Household Welfare Measurement and the Pricing of Basic Services

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Abstract

Employing total consumption as a household-level welfare indicator with which to measure poverty has often been criticised because it is felt that such an indicator does not account for differing access to, and cost of, publicly provided services. This paper discusses when and how adjustments can be made to expenditures derived from household surveys so as to reflect the consumption of basic services. Markets which are subsidised, rationed and subject to increasing marginal tariff pricing are examined and simple adjustment methods are discussed. Using Ecuador to illustrate the methods, the paper shows that incorporating adjustments in markets for water, electricity and cooking gas can significantly alter poverty estimates. Including such adjustments into a comprehensive measure of welfare can therefore be important and can also contribute to the wider acceptance and use of consumption as a welfare indicator guiding public policy development.

1. Introduction

Economic and social policies aimed at poverty alleviation in developing countries are increasingly guided by the analysis of household surveys. Surveys have been designed specifically to measure households' living standards, to identify the characteristics of distinct population groups and to determine the needs of the poorest in society. Analysis of such surveys now often forms the cornerstone upon which Governments, donors and NGOs base assessments of the need for and size of anti-poverty programs. Furthermore, household survey analysis can assist in the development of targeting mechanisms which can be used to reduce leakage of program resources to non-qualified beneficiaries.

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Access of the poor to basic services such as electricity, water, sewage or gas is often viewed as very important to the well-being of households. Access of a household to such services should not only be viewed as a reflection of the household's welfare standing, but also as a determinant of the latter. Basic services will in many instances be inputs into economic activities or will support them indirectly. For example, informal home-based businesses often rely on domestic power connections; time freed from fetching water or gathering fuelwood can be diverted to income-generating activities; and potable water and sewage help to protect household members from diarrhoea and other diseases.

Of course, defining household welfare solely in terms of access to basic services is also not ideal. This would ignore other important components of welfare such as food intake, the consumption of various non-food goods and services, the consumption of housing services, and so on. An integrated, comprehensive consumption indicator which is capable of combining these various components of well-being, is therefore likely to have advantages over concentrating on access to basic services alone.

How to incorporate the consumption of basic services into a household consumption aggregate is not always a straightforward matter of simply adding household expenditures on such services to the value of household consumption on other goods and services. Actual prices paid by consumers of basic services in many developing countries often vary widely in different market segments. Such markets are often highly subsidised and/or characterised by rationing. Poverty measurement can be biased if household expenditures do not reflect these market imperfections.

Focusing on the markets for basic services of water, electricity and gas in Ecuador, this paper discusses those circumstances when price adjustments are necessary, describes how these can be implemented, and illustrates their impact on poverty measurement. Our results for Ecuador show a marked influence of pricing basic services on measured extreme poverty, but less so on the household rankings which underlie the poverty profile. We start, in Section 2, with a general description of market characteristics within which price adjustments should precede poverty analysis. Section 3 shows how (and under what assumptions) adjustments to markets for services can be made, employing a Living Standard Measurement Survey for Ecuador. We investigate the importance of these adjustments for poverty rate calculations and comparisons in Section 4. Section 5 concludes.

2. Welfare Measurement, Rationing and Markets for Basic Services

An ideal measure of welfare will reflect the total utility derived from all goods and services consumed. In graphical terms, we would like to measure the entire area below the demand curve for all products and services consumed. Of course, in practice, there is no scope for measuring welfare in such a manner--not least because we do not generally know the shape of individual or household demand curves. Conventional practice, when measuring and comparing welfare levels across households or individuals, is to work with money metric utility--the minimum cost of reaching a given utility level u, when faced with a given vector of prices p (see Deaton and Muellbauer, 1980, and Deaton, 1980, for a detailed exposition of this approach). For a utility maximising household, money metric utility is given by that household's total expenditure level. Comparisons of welfare across households are made on the assumption that households of a given size and composition have a common utility function. Thus when all households face the same prices (as is the case in a perfectly competitive market setting), one can convert quantities consumed of different goods and services into expenditure terms by simply multiplying quantities times price, aggregate these expenditures across items to derive a total consumption figure, and then base welfare comparisons on these total consumption figures. Expenditures, measured in this way, are then a proxy for the real consumption of goods and services from which we assume people derive welfare. Since prices measure the marginal utility of consumption of a product they can be used to transform diverse quantities into some common numeraire and thereby provide a money metric measure of welfare. Under these assumptions, the money metric measure will provide a ranking of households which is ordinally equivalent to that obtained from a direct comparison of utilities (if these were observable).

