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Public Services and the Poor in Laos^{*}

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Both cross sectional and panel methods of analysis for Laos confirm that for public education and health services, the poorest quintile groups receive the smallest shares of total provision of these services. Nevertheless, poor groups' shares of an increase in the level of provision – their marginal shares – are generally higher than these average shares. For primary and lower secondary education and for primary health centers, expanding the overall level of provision delivers a pattern of marginal effects that is significantly more pro-poor than average shares indicate and the degree to which the poor benefit increases with the level of provision.

Keywords: Benefit incidence analysis; average benefit; marginal benefit; health services; education services; Lao PDR

JEL Classification D12, E21, H31

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1. INTRODUCTION

This paper analyzes the extent to which four forms of public service provision, two in education and two in health, achieve the Lao government's announced objective of reaching the poorest groups with its public services. The analysis distinguishes between average and marginal participation rates and draws upon two rounds of a large household income and expenditure survey data set. The survey covers about 8,000 households, spanning the interval 2002-03 to 2007-08 and includes a panel data component.

The Lao People's Democratic Republic (subsequently Laos, for brevity) is booming. Real gross domestic product (GDP) grew at an average of almost 7 per cent per year between 2000 and 2011, 8 per cent in 2012 and is projected to grow at around 8 per cent again in 2013 (World Bank 2013). This growth was based largely on rapidly expanding natural resource exports and a dominant proportion of these export revenues accrues directly to the government, through government ownership of the natural resources on which they are based (Warr, Menon and Yusuf 2012). Public expenditure is consequently booming as well (Menon and Warr 2013).

Figure 1 summarizes data on the recent evolution of total government expenditure and its allocation to education and health, covering the period 2000 to 2011. As a share of GDP, total public spending increased from 7.3 percent to 11.2 percent. The proportion of this expenditure allocated to education also increased, from around 7 percent to 11 per cent. The share of government spending allocated to health remained relatively unchanged. From just under 6 percent of total government expenditure in 2000, it peaked above 9 percent in 2009, returning to around 6 percent in 2011. Given the rising share of government expenditure in GDP over the period and the growth of real GDP itself, this still suggests an increase in the

absolute volume of public expenditure on health. Thus, provision of education services has expanded rapidly over this decade, along with a less pronounced expansion in the provision of health services.

But does an expansion in the total provision of public services necessarily deliver more services to the poor? And how do these effects compare with those accruing to better-off groups? A core development objective of the Lao government is to use public expenditures to deliver benefits to the poorest groups (Government of Lao PDR 2003). Of course, this is not the sole objective of provision of these services. The benefits received by other social groups are also relevant, along with long-run impacts on the rate of growth, through effects on productivity. Accordingly, the delivery or non-delivery of services to poor groups is one relevant performance criterion for evaluating the success or otherwise of the public programs supplying them, but not the only one.

Studies of the distributional effects of public services have traditionally focused on the shares of the total level of the public service concerned (education, health, and so forth) that are received by particular groups. This measure has come to be called average benefit incidence. It provides information of interest, but recent work has distinguished between average and marginal benefit incidence, the latter meaning, in the context of this paper, the share of an increase in the level of provision that is received by particular groups. If the relationship between the benefit received by a particular social group and the total level of service provision was linear for all groups, average and marginal incidence would be the same. But this would not be true if the relationship was nonlinear.

The nonlinear case is illustrated in Figure 2, based on a diagram discussed in Lanjouw and Ravallion (1999). The figure illustrates the hypothetical case of ‘early capture’ by better-off households, combined with ‘late capture’ by poorer households. In this hypothetical

example, at low levels of total service provision the benefits go primarily to the richer households. But as the level of provision rises, an increasing proportion goes to poorer households as the richer households progressively become satiated. The essence of the diagram is that the relationship between group participation and the total level of provision is concave from below for the rich and convex from below for the poor. At a total provision of S_1 (horizontal axis), the average share of rich households in total provision is given by the slope of the ray OA and that of the poor households by the slope of OB.

In this example, the average share of the rich exceeds that of the poor. But the effects of a marginal increase in total provision are given by the slopes of the respective distribution functions at A and B, respectively. As drawn, at level of provision S_1 the marginal share of the poor households exceeds that of the rich, the reverse of the ranking of their average shares. Lanjouw and Ravallion state that this is a common finding from earlier empirical studies, thus confirming the relevance of the 'early capture by the rich' model. Conversely, the hypothetical case of late capture by the rich and early capture by the poor would have the opposite implications.

Both average and marginal benefit incidence may be of interest for particular purposes, but to assess how changes in levels of provision (increases or reductions) will impact on different social groups, marginal incidence is the relevant concept. As the example shows, calculations of average benefit incidence might not provide reliable guidance for that purpose. Lanjouw and Ravallion use this framework to argue that earlier methods of benefit incidence analysis, looking only at average benefits, are potentially deceptive.

Figure 2 has a further implication, however, not discussed by Lanjouw and Ravallion, which points to a potential pitfall from marginal incidence analyses as well. Consider the lower level of provision, S_2 . A study of average and marginal benefit incidence at this point

would indicate, as above, that the average shares received by the rich are higher than those of the poor, as indicated by the slopes of rays OC and OD, respectively. Nevertheless, the marginal shares of the rich are *also* higher than those of the poor, as indicated by the slopes of the two schedules at points C and D, respectively. If these findings were taken to mean that expanding the level of provision of the service generates benefits mainly to the rich, this conclusion would be misleading, because the finding applies only locally.

The ‘early capture’ model implies that the distribution of marginal benefits from expanded provision depends on the *level* of provision. At low levels of provision, like S_2 , the distribution of benefits is locally pro-rich, in the sense that the rich receive a higher share of marginal provision than the poor. When the level of provision is increased, to levels like S_1 , the distribution becomes locally pro-poor. A key point is that at both levels of provision discussed above the marginal share of the poor exceeds their average share, implying that their average share is increasing as the level of provision rises. Conversely, the marginal share of the rich is less than their average share and their average share is thus declining. This is the distinguishing feature of the ‘early capture’ model. It is important to look at both average and marginal shares for each group and not just to compare the marginal shares for different social groups or different income categories, because the above discussion shows that this too can be deceptive.

This paper studies these issues in the context of public provision of education and health services for Laos. It utilizes data from a large household income and expenditure survey that records detailed information on the actual utilization of government-provided services, including education and health services, by individual households, along with the economic characteristics of those households. It includes a panel component. Section 2 describes the data and section 3 outlines the methodology used, describing three methodologies used in the literature to estimate marginal incidence, or proxies for it. Sections

4, 5 and 6 present the results of applying these three methodologies to the data for Laos. Section 7 compares their findings and Section 8 concludes.

