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Peter Warr is John Crawford Professor of Agricultural Economics, and Head, Arndt-Corden Department of Economics, Australian National University.
Jayant Menon is Lead Economist at the Office of Regional Economic Integration, Asian Development Bank. Sitthiroth Rasphone is a Ph.D student and part-time research assistant at the Australian National University

Asian Development Bank

Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
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CONTENTS

ABSTRACT

Studies of the incidence of benefits from public services have rightly stressed the difference between average and marginal benefits. Cross sectional methods of analysis for Lao PDR indicate that for public education and health services, total benefits are highest for the best-off quintile groups. Nevertheless, these groups' shares of marginal benefits are generally considerably lower and the marginal benefit shares of poorer quintile groups are correspondingly higher. For primary and secondary education and for primary health centers, expanding the overall level of provision delivers a pattern of marginal benefits that is significantly more pro-poor than average shares indicate. Although panel estimates show a pattern of marginal benefits that is somewhat less pro-poor than cross-sectional results suggest, they do not change the finding that the pattern of marginal benefits is more pro-poor than the overall pattern of average benefits.

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

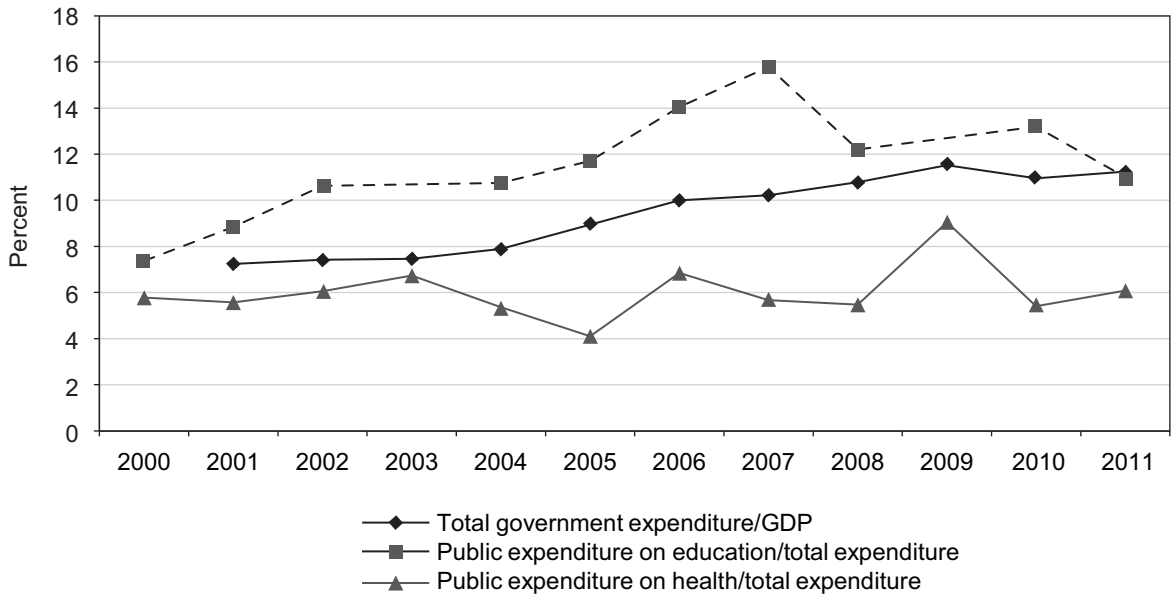
JEL Classification: D12, E21, H31

I. INTRODUCTION

The economy of the Lao People's Democratic Republic (Lao PDR) is booming. Real gross domestic product (GDP) is growing at around 8%, based largely on natural resource exports. A dominant proportion of these export revenues accrues directly to the government, through government ownership of the natural resources on which they are based, and public expenditure is consequently booming as well (Menon and Warr 2013). A core development objective of the government is to use public expenditures to reduce poverty.

Figure 1 presents data on the recent evolution of government expenditure as a share of GDP, as well as spending on health and education as shares of total government expenditure. Government expenditure as a share of GDP increased sharply and consistently between 2001 and 2011, rising from 7.25% to 11.24%. Despite some fluctuations, the share of government expenditure allocated to health remained relatively unchanged between 2000 and 2011. Having received just under 6% of total government expenditure in 2000, it peaked above 9% in 2009 only to return to around 6% again in 2011. Given the rising share of government expenditure in GDP over the period, this still suggests an increase in the volume, but not the share, of expenditure towards health. In contrast, the share of government expenditure allocated to education has increased steadily, from around 7% in 2000 to almost 16% in 2007, before falling back to 11% in 2011. In summary, there has been a large expansion in the provision of education services over this period, and a definite but less pronounced expansion in the provision of health services.