Since we want to compare welfare between different households, we value quantities consumed at identical prices across households. The assumption of a given price vector is quite strong, however. Spatial price variation driven by different underlying costs (such as transport and storage costs), is perhaps the most common reason for prices to differ between consuming households at any one time. If welfare is being compared over time then prices may also vary due to inflation, To resolve these problems, it is conventional practice to adjust for such spatial and/or temporal cost of living variation on the basis of price indices (See Deaton, 1980, Deaton and Muellbauer, 1980, Ravallion, 1994, for discussion of the construction of such price indices). These price indices can be used to deflate total consumption expenditures so as to render these comparable.

Prices can also vary across households for other reasons. For food products and certain non-food items, for example, discounts for bulk-purchases are not uncommon. Specific food items might also be subsidised on a selective basis, e.g. in a particular region of the country or for low-income households through the distribution of food stamps. Similarly, in many industrialised but also several higher income developing countries, low income families receive public co-payments for housing.

If prices for public utilities vary between households, this is mostly due to three reasons. The first is rationed markets. If this is the case, there are restrictions on the quantities available for purchase, but prices are kept from rising to clear the market. In such cases the price paid by some consumers may be different from that paid by others. This becomes particularly difficult if there are differences across households in the extent to which they are rationed with households not able to exchange the rationed commodity between them. A key feature of rationed markets is that the controlled prices do not reflect marginal utilities derived from consumption of the rationed goods. Second, some governments employ subsidies for public utilities to reduce prices for specific population groups. Third, increasing marginal tariff rates lead to rising unit costs with total quantity of the utility consumed.

But adjustments in the valuation of consumption are only necessary if the observed prices do not reflect actual benefits to the consumer or if interventions affect some households differently from others. For example, with full access to subsidies, all consumers demand products until the price paid for the last unit is equal to the benefit, or marginal utility, derived from consumption of that item. In the absence of any rationing, no consumers are constrained in any way from reaching that desired consumption level. The price paid need not be equal to the economic resource price of the product, if, for example, the government artificially changes the (relative) price of the product through taxes or subsidies. But as long as it reflects the consumer's marginal utility, it can be straightforwardly applied in constructing the consumption aggregate.

Markets for basic services in developing countries generally provide good examples of cases where nominal expenditures contained in household surveys do not reflect actual consumption levels. Consider, for example, the common case of public provision of water at highly subsidised prices which benefits only a fraction of the urban population connected to the network. The non-connected population must therefore look for alternative water sources, either buying it at high prices in the private market or fetching it from wells or rivers. Publicly provided sanitation and waste disposal services are similarly often available only to a fortunate few. Public electricity and water supplies are often irregular in many countries, with erratic periods of shortages restraining consumption. And, in developed and developing countries alike, increasing marginal tariff rates for electricity often cause nominal expenditures on electricity to divert from a linear relation with actual consumption of kilo-watt hours.

In the following section, we use examples from Ecuador to illustrate how the consumption of basic services can be integrated into aggregate household consumption. The examples touch on the three above-mentioned scenarios, namely rationing, subsidies and price variation due to increasing marginal tariff structures.

3. Pricing Water, Electricity and Gas: Examples from Ecuador

3.1. Subsidies with Rationing: Water

3.1.1. Water Consumption Patterns in Ecuador

Ecuadorans use a variety of different water sources, varying by region and household wealth. As shown in Table 1 below, the most important source in urban areas is the public network, with a total of about 70% of households being connected. The remainder meet their needs from a variety of different sources, the most important ones being rivers or wells (for the rural areas) and private water vendors (truck) for poorer urban families, especially in the coastal region.

Prices paid for water vary markedly, mainly reflecting the source of water supply. Most households connected to the public network do not pay for the service at all as cost recovery by the utilities in charge is highly irregular and piecemeal; according to the Living Standard Measurement Survey (SECAP 1994), more than fifty percent of connected households reported that they did not pay for publicly provided water. It is important to note, however, that in Ecuador rationing does occur in the public water market as water shortages mean that supply is frequently interrupted. Rural households which meet their water demand from rivers or rainwater also do not record water expenditures in the LSMS. Only the households depending on the water vendors report non-zero expenditures throughout.

