FGT indices is $(P_{2\alpha} - P_{\alpha}^2)/(n - 1)$. While the Kakwani standard errors are tremendously useful, when one doesn't have access to the unit-record data, an unfortunate aspect of the estimated standard errors is that they assume the sample was collected using a simple random design. As already noted, the EIHS data have a stratified, two-stage sample design. Howes and Lanjouw (1998) present evidence that estimated standard errors for the FGT poverty indices can have large biases when erroneous assumptions are made on the nature of the sample design. In particular, they show that the Kakwani standard errors significantly underestimate the correct standard errors when the data come from a multistage sample design.

Using the program described in Jolliffe and Semykina (1999), we estimate standard errors which are corrected for the sample stratification and clustering. Kish (1995) describes the ratio of the variance corrected for the sample design to the variance assuming the sample was selected in a single-stage, random draw as the design effect. The design effect decreases as there is more heterogeneity across strata and as there is more homogeneity within a stratum. In contrast, the design effect increases as the number of clusters decreases (for a fixed sample size) and as the homogeneity within the cluster increases. For the Egyptian poverty indices, we find that the design effect ranges from approximately 3.5 to 4.5. In the case of the headcount index using the reference poverty line, the design effect is 3.5 which means that standard errors following the Kakwani formula would underestimate the correct standard errors by 187%.

To examine inequality, we use the Gini coefficient, $G$, which can be expressed as

$$G = 2/[\mu N(N-1)] \sum_i \sum_j |x_i - x_j|, \tag{8}$$

where $x$ is consumption, $\mu$ is average consumption, and $N$ is the sample size. The double summation takes the sum of all possible pairings of $x$. Since there are a total of $N(N - 1)/2$ possible pairings of $x$, $G$ is the average value of all absolute deviations between the $x$ and it is measured relative to the mean, $\mu$, of the $x$. To construct standard errors for the Gini coefficient that are robust to the design effect, we use a bootstrap procedure which replicates the sample design. For more details, see Jolliffe and Krushelnytskyy (1999).

One interpretation of the Gini is in the context of a Lorenz curve. After ranking all persons by per capita consumption, the Lorenz curve plots the cumulative percentage of total consumption (or income) on the cumulative percentage of population. A Lorenz curve which is a straight 45-degree line would then represent perfect equality where everyone had the same consumption, and the area between the 45-degree line and the Lorenz curve gives a measure of the extent of inequality. The Gini coefficient is interpretable as the ratio of the area between the actual Lorenz curve and the 45-degree line of perfect equality to the area of the triangle underneath the 45-degree line.

## 4. Poverty in Egypt

### *1997 EIHS Estimates*

Table 2 shows that the mean nominal value of per capita consumption in Egypt during 1997, as estimated from the EIHS data, is EGP173.44 (Egyptian Pounds) per month. The mean value of consumption in the urban sector is EGP228.04 per person per month, while in the rural sector it is EGP132.71. These average levels of consumption,