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



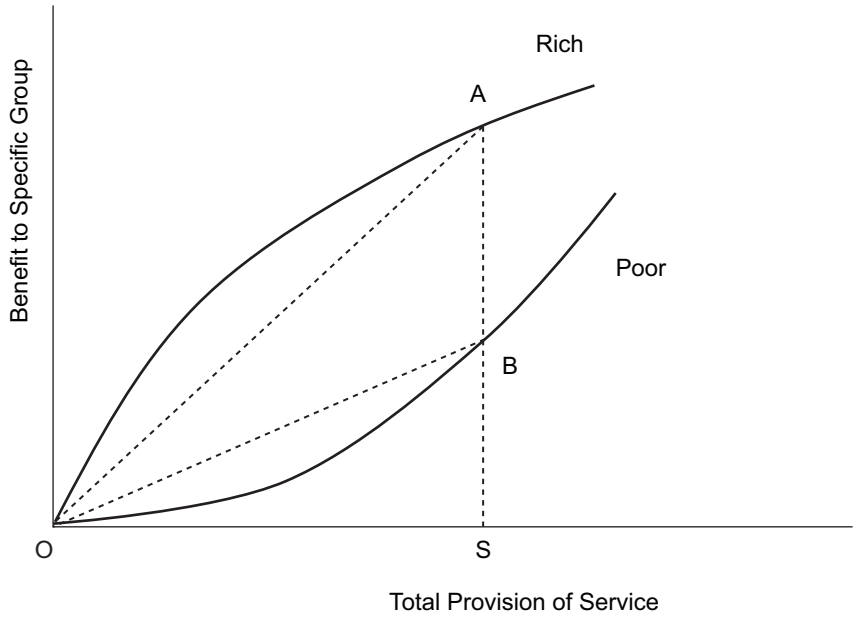
Source: Authors' calculations using data from Government of Lao PDR, World Bank and IMF estimates.

But does an expansion in the level of public services necessarily benefit the poor, and how do these benefits compare with those accruing to better off groups? The present paper investigates this question empirically for the Lao PDR, using a large household income and

expenditure survey data set. 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 share of an increase in spending 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. The diagram 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. At a total provision of S (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.

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



Source: Adapted by the authors from Lanjouw and Ravallion (1998).

As drawn, the marginal share of the poor households exceeds that of the rich, the reverse of the ranking of their average shares. Conversely, early capture by the poor could, hypothetically, have the opposite implication. 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. Careful empirical investigation is needed to estimate the true marginal incidence.

This paper attempts that exercise for the Lao PDR. It analyzes data from a large household income and expenditure survey that records detailed information on the actual utilization of government-provided services, including health and education services, by individual households, along with the economic characteristics of those households. Section II describes the data and Section III describes the methodology. Section IV presents the results and section V concludes.

II. 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 spending 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 2002–2003 round (known as LECS 3) and the 2007–2008 round (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 panel module, comprising about one-half of the total sample, making panel data methods applicable. The size of the LECS surveys is summarized in Table 1.

Table 1: Sample Sizes

	No. of Individuals	No. of Districts
2003–2004 (LECS 3)		
Total sample	49,789	136
School age (6–10)	7,536	
School age (11–13)	4,348	
Hospital users	517	
Health centrer users	152	
2007–2008 (LECS 4)		
Total sample	48,148	135
School age (6–10)	6,276	
School age (11–13)	4,048	
Hospital users	505	
Health center users	135	

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

[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).

III. METHODOLOGY

Consider a representative sample of households and suppose the households contained in the sample are ordered by income per person, from the lowest (poorest) to the highest (richest). Now consider dividing these households into five groups of equal population size: the poorest one-fifth (quintile 1), the next poorest one-fifth (quintile 2), 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,

Table 2: Variable Definitions

Variable Name	Education (primary and lower secondary)	Health (hospital outpatient and health center)
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.

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 $N^P = \sum_q N_q^P$.

[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 simplicity and convenience.

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 towards the poor than the overall program, on average.[3]

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

Approach (i) looks only at the data for a particular round of the survey. It can be applied to each round, but separately. Approach (ii) compares two representative rounds of the survey, in which the individual households surveyed in each round are not necessarily the same. 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 that are 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.

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[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 $\alpha_q = N_q / N = 1/5$ 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.

IV. ANALYSIS USING CROSS-SECTIONAL DATA

It is helpful to begin the discussion with the method used by Lanjouw and Ravallion (1999), who describe a method that can be used when the data available are in the form of district averages, rather than individual household level observations. OLS regression is used to estimate the equation:

$$P_{dsq} = \alpha_q + \beta_q P_s + u_{dsq}, \qquad q = 1, 2, \ldots, 5, \tag{1}$$

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* is now obtained from

$$MOP_q = \frac{dP_q}{dP} = \frac{\partial P_{dsq}}{\partial P_s} = \hat{\beta}_q . \tag{2}$$

A statistical problem is that in equation (1), the variable P_s includes the left-hand side variable P_{dsq}, giving rise to an endogeneity issue, which could lead to biased estimates of the parameter of interest, β_q. This issue is dealt with by the authors 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. The estimates have higher standard errors than alternative available methods because the method does not make use of all of the individual level information that is potentially available. The Lanjouw–Ravallion method 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

$$z_{idq} = \alpha_q + \beta_q P_d + \gamma_q X_{idq} + u_{idq} \quad q = 1, 2, \ldots, 5, \tag{3}$$

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. 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 3–12 present the results of applying Younger's method to the Lao data, using LECS 3 and LECS 4, separately. The estimates of the quintile-specific *MOPs* are each divided by their arithmetic means across quintiles to satisfy the requirement that the arithmetic mean of the adjusted estimates is 1.

Tables 3 to 6 relate to education and Tables 7–12 relate to health. The education results will be discussed first. Table 3 shows the results of estimating the combined equation (5) for primary school participation, ages 6–11. Equation (4) was also estimated for each of the five quintile groups, but for brevity these regression results are not presented. Each of these equations is estimated, controlling for the following household characteristics (the X variables appearing in equation (3): 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 *Lao Loum* (the dominant ethnic group), whether the area is rural, and the distance to the nearest school.

