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The Many Dimensions of Deprivation in Peru:

theoretical debates and empirical evidence

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This paper aims at evaluating the empirical consequences of the theoretical debate on the nature of poverty, focusing in particular on the differences between Sen's capability approach and the mainstream monetary approach. The empirical analysis is performed using data from the ENNIV 1994 survey from Peru. Beginning with a brief review of the main issues emerging from the theoretical debate on the definition of poverty, a framework for comparing capability based and consumption based approaches is presented.

A descriptive analysis of the various dimensions of deprivation is performed and the determinants of shortfall in basic capabilities are then modelled through "capability production functions". This analysis aims at identifying the relationship between monetary resources and individual achievements by testing for the significance and size of the "parametric variations" which are at the core of Sen's argument against identifying poverty with monetary indicators. By elaborating on the results obtained, the importance of some of the non-monetary factors which affect individual achievements for individuals of different deciles is highlighted. Some conclusions with respect to the priorities of a poverty reduction strategy are then drawn.

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Introduction

Poverty as a category is hard to define. The word brings to mind a situation of living in "obvious want and squalor", as already recognised in the definition adopted by Rowntree (Rowntree 1902; Veit-Wilson 1986) in what is acknowledged to be the first scientific analysis of the phenomenon. Nevertheless, the questions of "with respect to which standard", "measured in which space" and "with whose criteria" want and squalor should appear "obvious" do not lend themselves to straightforward answers, especially if aiming at a definition which might hold across different contexts and time. Poverty reduction, however, has taken a central role as an objective on the international policy agenda, endorsed by major multilateral and bilateral donors as well as national governments. So, while the academic literature flourishes with sophisticated analysis of different concepts of poverty and of the assumptions behind standard measurement practices, policy makers need clear operational definitions which might inform strategies and help targeting policies. Monetary measures, on which standard practices rely, indeed offer these advantages, and are widely accessible now due to a far greater availability of specifically tailored household surveys. But are monetary measures capturing the essence of poverty? And more fundamentally, do they offer the only perspective which might inform policies?

Thorough critiques have exposed the strong assumptions underlying standard monetary based assessments of poverty (Chambers 1995, Townsend 1970, Sen 1983), but despite widespread awareness of the main themes of the debate, it is still true that "(e)conomists usually prefer income (or consumption) based measures of poverty" (Baker et al. 1994, p.3). However given that the choice of any particular concept of poverty is not value-free, and as such cannot be portrayed as a unique and objective representation, it is important to explore alternative ones and to evaluate whether their adoption translates into different assessments of poverty.

Few empirical analysis have tried to do this, partly because very approach-specific informational bases are required for assessing most alternative measures of poverty. This is the case, for example, for participatory poverty assessments (based on qualitative information collected with methodologies closer to anthropological techniques than to those used in the collection of household surveys or census data). The consideration of alternative paradigms is therefore difficult, especially for economists used to think in monetary measures, such as shortfalls in consumption or income.

This paper tries to provide a constructive link between the theoretical debate and the practice of poverty assessments by evaluating the differences between alternative approaches empirically, or, more precisely, between the alternative indicators that alternative approaches suggest.
In fact, if at the empirical level the association between alternative indicators of deprivations is so strong that different approaches appear approximately observationally equivalent, policy makers would not need to worry about the theoretical debates.

Is that really the case? We will explore the question with reference to Peru. This analysis entails both checking how far different pictures of poverty overlap and trying to understand why.
To do so in part 1 we will briefly review Sen's capability approach and its critique of standard monetary based assessments of poverty. In part 2 we will present a framework which allows us to compare the capability approach with a monetary one empirically. We will introduce the concept of capability production functions and discuss the methodological choices entailed in their estimation. In part 3 we will then present our empirical analysis, based on Peruvian household data (ENNIV 1994). Our conclusions will follow.

Part 1. Sen and the debate on the nature of poverty.

This paper focuses on a comparison between a standard monetary based assessment of poverty and one based on Sen's capability model (e.g. Sen 1985). This particular model has been chosen as it is rooted in a behavioural model which parallels the one underlying a utilitarian approach, since it does not dismiss completely the use of monetary indicators but rather suggests a different emphasis (on "adequateness" rather than "sufficiency") and, not least, because its formulation in terms of economic categories allows a direct comparison with monetary based assessments when it comes to issues of targeting or of designing poverty reduction strategies. We will still have to face, however, the limitations of using data which have not been designed for this specific purpose and which therefore only allow us a restrictive (but hopefully still significant) interpretation of Sen's model.

Sen's critiques of the standard practice of measuring poverty (which in the Latin American literature is often referred to as the Poverty Line method) are rooted in a critical assessment of the utilitarian assumptions on

which the use of the monetary based approach is based.[2] In a nutshell, these critiques start from the claim that poverty consists of a lack of economic welfare (e.g. see Lipton et al. 1995) and aim at showing how imperfect a proxy for welfare utility is and point to the need for an alternative definition of welfare which includes what individuals can do and be in their lives.[3] On this basis, Sen suggests an alternative conceptualisation in which "well-being of a person is best seen as an index of the person's functionings" (Sen 1985, p.25) where the functionings represent the "doing and beings" of an individual, and where the set of alternative functionings available to the person constitute his capability set.

This conception of well-being[4] emerges from a model where, starting from a Gorman-Lancaster model of consumer behaviour, goods are seen as bundles of characteristics which individuals combine according to specific utilisation functions to do or to be "something". Food for example is employed to obtain nutrition or participation in community rituals or to face reciprocity obligations etc. The degree to which a being or a doing is achieved is called a "functioning", while the ability to be or do that something is the corresponding "capability".

It is to be stressed that in this view the resources available to the individual, of which private income represents only a subset, are valuable for him inasmuch as they represent means to the achievement of a given level of the capabilities he values. Because of his libertarian approach, Sen does not specify a list of capabilities on which an assessment of well-being should focus. They are only defined as intrinsically

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2 The use of monetary indicators, of income in particular, is at times justified on the basis of right based arguments. In this sense there is a similarity with Sen's perspective, even though Sen's concern for positive freedom still leaves monetary indicators (if used in a "sufficiency" perspective) open to the same kind of criticism about "parametric variations" which will be illustrated below.

3 More specifically he claims that: (a) the significance of utility maximisation can be questioned as only a "rational fool" would apply the same criterion to two issues as different as determining market choices and defining one's own well-being; (b) market choices might be determined by other factors than pure utility maximisation (as shown for example that Prisoner's Dilemma kind of interactions); (c) even if the utility outcome was the only thing that mattered for the individual, that outcome could be determined by different blends of individual characteristics and objective situations. If utility stands for desire fulfilment or happiness, then both the " physical-condition neglect" (i.e. the focus only on the mental disposition of a person and not on what that person can do) and the "valuation-neglect" (i.e. the fact that valuation might be conditional on what appears as reasonable or possible) may affect individual valuation in ways which someone attempting an objective valuation of well-being would not subscribe to. To note that the alternative definition of utility as mere description of choices without reference to the underlying psychological conditions, i.e. the Revealed Preference definition of utility, is even weaker in providing a basis for ethical judgement. In fact if choice between two options is not linked to an individual attaching any particular value to one choice compared to the other, that choice does not provide any ground for attributing to the chosen option any greater social value. (Sugden, 1993). (d) well-being and welfare are different as the former pertains only to purely self-seeking behaviour, and the latter includes also the consideration of agency (which includes other goals, values and ideals that are important in individual life despite not increasing an individual's well-being); in a welfare assessment one should include also what an individual can do ("advantage") and not only what the individual does.

4 In this paper we will be quite casual about the use of "well-being" and "welfare". For a discussion of the difference between them in a sennian perspective see Sen (1987).

valuable and, given that the concept of well-being itself is deemed to be fuzzy, it is not even required that an assessment of well-being produces a complete ordering.

This particular conceptualisation of the quality of life lends itself to the analysis of poverty seen as "capability deprivation" (Sen 1997, p 210). Poverty, therefore, is not about having insufficient income or consumption, it is about not being able to live a valuable life. In particular, poverty is defined with respect to those capabilities which can be labelled "basic" in that they entail satisfying certain "elementary and crucially important functionings up to a certain level" (Sen 1992, p 45, fn 19) and in that their fundamental role in determining well-being can be largely agreed upon. He lists some basic capabilities for poverty measurement: being adequately nourished, leading a long and healthy life, being literate (as a source of access to knowledge and communication or perhaps as the result of a structured and social process of learning), avoiding homelessness. These are likely to be recognised as part of the absolutist core of needs and agreement can be reached without specifying particular commodity bundles and particular ways of achieving functionings (Sen 1992).

As far as the choice of indicators that can be used for poverty analysis is concerned, it is important to stress that this approach entails that: 1) " the connection [of poverty] with lowness of income is only instrumental; 2) there are influences on capability deprivation *other* than lowness of income; and 3) the instrumental relation between low income and low capability is *parametrically variable* between different communities and even between different families and different individuals" (*ibid*. p 211). The emphasis is, therefore, on indicators which might directly capture the level of at which a given functioning is (or could be) achieved rather than on monetary measures.

Despite a now large consensus on the multidimensional nature of poverty (confirmed for example in the Copenhagen declaration, WSSD 1995), little attention has been paid to truly incorporate multidimensional concerns of the kind raised by Sen in the practice of poverty assessment. The implicit assumption seems to be that the role played by monetary resources in determining shortfalls in capabilities is so central that they can act as proxies for them. In other words, it is assumed that monetary indicators can capture the essence of poverty by driving all the other dimensions of deprivation.

The following quote well illustrates the point: "Being poor is related to a wide range of factors including income, health, education, access to goods, geographical location, gender, ethnic origin, and family

circumstances. It is difficult to measure poverty in such a way as to capture its multidimensional nature, but a commonly used measure of poverty is the income or consumption of individual or households" (The World Bank (1996), p. 2). It seems to us, however, that unless it is proven that income or consumption can really do a good job at capturing all the other relevant dimensions of deprivation the need to develop new indicators of poverty cannot be ruled out.

Part 2. Testing alternative approaches to poverty measurements.

