Petroleum Import Prices and Poverty: A General Equilibrium Analysis for Lao PDR

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Outline

Executive Summary

Increases in international petroleum prices during 2006 have raised concerns about their implications for the achievement of the Millennium Development Goals (MDGs) and in particular, their implications for poverty reduction. Studying this issue is complicated because increases in petroleum prices affect the poor through several different channels. These include effects on the costs of living of the poor, via increases in the consumer prices of transport and other goods and services which use petroleum as inputs, directly and indirectly. The effects also include impacts on the incomes of the poor, principally via the effects of petroleum prices on the costs of productive sectors of the economy and subsequent effects on employment and wages in these sectors. Finally, there are effects which operate through the government budget. If petroleum products are subsidized, the budgetary costs of these subsidies may be affected by increases in petroleum prices. If petroleum products are taxed, the magnitude of these tax revenues will be affected when petroleum prices change. When the government budget is affected, there may be second-round effects on the poor because the capacity of the government to finance expenditures that may benefit the poor is affected and because changes in tax rates may also be required.

This study examines the effect that petroleum price increases have on the poor of Lao PDR, using a general equilibrium modeling approach. This analytical approach is made necessary by the complexity of the linkages between petroleum prices and poverty. The model developed for this purpose is called *LaoGEM*. Most, but not all, of the poor people of Lao PDR are located in rural areas. These rural people differ widely in terms of the quality of their road access and thus the transport costs for goods and services that they face. A feature of the general equilibrium analysis contained in this study is that the model differentiates between four categories of Lao households: urban households and three categories of rural households, the latter divided according to the quality of road access available to them: (i) no vehicular access; (ii) dry season only access; and (iii) all weather access. Household survey data available for Lao PDR make this division of households possible. It seems likely that petroleum price increases will affect the transport costs faced by these four categories of households in different ways and the analysis aims to show these differences.

Our analysis indicates that increases in petroleum import prices raise poverty incidence. Reductions do the reverse. The source of the effect is that higher petroleum import price raise transport costs and this effect harms rural people, among whom poverty incidence is highest, more severely than urban people. It is estimated that an increase in petroleum import prices from US$70 to US$100 would increase poverty incidence in Lao PDR by 4.2 per cent of the population, or 230,000 people. Poverty incidence in rural areas would increase by 5.3 per cent of the rural population and poverty incidence in urban areas would increase by 1.3 per cent of the urban population. Larger increases in petroleum prices than this would produce larger increases in poverty incidence.

1. Introduction

Lao PDR imports virtually all of the petroleum products it uses. It is obvious that if the international prices of these imports rise, there will be negative economic consequences within Lao PDR. But how large will these effects be and how will different groups of people within Lao PDR be affected? And how will increases in petroleum prices affect the achievement of the Millennium Development Goals? All petroleum importing countries have been negatively affected by recent increases in petroleum prices, but Lao PDR has some particular features which make these issues especially important and which complicate the analysis. First, it is a poor and mountainous country with a high rate of poverty incidence, especially in rural areas. Second, roads in many rural areas remain badly maintained or even non-existent. The implication is that transport costs within Lao PDR are unusually high. Moreover, because the poorest people often reside far from urban centers, these people are the most disadvantaged by the high transport costs resulting from inadequate roads. Increases in petroleum prices imply increases in transport costs.

Over the past two decades Lao PDR has made considerable progress in reforming the legal and administrative obstacles to market-based development previously existed. But for people facing very high transport costs, arising from bad roads, these reforms may be of limited value. For them, markets cannot be accessed except at high cost. Considerable effort is being invested in the improvement of rural roads in Lao PDR. The expected benefits include reductions in the incidence of poverty within rural areas. Petroleum price increases are therefore a matter of concern because they threaten to undermine the contribution that improved roads can make to the achievement of sustained reductions in poverty incidence, along with other Millennium Development Goals to which both Lao PDR and the international community are committed.

The quantitative relationships between petroleum prices, transport and other costs, and poverty reduction are not well understood. The present study focuses on these

relationships. The analysis uses a general equilibrium modeling approach in which the relationship between transport costs and poverty incidence is a central focus.

Section 2 describes the information available on the relationship between road improvement and transport cost. We then use this information to analyze the effects of road improvement using a general equilibrium model of the economy of Lao PDR, especially constructed for this purpose. This model is described in Section 3. Three features of the model are important. First, it distinguishes four categories of households, one urban and three rural categories, the latter differentiated by the quality of roads which service the villages in which these rural households are located. Second, each of these four categories of households contains 100 household sub-categories, arranged by real expenditures per household member. Third, the three rural household categories differ according to the transport costs that they face, commensurate with the quality of roads servicing them. The results of the analysis are presented in Section 4. Finally, Section 5 draws out the major conclusions that follow from the study.