*Table 2. Preferred Poverty Measures by Sector, Region, and Nation: 1997*

| | *Population share* | *Mean consumption (EGP/person/month)* | | *Head-count index* | *Poverty gap index* | *Squared poverty gap index* | *Gini coefficient* |
|---|---|---|---|---|---|---|---|
| | | *Real* | *Nominal* | | | | |
| Urban | 0.43 | 260.17 | 228.04 | 23.06 | 5.65 | 2.05 | 0.37 |
| | | (12.29) | (11.23) | (2.59) | (0.77) | (0.33) | (0.02) |
| Rural | 0.57 | 203.49 | 132.71 | 29.07 | 7.46 | 2.93 | 0.32 |
| | | (6.34) | (4.13) | (2.19) | (0.89) | (0.48) | (0.01) |
| Upper | 0.37 | 236.18 | 165.44 | 27.08 | 6.95 | 2.73 | 0.37 |
| | | (10.53) | (7.60) | (2.55) | (0.83) | (0.40) | (0.02) |
| Lower | 0.63 | 222.72 | 178.13 | 26.16 | 6.53 | 2.45 | 0.33 |
| | | (8.03) | (7.25) | (2.20) | (0.83) | (0.43) | (0.01) |
| Strata | | | | | | | |
| Metropolitan | 0.19 | 250.04 | 250.04 | 26.07 | 6.72 | 2.43 | 0.37 |
| | | (20.38) | (20.38) | (4.61) | (1.35) | (0.60) | (0.03) |
| Lower urban | 0.12 | 229.08 | 180.37 | 24.20 | 5.39 | 1.95 | 0.33 |
| | | (15.25) | (12.01) | (4.23) | (1.27) | (0.56) | (0.02) |
| Lower rural | 0.32 | 204.24 | 134.98 | 26.95 | 6.85 | 2.65 | 0.30 |
| | | (8.28) | (5.47) | (2.95) | (1.35) | (0.74) | (0.02) |
| Upper urban | 0.12 | 308.63 | 242.14 | 17.05 | 4.20 | 1.50 | 0.38 |
| | | (26.99) | (21.18) | (3.96) | (1.16) | (0.47) | (0.03) |
| Upper rural | 0.25 | 202.55 | 129.84 | 31.74 | 8.23 | 3.30 | 0.34 |
| | | (9.87) | (6.33) | (3.32) | (1.11) | (0.55) | (0.02) |
| Nation | | 227.71 | 173.44 | 26.50 | 6.69 | 2.55 | 0.35 |
| | | (6.39) | (5.35) | (1.67) | (0.61) | (0.31) | (0.01) |

*Notes*: Estimates are adjusted for spatial-price variation and corrected for design effects. Standard errors are in parentheses and are corrected for both the stratification and two-stage design of the sample using Jolliffe and Semykina (1999) and Jolliffe and Krushelnytskyy (1999). Real per capita expenditure results from using the price level in the Metropolitan region as the base for the other regions.

though, fail to reflect cost-of-living differences across sectors and strata. As mentioned above, since the poverty lines incorporate differences in the cost of obtaining a minimum bundle of food and nonfood goods, the ratio of poverty lines can be interpreted as spatial-price indices for the poor.

In this paper, we use the poverty line for the Metropolitan region as a base and express real figures (those which have been adjusted for the spatial-price differences) in terms of the cost of living in the Metropolitan region. Using the reference poverty lines for different regions to make this adjustment, average real per capita expenditure at Metropolitan prices is EGP227.71 in the nation, EGP260.17 in the urban sector, and EGP203.49 in the rural sector. Not surprisingly, the gap in average real consumption levels in urban and rural Egypt is dramatically smaller than the gap in the nominal consumption levels. Nonetheless the gap is still significant and shows that, even after adjusting for cost of living differences and after correcting standard errors for design effects, on average urban individuals have significantly higher levels of living.[2]

When comparing Upper and Lower Egypt, the spatial-price adjustments have the effect of reversing the ranking of mean consumption levels. In nominal terms, average consumption in Lower Egypt is EGP178.13 per person per month which is 8% higher than average consumption in Upper Egypt where the figure is EGP165.44.[3] When adjusted for spatial-price differences, though, Upper Egypt has a higher per capita consumption level with an average value of EGP236.18 compared to EGP222.72 for Lower Egypt.[4]

The importance of the spatial-price adjustment is perhaps most readily noted by comparing the nominal and real incidence of poverty in Upper and Lower Egypt. Conventional wisdom is that Upper Egypt is significantly poorer than Lower Egypt. World Bank (1991, p. 13) notes that "Most of the governorates with a relatively high degree of poverty are found in Upper Egypt, *as expected* [emphasis added]." The Institute of National Planning (1996, ch. 2, p. 4–5) makes clear that this view persisted through the 1990s when stating that "*As it has been always indicated* [emphasis added] by different HIES [Household Income and Expenditure Surveys], there is a clear geographic distribution of poverty in Egypt. . . . Lower Egypt is relatively better off than Upper Egypt." This view of poverty is widely held and impacts policy recommendations. The Institute of National Planning (1996, ch. 4, p. 17) argues that "Upper Egypt should be a priority region for poverty reduction."

Indeed the nominal results in this paper support this view. Before adjusting for differences in the cost of living, Table 3 shows that the headcount index in Upper Egypt is 31.3. This estimate is statistically significantly greater than the nominal incidence of poverty in Lower Egypt, which is 23.6. This difference in the incidence of poverty between Upper and Lower Egypt vanishes once per capita expenditure is adjusted for spatial-price differences. Table 2 shows that in real terms the headcount index is 26.1 for Lower Egypt, which is not statistically different from the estimate of 27.1 for Upper Egypt.