Different concepts of poverty are based on assumptions and values which, as such, are not amenable to empirical testing. One might however try to test whether adopting alternative indicators, (such as those suggested by Sen's analysis, provides us with a different assessment and understanding of poverty than a money metric one. Sen's claim that parametric variations between individuals make a focus on monetary resources inappropriate helps identifying a testable hypothesis differentiating among different paradigms on poverty. Referring to his formalisation of the capabilities approach (Sen 1985) provides us with a framework to test whether such parametric variations exist and if their importance is such that proxying capabilities with a monetary measure of poverty would be seriously misleading, without at the same time having to identify a "preferred indicator" of poverty (as done for example in Glewwe et al. 1990, where consumption per equivalent adult is chosen as the benchmark against which the other indicators are assessed).

A simple representation of the way resources are mapped into functionings is provided by the following production function for the achievement b_i and the individual *i* living in household *h* (composed by him and other *o* members):

$$b_i = f_i\left(c(x_i(y_h, t_i, t_o, d_h, z_h, l)\right) + \varepsilon_i$$

with $f_i \in F_i$ and $F_i = \left[f_i | f_i = \left(t_i, t_o, d_h, z_h, l\right)\right]$

and where y_h is a measure of household resources, t_i is a set of individual characteristics, t_o represents a set of characteristics of other members of the household, d_h is a set of demographic characteristics of the household, z_h is a set of public goods available to the household, l is a location variable capturing other area specific influences, e_i is an individual specific error term which we assume to be normally and identically distributed. By remembering that basic capabilities are defined as "the achievement of a given functioning up to a crucial level", our analysis can be simplified, we can obtain a capability production function for the corresponding basic capability b^*_i, setting

$b_i^* = 1$ if $b_i \supset b_{line}$

$b_i^* = 0$ if $b_i \subseteq b_{line}$

where b_{line} is an appropriately specified "crucial level".[5]

This formulation presents two advantages: the first is that the problem presented in this form can be easily estimated with limited dependent variable techniques. In this way we can test for the existence, size and significance of differences between individuals with different characteristics, belonging to different kinds of households and living in locations with different access to public goods. This allows us both to test Sen's claim that parametric variation between individuals might distort a picture of deprivation based on monetary resources, and to judge which are the strongest limiting factors individuals face in achieving basic capabilities.

The second advantage of this way of looking at the relationship between basic capabilities and resources is that estimating the production function for the functioning b_i can be seen as equivalent to estimating a reduced form demand equation (see for example Behrman 1990). Such a function is derived from models where it is assumed that households maximise their utility subject to a full income constraint as well as the household production functions (which describes the biological and technical relations by which households obtain household goods such as for example health). The main characteristic of reduced form demand functions is that such relations "reduce responses of the household … to depend only on the exogenous or predetermined variables and parameters from the point of view of the household (and *not* on other variables currently determined by the household)" (*ibid*. p. 15). Strictly speaking, therefore, our capability production functions will be comparable to "quasi-reduced form demand equation" (e.g. Kennedy et al.

1994), as we include monetary resources as a determinant of achievements. This similarity will provide us with useful guidance in the analysis, as well as with terms of comparisons for the results, without having to resort to adopting a utility maximising assumption.

Before presenting our empirical results, there are two important questions that need to be addressed: which basic capabilities are we going to analyse and which indicators are we going to take. As far as the first one is concerned, a very minimalist view is taken here of which "elementary and crucially important functionings" are to be chosen, focusing only on health and education. These two capabilities always appear in Sen's treatment of which the basic capabilities are, and, indeed, emerge as part of the consensus interpretation of Sen's ideas, both in his writings and in the way his ideas have been popularised indirectly in the Human Development paradigm (e.g. UNDP 1990). Our pragmatic choice of capabilities dismisses the deep ethical question of what makes a life valuable, but this does not make our empirical analysis irrelevant, given that our concerns lie in the fungibility of indicators, and provided that health and education are at least part of any concern with deprivation in basic capabilities.

The practical choice of the indicators of deprivation which will be used in our analysis deserves more careful scrutiny. Our concern has been to reconcile data availability with consistency with Sen's model. A first criterion for the selection has therefore been to choose available indicators that truly represent functionings, i.e. that represent individual achievements.[6] It has already been mentioned that we take health and education to be valuable in themselves. One needs however to decide which among the possible indicators of these dimensions can be taken to identify an elementary and crucial functioning, and where to set the line between adequacy and deprivation. The two issues are actually intertwined, as by choosing an indicator one is also often implicitly setting the extent of deprivation: depending on the indicator (e.g. primary school attendance vs. secondary school attendance) chosen one is implicitly deciding for how many people deprivation in that respect will be binding. [7]

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[5] Obviously this is not a general specification of a capability production function, which would entail coming to grips with the freedom of achieving a given functioning entailed by the concept of capability itself.

[6] Access variables, such as distances to given amenities for example, have been excluded.

[7] To note that the issue of the definition of the lower end applies also to monetary indicators. We will not debate this issue explicitly but we will rely on the poverty line which is mostly used in the recent literature on Peru. We are in fact aiming at comparing the capacity of poverty measurement as generally performed to capture deprivations in other dimensions.

One obvious solution to both the problem of identifying the lower end and of identifying one or more indicators for a given basic capability is to select indicators which identify a non-negligible proportion of the population as deprived in a given dimension. [8] This is justifiable on the ground that there are many aspects to these basic capabilities and that not all of them may equally constrain the capability of individuals living in different contexts. This way of proceeding anchors our definition of deprivation to the more fundamental aspects of each basic capability considered, and at the same time keeps our sample size for empirical estimation of reasonable size for reliable inference.

Following these criteria and the literature discussing pros and cons of various indicators,[9] we decided to take as indicators of capability deprivation[10] child stunting (chronic malnutrition), self-reported morbidity and failure to reach functional literacy (4 years of schooling).[11]

Part 3. The empirical results.

In this section we will present our analysis of alternative indicators of poverty. It has been performed on the ENNIV 1994 survey for Peru (for more information on the survey and the monetary poverty lines adopted see Moncada et al. 1995). At the time almost half of the population of was deemed to be in monetary poverty according to an expenditure based indicator capturing the inability to buy a minimal basic consumption basket, while one in five people could not buy a minimal food basket (extreme poverty). From the disaggregation of the FGT indexes for poverty and extreme poverty presented in table 1 and 2

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[8] Incidentally, it is worth noting how this criterion differs from the use of correlational analysis(which was, for example, the validation criterion adopted by Mc Granahan 1972 when discussing indicators of development). These statistical techniques aim, in fact, at identifying the single indicator within a given dimension which captures more of the information carried by the others. The importance of that indicator then lies in it being tightly interdependent with other aspects of the same phenomenon which has to be measured. We have no problem, however, in acknowledging that different indicators capture different aspects of the same capability as we try to identify the one whose deprivation is more significant in a given context.

[9] For a discussion of stunting – low height for age – see for example Floud 1992, Osmani 1992, Seckler 1982. Various contributions in Feachem et al. 1992 offer a good discussion of morbidity indicators. A variety of indicators of educational achievement is present in the literature. For a discussion with respect to the Latin American case see Wolff (1994)

[10] It should be noted that the analysis performed here considers indicators one by one. We are not dealing here, therefore, with the issue of how to value a vector of different indicators (all the relevant functionings at once).

[11] Of the various indicators one could have adopted we selected one which could capture a contemporary deprivation in education, that is why we focused on an indicator which could be constructed for the 12-15 years old. We did not consider adult deprivations in education as it would have been very hard to disentangle the causal relation, especially because of the difficulty of finding good instruments to overcome simultaneity bias.

wide variations in the regional pattern of the indices are evident.[12] It is striking how rural areas fare worst than average under all profiles, especially relative to Metropolitan Lima.

[12] Further discussion of monetary poverty is and of its determinants is presented in Appendix 1.

Table 1 Monetary poverty in Peru 1994

	Incidence (*Headcount*)	**Depth (*Poverty Gap*)**	**Severity (*FGT(α=2) index*)**
TOTAL	0.496	0.178	0.086
Lima	0.354	0.100	0.039
Urban Coast	0.484	0.171	0.082
Rural Coast	0.641	0.239	0.118
Urban Sierra	0.428	0.155	0.075
Rural Sierra	0.696	0.282	0.149
Urban Selva	0.410	0.135	0.060
Rural Selva	0.707	0.284	0.145

Table 2 Extreme monetary poverty in Peru 1994

	Incidence (*Headcount*)	**Depth (*Poverty Gap*)**	**Severity (*FGT(α=2) index*)**
TOTAL	0.210	0.063	0.027
Lima	0.050	0.011	0.003
Urban Coast	0.150	0.038	0.015
Rural Coast	0.297	0.090	0.037
Urban Sierra	0.140	0.038	0.015
Rural Sierra	0.475	0.158	0.074
Urban Selva	0.148	0.035	0.012
Rural Selva	0.477	0.154	0.068

In our comparison we will examine health and education in turn, at first performing a descriptive analysis, focusing on the way individual observations fall into the four groups identified by a monetary and a non monetary indicator and then estimating capability production functions.

As our analysis has some analogies with the debate on targeting, it is worth noting that the tables of our descriptive analysis are of the kind shown below.

	Non-deprived in non-monetary dimension	**Deprived in non-monetary dimension**
Non-poor	Group A	Group B
Poor	Group C	Group D

In terms of targeting accuracy, if we take the objective to be identifying a non-monetary deprivation, then a monetary one identifies correctly the observations in Group I and IV, while Group II represents a targeting error I (i.e. an error of omission or "*F*-mistake" Stewart Cornia 1995, p. 351), while Group III represents a targeting error II, (i.e. an error of inclusion of the non deprived or "*E*-mistake", *ibid*.). Analysing the way these errors can be committed in a given circumstance can help focusing on the relation between monetary and non-monetary indicators of deprivation. In particular, if these errors were driven by some systematic pattern, one could identify systematic biases in a given targeting criterion.

After a preliminary analysis of the magnitude and possible geographical pattern of the errors, we will proceed to a more in depth analysis which will allow us to understand which factors influence the way resources are transformed into capabilities. In other words, our estimates should help us understanding why some people who are deprived in monetary resources are not deprived in other dimensions, or why monetary resources might not be enough to avoid other important forms of deprivations.

Stunting and monetary poverty.

Looking at the way in which observations are classified by consumption poverty and stunting, one finds that 54% of the cases are consistently classified (Table 3 below) and a simple test of association shows that stunting is statistically associated with consumption poverty. However, one in five stunted children is in a non-consumption poor household and more than 60% of the poor children do not suffer from long term malnutrition. Clearly, child malnutrition is a phenomenon whose determinants go beyond monetary poverty.

