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Toward Defining and Measuring the Affordability of Public Utility Services

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Abstract

This paper reviews the progress made in the literature toward defining and measuring the affordability of utilities. It highlights the relative merits of alternate affordability metrics; the practical challenges to their operationalization, including the underlying data requirements; and their implications for the design, evaluation, and implementation of appropriate affordability programs.

This paper—a product of the Environment and Energy Team, Development Research Group—is part of a larger effort in the department to address issues related to the pricing and affordability of public utility services. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at ikessides@worldbank.org.

Toward Defining and Measuring the Affordability of Public Utility Services

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Introduction

In recent years, there have been increasing concerns about how privatization and market-liberalization reforms in the public utility industries have been affecting low-income households in developing and transition economies. Moreover, escalating energy prices have given rise to real and growing affordability problems for many utility customers in the advanced industrial countries. Indeed, there are frequent press reports on the economic hardships faced by households that are struggling to pay their rising utility bills and are forced to choose between paying for food and medicine, and making their homes livable during the coldest months of winter and the scorching heat of the summer. And these distressing affordability problems are likely to become exarcebated in the context of the current global financial crisis. There is also growing anxiety about the potential impacts of the costs of addressing climate change on the price consumers must pay for energy, transportation, and more indirectly food, housing, and other essential products and services.

State-owned monopolies provided most utility services in developing and transition economies until the early 1990s. However, in the face of growing fiscal pressures, extraordinarily low levels of operating performance, rapid technological change, and a revolution in economic thinking, many governments began to reject the model of monolithic state-owned utilities, introducing a combination of institutional reforms that included privatization, regulatory reform, and competition in areas where it was viable. Although these changes were generally an integral part of reform programs intended to improve efficiency, remove constraints on investment, align tariffs with costs, and reduce the fiscal burden imposed by loss-making state-owned utilities, many observers were concerned that these reforms might have a negative impact on low-income households.

In particular, some worried that competition would make the traditional method of financing access for low-income households--cross-subsidies from higher income customers--more difficult. The fear was that new competitors entering the market would target only the most profitable customers (“cream-skimming”), eroding the profits that incumbent enterprises had used to subsidize service to low-income groups and high-cost areas. Consequently, even if privatization and competition resulted in

system expansion and lower average tariffs, it was thought that low-income households might end up paying higher prices and governments might need to find ways of financing universal access. Thus, policymakers in the developing and transition economies (DTEs) seemed to have been suffering from an apparently irreconcilable dilemma. Their own understandable predilections, supplemented by powerful political pressures, led them to impose a set of cross-subsidies in the pricing of basic infrastructural services, favoring household customers at the expense of business and industrial customers, isolated farmers at the expense of those near the source of supply, and the like. At the same time, in recent years these policymakers sought to competitively restructure, liberalize and privatize their public utilities.

Others have argued that with the exception of the water sector, the stress on social equity in the context of the public utilities is largely misplaced--electricity and telecoms are valuable enough even to the poor to pay cost-reflective prices. The evidence from successful rural electrification in poor countries (e.g., Bangladesh) and elsewhere suggests that apart perhaps from fixed connection costs, consumers are willing to pay the full costs. Still, in most countries there has been insufficient investment in the maintenance of existing public utilities' infrastructure. Especially in the developing countries, prices during the pre-reform era fell to levels that could not sustain a rate of investment out of retained profits to meet demand growth. Thus, the reality is that many utilities around the world will need to continue raising their rates in order to realign them with underlying costs. Rising utility bills will inevitably burden the poor and other disadvantaged groups. And as it is often pointed out, in essence correctly, the issue is the ability to pay and not the willingness to pay higher utility rates. Affordability is an issue and affordability analysis should be an integral part of every utilities reform program. However, as frequently claimed, affordability was not addressed carefully in the privatization and other utility reforms of the past two decades (AFUR 2009).

At the intutive level there is considerable agreement on what affordability means--ability to purchase a necessary quantity of a product or level of a service without suffering undue financial hardship. However, like poverty, this is a complex notion that gives rise to a host of semantic, substantive, and definitional issues and utlimately can be unpacked in a variety of different ways (Stone 2006). Efforts to

devise objective measures of affordability have been hampered by the substantial heterogeneity in people's needs and resources and the generally poor correlation between affordability and acquisition (Milne 2004). While it is widely accepted that basic utility services should be affordable, what this actually means in practice is rarely defined and even less often carefully measured.

This paper reviews the progress made in the literature towards defining and measuring affordability of utilities. It highlights the relative merits of alternate affordability metrics, the practical challenges to their operationalization including the underlying data requirements, and their implications for the design, evaluation, and implementation of appropriate affordability programs.

Public Utilities Pose Special Affordability Challenges

This paper's focus on the public utilities is motivated by the unique economic characteristics of these industries, which make them a natural target for government intervention and render the balance between economic efficiency and social equity/affordability particularly delicate. These characteristics include (Farsi *et al* 2008; Spiller and Savedoff 1999):

- Extensive economies of scale and scope that generally inhibit competition and thus lead to tight oligopoly/monopolistic organization.
- High ratio of sunk costs to fixed and variable (avoidable) costs that give rise to industry-specific barriers to entry.
- Services that are deemed "essential" to a broad range of users, making the provision and pricing politically sensitive.

The inherent substantial network economies (scale, scope, and joint production) promote concentration and discretionary behavior in pricing, network expansion, and bilateral dealings. Significant sunk costs exacerbate the problem of market power and virtually ensure that private unregulated pricing and investment decisions will not be socially optimal. Thus, concerns about market failure due to natural monopoly, the need to exploit all of the inherent network economies, and the critical importance of utility services has led to the judgement that in these sectors the public interest would be served better by the supersession of the market by an extensive and coherent system of governmental controls—i.e., a centralized system of governance (Trebing 1996) or

regulated vertical integration (Newbery 1999). Indeed, for most of the previous century and in most countries fairness—encompassing the fundamental goals of reasonable rates, absence of unjust discrimination, and universal service—and efficiency in the provision of basic utility services have been sought through the public utility paradigm of governmental ownership and regulation.

The Deficiencies of the Historic Model…

Initially, the state-owned, monolithic utility model produced reasonably satisfactory results (Fare *et al* 1985). In recent years, however, it has proven increasingly unsuited to changing market and technological conditions in both industrial and developing countries. And it ultimately has led to serious problems for the public interest. The demonstrated difficulties of effectively monitoring public enterprises and their attendant problems of inefficiency, waste, and lethargy of operations, have raised serious doubts about the efficacy of public ownership, even in utility industries where strong propensities for market failure exist due to natural monopoly. Moreover, inter-country experience has clearly demonstrated the extreme difficulty of insulating public enterprises from the damaging consequences of fluctuating political interference. The politicization of public utilities' business has often resulted in poorly managed companies, with political rather than economic decisions triggering investment and the pricing of many important services.