Using the reference poverty lines and real per capita consumption, Table 2 shows that 26.5% of the Egyptian population (or 15.7 million persons) were living in poverty in 1997.[5] In the rural sector, which comprises about 57% of the population, 29.1% of the population were living in poverty. In the urban sector, 23.1% of the population were living in poverty. Table 2 shows that the incidence of poverty was significantly higher in rural than in urban regions, but that there was no statistically significant difference between Upper and Lower Egypt.

Table 2 also shows that the incidence of poverty was the worst in the Upper rural region where 32% of the population lived in poverty. The next worst are the Lower

*Table 3. Nominal Poverty Measures by Sector, Region, and Nation: 1997*

| | Population share | Mean consumption (EGP/person/month) Real | Nominal | Headcount index | Poverty gap index | Squared poverty gap index | Gini coefficient |
|---|---|---|---|---|---|---|---|
| Urban | 0.43 | 260.17 | 228.04 | 12.85 | 2.82 | 1.00 | 0.37 |
| | | (12.29) | (11.23) | (1.87) | (0.48) | (0.22) | (0.02) |
| Rural | 0.57 | 203.49 | 132.71 | 36.66 | 9.66 | 3.89 | 0.32 |
| | | (6.34) | (4.13) | (2.49) | (0.98) | (0.55) | (0.01) |
| Upper | 0.37 | 236.18 | 165.44 | 31.34 | 8.55 | 3.43 | 0.39 |
| | | (10.53) | (7.60) | (2.67) | (0.93) | (0.47) | (0.02) |
| Lower | 0.63 | 222.72 | 178.13 | 23.63 | 5.70 | 2.20 | 0.36 |
| | | (8.03) | (7.25) | (2.18) | (0.79) | (0.45) | (0.02) |
| Strata | | | | | | | |
| Metropolitan | 0.19 | 250.04 | 250.04 | 9.82 | 1.84 | 0.72 | 0.37 |
| | | (20.38) | (20.38) | (2.71) | (0.60) | (0.33) | (0.03) |
| Lower urban | 0.12 | 229.08 | 180.37 | 17.22 | 3.87 | 1.38 | 0.33 |
| | | (15.25) | (12.01) | (3.72) | (1.05) | (0.43) | (0.02) |
| Lower rural | 0.32 | 204.24 | 134.98 | 34.20 | 8.61 | 3.38 | 0.30 |
| | | (8.28) | (5.47) | (3.56) | (1.43) | (0.83) | (0.02) |
| Upper urban | 0.12 | 308.63 | 242.14 | 13.19 | 3.14 | 1.05 | 0.36 |
| | | (26.99) | (21.18) | (3.52) | (0.95) | (0.36) | (0.03) |
| Upper rural | 0.25 | 202.55 | 129.84 | 39.77 | 11.06 | 4.53 | 0.34 |
| | | (9.87) | (6.33) | (3.57) | (1.30) | (0.67) | (0.02) |
| Nation | | 227.71 | 173.44 | 26.50 | 6.76 | 2.65 | 0.37 |
| | | (6.39) | (5.35) | (1.68) | (0.60) | (0.33) | (0.01) |

*Notes*: Estimates are *not* adjusted for spatial-price variation. See also Table 2.

rural region with 27% of the population in poverty and the Metropolitan region with 26% of the population living in poverty. The regions with the lowest incidence of poverty are Lower urban with a headcount index of 24% and Upper urban with a headcount index of 17%. The large standard errors on these estimates suggest caution in placing too much interpretation on the rankings of the poverty measures by the five regions. For example, there is no statistically significant difference between the headcount indices for the Lower rural, Metropolitan, Lower urban, and Upper rural regions. Though, the headcount index for Upper urban is significantly different from the headcount indices for Lower rural and Upper rural.