Table 3 Stunting vs. Consumption poverty (2054 obs)

	Non-Stunted	Stunted	Total
Non-poor			
col %	*43.22*	*21.03*	*36.48*
row %	*82.51*	*17.49*	*100.00*
Poor			
col %	*56.78*	*79.01*	*63.52*
row %	*62.27*	*37.78*	*100.00*
Total			
	100.00	*100.00*	*100.00*
	69.65	*30.35*	*100.00*

Pearson chi2(1)=92.3037 Pr=0.000

It is interesting to compare these results with those obtained by using the extreme definition of poverty which is based on the ability to buy only a minimally adequate food basket (table 4). While the number of cases consistently ranked increases to 67%, the percentage of children whose stunting goes unnoticed if using a monetary measure rises to half of the stunted children.

Table 4 Stunting vs. Extreme consumption poverty

	Non-Stunted	Stunted	Total
Non-poor			
col %	*73.85*	*49.20*	*66.36*
row %	*77.53*	*22.47*	*100.00*
Poor			
col %	*26.15*	*50.80*	*33.64*
row %	*54.12*	*45.88*	*100.00*
Total			
	100.00	*100.00*	*100.00*
	69.62	*30.38*	*100.00*

Pearson chi2(1)=118.8421 Pr=0.000

Inspection of the previous tables suggests that despite the statistical association between monetary resources and the anthropometrics status of the children, much remains unexplained with an exclusive focus on monetary resources. Some of the implications of relying on simple statistical associations are worth exploring further before trying to understand more of the complexity of the process by which resources are translated into achieved nutritional status.

What would be the effect of adopting monetary resources as targeting indicators in nutrition related interventions? The kind of errors committed could significantly affect certain groups, identified by gender, age, location. As an example, we have checked the neutrality of the errors with respect to geographical location. We ran a multinomial logit (Table 5 below) where the probability that observations are classified consistently (group A and D above), or that a targeting error I (omission as identified by group B) or that a targeting error II (as identified by group C) occurs when using consumption poverty to identify stunted children is related to the region of residence of the child.

Table 5 Regional factors and the targeting accuracy of monetary resources: stunting. Multinomial logit results (Relative Risk Ratios with Consistent Classification as the base case)

	Error I	**Error II**
	z	*z*
Urban Coast (-)	1.053	2.064**
	0.095	*4.062*
Rural Coast	2.553*	1.706**
	2.042	*2.770*
Urban Sierra	1.419	0.943
	0.757	*-0.319*
Rural Sierra	2.789**	1.420*
	2.655	*2.243*
Urban Selva	3.529**	0.923
	3.194	*-0.446*
Rural Selva	3.810**	1.443*
	3.352	*2.093*
Log Likelihood = -1765.0256		
chi2(12) = 63.69		

Prob > chi2 = 0.000
Pseudo R2 = 0.0177

(¯) Except Lima. (Outcome consistent=1 is the comparison group)

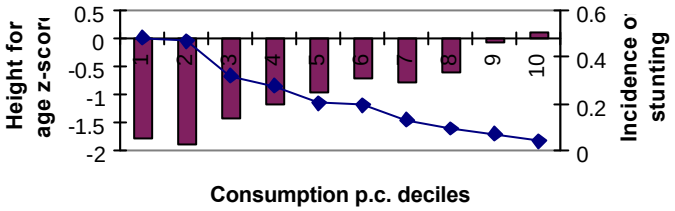
The probability of a child not being considered deprived when he is stunted (error I) as opposed to being correctly classified is greater for all the non-Lima regions, though only for those living in the rural areas and for those living in the Urban Selva is the coefficient significantly different from the base case (i.e. Lima). The probability of benefiting from, say, a nutritional intervention when one is not stunted (error II) is greater for children living in the rural areas and, even more, for those living in the Urban Coast.

Consideration of these results would warn against using consumption poverty as a proxy for malnutrition in the rural areas. In those regions this targeting criterion would be prone to both kind of errors, and particularly of error I, which would be much stronger than, for example, in Lima. This points to the fact that looking only at monetary resources when one is interested in people's basic capabilities is quite simplistic. Deprivation is not a homogeneous category, and looking at it through the lens of a monetary indicator assumes a uniformity (for example across regions) which is not necessarily there. The regional pattern which we have identified here could be due to a variety of factors, some of which might have to do with the way the consumption indicator or the poverty line have been constructed, some of which might have to do with some systematic characteristic linked, for example, to social service provision.

This provides a useful background for a more in depth analysis of the determinants of stunting by estimating the appropriate capability production function. Chart 1 below explores the relation between child stunting and resources by graphing the distribution of stunting and of the average standardised height for age value by expenditure deciles. It shows a varied pattern in the average standard score for child height. While stunting decreases monotonically, though at varying speed, average standardised height is lower in the second decile than in the first and in the 7^{th} than in the 6^{th}. Though not very marked this reduction in standards might be due to substitutions out of inferior goods with higher nutritional content, as well as to many other complex interactions about which our multivariate analysis will try to inquire further.[13]

[13] Nevertheless, fitting a line gives a coefficient of .43 (t ratio=11.966) on the expenditure per capita coefficient, R-squared 0.1166.

Chart 1. Average z-score of children's height and incidence of stunting by decile



In order to explore the relation between household resources and child stunting we have modelled the achievement in this basic capability as a function of resources, together with child characteristics, parental characteristics, household characteristics and structure and factors linked to community and household availability of publicly provided goods and services.

Table 6 An analysis of child stunting **(*: significant at the 5%, ** significant at the 1% level)**

	Probit		**Tobit**	**OLS results**	**OLS fixed effects** [$]
	Coef. *T*	dF/dx	Coef. *T*	Coef. *T*	Coef. *T*
Household expenditure per capita	-0.228* *-2.400*	-0.067	0.248** *2.951*	0.294** *4.184*	0.277** *4.128*
Sex	-0.046 *-0.524*	-0.014	-0.007 *-0.061*	0.033 *0.404*	0.030 *0.345*
Age of the child (months)	0.024** *5.808*	0.007	-0.028** *-6.086*	-0.033** *-8.199*	-0.033** *-8.434*
Mother with less than 5 years of schooling	0.270* *2.277*	0.079	-0.330* *-2.468*	-0.220 *-1.909*	-0.248* *-2.160*
Mother's age	-0.171** *-2.618*	-0.050	0.233** *3.541*	0.144* *2.320*	0.169** *2.691*
Mother's age squared	0.002* *2.190*	0.001	-0.003** *-3.144*	-0.002 *-1.860*	-0.002* *-2.226*
Female headed household	-0.012 *-0.063*	-0.003	-0.028 *-0.116*	0.056 *0.261*	-0.016 *-0.073*
Indigenous	0.155 *1.106*	0.046	-0.162 *-1.128*	-0.182 *-1.384*	-0.185 *-1.420*
Size of the household	0.077* *2.159*	0.022	-0.047 *-1.326*	-0.061 *-1.952*	-0.069* *-2.240*
Ratio of children in the household	1.833** *3.848*	0.535	-2.722** *-5.110*	-1.547** *-4.210*	-1.606** *-4.368*
Availability of public water in the house	0.570* *2.480*	0.166	-0.677* *-2.391*	-0.603** *-2.896*	-0.567** *-2.800*
Interaction term between public water and child age in months	-0.012* *-2.157*	-0.004	0.012 *1.728*	0.009 *1.837*	0.009 *1.814*

Availability of public sewage in the house	-0.492* *-2.295*	-0.138	0.505* *2.252*	0.614** *3.706*	0.541** *3.240*
Electricity	-0.061 *-0.408*	-0.018	-0.003 *-0.016*	-0.118 *-0.807*	-0.139 *-0.918*
Community morbidity rate	1.020* *2.207*	0.298	-1.358** *-3.043*	-1.358** *-3.875*	-1.414** *-3.633*
Time to reach a health facility*	-0.002 *-1.059*	-0.001	0.002 *1.000*	-0.001 *-1.118*	-0.001 *-0.984*
Time to be attended in a health facility *	-0.003 *-1.594*	-0.001	0.003 *1.617*	0.000 *0.087*	-0.001 *-0.353*
Constant	0.360 *0.358*		-2.393* *-2.390*	-1.504 *-1.574*	-2.436* *-2.489*
Number of obs	1001		1001	1001	1001
Joint Significance of the regressors	F(17,259)=9.97 *Prob>F=0.0000*		chi2(17)= 225.04 Prob>chi2=0.0000	F(17,259)=25.66 *Prob>F=0.0000*	F(44,232)=193.63 Prob>F=0.0000

•Household resources appear as instrumented in the OLS model, as the Hausman test rejected the null of exogeneity (t ratio: -2.136).

* **NB** positive coeff. in the tobit imply less negative gaps ♣ Fixed effects run at the department level

Such a specification poses a problem with potential simultaneity bias, if household resources and child stunting are jointly determined by some other factor. For example labour market participation, especially by the mother, jointly determines to the amount of household resources (positively) as well as the amount of care of which the child can benefit (negatively). This possibility is dealt with in the household model literature by estimating "quasi-reduced form estimates" (e.g. Kennedy et al. 1994), in which an instrumental household per capita expenditure variable is used together with a list of exogenous factors to explain the determinants of child stunting. In this paper we have adopted the 2SCML estimator suggested by River and Vuong (1988) for the probit model, and by Smith and Blundell (1986) for the tobit, which allows one both to test for potential endogeneity of resources and to correct the estimates accordingly.

Table 6 above presents the results we have obtained from a probit analysis of the determinants of stunting, a tobit analysis explaining the shortfall from the nutritional standard[14] and two linear regressions on the

14 Set at 2 standard deviation from the median of the international reference group.

whole of the distribution of the height-for-age standard score, one standard and one controlling for fixed effects at the department level.

Even if our main focus is on the first model, interesting insights on the mechanisms at work can be gained by analysing these models jointly. One feature which stands out is that, while the hypothesis of weak exogeneity could not be rejected in the probit and the tobit model, this is not so in the linear regression model. This could suggest that the amount of care received (or whatever else makes nutritional achievements and household per capita resources simultaneously determined) sets in as a binding factor only when some basic level of nutrition has been achieved.

