Roads and Poverty in Rural Laos*

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Abstract

The relationship between poverty incidence and road development is analyzed in this paper, in the context of rural Laos. The results indicate that improving road access is an effective way of reducing rural poverty. Between 1997-98 and 2002-03, rural poverty incidence in Laos declined by 9.5 per cent. The results suggest that about 13 per cent of this decline can be attributed to improved road access to areas already having dry season access. There is now a high return to providing dry weather access to the most isolated households of Laos – those with no road access at all.

JEL classifications: H53; I32; O53; R41

Key words: poverty incidence; rural roads; Lao PDR.

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1. Introduction

Most poor people of the world reside in rural areas, which are frequently characterized by low levels of public infrastructure, especially roads. Inadequate roads raise transport costs, limiting the use poor people can make of local markets for the sale of their produce, purchase of consumer goods and opportunities for off-farm employment. Access to educational and health facilities, where they exist, is also constrained when it is difficult to reach them. In tropical areas, unsealed roads may actually be impassable during the extended rainy periods of the year. These problems are particularly acute in Lao PDR (subsequently Laos), where inadequate roads are a severe problem for rural people. But significant road improvement is generally not a form of investment that rural people can make by themselves. Public sector involvement is required. Action to improve rural roads therefore seems a clear means by which large numbers of people might acquire the opportunity to participate in the market economy and thereby raise themselves out of poverty. But does it actually work?

At an aggregate level, the Lao economy has performed moderately well in recent years, with growth of real GDP consistently lying between 5 and 6 per cent since 2000, slightly above the average rate over the preceding decade. Measured poverty incidence at the national level declined over this period, from 46 per cent of the population in 1992-93 to 39 per cent in 1997-98. Estimates of the level in 2002-03 place it at 31 per cent. As in most developing countries, poverty in Laos is concentrated in rural areas. The percentage of the rural population with consumption expenditures below the official poverty line has been estimated at 52, 43 and 33 per cent, respectively, over the same years. The corresponding estimates for poverty incidence in urban areas were 27, 22 and 23 per cent, respectively.

Economic reforms, beginning around 1987, have seemingly contributed to these favorable outcomes by permitting greater participation in both local markets and markets in neighboring countries. However, it is recognized that removal of obstacles to the functioning of markets may be of little or no assistance to rural people if very poor roads prevent them from participating in these markets. This is especially important in the wet season, when many roads, even including some of the main highways connecting provinces, can be impassable for extended periods. Removal of obstacles to the functioning of markets may be of little or no assistance to rural people if very poor roads prevent them from participating in these markets. Basic infrastructure facilities are public goods and their inadequacy is a cause of market failure. Collective action is required to provide these facilities. Although there is still much progress to be made, over the past decade action by the Lao government, with assistance from international institutions, has resulted in significant improvements in the state of Lao rural roads. But there is still much progress to be made. This paper is an attempt to study the contribution that improved rural roads have made to poverty reduction in Laos in the recent past and - by extension - the scope for continued poverty reduction through this means.

A number of studies have suggested that improvement of infrastructure in rural areas can contribute to agricultural productivity and economic welfare in those areas. Examples include Binswanger et al. (1993), van de Walle and Nead (1995), van de Walle (1996 and 2002), Jacoby (2000) and Gibson and Rozelle (2003). Lanjouw (1999) demonstrates, for the case of Ecuador, the importance of access to off-farm employment in these outcomes. A study of rural China (Jalan and Ravallion 1998) suggested that higher density of roads in a particular area lowered the probability that households in that area would be poor. Srinivasan (1986) points to the special importance of these issues in landlocked countries such as Laos.

Suppose it is found that areas with better access to main roads had higher levels of consumption expenditures per person and lower levels of poverty incidence. This does not in itself prove that improved roads *cause* lower levels of poverty, for two kinds of reasons. First, because the regions with better roads (and lower poverty incidence) differ from those with inferior roads (and higher poverty incidence) in many respects, not just the quality of roads. Multivariate regression is a statistical device for dealing with this problem, by allowing for the levels of other variables such as education, health facilities and regional effects. If an association is still found between better access to roads and higher per capita consumption, then this point has been allowed for.

A second problem with a simple cross-sectional comparison of road (or other infrastructure) availability with economic indicators at a particular time is more problematic. If better-off areas are favored by the government for the construction of these infrastructure facilities, then the existence of a correlation between their provision and the economic indicator concerned may not indicate that the provision of the infrastructure causes better economic performance, but rather the reverse. Studies noting this potential problem, now known as the 'endogenous placement' problem include Binswanger et al. (1993), and van der Walle and Nead (1995). For this reason, wherever possible it is desirable to supplement such cross-sectional analyses with studies over time which focus on the effect that *changes* in road provision over time have on *changes* in economic indicators, like poverty incidence, income, expenditure and so forth.

Studies of poverty incidence in Laos are constrained by the availability of household survey data sets which can support this form of analysis. The only such data sets available are assembled by the government's National Statistical Center and are known as the Lao Expenditure and Consumption Survey (LECS). Three such surveys have been conducted to date:

LECS 1, covering 1992-93;

LECS 2 covering 1997-98; and

LECS 3, covering 2002-03.

Statistical changes in LECS 2 limited the scope for comparison with LECS 1, but LECS 2 and 3 are closely comparable. The data from LECS 3 were released in late 2004 and can now be analyzed. This paper makes extensive use of the data now available in LECS 2 and LECS 3.

Earlier poverty assessment studies for Laos, using the LECS 2 data set, confirm that in 1997-98 areas with better access to main roads had higher levels of consumption expenditures per person, allowing for the levels of other variables such as education, health facilities and regional effects. Two important examples are Datt and Wang (2001) and Kakwani, Datt, Sisouphanthong, Souksavath and Wang (2002). For the purposes of the present discussion, the two use similar statistical methods and reach similar conclusions. In each of these studies, the relationship between infrastructure and real expenditures is only one of many issues examined and this effect of road infrastructure occupies a minor part in the analysis and discussion. Neither of these studies estimates the implications of the results for poverty incidence and neither recognizes the possible relevance of the 'endogenous placement' effect. Consequently, it is not clear from the results presented whether the correlation between good roads and economic welfare means that better roads reduce poverty or merely that richer areas receive improved roads ahead of poorer areas.

The release of LECS 3 data means that a richer analysis of the relationship between infrastructure provision and poverty incidence is now possible, by comparing LECS 2 and LECS 3, which span an interval (1997-98 to 2002-03) during which there was significant progress in road provision. That is, the LECS 3 data make it possible to focus to focus on the determinants of *changes* in poverty incidence over time, rather than simply the *level* of poverty incidence at a particular time.

The structure of the paper is as follows. Section 2 reviews economic change in Laos since the late 1980s. This is important because this paper is concerned with analyzing changes in rural poverty incidence between 1997-98 (the date of the LECS 2 survey) and 2002-03 (the date of LECS 3). This requires an understanding of the economic background within which these changes occurred. Due to structural changes within the Lao economy, rural areas have been subjected to considerable economic pressure, which is relevant for an understanding of the changes in poverty incidence that have occurred. Section 3 then presents the results of the empirical analysis of the relationship between road development and poverty incidence in rural areas of Laos. Section 4 concludes.

2. Economic Background

Output

Laos is an especially poor country, with GDP per person in 2002 at US$ 310, and total GDP of US$ 1.7 billion. From 1991 to 2002 annual growth of GDP averaged 6.2 per cent per annum (annual data are in Figure 1), or around 3.8 per cent per person. The agricultural sector dominates employment, with 80 per cent of the workforce and it contributes about 50 per cent of GDP. Laos remains dependent on external support. In 2002/3 external donors contributed 61 per cent of the government's capital budget, representing 39 per cent of total public expenditure, and 7.6 per cent of GDP.