Table 1: Water Use in Ecuador, 1994

	Rural	*Urban*
Costa		
Public Netw.	7.5	62.1
Truck	1.0	17.3
other	91.5	20.6
	100	100
Sierra		
Public Netw.	30.1	90.7
Truck	0.0	2.0
other	69.9	7.3
	100	100
Oriente		
Publc Netw.	15.7	90.6
Truck	0.0	0.0
other	84.3	9.4
	100	100

Source: Living Standard Measurement Survey (SECAP 1994).

3.1.2. Imputations

Since our ultimate objective in poverty analysis is to compare welfare between households, we have to adjust for the varying prices households pay for water. If we had details on the quantity of water consumed by all households, our adjustments would involve identifying a 'reasonable' average price -- reflecting marginal utility -- with which we could convert quantity consumed into an expenditure figure. But the Ecuador LSMS, like most such surveys, does not provide separate information on quantities consumed and prices paid but only lists total water expenditures. This complicates the adjustment exercise considerably. As outlined above, we cannot simply include the reported nominal expenditures on water because this would distort our household welfare comparison: those families fortunate to have access to the public network are likely to consume a large quantity of water, recording low (or zero) nominal expenditures, while other families having to buy expensive water from private vendors might consume little but endure significant nominal outlays. Including nominal expenditures from the survey would hence understate the welfare level of those with a public network access.

As a starting point for our adjustment procedure, we only look at the private market for water represented by water vendors. When comparing the different water sources shown in the above table, only the households which purchase the water from private vendors pay the private market price. This can be assumed to equal opportunity costs. All other sources (public network, river, well) either pay a deliberately subsidised price (public network) or we cannot equate the observed price to the private opportunity cost. For example, rural dwellers who meet their water needs from a river, pay no monetary value for their consumption, but their private cost of obtaining the water includes the opportunity cost of time fetching the water, transporting it home, and, perhaps, boiling or treating it to convert it into water for home use. The individual household will equate these opportunity costs in production or acquisition to the opportunity cost of consumption. The opportunity cost of consuming the water is obviously selling it to neighbours or transporting it to urban areas.

We first explain nominal water expenditures in the private water market using a stepwise regression procedure which selects among a large number of wealth and living-standard variables. The log-linear model (all numerical variables are in logs, all binary ones in numbers) takes the following form:

$$(1) \qquad lnwater = f\,(lnrent,\ hhsize, room,\ shower,\ waste,\ lnfuel,\ lndurcon, region,\ e_i)$$

where *lnwater* is the logarithm of total household water expenditures, *lnrent* is the logarithm of rent paid for the dwelling[1], *hhsize* stands for the number of persons per household, *room* is a dummy variable for households occupying only one room, *shower* stands for a dummy variable for dwellings which have a shower, *waste* is a dummy variable for households living in an area with waste disposal, *lnfuel* is the logarithm of household expenditures on cooking fuel, *lndurcon* signifies the logarithm of household consumption of durable consumer goods (a derived variable from the stock of consumer goods per household), *region* stands for a dummy variable for the regional location (characterising the warmer and more humid Costa

[1] Before including rent as an exogenous variable, we tested whether the reported rental value includes a premium for water connections. This was not the case.

and Oriente region), and e_i is an additive error term with the usual properties. All parameter estimates carry the expected sign with the expenditure variables having a positive influence, dummy variables associated with wealth also being positive (waste disposal, shower), dummy variables indicating low living standards to be negative (single-room dwellings) and the regional dummy variable to reflect that people in the Costa and Oriente consume more water because of the hotter climate. The model explains 36% of the variation of the nominal expenditures in the private water market.[2]

We then use the parameter estimates to impute water expenditures. We consider two different alternatives here: first, we impute expenditures for *all* households except those used in the regression, whether they are connected to the public network or they obtain their water from rivers and wells. Hence, we apply the model based entirely in an urban setting (all households which report private purchases of water are located in the urban sector) to the whole country, including the rural segments. Second, we limit the imputation to those households in *urban* areas who had access to the public water network. In this scenario, expenditures reported by rural households are not replaced by the predicted values. Table 2 below compares the recorded expenditures on water with the predicted ones and the subsample water expenditures used in the regressions. As can be observed, both predicted variables have a considerably higher mean and lower standard deviation than the recorded water expenditures, compared to the subsample of private water market users only.