The level of household expenditure per capita is a significant determinant of child stunting. It is important to note, however, that the size of its coefficient and marginal effect depends also on its ability to capture other important mechanisms at work.[15] One such mechanism (which explains why the relation between resources and child height is "far from universal", Strauss et al. 1993) can be the fact that better off people live in better neighbourhoods, so that the importance of local level infrastructure and availability of public services matters a great deal in determining children health status. We will discuss the role of these particular factors below.

Of the individual characteristics we have considered, the age of the child is crucial, while gender is not. The importance of age for stunting is not surprising as one can expect the pattern of malnutrition to reflect different factors at different stages of development of the child. This plurality of factors means that children can be on different growth trajectories even within the broad categories of "normalcy" and "stunting", so that the coefficient on age is bigger and significant when considering the shortfall from the norm or the achievements in terms of standardised score. A crucial factor linked to age is when weaning takes place, with possible higher malnutrition (largely linked to intestinal diseases) when children are given powdered milk diluted with unclean water.[16] To capture this effect, an interaction term between water and age of the

[15] In the probit specification, the coefficient on household per capita expenditure drops from -0.560** (t ratio-6.6020; dF/dx:-0.170) in the bivariate case, to -0.607** (t ratio:-6.959; dF/dx :-0.180) when children characteristics are added, to -0.318 (t ratio:-3.440; dF/dx: 0.094) when control is taken also of households characteristics, before reaching 0.228* (t ratio -2.4; dF/dx: 0.067).

[16] In our sample 32 % of the children is given only maternal milk and 10% is never breast fed. On average the other children are given different kinds of milk by the time they are 6.5 months old. Children begin to drink other liquids than milk (water, herbal infusions) on average when they are 9 months old.

child has been included; it shows a significant and negative impact on the probability of stunting, though its beneficial effect is not significant when modelling the whole distribution of the standard score.

Parental characteristics are important to control for the genotypic (hereditary) and phenotypic (acquired through interaction with one's environment) characteristics of the child. As measures of parental height which are presented in the literature to control for the former factors were not available, we relied only on maternal education and age. The maternal education variable is intended to be "in part, as a proxy for maternal endowments and, in part, to represent better management of health inputs" (Kennedy et al. 1994, p. 689). Children of mothers who did not have at least 5 years of schooling[17] are more likely to be stunted and their shortfall from the norm is greater. This educational variable ceases to be a crucial one when determining the level of achievement for children at higher levels of nutrition, unless factors unobservable at department level are controlled for. The fact that the significance and size of this coefficient increase when these factors are controlled for, points to possible synergies with one's own environment in the "better management of health inputs", with some minimal level of education implying a greater capacity to take advantage of what is offered at the local level (e.g. in terms of health provision).

Mother's age, either because of its influence on birth weight (with very young mothers having smaller children), or because of some experience factor linked to child rearing, could affect child stunting. One would expect the effect to tail off at some stage as, for example, higher age is related to high parity and pregnancies and births deplete mothers' health. This is indeed the kind of pattern that seems to be at work when looking at the probability of being stunted and at the shortfall, with the turning point being at about 43 years of age in the case of the probit (39 years for the tobit).

The household characteristics we have considered are those linked to the demographic structure of the house and its ethnic origin. The impact of female headship on child malnutrition is statistically insignificant. Ethnicity does not play a significant role in determining child stunting.[18] In contrast the percentage of children under 5 is strong and significant while the size of the household is significant both in the probit (although its significance appears only when controlling for community variables and availability of public goods) and in the fixed effect model. The significance of the percentage of children under 5 suggests a strong effect of the amount of care that is available to the child. The effect of size of the household is more

17 This particular cut off line is the only one among the various variables chosen which has proven significant.
18 In the probit specification of the model, size and significance are affected by the inclusion of community characteristics, pointing to strong location effects.

puzzling, as this is an effect of numbers above that arising from allocating household total expenditure to a larger number of people. Larger households seem to adopt a technology which is in itself less efficient in preventing child stunting, though it does not affect the exact level of height for age achieved unless one controls for local unobservable factors.

Finally, we have controlled for availability of publicly provided goods and services. It is in this context that the fixed effect models is particularly relevant, as it tries to capture all the specific characteristics of a given locality (among which an important role is played by a wider spectrum of publicly provided goods and services than those captured by the last batch of variables we have discussed). Access to electricity has no significant impact on child nutritional status. Publicly provided waste disposal has in contrast a great impact in reducing child stunting and the severity of the stunting as well as generally improving achievements. Piped water has a strong perverse effect, which points to worryingly bad quality of water[19] from the public distribution system to which, as already mentioned, young children are particularly exposed. Similar results have been obtained elsewhere (Bevan et al. 1993) and factors such as the low pressure of water in the pipes which allows water to stagnate in the pipes have been put forward as explanations. It is also possible to speculate that this effect is due to a greater confidence and ease in using powdered milk if there is public water. The effect on the probability of being stunted, as already mentioned, is partially offset for older children. The effect of public utilities is non significant in the fixed effects model, possibly also because relatively little variation is experienced at the local level in access to those goods.

Reported morbidity in the community tries to capture some feature of the epidemiological environment children live in. It has a strong and statistically significant effect in the four models presented. The average time needed to reach health facilities for the community on average is included as a measure of public service availability. The argument for using indicators of availability is that both usage and prices (if they exist and are not regulated) might depend on the quality of services, therefore resulting in endogeneity (Strauss et al. 1993).[20] The community average time waiting to be attended in the health facilities was included as an indicator of service quality. Both variables appear as decreasing the chances of a child being stunted, though statistically insignificant. It should be born in mind, however, that they might be averaging

19 It is interesting to note that 60% of the households with public provision of water think that the water they consume is polluted.

20 Note however that against the use of community averages is the consideration that the primary sampling units of the ENNIV are quite small (see Behrman 1990)

over too many different health services to capture those services more important for a child healthy development effectively.

What is the bearing of the findings of this subsection for our discussion of the role of monetary indicators as proxies for capability deprivation? Our descriptive analysis has shown that if we consider that missing out one in five stunted children is a high loss of information for our indicator of deprivation, then a direct indicator of stunting is preferable to consumption poverty to capture this dimension of deprivation. The main conclusion that we can draw from that analysis is that much depends on the trade-off we are ready to accept for targeting errors I and II, and for their geographical distribution.

Further, our analysis of the determinants of stunting sheds light on what conditions the way resources are translated into achieved nutrition. In summary these results show the importance of child age, maternal characteristics, the demographic characteristics of the household and access to sanitation and water of better quality for child malnutrition. These variables remain significant also when introducing fixed effects. This reinforces the claim that our social service provision variables, however far from ideal they may be, are picking up the important role of the provision of these goods for improving the way in which household expenditure is translated into nutrition.

Table 7 below helps to get a clearer idea of the magnitude of these effects. We have calculated "marginal" effects of having sewage and maternal education for the lowest, the fifth[21] and the top decile, presenting them together with the level of household per capita expenditure which would be needed in order to compensate for a negative outcome in these two variables in turn (labelled "equivalent expenditure" and presented both in thousand pesos and as a proportion of average expenditure for that decile).

[21] It can be recalled that as about half of the population are poor in term of consumption, the poverty line can be seen as roughly equivalent to the median and the fifth decile includes the better off of the poor.

Table 7 Equivalent expenditure needed to compensate for not having access to sewage and for low levels of maternal education.

	1st decile	5th decile	Top decile
Prob. of being stunted if			
Without sewage	0.372	0.293	0.042
With sewage	0.206	0.150	0.013
Impact of sewage on probability	0.166	0.143	0.029
Equivalent expenditure *(000)*	2.600	3.550	8.740
Change in expenditure			
In absolute terms *(000)*	2.165	2.156	2.165
As a proportion of average exp.	5.977	2.547	1.329
Prob. of being stunted if			
Mother without 5 years of education	0.353	0.276	0.038
Mother with 5 years of education	0.259	0.194	0.020
Impact of maternal education on probability	0.094	0.082	0.018
Equivalent expenditure	1.620	2.579	8.020
Change in expenditure			
In absolute terms *(000)*	1.185	1.185	1.445
As a proportion of average exp.	3.724	1.850	1.220
Mean expenditure	435	1394	6575
Incidence of stunting (%)	48.32	20.2	0.037
Percentage of households without public sewage	87.3	40.93	5.23
Percentage of under 5 whose mothers are without 5 years of schooling	92.66	65.84	19.26

Looked at in this way the results are quite telling: the availability of private resources is an important binding factor in the production of a child nutritional outcomes, though they display "diminishing returns". "Sterilising" the effects of lack of sewage and of lack of maternal education on the probability of stunting would however require the income of the poorest to rise by as much as 6 times. Even if a significant growth in their income was to occur, therefore, in the context of lack of infrastructure or of low education, no substantive improvement would occur in terms of nutrition. Notice for example that even if the income of the poorest were to rise by 6 times, without sewage the probability of a child being malnourished would still be 21%, more than 5 times the probability of a rich child in similar conditions.

The same pattern can be found in relation to maternal education: to compensate for the lack of it would require an increase of household resources to 3.7 times the average for those in the lowest decile, while it would take only an increase by 22% for those in the upper decile. Even after such a compensation, those in the lowest decile would face a probability of stunting which is 6 times as much as those in the upper decile whose mother has not had 5 years of education.

Morbidity and monetary poverty

As Table 8 shows, the patterns of self- perceived morbidity and consumption poverty are such that not even the hypothesis of complete randomness can be rejected. As many cases are consistently as inconsistently classified by both indicators, making one a very bad predictor of the other.

Table 8. Self-reported morbidity vs. Consumption poverty (18667 Observations).

	Non-Sick*	**Sick***	**Total**
Non-poor			
col %	*48.74*	*47.53*	*48.35*
row %	68.80	31.20	100.00
Poor			
col %	*51.26*	*52.47*	*51.65*
row %	51.26	52.47	100.00
Total			
	100.00	*100.00*	*100*
	68.26	31.74	100

*** in the last 4 weeks Pearson chi2(1)=2.3673 Pr=0.124.**

Such a conclusion can be sensitive to the cut off point chosen for the identification of poverty. Focusing on extreme consumption poverty (Table 9) the number of cases consistently identified by extreme consumption poverty and morbidity rises to about 60% of the total observations, as the "misclassification" of individuals non-reporting morbidity but poor declines. Even though the association between the variables appears statistically significant, three fourths of the morbidity cases would be missed out by something like a means tested intervention related to health (targeting error I).