2. DATA

With the assistance of Statistics Sweden and the World Bank, the Lao government has published the results of four rounds of a household economic survey called the Lao Expenditure and Consumption Survey (LECS). A central objective of the survey is to estimate poverty incidence for the country and its major regions,¹ but it also collects data on utilization by households of some important categories of public services, notably schools and health facilities, making it possible to study the distributional impacts of service provision in these categories.

The survey has been conducted every 5 years since 1992–1993, the latest available to date being 2007–2008. The formats of the third round, 2002–2003 (known as LECS 3) and the fourth round, 2007–2008 (LECS 4) are almost identical, making these two rounds suitable for comparative statistical analysis. In addition, the LECS 3 and LECS 4 rounds include a representative panel module, comprising about one-half of the total sample, making panel data methods applicable. The sizes of these two LECS surveys are summarized in Table 1.

3. METHODOLOGY

Table 2 defines the major variables used in the study. Consider a representative sample of households and suppose the households it contains are ordered by income per person, from the lowest (poorest) to the highest (richest). We divide these households into five groups of equal population size: the poorest one-fifth (quintile 1), the next poorest one-fifth (quintile 2),

¹ A summary of findings on poverty incidence, based on this survey, is contained in Lao Statistics Bureau (2008) and its use to monitor findings on progress towards the Millennium Development Goals is described in Lao People's Democratic Republic (2010).

up to the richest one-fifth (quintile 5).² Now consider a government program of some kind and assume that participation in this program is recorded in the data set. Let N and N_q denote the sizes of the total population and quintile q , respectively, where $N_q = N/5$, and let denote the numbers of program participants in the total population and quintile q be N^P and N_q^P , respectively, where $N^P = \sum_q N_q^P$.

The program participation rates of quintile q and the total population are now defined as $P_q = N_q^P / N_q$ and $P = N^P / N$, respectively.

The *average odds of participation* (AOP) for a particular quintile group is defined as the quintile participation rate (P_q) relative to the total participation rate (P), calculated across all quintiles. Thus $AOP_q = P_q / P$.

The *marginal odds of participation* (MOP) for a particular quintile group is defined as the change in the quintile participation rate as the size of the program changes relative to the change in the overall participation rate. Thus $MOP_q = dP_q / dP$.

The purpose of calculating these two measures is to determine the extent to which an expansion in a public program is targeted to the poor. If the *MOP* for a poor quintile is greater than the corresponding *AOP* for the same quintile, this is interpreted to mean that an increment in program size is better targeted toward the poor than the overall program, on average.³

² It is of course possible to divide the sample into four groups (quartiles), ten groups (deciles), 100 groups (centiles), or any other arbitrary number. In this study we confine the discussion to quintiles, for convenience.

³ It is easily shown that $\sum_q \alpha_q AOP_q = 1$ and $\sum_q \alpha_q MOP_q = 1$. The population share weighted sum of average odds of participation and marginal odds of participation are both equal to unity, where

In this study, the LECS 3 and LECS 4 data sets are used to study quintile-specific average and marginal benefit incidence using three different empirical approaches, each drawing upon the earlier literature. The estimation of *AOP* is the same with all three approaches, but they differ in the estimation of *MOP*. The three approaches are:

- (i) Comparative time series analysis of the changes between LECS 3 and LECS 4.
- (ii) Econometric analysis of cross-sectional data, separately for LECS 3 and LECS 4.
- (iii) Econometric analysis of the panel data component of LECS 3 and LECS 4.

Approach (i) compares two representative rounds of the survey, in which the individual households surveyed in each round are not necessarily the same. Approach (ii) looks only at the data for a particular round of the survey. It can be applied to multiple rounds, but separately. It is normal in representative surveys that the specific identity of households is not recorded, so there is no way of discovering whether any of the particular households surveyed in one round are also surveyed in the other. Approach (iii) requires that some subset of the individual households surveyed in the second round coincide with some of those surveyed in the first, and that it is possible to identify those households common to the two surveys. Panel methods focus on that common subset of the two (or more) rounds. The LECS data make it possible to apply all three of these methods for estimation of *MOP* and to compare the results obtained.

4. COMPARATIVE ANALYSIS USING CROSS-SECTIONAL DATA

As public programs expand over time, their distributional impacts can change. This is the perspective adopted when cross-sectional data are compared explicitly across time. In van de Walle (2003) two methods are described for doing this. Both begin by calculating quintile-

$\alpha_q = N_q / N = 1 / 5$ is the population share of quintile q . This means that the quintile-specific values of AOP_q and MOP_q are distributed around 1. They must sum to 5 and their arithmetic mean must be 1. Some values may exceed 1, but others must then be less than 1.

specific participation rates for each program category and each time period, along with the corresponding overall participation rates for the total population, like those summarized for Laos in Table 3.

We shall write P_{qt}^i for the participation rate observed under program category i for quintile q at time t and P_t^i for the corresponding average participation rate observed for the total population. Method 1 then computes the change over time in the ratio of these two quantities, which we will call C_q^i , where

$$C_q^i = (E_{qt}^i / E_t^i) - (E_{qt-1}^i / E_{t-1}^i). \quad (1)$$

If C_q^i is positive for quintile q , then the participation rate of that quintile is increasing, relative to the overall participation rate, and vice versa if C_q^i is negative.

Method 2 computes the change in the participation rate for quintile q and the change in the overall participation rate and then calculated the ratio of these two changes over time.

We can call this D_q^i , where

$$D_q^i = (E_{qt}^i - E_{qt-1}^i) / (E_t^i - E_{t-1}^i). \quad (2)$$

If D_q^i is greater than one, the participation rate of quintile q is increasing more than the overall participation rate, and vice versa.

The two methods differ, in a seemingly arbitrary manner, in the way that they compare changes in average incidence over time. It is not obvious whether a difference in two ratios (Method 1) or a ratio of two differences (Method 2) is a better way of measuring the change in average incidence over time. The calculations have the advantage of relying on aggregate data, not requiring district or individual household level data and not requiring

detailed regression analysis or the associated collection of the set of control variables, described in the sections below. But largely for that reason, they are not true measures of marginal incidence. They relate to the change over time in average incidence and although this is a calculation of interest, it is not the same as marginal incidence.

Because the calculation does not control for changes in variables other than the size of the program, the measured changes in average incidence could be caused by changes in these other variables. For example, changes in participation could be caused by changes in household incomes or expenditures and not by changes in the level of public provision of the service. That is, changes in average participation over time do not isolate the effect of changes in the level of provision.