The poverty-gap index for the nation is 6.7, which implies an average poverty deficit for the poor (the proportionate shortfall of their average consumption from the poverty line) of 25% of the reference poverty line. As with the headcount index, the poverty gap is the worst in the Upper rural region followed by the Lower rural region. This ranking of rural regions as the worst off is also evident in the squared poverty-gap index. While the poverty-gap and squared poverty-gap indices are the worst in the rural regions, the Gini coefficient measuring inequality in per capita consumption is worse in the urban region. In the case of the Gini coefficients, the difference between the worst region and the region with the least inequality is statistically significant. The $p$-value for testing the null hypothesis of no difference is 0.026.

In interpreting the results from Table 2 it is important to note that these estimates reflect differences in cost of living across regions. The region-specific poverty lines

*Table 4. Extreme Poverty Measures by Sector, Region, and Nation: 1997*

| | Population share | Mean consumption (EGP/person/month) | | Headcount index | Poverty gap index | Squared poverty gap index | Gini coefficient |
|---|---|---|---|---|---|---|---|
| | | Real | Nominal | | | | |
| Urban | 0.43 | 241.74 | 228.04 | 5.27 | 1.03 | 0.34 | 0.37 |
| | | (11.67) | (11.23) | (1.02) | (0.26) | (0.12) | (0.02) |
| Rural | 0.57 | 168.66 | 132.71 | 11.14 | 2.65 | 0.93 | 0.32 |
| | | (5.37) | (4.13) | (1.68) | (0.59) | (0.25) | (0.01) |
| Upper | 0.37 | 210.90 | 165.44 | 7.95 | 1.77 | 0.62 | 0.37 |
| | | (9.37) | (7.60) | (1.32) | (0.34) | (0.15) | (0.02) |
| Lower | 0.63 | 193.40 | 178.13 | 9.03 | 2.07 | 0.71 | 0.35 |
| | | (7.50) | (7.25) | (1.49) | (0.53) | (0.23) | (0.02) |
| Strata | | | | | | | |
| Metropolitan | 0.19 | 250.04 | 250.04 | 3.99 | 0.90 | 0.40 | 0.37 |
| | | (20.38) | (20.38) | (1.28) | (0.44) | (0.26) | (0.03) |
| Lower urban | 0.12 | 201.32 | 180.37 | 7.30 | 1.36 | 0.36 | 0.33 |
| | | (13.40) | (12.01) | (2.41) | (0.47) | (0.14) | (0.02) |
| Lower rural | 0.32 | 157.07 | 134.98 | 12.66 | 3.02 | 1.02 | 0.30 |
| | | (6.37) | (5.47) | (2.66) | (0.99) | (0.42) | (0.02) |
| Upper urban | 0.12 | 270.30 | 242.14 | 5.21 | 0.90 | 0.22 | 0.38 |
| | | (23.64) | (21.18) | (1.84) | (0.37) | (0.09) | (0.03) |
| Upper rural | 0.25 | 183.33 | 129.84 | 9.23 | 2.17 | 0.80 | 0.34 |
| | | (8.93) | (6.33) | (1.75) | (0.47) | (0.22) | (0.02) |
| Nation | | 199.88 | 173.44 | 8.63 | 1.96 | 0.67 | 0.36 |
| | | (5.87) | (5.35) | (1.06) | (0.36) | (0.15) | (0.01) |

*Notes*: Estimates are adjusted for spatial-price variation and corrected for design effects. See also Table 2.

presented in Table 1 show that obtaining the minimum consumption bundle is significantly more expensive in the Metropolitan region than any other area. In particular, the Metropolitan poverty line is 56% higher than the poverty line for Upper rural Egypt.

Given the magnitude of the change in the poverty lines from adjustments reflecting differences in prices, it is worthwhile comparing the results in Table 2 with poverty estimates in which no adjustments are made for differences in the cost of living. Table 3 presents the results from re-estimating the poverty measures without adjusting for price differences and fixes the headcount index for the nation at 26.5 (the same as is found in Table 2). When there is no accounting for price differences across regions, there are stark differences in the poverty measures across regions and across the two tables. For example, rural regions with a headcount index of 36.7% were significantly worse off than urban regions, which had a headcount index of 12.9%.[6] Similarly, the headcount index of 31.3% for Upper Egypt is significantly higher than the headcount index of 23.6% for Lower Egypt.