2. Road Access, Transport Costs and Poverty Incidence

Petroleum prices affect the poor via their effects on transport costs. An analysis of the way petroleum prices affect poverty in Lao PDR should take account of the wide differences in transport costs faced by different categories of households within that country. Motorized vehicles are the dominant mode of transport in Lao PDR, carrying 91 per cent of total freight ton-kilometers and 95 per cent of total passenger-kilometers. The road system in Lao PDR, which totals just above 31,000 kilometers, is mostly in poor condition. At present, less than 20 percent of this total network is paved. The national roads, linking major towns and provincial capitals and providing connections to neighboring countries, total about 3700 kilometers, or about 23 percent of the road network. About half of this national road network is now paved, with the remainder having gravel or earth surfaces. In consequence, only about half of the best

segment of the overall road network – the national roads – can be relied upon to provide all weather connectivity.

Table 1 summarises information about the importance road access by comparing the results from the two most recent rounds of the Lao Expenditure and Consumption Survey (LECS) – for 1997-98 (LECS 2) and 2002-03 (LECS 3). In 2002-03 rural areas represented 77 per cent of the population of Lao PDR but a much higher proportion of its poor people because poverty incidence is much higher in rural than in urban areas. Within rural areas, 42 per cent of the population (33 per cent of the national population) lacked all season road access. Among these rural villages, poverty incidence was higher than the rural average and very much higher than the national average.

Three types of road access within rural areas can be distinguished within these data. These are: (i) no vehicular access; (ii) dry season only access; and (iii) all weather access. No vehicular access means that the pathways through which the village is normally reached cannot accommodate conventional motorized vehicles. This does not necessarily mean that the village is completely isolated. It may still be able to accommodate low-cost vehicles and carrying devices appropriate to local-level transport tasks. Examples include the carrying of loads by people, such as the shoulder pole and the backpack frame; human-powered vehicles such as wheelbarrows, handcarts and bicycles; animal-powered devices such as donkeys with panniers, and animal drawn carts and sledges; and some two-wheeled motorized vehicles such as motorcycles.

Dry season only access roads consist predominantly of unpaved roads that are accessible to conventional motorized vehicles during the dry season but not necessarily during the wet season. For such roads during the wet season, vehicles will be forced to find alternative routes or use alternative paths along the existing road that would facilitate passage but would result in higher transport costs due to a change in travel distance, road roughness, and speeds. Depending on its condition, this covers most, but not all, earth and gravel road surfaces.

Finally, all weather access roads can be used by conventional motorized vehicles during the dry and wet seasons. In other words, unlike dry season access roads, these roads would not be subject to frequent closure as a result of flooding during the wet season. This covers almost all paved roads.

The Lao Expenditure and Consumption Survey (LECS), which has been conducted for 1992-93 (LECS 1), 1997-98 (LECS 2) and 2002-03 (LECS 3), provides a classification of roads into these categories and records the category of road servicing each village. **Table 2** summarises information about the importance of these three categories of rural road access. One point that comes across clearly from this table is that over the five year interval between these two surveys there was a decline in the proportion of rural households living in villages with "dry season access only" road access but no change in the proportion having "no access any season". In 2002-03 almost one third of all rural households lived in villages without roads that support motorized vehicle access.

The socio-economic status of rural households living in these three types of villages is quite different. **Tables 3 and 4** take this comparison further, using data from the LECS 3 survey for 2002-03. Villages without road access have lower rates of school attendance for both male and female children, lower per capita expenditures on education, higher rates of sickness and lower likelihood of seeking treatment when they are ill. The implications seem clear. Higher transport costs mean higher rates of poverty incidence, lower rates of school attendance and lower health status. Anything which increases transport costs is bad news for the poor and threatens Lao PDR's chances of achieving its Millennium Development Goals.

3. A General Equilibrium Model of the Economy of Lao PDR

This section describes *LaoGEM* (Lao General Equilibrium Model), a 20 sector, 400 household general equilibrium model of the Lao economy, constructed specifically for the analysis of the effect of road improvement on rural poverty incidence in Lao PDR. Unless otherwise stated, the database of the model refers to the year 2002. The model's main features are as follows.

3.1 Model structure

The theoretical structure of *LaoGEM* is relatively conventional. It belongs to the class of general equilibrium models which are linear in proportional changes, sometimes referred to as Johansen models. The highly influential *ORANI* general equilibrium model of the Australian economy (Dixon, *et al.* 1982) also used this approach. The detailed structure of *LaoGEM* is based on the *PARA* and *Wayang* general equilibrium models of the Thai and Indonesian economies, respectively, described in detail in Warr (2001) and Warr (2005), respectively.[1] However, this general structure is adapted to reflect the specific objectives of the present study and important features of the Lao economy.

