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Details on Consumption Aggregates

From Ecuador: Poverty Report, Working Paper 1, Annex 1

Annex I

This Annex spells out how we derived the poverty line and how robust our estimates of poverty are with respect to several key underlying assumptions. The first section, concerned with the poverty line, pays particular attention to our methodology to value housing, consumer durables and water consumption. In the second section, we examine the robustness of our estimates with respect to adult equivalency scales and the chosen imputation methodology for housing and water. Further, we present the results of statistical dominance tests, important when comparing regional poverty independent of the poverty line chosen.

A.1. Derivation of a Poverty Line

We needed a fair number of steps to arrive at a consumption-based poverty line for Ecuador. Several of these steps were also required for the general process of constructing consumption aggregates from the item-by-item entries in the dataset. First, we converted information on household purchases of food items into a monetary aggregate. Second, we calculated the calorie equivalent of the observed food consumption per household and derived the extreme poverty line. Third. we evaluated and priced non-food expenditures. Fourth, we derived the poverty and vulnerability lines. Finally, we adjusted nominal expenditures of all households for the variation in prices between different areas and regions. We briefly describe each of these steps below.

Conversion of Household Purchases of Food Items into a Monetary Aggregate. The LSMS contains detailed information on the quantity of up to 73 food items although the respective data were not always complete for all households; e.g. in some cases the entry for quantity, expenditure, price, the quantity unit (gram, pound, 'basket', 'bunch', etc.), or the frequency of purchase, was not reported or was incomplete. In such cases efforts we corrected for these omissions by judiciously imputing responses at the level of ciudades or regions.

Calorie Conversion and Food Poverty Line Derivation. Using a standard conversion table, we derived calorie equivalents from the observed consumption pattern. The food poverty line indicates what expenditure is needed to acquire a minimum caloric intake per person (2237 kcal per capita[37]) associated with the consumption pattern of those in the second and third quintiles of the expenditure distribution.

The food poverty line was calculated in a series of steps. First, the average consumption bundle consumed by households in the 2nd and 3rd quintile of the national consumption expenditure distribution (in raw terms, without any previous adjustment to expenditures) was calculated. Using a calorie conversion table we estimated the kilo-calorie content of this consumption bundle by first converting the quantity consumed of each item in the bundle into a calorie figure and then summing up these calorie figures across all food items in the consumption bundle. The figure obtained was

[37] This kcal intake is taken from the study by Cabrera, Martinez and Morales, 1993.

then compared against the calorie cut-off level of 2237 kcal per person taken from Cabrera et al (1993). All quantities in the consumption bundle were then uniformly scaled by the ratio of 2237 to the total calorie figure obtained, so as to ensure that the consumption bundle, based on the consumption pattern of the 2nd and 3rd quintile of the national population, yielded exactly 2237 kcals.

The vector of quantities in the consumption bundle was then valued by multiplying each good in the basket by the ciudad-specific modal price of that good. Summing across all values in the basket thus yielded a 'food poverty line' for each ciudad in the data set. A national-level food poverty line was then obtained by taking a population-weighted average of all ciudad level food poverty lines. The line obtained corresponds to 30,733 sucres per person per day (equivalent roughly to US$ 1.50 per person per day in 1994).

Box A.1: Evaluation of Consumer Durables and Housing

As we are concerned with the most accurate definition of welfare for the purpose of poverty analysis, we included both the consumption of durable consumer goods and housing in the household expenditure indicator. Households which possess goods such as cars or washing machines derive a value from the consumption of these goods which increases their welfare. Our welfare measure should take account of these goods.

We calculated the consumption of consumer durables applying a standard age profile to consumer durables reported in the LSMS. Section 1 (housing) of the LSMS reports the type, amount, age and replacement value for seventeen consumer durables ranging from refrigerators to sewing machines and from kitchens to cars. We assumed that the *average* replacement value of a particular durable (of the sample) would be a good proxy for those observations which did not give a replacement value. Further, we estimated the lifetime of each durable as twice its average age found in the survey. This computation is based on the premise that the purchase of consumer durables did not vary significantly over the past ten years in Ecuador which would result in a flat distribution of the age of durables over time. In this setting, the lifetime of a durable is twice its average age. Finally, we defined consumption (or depreciation) of a consumer durable as the sum of all replacement values divided by the average lifetime of this type of durable.