Table 4 presents the same information as Table 2 (i.e. poverty measures adjusted for price differences by sector, region, and nation) except that the extreme poverty line is used to define who is poor. When using the extreme poverty line, the headcount index falls to 8.6%. Both the extreme and reference poverty lines suggest that the incidence of poverty is the worst in rural regions, and that there is no significant difference between Upper and Lower Egypt.

*Comparison of Poverty Estimates to Other Sources*

The poverty measures in this paper are determined by our estimates of the poverty lines, household consumption per capita, and its distribution across households. Different estimates can arise due to differences in both data and methodology. In interpreting the estimated levels of poverty from the EIHS data it is useful to compare them with estimates from other sources.

An important point of comparison is with estimates based on the Household Income, Expenditure and Consumption Survey (HIECS) carried out from October 1995 to September 1996 by the Central Agency for Public Mobilization and Statistics (CAPMAS). Notable among the HIECS-based estimates are those by Cardiff (1997), El-Laithy and Osman (1996), and Institute of National Planning (1996), all of which estimate poverty to be significantly higher than what we find. For example, using these data, Cardiff (1997) estimates a national headcount index of 44% for 1995/96. That is almost two-thirds higher than our estimate of 26.5%.

El-Laithy and Osman (1996) also report poverty estimates based on the 1995/96 HIECS data using two different poverty lines.[7] For their lower line, the headcount indices of poverty are estimated at 22.9% nationally, and 23.3% and 22.5% in rural and urban areas, respectively. For their upper line, these rates are 48% nationally, and 50.2% and 45.0% for rural and urban Egypt, respectively.[8] Their upper line estimates are comparable with the EIHS-based estimates in Table 2, and their lower estimates are comparable with our extreme poverty rates reported in Table 4. As with Cardiff, these estimates are substantially higher than the EIHS estimates.

This dramatic difference in estimates is surprising given that the two surveys were conducted no more than a year apart, and there are clear parallels in the consumption modules of the two surveys.[9] To understand the cause of this difference, we follow the methodology proposed by Datt and Ravallion (1992) and decompose the difference in poverty estimates into three different potential sources. Noting that poverty measures ($P$) can be generally written as a function of mean consumption ($\mu$), relative inequalities encompassed by the Lorenz curve ($L$) and the poverty line ($z$), and using superscript "H" to denote the 1995/96 HIECS-based El-Laithy and Osman estimate of 48% and "E" to denote our 1997 EIHS estimate of 26.5%, we decompose the difference in the two poverty estimates as

$$\begin{aligned} P(\mu^{\mathrm{H}}, L^{\mathrm{H}}, z^{\mathrm{H}}) - P(\mu^{\mathrm{E}}, L^{\mathrm{E}}, z^{\mathrm{E}}) = {} & [P(\mu^{\mathrm{H}}, L^{\mathrm{H}}, z^{\mathrm{H}}) - P(\mu^{\mathrm{H}}, L^{\mathrm{H}}, z^{\mathrm{E}})] \\ & + [P(\mu^{\mathrm{H}}, L^{\mathrm{E}}, z^{\mathrm{E}}) - P(\mu^{\mathrm{E}}, L^{\mathrm{E}}, z^{\mathrm{E}})] \\ & + [P(\mu^{\mathrm{H}}, L^{\mathrm{H}}, z^{\mathrm{E}}) - P(\mu^{\mathrm{H}}, L^{\mathrm{E}}, z^{\mathrm{E}})], \end{aligned} \tag{9}$$

where $\mu$ and $z$ are expressed in real, constant-price terms. Thus, the poverty difference is decomposed into (i) a component due to the difference in the real poverty lines (the first term in square brackets), (ii) a component due to the difference in real mean consumption (the second term in square brackets), and (iii) a component due to the difference in the Lorenz curves (the third term in square brackets).

To assess how much of the difference in the EIHS and HIECS estimates is on account of the differences in the poverty lines used (the first term), we apply our reference poverty lines to the 1995/96 HIECS data, after deflating them for change in the consumer price level between the two surveys. This results in an estimate of the national headcount index of 50.5% for 1995/96, which is comparable with the 48% estimate of El-Laithy and Osman.