Table 3: Regression Results: Probability of Attending Primary School (ages 6–10)

Dependent Variable: Probability of Attendance				
	2003–2004 (LECS 3)		**2007–2008 (LECS 4)**	
Independent Variables	**Marginal effect**	**Z-value**	**Marginal effect**	**Z-value**
District average participation rate	0.770	20.900***	0.640	18.200***
Log monthly per capita consumption	0.100	7.200***	0.046	3.900***
Log household size	–0.050	–2.400***	–0.070	–4.070***
Child is female	–0.050	–4.520***	–0.018	–1.820***
Child is 7	0.190	15.100***	0.150	16.800***
Child is 8	0.270	24.400***	0.180	23.000***
Child is 9	0.310	30.800***	0.210	27.700***
Child is 10	0.340	34.470***	0.210	27.700***
Age of household head	–0.004	–1.400	–0.005	–2.150***
Age of head squared	0.00006	1.720*	0.00007	2.600***
Male household head	0.100	3.900***	0.350	1.420
Household head's years of schooling	0.022	11.500***	0.017	9.900***
Dependant ratio	–0.015	–2.400	–0.020	–3.580***
Child is non-*Lao Loum*	–0.035	–2.500	–0.015	–1.200
Rural area	–0.080	–4.960	–0.060	–4.030
Distance to nearest primary school	–0.050	–11.300	–0.008	–2.700
Number of observations	7,449		6,144	
Pseudo R^2	0.32		0.28	
Wald test: Chi^2	2,976.98		1,847.96	
$Prob>Chi^2$	0.0000		0.0000	

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

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

Table 4: Marginal and Average Odds of Enrollment, Primary School (ages 6–10)

	2002–2003 (LECS 3)			**2007–2008** (LECS 4)		
Quintile	**Average Odds**	**Marginal Odds**	**Adjusted Marginal Odds**	**Average Odds**	**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	1.2	0.23***	0.40
Mean	1	0.67	1	1	0.57	1

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

Adjusted marginal odds means that the directly estimated marginal odds (columns 2 and 5) have been divided by the arithmetic mean to satisfy the theoretical requirement that their mean is 1.

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

In the case of primary education, 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 1. 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.

Tables 5 and 6 now show the corresponding information for lower secondary school participation, for children aged 11–13. 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.

Table 5: Regression Results: Probability of Attending Lower Secondary School
(ages 11–13)

Dependent Variable: Probability of Attendance				
	2003–2004 (LECS 3)		**2007–2008** (LECS 4)	
Independent Variables	**Marginal Effect**	**Z-value**	**Marginal Effect**	**Z-value**
District average participation rate	0.930	12.880***	1.020	14.40***
Log monthly per capita consumption	0.220	5.900***	0.170	5.000***
Log household size	–0.050	–0.950	–0.080	–1.600
Child is female	–0.17	–5.330***	–0.160	–5.700***
Child is 12	–0.055	–1.100	0.040	0.920
Child is 13	0.003	0.060	0.040	0.990
Age of household head	0.024	2.530	0.00015	0.010
Age of head squared	–0.0002	–2.260	0.0000001	0.010
Male household head	0.120	1.440	0.046	0.700
Household head's years of schooling	0.023	4.800	0.031	6.700***
Dependant ratio	–0.017	–1.000	–0.017	–0.980
Child is non-Lao loum	0.010	0.270	0.050	1.570
Rural area	–0.070	–1.760*	–0.130	–3.780
Distance to nearest primary school	–0.008	–5.500***	–0.010	–1.200
Number of observations	1,679		1,574	
Pseudo R^2	0.28		0.42	
Wald test: Chi^2	1,847.96		875.7	
$Prob>Chi^2$	0.0000		0.0000	

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

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

Table 6: Marginal and Average Odds of Enrollment, Lower Secondary School
(ages 11–13)

	2002–2003 (LECS 3)			**2007–2008** (LECS 4)		
Quintile	**Average Odds**	**Marginal Odds**	**Adjusted Marginal Odds**	**Average Odds**	**Marginal Odds**	**Adjusted Marginal Odds**
Poorest	0.32	0.36***	0.56	0.45	0.53***	0.60
2nd	0.62	0.7***	1.08	0.82	1.2***	1.34
3rd	1.02	1.1***	1.70	0.96	1.5***	1.68
4th	1.30	0.72***	1.11	1.17	0.88***	0.98
Richest	1.64	0.35***	0.54	1.46	0.35***	0.39
Mean	1	0.65	1	1	0.9	1

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

Adjusted marginal odds means that the directly estimated marginal odds (columns 2 and 5) have been divided by the arithmetic mean to satisfy the theoretical requirement that their mean is 1.

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

Turning to health expenditures, Tables 7 and 8 show 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 the marginal benefits to the poorest quintiles again increasing very significantly between LECS 3 and 4.