Especially in developing countries, public utilities were plagued by three related problems (Kessides 2004):

- Chronic underinvestment—causing significant deterioration in service quality and seriously undermining providers' ability to respond to new demands and expand service. As a result large portions of rural and poor urban populations lack access to basic services.
- Underpricing—with both the level and structure of prices conflicting with the dictates of economic efficiency and arguably with social equity as well.
- Extraordinarily low operating and financial performance—with inefficient public utilities draining state budgets, diverting resources from other essential services such as health and education, and impeding domestic economic growth and international competitiveness.

The key problem of the old model was underinvestment in large part caused by underpricing. The state-owned utilities (and not just in DTEs) have proven hopeless at

attributing the right cost of capital, particularly in high inflation periods, so that prices fell to levels that could not sustain a rate of investment out of retained profits to meet demand growth. Thus, inefficient pricing policies have been one of the most important causes for the secular deterioration in the performance of the public utilities in the DTEs prior to the reform era. These countries, unfortunately, were in even less of a position to afford the costs of resource misallocation and inefficiency in production than their developed counterparts. Price controls were imposed in disregard of the performance implications of the pricing rules involved, subjecting the operating entities to considerable financial distress and substantially impairing their ability to maintain and expand service, especially in poor and rural areas. As a result, a significant portion of the population in many developing countries remained without access to basic utility services. Moreover, the failure of many governments to prescribe adequate rate increases effectively decapitalized their public utilities. Quality of service often suffered. The consequent inability of financially impaired utility industries in the DTEs to respond sufficiently to the increasing demands of modernized economies for reliable utility services constrained these countries' domestic growth and hampered their international competitiveness.

Another notable characteristic of past public policies in the infrastructure sectors is that they have led to prices with systematic elements of cross-subsidization (Baumol 1996; World Bank 1994; Kahn 1984). The publicly articulated rationales for these policies is that they foster desirable social goals (e.g. helping certain classes of customers who would otherwise be disadvantaged) and positive economic externalities like those associated with universal service. In actual practice, however, a substantial portion of the benefits frequently flowed to those outside of the intended ambit of the subsidy program. The lack of strong policy attention to tight targeting led to significant distortions in usage and investment decisions. Moreover, both economic theory and regulatory experience suggest that it is impossible to maintain significant cross-subsidies in the structure of prices for long, with open entry and no remedial policies, whether or not that would seem to policy makers to be desirable. Thus, policy makers in the DTEs were increasingly confronted with a seemingly irreconcilable dilemma because of the alleged incompatibility of cross-subsidies with the promotion of market liberalization and competition (Baumol 1999).[1]

…And the Challenges in the New Paradigm

Pricing reform has been a key component of almost every reform program in the public utilities and remains one of the most important and challenging tasks facing policymakers in the DTEs. Indeed, the historic policies of under-pricing and cross-subsidies in the public utility industries are being reversed in many countries around the world. The observed realignment of prices with economic costs is surely necessary both for the revenue adequacy of operators and for the public interest. Clearly, pricing policies that led to fiscal drain, under-investment and inadequate maintenance did not serve the public well in the long run. Moreover, despite their purported focus on social equity, the historic pricing policies of most DTEs did not serve the poor well either, since many of them have not had access to basic infrastructural services (Estache and Fay 2007).

Public utility services are often regarded as "essential" both to the public and to the effective functioning of the economy. Some of these services also tend to be extremely price and income inelastic. Thus, their pricing has important distributional implications. Subsidizing basic services, such as electricity and water, appears politically attractive as it can approximate a lump-sum grant, targeted in proportion to the number of household members. Conversely, raising the price of basic infrastructural services appears like a lump-sum tax bearing heavily on the poor, elderly, and those with large families (Newbery 1999). Not surprisingly, the movement towards cost-reflective tariffs frequently encounters strong political obstacles. It is also, at least partially, responsible for the growing disenchantment with privatization reforms in Latin America and other parts of the world (Andres *et al* 2008).

If the problem of underinvestment and poor quality is largely due to underpricing, then prices will have to rise and existing consumers will be upset. New consumers have little political voice and may not realize that the counterfactual is one in which they are unserved. Moreover, if the international financial institutions are no longer willing or able to bail out governments, then the choice is either more taxation or higher prices. The latter will fall on those who benefit, and who are likely to be middle class and richer consumers, while the former is likely to be partly via inflation taxes which hit the poor, or more cash dependent parts of the population. If taxes are not raised,

expenditure elsewhere will suffer, and again it is likely that the more deserving will lose the benefits of increased public expenditure.

In view of the critical role of the public utilities, it is imperative that the removal of pricing distortions in these sectors be a key component of any economic reform program in the DTEs. However, it is worth emphasizing that as a matter of policy, there are good reasons to avoid too abrupt price changes. It is well known that abrupt and substantial price changes cause large and unnecessary adjustment costs to consumers and firms alike, and can lead to significant affordability problems. Even optimal prices, if instituted extremely rapidly and without sufficient notice, can lead to a transition process that is damaging and costly and hence really far from optimal (Baumol 1995). This is a point that has been unfortunately ignored in some privatization and restructuring programs, thereby creating public disenchantment with the reform process and a real danger of policy reversal. This does not, of course, mean mere postponement. On the contrary, policy makers need to plan early on for a smooth and deliberate transition to efficient pricing levels and structures—a transition that is designed to minimize the affordability burden.

Another characteristic of the public utilities that renders the balance between economic efficiency and fairness/affordability delicate is the prevalence of large fixed and common costs that make it impossible for the supply of their services to become financially self-supporting with marginal cost pricing. Indeed, the most striking feature of these industries is that a significant portion of their costs cannot properly be attributed to any of their services in particular at a specific point in time. That is, in each utility, a significant proportion of costs are incurred on behalf of several of the utility's activities and do not vary with the amount of the service provided (Kahn 1988). The apportionment rules for allocating these fixed and common costs can have important implications for economic efficiency. They may also conflict with politically acceptable notions of fairness and can give rise to affordability concerns (Jones and Mann 2001; Costello 1998).

No public policy can be justified on purely economic grounds if the polity regards its results as unjust. There is a strong emerging consensus that the worldwide policies of privatization and market liberalization in the public utilities have brought about significant benefits in terms of enhanced productivity and cost-effectiveness, greater

responsiveness to consumer and business needs, and increased investment driven by market incentives rather than bureaucratic preference (Gassner *et al* 2008). However, there are also concerns that are increasingly being expressed about the distributional consequences of these reform programs--especially their impacts on the affordability of basic service provision to poor households and other disadvantaged groups.