We next turn to the difference in mean consumption from the two surveys. The EIHS data generate an estimate of average per capita, yearly nominal consumption for 1997 at EGP2,081.25. After deflation, using the domain-specific rural and urban Consumer Price Indices (CPI) from the CAPMAS, at October 1995–September 1996 prices, this comes to EGP2,010.13 per person per month. This contrasts sharply with the estimate of per capita consumption from the 1995/96 HIECS of EGP1,356.72 per person per year. The HIECS estimate is thus about 32.5% lower in real terms.[10] Differences of this magnitude in estimated levels of mean consumption are sure to have large effects on poverty estimates. Indeed when we estimate $P(\mu^{H}, L^{E}, z^{E})$—i.e. what EIHS-based poverty levels would have been if one were to replace the EIHS real, mean consumption by that estimated from the HIECS (while keeping relative inequalities fixed, as determined by the EIHS data)—we estimate a headcount index of 55.5%.[11]

By using both the HIECS mean and the HIECS Lorenz curve, we estimate the headcount index as 50.5%. This estimate fills in the last component of the decomposition above, and gives us an estimate of the poverty difference attributable to the change in relative inequalities between the two surveys. Putting all these results together, our estimate of the decomposition for the difference in the headcount index in percentage points from the three sources is:[12] [48.0 – 26.5] = [48.0 – 50.5] + [55.5 – 26.5] + [50.5 – 55.5]. In other words, of the 21.5 point difference in the headcount indices, –2.5 points come from the difference in poverty lines, +29.0 points come from the difference in means, and –5.0 points results from the difference in the Lorenz curves.

This makes clear that the large positive difference between the HIECS and EIHS poverty estimates is not on account of the difference in (real) poverty lines, nor is it on account of the difference in the HIECS and EIHS Lorenz curves. If anything, these two factors on their own would have tended to make the HIECS estimates lower than the EIHS estimates. The difference between the HIECS poverty estimates and the EIHS estimates is entirely attributable to the much lower mean consumption from the HIECS.

This raises the question of why we observe such large differences in the mean consumption estimates from the two surveys. The consumption components of the EIHS and HIECS surveys are similar, so one might expect comparable estimates of per capita consumption. However, one potential source of difference exists which concerns the value of the services from durable goods. Although both surveys include information on durable goods, in the HIECS-based consumption measure the durable-goods-related components account for about 3% of total consumption, while they account for about 16% of the EIHS-based consumption measure. One reason for this difference is that the HIECS-based consumption includes the value of actual purchases of durable goods over an annual reference period, while our consumption measure estimates an opportunity cost-based value for the flow of services of currently possessed durable goods.

In order to ascertain how much this differential contributes to the poverty difference between the two surveys, we estimate EIHS poverty measures using per capita consumption net of use-value of durables. This produced a national headcount index of 33.3%. In other words if one were to decompose further the mean-difference component in decomposition above, of the 29 percentage points, then 6.8 percentage points, or about a quarter of the mean-difference component, would have been due to the difference in the treatment of use-value of durable goods. Locating other sources of differences would require a thorough cross-validation of item-by-item consumption estimates from the two surveys, and is beyond the scope of this paper.

Thus, while the estimates of household consumption based on the EIHS are substantially higher than those obtained from the HIECS, which estimates are "better" remains for now an unresolved question. In defense of our estimate, we note that Egypt's national income account data suggest that the value of per capita, household consumption is EGP2,798.87.[13] This estimate of per capita consumption is about 34% greater than the EIHS estimate of per capita consumption, but it is approximately twice as large as the HIECS estimate.

For another comparison of our poverty estimates to others, a poverty threshold frequently used for international comparisons is the poverty line set at one US dollar per day in 1985 PPP dollars. Using this poverty line, the World Bank (2000b) estimates the headcount index for Egypt in 1991 to be 7.6%. The final comparison we consider is to use the dollar-a-day poverty line, adjusted to 1997 Egyptian pounds, with the EIHS data. The international poverty line of 1985 US$1 per person per day, when converted to April 1997 Egyptian pounds using the 1985 purchasing power parity (PPP) for private consumption as reported by Summers and Heston (1998) in the Penn World Tables, Mark 5.6, and the consumer price indices International Monetary Fund (1997), produces a poverty line of EGP56.82 per capita per month at April 1997 prices. To estimate a headcount index which is comparable to the 7.6% estimate, there is no need to adjust for spatial-price differences. Without spatial-price adjustments and using the EGP56.82 (per capita, per month) poverty line, the EIHS data estimate a headcount index of 7.1%.