In Tables 4 and 5 the two methods outlined above are applied to the LECS 3 and LECS 4 data, using the participation rates shown in Table 3. These participation rates are uniformly higher for upper income groups, with the partial exception of outpatient hospital services. Using Method 1 (Table 4), the average incidence of primary education moved in favor of lower income quintiles and against upper income quintiles. The same applied to lower secondary education, except that quintile 2 (the second poorest) enjoyed the largest increase in its average incidence. Method 2 (Table 5) reveals a similar, but not identical story. In the case of lower secondary education, average incidence for the poorest quintile appears to have declined slightly. Other results are roughly the same.

Turning to the results for the health sector, according to Method 1, primary health care seems to have become more pro-poor over time, particularly in relation to the poorest quintile, and the incidence of outpatient hospital services also moved in the direction of lower income quintiles and against upper income quintiles, with the exception of the richest. Method 2 loosely supports the conclusion of movement toward a more pro-poor pattern of

incidence for primary health care centers but suggests that the incidence of outpatient hospital services moved towards middle income and upper quintiles rather than the poorest.

5. ECONOMETRIC ANALYSIS USING CROSS-SECTIONAL DATA

It is convenient to begin the discussion with an early and important study using econometric methods by Lanjouw and Ravallion (1998). Its strength is that it can be used when the available data are in the form of district averages, rather than individual household level observations. Data available for developing countries often exist only in this district-level form. OLS regression is used to estimate the equation:

$$P_{dsq} = \alpha_q + \beta_q P_s + u_{dsq}, \quad q = 1, 2, \dots, 5, \quad (3)$$

where, P_{dsq} is the average participation rate in district d , province s , and quintile q , α_q is a quintile-specific intercept term, β_q is a quintile-specific estimated coefficient, P_s is the average participation rate in province s , and u_{dsq} is an error term. The equation is estimated separately for each quintile. The right-hand side variable P_s is the same for each quintile.

The estimate of *MOP* for each quintile is now obtained from

$$MOP_q = \frac{dP_q}{dP} = \frac{\partial P_{dsq}}{\partial P_s} = \hat{\beta}_q. \quad (4)$$

A statistical problem is that in equation (3) the left-hand side variable P_s includes the right-hand side variable P_{dsq} , giving rise to an endogeneity issue, which could produced biased estimates of the parameter of interest, β_q . Lanjouw and Ravallion deal with this problem using an instrumental variable approach. The ‘left-out mean,’ the participation rate for all of province s except those individuals in district d and quintile q , is used as an

instrument for estimating P_s and this estimated value, \hat{P}_s is the variable used on the right hand side of the estimated equation.

The disadvantage of this method is that it produces inefficient estimates of the relevant parameters because it does not make use of all of the individual level information that is potentially available. It is useful when individual level data are unavailable, but not otherwise.

Younger (2003) draws upon the logit model to take advantage of individual household level observations. Younger uses logit methods to estimate the equation

$$z_{idq} = \alpha_q + \beta_q P_d + \gamma_q X_{idq} + u_{idq} \quad q = 1, 2, \dots, 5, \quad (5)$$

where i denotes the individual household member and $z_{idq} = 1$ means that the household member uses the public service and $z_{idq} = 0$ otherwise. It is important to note that the unit of observation, i , is the individual and not the household. Again, the equation is estimated separately for each quintile q . As before, the right hand side variable P_d is the same for each quintile. The estimation of the coefficients β_q is improved by controlling for a vector of other household characteristics on the right hand side, X_{idq} .

Tables 6 to 10 present the results of applying Younger's method to the Lao data, using LECS 3 and LECS 4, separately. Tables 6 to 8 relate to primary education and show the detailed method of estimating marginal incidence with this approach. Tables 9 and 10 summarize the corresponding final results for lower secondary education and the two categories of health expenditures discussed above. The primary education results will be discussed first. Table 6 shows the results of estimating equation (5) for primary school participation, children aged 6 to 11, for each of the five quintile groups and for the full, combined sample, using the data for 2002-03 (LECS 3). The estimated equations control for

the following household characteristics (the X variables appearing in equation (5)): monthly per capita consumption, household size, gender of child, age of child, age of household head, age of household head squared, household head's years of schooling, the ratio of dependants to income earners (dependant ratio), whether the child is *Laoloum* (the dominant ethnic group of Laos), whether the area is rural, and the distance to the nearest school. Table 7 provides the corresponding estimates for 2007-08 (LECS 4).

Table 8 shows the implications of these results for average and marginal shares. The estimates of the quintile-specific *MOPs*, obtained using the method of Wooldridge (2009, pp. 580-582), are each divided by their population-weighted means across quintiles to satisfy the requirement that the population-weighted mean of the adjusted estimates is 1 (as in footnote 4, above). The average odds indicate that richer households enjoy a larger share of total benefits than poorer households. But the marginal odds reverse this conclusion. The findings thus correspond closely to early capture by richer households, followed by late capture by poorer households, as depicted in Figure 2. This same pattern was repeated in the case of LECS 4, even more strongly. Average rates of participation of different income groups provide a highly misleading indicator of marginal rates.

The information corresponding to Table 8 is now summarized for the other three categories of public services in Tables 9 (2002-03 results) and 10 (2007-08 results). For brevity, the detailed econometric results corresponding to Tables 6 and 7 are not shown. Again, the average odds of participation show a much higher participation rate for richer households, in both periods. The marginal rates are highest for the middle quintile (quintile 3), and this is true for both LECS 3 and 4. At the margin, expanded enrollments at the lower secondary level favor the middle quintile, not the poorest and not the richest. Although rich

households do indeed enjoy early capture, as expenditure levels rise the main beneficiaries at the margin are in the middle of the income distribution.

Turning to the results for primary health care centers, average odds of participation indicate a pattern of distribution most strongly favoring middle-income quintiles and moving increasingly in favor of lower income quintiles in the transition to LECS 4. The marginal odds similarly favor middle-income quintiles with marginal benefits to the poorest quintiles again increasing very significantly between LECS 3 and 4. The participation rates of outpatient services in public hospitals show higher average odds of participation among richer households, as observed above with education. The pattern of marginal odds also shows this pattern in the case of LECS 3, but the LECS 4 results show a pattern of benefits moving in favor of middle-income quintiles, resembling the lower secondary school pattern.

In summary, it has been possible to compute average and marginal odds of participation, in two time periods, in each of four specific forms of public expenditure—two in education services (primary and lower secondary) and two in public health services (outpatient primary health centers and outpatient hospital services). In all cases, except outpatient primary health care centers, the calculation of average odds of participation strongly indicates that richer households were disproportionate beneficiaries of the public service concerned. The comparison of changes in participation rates over time suggests that the average participation rates for the rich generally declined and those of the poor generally increased.