Table 7: Regression Results: Probability of Access to Outpatient Primary Health Centers

Dependent Variable: Probability of Access				
	2003–2004 (LECS 3)		**2007–2008 (**LECS 4)	
Independent Variables	**Marginal Effect**	**Z-value**	**Marginal Effect**	**Z-value**
District average participation rate	0.380	7.900***	0.740	9.790***
Log monthly per capita consumption	0.020	1.710**	0.025	1.340
Log household size	0.006	0.480	0.025	1.090
Female	–0.003	–0.310	0.010	0.550
Age	–0.003	–0.330	–0.0001	–0.090
Age squared	–0.000006	–0.080	–0.00001	–0.960
Minority	–0.040	–2.830***	–0.040	–1.530*
Rural area	0.016	1.170	0.076	4.560***
Villages having medical bag	0.030	2.560***	0.021	1.050
Village having traditional healer	–0.010	–1.070	0.020	0.840
Village having health volunteer	0.020	1.920**	0.010	0.520
Distance nearest primary health center	–0.001	–2.120***	0.0008	1.300
Being Long term illness	0.004	0.430	–0.030	–1.520*
Number of observations	1,699		911	
Pseudo R^2	0.31		0.36	
Wald test: Chi^2	318.68		281.4	
$Prob>Chi^2$	0.0000		0.0000	

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

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

Table 8: Marginal and Average Odds of Access to Outpatient Primary Health Centers

	2002–2003 (LECS 3)			**2007–2008** (LECS 4**)**		
Quintile	**Average Odds**	**Marginal Odds**	**Adjusted Marginal Odds**	**Average Odds**	**Marginal Odds**	**Adjusted Marginal Odds**
Poorest	0.52	0.006	0.02	1.00	0.75***	1.21
2nd	0.8	0.35***	1.10	1.32	1.16***	1.86
3rd	1.15	0.42***	1.32	0.95	0.40***	0.64
4th	1.7	0.6***	1.90	0.72	0.33	0.53
Richest	1.22	0.21*	0.66	0.85	0.47*	0.75
Mean	1	0.32	1	1	0.67	1

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

Adjusted marginal odds means that the directly estimated marginal odds (columns 2 and 5) have been divided by the arithmetic mean to satisfy the theoretical requirement that their mean is 1.

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

The participation rates of outpatient services in public hospitals, summarized in Tables 8 and 9, show much higher average odds of participation among richer households, as with the education results discussed. The pattern of marginal odds also shows this pattern in the case of LECS 3, but the LECS 4 results show benefits moving in favor of middle income quintiles and resembles the lower secondary school pattern.

Table 9: Regression Results: Probability of Access to Outpatient Hospital Services

Dependent Variable: Probability of Access				
	2003–2004 (LECS 3)		**2007–2008** (LECS 4)	
Independent Variables	**Marginal Effect**	**Z-value**	**Marginal Effect**	**Z-value**
District average participation rate	0.710	13.460***	1.000	14.060****
Log monthly per capita	0.060	3.320***	0.130	4.180***
consumption	0.020	0.700	0.060	1.270
Log household size	–0.140	–0.770	0.070	2.320***
Female	0.002	1.970**	0.008	3.260***
Age	–0.00004	–2.39***	–0.0001	–4.28***
Age squared	–0.009	–0.440	–0.010	–0.300
Minority	–0.050	–1.670*	–0.050	–1.230
Rural area	–0.004	–7.260***	–0.003	–3.850***
Distance to nearest hospital	0.060	2.780***	–0.0005	–0.010
Being Long term illness				
Number of observations	2,063		1,270	
Pseudo R^2	0.27		0.32	
Wald test: Chi^2	631.4		561.58	
$Prob>Chi^2$	0.0000		0.0000	

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

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

Table 10: Marginal and Average Odds of Participation in Outpatient Hospital Services

	2002–2003 (LECS 3)			**2007–2008** (LECS 4)		
Quintile	**Average Odds**	**Marginal Odds**	**Adjusted Marginal Odds**	**Average Odds**	**Marginal Odds**	**Adjusted Marginal Odds**
Poorest	0.32	0.22***	0.32	0.35	0.39***	0.44
2nd	0.57	0.68***	1.00	0.77	0.87***	1.00
3rd	1.08	0.67***	1.00	1.1	1.35***	1.53
4th	1.46	0.77***	1.14	1.45	0.88***	1.00
Richest	1.84	1.04***	1.54	1.6	0.91***	1.03
Mean	1	0.60	1	1	0.88	1

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

Adjusted marginal odds means that the directly estimated marginal odds (columns 2 and 5) have been divided by the arithmetic mean to satisfy the theoretical requirement that their mean is 1.

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

Finally, in the results for inpatient hospital services (Tables 11 and 12), both average and marginal odds of participation strongly favor the richest quintiles. Disproportionately, only the better-off households can afford to stay overnight in a hospital. Expansion of this facility benefits primarily these households.

In summary, drawing upon Younger's cross-sectional approach, it has been possible to compute average and marginal odds of participation , in two time periods, in each of five specific forms of public expenditure—two in education services (primary and lower secondary) and three in public health services (outpatient hospital services, inpatient hospital services, and outpatient primary health center services). In all cases, except outpatient primary health care centers, the calculation of average odds of participation indicated strongly that richer households were disproportionate beneficiaries of the public service concerned.