Structural change within the Lao economy has been significant. The agricultural sector contracted from 61 per cent of GDP in 1990 to 50 per cent in 2002 (Figure 2). Most of this contraction occurred in the crops sector (Figure 3), but the contraction of the crops sector was concentrated in the first half of the 1990s, when its share of GDP fell from 37 to 25 per cent. From then until the present, the share of the crops sector recovered to around 30 per cent of GDP. Heavy public investment in irrigation in the second half of the 1990s accounted for this change.

One feature of the changes in the crop sector is important. The total area planted to rice remained virtually unchanged from 1990 to 2000, but within this the irrigated rice sector expanded very markedly, responding to the irrigation investments mentioned above, and the upland rice area (non-irrigated) contracted by 70 per cent. Rice became a less attractive activity for upland people. To some extent this was due to the availability of alternative crops with market outlets both within Laos and in neighboring countries, partly to the relaxed insistence from the government that all regions of the country strive for rice self-sufficiency, but it was also due to the declining profitability of rice itself, reflecting relative price movements within the country.

Prices

Inflation was moderate through the first half of the 1990s, at single digit levels for most of this period, but accelerated from 1998 to 2000, peaking at 142 per cent in 1999 (Figure 1). This inflationary surge was related to agricultural policy. The government of Laos is committed to a goal of rice self-sufficiency. However, it was apparent through the first half of the 1990s that rice output was not growing as fast as population. A large public investment in irrigation facilities followed, beginning in 1996-97, producing large public sector deficits, especially in 1998-99. But the deficits were financed to a considerable extent by monetary creation, producing the inflation and currency depreciation of the late 1990s. Since 2001 consumer price inflation has been contained, with an average annual rate just under 10 per cent.

Figure 4, combined with Figure 1, shows that the inflation in consumer prices in the late 1990s coincided with a collapse of the exchange rate. The kip / dollar rate collapsed from roughly 2,000 at the end of 1997 to 8,200 at the end of 2001. Since Thailand is the major trading partner of Laos it is relevant to look at kip / baht exchange rates as well. This inflation arose from a large budget deficit in 1998/99 which was financed by monetary creation. Although the Thai baht was also depreciating in the late 1990s, as a result of Thailand's financial crisis, the kip's depreciation far exceed this. The kip / baht rate declined from 47 at the end of 1997 to about 200 at the end of 2000. This depreciation of the nominal exchange rate had implications for real exchange rates, and these were relevant for the central theme of this report. These issues are discussed below.

The macroeconomic events described above produced significant relative price changes within Laos. They are summarized in Figure 5. Because producer prices are unavailable, this figure draws on consumer price data to show a decline in food prices relative to services prices. Because of changes in the way consumer price data are calculated, the figure contains three segments, spliced together.

(i) *Food / Services I – 1988 to 1997.* This series shows the ratio of food to services prices, intended as proxies for traded and non-traded goods prices, respectively.

(ii) *Food / Energy and Construction – 1997 to 2000.* In 1997 the consumer price category ‘services’ was discontinued and for this purpose the category ‘Energy and Construction’ has been used as a proxy for non-traded goods prices.

(iii) *Food / Services II.* The format of consumer prices was changed again in 2000 and the third series constructs a ‘services’ price series as a weighted average from components of the new classification corresponding to services, using the CPI weights to aggregate these series.

These data tell a clear story. They indicate that agricultural commodity prices declined markedly relative to non-agricultural prices, especially those of services and construction. An economic boom followed the more open economic environment created by the reforms, but this boom was concentrated in the services and construction sectors of the economy, which drew resources from elsewhere, especially from agriculture.

The reform program was officially called the New Economic Mechanism (NEM). The program had indirect macroeconomic effects on agricultural output, which were in some cases negative. The increased domestic expenditure made possible by foreign aid and foreign investment produces demand-side effects that imply contraction of agriculture. Increased demand produces increases in the domestic prices of those goods and services that cannot readily be imported. These include most services and construction and the expansion of these sectors attracts resources, including labour, away from agriculture. This phenomenon has been observed in many countries experiencing large increases in capital or export revenue inflows from abroad and it is known as the ‘Dutch Disease’ or ‘booming sector’ effect. It causes the prices of agricultural and other traded commodities to decline relative to other prices, with negative effects on agricultural production. To the extent that the NEM increased the exposure of agricultural commodities to international markets, this policy change indirectly increased the impact that these market phenomena had on agricultural production.

From 1997 to 1999 this real appreciation was reversed by the massive nominal depreciation described above. The mechanism is that a nominal depreciation increases the nominal prices of traded goods. Some stickiness in non-traded goods prices caused them to respond slowly to the monetary expansion that was occurring at the same time, with the result that the ratio of traded to non-traded goods prices increased. This effect ceased after 2000 and real appreciation resumed.

The relevance of these events is that since around 1990 agricultural producers in Laos have been subject to a considerable cost-price squeeze. This phenomenon has accelerated the rate of rural to urban migration that would otherwise have occurred. The deterioration in the profitability of agricultural production for the market has also impeded the entry into the market economy of subsistence agricultural producers. In short, these events have resulted in higher levels of rural poverty incidence than might otherwise have occurred. This background is important for understanding rural poverty in Laos.

Poverty

Available data on poverty incidence and inequality in Laos are shown in Figure 6. These data were assembled by the World Bank office, Vientiane.[1] Official Lao data for 2002-03 were not yet available, as of early 2005. These data are based on comparisons of household *expenditures* (rather than incomes) with an official poverty line adjusted over time to hold real purchasing power constant.[2] According to these data, over a 10 year period poverty incidence in Laos declined from 46 per cent to 31 per cent of the population, that is, by 1.5 per cent of the population per year. Among neighboring countries, this performance

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[1] See the footnote to Table 1.
[2] Among Southeast Asian countries, Indonesia, Cambodia and Vietnam also use household expenditures for this purpose, but Thailand , Malaysia and the Philippines use household *incomes*.

compares favorably with Cambodia (0.5 per cent decline per year) and is similar to Thailand (1.6 per cent per year over the 30 years for which data are available), but is less than Vietnam's reported rate of decline (roughly 3 per cent of the population per year over the 6 years for which data are available).[3] The Lao rate of poverty reduction is clearly encouraging. Sustaining it over an extended period will reduce poverty incidence to very low levels.

3. Roads and Poverty

We now turn to the estimation of the effects that road development has on poverty in rural Laos. Travelers in rural Laos cannot fail to be impressed by the low quality of the road system. It seems obvious that improving these roads could contribute to poverty reduction by improving poor peoples' capacity to take advantage of the market economy. But by now much can poverty be reduced in this way?

The LECS data

The LECS surveys have been undertaken every 5 years since 1992-93:

- LECS 1 1992-93
- LECS 2 1997-98
- LECS 3 2002-03

The LECS 1 survey is different from the latter two, making comparison of its results with the later surveys hazardous. LECS 2 and 3 are quite similar and can be compared. The present study focuses on these two surveys. The 1997-98 survey (LECS 2) covered 8,882 households

[3] Sources: Laos (1992 to 2002) - Kaspar Richter, 'Some Poverty Statistics of Lao PDR', World Bank, Vientiane, March 2004; Cambodia and Vietnam (1996 to 2001) - World Bank, 2002. *East Asia Rebounds, But How Far?* Washington, April (Appendix Table 8); Thailand (1962 to 2002) - National Economic and Social Development Board, Bangkok.

containing 57,624 individuals. The data collection ran from March 1997 to February 1998 with about the same number of households (about 740) interviewed each month. The timing of the survey is important because as the discussion above indicates, LECS 2 was conducted at a time of high inflation, which reached annual rates well over 100 per cent. The data on consumption expenditures were collected in current prices, making the deflation of these expenditures into constant price terms particularly important. Of the 8,882 households covered, 6,874 were rural and the remaining 2,008 urban. In this study, only the data relating to rural households are used.