The microeconomic behaviour assumed within *LaoGEM* is competitive profit maximisation on the part of all firms and competitive utility maximisation on the part of consumers. Each industry has a constant returns to scale technology and there is at least one industry-specific factor present in each industry. In the simulations reported in this paper, the markets for final outputs, intermediate goods and factors of production are all assumed to clear at prices that are determined endogenously within the model. However, an exception is the "Immediate impact" simulations, in which levels of labour and capital employment are held constant. The nominal exchange rate between the Lao *kip* and the US dollar is endogenous and the nominal prices of services are fixed exogenously. Monetary and exchange rate policies are assumed to adjust so that nominal prices of services do not change. The model is homogeneous (degree one for prices and degree zero for quantities) with respect to the exchange rate. This means that because domestic prices adjust flexibly to clear markets, a 1 percent increase in the kip/dollar exchange rate will result in a 1 percent increase in all nominal domestic prices, leaving all real variables unchanged.

Industries

The model contains 20 industries, listed in **Appendix Table 1**. They include three agricultural industries: crops; livestock and poultry; forestry and logging. Non-agricultural industries include: mining and quarrying; seven manufacturing industries;

[1] The structure also draws on elements of a revised version of the *ORANI* model of the Australian economy called *ORANI-G* (Horridge 2004).

and nine services and utilities industries, one of which is transport. The transport industry will be important for the present study. Each industry produces a single output, and the set of commodities therefore coincides with the set of industries. Exports are not identical with domestically sold commodities. In each industry the two are produced by a transformation process with a constant elasticity of transformation.

The core of the production side of the model is a 20 sector input-output table for Lao PDR, estimated especially for this study. No input-output table is currently available for Lao PDR and the table constructed for the present study is thus the first publicly available input-output table for the country. It is based on information from two sources. First, there is a 20 sector input-output table for Savannaket Province of Lao PDR, relating to the year 2003, recently constructed in a detailed study by researchers at the Asian Development Bank. This table is then adjusted using data from the Lao National Accounts for 2002. The method of adjustment may be understood as follows. The value added totals for the various sectors of the Savannaket table are compared with those for Lao PDR, derived from the National Accounts. The Savannaket table is then amended using a method called RAS (row and column sum) to force the value added totals to match those for Lao PDR.

The resulting table has a structure which reflects the industry structure of Lao PDR, as reflected in its National Accounts, but within each industry the input-output technology reflects that of Savannaket Province. The method thus assumes that the input-output technology for each industry in Lao PDR is similar to that of Savannaket, even though the relative importance of these various industries in Lao PDR is quite different from that of Savannaket. Fortuitously, Savannaket Province seems a suitable basis for this kind of exercise in that it is roughly intermediate within the provinces of Lao PDR in terms of its level of technology, neither the most nor the least advanced. The resulting table seems to make sense. When a properly constructed input-output table for Lao PDR becomes available, it should presumably replace the table constructed as above. In the meantime, this table is considered the best available. The cost structures of these 20 industries, derived from this IO Table, are summarized in **Appendix Table 2** and their sales structures are summarized in **Appendix Table 3**.

Commodities

Although the sets of producer goods and consumer goods have the same names, the commodities themselves are not identical. Each of the 20 consumed goods consists of a composite of the domestically produced and imported version of the same commodity, where the two are imperfect substitutes. The proportions in which they are combined reflect consumer choices and depend on both (a) the relative prices of these imported and domestically produced versions of the good and (b) the (Armington) elasticity of substitution between them.

Factors of production

The mobility of factors of production is a critical feature of any general equilibrium system, where the term 'mobility' here means mobility across economic activities (industries), rather than geographical mobility. The greater the factor mobility that is built into the model, the greater is the flexibility of the economy, as reflected in its simulated capacity to respond to changes in the economic environment. It is clearly essential that assumptions about the mobility of factors of production be consistent with the length of run that the model is intended to capture.

Except in Simuation Set A, labour is assumed to be fully mobile across all sectors. These assumptions imply that wages must be equal in all sectors, and move together. There are three kinds of capital: capital that is immobile across industries but mobile within industries, referred to subsequently as fixed capital; capital that is mobile among agricultural industries but not mobile between agriculture and the non-agricultural industries, referred to as agricultural mobile capital; and capital that is mobile among the non-agricultural industries but not between these industries and the agricultural industries, referred to here as non-agricultural mobile capital.

In this treatment, fixed capital in agriculture is thought of as including some land, but also some light machinery and equipment of an industry-specific kind. Mobile capital in agriculture includes some land but also machinery such as light tractors and also draft animals that can be used in the production of a range of agricultural commodities. Neither agricultural land nor agricultural capital (machinery and draft

animals) are usable in the non-agricultural industries. Non-agricultural capital is thought of as including industrial machinery and buildings.

Technology

Every sector is assumed to have a constant elasticity of substitution (CES) production technology with diminishing returns to scale to variable factors alone. However, there is also a sector specific fixed factor (immobile capital or land) in every sector to assure that there are constant returns to scale in production to all factors. For convenience, we shall refer to the set of specific factors in the agricultural sectors as 'land', and to the set of those in the non-agricultural sectors as 'fixed capital', but for the reasons described above, this language is accurate only in an approximate way. The assumption of constant returns means that all factor demand functions are homogeneous of degree one in output. In each sector, there is a zero profit condition, which equates the price of output to the minimum unit cost of production. This condition can be thought of determining the price of the fixed factor in that sector.