Defining and Measuring Affordability

There is a vast and growing literature evaluating the changes in consumer welfare due to innovation and restructuring in the supply of public utility services. Foster, Tiongson and Laderchi (2005) review the different strategies of analyzing the social impacts of utility market reforms. The approaches are remarkably heterogeneous both in terms of their analytical foundations and data requirements. The welfare impact assessment can rely upon standard neoclassical economic analysis and therefore it may provide estimates of the changes in consumer surplus induced by the joint changes in the price of, and access to, utility services (Lampietti 2004; McKenzie and Mookherjee 2003). Alternatively, it is based on the calibration of computable general equilibrium models estimating the impacts of price adjustments on the poverty and inequality among different household groups (Jensen *et al* 2008; Boccanfuso *et al* 2006 and 2007; Chisari *et al* 1999). Such an assessment could also rely on the willingness to pay for utility services estimated from discrete choice household surveys (Wang *et al* 2008) or stated preference conjoint surveys (Yang *et al* 2006). Finally, many social impact assessments refer to some affordability concept usually based on a "burden-threshold" of the household's total income [Barrantes and Galparin 2008 (telecommunications); Estupinan *et al* 2007 (urban transportation); Fankhauser and Tepic 2006 (energy and water); Carruthers *et al* 2005 (transportation); Navas-Sabater *et al* 2002 (telecommunications); Foster and Tre 2000 (energy); Milne 2000 (telecommunications)].

Changes in prices are often associated to changes in the quality of the services provided, but the potential benefits of improved quality are difficult to estimate mainly due to measurement problems, and are thus rarely considered (Klytchnikova and Lokshin 2007). Improved access to good quality utility services may significantly impact on many determinants of some key non-monetary dimensions of well-being (e.g.

health and environmental conditions, or participation in the social life of the community). This calls for a multidimensional analysis of well-being that merges a quantitative approach with a qualitative one (Kanbur 2003). The UNDP's Human Development Index is an attempt to combine monetary and non monetary dimensions (education and health), but the debate on the suitable ways to combine the income/consumption poverty approach with the deprivation and social exclusion approach is still ongoing (see Kakwani and Silber 2008, for the methodological debate; and Boarini and d'Ercole 2006, for a survey of the practices in OECD countries). Finally, there are cases in which the estimated measures of welfare change are not consistent with the public opinion discontent about the reforms (Di Tella *et al* 2008; Lora, 2008; Carrera *et al* 2004). And there is a long lasting debate on how to exploit both "objective" and "subjective" information (see Eroglu 2006, and the references therein).

Within this framework, the affordability indices can be seen as welfare indices which combine the standard poverty approach with a deprivation assessment. They can be used to provide information on the direction and magnitude of changes in consumer welfare due to changes in tariffs, increased enforcement of utility contracts, and legalization of illegal connections. An *ex ante* affordability analysis may help to identify the target population of the mitigation actions which may accompany price changes (as in kind or cash benefits, or the introduction of social tariffs) as well as groups who will oppose the innovation. An *ex post* analysis in the same direction may help to better understand the causes of the discontent.

In what follows, we first present a survey of the measures usually adopted to evaluate affordability in public utility sectors - mainly relying on Miniaci *et al*. (2008a). In so doing, we explain why the standard headcount and poverty gap indices - based on actual and/or potential household consumption - are not satisfactory in describing the affordability issue. Moreover, we present new measures based on residual income and we discuss how to take into account investments in infrastructure which, in turn, may be needed to connect more customers and improve service quality.

Indices Based on Budget Shares

A useful construct to assess the burden of utility spending is the utility affordability ratio—i.e., the percentage of household budget devoted to paying utility bills (Fankhauser *et al* 2008). Some authors refer to indices which adapt standard poverty income measures to the case of public utility consumption. Within this framework, an affordability summary statistic can be provided by the percentage of households who spend on utility services more than a given share of their budget (Fankhauser and Tepic 2007).

Formally, let us label x_h the total expenditure of household *h*, which can be considered as the sum of x_h^u, the observed expenditure for utilities (*u*), and x_h^c, the household's expenditure for all other goods. The standard practice suggests to classify a household *h* as one which suffers an utility affordability problem (i.e. its utility costs represent an "excessive burden" on its income/budget) if its expenditure share for utilities – that is $r_h = \frac{x_h^u}{x_h}$ – exceeds a given critical "burden-threshold" level r^u. A basic headcount index *HI* based on the above affordability ratio is given by the fraction of households with $r_h \geq r^u$, that is:

$$HI \equiv \frac{\sum_h 1\left(r_h \geq r^u\right)}{N}$$

where *N* is the total number of households, $1(\cdot)$ equals one if its argument is true, zero otherwise.

To understand how the headcount statistic *HI* works, and its logical flaws, it is convenient to have a look at Figure 1 below, in which we define first the absolute poverty (budget) line as $x^p = p_u q^u + p_c q^c$, where $x^p = p_u q^{up} + p_c q^{cp}$, q^{up} and q^{cp} are the minimum quantities respectively of utility services and of other goods necessary to reach a decent standard of living, and where p_u and p_c are their corresponding prices. It should be noted that the socially-desirable minimum standards of the two goods q^{up} and q^{cp} are likely to vary with the composition and size of the household, climatic conditions and other regional differences.[2]

The index *HI* tells us how many households spend more than a "reasonable amount of money" for utility services. All households whose total expenditure falls below the poverty line are poor (area A + B)—in the sense that they cannot afford to purchase the socially-desirable minimum standards of utility services and the other goods. However, among them, only those whose ratio r_h lies above the ray r^u are classified as facing affordability problems (area A). The remaining poor households (B) are considered not having affordability problems, even if they may be unable to afford heating their houses ($x_h < p_u q^{up}$). A non-negligible fraction of non-poor households may be classified as facing affordability problems, even though their total expenditure is well above the poverty line (area C in Figure 1). Moreover, note that according to this definition, households without access to the service – or household which are abusively connected to the service - are not considered as having any affordability problem at all.

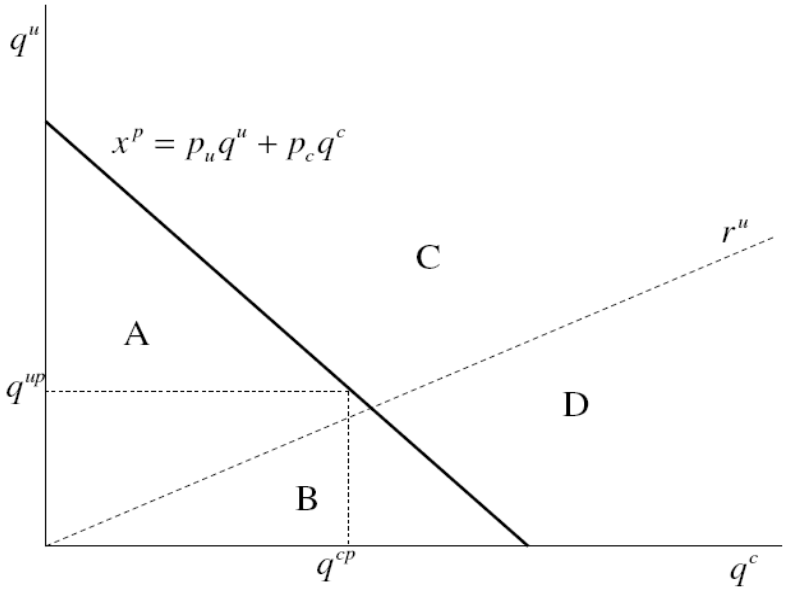

Figure 1: The absolute poverty line and the *HI*

Thus, the affordability ratio r_h and its associated headcount statistic *HI* lack specific consideration of the household's ability to pay. And they do not explicitly incorporate any information about the socially-desirable minimum levels of consumption of utility services and the other goods. As a relative measure, r_h does not distinguish between households with widely different budgets/incomes--a household with $100/month utility expenditures and income/budget $1,000/month would have the

same affordability ratio as a household with $500/month utility expenditures and income/budget $5,000/month (Chaplin and Freeman 1999).