Regarding housing, we imputed the housing rent for a relatively small fraction of households which had not reported this variable. The LSMS contains two variables related to rent: one which records rent actually paid and one which inhabitants think they would have paid had they rented their apartment or building. We spliced both of these answers together assuming that inhabitants have a rational idea about the rental market. After excluding several obvious outliers (or misrecordings), about 5% of the observations in the dataset were missing. We imputed the rent variable separately for all areas and regions in the country using the predictive power of simple regression analysis. Exogenous variables were largely housing variables (wall material, number of rooms, number of bathrooms, availability of kitchen) but also other wealth indicators such as the consumption of durable consumer goods.

Evaluation and Pricing of Non-Food Expenditures. We have included a large number of non-food expenditures in the welfare measurement of households: electricity, water, transport, durable consumer goods, clothing, miscellaneous purchases, education and services, including also expenditures on prepared foods purchased outside the home. For some of these such as clothing and transportation this was quite easy as the data included both a category of monthly and yearly expenses which we could adjust to bi-weekly period. For others, such as housing or consumer durables, we applied a relatively straight forward imputation or evaluation method (see Box A.1).

For water, the task was more complex. Theoretically, if our aim is to measure the welfare level of a household, we would want to ensure that we include all consumed goods during a certain reference period. We implicitly assume that welfare arises from the consumption of goods so in order to enable us to make welfare comparisons between households, we have to control both for the price and the quality of the item looked at. In the case of water, households report only their total water expenditures and not the actual quantity of water consumed in the LSMS.

Prices of water vary widely in Ecuador, depending largely on the form of access: Consumers of water with access to the public water network tend to be heavily subsidized -- almost two thirds of the sampled households connected to the public water network actually reported that they do not pay for their consumed water at all. On the other hand, especially households with little access to river water or wells pay dearly for this life necessity. The population in urban areas without connection, often the poor, are forced to buy their water from street vendors. Simply aggregating nominal expenditures without adjusting the data in some way, would induce a bias in our welfare measurement: we would either overstate the welfare of the not connected households or understate the welfare of the connected ones.

As we could not deduce the actual quantity of water consumed for consumers connected to the public water network, we imputed total water expenditures for all households not purchasing water from private vendors. Most public network water consumers specified that they did not pay for the service they received so that the actual price for them was zero, rendering the calculation of actual quantities consumed impossible. Under a number of restrictive assumptions, we therefore imputed both price and quantity of water consumed jointly (see Box A.2).

Box A.2.: Imputation of Water Expenditures

We paid particular attention to the adjustments of water expenditures because access to this service is widely discussed in Ecuador. In the debate, water is generally used as the most important example of the unequal access to many basic services which tend to be biased in favor of the urban Sierra region. Further, access to water is used as an example in the debate why expenditures (or income) cannot be used to measure poverty. While a large part of the households connected to the public network receive their water for free, others have to pay high prices to purchase water from street vendors.

We imputed water expenditures by evaluating household consumption of water at its marginal value. As a starting point for the adjustment procedure, we only looked at the private market for water represented by water vendors which we find to operate almost exclusively in urban areas. We are only able to observe the marginal value of water for these households: in rural areas, no price is attached to water consumption although the opportunity cost can be significant; and in the public water network, the marginal value of water consumption and the actual price differ because of supply constraints and hence demand rationing. We imputed water expenditures using a number of wealth and living standard variables. Using a stepwise regression procedure to estimate a log-model, we determined variables such as household size, expenditures on cooking fuel, consumption of durable consumer goods and an array of housing variables to be significantly correlated to water expenditures.

Such an imputation is a valid method to adjust water expenditures if a number of assumptions hold. First, water of different sources and in different areas must have approximately the same quality. Second, water supply in the public water network must be restricted so that the marginal value of water differs from the actual price paid to the water companies. Third, a ranking of expenditures must reflect a ranking of quantities actually consumed which implies that the demand for water has to be very inelastic in a certain range. Fourth, the vendors water market has to be competitive with few barriers to entry and exit. Finally, (marginal) transportation costs of water need to be relatively small. See Hentschel and Lanjouw (1995) for a detailed analysis of the imputation methodology and its underlying assumptions.