In virtually all cases, the pattern of distribution of marginal effects of public expenditures was very different from the average pattern. The computation of marginal odds of participation using Younger's cross-sectional approach indicates a pattern of marginal effects that is pro-poor in the case of primary education and moving increasingly in that

direction over time. The pattern of marginal effects favored middle-income quintiles in the case of lower secondary education and outpatient health care centers. In the case of outpatient hospital services the results indicated a movement of marginal effects over time away from the richest quintiles and toward middle-income quintile groups.

6. ECONOMETRIC ANALYSIS USING PANEL DATA

Panel datasets track the experience of individual households over time. Since many household characteristics remain constant from one period to the next, this facilitates analysis of causal relationships in a way that is otherwise difficult with repeated independent random samples. The LECS 3 and LECS 4 surveys included a panel subset—one in which the households remained the same—and this panel subset is analyzed in this section. The panel subset is just under half of the size of the full sample, as described in Table 1, above. The table also shows the number of primary school children, secondary school children, health center and hospital outpatient users in each sample.

The methodology of analysis resembles that used in equations (4) and (5) above for cross-sectional analysis, except that there are now two identified time periods. We first pool the panel samples and estimate the following probit model, analogously to equation (3):

$$z_{igt} = \alpha_q + \beta_q P_{dt} + \gamma_q X_{igt} + \eta_q Y_t + u_{igt}, \quad q = 1, 2, \dots, 5 \quad (6)$$

where z_{igt} is a binary variable taking the value 1 if the individual uses the public service in year t and 0 otherwise, P_{dt} is the participation rate at the district level, X_{igt} is a vector of individual characteristics, Y_t is a binary variable indicating whether the observation belongs to the LECS 3 or LECS 4 time period, and u_{igt} is an error term. This is done for each of the

five quintile groups. The marginal odds of participation for each quintile are then estimated as in equation (3) and adjusted by their means, as described above.

Table 11 summarizes the results of estimating equation (6) for participation in primary schooling and Table 13 summarizes the resulting estimates of the marginal odds of participation. The marginal odds are highest for the lowest income quintile and decline at higher quintiles. This result supports the notion that expansion of primary education delivers benefits, at the margin, primarily to lower income households. For brevity, the detailed econometric results for each of the other three categories of public spending, analogous to Table 11, are not reported here. The summaries of results, analogous to Tables 8 and 9, are shown in Tables 12 and 13, respectively. In the case of lower secondary education, the benefits favor the middle-income quintiles, as they do with primary health centers. In the case of outpatient hospital services, the marginal benefits are concentrated in the middle and upper income quintiles.

7. COMPARISON OF RESULTS

The results can now be compared in terms of the picture they give of the pattern of average and marginal odds of participation. Table 14 summarizes the findings. With minor exceptions, in each of the four categories of expenditure studied, the richest groups receive the largest shares of total provision. Their average odds of participation are substantially higher than poorer groups, indicated by downward-pointing arrows in the first two columns. The change in average odds over time (Section 4) tends to favor the poor. This simple comparative method does not measure marginal odds directly but the fact that, for the poor, the average odds of the poor increase as the level of provision rises suggests that the marginal odds of the poor exceeds their average odds.

The cross-sectional econometric approach (Section 5) broadly supports these findings, further suggesting that the marginal odds of participation of the poor relative to the rich increased over time as the overall level of provision increased. Raising primary school participation delivers benefits at the margin that disproportionately favor the poorest quintile groups; at the margin, expansion of primary education facilities is strongly pro-poor, contrary to the pattern of average shares. Expansion of lower secondary education delivers benefits at the margin primarily to the middle-income quintiles, not the richest quintiles as indicated by the pattern of average shares. Similar results were also found for primary health centers. In the results for outpatient hospital services the cross-sectional results indicate a pro-rich pattern of benefits at the margin (2002-03), changing to one favoring middle-income groups (2007-08).

Finally, although panel methods have clear analytical advantages over repeated cross-sectional methods, the results obtained (Section 6) were qualitatively similar to those obtained with the cross-sectional approach and support the broad finding that the pattern of marginal effects of expanded public provision is more pro-poor than the pattern of average effects.

8. CONCLUSIONS

The analysis of this paper deals with the distributional effects of the provision of four forms of public services as they operated in Laos between 2002-03 and 2007-08. These four public services were chosen for analysis because their utilization at the household level is recorded in a large household income and expenditure survey. The analysis distinguishes between average odds of participation of different income groups and marginal odds of participation, arising from changes in the aggregate level of provision.

The results of the analysis imply that of the four forms of public services studied in this paper, participation of the poor is currently best achieved, at the margin, by expansion of

public provision of primary education. It is least well met by expanding outpatient hospital services. Lower secondary education and health care centers are intermediate. While these results suggest that primary education provision is the most pro-poor, they do not imply that other public service categories, especially lower secondary education and health care centers, should be neglected. First, benefits to groups other than the poor are also relevant, even though they may not be the primary focus of government policy. Second, these programs also serve other policy objectives, including the promotion of overall economic growth. Third, the results of this study indicate that as their level of provision increases, the distribution of these public services becomes more pro-poor. It would presumably be possible to modify the delivery of all four of these services to make them more pro-poor. Reforms of this kind could be very important, but they are not the focus of this paper.

The findings support the analytical model of early capture by the rich, followed by late capture by the poor. For all four forms of public services studied, the best-off groups enjoy the highest shares of total provision of these services. That is, their average odds of participation are highest. But as the aggregate level of provision increases, the average shares of the rich fall and those of the poor rise. For the poorest households, their share of the increase in total participation arising from an expansion in the level of public provision is generally much higher than their share of total participation. That is, for the poor, marginal shares are larger than average shares and vice versa for the rich. Average participation shares are not good indicators of marginal shares.

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Table 1. Sample sizes

	Full sample		Panel sample	
	No. of individuals	No. of households	No. of individuals	No. of households
2003-2004 (LECS 3)				
Total sample	49,789	8,092	24,215	3,887
School age (6-10)	7,449	2,373	3,395	1,145
School age (11-15)	3,485	1,407	1,928	756
Healthcare center outpatient users	218	201	110	92
Hospital outpatient users	586	502	282	253
2007-2008 (LECS 4)				
Total sample	48,148	8,296	23,618	3,887
School age (6–10)	6,144	2,011	3,284	964
School age (11–15)	3,297	1,376	1,765	606
Health center outpatient users	152	140	87	74
Hospital outpatient users	570	558	266	252

Note: The number of districts in the full sample is 136 (LECS 3) and 135 (LECS 4).