Factor mobility and length of run

The mobility across sectors of labour, but only partial immobility of capital, means that the analysis refers to a short-run to intermediate-run period of adjustment – not very short-run, or else labour would not be fully mobile and capital might not be mobile at all – and not very long run, or else capital would be more fully mobile. The period of adjustment consistent with these assumptions is thus around 5 years. These assumptions characterize Simulation Sets B and C in **Table 6**. To capture more immediate impacts of the shocks to be discussed, a second closure is used, in which labour and capital are assumed to be completely immobile. This closure is used in Simulation Set A.

Households

The model contains four major household categories – one urban (subsequently HU) and three rural. The three rural categories are differentiated by the quality of road access shared by the members of the village concerned. The three categories of road access are summarized in **Table 5**.

Category HR1 refers to villages not serviced by a road at all, meaning that the only access to the village is by foot or by motorcycle, along pathways, but not reachable by vehicles. Category HR2 refers to dirt roads which are not usable during the wet season. Category HR3 refers to sealed roads or well-maintained dirt or gravel roads which can be used by vehicles at all times of the year.

The incomes of each of these three household types depend on their ownership of factors of production, the returns to those factors, and their non-factor incomes, mainly consisting of transfers from others. Since our focus is on income distribution, the sources of income of the various households are of particular interest. These differ among the four household categories. The data are extracted from the 2002-03 household income and expenditure survey, the Lao Expenditure and Consumption Survey, commonly called LECS 3.[2] The SAM is based on data from this survey, the input-output table described above, the Lao National Accounts for 2002 and Lao trade data.

Within the *LAOGEM* model, each of the four household categories is sub-divided into a further 100 sub-categories (centile groups) each of the same population size, arranged by real consumption expenditures per capita, giving a total of 400 sub-categories.[3] The consumer demand equations for the various household types are based on a Cobb-Douglas demand system, using data on expenditure shares extracted from the LECS 3 survey. Within each of the 4 major categories, the 100 sub-categories thus differ according to both (i) their budget shares in consumption and (ii) their sources of factor and non-factor incomes.

Elasticity estimates

The elasticity estimates used in *LaoGEM* for the factor demand systems were taken from empirical estimates derived econometrically for a structurally similar model of the Thai economy, known as *PARA*. These parameters were amended to match the

[2] As noted above, the "3" in LECS 3 signifies that it is the third (and currently the most recent) such survey to be conducted. The previous two (LECS 1 and 2) were for 1992-93 and 1997-98, respectively.
[3] The population sizes of the 4 major categories are not the same, but *within* each of these 4 categories the population sizes of the 100 sub-categories are the same.

differences between the data bases for *LaoGEM* and *PARA* so as to ensure the homogeneity properties required by economic theory. All export demand elasticities were set equal to 20. The elasticities of supply of imports to Lao PDR were assumed to be infinite and import prices were thus set exogenously. All production functions are assumed be CES in primary factors with elasticities of substitution of 0.5 except for the paddy production industry where this elasticity is set at 0.25, reflecting the empirical observation of low elasticities of supply response in this industry. The Armington elasticities of substitution in demand between imports and domestically produced goods were set equal to 2 for all commodities.

Treatment of transport costs

Information on transport costs in the three categories of roads is used to allocate the output of the "transport" industry in the input-output table to transport margins between consumer and producer prices in each of the four household categories. The relative magnitudes of total transport costs for each category of rural household are estimated as total tonnage of goods transported multiplied by distance to nearest market multiplied by vehicle operating cost per kilometer on this type of road. Transport costs are assumed to be incurred primarily between the local market and the village concerned. Transport margins differ across the three categories of rural households but within each of these categories they are the same for all households. Within each household category, the transport margins are the same for all commodities as proportions of consumer prices.

There are two other categories of margins between consumer and producer prices defined within the model – trade and tax margins. As **Appendix Table 3** shows, trade margins are even larger in total magnitude than transport margins. It is assumed in this study that trade margins (meaning costs of warehousing, retailing and advertising) do not depend on the type of road servicing a particular village. Trade and tax margins are therefore assumed to be the same for all households and as proportions of consumer prices trade margins are the same for all commodities, while tax margins differ according to the tax rates concerned.

4. Simulating the Effects of Changes in Petroleum Prices

4.1 The shocks

The *shocks* are summarized in **Table 7.** The shocks are interpreted as changes in the import price of petroleum, measured in US$ per barrel. The base price is taken to be US$70 per barrel. Shocks 1 and 2 are hypothetical reductions of petroleum prices to US$50 and US$60 per barrel, respectively. Shocks 3, 4 and 5 are hypothetical increases to US$100, US$120 and US$150 per barrel, respectively. The magnitudes of the shocks are selected for consistency with other parts of the REP-PoR project.