Table 2:
Imputation Results for Water Expenditures in Ecuador

	Observations	Mean	Std Dev	Median	Minimum	Maximum
predicted nominal expenditure, urban and rural (total sample)	4391	23935	14126	21187	694.5	96131
predicted nominal expenditure, urban only (rural remain unadjusted)	4379	19661	17325	18495	0	96781
unadjusted nominal expenditure	4347	8850	23734	1200	0	700000
subsample: private water market	324	26047	20596	20800	1380	200000

[2] Regression results are lnwater = 6.54 (.48) + .11 (.043) lnrent + 0.29 (0.069) hhsize - .92 (.23) room + .33 (.11) shower + .16 (.07) waste + .036 (.018) lnfuel + .125 (.025) lndurcon + .29 (.13) region. Standard deviations are given in parenthesis. The regression had 324 observations, an R-squared of 36.1% and returned an f-value of 22.31. One issue, which we have not dealt with here explicitely, is a possible selection bias as we restrict the regressions to the households which consume water on the private vendor market only.

Source: Authors' calculations based on SECAP (1994)

The vectors for water expenditures we will use in the consumption aggregation is 'spliced', taking the real observed water expenditures in the subsample and filling in the predicted values for all other households.

3.1.3. Underlying Assumptions of the Imputation Procedure

Imputation of price, quantity or expenditure information is applicable only under quite stringent assumptions. The above outlined imputation of water expenditures for Ecuador, building on a simple econometric relationship between water expenditures in the private water market and a variety of wealth variables, is a valid methodology only if a number of assumptions hold.

First, water of different sources and in different areas must have approximately the same quality. Otherwise one cannot expect consumers to value similar quantities of water equally. Second, water supply in the public water network must be restricted and all households in this sector must be rationed. If the public market were not rationed, we would have no theoretical ground to impute values. In fact, in a non-rationed public market, the observed prices of public and private water should only differ by the costs of arbitration between the different market segments. In the Ecuador case however, private prices of water are a multiple of the public water prices due to the fact that rationing occurs in the public market.

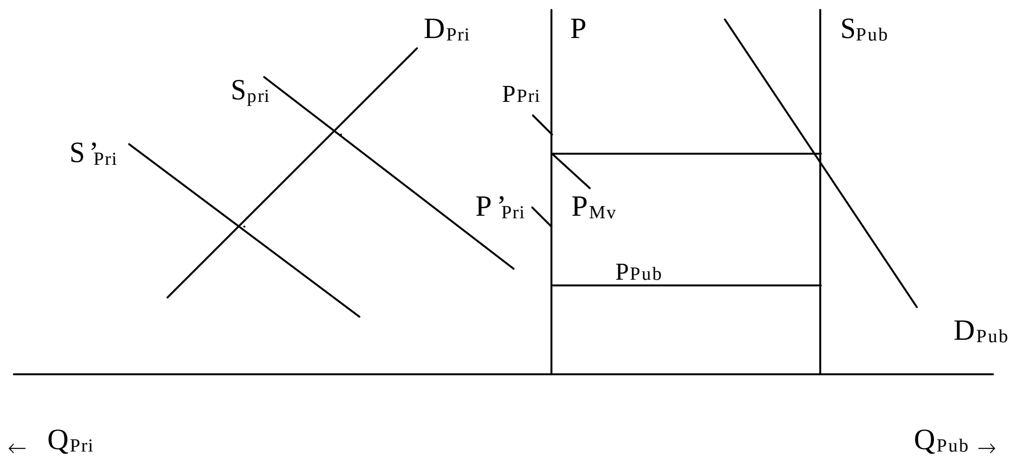
Third, and closely linked to the argument just made above, transportation and arbitrage costs between the public and private market must be pretty low. This also requires that the vendor market must be competitive with few barriers to entry and exit.

Fourth, if we apply the model prediction to the all households -- also in rural areas -- we assume that the opportunity cost of water in rural areas must be near or at the price prevailing in the private urban market. In a well integrated market the opportunity cost of consumption is obviously selling it to neighbours or even to nearby urban areas. This is probably the most binding assumption we are making as transportation and arbitration costs between more remote rural areas and more urban settings might be quite substantial. Therefore, in the alternative imputation, we only used the model to impute water expenditures for urban households.

Finally, as we are imputing expenditures and not quantities, the demand curve for public water must be highly inelastic in a small range around the current price of water in the private market. By imputing the value of total expenditures on water as observed in the private market, we implicitly calculate how much households in the other markets would have consumed had they faced the private price. The range in which the demand curve needs to be inelastic is a function of the degree of market-integration of an economy. A graph may help to illustrate this point (Graph 1). The right hand-side of the graph depicts the public network water market (with quantity Q_{Pub} increasing to the right), the left-hand side of the graph depicts the private water market (with quantities Q_{Pri} increasing to the left). S_{Pub} and D_{Pub} are the public network supply and demand curves, S_{Pri} and D_{Pri} depict the private water market supply and demand. P_{Pub} is the water price per cubicmeter charged by the public water utility, P_{Mv} is the marginal value of water consumption in the public water network and P_{Pri} is the price for a cubicmeter of water paid in the private market.