Source: Authors' estimations, using LECS 3 and LECS 4 data.

Table 2. Variable Definitions

Variable name	Education (primary and lower secondary)	Health (health center and hospital outpatient)
E	Number of individuals of relevant age group currently enrolled in a publicly funded school	Number of individuals who used the program within the last 4 weeks
N	Total population of relevant age group	Total population who reported having health problems within the last 4 weeks
P (= E/N)	Proportion of total population of relevant age group currently enrolled in a publicly funded school	Proportion of total population reporting health problems who used the program within the last 4 weeks
E_q	Number of individuals of relevant age group within per capita consumption quintile q currently enrolled in a publicly funded school	Number of individuals within per capita consumption quintile q who used the program within the last 4 weeks
N_q	Total population of relevant age group within per capita consumption quintile q	Total population within per capita consumption quintile q who reported having health problems within the last 4 weeks
P_q (= E_q/N_q)	Proportion of total population of relevant age group within per capita consumption quintile q currently enrolled in a publicly funded school	Proportion of total population within per capita consumption quintile q who used the program within the last 4 weeks
E_{dq}	Number of individuals of relevant age group within district d and per capita consumption quintile q currently enrolled in a publicly funded school	Number of individuals within district d and per capita consumption quintile q who used the program within the last 4 weeks
N_{dq}	Total population of relevant age group within district d and per capita consumption quintile q	Total population within district d and per capita consumption quintile q who reported having health problems within the last 4 weeks
P_{dq} (= E_{dq}/N_{dq})	Proportion of population of relevant age group within district d and per capita consumption quintile q currently enrolled in a publicly funded school	Proportion of population within district d and per capita consumption quintile q who used the program within the last 4 weeks

Source: Authors' data definitions.

Table 3. Participation rates, 2002-03 and 2007-08 (percent)

Quintile	Primary School	Secondary School	Health Care Center	Outpatient Hospital
2002-03 (LECS 3)				
Poorest	48.26	15.34	4.66	8.12
2nd	61.85	29.39	7.24	14.44
3rd	72.37	50.61	10.33	26.98
4th	79.38	65.91	15.16	36.49
Richest	84.78	82.56	10.91	46.15
Total	67.36	51.24	8.91	24.98
2007-08 (LECS 4)				
Poorest	61.56	27.20	14.70	14.70
2nd	75.30	50.19	19.39	31.90
3rd	81.21	61.58	13.85	46.15
4th	87.27	73.57	9.80	60.17
Richest	92.62	92.01	12.50	67.03
Total	77.18	63.98	14.79	41.42

Source: Authors' calculations, using LECS 3 and LECS 4 data.

Table 4. Analysis of repeated cross-sections (Method 1)

Quintile	(E_{qt}^i / E_t^i)	(E_{qt-1}^i / E_{t-1}^i)	Change (C_q^i)	(E_{qt}^i / E_t^i)	(E_{qt-1}^i / E_{t-1}^i)	Change (C_q^i)
	Primary School (ages 6–10)			Lower Secondary School (ages 11–15)		
Poorest	17.07	20.35	3.28	5.53	6.69	1.16
2 nd	20.6	23.50	2.91	10.02	13.19	3.17
3 rd	22.54	22.51	-0.03	19.01	20.67	1.66
4 th	21.35	19.15	-2.22	26.73	26.57	-0.16
Richest	18.44	14.49	-3.94	38.71	32.87	-5.84
	Outpatient Primary Health Centers			Outpatient Hospital Services		
Poorest	13.82	41.48	27.66	7.35	10.18	2.83
2 nd	20.39	28.15	7.76	12.96	13.45	0.49
3 rd	22.37	13.33	-9.04	21.08	17.45	-3.63
4 th	27.63	7.41	-20.22	26.11	25.27	-0.84
Richest	15.79	9.63	-6.16	32.5	33.64	1.14

Note: Calculations above refer to equation (2) in the text. Columns (1), (2), (4) and (5) have been multiplied by 100 for convenience.

Source: Authors' calculations, using LECS 3 and LECS 4 data.

Table 5. Analysis of repeated cross-sections (Method 2)

Quintile	$(E_{qt}^i - E_{qt-1}^i)$	$(E_t^i - E_{t-1}^i)$	Ratio (D_q^i)	$(E_{qt}^i - E_{qt-1}^i)$	$(E_t^i - E_{t-1}^i)$	Ratio (D_q^i)
	Primary School (Ages 6–10)			Lower Secondary School (Ages 11–15)		
Poorest	13.30	9.82	1.35	11.86	12.74	0.93
2nd	13.45	9.82	1.36	20.8	12.74	1.63
3rd	8.84	9.82	0.90	10.97	12.74	0.86
4th	7.89	9.82	0.80	7.66	12.74	0.60
Richest	7.84	9.82	0.79	9.45	12.74	0.74
	Outpatient Primary Health Centers			Outpatient Hospital Services		
Poorest	10.04	5.88	1.70	6.58	16.44	0.40
2nd	12.15	5.88	2.06	17.46	16.44	1.06
3rd	3.52	5.88	0.59	19.17	16.44	1.16
4th	-5.36	5.88	-0.90	23.68	16.44	1.43
Richest	1.59	5.88	0.27	20.88	16.44	1.27

Note: Calculations above refer to equation (2) in the text. Columns (1), (2), (4) and (5) All terms have been multiplied by 100 for convenience.

Source: Authors' calculations, using LECS 3 and LECS 4 data.

Table 6. Estimated probability of attending primary school, cross-sectional data, 2002–03