4.2 Model closure

Three sets of closure are used. Simulation Set A aims to capture the immediate impact of petroleum price changes, before any supply side response can take place. The impact of the petroleum price changes therefore does not include the response of producers to changes in relative price. The effect on households is therefore primarily through consumer prices they face rather than through their incomes. In Simulation Set A the current account is determined exogenously. The length of adjustment implicit in these assumptions should be considered to be well under one year.

Simulation Set B allows supply side adjustment to the effects of petroleum price changes. Employment of labour and mobile capital can change, subject to the limitation that total employment cannot exceed the available supply. The length of adjustment consistent with this corresponds to about five years. The treatment of the current account is the same as in Simulation Set A.

The reason for holding the current account exogenous in Simulation Sets A and B is as follows. Since the real consumption expenditure of each household is chosen as the basis for welfare measurement, and is the basis for the calculation of poverty incidence, it can be argued that the macroeconomic closure should be consistent with both this measure and with the single-period horizon of the model. This is done by ensuring that the full economic effects of the shocks to be introduced are channeled into current-period household consumption and do not 'leak' into other directions, with real-world intertemporal welfare implications not captured by the welfare

measure. To prevent leakages of this kind, the simulations are conducted with balanced trade (exogenous balance on current account). This ensures that the potential effects of the petroleum price change do not flow to foreigners, through a current account surplus, or that increases in domestic consumption are not achieved at the expense of borrowing from abroad, in the case of a current account deficit.

Although the above argument makes sense in modelling terms, it is of interest to see whether this exogenous fixing of the current account is affecting the results. To see the importance of this closure assumption, Simulation Set C treats the current account as endogenous. This is done, in modelling terms, by fixing household savings rates exogenously. The supply side of the model as in Simulation Set B, thus corresponding to a length of run of about five years.

4.3 Simulation results

Macroeconomic effects

The estimated macroeconomic effects of shocks to petroleum import prices are summarized in **Tables 8, 9 and 10.** Because Shock 5 (an increase in petroleum import prices to US$150 per barrel) makes sense only as a hypothetical intermediate to long term outcome, it is presented only for Simulation Sets B and C. As expected, petroleum price reductions produce positive economic effects within Lao PDR and increases produce negative effects. The immediate effects (Simulation Set A, **Table 8)** involve almost no effects on the supply side of the economy. GDP is barely affected. But since cost increases are passed along to the consumer, real consumption falls dramatically. In Simulation A3 (an increase in petroleum prices from US$70 to US$100), aggregate real consumption falls by 18 per cent.

The intermediate run effects (Simulation Set B, **Table 9)** the effects are moderated somewhat by adjustment on the supply side of the economy, but the effects are still large. In Simulation B3 (an increase in petroleum prices from US$70 to US$100), aggregate real consumption falls by 7.6 per cent.

Simulation Set C makes it possible to see the extent to which the fixing of the current account balance exogenously in Simulations A and B is affecting the results. In Simulation Set C the endogenous current account leads to smaller changes in real consumption than in Simulation Set B. For example, in Simulation C3 (an increase in petroleum prices from US$70 to US$100), real consumption falls by only 5.6 per cent. But this is achieved only through an increase is the current account deficit. Since this deficit must be financed by borrowing, it is a claim on future consumption not counted in current real consumption.

Composition of GDP

In Simulation Set A, no supply side adjustment occurs, by construction, so the discussion can focus on Simulation Sets B and C. A simple way of understanding the sectoral results in Simulation Set B is that an increase in petroleum prices induces a real appreciation – an increase in traded goods prices relative to non-traded goods prices. A reduction in petroleum prices does the opposite – a real appreciation. A real depreciation causes traded goods sectors of the economy (sectors 1 to 11) to expand and non-traded goods and services (sectors 12 to 20) to contract. These are exactly the effects that we observe. In Simulation Set C, the effects are similar to this but muted, because the endogenous current account balance is able to absorb some of the effect of the exogenous shock. Accordingly, not all of the effect of the shock is reflected in a change in the real exchange rate.

Poverty effects

The effects on poverty are summarized in Tables 13 to 15. Figures 1 to 3 illustrate the method of calculation of poverty incidence, using Shock 3 for this purpose. In all calculations of poverty incidence, the poverty line is held constant in real terms, using household-specific consumer price indices to adjust its nominal value. Poverty incidence (headcount measure) thus means the proportion of the population or sub-group concerned whose expenditures fall below their respective poverty line.

The results on changes in poverty incidence are qualitatively similar to the results on changes in real expenditures, with signs reversed. When real expenditures fall, poverty incidence rises. The effects on poverty incidence are largest in Simulation Set A, smallest in Simulation Set C. In Simulation B3 (an increase in petroleum import prices from US$70 to US$100) total poverty incidence increases from 31.4 per cent to 35.6 per cent, and increase of 4.2 per cent of the population. The increase is larger in the rural population (5.3 per cent) than in the urban population (1.3 per cent). An increase in poverty incidence of 4.2 per cent of the population of Lao PDR means that the number of people with real expenditures below the poverty line increases from 1.85 million to 2.03 million.