The 2002-03 survey (LECS 3) covered 8,092 households containing 49,790 individuals with the data collection extending from March 2002 to February 2003. Of these households 6,488 were rural and the remaining 1,604 were urban. It is important to note that these are sample surveys, not censuses. The number of households sampled is about 1.2 per cent of the total number of households within Laos, and the individual households sampled in each survey are seldom the same. In any case, households are not identified individually and it is therefore not possible to compare the same households across LECS 2 and LECS 3.

Regression analysis

It is convenient to move directly to the regressions that were estimated. Nominal consumption expenditures per household member were deflated to December 1999 prices using monthly provincial consumer price index data, thus taking account of the specific month in which the data were collected. This is especially important in the case of LECS 2, because of the rapid inflation of that time. The dependent variable was then the natural logarithm of real per capita expenditure.

The treatment of the dummy variables for dry season access to roads and wet season access needs explanation. Dummy variables D and W were used, where D takes the value 0 if the household reports no dry season access and 1 if it reports road access. Then, W is defined similarly for wet season access. There was no household for which D was zero and W was 1. With respect to road access there were therefore three categories of households:

(i) no road access at all: $D = 0$, $W = 0$;

(ii) access in dry season but not wet season: $D = 1$, $W = 0$; and

(iii) access in both seasons: $D = 1$, $W = 1$.

The numbers of households belonging to each of these categories are summarized in Table 2. In LECS 2, 31 per cent of households belonged to category (i) and this barely changed in LECS 3. These are the most isolated households of the country and according to these data little progress was made in providing them with road access over this period. In category (ii) – dry season access but not wet season access – the proportion declined from 28 per cent in LECS 2 to 16 per cent in LECS 3. Thus the number of households which had wet season access as well as dry season access increased between these two surveys by 12 per cent of all households. In LECS 3, 52 per cent of all household had year-round road access.

The estimated regression equation handled this combination of outcomes through an interaction term. The right hand side variables thus included the terms

$$\alpha D + \beta D.W$$

where α and β are estimated coefficients. In case (i) above D and $D.W$ are both 0. In case (ii) $D = 1$ and $D.W = 0$. In case (iii) D and $D.W$ are both 1. The effect of dry season access alone is given by α and (noting that whenever $W = 1$, $D = 1$ also) the combined effect of dry and wet season access is given by $\alpha + \beta$.

Regression results: LECS 2 – 1997-98

The regression results for LECS 2 are reported in Table 3. The estimated coefficients had the expected signs, including the education variables and asset ownership variables, with the exception of "Not female head", which had a negative but not significant sign. The variable "Reach dry" had the expected positive sign, but was not significant. The variable "Reach rain" had a positive and highly significant coefficient. According to these results, there was a high return to having wet season access in the LECS 2 data set.

The significance of this result for poverty incidence is explored in Figure 7 and in Table 5. Figure 7 shows the estimated cumulative distribution of the logarithm of real consumption expenditures per person for 1997-98. These data were assembled by calculating the estimated value of real consumption expenditures per person for all rural households contained in the LECS 2 data set, using the results of the regression summarized above combined with the LECS 2 data, taking the natural logarithm and then sorting them from the lowest to the highest. The diagram shows three estimated distributions.

P1. The predicted level of real expenditures using the actual values of the dummy variables *D* and *W* as observed in the data as well as actual values of all other independent variables. The difference between this prediction and the actual data is the error of the regression.

P2. The predicted level of real expenditure when all households have the value of $D = 1$ and *W* takes its values in the actual data, along with the actual values of all other independent variables.

P3. The predicted level of real expenditure when D = 1 and W = 1 for all households, along with the actual values of all other independent variables.

The difference between P1 and P2 is an estimate of the degree to which real consumption expenditures could be increased if all households had access to roads in the dry season, but wet season access remained as observed in the data. The difference between this and P3 is then the degree to which real expenditures could be increased if all households had access to roads in the dry season and the wet season as well. Clearly, the difference between P1 and P3 indicates the potential for increasing real expenditures through road improvement.

The figure then uses these calculations to project levels of poverty incidence. In this exercise the poverty line is selected so that the predicted level of rural poverty incidence (P1 above) replicates the level of rural poverty incidence officially estimated for the LECS 2 data – 42.5 %. Because the estimated coefficient α is so small, the difference between the estimated level of poverty incidence in P1 and P2 is merely 0.06 per cent of the rural population (poverty incidence under P2 is 42.44%) and this small difference is not discernable in the diagram. But the difference between P3 and P2 is a further 7.58 per cent of the rural population (poverty incidence under P3 is 34.86%). This is the lower horizontal line in Figure 7. This number of rural people is equivalent to about 6 per cent of the total population of Laos. According to these estimates, poverty incidence in Laos could be reduced permanently by 6 per cent by providing all weather roads to all rural people.

It is notable that between the dates of LECS 2 and LECS 3, improved access to wet weather roads was indeed provided, as shown in Table 2, above. Fully 12 per cent of the rural population gained this form of access, compared with the 60 per cent of the same population that lacked it in 1997-98. This improvement was therefore about one fifth of the potential increase in wet season access. Interpolating linearly, the reduction in poverty incidence may therefore be estimated at about 1.2 per cent of the rural population. Rural poverty incidence actually declined by 9.5 per cent over this same period (Table 1). Therefore these results imply that about 13 per cent (one sixth) of the reduction in rural poverty incidence that occurred between LECS 2 and LECS 3 can be attributed to improved wet season road access.

Regression results: LECS 3 – 2002-03

Table 4 summarizes the regression results for the LECS 3. The coefficient for dry season access is larger than for LECS 2 and more significant. The coefficient for wet season access, while still highly significant is now about two thirds of its value in LECS 2. The combined effect of providing dry and wet season access, the sum of these two coefficients, increased from 0.134 to 0.19. These results may be interpreted as follows. The improvement in wet season access that occurred between LECS 2 and LECS 3 reduced somewhat the marginal return to providing wet season access, but it still remained large. Although there was no significant improvement in provision of dry season access between these two surveys, the increased market access available to households which had dry season access raised the real expenditure differential between those which did and those which did not have dry season access. This increase in market activity raised the real return to provision of road access.

Figure 8 now shows the implications of these results for predicted real expenditures, as previously, and Table 6 summarizes estimates of their implications for poverty incidence. Again, the poverty line is chosen such that the predicted level of poverty incidence replicates the preliminary World Bank estimate of rural poverty incidence based on LECS 3 of 33 % (Table 1). The three horizontal lines shown in Figure 7 correspond to the levels of poverty incidence under P1 (33.00%, the top line), P2 (29.72%, the middle line) and P3 (25.90%, the lower line).

It should be noted that the World Bank estimates of rural poverty incidence for LECS 2 and LECS 3 (42.5% and 33%, respectively), when combined with the LECS 2 and LECS 3 survey data, imply poverty lines of 114,281 and 99,138 kip per person per month, respectively, when deflated by the consumer price index and expressed in December 1999 prices.[4] That is, the World Bank's rural poverty lines increased in nominal terms somewhat less than the CPI. This outcome seems broadly consistent with the fact that the expenditures of the poor include

[4] The poverty lines shown on the horizontal axes of Figures 7 and 8 are the natural logarithms of these values.

larger shares of food than the non-poor, and (from Figure 8) the prices of food declined relative to those of non-food over this period.