Dependent variable: Probability of attendance						
Independent variables	Q1 Marginal effect	Q2 Marginal effect	Q3 Marginal effect	Q4 Marginal effect	Q5 Marginal effect	Full sample Marginal effect
District average participation rate	0.81*** (0.085)	0.92*** (0.074)	0.74*** (0.065)	0.52*** (0.059)	0.35*** (0.057)	0.77*** (0.035)
Log of monthly per capita consumption	0.061 (0.061)	0.41** (0.161)	0.14 (0.152)	0.066 (0.104)	0.0003*** (0.026)	0.095*** (0.015)
Household size	-0.095* (0.049)	-0.064 (0.046)	-0.05 (0.043)	0.014 (0.034)	-0.028 (0.03)	-0.055** (0.021)
Child is female	-0.073** (0.026)	-0.088*** (0.026)	-0.029 (0.023)	-0.047** (0.02)	0.007 (0.018)	-0.053*** (0.011)
Child is 7	0.219*** (0.042)	0.24*** (0.039)	0.20*** (0.033)	0.18*** (0.03)	0.10*** (0.027)	0.220*** (0.018)
Child is 8	0.368*** (0.042)	0.39*** (0.039)	0.34*** (0.035)	0.26*** (0.031)	0.14*** (0.027)	0.34*** (0.018)
Child is 9	0.5*** (0.044)	0.48*** (0.042)	0.42*** (0.036)	0.31*** (0.034)	0.18*** (0.029)	0.440*** (0.019)
Child is 10	0.58*** (0.045)	0.57*** (0.045)	0.44*** (0.038)	0.34*** (0.034)	0.22*** (0.029)	0.500*** (0.020)
Age of household head	0.004*** (0.001)	0.0007 (0.0012)	-0.0003 (0.0011)	-0.0002 (0.001)	-0.0024* (0.001)	0.0007 (0.0006)
Female household head	0.049 (0.074)	0.25*** (0.092)	0.18** (0.084)	0.24** (0.087)	-0.01 (0.048)	0.127*** (0.038)
Household head's years of schooling	0.032*** (0.005)	0.023*** (0.0044)	0.016*** (0.0038)	0.02*** (0.0028)	0.007** (0.002)	0.022*** (0.002)
Dependant ratio	-0.025* (0.014)	-0.024 (0.015)	-0.003 (0.013)	0.015 (0.013)	-0.012 (0.012)	-0.014* (0.007)
Being non- <i>Laoloum</i>	-0.028 (0.034)	0.022 (0.032)	-0.03 (0.027)	-0.036* (0.022)	-0.064*** (0.02)	-0.033** (0.014)
Rural resident	-0.28** (0.254)	-0.11* (0.062)	-0.066 (0.043)	0.0044 (0.031)	-0.049** (0.021)	-0.087*** (0.023)
Distance to nearest primary school	-0.07*** (0.008)	-0.046*** (0.008)	-0.04*** (0.008)	-0.034*** (0.008)	-0.019*** (0.005)	-0.051*** (0.0120)
Observations	1,778	1,676	1,567	1,339	1,089	7,449
Pseudo R^2	0.28	0.25	0.27	0.32	0.29	0.31
Wald Chi^2	413.40	395.8	397.24	309.14	224.76	1807.16
Prob. > Chi^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: Q1 to Q5 means population quintiles 1 to 5. Marginal effect means the predicted change in the dependent variable from a one unit change in the independent variable, evaluated at the mean of the latter, calculated from the coefficients estimated from equation (3) as in Wooldridge (2009, pp. 580-582).

Numbers in parentheses are robust standard errors corrected for heteroskedascity. The number of observations differs between quintiles because the number of households in each quintile is the same but the average number of primary school aged children per household is not the same across quintiles.

*** means significant at 1% level; ** significant at 5% level; and * significant at 10% level.

Source: Authors' calculations, using LECS 3 data.

Table 7. Estimated probability of attending primary school, cross-sectional data, 2007–2008

Dependent variable: Probability of attendance						
Independent variables	Q1 Marginal effect	Q2 Marginal effect	Q3 Marginal effect	Q4 Marginal effect	Q5 Marginal effect	Full Marginal effect
District average participation rate	0.96*** (0.081)	0.57*** (0.07)	0.68*** (0.077)	0.41*** (0.06)	0.23*** (0.056)	0.64*** (0.034)
Log of monthly per capita consumption	0.094* (0.05)	-0.058 (0.135)	0.12 (0.11)	0.147* (0.067)	0.0002 (0.018)	0.046*** (0.012)
Household size	-0.13*** (0.043)	-0.065 (0.04)	-0.08** (0.034)	-0.01 (0.014)	-0.015 (0.02)	-0.073*** (0.016)
Child is female	-0.033 (0.026)	-0.032*** (0.022)	-0.002 (0.018)	-0.047** (0.02)	0.004 (0.012)	-0.017* (0.009)
Child is 7	0.28*** (0.039)	0.21*** (0.031)	0.13*** (0.026)	0.10*** (0.022)	0.08*** (0.019)	0.19*** (0.014)
Child is 8	0.41*** (0.042)	0.34*** (0.033)	0.22*** (0.029)	0.11*** (0.022)	0.082*** (0.019)	0.26*** (0.015)
Child is 9	0.52*** (0.043)	0.35*** (0.035)	0.23*** (0.03)	0.20*** (0.027)	0.13*** (0.026)	0.32*** (0.016)
Child is 10	0.51*** (0.045)	0.38*** (0.036)	0.32*** (0.033)	0.16*** (0.026)	0.09*** (0.0211)	0.33*** (0.016)
Age of household Head	0.0002 (0.0012)	0.002** (0.001)	-0.0017 (0.0008)	0.0004 (0.0006)	-0.00004 (0.0005)	0.0011** (0.0004)
Female household Head	0.107 (0.089)	0.13* (0.07)	-0.035** (0.05)	0.0007 (0.033)	-0.018 (0.028)	0.04 (0.03)
Household head's years of schooling	0.021*** (0.005)	0.028*** (0.004)	0.014*** (0.003)	0.012*** (0.002)	0.0022 (0.0016)	0.017*** (0.0018)
Dependant ratio	-0.031** (0.013)	-0.007 (0.012)	-0.024** (0.01)	-0.007 (0.008)	-0.0008 (0.009)	-0.017*** (0.005)
Being non-	-0.14*** (0.046)	-0.028 (0.027)	-0.01 (0.021)	0.051** (0.017)	-0.024* (0.014)	-0.015 (0.012)
Rural resident	-0.035 (0.082)	-0.13** (0.045)	-0.05 (0.031)	-0.0036* (0.021)	-0.029** (0.014)	-0.065*** (0.018)
Distance to nearest primary school	-0.015*** (0.01)	-0.044 (0.008)	-0.06*** (0.014)	- (0.009)	-0.017 (0.002)	-0.008*** (0.0023)
Observations	1,564	1,317	1,567	1,043	742	6,144
Pseudo R^2	0.22	0.27	0.27	0.28	0.24	0.28
Wald Chi^2	362.74	229.58	397.24	158.29	86.57	1269.01
Prob. > Chi^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: See notes to Table 6.

Source: Authors' calculations, using LECS 4 data.

Table 8. Average and marginal odds of enrollment, primary school, cross-sectional data

Quintile	2002-03 (LECS 3)			2007-08 (LECS 4)		
	Average odds	Estimated marginal odds	Adjusted marginal odds	Average odds	Estimated marginal odds	Adjusted marginal odds
Poorest	0.71	0.81***	1.21***	0.79	0.96***	1.68***
2nd	0.91	0.92***	1.38***	0.97	0.57***	1.00***
3rd	1.07	0.74***	1.11***	1.05	0.68***	1.19***
4th	1.18	0.52***	0.78***	1.12	0.41***	0.72***
Richest	1.25	0.35***	0.52***	1.20	0.23***	0.40***
Mean	1	0.67	1	1	0.57	1

Notes: See notes to Table 6. Adjusted marginal odds means the estimated marginal odds from Tables 4 and 5, each divided by its population-weighted mean across quintiles to satisfy the theoretical requirement that their population-weighted mean is 1 (footnote 4 in the text).