One point requires emphasis. Focusing on Shock 3 as an illustration, Tables 13 to 15 show that the reductions in real expenditures for the three categories of rural households exceed those for the urban households. Similarly, the percentage increases in poverty incidence among these rural groups exceed those for the urban population. Rural households, facing higher transport costs, are affected more severely by petroleum price increases than urban households.

Inequality effects

Changes in the Gini coefficient of inequality are small. The immediate effects of petroleum price increases (Simulation Set A) are small increases in inequality. This occurs because the poorest rural households are affected the most by transport cost increases. On the other hand, these groups have smaller proportions of their expenditures on goods purchases from distant markets than richer households and this offsets the inequality increasing effect. The intermediate run effects of petroleum price increases (Simulation Sets B and C) are very small reductions in inequality. As time for adjustment occurs, transport costs adjust to the higher price of petroleum and it is the richer households who are affected the most.

5. Conclusions: Higher Petroleum Prices Raise Poverty Incidence

Our analysis indicates that increases in petroleum import prices raise poverty incidence in Lao PDR and by a substantial amount. Reductions do the reverse. The source of the effect is that higher petroleum import price raise transport costs and this effect harms rural people disproportionately, especially those with poor road access and thus high transport costs. But these are already the poorest groups in the country. For example, it is estimated that an increase in petroleum import prices from US$70 to US$100 would increase poverty incidence in Lao PDR by 4.2 per cent of the population, or 230,000 people. An increase to US$150 would raise poverty incidence by 11.6 per cent of the population, or 640,000 people.

References

Codsi, G., K.R. Pearson, and P.J. Wilcoxen (1991). 'General Purpose Software for Intertemporal Modeling', *Impact Working Paper*, No. IP-51 University of Melbourne, Melbourne, Victoria, Australia, May.

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

Dixon, P.B., B.R. Parmenter, J. Sutton and D.P. Vincent (1982). *ORANI: A Multisectoral Model of the Australian Economy*, Amsterdam: North-Holland.

George Fane and Peter Warr (2002). 'How Economic Growth Reduces Poverty: A General Equilibrium Analysis for Indonesia', in A. Shorrocks and R. Van der Hoeven (eds.), *Perspectives on Growth and Poverty*, United Nations University Press, 217-34.

Horridge, M. (2004). 'ORANI-G: A Generic Single-Country Computable General Equilibrium Model', Centre of Policy Studies, Monash University, Melbourne, available at: http://www.monash.edu.au/policy/oranig.htm (accessed 6 October, 2006).

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

Limao, N., Venables, A. J. (2001) Infrastructure, Geographical Disadvantage and Transport Costs. *World Bank Economic Review* 15: 451-479.

Minten, Bart, and Steven Kyle (1999), "The Effect of Distance and Road Quality on Food Collection, Marketing Margin, and Traders' Wages: Evidence from the Former Zaire", *Journal of Development Economics* Vol. 60.

Richter, Kaspar, Roy van der Weide and Phonesaly Sopuksavath (2005). Lao PDR Poverty Trends 1992/3 – 2002/3, Draft Report, Committee for Planning and Investment, National Statistical Center and World Bank, Vientiane, March.

Starkey, Paul (2001) "Promoting the use of intermediate means of transport – vehicle choice, potential barriers, and criteria for success", Module 4- Rural Transport Services and Intermediate Means of Transport, London: DFID.

Warr, Peter (2001). 'Welfare Effects of an Export Tax: Thailand's Rice Premium', *American Journal of Agricultural Economics*, vol. 83 (November), 903-920.

Warr, Peter (2005). 'Food Policy and Poverty in Indonesia: A General Equilibrium Analysis', *Australian Journal of Agricultural and Resource Economics*, vol. 49 (December), 429-451.

Table 1 Lao PDR: Socio-economic change and road access, 1997-98 to 2002-03

		1997-98	2002-03
Population (million)	Lao PDR	5.087	5.519
Population shares (%)	- Urban	16.7	23.0
	- Rural	83.3	77.0
	-With all season road	36.0	43.9
	-Without all season road	47.3	33.1
Poverty incidence (%)	Lao PDR	39.1	33.5
	- Urban	22.1	19.7
	- Rural	42.5	37.6
	-With all season road	31.7	31.3
	-Without all season road	50.8	46.2

Source: Richter, van der Weide and Souksavath (2005), using data from LECS surveys, National Statistical Centre, Vientiane.

Table 2 Lao PDR: Numbers of rural households by road access

Road access		Number of households		Per cent of households	
		LECS 2 1997-98	LECS 3 2002-03	LECS 2 1997-98	LECS 3 2002-03
No access any season	HR1	2,146	2,052	31.2	31.6
Dry season access only	HR2	1,934	1,050	28.1	16.2
All season access	HR3	2,794	3,386	40.7	52.2
All rural households		6,874	6,488	100	100

Source: Author's calculations from LECS 2 and LECS 3 survey data.