Table 11: Regression Results: Probability of Access to Inpatient Hospital Services

Dependent Variable: Probability of Access				
	2003–2004 (LECS 3)		**2007–2008** (LECS 4**)**	
Independent Variables	**Marginal Effect**	**Z-value**	**Marginal Effect**	**Z-value**
District average participation rate	0.560	17.250***	0.670	13.900***
Log monthly per capita consumption	0.006	6.500***	0.004	4.270***
Log household size	–0.003	–2.200***	–0.003	–2.300***
female	0.001	1.200	0.0006	0.600
Age	0.0001	1.220	0.0002	5.720***
Age squared	0.0000006	0.550	–0.0000002	–1.020
Minority	0.00006	0.050	0.003	2.730***
Rural area	0.003	2.530***	–0.001	–0.750
Distance to nearest hospital	–0.00015	–4.300***	0.00004	1.220
Being Long term illness	0.084	13.820***	0.100	10.780***
Number of observations	49,042		47,731	
Pseudo R^2	0.11		0.1	
Wald test: Chi^2	1,140.2		706.26	
$Prob>Chi^2$	0.0000		0.0000	

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

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

Table 12: Marginal and Average Odds of Access to Inpatient Hospital Services

	2002–2003 (LECS 3)			**2007–2008** (LECS 4)		
Quintile	**Average Odds**	**Marginal Odds**	**Adjusted Marginal Odds**	**Average Odds**	**Marginal Odds**	**Adjusted Marginal Odds**
Poorest	0.5	0.22***	0.38	0.67	0.41***	0.62
2nd	0.77	0.48***	0.83	0.82	0.66***	1.00
3rd	0.95	0.7***	1.21	0.95	0.51***	0.77
4th	1.25	0.63***	1.09	1.26	0.86***	1.30
Richest	1.48	0.86***	1.50	1.28	0.87***	1.31
Mean	1	0.58	1	1	0.66	1

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

Adjusted marginal odds means that the directly estimated marginal odds (columns 2 and 5) have been divided by the arithmetic mean to satisfy the theoretical requirement that their mean is 1.

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

This is useful information. But the computation of marginal odds of participation indicated a substantially different pattern of benefits at the margin in both forms of education expenditure, with estimated marginal benefits strongly pro-poor in the case of primary education and favoring middle income quintiles in the case of primary education. In the case of outpatient hospital services the results indicated a substantial movement of marginal benefits away from the richest quintiles and toward lower income quintile groups.

In almost all cases, the pattern of distribution of the benefits of public expenditures was very different at the margin from the average pattern. Only in the case of inpatient hospital services did average and marginal benefits follow a similar pattern, favoring the richest groups both on average and at the margin.

V. ANALYSIS USING REPEATED CROSS-SECTION DATA

As public expenditure programs expand over time, their distributional effects can change. This is the perspective adopted when cross-sectional data are compared explicitly over time. In van de Walle (2003) two methods are described for doing this without requiring the econometric methods used in the Younger approach described above.

Method 1 compares the quintile-specific participation rates over time. Taking the example of education to illustrate, we write P_{qt}^{i} for the participation rate observed under expenditure of type *i* for quintile *q* at time *t.* Then P_{t}^{i} denotes the average participation rate observed over all quintile groups. We then compute the change over time in the ratio of these two quantities, which we will call C_{q}^{i}, where

$$C_{q}^{i} = (P_{qt}^{i} / P_{t}^{i}) - (P_{qt-1}^{i} / P_{t-1}^{i}). \quad (4)$$

If C_{q}^{i} is positive, then the participation rate of quintile *q* in public expenditure of type *i* is increasing, relative to the overall participation rate, and vice versa if C_{q}^{i} is negative.

Method 2 computes the ratio between the change in the participation rate for quintile *q* and the change in the overall participation rate. We can call this D_{q}^{i}, where

$$D_{q}^{i} = \left(P_{qt}^{i} - P_{qt-1}^{i}\right) / \left(P_{t}^{i} - P_{t-1}^{i}\right). \quad (5)$$

Although these calculations have the advantage of not requiring detailed regression analysis and the associated collection of the set of control variables described in the previous section, neither method really calculates marginal incidence. Rather, both measure the change over time in average incidence. Moreover, the two methods differ in the way that they do this in a seemingly arbitrary way. Method 1 calculates for each time period the ratio between the average incidence for quintile *q* to the average incidence overall. It then calculates the difference across time in these two ratios. Method 2 calculates for each time period the difference between average incidence for quintile *q* and the average incidence overall and then computes the ratio of these two differences for different periods. Although Method 1 seems more straightforward, 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.

Both methods use participation rates as the basis for their calculations. These participation rates are summarized for LECS 3 and LECS 4 in Tables 13 and 14, respectively. In Tables 15 to 18 the two methods outlined above are applied to the LECS 3 and LECS 4 data. From Table 15, using Method 1, 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. Table 14 shows that Method 2 reveals a very 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.

Table 13: Participation Rates, LECS 3 (2002–2003)

Quintile	Primary School	Secondary School	Health Care Center	Outpatient Hospital	Inpatient Hospital
Poorest	48.26	15.34	4.66	8.12	1.14
2nd	61.85	29.39	7.24	14.44	1.67
3rd	72.37	50.61	10.33	26.98	2.05
4th	79.38	65.91	15.16	36.49	2.70
Richest	84.78	82.56	10.91	46.15	3.18
Total	67.36	51.24	8.91	24.98	2.15

Source: Authors' calculations, using LECS 3 data.

Table 14: Participation Rates, LECS 4 (2007–2008)

Quintile	Primary School	Secondary School	Health Care Center	Outpatient Hospital	Inpatient Hospital
Poorest	61.56	27.20	14.70	14.70	1.23
2nd	75.3	50.19	19.39	31.90	1.51
3rd	81.21	61.58	13.85	46.15	1.74
4_{th}	87.27	73.57	9.80	60.17	2.32
Richest	92.62	92.01	12.50	67.03	2.34
Total	77.18	63.98	14.79	41.42	1.83

Source: Authors' calculations, using LECS 4 data.