According to these estimates, in 2002-03 rural poverty incidence could have been reduced by 3.32 % (one tenth of the present number of the rural poor) if all rural households had dry season road access without any improvement in wet season access (the difference between P1 and P2). A further 3.77 per cent of the rural population could have been raised from poverty if in addition all rural households had access to usable roads in the wet season. Together, if all rural households were provided with all-weather road access, poverty incidence in rural areas could have been reduced by 7 per cent, equivalent to about 5.6 per cent of the total population of Laos. This estimate is very close to that obtained from LECS 2.

Regression results: The change from LECS 2 to LECS 3

A possible objection to the analysis performed above is that it ignores the possible implications of the 'endogenous placement' problem. If improved roads were provided to better off areas, rather than independently of household real consumption, the relationship between better roads and real expenditures might not have the causal interpretation attributed to it in the above discussion. This possibility was tested by assembling data on road improvement that occurred between LECS 2 and LECS 3. These data were assembled at the district level of which there are 140 in Laos. The data were not derived from LECS but from independent compilation of data from regional government offices and from the Ministry of Roads in Vientiane. Some judgment is involved in assessing whether roads were or were not 'all weather' and whether they were maintained. These judgments reflect the assessments of regional level officers of the Ministry of Roads.

The change in average real expenditures per capita between LECS 2 and LECS 3 was then related to the improvement or non-improvement of roads as captured in this data set. The base level of real per capita expenditures in LECS 2 (1997-98) was significant and with a negative coefficient, meaning that better off households did less well in proportional terms (the dependent variable is the change in the log of real expenditures) than poorer households. The base level of road access in 1997-98 was less important in explaining the improvement in average real consumption expenditures at the district level than the change in road access, where the coefficient was highly significant and numerically of similar magnitude to the value obtained from the cross sectional results.

A further, more direct, test of the endogenous placement problem was conducted by regressing the change in road access that occurred between LECS 2 and 3 on the level of initial real per capita expenditure in LECS 2. The regression was done using regional level observations by taking the means of the district level dummy variables for improved road access for each district within the region and regressing this on the regional means of the district level real per capita expenditure as recorded in LECS 2. If better off areas received preferential treatment in road improvement a significant and positive coefficient would be expected. The estimated coefficient was negative but insignificant. These results are supportive of the findings of the cross-sectional analysis reported above, confirming that improved road access raises real consumption expenditures and thereby reduces poverty.

4. Conclusions

Between 1997-98 and 2002-03, rural poverty incidence in Laos declined by 9.5 per cent of the rural population. This occurred even though some of the macroeconomic conditions in Laos mitigated, to some extent, against the interests of rural people. The analysis of the relationship between poverty incidence and road development provided in this paper suggests that about 13 per cent of this decline in rural poverty can be attributed to improved road access alone.

Between 1997-98 and 2002-03 the improvement in road access took the form of providing wet weather access to areas which already had dry season access. The analysis provided in this paper suggests that this strategy had a high pay-off in terms of reduced poverty incidence and additional investments in this form of road provision offer the opportunity for further poverty reduction. Nevertheless, there is now a high return to providing dry weather access to the most isolated households of Laos – those who have no road access at all. They constitute 31.6 per cent of all rural households in Laos and are being left behind by the development of the market economy. By providing them with dry season road access, rural poverty incidence could be reduced permanently from the present 33 per cent to 29.7 per cent. A further reduction to 26 per cent could be obtained by providing all rural households with all-weather road access.

The benefits of rural road provision, measured in terms of poverty reduction or any other dimension of economic welfare, must of course be compared with its costs. Nevertheless, the results of this study confirm that in a country like Laos, where roads are primitive, improving road access is an effective way of reducing rural poverty.

References

Binswanger, Hans, Shahidur Khandker and Mark Rosenzweig, 1993. 'How Infrastructure and Financial Institutions Affect Agricultural Output and Investment in India', Journal of Development Economics, 41 August, 337-66.

Datt, Guarav and Limin Wang, 2001. 'Poverty in Lao PDR: 1992/93 – 1997/98', World Bank, Washington DC, mimeo.

Gibson , John and Scott Rozelle, 2003. 'Poverty and Access to Roads in Papua New Guinea', Economic Development and Cultural Change 52 (1), October, 151-185.

Jacoby, Hanan G., 2000. 'Access to Markets and the Benefits of Rural Roads', Economic Journal, 110 July 717-37.

Jalan, Jyotsna and Martin Ravallion, 1998. 'Determinants of Transcient and Chronic Poverty: Evidence From Rural China' World Bank, Washington DC, mimeo.

Kakwani Nanak, Guarav Datt, Bounthavy Sisouphanthong, Phonesaly Souksavath and Limin Wang, 2002. 'Poverty in Lao PDR during the 1990s', Asian Development Bank, Manila, mimeo.

Richter, Kaspar, 2004, 'Some Poverty Statistics of Lao PDR', World Bank, Vientiane, March.

Lanjouw, Peter, 1999. 'Rural Nonagricultural Employment and Poverty in Ecuador', Economic Development and Cultural Change 48 (1), October, 91-122.

Srinivasan, T.N., 1986. 'The Costs and Benefits of Being a Small, Remote, Island, Landlocked or Ministate Ecvonomy' World Bank Research Observer 1 (2) July, 205-218.

van de Walle, Dominique, 1996. 'Infrastructure and Poverty in Vietnam', Living Standards Measurement Study Working Paper 121, World Bank Policy Research Department, Washington, DC.

van de Walle, Dominique, 2002. 'Choosing Rural Road Investments to Help Reduce Poverty'. World Development, April, 575-89.

van de Walle, Dominique and Kimberly Nead (eds), 1995. Public Spending and the Poor: Theory and Evidence, Baltimore: Johns Hopkins University Press.

Table 1 Poverty incidence and inequality in Laos, 1992 to 2002
(Units: per cent, except Gini coefficient)

	National Poverty	Rural Poverty	Urban Poverty	Gini Coefficient
1992-93	46.0	51.8	26.5	0.31
1997-98	39.1	42.5	22.1	0.35
2002-03	30.7	33.0	23.0	0.33

Source: Kaspar Richter, 'Some Poverty Statistics of Lao PDR', World Bank, Vientiane, March 2004.
Note: 2002-03 estimates are preliminary.

Note: National poverty is the percentage of the total population of the country whose real expenditures fall below a poverty line held constant over time in real terms; rural poverty is the percentage of the rural population whose real expenditures fall below a poverty line held constant over time in real terms, and so forth.

Table 2 Laos: Numbers of households by road access, LECS 2 and LECS 3 surveys

	Number of households		Per cent of households	
	LECS II 1997-98	LECS III 2002-03	LECS II 1997-98	LECS III 2002-03
No access any season	2,146	2,052	31.2	31.6
Dry season access only	1,934	1,050	28.1	16.2
Dry and wet season access	2,794	3,386	40.7	52.2
All households	6,874	6,488	100	100

Source: Author's calculations from LECS survey data.