Source: Authors' calculations, using LECS 3 and LECS 4 data.

Table 9. Average and marginal odds of enrollment, cross-sectional data, 2002-03 (LECS 3)

Quintile	Lower secondary schools		Outpatient health centers		Outpatient hospital services	
	Average Odds	Adjusted Marginal Odds	Average Odds	Adjusted Marginal Odds	Average Odds	Adjusted Marginal Odds
Poorest	0.32	0.56***	0.52	0.02	0.32	0.32***
2nd	0.62	1.08***	0.80	1.10***	0.57	1.00***
3rd	1.02	1.70***	1.15	1.32***	1.08	1.00***
4th	1.30	1.11***	1.70	1.90***	1.46	1.14***
Richest	1.64	0.54***	1.22	0.66*	1.84	1.54***
Mean	1	1	1	1	1	1

Note: See notes to Table 8.

Source: Authors' calculations, using LECS 3 data.

Table 10. Average and marginal odds of enrollment, cross-sectional data, 2007-08 (LECS 4)

Quintile	Lower secondary schools		Outpatient health centers		Outpatient hospital services	
	Average Odds	Adjusted Marginal Odds	Average Odds	Adjusted Marginal Odds	Average Odds	Adjusted Marginal Odds
Poorest	0.45	0.60***	1.00	1.21***	0.35	0.44***
2nd	0.82	1.34***	1.32	1.86***	0.77	1.00***
3rd	0.96	1.68***	0.95	0.64***	1.10	1.53***
4th	1.17	0.98***	0.72	0.53	1.45	1.00***
Richest	1.46	0.39***	0.85	0.75*	1.60	1.03***
Mean	1	1	1	1	1	1

Note: See notes to Table 8.

Source: Authors' calculations, using LECS 4 data.

Table 11. Estimated probability of attending primary school, panel data, 2002–03 to 2007-08

Dependent variable: Probability of attendance						
Independent variables	Q1 Marginal effect	Q2 Marginal effect	Q3 Marginal effect	Q4 Marginal effect	Q5 Marginal effect	Full sample Marginal effect
District average participation rate	0.91*** (0.096)	0.89*** (0.08)	0.49*** (0.067)	0.43*** (0.063)	0.37*** (0.069)	0.73*** (0.038)
Log of monthly per capita consumption	0.033 (0.057)	0.34* (0.157)	0.002 (0.122)	0.043 (0.073)	-0.021*** (0.021)	0.052*** (0.014)
Household size	-0.016** (0.052)	-0.008 (0.005)	-0.008 (0.005)	0.0005 (0.004)	-0.0032 (0.0035)	-0.01*** (0.002)
Child is female	-0.05* (0.028)	-0.036 (0.024)	-0.011** (0.019)	-0.037** (0.015)	-0.0054 (0.015)	-0.034*** (0.01)
Child is 7	0.26*** (0.037)	0.29*** (0.041)	0.24*** (0.04)	0.24*** (0.046)	0.18*** (0.044)	0.27*** (0.02)
Child is 8	0.4*** (0.038)	0.39*** (0.039)	0.35*** (0.037)	0.29*** (0.04)	0.18*** (0.043)	0.36*** (0.018)
Child is 9	0.5*** (0.036)	0.45*** (0.037)	0.38*** (0.036)	0.35*** (0.04)	0.22*** (0.041)	0.42*** (0.019)
Child is 10	0.53*** (0.038)	0.47*** (0.037)	0.40*** (0.035)	0.36*** (0.034)	0.21*** (0.041)	0.44*** (0.018)
Age of household Head	0.004*** (0.001)	0.003** (0.0012)	0.001* (0.0009)	-0.00005 (0.0007)	-0.00008 (0.0008)	0.002 (0.0005)
Female household Head	0.17* (0.089)	0.23** (0.1)	0.037 (0.061)	0.093* (0.056)	-0.019 (0.019)	0.097** (0.038)
Household head's years of schooling	0.036*** (0.006)	0.025*** (0.004)	0.016*** (0.0034)	0.015*** (0.0026)	0.006** (0.002)	0.021*** (0.002)
Dependant ratio	-0.04** (0.014)	-0.024 (0.015)	0.005 (0.011)	-0.004 (0.009)	0.002 (0.012)	-0.016** (0.006)
Being non- <i>Laoloum</i>	-0.08* (0.046)	-0.034 (0.034)	-0.07** (0.025)	-0.017 (0.02)	-0.019 (0.02)	-0.051*** (0.015)
Rural resident	-0.16** (0.1)	-0.09* (0.051)	-0.016 (0.035)	-0.015 (0.026)	-0.035** (0.017)	-0.055** (0.023)
Distance to nearest primary school	-0.054*** (0.01)	-0.02** (0.007)	-0.03*** (0.08)	-0.026*** (0.007)	-0.005** (0.0024)	-0.027*** (0.004)
Year dummy (2007-08)	-0.024* (0.014)	-0.21 (0.046)	-0.19* (0.10)	0.015 (0.081)	-0.033 (0.057)	-0.024* (0.014)
Observations	1,631	1,573	1,412	1,155	889	6,679
Pseudo R^2	0.27	0.28	0.29	0.37	0.34	0.32
Wald Chi^2	415.90	398.99	1406.80	267.75	214.30	1588.84
Prob > Chi^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: See notes to Table 6.

Source: Authors' calculations, using LECS 3 and LECS 4 data.

Table 12. Average and marginal odds of enrollment in primary schooling, panel data, 2002–03 to 2007-08

Quintile	Average odds (2002–03)	Average odds (2007-08)	Marginal odds	Adjusted marginal odds
Poorest	0.71	0.79	0.91***	1.47***
2nd	0.92	0.98	0.89***	1.44***
3rd	1.07	1.06	0.49***	0.79***
4th	1.19	1.13	0.43***	0.69***
Richest	1.23	1.20	0.37***	0.60***
Mean	1	1	0.62	1

Note: See notes to Table 6. Average odds are defined for each time period but the panel dataset makes it possible to estimate marginal odds for the change from one period to the other. Because the panel sample is a subset of the full sample, average odds of participation reported above need not necessarily be the same as those reported in Table 6 for the full sample. They are very similar, confirming that the panel subset is representative.