Any subsidy program based on the affordability ratio and the associated headcount statistics will inevitably suffer from poor targeting and thus lead to undesirable consequences. Households with the poorest affordability (area B) will be ignored while those with no genuine affordability problems (area C) could end up receiving the bulk of the subsidy. Similarly, employing these constructs to assess the impacts of tariff rebalancing on affordability is liable to lead to misleading estimates and policy conclusions. An increase in p_u could lead to a substantial increase in area C—i.e., the number of households who have no genuine affordability problems but are counted as being utility poor—and thus erroneously signal that the underlying policy reforms give rise to severe affordability problems. Furthermore, in many empirical applications of *HI*, the heterogeneity in households' size and incomes, as well as the disparities in regional infrastructure, in the equipment and quality of the items consumed appear to be neglected.

Another issue which typically remains outside the analysis is the "depth" of the affordability problem. This latter feature is specifically addressed by the "poverty gap index" (*PGI*) which takes into consideration the distance between the actual share r_h and the critical threshold r^u as follows:

$$PGI \equiv \frac{\sum_h 1\left(r_h \geq r^u\right) \times \left(r_h - r^u\right)^\alpha}{N}$$

where $\alpha \geq 0$ represents the policy-maker's concern for the depth of the affordability issues (with $\alpha = 0$, $PGI = HI$). This index mimics the standard FGT poverty index (Foster *et al* 1984), it is additively separable, meaning that it can be calculated for different household types and aggregated using a weighted sum, where the weights are given by the fraction of households falling in each type relative to the total number of households.

Indices of Potential Affordability

Remaining within the same logic, which looks at budget shares, notice that both the *HI* and *PGI* indices can be calculated referring to what consumers actually spend (actual consumption levels) or to what they "would" spend to buy a pre-specified

quantity of services (standard consumption levels). From the policy maker's viewpoint these two reference points lead to very different considerations. Indeed, policy makers can operate in a situation where actual consumption levels may be "too high" (e.g., because of inefficiency or artificially low prices) or "too low" (e.g., because of extreme poverty conditions). If this is the case, it may thus be appropriate to construct *HI* and *PGI* on the basis of standard consumption levels, that is, quantity of services considered necessary for a decent standard of living. The budget share to look at, could therefore be defined on the basis of the necessary basket of utility services q^{up} as follows :

$$r_h^* \equiv \frac{p_u q^{up}}{x_h}.$$

Which allows us to write the following two new indices:

$$HI^* \equiv \frac{1}{N}\sum_h 1\left(r_h^* > r^u\right)$$

and

$$PGI^* \equiv \frac{1}{N}\sum_h 1\left(r_h^* > r^u\right)\times\left(r_h^* - r^u\right)^{\alpha}$$

The above indices stem from a "potential affordability approach" (Thalmann 2003) which has relevant advantages with respect to the previous ones. First of all, this "potential" approach refers to a basket of public utilities which explicitly identifies the minimum standard of living the policy maker is targeting: this may be interpreted saying that the policy maker considers the public utility service as a merit good (Hancock 1993) and, in so doing, the definition of affordability incorporates an explicit political choice.

Moreover, this approach *de facto* permits one to exclude households characterised by large levels of consumption and high incomes from the identification of those with affordability problems (that is, now, area C in Figure 1 is excluded). In the same way, the potential affordability approach can correctly recognize an affordability problem for those households whose actual consumption is lower than the minimum standard quantity (i.e.: area B in Figure 1 collecting households with $q_h^u < q^{up}$ is now included). Finally, this potential approach does not require one to forecast a household's reaction to a price change, as q^{up} is defined in absolute terms.

As anticipated, this makes the choice of the reference basket crucial.[3] In the empirical analyses, the amount of utility services in the reference basket varies with the size of the households, the climatic conditions, and possibly also with the house's technological efficiency and the area of residence, while differences in the thresholds are difficult to defend in a policy debate. It therefore seems a natural choice to let the reference basket vary, while keeping the threshold constant across households. By doing so it is recognized i) that needs vary across the population, ii) that utility services are inputs in a home production function with a given technology, which displays economies of scale, iii) and that the affordability issue can be solved (in the medium run) also by improving the technological efficiency of the households.

Note that the approach based on the standard consumption of utility services in its own tends to implement "general income support" policies as the direct tool to overcome affordability problems: indeed, given the cost of the standard basket of utility, the simplest policy to solve the problem would be increasing the income of the households which are below the threshold.

The Residual Income Approach

The indices considered so far do not explicitly take into account that public utilities, although essential, are not the only goods households need in order to live decently. Families should also afford a standard basket of other goods ($x^{cp} = p_c q^{cp}$). These considerations have induced Miniaci *et al* (2008a) to adapt the approach of residual income from the literature of housing economics (Thalmann 2003) to measure affordability in public utilities. Following this approach, there is an affordability issue with respect to public utility expenditure if - after having paid the public utility bills - the household does not have enough resources to finance a minimum level of the other goods' consumption. In other words, the residual income approach allows us to consider a "public utility induced poverty" (Stone 1993; Kutty 2005).

To apply these ideas, one should however specify the level of consumption of public utility services which is considered, as well as the consumption level of other goods associated to the notion of poverty. If we consider the actual level of consumption in utilities q_h^u, a household h faces an affordability problem if its residual income $RI \equiv$

$x_h - p_u q_h^u$ is lower than the monetary value of the minimum level of consumption of the other goods, that is $x_h - p_u q_h^u < p_c q^{cp}$.

We can now observe in Figure 2 that poor households falling in E and F areas, as well as non-poor households belonging to the A area, face what we have called public utility induced poverty.