Table 15: Education Sector: Analysis of Repeated Cross-sections (Method 1)

Quintile	Primary School (Ages 6–10)			Lower Secondary School (Ages 11–13)		
	(P^i_{qt} / P^i_t)	(P^i_{qt-1} / P^i_{t-1})	**Change (C^i_q)**	(P^i_{qt} / P^i_t)	(P^i_{qt-1} / P^i_{t-1})	**Change (C^i_q)**
Poorest	17.07	20.35	3.28	5.53	6.69	1.16
2nd	20.6	23.5	2.91	10.02	13.19	3.17
3rd	22.54	22.51	–0.03	19.01	20.67	1.66
4th	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

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

Table 16: Education Sector: Analysis of Repeated Cross-sections (Method 2)

Quintile	Primary School (Ages 6–10)			Lower Secondary School (Ages 11–13)		
	$\left(P^i_{qt} - P^i_{qt-1}\right)$	$\left(P^i_t - P^i_{t-1}\right)$	**Ratio (D^i_q)**	$\left(P^i_{qt} - P^i_{qt-1}\right)$	$\left(P^i_t - P^i_{t-1}\right)$	**Ratio (D^i_q)**
Poorest	13.3	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	0.9	10.97	12.74	0.86
4th	7.89	9.82	0.8	7.66	12.74	0.6
Richest	7.84	9.82	0.79	9.45	12.74	0.74

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

Table 17: Health Sector: Analysis of Repeated Cross-sections (Method 1)

Quintile	Outpatient Primary Health Centers			Outpatient Hospital Services		
	(P^i_{qt} / P^i_t)	(P^i_{qt-1} / P^i_{t-1})	Change (C^i_q)	(P^i_{qt} / P^i_t)	(P^i_{qt-1} / P^i_{t-1})	Change (C^i_q)
Poorest	13.82	41.48	27.66	7.35	10.18	2.83
2nd	20.39	28.15	7.76	12.96	13.45	0.49
3rd	22.37	13.33	–9.04	21.08	17.45	–3.63
4th	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

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

Table 17: (cont'd) **Health Sector: Analysis of Repeated Cross-sections** (Method 1)

Quintile	Inpatient Hospital Services		
	(P^i_{qt} / P^i_t)	(P^i_{qt-1} / P^i_{t-1})	Change (C^i_q)
Poorest	13.65	10.55	3.1
2nd	16.63	15.54	1.1
3rd	18.81	19.11	–0.3
4th	25.69	25.24	0.45
Richest	25.23	29.57	–4.34

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

Table 18: Health Sector: Analysis of Repeated Cross-sections (Method 2)

Quintile	Outpatient Primary Health Centers			Outpatient Hospital Services		
	$\left(P^i_{qt} - P^i_{qt-1}\right)$	$\left(P^i_t - P^i_{t-1}\right)$	Ratio (D^i_q)	$\left(P^i_{qt} - P^i_{qt-1}\right)$	$\left(P^i_t - P^i_{t-1}\right)$	Ratio (D^i_q)
Poorest	10.04	5.88	1.70	6.58	16.44	0.4
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

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

Table 18: (cont'd) **Health Sector: Analysis of Repeated Cross-sections** (Method 2)

Quintile	Inpatient Hospital Services		
	(P^i_{qt} / P^i_t)	(P^i_{qt-1} / P^i_{t-1})	Change (C^i_q)
Poorest	0.09	–0.32	–0.28
2nd	–0.16	–0.32	0.5
3rd	–0.31	–0.32	0.96
4th	–0.38	–0.32	1.18
Richest	–0.84	–0.32	2.62

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

Turning to the results for the health sector shown in Tables 17 and 18, 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 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. Finally, in the case of inpatient hospital services the two methods suggest opposite patterns of results. Method 1 suggests that the pattern of incidence has moved in favor of the poorest quintiles while method 2 suggests the reverse. The more basic point is that both forms of calculation obscure the underlying fact that the pattern of incidence strongly favors the richest quintiles, in both periods.

VI. ANALYSIS USING PANEL DATA

Panel data sets 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 which 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 data subset is just under half of the size of the full sample and is described in Table 19. The table also shows the number of primary school children, secondary school children, health center and hospital outpatient users in each sample.

Table 19: Panel Data Subsets, LECS 3 and LECS 4

	No. of Individuals	No of Households	No. of Districts
LECS 3			
Total sample	49,789	8,092	136
Panel sample	24,372	3,914	136
School age (6–10)	7,536		
School age (11–13)	4,348		
Health center users	825		
Hospital outpatient users	998		
Hospital inpatient users	24,069		
LECS 4			
Total sample	48,148	8,296	135
Panel sample	23,582	3,914	135
School age (6–10)	6,276		
School age (11–13)	4,048		
Health center users	451		
Hospital outpatient users	630		
Hospital inpatient users	23,618		

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

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):

$$z_{iqt} = \alpha_q + \beta_q P_{dt} + \gamma_q X_{iqt} + \eta_q Y_t + u_{iqt}, \quad q = 1, 2, \ldots, 5 \tag{6}$$

where z_{iqt} 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_{iqt} 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_{iqt} 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 20 summarizes the results of estimating equation (6) for participation in primary schooling and Table 21 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 public investment in primary education delivers benefits, at the margin, primarily to lower income households. In the case of lower secondary education, the benefits favor the middle income quintiles, as they do in the case of primary health centers. In the case of outpatient hospital services, the marginal benefits are concentrated in the middle and upper income quintiles.