Table 9 . Self-reported morbidity vs. Extreme consumption poverty (18667 observations)

	Non-Sick*	**Sick***	**Total**
Non-poor			
col %	*77.1*	*75.36*	*76.55*
row %	68.75	31.25	100.00
Poor			
col %	*22.9*	*24.64*	*23.45*
row %	66.65	33.35	100.00
Total			
	100.00	*100.00*	*100*
	68.26	31.74	100

*** in the last 4 weeks**

Pearson chi2(1)=6.8261 Pr=0.009

The following table presents our multinomial logit results, where the probability of observations being consistently or inconsistently classified by consumption poverty and morbidity are related to the region of residence of the individual.

Table 10 Regional factors and the targeting accuracy of monetary resources: morbidity. Multinomial logit results (Relative Risk Ratios with Consistent Classification as the base case)

	Error I *z*	**Error II** *z*
Urban Coast (¯)	1.616** *6.621*	1.282** *4.432*
Rural Coast	1.339** *2.914*	2.219** *11.918*
Urban Sierra	1.958** *9.513*	1.220** *3.473*
Rural Sierra	1.265** *3.223*	2.116** *15.105*
Urban Selva	2.048** *9.774*	1.076 *1.179*
Rural Selva	1.182 *1.870*	1.748** *9.222*
Log Likelihood = -18363.911		
chi2(12) = 590.40		
Prob > chi2 =0.0000		
Pseudo R2 = 0.0158		

(¯) Except Lima

The association between morbidity and resources appears to be stronger in Lima than elsewhere, as targeting errors of both kind seem to be more likely to occur in the rest of Peru than in Lima. As far as type I errors are concerned coefficients are everywhere positive and significant except in the Rural Selva where the effect though positive, is not significantly different than in Lima. The same occurs for people in the Urban Selva with respect to error II.

These results imply not only that it would not be a good idea in general to target health interventions on the basis of consumption poverty as shown by table 9 above, but also that people in certain regions would be particularly affected. In the urban areas in particular, the relative risk of error I is higher and of error II

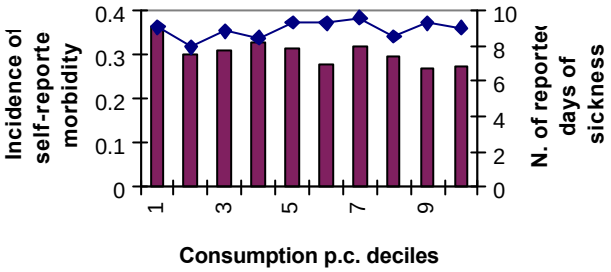
smaller. This configuration of the errors seems to point in the direction of greater availability of health services (likely to occur in urban areas) and greater resources being positively associated with morbidity, but this is a result which needs to be tested.

In attempting to estimate a capability production function for morbidity we are well aware that "causes of socio-economic patterns in self-perceived data are difficult to determine" (Murray et al 1992). This also explains why comparatively few studies have analysed data of this kind. Some analysis is however available from a study of an earlier LSMS survey (Murray et al 1992) on Cote d' Ivoire, Ghana and Peru. It is of particular interest as it provides us with a picture from the first round of the ENNIV data collected in 1985/86. In Peru correlations were found among morbidity and: age (older people reporting greater morbidity), size of the household (smaller households reporting more morbidity, for both adults and children), gender (with women reporting greater morbidity and in particular pregnant women reporting greater and longer illnesses than non-pregnant women), area of residence (urban areas being characterised by greater reporting, though illnesses were "perceived to be less disabling than in rural areas") and total household expenditure (reported morbidity increased from 34% for the lowest quartile to 41% for the highest). Of the three country studies mentioned above, in the Peruvian one no regression analysis has been performed, but nevertheless that descriptive analysis provides a benchmark against which to compare our findings.

Chart 2 below shows the distribution of reported morbidity by decile. We have also graphed the average number of days of sickness of those who reported morbidity trying to capture the seriousness of their illness. As the chart shows there is much more than household per capita expenditure driving the morbidity pattern even though one can picture a downward trend which contrasts with the 1985 finding reported above.[22]

[22] Fitting a trend would give a coefficient of -0.0083 (t-ratio: -3.585). This result is not, however, very robust as when running a similar regression on the smaller sample on which it has been possible to estimate the probit and tobit models shown below, the result does not hold.

Chart 2. Average incidence of morbidity and average n. of days of sickness, by decile



Trying to make sense of which other factors lie behind the pattern shown above, we have estimated the determinants of reported morbidity, controlling for the individual and household variables mentioned above, as well as for education (which is actually the single factor to which most attention has been devoted when estimating adult morbidity functions, e.g. Behrman et al. 1989, Strauss et al. 1993), the demographic and ethnic structure of the household as well as social service provision and location. We also present a tobit model based of the number of days respondents reported they had been sick. The use of the tobit is justified by reference to an unobservable health variable, which upon reaching some threshold level appears as number of days of sickness. The tobit has also been run taking into account a series of dummies to purge the estimates of the fixed effects associated with different departments.

The potential endogeneity of household resources has been dealt with adopting the Rivers and Vuong (1986) two stage procedure. Household per capita expenditure was instrumented by ownership of real assets and of consumer durables.[23] The hypothesis of weak exogeneity could not be rejected, however, so in the models included in table 10 expenditure appears non-instrumented.

The weak exogeneity of household expenditure with respect to morbidity is of interest as one would expect that household resources are affected by participation in the labour market or by productivity related wage differentials related to household members health. Several considerations are in order. First of all the self reported nature of the data can be held responsible for this result. In addition, the link with the labour market is less strong at the upper end of the income distribution, where people are more likely to enjoy some work related welfare provision against illness. One can argue therefore that while for the rich the link between morbidity and income does not exist, for the poorest a link exists but that is through "objective" (and severe) disease, which may be weakly correlated to the subjective dependent variable we examine

here.[24] Weak exogeneity in this case seems, therefore, to reinforce the scepticism about using self-reported morbidity data. Without repeating the arguments already discussed on why this analysis can still be of interest, it is worth noting that the Hausman test in the Rivers and Vuong (1986) procedure is a general specification test. The finding might therefore also reflect the difficulty in finding appropriate instruments for the first stage among the available variables.[25]

As table 11 below shows, it has been easier to identify factors significantly associated with the number of days of illness than with the probability of being ill or not.

In the face of such a complex phenomenon as health, aggregating over a wide range of conditions and not being able to control for all the factors which might cause unobserved heterogeneity in our sample (such as genotypic characteristics which are not directly depending on age, sex and ethnicity) this is perhaps not surprising.

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[23] The joint significance of the regressors of this first stage was F(37,308)=160.93 Prob>F =0.0000.

[24] It should be noted however that by including parental education variables, one obtains a sample of younger cohorts (the individual who still have cohabiting parents) and that weak exogeneity is rejected on this younger sample. The amount of time spent by parents with sick children instead than at work is one possible mechanism responsible for this endogeneity.

[25] Note that this time it has not been possible to perform directly a Sargan test on the choice of the instruments as we did for the stunting model, as the continuous variable we are using is censored.
The spirit of the test was however replicated by directly including the instruments in the second stage of the tobit and checking for their joint significance. The results of this test were such that the joint significance of these instruments in the second stage could not be rejected [F(15,11943)=2.40, Prob>F=0.0018]. It was been very difficult however to find alternative instruments.

Table 11. An analysis of morbidity

	Probit		**Tobit**	**Fixed Effects**
	Coef. *t*	dF/dx	Coef. *t*	Coef. *t*
Household per capita exp.	0.022** *2.678*	0.007	0.240* *2.471*	0.266** *2.649*
Age	-0.002 *-0.485*	-0.001	0.013 *0.248*	-0.011 *-0.209*
Age Squared	0.00009* *2.097*	0.000	0.001* *2.415*	0.002** *2.841*
Sex	0.032 *0.626*	0.010	0.458 *0.707*	0.336 *0.521*
Interaction term between sex and age	0.003* *2.191*	0.001	0.041* *2.242*	0.046* *2.513*
Years of schooling	-0.027** *-6.661*	-0.009	-0.380** *-7.293*	-0.352** *-6.761*
Indigenous	0.037 *0.722*	0.012	-0.188 *-0.353*	-0.086 *-0.159*
Female headed household	0.084 *1.618*	0.027	1.115* *2.194*	1.348** *2.644*
Age of the head	0.013 *1.561*	0.004	0.230** *2.662*	0.233** *2.687*
Age of the head squared	0.00014 *-1.706*	0.000	-0.002** *-2.736*	-0.002** *-2.696*
Size of the household	-0.022 *-1.968*	-0.007	-0.394** *-4.872*	-0.428** *-5.189*
Ratio of children in the household	0.265** *2.592*	0.085	4.464** *4.181*	4.529** *4.234*
Availability of public water in the household	-0.157 *-1.706*	-0.052	-1.879* *-2.209*	-2.097* *-2.411*
Availability of public sewage in the household	0.095 *0.911*	0.030	1.748* *2.060*	1.572 *1.810*
Time to reach a health facility*	0.00003 *0.034*	0.000	0.002 *0.324*	0.005 *0.683*
Time to be attended in a health facility*	0.001 *1.455*	0.000	0.012* *2.180*	0.013* *2.318*
Community literacy rate*	0.462	0.148	5.788**	4.757*

	1.908		*2.814*	*2.260*
Urban Coast	0.432**	0.149	6.284**	7.576**
	6.270		*10.679*	*9.706*
Rural Coast	0.114	0.038	3.019**	4.393**
	1.000		*3.198*	*4.065*
Urban Sierra	0.492**	0.172	7.367**	8.714**
	7.969		*12.696*	*11.836*
Rural Sierra	0.315**	0.108	5.776**	7.207**
	3.138		*6.702*	*7.337*
Rural Selva	0.449**	0.160	7.298**	7.917**
	4.264		*7.876*	*7.438*
Urban Selva	0.436**	0.155	6.533**	8.616**
	5.618		*9.793*	*10.074*
Constant	-1.308**		-21.918**	-23.302**
	-5.231		*-8.571*	*-5.891*
Number of obs	11987		11981	11981
Joint significance	F(23,322)=19.62		chi2(23)= 800.96	chi2(59)= 958.20
	Prob > F = 0.0000		Prob>chi2= 0.0000	Prob > chi2 = 0.0000

Monetary resources appear as strongly influencing morbidity, with its sign and size influenced by the other correlates taken into consideration. While, as mentioned above, a negative trend could be fitted in the chart 2, the coefficient on household per capita expenditure in the three models presented points to greater affluence being linked to higher probability of illness and longer duration. It can further be noticed that if regional variables were not included, the effect of household resources, though positive, would be insignificant. One can speculate on what kind of inter-regional heterogeneity is responsible for the insignificance of the household expenditure coefficient. Part of the result could be due to inadequate inter-regional adjustments in prices. Whatever the reason, the conclusion that the relation between monetary resources and morbidity depends on a variety of factors is a robust finding from table 10 above. This challenges exclusive reliance on simple correlations (as done in Murray et al. 1992).