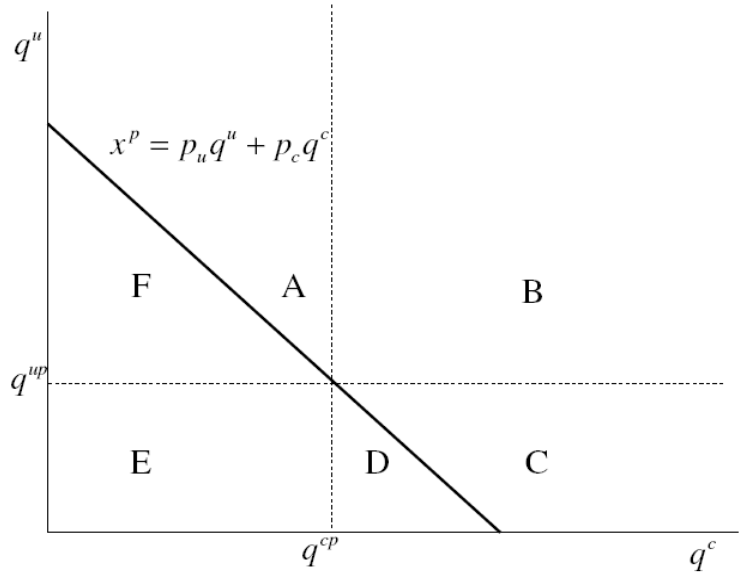

Figure 2: The absolute poverty line and the residual income approach

The condition $x_h - p_u q_h^u < p_c q^{cp}$ can be used to analyze the short term effects of price reforms in public utilities, as these markets usually lack prompt adjustments of q_h^u in response to a price change (i.e., low price elasticity) and for this reason such effects can be relevant for vulnerable households. However, there are three important caveats. First, as in the case of the affordability measures based on the bills-to-income-ratios r_h, if we do not introduce an upper limit to q_h^u, a definition simply based the above condition would suffer the so- called "perverse" preferences problem (Hancock 1993): some households may have preferences (or having an inefficient use of the utility) such that--even though they can afford a higher quantity of other goods--they prefer a consumption level lower than the minimum standard. Second, without a lower limit, some households could "solve" their public utility induced poverty by reducing to (almost) zero their consumption of public utility services. As can be observed in Figure

2, poor households represented in the D area, do not buy the minimum standard q^{up} but--according to the above condition--are not in public utility induced poverty.

These considerations lead us to adopt the following criteria to define public utilities as unaffordable: $x_h - p_u q_h^u < p_c q^{cp}$ or $x_h - p_c q_h^c < p_u q^{up}$ and $q_h^c > q^{cp}$. With this refinement, now households falling in areas C and D in Figure 2 join the subset of the households in public utility induced poverty.[4]

A positive feature of the public utility induced poverty approach is that it provides better clues in recognizing the possible source of the affordability issue. Indeed, considering household groups as in Figure 2, we can observe that households in area A are not below the poverty line, but they are over-consuming public utility services. For them it is relevant to recognize whether this is due to their preferences or it is because they have some binding technological constraint (for instance, they are locked in with the heating technology). In this latter hypothesis, a targeted program would specifically offer incentives to increase energy efficiency through the adoption of a new technology. Moreover, households in C are not poor, but they are under-consuming public utilities; again, this can be a matter of tastes, of a better technology, or it could happen because they do not have access to the desired (and monetarily affordable) quantity of public utilities.

Affordability and the Access Issue

So far, we have considered the household's consumption level, without considering whether that household is linked or not to the network. Especially in developing countries, this aspect cannot be neglected, given that the connection rates are often quite low.[5] Especially when considering poor countries, and even more if we look at rural (i.e., often the poorest) areas in those countries, an affordability analysis should consider the issue of whether the access to the service is too expensive.

To this end, we can modify the above approach considering a connection fee which is constant and independent of the amount of the service consumed. This produces at least two effects: i) if households pay the connection fees, the available income is reduced, that is, households' budget constraints become tighter than in the case where no connection fee is due, with more households under-consuming utilities and/or other goods.; ii) the cost of the minimum quantity of utility service, q^{up}, will be

higher than in the previous case. This leads us to adopt the refined affordability criterion: $x_h - p_u q_h^u - a < p_c q^{cp}$ or $x_h - p_c q_h^c - a < p_u q^{up}$ and $q_h^c > q^{cp}$, and where *a* is a constant connection fee.

We can now go back to the previous analysis, in order to distinguish different groups of customers with affordability problems. In other words, using the above refined affordability condition, it becomes possible to conceptually identify at least three different types of consumers:

(i) The (absolutely) poor, who cannot afford the minimum quantities (q^{cp} , q^{up}) . General income support to these households may be advisable. Among those who consume lower quantities than q^{up} , it would relevant to be able to pick out those who suffer lack of coverage and/or low reliability of the service provision.

(ii) Those "over-consuming" public utility services. For these households it is important to investigate the specific reasons, so as to devise corrective policies (for instance, depending on whether this is due to the adoption of obsolete technologies or to their preferences).

(iii) Those "under-consuming" public utility services, possibly because of non-monetary constraints. Policies aimed at relaxing these constraints may be more effective. In this respect, it is important to distinguish which households under-consume the utility because they are not really connected versus from those who are under-consuming because of tight budget constraints. In the former group, moreover, one should identify (a) those who are not connected because they cannot afford it, (b) those who can afford it, but they choose not to get connected and (iii) those who cannot get a connection as they live in a neighbourhood not reached by the service.

Empirical Analysis

In what follows we discuss two key issues concerning the estimation and interpretation of the affordability indices: how to define the subsistence level of household utility consumption and how to identify the related data requirement. We also present some empirical evidence on the different affordability ratios and the associated headcount statistics.

Identification and Estimation of the Reference Subsistence Level

It is standard practice to estimate the absolute poverty line using a two step process (Kakwani 2003). As the first step, a food poverty line is defined following a "Direct Calorie Intake", a "Food Energy Intake" or a "Cost of Basic Needs" approach; as a second step, the total poverty line is estimated by multiplying the food poverty by the inverse of the Engel ratio of the households around the food poverty line.

The first step has its root in Sen's approach to poverty definition in terms of a fixed set of capabilities[6]. As noted by Ravallion (1998), it poses two main issues. First of all, it requires the definition of the normative capabilities of the poverty line it refers to, and there is no bi-univocal relation between capabilities and consumption/income spaces. The second step of the process has a behavioural foundation, rather than a normative one, and it is of little help for an affordability analysis based on the residual income approach. Finding a consensus on how to improve upon standard practice is not straightforward [see Blank (2008) for the US case) but some efforts have been made.

Foster and Tre (2000) estimate the energy subsistence threshold for Guatemalan households in two alternative ways: in the first as *"the average total net energy consumption of those households whose overall consumption levels fell within plus or minus 10% of the US$1 (Purchasing Power Parity adjusted) extreme poverty line"*. In the second one, they identify a basic set of energy needs in consultation with energy experts based on local knowledge of energy consumption patterns among low income rural households. "*This threshold provides enough energy to run two 60 watt light bulbs and one 16 watt radio for four hours each day, and incorporates a cooking requirement of five two kilogram logs of fuelwood each day."* Such a threshold should in general be based on what would be required to perform basic functions such as lighting, cooking and (depending on climate) heating.