Table 20: Panel Regression Results: Probability of Access to Primary Schooling

Independent Variables	Marginal Effect	Z value
District participation rate	0.78	16.78***
Log of monthly per capita consumption	0.07	4.42***
Log of household size	–0.02	–0.47***
Child is 7	0.19	12.85***
Child is 8	0.26	20.3***
Child is 9	0.30	26.24***
Child is 10	0.31	27.7***
Child is female	–0.03	–2.43***
Age of household head	0.002	3.04***
Female household head	0.16	5.93***
Household head's years of schooling	0.026	9.76***
Dependant ratio	–0.018	–2.28***
Child is non-Lao lum	–0.016	–0.88
Rural area	–0.06	–2.72***
Distance to nearest primary school	–0.034	–7.72***
Year 2007	–0.043	–2.34
Number of observations	4,415	
Pseudo R^2	0.3	
Wald test: *Chi*^{2}	1,690.88	
Prob>Chi^2	0.000	

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

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

Table 21: Marginal Odds of Participation in Primary Schooling

Quintile	Marginal Odds	Adjusted Marginal Odds	Marginal Effect of Distance to School
Poorest	0.83***	1.30	–0.057***
2nd	0.87***	1.35	–0.031***
3rd	0.67***	1.04	–0.05***
4th	0.52***	0.81	–0.041***
Richest	0.33**	0.51	–0.002
Mean	0.64	1	–0.0362

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

Adjusted marginal odds means that the directly estimated marginal odds (column 1) have been divided by the arithmetic mean to satisfy the theoretical requirement that their mean is 1.

Source: Authors' calculations, using results from Table 20.

Tables 21, 23, 25, 27, and 29 also include the marginal effect that distance to the school or health facility has on participation. In the case of primary and lower secondary education, the marginal effect of distance from the school is negative and significant for all but the richest quintile in the case of primary schooling and for all quintiles in the case of lower secondary schooling. Distance from school is an important impediment to school participation in the Lao PDR. The same result applies for outpatient hospital services but not to primary health centers. These centers are sufficiently dispersed throughout the country that distance to the nearest center is not a significant impediment to using its services.

Table 22: Panel Regression Results: Probability of Access to Lower Secondary Schooling

Independent Variables	Marginal Effect	Z value
District participation rate	0.92	17.94***
Log of monthly per capita consumption	0.15	6.68***
Log of household size	0.04	1.21
Child is 12	0.08	3.03***
Child is 13	0.12	4.92***
Child is female	–0.23	–11.42***
Age of household head	0.003	2.54
Female household head	0.13	2.34
Household head's years of schooling	0.027	8.4
Dependant ratio	–0.009	–0.82
Child is non-Laolum	0.065	2.82
Rural area	–0.11	–4.22
Distance to nearest primary school	–0.01	–8.87
Year 2007	–0.11	–4.89
Number of observations	3,404	
Pseudo R^2	0.36	
Wald test: Chi^2	1,714.25	
Prob>Chi^2	0.0000	

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

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

Table 23: Marginal Odds of Participation in Lower Secondary Schooling

Quintile	Marginal Odds	Adjusted Marginal Odds	Marginal Effect of Distance to School
Poorest	0.55***	0.75	–0.004***
2nd	1.03***	1.42	–0.009***
3rd	0.83***	1.13	–0.018***
4th	0.79***	1.08	–0.020***
Richest	0.45***	0.62	–0.008***
Mean	0.73	1	–0.012

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

Adjusted marginal odds means that the directly estimated marginal odds (column 1) have been divided by the arithmetic mean to satisfy the theoretical requirement that their mean is 1.

Source: Authors' calculations, using results from Table 22.

Table 24: Panel Regression Results: Probability of Access to Primary Health Centers

Independent Variables	Marginal Effect	Z value
District participation rate	0.60	9.90***
Log of monthly per capita consumption	0.036	2.56**
Log of household size	0.025	1.38
Child is female	–0.005	–0.38
Age	–0.0007	–0.78
Age square	0.000004	0.36
Individual is non-Lao majority	–0.074	–3.69***
Living in rural area	0.027	1.43
Living in village having medical bags	0.018	1.19
Living in village having traditional healer	–0.004	–0.28
Living in village having health volunteer	0.031	2.23**
Living in village having trained doctor	0.013	0.69
Living in village having Anti-malaria program	0.002	0.18
Distance to nearest hospital		
Year 2007	0.001	2.07**
		0.01
Number of observations	1,276	
Pseudo R^2	0.34	
Wald test: Chi^2	320.41	
$Prob>Chi^2$	0.0000	

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

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

Table 25: Marginal Odds of Participation in Primary Health Centers

Quintile	Marginal Odds	Adjusted Marginal Odds	Marginal Effect of Distance to Facility
Poorest	0.035	0.08	0.0001
2nd	0.89***	1.95	0.00001
3rd	0.33***	0.72	–0.0016
4th	0.73***	1.60	–0.0013
Richest	0.30*	0.65	–0.00003
Mean	0.46	1	–0.00056

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

Adjusted marginal odds means that the directly estimated marginal odds (column 1) have been divided by the arithmetic mean to satisfy the theoretical requirement that their mean is 1.