Of all the individual characteristics considered, age and sex are expected to play some role. As already mentioned, others have found that gender influenced reported morbidity (*ibid*.), while ageing is generally associated with greater illness. In our results, age does not play a significant role in general (though it does so for women), with only the squared age having a tiny though significant effect with an increasing rate of

reporting as age increases.[26] Gender does not appear as significant in any of the models above, though the coefficients on the tobits are very big. The non significance of this regressor is quite different from the reporting pattern identified in other developing countries,[27] where a gender differential seems to hold strongly over the life cycle, and also when focusing on other measures such as the ADL (Activity of Daily Living) (Strauss et al 1993).

Years of schooling play a very significant role in all our models as it has been reported elsewhere. This finding has been found to persist when one controls for individual's and parental background (e.g. Behrman et al. 1989, Strauss et al 1993). The claim is that this variable is doing more than picking up individual specificities (which would both favour scholastic achievements and better health), suggesting that education improves the technology with which resources are transformed into health.

We could impose some form of control for parental characteristics by considering their education. Given the nature of our data, however, we could do so only on a small (and younger) part of our sample (3980 obs., average age 13.5). For all the parental education variables which were tried, the effect was to make years of schooling insignificant. Given, however, the young age of these individuals, it does not seem surprising that their own schooling is not significant in determining their health status.

Ethnicity as well as female headship of the household do not play an independent role in determining whether people are sick or not. Individuals in female headed households are however sick for longer. The age of the head of the household has also been controlled for. As we were already controlling for individuals' age, these controls have been inserted to capture for some of the background characteristics of the individual. In this sense people living in households headed by older heads have experienced an "older technology" in transforming health inputs into health; most likely low parental education is the main characteristic of such an older technology. On the younger sample for which we could consider parental education, none of the variables gave significant results. A pattern of greater morbidity tailing off with the age of the head, compatible with the education hypothesis, was however found in explaining the number of days of illness, with a turning point at about 58 years of the head of the household.

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[26] As the head is answering for all the members of the household, it is also possible that if he is a male he will be less aware of minor health problems of the small children, which might further contribute to this result.

[27] In Thailand and Pakistan, however, when respondents answered about other members of the household they tended to report greater morbidity for boys than for girls, possibly because of cultural biases (Murray et al 1992.) . In our data however this is not the case: morbidity was reported for 1265 out of 3556 girls under 15 and 1290 out of 3562 boys under 15.

The size of the household diminishes the probability of being sick, though significantly so only when looking at the days of illness. The percentage of household members below 5 significantly increases the chances of reporting morbidity, possibly because there are more chances that one of them will get an infectious disease and pass it on to other children in the household, while controlling for the percentage of women produces a coefficient also positive but insignificant.[28]

The variables we have included to control for provision of social services both at the household and at the community level do not seem to capture much which is significant in explaining the chances of being ill. Having access to public water reduces the severity of the illness, especially when considering the fixed effect model, though it is insignificant in explaining the chances of reporting morbidity. Sewage provides a "perverse" effect in determining the number of days of illness, perhaps linked to higher ideals of health in neighbourhoods better provided with infrastructure, which is compatible with its insignificance once department level effects are controlled for. The variables that should capture access and quality of health (which one would expect to play a role)[29] do not seem to be doing so in the probit model, though at least waiting time increases the number of days of illness. The last variable of this group is the percentage of adults in the community who have not attended school enough to gain functional literacy. Similar variables have been used by others (e.g. Behrman et al. 1989) to proxy prices on the ground that "relative prices broadly defined (i.e. to include infrastructure as well as nominal prices) usually are systematically related to the size of the urban area and the extent of education of the population in which one resides" (*ibid.* p. 650). In that study using Nicaraguan data, the literacy variable did not prove significant, while in contrast we find it significant in increasing the days of illness, either because it proxies prices or because of some more general effect through the impact of schooling on the environment one lives in.[30] As the coefficient would be significant also in the probit model if the regional dummies were excluded, it is more likely that the variable is capturing some broader environmental effect than literacy *per se*.

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[28] An alternative specification controlling also for the percentage of women in the household (to avoid collinearity the percentage of men was not included) way tried. The coefficient on the percentage of women was 0595805 (t-ratio 0.480); and the one on the proportion of children was .1673851 (t ratio 1.736). The drop in both the size and the significance of the coefficient on the proportion of children in the household could be due to the coefficient in table 11 above picking up part of the high parity-maternal depletion link (see for example Strauss et al 1993).

[29] For example Gertler and Van dee Gaag (1990) estimating a model of medical choices in Peru using data from the ENNIV 1991 found a significant effect of the time needed to travel on each of the choices.

[30] Also this one, as the other community variables, might be problematic as it averages over the small number of observations included in every PSU.

The last batch of variables we have included is a set of regional dummies. As already stressed, these variables do not have a true explanatory power in themselves, but rather capture residual effects which have some geographical pattern. Apart from the Rural Coast, people outside Lima (the region we are taking as a benchmark) seem more likely to declare themselves ill, and even in the Rural Coast they are ill for longer. Given the varied picture of these regions, one has to recognise the complexity of factors behind these regional influences. In other words the reasons why morbidity is higher everywhere else than in the capital are likely to vary in different contexts, and it seems very difficult to unpack this bunch of factors.

In summary, what emerges from our analysis of the relationship between resources and reported morbidity points to a complex relationship. From our descriptive analysis it appeared that they are not associated in a statistically significant way, though the indicators of monetary poverty and morbidity seemed to identify deprivation more consistently in Lima than elsewhere in Peru. By modelling morbidity we have been able to go beyond the correlations which were found on an earlier round of the same survey. Regional factors appeared once again as playing an important pattern both directly and by conditioning the effect of household resources. Of the factors which were significantly associated with morbidity in the 1985/1986 study (Murray et al 1992), age is significant only for women, while the size of the household is significantly linked only with the number of days of illness, rather than the probability of being ill in itself. Further, our significant regional effects, do not seem to be of the kind described by Murray et al. (1992) (i.e. greater morbidity in urban areas but less disabling illness).

In table 12 we have elaborated our results a bit further, exploring the effects of education on morbidity. This is useful both because it represents an important instrumental link for health policies and because by looking at marginal effects disaggregated by decile it allows us to explore the complementarities between resources and education. In this case the same pattern is found as for stunting, with education having the greatest effect for the poorest, while at the same time the "perverse" effect of affluence on illness is the strongest for the richest.

Table 12

	1st decile	5th decile	Top decile
Prob. of being ill if			
Average years of schooling	0.272	0.256	0.258
One year of schooling more than average	0.263	0.247	0.249
Impact of years of schooling on probability	0.008871	0.008592	0.008631
Marginal effect of expenditure	0.06741	0.06838	0.073
Mean expenditure	435	1394	6575
Incidence of morbidity (%)	36.46	31.34	27.20
Average years of schooling	4.3	6.9	10.8

It is interesting to note that because of the latter effect, those in the upper decile would have a probability of being ill greater than those in the lowest if they had the same years of education of those in the lowest decile (31.74% instead than 27.2%). On the other hand it would take almost 6 years of schooling for those in the lowest decile to achieve the same level of probability (25.7) as those in the upper decile, which corresponds to an almost 40% increase over the years of schooling they presently have. It can be noted incidentally, that this last result can be taken to argue indirectly for the importance of completed primary education for everybody in Peru.

Educational achievements and monetary poverty.

The association between low educational achievement for the 12-15 years old and monetary poverty is strong and significant. Even so, a fifth of the children of this age group who have not yet achieved functional literacy are to be found in non-poor households (table 13). At the same time, however, 68% of the poor children in this age bracket have had at least 4 years of primary, which shows that monetary poverty in itself is not sufficient to reduce the chances of a child reaching this minimal level of education within a reasonable amount of time.

Table 13. Monetary poverty and children educational achievements (children 12-15 years old) (1833)

	Having had 4 years of schooling	**Not having had 4 years of schooling**	**Total**
Non-poor			
col %	*48.87*	*20.76*	*42.44*
row %	88.82	11.18	100.00
Poor			
col %	*51.13*	*79.24*	*57.56*
row %	68.53	31.47	100.00
Total			
	100.00	*100.00*	*100.00*
	77.14	22.86	100.00

Pearson chi2(1) = 104.5088 Pr = 0.000

Table 14 focuses on those in extreme poverty. Adopting this lower poverty line implies that children without the 4rd grade are equally divided between poor and non-poor. The fact that error II diminishes more than proportionally as compared to the decrease in those now labelled as poor, suggests that those among the poor children who have achieved our minimal educational target are among the relatively better off.

Table 14 Extreme Monetary Poverty and educational achievements (children 12-15 years old) (1833)

	Having had 4 years of schooling	**Not having had 4 years of schooling**	**Total**
Non-poor			
col %	*79.00*	*52.27*	*72.89*
row %	83.61	16.39	100.00
Poor			
col %	*21.00*	*47.73*	*27.11*
row %	59.76	40.24	100.00
Total			
	100.00	*100.00*	*100.00*
	77.14	22.86	100.00

Pearson chi2(1) = 116.8452 Pr = 0.000

As in the case of health, we have tried to assess whether the errors in targeting reflected some systematic pattern, as captured by regional variables. What we find is that in this case what we have conceptualised as targeting errors are almost everywhere as likely to occur as in Lima. The only exception is the Rural Sierra where errors 2 are more likely to occur than in Lima.