As depicted in the right-hand side of the graph, a gap exists in the public sector market between the water tarif (P_{Pub}) and the marginal value to the consumer (P_{Mv}). The public network market is characterised by rationing, i.e. households can generally not consume as much water as they want but are restricted to use it during certain times of the day -- sometimes the water supply is stopped for whole days if water is in short supply. This implies that private consumers are not able to equate the price they are charged by the water company with the marginal value they attach to the consumption of the last water unit.

Graph 1: The Private and Public Water Market in Ecuador



Why do we have to assume that the demand for water in the public network market is completely inelastic around P_{MV}? By imputing the value of total expenditures as observed in the *private market* section, we implicitly calculate how much households in the *public network market* would have consumed had they faced the private market price. Since we want to make water consumption by different households comparable, we would ideally hope that their water consumption does not change if the private water price differs somewhat from the marginal value of consumption in the public network market -- hence the assumption of a highly inelastic supply curve in the public water market around the actual (but unobservable) P_{Mv}.

We can determine the range of the public network demand function in which we require low elasticity by describing an upper and lower bound of the private market price (since we implicitly use this price in the imputation) in relation to the marginal utility in the public market. The upper bound price in the private sector market is characterised by the marginal value of water to the consumer in the public market (P_{Mv}) plus transaction costs. This can easily be established by asking at what price consumers connected to the public network would be willing to sell the water they receive. This price has to be at least as high as the marginal value of water plus any additional transaction costs they would have to incur in order to sell the water. This provides us with an upper limit for the price in the private water market because competitive forces will keep the private vendor price from rising above this level -- if the margin of the private market price over the marginal value to the consumer in the public market would grow substantially, more private vendors would emerge and would drive the private market price down.

But we can also establish that the public network market price (P_{Mv}) will not be significantly above the private vendor price (P_{Pri}) either. Suppliers of water to the private market will not only use water from the public network but also wells, rivers or even rain water. If the private supply function S'_{Pri} were to cross the private demand function significantly below the marginal value of public water of the public consumers establishing a price P'_{Pri} , we would actually observe that the consumers connected to the public network would diversify their water sources and, in addition to water from the water company, also demand water from the private vendors. But we do not observe this in reality -- only very few of the households connected to the public network in Ecuador report that they use both public and private water sources to satisfy their water demand. Consequently, we can safely assume that the lower bound of the private sector market price is the marginal value of public water minus transaction costs.

If transaction costs are relatively low within urban areas, then the possible price variation between the imputed private market price and the marginal value of the consumer of public water is also low so that the relevant range of the demand function D_{Pub} is quite small. This does not hold once we introduce imperfections in the market such as risk-averse consumers. If only well-established vendors, who might have to drive a water truck and not simply carry buckets of water, possess consumer confidence, such a market imperfection exits. It acts like a barrier to entry and allows the vendor to apply monopolistic pricing which enlarges the range for which we require inelasticity on the demand curve.

It is generally believed that the demand for water is price inelastic which justifies an imputation of water values.[3] Water is an essential consumption good for drinking and

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[3] Arcia and Bustamante (1992, p.8) cite a price elasticity of demand for water in Quito, Ecuador, of -0.1.

washing. While we can envision a higher price elasticity for high incomes (as water is used for luxury goods as swimming pools and gardening), we can assume that the elasticities for the poor or near poor -- for whom an imputation of water values could have an impact on welfare rankings -- are small. With a low elasticity in the above-shown small relevant range of the public demand curve, the imputation of water values becomes an option which is defensible on theoretical grounds. As mentioned above, the most stringent assumption is to assume that transaction costs are also low between rural and urban areas which would then justify imputation of water expenditures also for rural households. This assumption is very difficult to test so that we have relaxed it in one scenario and imputed values only for urban public network consumers.