Source: Authors' calculations, using results from Table 24.

Table 26: Panel Regression Results: Probability of Access to Outpatient Hospital Services

Independent Variables	Marginal Effect	Z value
District participation rate	0.80	12.88***
Log of monthly per capita consumption	0.088	3.45***
Log of household size	0.012	0.35
Child is female	0.008	0.34
Age	0.006	3.3***
Age square	–0.00008	–3.66***
Individual is non-Lao majority	–0.0015	–0.06
Living in rural area	–0.06	–1.55
Living in village having medical bags	0.016	0.6
Living in village having traditional healer	–0.006	–0.24
Living in village having health volunteer	0.045	1.75
Living in village having trained doctor	–0.03	–1.08
Living in village having Anti-malaria program	0.03	–5.82
Distance to nearest hospital		
Year 2007	–0.004	1.17
	–0.0003	–0.01
Number of observations	1,602	
Pseudo R^2	0.27	
Wald test: Chi^2	529.05	
Prob>Chi^2	0.0000	

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

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

Table 27: Marginal Odds of Participation in Outpatient Hospital Services

Quintile	Marginal Odds	Adjusted Marginal Odds	Marginal Effect of Distance to Facility
Poorest	0.41***	0.52	–0.0015**
2nd	0.78***	0.98	–0.0013
3rd	0.96***	1.22	–0.006**
4th	0.80***	1.00	–0.007***
Richest	1.00***	1.26	–0.009***
Total	0.80	1	–0.005

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

Adjusted marginal odds means that the directly estimated marginal odds (column 1) have been divided by the arithmetic mean to satisfy the theoretical requirement that their mean is 1.

Source: Authors' calculations, using results from Table 26.

Table 28: Panel Regression Results: Probability of Access to Inpatient Hospital Services

Independent Variables	Marginal Effect	Z value
District participation rate	0.66	16.3***
Log of monthly per capita consumption	0.007	6.9***
Log of household size	–0.004	–2.7**
Child is female	0.0003	0.3
Age	–0.000002	–0.1
Age square	0.00000007	0.01
Individual is non-Lao majority	–0.001	–0.9
Living in rural area	0.002	1.7*
Living in village having medical bags	0.001	0.8
Living in village having traditional healer	–0.0004	–0.4
Living in village having health volunteer	0.003	2.2*
Living in village having trained doctor	–0.002	–1.6
Living in village with Anti-malaria program	0.001	1.2
Distance to nearest hospital	–0.00008	–2.2*
Year 2007	–0.007	–4.7***
Number of observations	46,364	
Pseudo R^2	0.05	
Wald test: Chi^2	407.12	
$Prob>Chi^2$	0.0000	

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

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

Table 29: Marginal Odds of Participation in Inpatient Hospital Services

Quintile	Marginal Odds	Adjusted Marginal Odds	Marginal Effect of Distance to Facility
Poorest	0.34***	0.52	–0.00001**
2nd	0.51***	0.78	0.00007
3rd	0.75***	1.14	–0.00002*
4th	0.85***	1.30	–0.00022*
Richest	0.83***	1.26	–0.00025*
Mean	0.65	1	–0.0001

Note: *** indicates statistical significance at 1% level, ** at 5% level and * at 10% level.

Adjusted marginal odds means that the directly estimated marginal odds (column 1) have been divided by the arithmetic mean to satisfy the theoretical requirement that their mean is 1.

Source: Authors' calculations, using results from Table 28.

VII. COMPARISON OF RESULTS

The results for the three sets of measures can now be compared in the picture that they give of the pattern of marginal benefits. The measures agree that public investment that raises 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. The measures also agree that expansion of secondary education delivers benefits at the margin primarily to the middle income quintiles. The measures also agree that inpatient hospital service delivers benefits at the margin mainly to the rich. In the case of primary health centers and hospital outpatient services, the cross-sectional measures suggest a pattern of benefits that favors middle income quintiles, but the panel results suggest a pro-rich pattern of benefits at the margin.

VIII. CONCLUSIONS

Methods of determining the incidence of benefits from public expenditures have rightly stressed the difference between average and marginal benefits. Cross sectional methods of analysis indicate that for all five forms of public expenditure studied in this paper (primary education, secondary education, outpatient primary health centers, outpatient hospital services, and inpatient hospital services) the best-off quintile groups do enjoy the highest share of total benefits from provision of these services. That is, their share of average benefits is highest. But their share of marginal benefits, when the level of public provision is increased, is considerably lower, except in the case of inpatient hospital services. In the case of primary education and to a lesser extent secondary education and primary health centers, expanding the overall level of provision delivers a pattern of benefits that is significantly more pro-poor than these average shares indicate. This result was strongest in the case of primary education.

The study also found that use of panel data, when they are available, can produce a more accurate estimation of the pattern of marginal benefits. Except in the case of primary education, the panel results showed that the pattern of marginal benefits was somewhat less pro-poor than cross-sectional results indicated, but did not change the finding that the pattern of marginal benefits is more pro-poor than the overall pattern of average benefits.

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How Public Spending Affects the Poor: The Case of Lao People's Democratic Republic
The average and marginal benefits from expanding public services can vary by income group. We test this for the Lao People's Democratic Republic using a rich database and through panel and cross-section estimation methods. We find that for primary and secondary education and for primary health centers, expanding the overall level of provision delivers a pattern of marginal benefits that is significantly more pro-poor than average shares indicate.

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