Table 3 Lao PDR: Educational participation and road access, 2002-03

	All Season Access	Dry Season Access Only	No Road Access	All
School Attendance	80.67	70.48	51.90	69.41
Females (%)	80.00	67.82	47.54	67.06
Males (%)	81.37	72.98	56.27	71.72
Average time traveling to school	8.14	9.02	6.24	7.79
Average expend. on education	111,963	86,973	65,152	96,209

Note: Expenditure on education is measured in kip per student per month..

Source: Author's calculations from LECS 3 survey data, National Statistical Centre, Vientiane

Table 4 Lao PDR: Health status and road access, 2002-03

	All Season	Dry Season Access Only	No Road	All
Proportion of persons who became ill 4 weeks (%)	13.31	13.37	15.63	14.07
Of those ill, those who did not seek treatment (%)	80.69	83.16	89.80	84.35
No treatment because too difficult to get there (%)	11.83	24.83	24.10	18.55
Average days missed due to poor health (days per household, last 4 weeks)	0.58	0.58	0.76	0.64
Average expenditure on transport to hospital (kip per household per year)	102,958	72,460	50,564	85,494

Source: Author's calculations from LECS 3 survey data, National Statistical Centre, Vientiane.

Table 5 Naming of household categories

Description	Classification
Urban	HU
Rural, no road access	HR1
Rural, dry season access	HR2
Rural, all season access	HR3

Table 6 Summary of model closures

Simulation set	Length of adjustment period	Current account
A	**Immediate impact (a few months)**	**Endogenous**
B	**Intermediate run (about 5 years)**	**Endogenous**
C	**Intermediate run (about 5 years)**	**Exogenous**

Table 7 Summary of shocks

Import price of petroleum	**Shock 1**	**Shock 2**	**Shock 3**	**Shock 4**	**Shock 5**
Base price ($US per barrel)	70	70	70	70	70
Hypothetical price ($US per barrel)	50	60	100	120	150
Shock to petroleum import price (%)	-28.6	-14.3	42.9	71.4	114.3

Table 8 Macroeconomic results – Simulation Set A
(Immediate impact; current account exogenous)

Simulation		**A1**	**A2**	**A3**	**A4**
Shock to petroleum import price (%)		-28.6	-14.3	42.9	71.4
Overall economy					
Gross Domestic Product					
Nominal (local currency)		11.9	2.4	3.3	18.2
Real		0.0	0.1	-0.9	-1.4
Consumer Price Index		7.3	0.3	13.6	42.5
GDP Deflator		11.9	2.3	4.2	19.9
Wage (nominal)		0.0	0.0	0.0	0.0
Wage (real)		-7.7	-0.3	-12.0	-29.9
External sector (foreign currency)					
Export Revenue		-36.1	-15.5	194.6	538.4
Import Bill		-20.7	-9.8	133.2	371.5
Change in CA/GDP (%)		0.0	0.0	0.0	0.0
Government Budget (local currency)					
Revenue	Total revenue	-8.2	-8.2	112.7	314.7
	Tariff revenue	-23.0	-11.0	141.2	393.6
Expenditure	Nominal	-1.9	-2.0	27.1	72.3
Household sector					
Consumption	Nominal	15.8	3.8	-6.8	-6.2
	Real (CPI deflator)	8.1	3.5	-18.0	-34.3

Source: Author's calculations.

Table 9 Macroeconomic Results: Simulation Set B –
(Intermediate run; current account exogenous)

		B1	B2	B3	B4	B5
Shock to petroleum import price (%)		-28.6	-14.3	42.9	71.4	114.3
Overall economy						
Gross Domestic Product						
Nominal (local currency)		-7.0	-3.3	7.0	9.1	8.8
Real		0.7	0.4	-1.1	-2.0	-3.1
Consumer Price Index		-10.2	-5.0	12.9	19.0	24.7
GDP Deflator		-7.6	-3.7	8.3	11.2	12.3
Wage (nominal)		-7.3	-3.4	7.1	8.9	8.2
Wage (real)		3.3	1.7	-5.1	-8.5	-13.2
External sector (foreign currency)						
Export Revenue		-13.4	-7.0	25.2	42.7	65.8
Import Bill		-11.3	-5.8	19.4	31.9	47.5
Change in CA/GDP (%)		0.0	0.0	0.0	0.0	0.0
Government Budget (local currency)						
Revenue	Total revenue	-16.4	-8.3	24.9	39.5	56.6
	Tariff revenue	-13.1	-6.7	22.0	36.3	54.0
Expenditure	Nominal	-10.9	-5.5	16.0	25.4	36.5
Household sector						
Consumption	Nominal	-5.7	-2.6	4.3	4.2	0.7
	Real (CPI deflator)	5.0	2.5	-7.6	-12.5	-19.2

Source: Author's calculations.