In other terms, this follows a "Cost of Basic Needs" approach and it is consistent with the "capabilities" approach to poverty. But - as in the case of food – this raises the issue that many different consumption choices may satisfy the specified energy requirement: for instance, electricity can come either from (community or private) generators or from the grid, firewood may be substituted with (more expensive but healthier) LPG or electricity, and so on. The households choice set may markedly vary with their residence (firewood, sawdust and dung might be unavailable to urban

households) and the extension of the service network [access to electricity can be as low as 4% in Chad; see World Bank (2009)].

Furthermore, households react to the relative prices of the alternative source of energy (Heltberg 2005; Wu *et al* 2004). Therefore, satisfying the minimum energy requirements may require different amounts of money, depending on accessibility and on price configurations. This is the *specificity* issue (Ravallion and Bidani 1994), whose relevance is somewhat reduced if the affordability index is computed to answer questions like "Were the service accessible, could the households afford to meet their minimum energy requirements using it?" In fact, the normative capabilities approach might justify paying attention not only to meeting the minimum energy requirements, but also – because of the health, safety and environmental externalities - to the mix of fuels used. The minimum energy requirement varies with the energy efficiency of the accommodations and the lighting, cooking or heating technologies. This adds a further dimension to the specificity issue, because the household production functions are – at least in the short run – constrained by the stock of durables. Considering the same input of energy when the efficiencies of the household production functions are different violates the horizontal equity principle, because the welfare of the households is different. A different way to look at the problem is to consider the cost heterogeneity of the complementary capital investments required to make productive use of the energy (Foster and Tre 2000).

A similar line or reasoning can be followed for other public services. As for water, the identification of the subsistence threshold is probably easier, but still the problems of multiple sources and capital costs need to be solved. In fact, water can be provided by conventional piped distribution, private wells, public standpipes, private vendors or collected directly from nature. As in the case of energy, the degree of substitution and complementarity among different sources is related not only to the relative prices, but also to the quality and reliability of the service and its own cost of access.

For telecommunications and transport the definition of the subsistence threshold should refer to the minimum quantity of these services necessary to the individuals to fully participate in the society they belong to. For transport this "*could be interpreted in terms of the distance required for essential travel, such as commuting to work, travelling to school and visiting the local market*" (Foster and Tre 2000). This, again,

raises the problem of the available set of alternatives with their capital costs, relative prices and quality. In many cases the telecommunications tariffs are such that – for small amounts of traffic - the marginal cost of the calls is negligible relative to the fixed and/or capital costs. If this is the case, the consumption threshold for an affordability assessment of the telecommunication services can be identified with these costs.

Data Requirements

An affordability assessment exercise could be described as a multistage process with different data requirements at each stage (Foster 2000). First, it is necessary to identify the basic needs the affordability concept refers to. This can be the outcome of consultations with representatives of the stakeholders (e.g. governmental and donors agencies, consumer groups and service providers). At the second stage the providers' datasets together with engineering considerations can be used to estimate the minimum expenditure necessary to meet the basic needs. Survey data are necessary at the third stage in order to analyse how many households can afford the utilities and which are the main causes of un-affordability and under-consumption. Here we focus on the third stage, namely on the information the survey data should provide. The ideal survey should provide valuable information on household conditions, their choice sets, their actual choice and their constraints. In more detail, the data should help to answer to the following questions:

1. Is the service accessible? Expansion of the service network has been often presented as a positive outcome of utility markets reforms. An affordability assessment without taking into consideration whether the households can or cannot access the services makes little sense. All households without access could be deemed as falling below the q^{up} line in Figure 2, and therefore as having an affordability problem**.** Accessibility information is therefore necessary to distinguish households who *choose* to spend less than the threshold and those who spend less than the minimum amount (probably, zero) because they do not have access. But a further distinction is necessary: some households may choose not to have access to the service, while some may be excluded because their area is not reached by the network. The survey should thus first of all provide information about the overall coverage (i.e., the potential basin reached by a

2. Which alternatives to the service are available? What is the consumption level of the utilities of interest and their close substitutes? Knowing which (energy/water sources, telecommunication or transport) services a household could potentially use (because they are available in the area) as well as which services the household actually uses, helps one to understand to what extent observed patterns of consumption reflect demand decisions or supply constraints. As the reference consumption bundle is defined on the basis of a normative approach, in order to assess how severe the affordability problem is, one must investigate whether spending below the thresholds means that the basic needs are met using cheaper strategies, or not.
3. Which prices and payment schemes are faced by the households? How often do the households fall into arrears with the bills' payments? Prices affect the household's decision to switch from one service to the other. Some alternative may not have a market price (e.g. firewood from the forest, water from community standpipes, springs or rivers). For these sources, the survey should provide enough information to evaluate the opportunity cost of such alternatives (for instance by asking for time spent collecting wood or water). Payment schemes may also be crucial for the affordability of the service, with pre-payment arrangements often preferred by poor households. Data on arrears are a first indicator of the affordability of the service and they can complement the evidence based on the definition of affordability.
4. Are the services reliable and of good quality? Consumers place value on multiple service attributes, not just costs. The unreliability of the electricity supply motivates a household's investment in a private power generator, as the poor quality of piped water may drive the consumption of tap water. The poor quality of the service may push consumers towards other solutions (either cheaper or more expensive) in order to meet their needs, with ambiguous effects on the affordability index. Information on quality and reliability can be gathered asking objective questions (for instance about the number of hours each service

5. What are the housing conditions and the stock of durables? Household energy and water demand are conditional upon housing and the stock of durables available. They affect the monetary and opportunity costs of the different strategies to meet the basic needs, as well as the costs to connect to the services.
6. What is the total household consumption / income? Although cost and availability of a service are crucial, the main driver of affordability is the total resources available to the family. Whether to consider consumption or income as the best measure of the spending capacity of the households has originated a debate. In principle we would like to have both measures because, following Meyer and Sullivan (2003) "*(t)he closer link between consumption and well-being and its better measurement favor the use of consumption when setting benefits and evaluating transfer programs. However, income retains its convenience for determining program eligibility*".
7. Do the households think to spend too much or to consume too little of the utilities? What do they think the minimum consumption should be? Data on the perceived affordability of the utilities are receiving and increasing attention, both for the need to evaluate the political feasibility of any proposal about utility market reforms, and because of the growing literature on the qualitative – quantitative (Q2) methods in the poverty analysis [see the special issue of the *Journal of Development Studies,* 42(7), 2006]. Finally, data on the subjective minimum consumption could be used to identify the value of the objective poverty lines (Ravallion 1998).