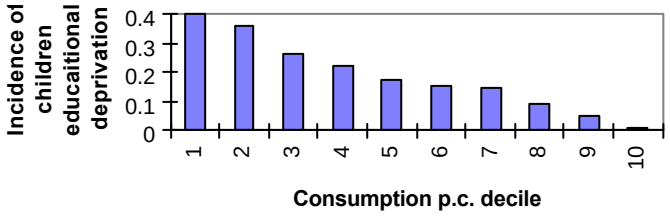
Table 15 Regional factors and the targeting accuracy of monetary resources: child educational achievement. Multinomial logit results (Relative Risk Ratios with Consistent Classification as the base case)

	Error I *z*	**Error II** *z*
Urban Coast (¯)	0.970 *-0.073*	1.186 *1.003*
Rural Coast	0.963 *-0.071*	1.311 *1.301*
Urban Sierra	1.067 *0.157*	1.152 *0.830*
Rural Sierra	1.328 *0.779*	1.523** *2.751*
Urban Selva	1.178 *0.417*	0.784 *-1.350*
Rural Selva	1.793 *1.524*	0.979 *-0.111*
Log Likelihood = -1523.2719		
chi2(12) = 22.24		
Prob > chi2 = 0.0349		
Pseudo R2 = 0.0072		

(¯) Except Lima

Chart 3 graphs how children without the 4th grade of primary schooling are distributed by deciles.

Chart 3. Distribution of children (12-15) without the 4th grade of primary, by decile



Household resources are unequivocally associated with this deprivation. It can be noted that in a pure investment model of education, in which individual's efficient choice of the level of schooling is determined only by the (expected) benefits of schooling and by its cost, income should play no role if credit markets are perfect. The absence of individual liquidity constraints is however a strong assumption, for poor people in particular. Further, education might have some consumption characteristics if individuals see an intrinsic value in it.

Studies controlling for the family background of the individual have found that income might be partially proxying other things. For example Behrman et al.'s (1987) estimates of children's schooling using fixed effects for the mothers' sibling see the effect of household income (which was already found small and not significant in the standard case) reduced by 2/3. However Behrman (1990) reports results from a Thailand study showing that income had a positive though decreasing effect on post-primary continuation rates, and that this effect does not change when controlling for parental schooling or for some community characteristics.

Harbison and Hanuschek (1992), reviewing an extensive body of literature in the U.S. and the developing world, present a useful grouping of the variables which have been adopted in the literature to explain educational production. Apart from income and socio-demographic variables to capture family inputs, which we have already mentioned, they list aggregate summaries of socio-demographic characteristics of other students in the school to capture peer inputs, and teachers' characteristics, schools' organisation, and community factors which should capture school inputs. Such a wealth of information is not generally available in household surveys and the ENNIV is no exception. In our estimates we have tried to find variables which could capture as much as possible of these effects. We are well aware however, that "the estimated models of educational performance undoubtedly fail to capture many of the truly important inputs to the educational process" (*ibid.* p. 25).

Table 16 shows various estimates of the determinants of children 12-15 without 4 years of schooling. We have also run a linear model of years of schooling for the same age group, as well as a fixed effect model for this last regression. The probit model adopts the Rivers and Vuong (2SCML) two-stage estimator as weak exogeneity could not be rejected. We could not, in fact, exclude *a priori* the possibility that child labour might help the household to be able to afford to send the children themselves to school. More generally, child schooling decisions might be jointly determined with the household labour supply.

For the same reason, in the linear models household expenditure per capita was instrumented with household assets and durables.[31]

Table 16 Children 12-15 without 4 years of schooling.

	Probit		**Linear Regression**	**Fixed Effects**
	Coef. *t*	dF/dx	Coef. *t*	Coef. *t*
Household pc. expend.	-0.370** *-4.188*	-0.064	0.124* *2.571*	0.142** *3.451*
Gender	-0.020 *-0.173*	-0.003	-0.053 *-0.510*	-0.058 *-0.564*
Age	-3.696* *-2.414*	-0.638	3.906** *2.969*	3.405** *2.640*
Age squared	0.126* *2.197*	0.022	-0.110* *-2.236*	-0.091 *-1.894*
Father without 4 years of schooling	0.315* *2.099*	0.062	-0.366* *-2.018*	-0.398* *-2.239*
Mother without 4 years of schooling	0.446** *3.169*	0.087	-0.506** *-3.280*	-0.515** *-3.416*
Indigenous	0.107 *0.546*	0.019	-0.401 *-1.764*	-0.369 *-1.542*
Female headed households	~	~	-0.070 *-0.115*	0.349 *0.606*
Size	-0.017 *-0.512*	-0.003	-0.009 *-0.263*	0.021 *0.707*
Proportion of children in the household	0.261 *0.680*	0.045	-0.976** *-2.765*	-0.878* *-2.422*
Availability of public	-0.157	-0.029	0.396**	0.497**

[31] Running a Hausman test by inserting the error from the first stage in the linear model gave a coefficient significant at the 1 % (t: -4.446)

water in the house	*-1.149*		*2.666*	*3.312*
Time to school	-0.005	-0.001	0.008	0.010
(minutes)	*-1.103*		*1.460*	*1.778*
School with no water	0.085	0.015	-0.381	-0.412*
and sewage	*0.475*		*-1.842*	*-1.992*
Constant	26.196**		-25.755**	-22.395**
	2.586		*-2.953*	*-2.628*
N of observations	968		974	974
Joint significance of the	F(12,290)=11.61		F(13,291)=58.76	F(45,259)=7.46
regressors	Prob>F=0.0000		Prob>F=0.0000	Prob>F=0.0000
R-squared			0.4337	0.4713

The models presented here do not correct for simultaneity bias as the R&V test rejected the hypothesis of endogeneity.[32] Household per capita resources appear as significantly reducing the chances that a child 12-15 will not have completed his fourth year of schooling, including when adding controls for parental education and for quality of education.

Gender plays no statistically significant role, though it is interesting to see that the effect would be one of decreasing the chances of low achievement in school for females. As the age of the child increases we find, as expected, that the chances of him reaching grade 4 increase, though at a decreasing rate. It can be noted that the marginal effect of age alone is very large. It is appropriate to remember, however, that children in Peru are supposed to have reached grade 4 by the time they are 10, so that even if the chances of them reaching it increase with time, if that happens while they are 12-15 it still happens with a considerable delay compared to the schedule.

The parental variables we have considered control for parental background and ability as well as for direct educational achievements of the parents. The effect of paternal education is significant, though not as much as maternal education. The effect of mothers not having functional literacy themselves is amplified by the

[32] The implications of this result for the prevalence of child labour (if indeed child labour is the link which makes household resources endogenous) are not, however, very clear. The coefficient on the error term from the first stage fails by a small measure to be considered significantly different from zero at the usual significance level.

consideration of the community effects variables,[33] hinting that better educated mothers might be better at taking advantage of the infrastructure communities are provided with. This would be a different mechanism than the one found by Birdsall (1985) using data from Brazil,[34] where a partial substitutability between public inputs (less available where distance is greater) and private ones was hypothesised. It is also interesting to see that when running the model separately for boys and girls one finds that it is the education of the parent of the same gender which matters for the child, with mother's education being particularly powerful in the case of girls.

The effect of ethnicity in lowering the chances of low achievement is not significant (and for the probit becomes even less so when considering the community variables). Similarly, the size of the household does not have a significant coefficient. The percentage of children in the household is not significant in determining the probability of low achievement, though it affects negatively and very significantly the years of schooling achieved by children in this age group. It is nor clear, however, what the role of this demographic variable could be, as while larger households could imply a greater amount of household chores to be performed (especially for older daughters), older children working inside and outside the house might make it easier for some of their siblings to go to school. Further, the positive effects of learning from siblings or other members of the household may be a factor.

Finally we have tried to control for the availability of some public goods within the household and the community. All of these variables appear as not significant in the probit, though the water connections to the house are significant and of the expected sign in the linear models. Once locality fixed effects are included, the variable for schools without water and sewage becomes significant also, hinting that within a given department the distribution of access to good quality schools might be an important element. The distance variable though insignificant has a positive effect on children's years of schooling. This could be due to the fact that some of the children in that age group are already attending secondary schools (provided that there are comparatively fewer secondary then primary schools so that children who are already in secondary travel longer distances) or more simply to an unobserved quality component.

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[33] Also in the probit a similar effect can be noted as shown by the increase in the coefficient from .349 to 0.37 when community variables are inserted.

[34] She found that public inputs (that she captured as teachers education) had a greater effect on child schooling the less educated the mother.

In conclusion, looking at the relation between monetary resources and children's educational achievement it has been found that despite the important role played by household per capita resources, there are other important factors which play a role in determining a child chances of achieving functional literacy on time. Parental education is the factor which affects most such chances.

Table 17 below summarises the impact of parental education for children of different expenditure deciles. For the lowest decile of the distribution, maternal education implies about 15% less chance of children having a low achievement in school. Household resources would need to be almost quadrupled to achieve the same result. At the same time, for children in the top decile maternal education is a much less critical factor, having an effect equivalent to an increase household resources of 14%. The effect of paternal education is smaller but also striking. To make up for the effect of the father not having achieved functional literacy, household per capita resources needs to be multiplied on average by a factor of 3 for those in the bottom decile. A glance at the last section of the table, showing the proportion of individuals whose mother and father have not achieved functional literacy, allows one to put the magnitude of the problem for children in different deciles into perspective. Once more it appears that interventions of a non-monetary nature are not only more effective but also more needed for those who are at the bottom of the distribution of monetary resources.

Table 17

	1st decile	5th decile	Top decile
Prob. of low achievement if			
Mother without 4 years of education	0.341	0.222	0.004
Mother with 4 years of education	0.196	0.113	0.001
Impact of maternal education on probability	0.145	0.109	0.003
Equivalent expenditure	1.650	2.590	7.500
Change in expenditure			
In absolute terms *(000)*	1.215	1.196	0.925
As a proportion of average exp.	3.796	1.858	1.141
Prob. of low achievement if			
Father without 4 years of education	0.322	0.207	0.003
Father with 4 years of education	0.219	0.128	0.001
Impact of paternal education on probability	0.103	0.079	0.002
Equivalent expenditure	1.280	2.250	7.500
Change in expenditure			
In absolute terms *(000)*	0.845	0.856	0.925
As a proportion of average exp.	2.945	1.615	1.141
Mean expenditure	435	1394	6575
Incidence of low achievement (%)	39.74	17.61	1.35
Percentage of children 12-15 whose mothers are without 4 years of schooling	71.64	31.98	5.99
Percentage of children 12-15 whose fathers are without 4 years	52.73	20.93	3.80

of schooling			

Part 4. Conclusions

Our analysis aimed at evaluating whether adopting a monetary based measure of poverty compared to others which tried to capture directly deprivations in the capability space would lead to a different identification of the poor. To do so we both explored the extent to which different measures of poverty overlap, and the role that monetary resources play in determining achievements in the capability space.