Table 3 Regression results: LECS 2 (1997-98)

Dependent variable: Log of real per capita expenditure

Independent variables:	Coefficient	t-statistic	p-value
Constant	11.646	110.094	0.000
Age at last birthday (household head)	0.024	5.755	0.000
Age at last birthday squared (household head)	0.000	-5.015	0.000
Primary (1-5 years)	0.217	9.609	0.000
Lower secondary (6-8 years)	0.306	10.420	0.000
Upper secondary (9-11 years)	0.382	8.844	0.000
Higher (12+ years)	0.476	8.257	0.000
Working_Head1	0.219	5.239	0.000
Farming_Head1	-0.155	-4.718	0.000
NotLF_Head	-0.050	-1.490	0.136
Adult (18<= AgeAdult < 65)	0.041	4.612	0.000
Total number of members in the household	-0.192	-13.484	0.000
Total number of members in the household squared	0.007	7.319	0.000
Cows or buffalo, owned and free access, no. of animals	0.015	8.233	0.000
Market_n	0.096	2.194	0.028
Transport_n	0.050	2.051	0.040
PipedWater_n	0.107	5.151	0.000
CommunityHealth_n	0.056	2.712	0.007
ReachDry_n	0.003	0.112	0.911
ReachRain_n	0.123	4.835	0.000
prov1	0.786	10.145	0.000
prov2	-0.115	-2.239	0.025
prov3	-0.087	-1.621	0.105
prov4	-0.262	-4.866	0.000
prov5	0.027	0.528	0.597
prov6	0.181	3.423	0.001
prov7	-0.262	-5.063	0.000
prov8	0.563	10.497	0.000
prov9	0.136	2.596	0.009
prov10	0.460	8.211	0.000
prov11	0.001	0.019	0.985
prov12	-0.146	-2.700	0.007
prov13	0.070	1.296	0.195
prov14	0.141	2.704	0.007
prov15	-0.102	-1.885	0.060
prov16	0.184	3.271	0.001
prov17	0.039	0.761	0.446

Summary diagnostics:
No. of observations = 6,874. R^2 = 0.285; adj. R^2 = 0.281; s.e. of estimate = 0.723; F = 75.73; sig. = 0.000.

Source: Author's calculations from LECS 2 survey data.

Table 4 Regression results: LECS 3 (2002-03)

Dependent variable: Log of real per capita expenditure

Independent variables:	**Coefficient**	**t-statistic**	**p-value**
(Constant)	10.911	87.710	0.000
Age at last birthday	0.032	7.073	0.000
Age at last birthday squared (household head)	0.000	-6.138	0.000
Primary (1-5 years)	0.140	6.159	0.000
Lower secondary (6-8 years)	0.330	10.439	0.000
Upper secondary (9-11 years)	0.380	6.900	0.000
Higher (vocational training or university/institute)	0.541	9.679	0.000
Paid employment	0.257	4.623	0.000
Farm employment	0.055	1.021	0.307
Not in labour force	0.135	2.098	0.036
Number of adults in household (18 <= AgeAdult < 65)	0.060	6.070	0.000
Total number of members in household	-0.115	-23.015	0.000
Total number of cows and buffaloes	0.021	11.543	0.000
Electricity_n	0.194	8.408	0.000
DailyMarket_n	0.084	1.381	0.167
BusStop_n	0.029	0.988	0.323
CleanWater_n	0.061	2.883	0.004
HospitalInVillage	0.350	5.619	0.000
AccessDrySeason_n	0.102	3.403	0.001
AccessWetSeason_n	0.086	2.638	0.008
prov1	0.206	2.473	0.013
prov2	-0.354	-4.705	0.000
prov3	0.020	0.277	0.782
prov4	-0.076	-1.010	0.312
prov5	-0.060	-0.813	0.416
prov6	0.245	3.499	0.000
prov7	0.006	0.089	0.929
prov8	0.533	7.775	0.000
prov9	0.063	0.832	0.405
prov10	0.315	4.534	0.000
prov11	0.126	1.724	0.085
prov12	0.040	0.567	0.571
prov13	-0.028	-0.413	0.680
prov14	-0.269	-3.925	0.000
prov15	-0.380	-4.776	0.000
prov16	0.145	2.115	0.034
prov17	-0.380	-5.007	0.000

Summary diagnostics:
No. of observations = 6,488. R^2 = 0.318; adj. R^2 = 0.314; s.e. of estimate = 0.729; F = 85.55; sig. = 0.000.

Source: Author’s calculations from LECS 3 survey data.

Table 5 Estimated poverty incidence (%) under alternative road conditions – LECS 2 – 1997-98

Dry season road access	Wet season road access	Code	Estimated poverty incidence (%)
Observed levels in data	Observed levels in data	P1	42.50
All households with access	Observed levels in data	P2	42.44
All households with access	All households with access	P3	34.86

Source: Author's calculations.

Table 6 Estimated poverty incidence (%) under alternative road conditions – LECS 3 – 2002-03

Dry season road access	Wet season road access	Code	Estimated poverty incidence (%)
Observed levels in data	Observed levels in data	P1	33.00
All households with access	Observed levels in data	P2	29.68
All households with access	All households with access	P3	25.91

Source: Author's calculations.

Table 7 Change from LECS 2 to LECS 3: Regression results at district level

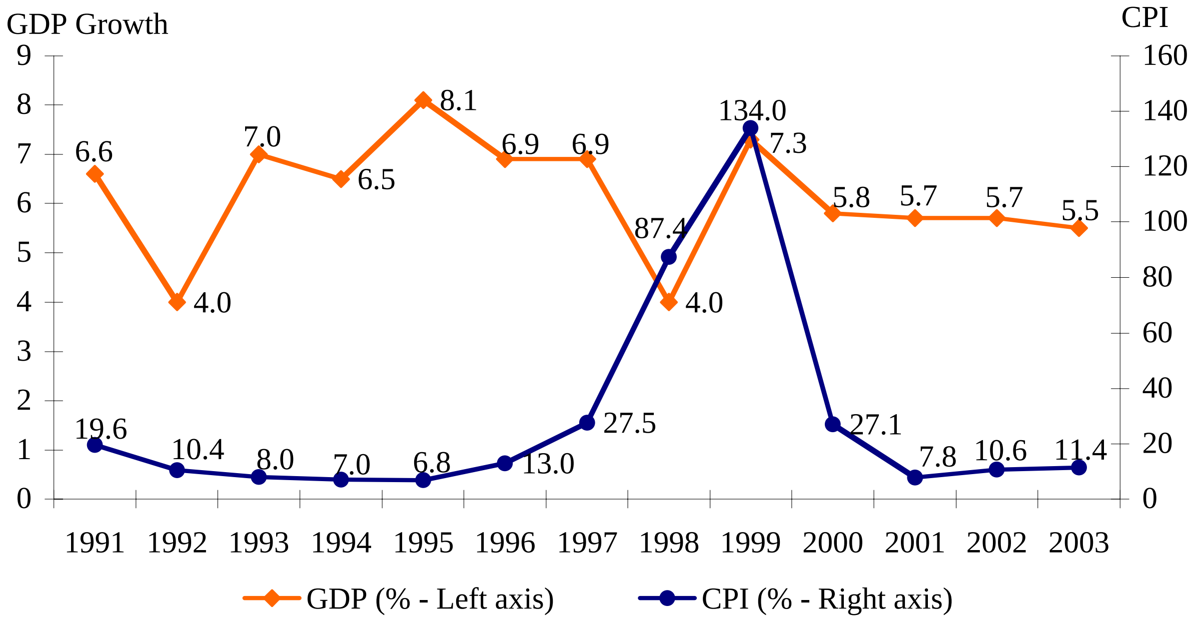
Dependent variable: Real per capita expenditure

	Coefficient	t-statistic	p-value
Constant	3.934	4.131	0.000
Real per capita expenditure LECS2	-0.334	-4.210	0.000
Age at last birthday (household head)	0.078	0.390	0.697
Age at last birthday squared (household head)	-0.001	-0.342	0.733
Primary (1-5 years)	0.441	1.535	0.128
Lower secondary (6-8 years)	0.537	1.006	0.317
Upper secondary (9-11 years)	-0.442	-0.478	0.634
Higher (12+ years)	2.536	2.847	0.005
Working_Head1	0.330	0.855	0.395
Farming_Head1	0.389	1.136	0.259
NotLF_Head	0.162	0.471	0.638
Adult (18<= AgeAdult < 65)	0.080	0.425	0.672
Total number of members in the household	-1.241	-2.225	0.028
Total number of members in the household squared	0.075	1.780	0.078
Cows or buffalo, owned and free access, no. of animals	-0.001	-0.030	0.976
Market_n	0.128	0.421	0.675
Transport_n	0.068	0.525	0.600
PipedWater_n	0.095	0.635	0.527
CommunityHealth_n	0.075	0.537	0.593
District has all weather road in 1997	0.021	0.199	0.842
District built road during 1997 and 2002	0.188	1.821	0.071

Summary diagnostics:
R^2 = 0.393; adj. R^2 = 0.155; s.e. of estimate = 0.1322; F = 6.944; sig. = 0.000.