3.2. Subsidy without Rationing: Cooking Gas

Cooking gas in Ecuador today is highly subsidised. With the nominal price of cooking gas (LPG) fixed at 2900 sucres, the total LPG subsidy is growing rapidly due to increases in demand (about 15% per annum) and non-adjustment for the devaluation of the sucre. While the ratio between the domestic subsidised price to the international price was about 1:4 in 1994, it reached a relation of 1:6 in 1996. Consequently, the subsidy grew from about $US120 million dollars in 1994 to about $US200 million in 1996. The domestic market is highly regulated with the National Directorate of Hydrocarbons determining how much gas is bottled and sold by company and per geographic area.

In contrast to water, access to cooking gas is not restricted and no demand rationing takes place. About half of Ecuador's LPG consumption is produced domestically, half is imported and the Government is currently committed to import even larger quantities to satisfy domestic demand at the artificially low price. LPG is traded in bottles which are sold through a network of six private companies in the whole country, reaching even the remoter rural areas. Hence, households are not rationed in their demand for LPG and access is free as no public connection is necessary.

For household welfare measurement, we can include the nominal expenditures on cooking gas in the consumption aggregate. With the market characterised neither by entry barriers nor rationing, households will demand LPG up to the point for which they equate the (fixed) price to their marginal utility. It would hence be wrong to include the subsidy component in the welfare measurement. This would measure the true economic costs to society (the non-subsidised price) but not the marginal utility to consumers (the subsidised price).[4]

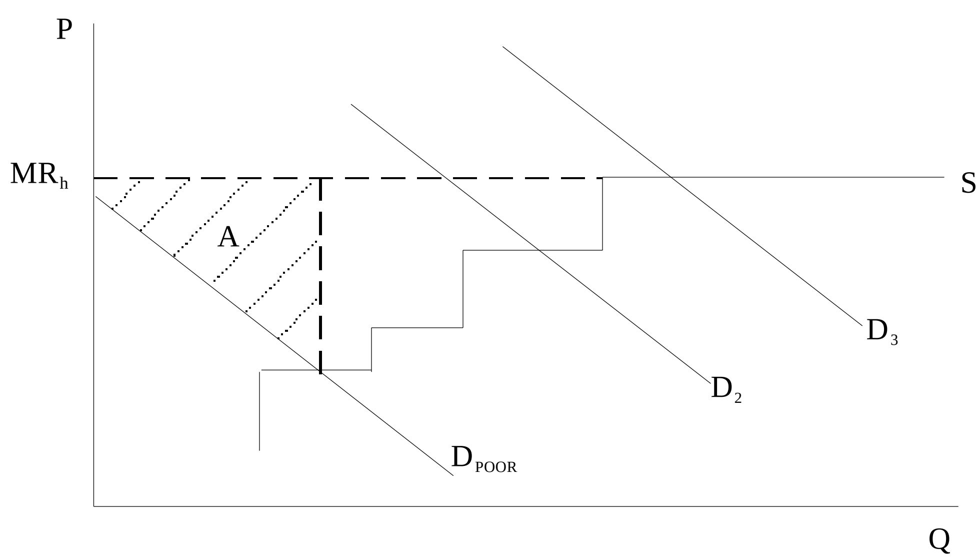
3.3. Increasing Marginal Tariff Rates: Electricity

If prices of public services vary with the consumed quantity, adjustments have to be made. A typical case in many countries -- and also in Ecuador -- is the electricity sector. The public utility company charges customers increasing marginal tariffs. Hence, the average price for the consumption of a kwh varies with the consumption level. As argued earlier, for welfare comparisons, we would ideally want to measure quantity consumed at a constant price, but here the price paid per unit of electricity is higher for the heavy users of electricity than for those with low consumption of electricity. From the perspective of welfare rankings, this might not be too disturbing because the distribution of nominal expenditures on electricity will essentially only overstate the distribution of welfare from electricity use - it is not the case that nominal expenditures give a false ranking of households' consumption of electricity. However, while we might be concerned mainly with the welfare rankings which obtain with our final consumption aggregate (and would therefore not be too concerned with a final consumption measure which overstates the total distance between households), actual expenditure *levels* are important at the component level. It is easy to construct examples where transformations of component expenditures, which leave unaffected the welfare rankings within those components, lead to major rerankings at the aggregated level.

4 Additionally, adjusting for the subsidy would also imply that consumers do not change their demand behaviour while facing a sixfold increase in the price of cooking gas. While the demand elasticity for cooking gas is likely to be very small, it is generally not found to be zero (see Hope and Singh, 1995).