Source: Authors' calculations, using LECS 3 and LECS 4 data.

Table 13. Average and marginal odds of enrollment, panel data, 2002-03 and 2007-08

Quintile	Lower secondary schools			Outpatient health centers			Outpatient hospital services		
	Average Odds 2002-03	Average Odds 2007-08	Adjusted Marginal Odds	Average Odds 2002-03	Average Odds 2007-08	Adjusted Marginal Odds	Average Odds 2002-03	Average Odds 2007-08	Adjusted Marginal Odds
Poorest	0.37	0.48	0.71***	0.53	1.54	0.67*	0.36	0.60	0.52***
2nd	0.63	0.80	1.18***	1.31	1.70	1.71***	0.64	0.73	0.98***
3rd	1.07	1.03	1.25***	1.01	0.86	0.63***	1.15	1.21	1.21***
4th	1.16	1.18	1.08***	1.50	0.42	1.40***	1.33	1.15	1.01***
Richest	1.55	1.45	0.77***	0.60	0.40	0.57*	1.43	1.35	1.26***
Mean	1	1	1	1	1	1	1	1	1

Note: See notes to Tables 6 and 12.

Source: Authors' calculations, using LECS 3 and LECS 4 data.

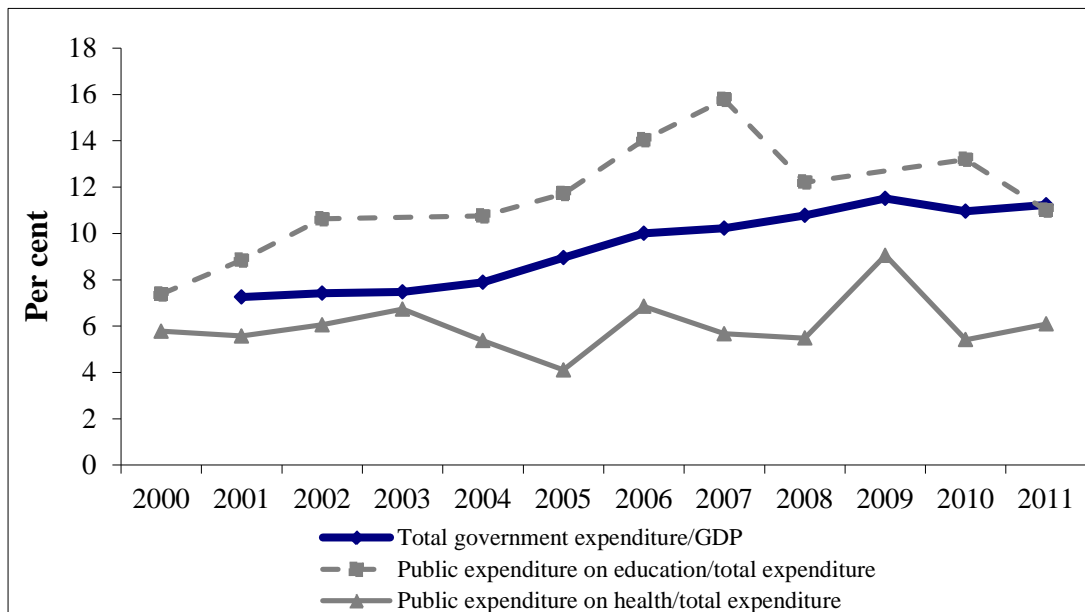
Table 14. Summary of results: Average and marginal incidence

Data type	Aggregate				Cross-section		Panel
Measure	Average odds		Change in average odds		Marginal odds		Marginal odds
	2002/ 2003	2007/ 2008	Method 1	Method 1	2002/ 2003	2007/ 2008	Whole period
Primary education	↓	↓	↑	↑	↓ ↑	↑	↑
Lower secondary education	↓	↓	↑	↓ ↑	↓ ↑	↓ ↑	↓ ↑
Outpatient primary health centers	↓	↓ ↑	↑	↓ ↑	↓ ↑	↓ ↑	↓ ↑
Outpatient hospital service	↓	↓	↑	↓ ↑	↓	↓ ↑	↓

Note: A downward pointing arrow (as in aggregate data, average odds, 2002/2003, primary education) means that the measure is increasing from quintile 1 (poorest) to quintile 5 (richest). An upward pointing arrow means the opposite. A combination of downward pointing and upward pointing (as in cross-section data, marginal odds, 2002/2003, primary education) means that the measure increases from quintile 1 until one of quintiles 2, 3 or 4 and then declines to quintile 5.

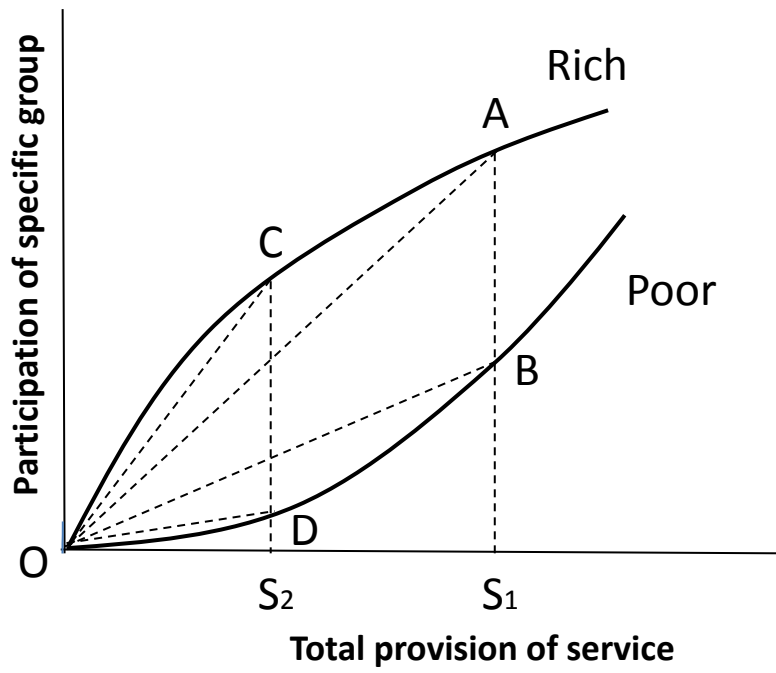
Source: Authors' calculations, using LECS 3 and LECS 4 data.

Figure 1 Total Government Expenditure and Shares of Spending on Education and Health, 2000-2011 (per cent)



Source: Authors' calculations using data from Government of Lao PDR, World Bank and IMF estimates.

Figure 2 Distributional Effects of Public Service Provision: Early Capture by the Rich



Source: Adapted by the authors from Lanjouw and Ravallion (1999).

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