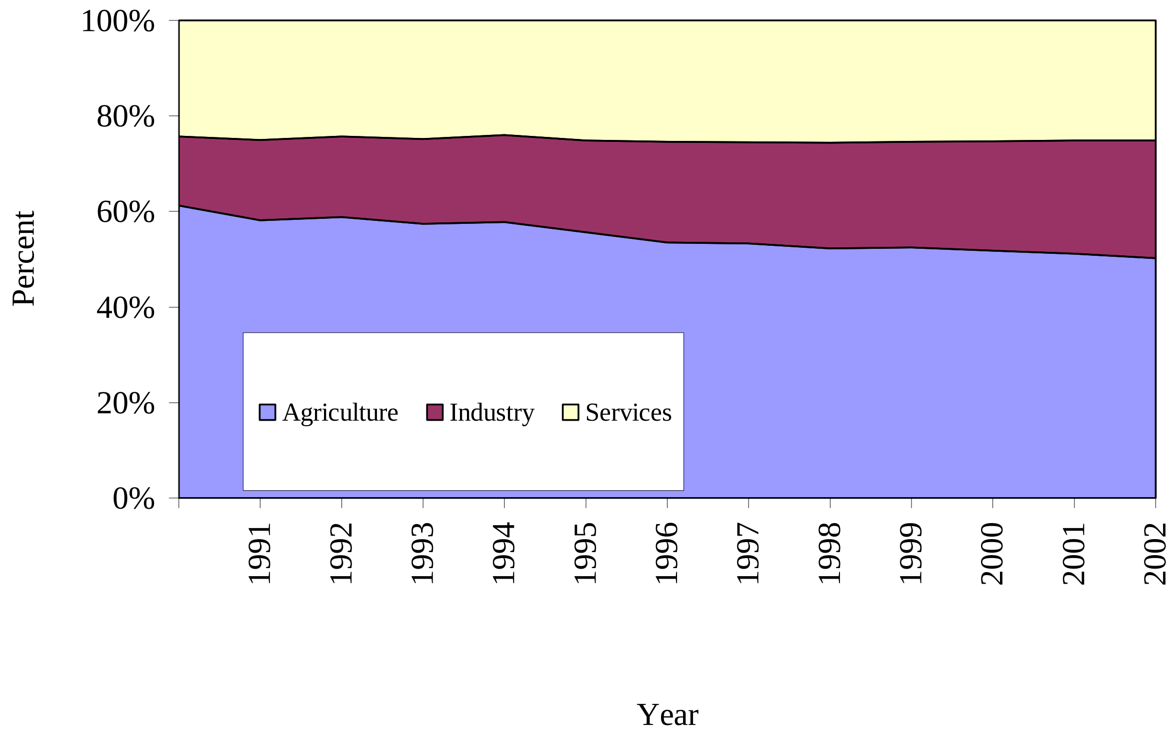
Source: Author's calculations.

Figure 1 Laos: Real GDP growth (%) and CPI inflation (%)



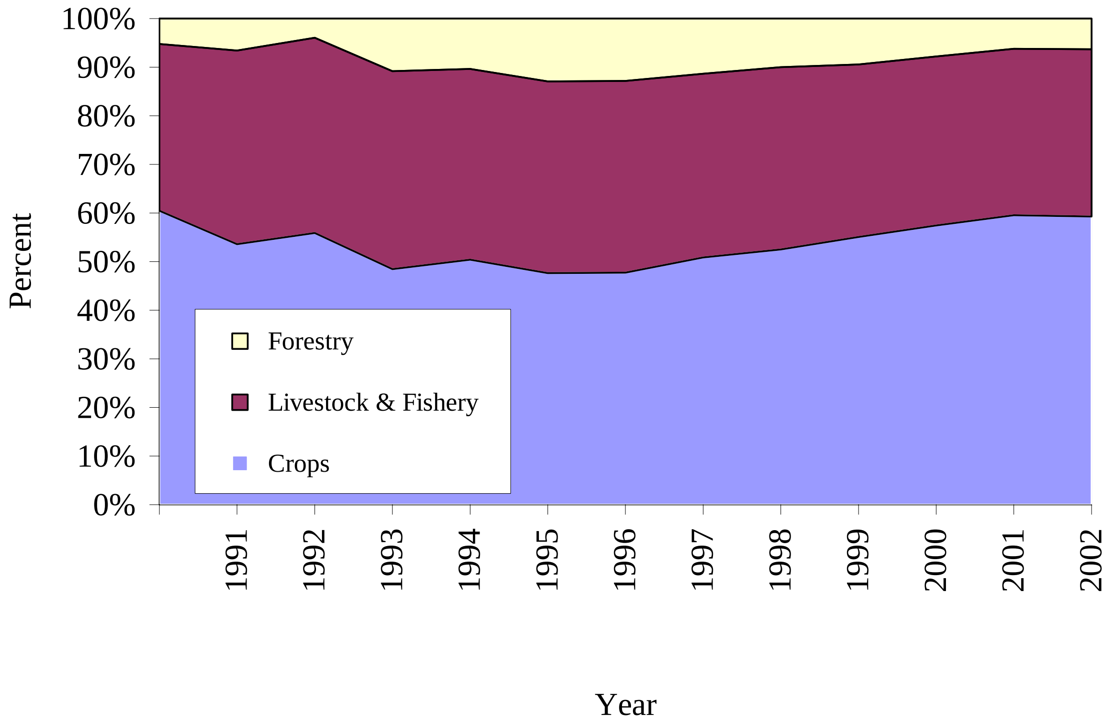
Source: Author's calculations using data from National Statistical Centre, Vientiane.
Note: GDP growth is deflated by the GDP deflator.