Usually household surveys, such as the Ecuador LSMS, supply the analyst only with a total nominal expenditure for electricity, making it difficult to ascertain what quantity was actually consumed. However, as the tariff schedule (including fixed connection costs) is available from published sources, we are able to derive actual electricity consumption by calculating threshold levels of consumption which will place the household in a specific marginal tariff bracket. Once quantities consumed have been derived, a uniform price can be applied. As figure 2 shows, the choice of a uniform price is not easy. Different households demand different quantities of electricity, paying different marginal tariff rates. Applying, for example, the highest marginal tariff rate across all consumer classes (MR_h) would return a high welfare of poor households (area A higher than original welfare). Alternatively, applying the lowest marginal tariff rate would return a low welfare measure of richer consumers.

Graph 2: The Electricity Market



We apply as a proxy price the average cost of electricity consumption per kwh across all consumers, in line with the general principle outlined above that we seek to evaluate consumption at the 'average' marginal utility to consumers. Note, if rationing also occurs in the electricity market, marginal value will exceed prices actually paid. During the time period the survey was fielded no significant powercuts took place in the electricity market (July -- October 1994) although this situation has changed since. As our base for welfare comparisons is the period during which the survey was fielded, we decided to stay within the non-rationing environment and evaluated all electricity consumption at its average price to consumers.

4. Poverty Measures, Household Rankings and the Pricing of Basic Services

How significant are the above mentioned adjustments in basic services markets for making household welfare comparisons in Ecuador? To investigate this question, we compare a number of different combinations to treat the three different basic services markets in Ecuador and include them in a consumption aggregate to measure household welfare. Apart from the household expenditures on electricity, gas and water, the consumption aggregate includes food expenditures, housing, consumer durables and a variety of other non-food expenditures (see Hentschel and Lanjouw, 1996).[5]

While expenditures for basic services typically constitute only a relatively small fraction of total household expenditures, the Ecuador case shows that their measurement can have a quite substantial impact on poverty measures. Table 3 below compares the incidence and the poverty gap which obtain at the lowest of three poverty lines which were developed in the Ecuador Poverty Report (World Bank, 1996) for three different aggregate consumption measures; this is the extreme poverty line which is derived from valuing a basic basket of food items in various parts of the country and characterising those households as extremely poor who can not even purchase this very basic basket even if they spent their total expenditure on food. This extreme poverty line is invariant in the computations shown in the table.[6] These differ only with respect to the inclusion of water and electricity

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[5] See Deaton (1994) and Ravallion (1994) for using consumption as a welfare measure.

[6] The extreme poverty line is 'fixed' as it only consists of food products. If we were to compare expenditures against a poverty line which incorporates some allowances for non-food items, the

expenditures. As explained above, we have not adjusted for subsidies in the gas market as consumers are able to equate their marginal utility in consumption to the prevailing market price. The first column takes as a benchmark a consumption aggregate concept which includes the non-adjusted expenditures values in the water and electricity markets. We set a series of statistics describing the distribution of this consumption aggregate to 100 and examine deviations from this index value as we allow the consumption definition to incorporate alternative adjustments. The consumption aggregate in the second column represents adjusted water (rural and urban imputations) and electricity expenditures while the consumption concept in the third column also makes adjustment in both markets but applies water imputations to urban households in Ecuador only. As can be seen, the incidence of extreme poverty (fourth row) varies quite markedly with the different concepts, dropping by 19.3 percentage points, and by 8.9 percentage points between the first and third column.

It is possible to calculate whether the estimates are significantly different from each other by calculating variances and covariance's of the poverty estimates, taking into account that they are derived from a non-random sample design (see Appendix). We find that making the above described adjustments causes highly significant changes in the poverty estimates.

line itself would change in the different scenarios as it varies in accordance with the share of non-food expenditures in total expenditures (see Lanjouw and Lanjouw, 1997).

Table 3: Consumption and Extreme Poverty Indicators for Alternative Consumption Concepts, Ecuador, 1994

consumption & poverty (index)	nominal gas nominal electricity nominal water	nominal gas adj. electricity adj. water (rural & urban)	nominal gas adj. electricity adj.water (urban only)
mean consumption	100	103.6	101.9
consumption of bottom 20 %	100	106.5	103.7
consumption of bottom 40 %	100	105.0	103.7
extreme poverty rate	100***	80.7***	91.1***
poverty gap	100***	80.6***	94.0***

Source: Ecuador Living Standard Measurement Survey, 1994.
*** estimate is significantly different from the other two estimates in the row entry at the 99% confidence level. See Appendix for discussion.