In practice, finding a survey which provides all the desirable information for the period and the population of interest is extremely rare. For some countries national labour force and family expenditure surveys are available. They are typically run on regular basis with a representative sample of the national population. They provide accurate estimate of household resources, housing condition and (the expenditure survey) on consumption pattern, but they have little informative power on accessibility at the community level, prices, quality and perceived affordability. The Living Standard Measurement Study surveys (Grosh and Glewwe 2000) are typically informative about

individual access, expenditure and consumption patterns while data at the community level, on the quality and reliability of the service and subjective assessment are missing. The Demographic and Health Surveys gather information on individual access only; information at the community level are recorded by the China Economic, Population, Nutrition and Health Survey together with all the necessary information about household income and consumption pattern, but not on opinions; household opinions about their living standard are instead one of the main focus of the Life in Transition Surveys (EBRD 2006). Designing an ad hoc household survey is obviously an open option, but it is costly and time consuming.

Some Empirical Evidence

Miniaci *et al* (2008a) empirically compare the affordability indices related to the actual and potential budget shares with the one relying on the residual income approach. The authors exploit the information of a standard consumer expenditure survey to assess the affordability of water, gas and electricity in Italy for the period 1998-2005 which has been characterized by major tariff reforms. They identify the reference subsistence level (conditional on family size and regional area of residence) as the median expenditure of those households deemed as relatively poor; and the threshold budget share as the median budget share of the actual utility bills to total expenditure for the relatively poor.

When the actual utility bill to total expenditure is considered, the utilities were unaffordable for 27.9% of the Italian households in 2005. This percentage drops to 5.9% if the ratio is based on the reference subsistence level of consumption. When they consider the residual income approach the fraction of households with affordability problems is 28.1%, but it drops to a mere 3.6% when the households who are above the poverty line but who spend less than the reference subsistence level are excluded (i.e. excluding those falling in area C). The authors show that in the Italian case the under-consumers do not suffer an affordability problem, as they are typically households with high incomes and energy efficient housing conditions.

Monitoring Affordability: The Policy Issues

The status of utility services is often the one of merit goods, for several reasons already mentioned (Le Blanc 2008). In order to avoid underconsumption or, more precisely,

situations where certain households remain below a given minimum consumption threshold, the policy maker should try and ensure affordability. This entails a number of issues, which may be appropriate to analyse separately.

How to Identify and Classify Affordability Problems

The "best" way to define affordability depends on why we want to define it, on what one wants to avoid (all definitions are subject to errors of both types, including households which have little problems, or vice-versa) on available data and so on. As argued above, focussing on residual income has the advantage of allowing one to identify different sources of the affordability problem. In particular, it seems essential (within this approach, but not only) not to limit oneself to a headcount of household which appear to have problems, but to consider separately different cases, such as:

(i) Households not connected to the service; among them, it is relevant to distinguish those who
   a. live in areas not covered by the service;
   b. choose not to be connected;
   c. cannot afford the service (possibly because access is too expensive, or because they forecast that they would have problems paying for future bills).

(ii) Connected households which consume less than the minimum normal quantity of the utility service, distinguishing in turn between
   a. those who under-consume because of absolute poverty problems;
   b. those who under-consume because of non-monetary constraints.

(iii) Households which are in affordability problems because of excessive consumption levels, distinguishing again between those who
   a. "over-consume" public utility services for specific problems (e.g., illnesses);
   b. "over-consume" the service for an obsolete technological endowment (e.g., leaking pipes, inefficient heating system, …)[7].

If the source of the problem is identified, then different policies to alleviate affordability can be adopted. Clearly, when a household consumes zero because it lives in an area not reached by the service, access becomes a key aspect. When the reason of under-consumption is absolute poverty, probably a general income support policy is the most

natural response. When instead we face excessive spending because of the inefficiency of the household's technological endowment, more specific (and less easy to design) policies become more appropriate; notice that this is likely to be an issue especially for heating in cold areas. Examples of interventions of this kind can be found in Britain, where specific actions against "fuel poverty" may envisage a specific advice to families or in some parts of Italy where a plan of re-qualification of public houses (which are particularly old and lived in by households in need) is under discussion.

How to Shape Cross Subsidies

Textbook economics indicates that prices should be cost reflective, and that households in need should be helped with traditional income support policies. First of all, notice that even an "efficient" price schedule is not neutral to the distribution of benefits: indeed, with any change in price, however one designs it (flat; increasing block tariffs; …), some consumers will benefit, others may suffer a loss. The desirability of such a scheme, however, is that it would not convey a distorted price signal both to customers and to firms.

In many cases, however, the fiscal problems of the government or its aversion to designing a transparent taxation scheme to fund the subsidies may make it preferable to have cross subsidies. Distorting the price relative to the textbook optimum is very common, but very hard to do "optimally", i.e., in order to achieve a specific goal.

When dealing with the affordability problem, ideally one would like to design prices such that poor households pay each unit of the service less, and rich consumers pay more. A scheme of this type resembles a kind of price discrimination. Following this notion, there may be at least two kinds of discriminatory schemes.

The first one is based on the notion of self-selection, which entails offering menus of contracts, such that different income groups choose a different one, so that the poor end up paying less, and vice-versa. Sometimes this is done through increasing block tariffs, but this may go in the right direction only if the per capita consumption of rich consumers is higher. The evidence available, however, is that schemes of this kind often have regressive effects, which is intended (Komives *et al* 2006).

A related way to implement the same kind of price discrimination is through the most common scheme used by utilities, whose payment schemes entail a quantity related price together with a fixed (e.g., monthly) payment, i.e., a two part tariff. In this

respect, one should recall that these fixed charges penalize low consumption households, which are often (but not always) low income ones. Every price structure based on high fixed components is likely to have heavy consequences on poor households.

Notice that the feasibility of quantity related price schedules crucially depends on the availability of metering. Given the large cost of metering devices, the potential benefits of such schemes should be weighed against these costs; how one compares the (non monetary) benefits with these (very concrete) costs, is an open issue. The answer will certainly depend on the specific service at stake, as meters may be very simple tools or fairly expensive ones.

Moreover, sophisticated tariff schemes are unlikely to be effective screening devices; different consumer groups are not equally sophisticated and able to understand the economic implications of accepting one scheme or the other. Notice that even in Britain the liberalization of energy prices has often led households to choose prices which at the end turned out not to be to their advantage.[8]

When this kind of quantity based discrimination is considered infeasible (or not effective), a further alternative (third degree price discrimination) is to try and divide the population into sub-groups, offering each sub-group a different price scheme. The problem with these "targeted" price policies is to find observable characteristics of poor households and design prices for the customers who have those specific characteristics. A typical example is given by geographic discrimination, which may be used if one could convincingly argue that specific areas are associated with high (or low) income levels.