If the quality of a consumed good varies and we cannot observe its price for a specific household or at least region, an imputation method to make welfare levels comparable between households becomes impossible. . We were only able to impute water expenditures because we assumed that the water quality between the piped water and the one street vendors sell does not vary significantly. Health expenditures are an example where we cannot control for such quality. The coverage of health care, especially in rural areas, is dismal in Ecuador, forcing many of the rural poor to seek help in private clinics or from traveling doctors. We have no yardstick to compare the health services rendered by these private clinics to public health centers. If everybody had access to public health care we could assume that the population which does seek help at private facilities expects a better service than the one provided in the public health posts.[38] But since this access is not universal, simply including health expenditures in our welfare measure would not be correct. The point is that by excluding health expenditures altogether, we have a better chance of preserving

[38] Along this line of argumentation, we have included nominal education expenditures in our aggregate poverty measure. Access to both primary and secondary public education is given in Ecuador although at times it involves a lengthy commute in rural areas. With access to public education given, we can interprete the choice of households for private education as a choice for a different, and better, quality of the education.

the 'true' welfare rankings than by either including expenditures without adjustment or some type of imputed health expenditures.

Poverty Line and Vulnerability Line Derivation. We then obtained the *poverty line* by determining the average proportion of total consumption which was spent on non-food items by those members of the population who were in principle just able to meet their calorie needs, if they were to devote their total expenditure to the purchase of food items. The poverty line was then calculated by scaling up the national-level food poverty line by that empirically estimated proportion (for further details consult Ravallion 1994). In order to derive the *vulnerability line*, we determined the average proportion of total consumption which was spent on non-food items by those members of the population who recorded food expenditures equal to the food poverty line. Again, we then computed the vulnerability line by scaling up the food poverty line by this proportion.

Price adjustments. Finally, rather than operating with a large amount of poverty lines, we adjusted total household expenditures for price variations in the different regions and areas in Ecuador. Price variations are very pronounced in Ecuador due to its geographic and climate diversity. Having calculated food poverty lines at the ciudad-level we adjusted nominal expenditures of households with a cost-of-living index obtained by taking the ratio of the ciudad-level food poverty line to a population weighted average, and dividing the expenditure figure in the sample by this ratio. Note that imputed water expenditures were not adjusted in this way but were added to 'real' expenditures after adjustment.

A.2. Robustness of the Poverty Estimates

In this section, we are concerned with how robust the above presented estimates of poverty in Ecuador are. We start with examining how sensitive the calculated poverty rates are to the choice of the poverty line. The above described derivation of the poverty line depends on a large number of assumptions ranging from the implicit application of an adult calorie equivalency scale to the economic rationale under which we imputed water and housing expenditures, the exact poverty line chosen, or the specific poverty measure employed. By changing these assumptions, we will discover how important they are for our overall poverty estimates. The second part of this section then turns to regional poverty rankings. We examine regional poverty indicators for a wide range of possible poverty lines to find out whether we can make statements about the relative regional rankings of poverty without referring to a specific poverty line.

A.2.1. Sensitivity Analysis

We conduct two sensitivity analyses of our poverty estimates. First, we apply an explicit adult equivalency scale. The equivalency scale adjustment is based on the assumption that adults and children have different kcal requirements so that, consequently, the poverty line for each

different household is a function of the composition of the household itself. In the base case, the 2237 cut-off point of Cabrera et al. (1993, p.174) reflects the nutritional requirements of an 'average' household in terms of size with an 'average' composition. Hence, the base case takes an equivalency scale implicitly into account by arriving at the kcal average but it does not explicitly endogenize the poverty line for each individual household. Second, we conduct a sensitivity analysis regarding our above referenced imputation of water and housing values. Instead of using the imputed values, we include the nominal expenditures recorded in the LSMS in the sensitivity analysis.

Table A.1: Poverty in Ecuador 1994: Sensitivity Analysis of Extreme Poverty Rates

		Base Case Extreme	Adult Equivalency Scale [1]	Adult Equivalency Scale [2]	Water, Rent and Consumer Durables [3]
Costa	urban	9	9	6	10
	rural	22	24	19	25
Sierra	urban	11	12	10	13
	rural	20	19	16	22
Oriente	urban	7	7	3	8
	rural	50	46	38	53
National	urban	10	10	8	12
	rural	22	23	19	25
Total		15	16	13	18

1 Equivalency scale of children as .7 adult euqivalents and infants as .5.
2 Equivalency scale of children as .5 adult equivalents and infants as .3.
3 Uses nominal expenditures for water and housing, and excludes consumer durables consumption.

Poverty rate estimates of the two alternative calculations vary somewhat from the base case. We conduct the analysis for the extreme poverty line (only food expenditures), applying an adult equivalency scale of .5 for infants and .7 for children to an adult calorie requirement of 2700 kcal, the amount suggested by CEPAL (1991). Poverty rate calculations vary only marginally from our base case with the national estimate of extreme poverty increasing slightly from 15 to 16%. Even reducing the adult equivalency units of children to .5 and infants to .3 leaves us with a extreme poverty rate of 13% Turning to the sensitivity of our estimates with respect to imputations of water, rent and our evaluation of consumer durables, the poverty rate increases from 15% (base case) to 18%. The direction of this shift could be expected as we adjust recorded expenditures in

the LSMS upward in the base case scenario. It is interesting to observe that the (absolute) influence of the imputation exercise is higher than the adult equivalency scale application.