From the results presented it is clear that the parametric variations, which according to Sen's analysis make monetary resources a very imperfect indicator of achievements in terms of capabilities, exist and act as a very significant wedge between means and achievements. Direct indicators rather than monetary ones should be adopted for poverty assessments if one accepts Sen's claim that individual welfare should be evaluated in the capability space.

But this also has a more important bearing on the debate on poverty measurement. The widespread opinion that relying on monetary indicators, whatever their theoretical underpinnings, is practically value-free given the high degree of correlation between alternative indicators, has been challenged. Greater awareness of the consequences of the simplifying assumptions adopted for measurement purposes and testing in different institutional settings is therefore needed.

We have also tried to explore some policy implications of using an approach which aims at capturing deprivation in terms of capabilities. A focus on monetary resources alone tends to assume that whatever increases the private resources of the poor would be helpful in alleviating their poverty. Our analysis questions that view pointing to the non monetary factors which greatly reduce the effectiveness of private resources in bringing about improvements in well-being. As we have shown, given the differential impact of these non monetary constraints for different expenditure deciles, a greater concentration of direct action including public expenditure on removing these constraints for the weakest groups is called for.

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APPENDIX 1

This appendix explores which factors are systematically associated with poverty and its depth.[35] The former task was performed through a probit analysis aiming at explaining the probability of being deemed poor. The latter exercise aimed at finding the determinants of the household's relative shortfall from the poverty line. As this analysis focuses on the poor, the distribution is censored at the poverty line, so that the appropriate tool is the estimation of a tobit model.

The characteristics we have considered as potential correlates of poverty are the region of residence, some characteristics of the head of the household such his ethnic origin gender and education, the area where the household lives, the access the household has to public goods such as water and sewage and electrical light.

It could be argued that some of these variables pose problems of simultaneity bias as they are jointly determined with the level of resources of the household. Processes affecting the intergenerational transmission of both poverty and low educational achievements or mechanisms of assortive mating could underlie, for example, both the educational level of the household head and the probability of the household being poor.[36] Similarly, the characteristics of the area of residence could be seen as determined by household choices on where to live, choices which are possibly affected by household resources themselves. While it would be possible to deal with such a potential endogeneity with two stage procedures (e.g. River and Vuong 1988), it is hard to find good instruments for this kind of variables. An auxiliary regression for the head of the household education level, for example, would require the identification of variables which have some explanatory power on the education level without being correlated with household resources themselves. Variables which share these characteristics do not seem to be available in our data set.

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[35] In both cases the analysis was conducted at the household level, as expenditure (the indicator with respect to which the poverty line is determined) is recorded at the household level. This analysis will not, therefore, deal with inequality within the household. Evidence from the Philippines (Haddad and Kanbur 1989) suggests that the neglect of intra-household inequality might lead to an underestimation of the level of poverty, though the inference about its correlates can still be valid.

[36] Despite the fact that the economic contribution to the household is used only as a subsidiary criterion in the identification of the head – (the head is defined in the ENNIV 1994 survey as the person (man or woman) who is recognised by most of the member of the household as such; in case of doubt the person with the greatest economic responsibility and, failing this criterion, on the basis of age)—it is likely that the level of education of the head via the labour market affects significantly the total level of resources of the household.

Table A.1. below shows how significantly the characteristics listed above are in explaining the probability of being poor and of being extremely poor. It is important to note that factors like the ones we have considered do not offer a causal explanation of poverty itself – they do not answer for example why in one region people have a higher conditional probability of being poor than in another region — but have more of a descriptive character.

Indigenous people and more numerous households are more likely to be poor or extremely poor even when other socio-demographic and geographic factors are taken into account. Female headed households, are less likely to be poor (though not of being in extreme poverty) when all these other factors are taken into account. Older household heads reduce the chances of a household being poor or extremely poor, possibly because of family life cycle considerations, though the effect tails off as age increases. The years of schooling of the household head have, as expected, a strong and significant effect in reducing the chances of a household being poor. The "school with water and sewage" variable was included to provide some information on the quality of schooling enjoyed by the head, but its coefficient is insignificant though of the expected positive sign. The variables referring to the public provision of water, sewage and electricity to the household have all a negative coefficient, which shows that there are less chances for the worst off to enjoy them as opposed to the non-poor. The coefficient on water is, however, not significant. The last set of variables whose association with poverty we have considered, are regional variables. The coefficient is significant if the effects captured by the geographical area are significantly different than in Lima, which constitutes the benchmark. It is to be underlined that these variables pick up mostly residual effects that are not captured elsewhere, and possibly systematic factors linked to the way the poverty line has been set (see Moncada et al. 1995). These variables show that households with the same characteristics have significantly less chances of being poor in the rural areas and in the urban selva as opposed to Lima.[37] As far as extreme poverty is concerned, instead, the only significant coefficient is for the Urban Coast, where households are significantly more likely to be poor.

The final table of this section shows how the same factors we have just considered influence the extent of the household shortfall from the poverty line, expressed as a fraction of the poverty line itself.

[37] It is worth stressing that this result holds only given this *ceteris paribus* assumption. The variables we have considered are instead unlikely to be similarly distributed across regions.Taking as an example the years of schooling of the household head it can be seen that while the national average is 8.14 years, the regional averages are respectively: Urban Coast=8.40; Rural Coast=5.76; Urban Selva=8.60; Rural Selva=5.31; Urban Sierra=9.47; Rural Sierra=5.54.

Table A.1. Determinants of Monetary Poverty

	Poverty			Extreme Poverty		
	Coef.	**t**	**P>|t|**	**Coef.**	**t**	**P>|t|**
Indigenous	0.274	3.400	0.001	0.288	2.974	0.003
Size of the household	0.233	14.614	0.000	0.213	12.570	0.000
Female headed household	-0.250	-2.755	0.006	-0.043	-0.306	0.760
Age of the head	-0.060	-4.521	0.000	-0.063	-3.258	0.001
Age of the head squared	0.0004	3.211	0.001	0.0005	2.431	0.016
Head years of schooling	-0.088	-9.145	0.000	-0.067	-5.297	0.000
School with no water and sewage	0.126	1.746	0.082	0.158	1.790	0.074
Availability of public water in the house	-0.060	-0.369	0.712	-0.003	-0.023	0.981
Availability of public sewage in the house	-0.652	-4.170	0.000	-0.624	-4.021	0.000
Electricity	-0.562	-4.660	0.000	-0.590	-4.452	0.000
Urban Coast	0.218	1.858	0.064	0.481	3.112	0.002
Rural Coast	-0.536	-2.771	0.006	0.160	0.756	0.450
Urban Sierra	-0.170	-1.499	0.135	0.171	1.010	0.313
Rural Sierra	-0.724	-5.050	0.000	0.279	1.678	0.094
Rural Selva	-0.756	-4.276	0.000	0.267	1.400	0.162
Urban Selva	-0.520	-4.410	0.000	0.033	0.190	0.849
Constant	1.888	5.144	0.000	0.129	0.269	0.788
	Number of obs = 2726			Number of obs = 2726		
	F(16, 337) = 38.00			F(16, 337) = 25.47		
	Prob > F = 0.0000			Prob > F = 0.0000		

Ethnicity as well as large household size are associated with greater depth of poverty. Female headed household instead, experience lesser poverty (but again the coefficient on extreme poverty is not significant) once other socio-demographic characteristics have been accounted for. Older heads imply that the

household suffers lesser shortfalls, though again the effects tails off. While the years of schooling of the head decrease the distance from the poverty lines as before, the variable showing whether the school attended by the head has water and sewage is now significant. Whether taking it as a proxy for quality of teaching or simply telling us about the distribution of the quality of infrastructure, it is showing that those who are experiencing worst poverty are more deprived also in this respect. The analysis of the other variables reflecting the distribution of public expenditure show that even among the poor are the better off which are more likely to benefit from public sewage and electricity, while the coefficient on water is not significant. The regional variables are again picking up the systematic factors which we have not captured directly. These factors imply that other things being equal households experience greater shortfalls from the poverty line in the coastal area as opposed to Lima (the benchmark case) and lesser ones in the rest of the country. Only the higher depth of poverty in the urban coast appears as significant when we consider shortfalls from the extreme poverty line.

Table A.2. Determinants of the depth of poverty

	Poverty			**Extreme Poverty**		
	Coef.	t	P>|t|	Coef.	t	P>|t|
Indigenous	-103.456	-4.296	0.000	-78.560	-4.053	0.000
Size of the household	-83.456	-18.963	0.000	-47.358	-12.642	0.000
Female headed household	67.283	2.263	0.024	2.406	0.087	0.931
Age of the head	22.870	5.574	0.000	12.618	3.532	0.000
Age of the head squared	-0.162	-3.984	0.000	-0.097	-2.687	0.007
Head years of schooling	32.810	11.035	0.000	15.824	5.670	0.000
School with no water and sewage	-59.920	-2.665	0.008	-37.980	-2.065	0.039
Availability of public water in the house	21.629	0.517	0.605	-9.891	-0.304	0.761
Availability of public sewage in the house	250.964	5.917	0.000	129.669	3.411	0.001
Electricity	221.927	6.374	0.000	163.196	5.848	0.000

Urban Coast	-84.351	-2.694	0.007	-106.100	-3.043	0.002
Rural Coast	267.827	5.472	0.000	-48.172	-1.139	0.255
Urban Sierra	101.422	2.998	0.003	-29.497	-0.796	0.426
Rural Sierra	422.651	9.449	0.000	-47.660	-1.240	0.215
Rural Selva	421.834	8.561	0.000	-49.308	-1.198	0.231
Urban Selva	253.010	6.541	0.000	-2.331	-0.060	0.952
Constant	-800.752	-7.559	0.000	5.430	0.059	0.953
	Number of obs =2726			Number of obs = 2726		
	chi2(16) =1121.81			chi2(16) = 824.62		
	Prob > chi2 = 0.0000			Prob > chi2 = 0.0000		
	Pseudo R2 = 0.0626			Pseudo R2 = 0.1109		

NB the dependent variable has been defined as (Household expenditure per capita-the poverty line).

Positive coefficients imply that a given variable is associated with less negative gaps.