Access Issues: Affordability and Investments

In situations where many customers do not have access to the service and where expanding the network is the key concern, the crucial pre-condition to consumption is providing access and making it affordable.[9] As one can expect, data confirm that the rate of access to utility services – especially in developing countries - is highly correlated with income.[10] Access is a crucial issue particularly in relatively low density areas, i.e., rural areas (Saghir 2005). It is often debated, or can be debated, whether pursuing affordability of access requires a totally different analysis and whether the policy implications (and potential remedies to affordability problems) are different.

The arguments which support the notion that utility services are "merit" goods have to do with access to the service, rather than actual consumption levels. For instance, for health reasons it is important that households have clean water in the house, not that their consumption of water is particularly large. And to enable children to study at home, the actual availability of electricity is certainly more important than promoting a large consumption of it. Therefore, while obviously the affordability of minimum consumption levels remains important, it seems that access to these services is the most crucial issue. Given this strong social interest, access qualifies as a natural area for public subsidies, probably even more than consumption levels themselves.

Should these connection subsidies be different from consumption subsidies? Notice that while connection is a one-off decision, consumption is not. However, while the firm bears the cost in the initial phase, its impact on the firm's accounts takes place over time as the infrastructure is amortized, and in principle one could conceive a connection charge spread over a significant period of time. In this perspective, a connection charge is no different from a fixed cost in a two part tariff: the notion of connection subsidy is thus quite similar to an intervention to decrease fixed components of two part tariffs, and improves affordability especially in services where consumption grows significantly with income.

Finally, consider that the typical cost structure of utility services entails a large fixed cost and a variable cost which is primarily a function of the number of customers connected, even more than of actual quantities consumed. Recovering fixed set-up costs with margins on quantities consumed entails an additional distortion (and one which is very unlikely to provide sufficient funds in typical low price services, such as water). Therefore, when expanding the network is considered necessary, if access is not affordable we not only have a "social" problem, but we also have a problem of covering the set-up costs; the fewer the customers who decide to get connected, the higher the cost these customers have to bear. In other words, we have positive network externalities.

In this perspective, when access affordability matters, measuring affordability with the residual income approach becomes particularly relevant. If the residual income left to households after paying for access is too low, households will never decide to connect to the network. Having a sufficient residual income is necessary (albeit not

sufficient) to induce a household to establish a connection to the network. A headcount index, measuring how many households do not meet this necessary condition, would provide a relevant indication of the likelihood that the infrastructure would be able to serve a sufficient number of customers. This measurement could be particularly relevant for a private operators' decision[11] to provide connection in rural areas, as it could help verify the possibility to recover set-up costs.[12]

Summary

Measuring the affordability of utility services, and how affordability varies with price reforms, is not an easy task. The first problem is to find the most appropriate definition of affordability, which probably depends on the problem at hand. As we have seen, especially where network extensions are a key policy issue, considering residual income (how much a households has left after paying for the utility) provides particularly relevant information. An effective affordability analysis based on the residual income approach could be complemented by the identification of the different reasons why spending in public utilities may be excessive.

The residual income approach is particularly relevant, as it opens the possibility of considering specific, targeted remedies to the affordability problem. For some consumers who fall below the poverty line, income support policies may be needed, while for others excessive consumption may be due to the inefficiency of their housing conditions or the technologies available (piping, heating systems, etc.) For many consumers, if a government does not want explicit subsidies, adequate price policies and cross subsidies may be useful.

One of the key policy issues in developing countries is whether reaching a substantially larger number of households with adequate utility services would be economically feasible, both considering the impact on consumers' welfare and the possibility to charge average prices which cover average costs. Studying the effect of access fees on the residual income of potential new customers can help us understand the potential success of alternative investment programs. The advantage of a careful analysis of the origins of the affordability problem may allow one to identify how different price structures (e.g., an articulation of two-part tariff schemes) can affect the

households’ ability to afford the utility service while respecting the constraint that costs must be covered by revenues.

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[1] Economic logic teaches that prices with cross-subsidies are unsustainable in an environment of open entry, and that such competition predictably leads to inefficiencies. The reason is simple—entrants will be impelled by the profit motive to divert the overpriced business, regardless of these entrants' efficiency, while entrants are unlikely to relieve the incumbent service provider from the financial burden of serving customers whose prices are not compensatory of the costs required to serve them. Thus, even suppliers with inefficiently high costs may find entry profitable in reaction to pricing that has the mandate of providing a flow of cross subsidies. Entry of this kind not only unnecessarily raises industry costs, but it also erodes the very ability to finance the subsidies that motivate the policy (Willig 1994).

[2] The actual definitions of these levels of consumption is an important issue, which we leave aside for the moment.

[3] See Miniaci *et al* (2008b) for a definition of the basket in terms of relative consumption levels. On the advantages and the difficulty of having objective definitions, see Waddams *et al* (2007).

[4] A headcount index and/or a poverty gap index can now be defined using conditions $x_h - p_u q_h^u < p_c q^{cp}$ or $x_h - p_c q_h^c < p_u q^{up}$ and $q_h^c > q^{cp}$. Define

$$I_h^u = 1\left(x_h - p_u q_h^u < p_c q^{cp}\right)$$

and

$$I_h^c = 1\left(x_h - p_c q_h^c < p_u q^{up}\right).$$

Moreover,

$$HI_u^{RI} = \frac{1}{N}\sum_h I_h^u, \quad PGI_u^{RI} = \frac{1}{N}\sum_h I_h^u \times \left(p_c q^{cp} - p_c q_h^c\right)$$

$$HI_c^{RI} = \frac{1}{N}\sum_h I_h^c, \quad PGI_c^{RI} = \frac{1}{N}\sum_h I_h^c \times \left(p_u q^{up} - p_u q_h^u\right) \quad .$$

A headcount index based on the residual income approach HI^{RI} can thus be defined as:

$$HI^{RI} = \frac{\sum_h (I_h{}^u + I_h{}^c - I_h{}^c I_h{}^u)}{N} \quad .$$

[5] See Komives *et al* (2006) and Le Blanc (2008).

[6] Sen (1985).

[7] See Miniaci *et al* (2008b) and Wu *et al* (2004).

[8] See Wilson and Waddams (2007).

[9] Chisari and Kessides (2007) developed a theoretical model to investigate the utility's optimal pricing as its infrastructure network expands.
[10] As showed in Estache and Fay (2007), upper middle income countries record the largest access rate and "are very close to meeting the infrastructure needs of all but 10% of their population", while lowest income countries are very far from these coverage needs.
[11] Another relevant indicator for investors' decision is the system of regulatory governance: private operators' commitment in long-term investments is directly related to regulatory risk, which, in turn, is usually evaluated on the basis of the historical experience of regulation and expectation regarding the future (Kessides 2004).
[12] Notice that an extended empirical economic literature - surveyed by Romp et de Haan (2005) – shows the impact of utilities network on economic growth: the general result shows a positive correlation between network's coverage and productivity, a result which, in turn, would call for public finance intervention.