A.2.2 Rankings of Poverty

How confident can we be about our finding that rural poverty is higher than urban poverty? Further, can we make a judgment about poverty rankings between regions which do not depend on the exact poverty line chosen? In order to answer these two questions, we conducted tests of stochastic dominance.

Stochastic Dominance Tests Advances in the measurement of poverty have in recent years yielded very simply to apply techniques for comparing poverty while retaining a firm focus on the robustness of the comparison.[39] We begin with a straightforward plot of the distribution functions between the populations being compared. The location of the distribution functions is of immense importance for making judgments about poverty rankings: From the theory underlying these techniques, it can be shown that if the curves do not intersect at any point in the graph, poverty in the population represented by the curve lying everywhere above the other is greater. And this is true not only for the incidence of poverty but is also true for any other poverty measure in common use.

Urban - Rural Comparison. Examining the distribution function for urban and rural poverty first, we find unequivocally that rural poverty is higher than urban poverty independently of the poverty line chosen (compare Figure 1 in Working Paper 4). The rural distribution function of consumption lies above the urban distribution function over the whole range per capita expenditures. Hence, for whatever poverty line we choose, rural poverty indicators like the headcount index or the depth and severity of poverty are above those for the urban areas.

The presented distribution function is also helpful to visualize how our calculated poverty rate varies if we change the poverty line. We note that the poverty line of Sucres 45,000 per person per fortnight cuts the rural distribution function in a relatively steep and the urban distribution function in a much flatter part. This indicates that relatively minor adjustments in prices will have a pronounced impact on the measured incidence of poverty. The vulnerability line, for example, is around Sucres 60,000 (an increase of about US$0.5 to US$2.0 per person per day) which increases the incidence of poverty in rural areas would rise from 47% to 67% (a rate much closer to what other studies have found) while the urban rate rises from 25% to 40%.

Regional Rankings. Turning from the aggregate urban and rural areas to examining stochastic dominance between regions, we find that we can draw only few conclusions. The results

[39] The literature on poverty measrument using stochastic dominacne techniques has been growing rapidly. Good overviews can be found in Atkinson (1989), Howes (1994) and Ravallion (1994).

of both first and second order tests of stochastic dominance are presented in Table A.2.[40] Varying the poverty line over a very wide range (from sucres 10,000 to 60,000), we can only say that both the rural Oriente and the rural Sierra are poorer than the urban Oriente and urban Costa, irrespective of the location of the poverty line and the type of poverty measure used. And even this result has to be interpreted with care, however, as it does not take the contribution towards poverty into account. Thus, for example, poverty rates in the rural Oriente are always higher than in the urban Costa but the number of poor is always greater in the latter as the urban Costa as a large population.

Table A.2.: Regional Rankings of Poverty: Statistical Dominance Tests

	Urban Costa	Urban Sierra	Rural Costa	Rural Sierra	Rural Oriente
Urban Oriente	Second-Order	X	Second-Order	First-Order	First-Order
Urban Costa		X	X	First-Order	First-Order
Urban Sierra			X	X	X
Rural Costa				X	X
Rural Sierra					X

1 First-Order indicates that with 95% confidence, poverty in the population corresponding to the row entry is lower than in the population corresponding to the column entry over all poverty lines between sucres 10,000 and 60,000 per fortnight and over all poverty measures, including the head county ratio (see Atkinson, 1987, and Ravallion, 1994. On statistical testing of stochastic dominance see Howes, 1994).

2 'Second-Order' indicates that with 95% confidence, poverty in the population corresponding to the row entry is lower than in the population corresponding to the column entry over all poverty lines between sucres 10,000 and 60,000 per person per fortnight and over all poverty measures which are strictly decreasing and at least weakly convex, i.e. excluding the head count ratio but including the poverty gap and poverty severity measurers.

3 Where an 'X' is entered these is no unambiguous ranking of the two regions over all poverty measures and all poverty lines (in the range between sucres 10,000 and 60,000 per person per fortnight).

40 While first order stochastic dominance tests compared the distribution functions, second order stochastic dominance tests examine the location of the deficit curves.