## 5. Summary and Conclusions

About 15.7 million persons, or about 26.5% of the population, are deemed to be poor in Egypt in 1997. Our population estimates rely on the 1996 CAPMAS census population figures and a poverty line resulting from a cost-of-basic-needs methodology which allows for basic food and nonfood expenditure. Of these, 5.1 million are deemed to be in extreme poverty. This estimate is based on the same population numbers and uses a lower poverty line that provides a less generous allowance for basic nonfood expenditure.

Poverty rates are observed to be significantly higher in the rural sector, and about 63% of the poor live in rural areas. The rural sector accounts for about the same proportion of national poverty for the different measures of poverty, including the poverty-gap and squared, poverty-gap index. When considering different poverty lines, this proportion does change as the rural sector comprises about 74% of those individuals living in extreme poverty.

Our results indicate a sharp sectoral difference in poverty with rural areas being significantly poorer, but we do not find differences in poverty between Upper and Lower Egypt. In this respect our findings depart from the conventional wisdom that Upper Egypt is substantially poorer than Lower Egypt. One important reason for the difference in our results is that ours is perhaps the only study that allows for regional differences in cost of living (and basic nonfood needs). Conventional wisdom has been founded on poverty studies that have ignored spatial-price differentials. Indeed, when we suppress spatial differences in poverty lines, we can reproduce a regional poverty profile that is more in accordance with conventional expectations.

In addition to adjusting our welfare measure for cost of living differences across regions of Egypt, our analysis is careful to correct standard errors for the characteristics of the sample design. We find that this correction results in standard errors for our poverty estimates to increase by approximately two-fold. We assert that this correction is typically not made and poverty estimates which fail to make this correction will significantly underestimate the variance of the poverty indices. This correction to the standard errors, though, further dampens the significance of observed differences in poverty estimates across sectors and regions. An implication of the lack of a sharp regional poverty profile is that geographical targeting at the level of these five regional domains is unlikely to hold a large potential for poverty reduction unless combined with other stronger correlates of absolute poverty. The results do suggest, though, that there is scope for using sectoral targeting to reduce poverty due to the large difference in poverty between urban and rural sectors.

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## Notes

1. For both methods, the neighborhood of $z^F$ is defined to ensure that there are significantly more than 10 observations supporting the estimate of $z^N$.
2. For both the real and nominal average consumption levels, tests for equality of the means are strongly rejected. The $p$-values for both of these tests are essentially zero ($p < 0.001$).
3. A test for whether these two means are different fails to reject the null hypothesis of equality at the $\alpha = 0.1$ level. The probability value of this test is 0.226.
4. While this rank reversal is interesting and informative of the importance of the differences in living costs across Egypt, it is also important to note that neither of these differences is statistically significant.
5. The population estimate used for 1997 is the 1996 CAPMAS census population estimate.
6. This difference between the two headcount indices is significant with a $p$-value of less than 0.01.
7. Their estimates, produced as a background paper for the Egypt Human Development Report (INP, 1996), are identical to those published in that Report.
8. These estimates have been cited in various publications including World Bank (2001) and Institute of National Planning (1996).
9. The EIHS list of consumption items is a slightly modified version of the HIECS list.
10. Comparisons with Cardiff (1997) yield differences of similar magnitude. Using the HIECS data, Cardiff estimates average per capita consumption during the time of the survey to be EGP1,342.46. Adjusting this estimate to 1997 Egyptian pounds using the CPI, results in an estimated average per capita consumption level of EGP1,417.64. Our estimate of per capita consumption with the EIHS data is 47% larger.
11. This observed HIECS–EIHS poverty difference seems consistent with a typical absolute elasticity of the headcount index with respect to mean consumption of around 2.
12. Similar results were obtained for the poverty gap and squared poverty gap indices.
13. Ministry of Planning (1999) estimates that total household consumption makes up 68.44% of gross domestic product, and the International Monetary Fund (2000) estimates per capita gross domestic product at EGP4,089.6783, which imply that per capita household consumption is EGP2,798.87.