Figure 2 Laos: Share of GDP



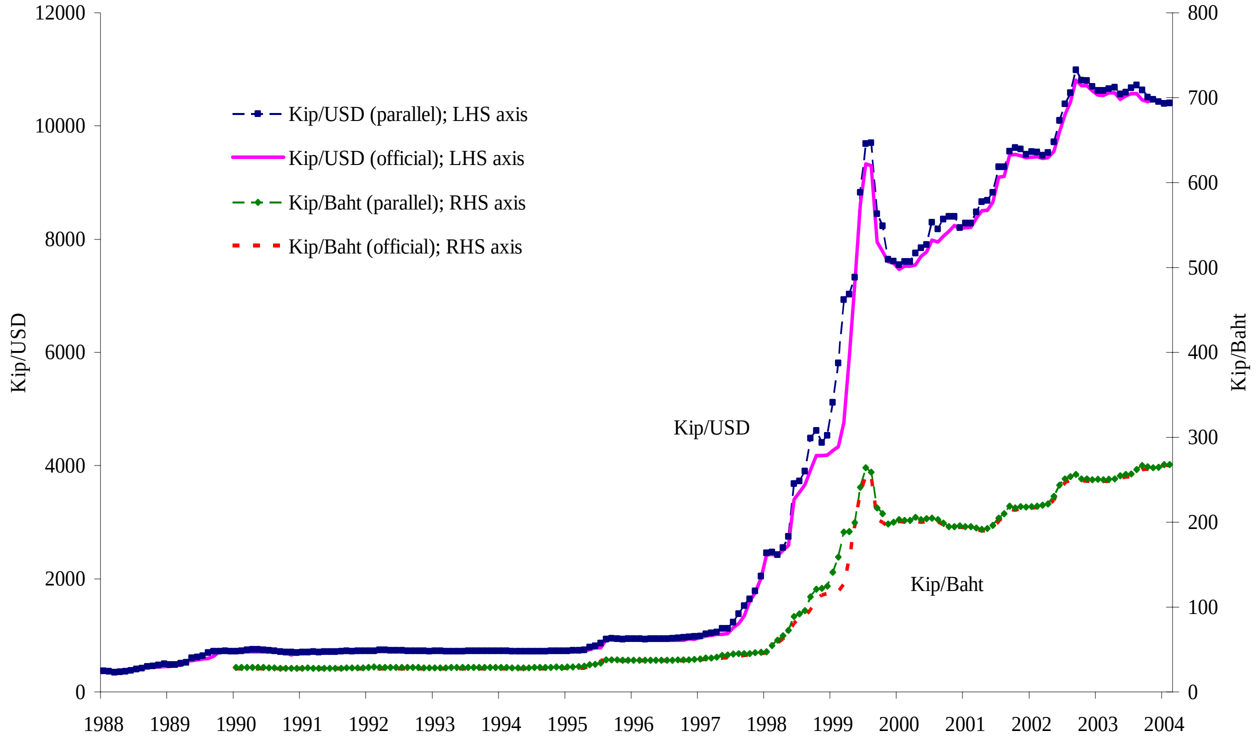
Source: Author's calculations using data from National Statistical Centre, Vientiane.

Figure 3 Laos: Share of agricultural components with agricultural GDP



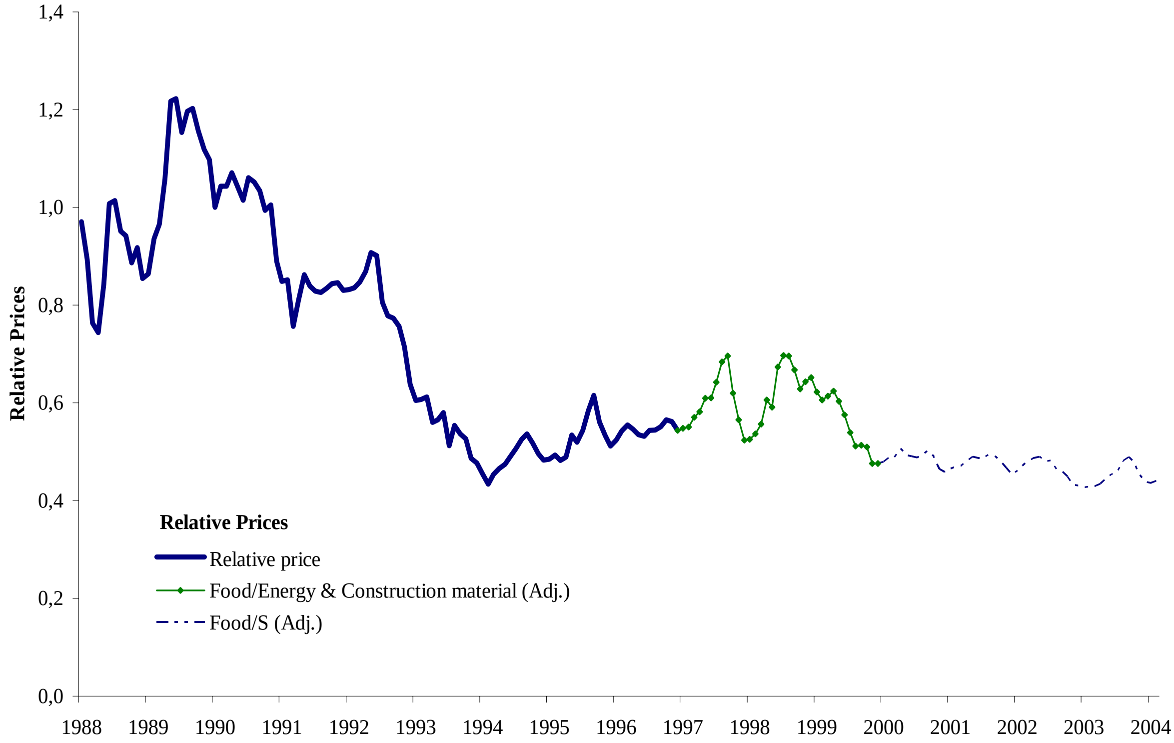
Source: Author's calculations using data from National Statistical Centre, Vientiane.

Figure 4 Laos: Exchange Rates, 1988 to 2004



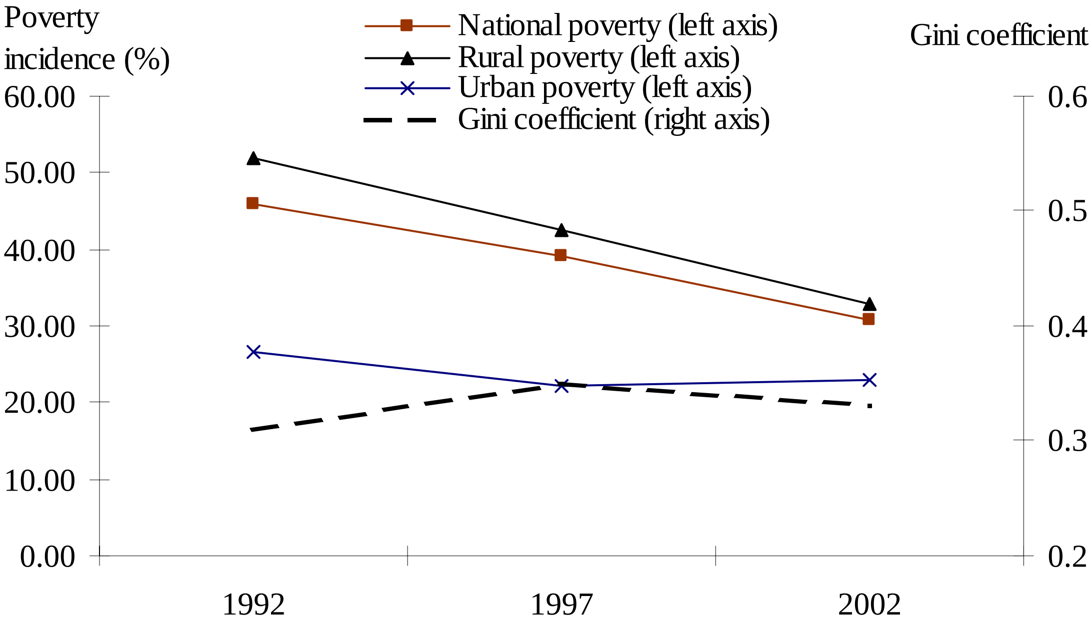
Source: Author's calculations using data from International Monetary Fund, *International Financial Statistics*, various issues.