While we detect a pronounced variation in poverty measures due to the pricing of basic services, the influence on the poverty profile is not that significant. We illustrate the degree of re-ranking which occurs on the basis of a transition matrix which compares how the population welfare rankings change if we vary the definition of consumption. In Table 4, if members of each decile under the 'unadjusted' consumption definition (column 1 in Table 3) are found to be highly represented in the corresponding decile under our preferred consumption definition (column 2 in Table 3), then 'mobility' across definitions will be low and the characteristics associated with the population groups are relatively invariant with respect to the consumption definition. As can be observed in the table, rerankings are relatively small and only in the fifth decile are more than 10 percent of the population re-ranked.

Table 4:
Transition Matrix Comparing Household Welfare Rankings Between Nominal Consumption Measure and Preferred Consumption Aggregate

Preferred Consumption Aggregate

Decile	1	2	3	4	5	6	7	8	9	10
1	0.98	0.02	0	0	0	0	0	0	0	0
2	0.02	0.96	0.02	0	0	0	0	0	0	0
3	0	0.02	0.94	0.04	0	0	0	0	0	0
4	0	0	0.04	0.92	0.05	0	0	0	0	0
5	0	0	0	0.05	0.89	0.06	0	0	0	0
6	0	0	0	0	0.05	0.93	0.03	0	0	0
7	0	0	0	0	0	0.04	0.94	0.02	0	0
8	0	0	0	0	0	0	0.04	0.95	0.02	0
9	0	0	0	0	0	0	0	0.02	0.96	0.02
10	0	0	0	0	0	0	0	0	0.02	0.98

Source: Authors calculations based on SECAP (1994).

5. Concluding Remarks

Many countries continue to rely on access to basic services for the measurement and distribution of poverty. Officials in these countries feel that consumption indicators derived from household surveys pose serious problems for the measurement of poverty because many basic services like water, electricity or gas are purchased by consumers at widely varying prices. As a result, consumption aggregates based on nominal expenditures, it is sometimes argued, do not reflect real welfare levels.

This paper discussed when and how adjustments in expenditures derived from household surveys in markets for basic services can be made. We started from the basic notion that household welfare is approximated by real consumption of individual goods, which should be measured at the same price across households and individuals. Further, this price should reflect the average marginal utility to the consumer. Rationed markets, in which the observed price differs from the marginal utility to the consumer, thus require adjustments to arrive at correct welfare rankings of households. Markets which are subsidised only require adjustments if they lead to rationing -- subsidies per se do not pose a problem. Using Ecuador as an example, we showed how simple adjustments can be made for markets like water (where often the affluent urban population has access to subsidised public water and the poor population depends on the private market) and electricity (where increasing marginal tariff rates lead to different prices per kwh). Highly subsidised cooking gas in Ecuador is an example of a market which does not require adjustments because consumers are not rationed. We point out that assumptions of imputation procedures are stringent, however.

Finally, we compared the sensitivity of poverty indicators and the poverty profile to adjusting nominal expenditures for basic services in Ecuador. While the poverty profile showed relatively little changes, poverty indicators (headcount and poverty gap for extreme poverty) changed statistically significantly. The results point to the importance of careful analysis and correction of markets for basic services when deriving welfare measures from household surveys.

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Appendix: Conducting Significance Tests for Poverty Rates Derived from a Non-Random Sample

Calculating the t-statistic for a test with the null-hypothesis that two poverty measures p1 (for poverty criteria 1) and p2 (for poverty criteria 2) are equal takes the general form:

$$t = \frac{p_1 - p_2}{\text{Var}(p_1) + \text{Var}(p_2) + 2\,\text{Cov}(p_1, p_2)}$$

where Var (p1) and Var (p2) are the variances of the poverty measures and Cov (p1, p2) is their covariance. Following Ravallion and Datt (1995) the covariances can be calculated as

$$\text{Cov}(p_1, p_2) = [1+\text{var}(w)]\,(p_{12} - p_{1*}p_2)\,/\,n$$

with p12 an estimate of the poverty measure applying both poverty criteria, n the sample size (households) and w representing the sample weights needed to match the survey with the population. The individual weights wi are defined so that

$$n = \sum_i w_i$$

In clustered and stratified samples the weights wi will vary between households while they will be the same in strict random samples. Further, if poverty measures are derived from independent distributions (see Kakwani, 1993), then p12 = p1*p2 which will result in a zero covariance term. In our case the covariance term is high since the two poverty measures are derived from total consumption definitions which differ from each other several (electricity, gas, water) but by far not all components.