Figure 5 Laos: Relative prices, food to non-food, 1988 to 2004



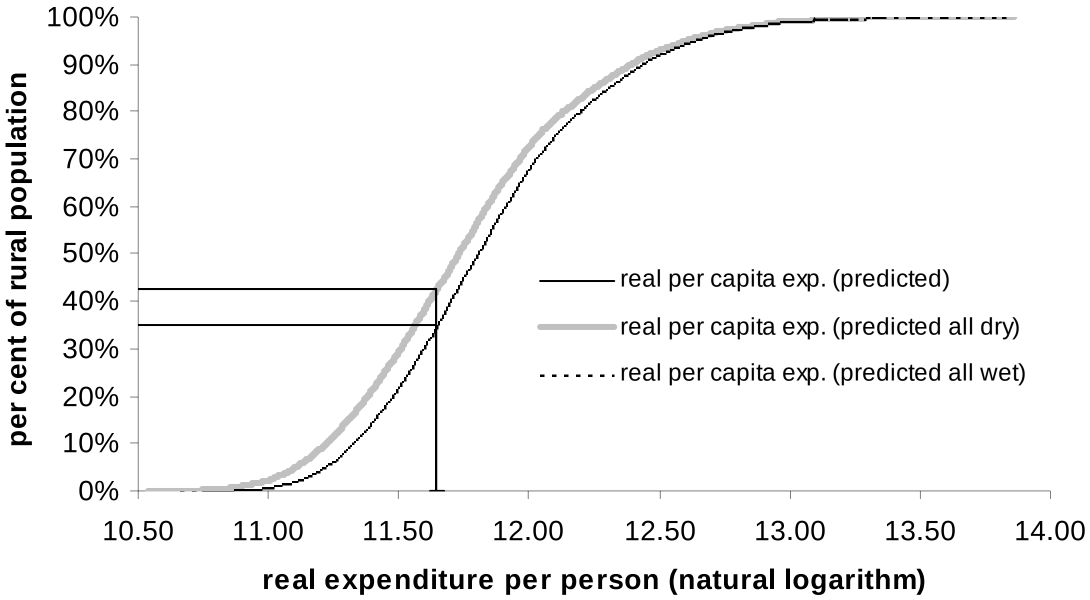
Source: Author's calculations using data from National Statistical Centre, Vientiane.

Figure 6 Laos: Poverty incidence and inequality, 1992 to 2002



Source: Data from Kaspar Richter, 'Some Poverty Statistics of Lao PDR', World Bank, Vientiane, March 2004.
Note: 2002-03 estimates are preliminary.

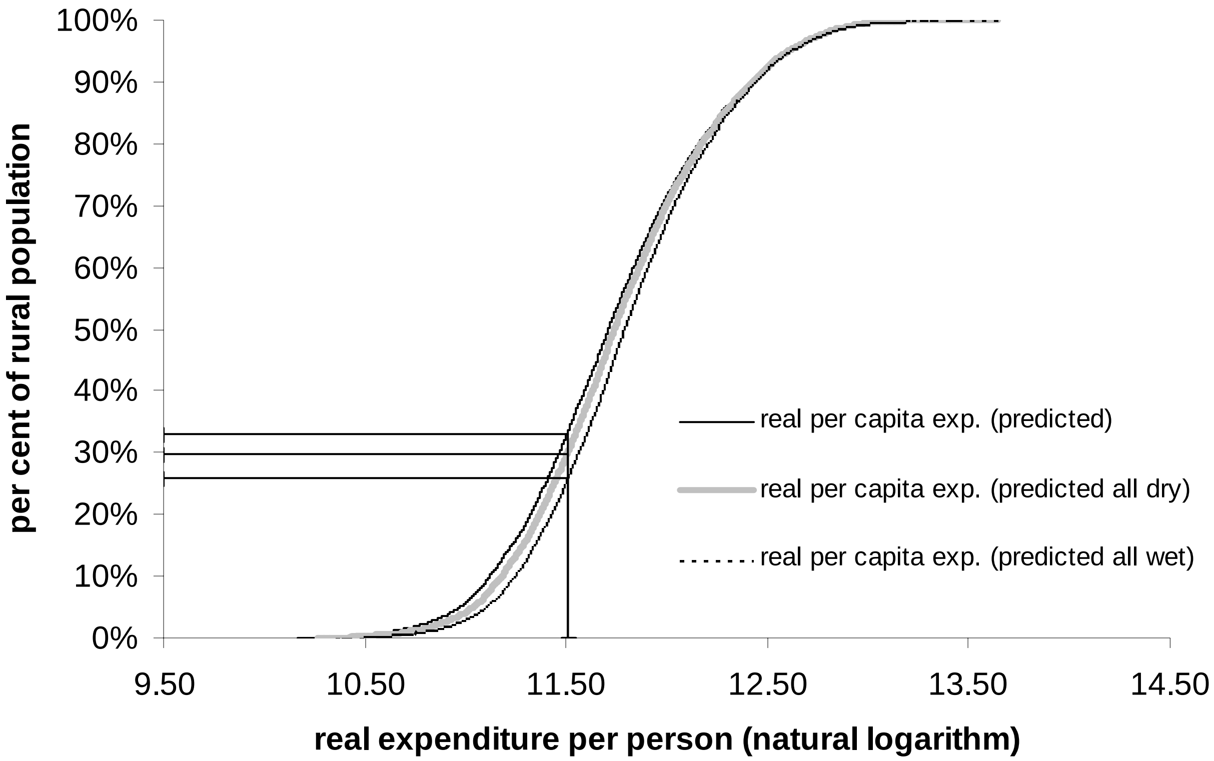
Figure 7 Predicted distribution of real expenditures per person under alternative road conditions: LECS 2 – 1997-98



Source: Author's calculations based on LECS 2 household survey data from National Statistical Center, Vientiane, and regression results shown in Table 3, above.

Note: Units on the horizontal axis are the natural logarithm of real household consumption expenditures per person expressed in December 1999 prices. "real per capita exp. (predicted)" refers to P1 in the text. "real per capita exp. (predicted all dry)" refers to P2 in the text. "real per capita exp. (predicted)" refers to P3 in the text.

Figure 8 Predicted distribution of real expenditures per person under alternative road conditions: LECS 3 – 2002-03



Source: Author's calculations based on LECS 3 household survey data from National Statistical Center, Vientiane, and regression results shown in Table 4, above.

Note: Units on the horizontal axis are the natural logarithm of real household consumption expenditures per person expressed in December 1999 prices. "real per capita exp. (predicted)" refers to P1 in the text. "real per capita exp. (predicted all dry)" refers to P2 in the text. "real per capita exp. (predicted)" refers to P3 in the text.

Appendix: LECS Variables

In addition to data on expenditures, the LECS data include the following relevant variables (section codes of LECS in parentheses):

Province
District
Village

Characteristics of household
Number of adults
Number of members
Household consumption expenditure per person
Household income per person

Household ownership of assets
Irrigated land (B)
Dry land (B)
Rice husking machine (B)
Number of cows or buffaloes

Characteristics of household head
Age
Male (B)
Years of schooling
Unemployed (B)
Paid employee (B)
Employer (B)
Self-employed (B)
Farmer (B)
Unpaid family worker (B)
Outside labor force (B)

Educational characteristics of children in primary age group
Whether enrolled in school during past 12 months – C 5 (B)
If not, why not – C 6
Household expenditure on that child's education – C 11
Distance from home to school attended – C 14
Time taken to travel to school – C 15

Health of household members
Whether treatment sought during last 4 weeks – D 7 (B)
Type of facility – D 9
Transport cost incurred in accessing the facility during the last 4 weeks – D 13

Village characteristics
Electricity network (B)
Permanent market (B)
Scheduled passenger transport (B)
Distance to main road
Primary school (B)

Piped water or protected well (B)
Pharmacy (B)
Medical practitioner (B)
Trained nurse (B)
Community health worker (B)
Immunization program (B)
Urban (B)
Rural with access to road (B)
Rural without access to road (B)

Although “Distance to main road” is one of the variables listed, this variable is known to be of unreliable quality, a point that is emphasized by data enumerators themselves. The variables “Rural with access to road” and “Rural without access to road” are considered more reliable and these are the data used in the present study. These variables reflect yes/no answers from households and are treated as dummy (0,1) variables in the regression analysis.