Table 10 Macroeconomic Results: Simulation Set C –
(Intermediate run; current account endogenous)

		C1	C2	C3	C4	C5
Shock to petroleum import price (%)		-28.6	-14.3	42.9	71.4	114.3
Overall economy						
Gross Domestic Product						
Nominal (local currency)		-7.5	-3.6	7.7	10.0	10.4
Real		0.7	0.4	-1.1	-1.8	-2.8
Consumer Price Index		-10.6	-5.2	13.0	19.1	24.8
GDP Deflator		-8.1	-3.9	8.9	12.1	13.6
Wage (nominal)		-7.8	-3.7	7.8	9.9	9.8
Wage (real)		3.1	1.6	-4.7	-7.7	-12.0
External sector (foreign currency)						
Export Revenue		-11.1	-5.5	15.2	23.6	34.4
Import Bill		-11.7	-5.9	16.9	26.8	39.4
Change in CA/GDP (%)		0.5	0.3	-1.0	-1.8	-3.1
Government Budget (local currency)						
Revenue	Total revenue	-16.4	-8.2	22.5	34.9	49.8
	Tariff revenue	-13.3	-6.7	19.3	30.5	45.0
Expenditure	Nominal	-11.1	-5.6	15.4	23.7	33.5
Household sector						
Consumption	Nominal	-6.9	-3.3	6.7	8.4	7.7
	Real (CPI deflator)	4.1	2.0	-5.6	-9.0	-13.7

Source: Author's calculations.

Table 11 Effects on Composition of GDP: Simulation Set B
(Intermediate run; current account exogenous)

	Sectoral Value Added / GDP (% of GDP)					
	BASE	**B1**	**B2**	**B3**	**B4**	**B5**
1 CROPS	30.52	28.52	29.50	33.79	36.11	39.57
2 LVSTK	17.67	16.65	17.18	18.80	19.30	19.74
3 FOREST	3.06	2.65	2.84	3.81	4.28	4.82
4 MINING	0.48	0.66	0.57	0.28	0.20	0.12
5 FOOD	15.22	15.72	15.51	13.86	12.72	11.04
6 TEXTILE	1.12	0.93	1.02	1.46	1.67	1.90
7 WOOD	0.59	0.45	0.52	0.84	0.98	1.04
8 PETROLEUM	0.01	0.01	0.01	0.01	0.01	0.01
9 MINERAL	0.61	0.63	0.62	0.57	0.55	0.51
10 METAL	0.29	0.24	0.26	0.34	0.36	0.36
11 OTHMAN	0.92	0.90	0.91	0.92	0.91	0.88
12 ELECWAT	2.73	3.45	3.07	1.91	1.53	1.14
13 CONSTR	2.21	2.28	2.24	2.08	1.99	1.87
14 TRANSP	5.26	5.76	5.50	4.55	4.12	3.57
15 POSTEL	0.79	0.86	0.82	0.67	0.60	0.52
16 TRADE	9.26	10.33	9.79	7.79	6.93	5.85
17 BANK	0.82	0.95	0.89	0.65	0.55	0.44
18 ESTATE	2.71	2.74	2.73	2.65	2.59	2.49
19 GOVT	2.89	2.87	2.88	2.89	2.88	2.86
20 OTHSERV	2.87	3.38	3.13	2.13	1.72	1.28
Total	100	100	100	100	100	100

Source: Author's calculations.

Table 12 Effects on Composition of GDP: Simulation Set C –
(Intermediate run; current account endogenous)

	Sectoral Value Added / GDP (% of GDP)					
	Base	**C1**	**C2**	**C3**	**C4**	**C5**
1 CROPS	30.52	28.62	29.57	33.31	35.09	37.63
2 LVSTK	17.67	16.66	17.18	18.83	19.38	19.95
3 FOREST	3.06	2.71	2.88	3.58	3.86	4.17
4 MINING	0.48	0.69	0.58	0.27	0.18	0.11
5 FOOD	15.22	15.62	15.45	14.27	13.52	12.40
6 TEXTILE	1.12	0.95	1.04	1.39	1.55	1.73
7 WOOD	0.59	0.48	0.53	0.75	0.81	0.82
8 PETROLEUM	0.01	0.01	0.01	0.01	0.01	0.01
9 MINERAL	0.61	0.63	0.62	0.58	0.56	0.53
10 METAL	0.29	0.25	0.27	0.32	0.33	0.31
11 OTHMAN	0.92	0.90	0.91	0.91	0.90	0.87
12 ELECWAT	2.73	3.49	3.09	1.92	1.57	1.23
13 CONSTR	2.21	2.27	2.24	2.10	2.03	1.94
14 TRANSP	5.26	5.70	5.47	4.67	4.33	3.91
15 POSTEL	0.79	0.86	0.82	0.69	0.63	0.56
16 TRADE	9.26	10.29	9.76	7.94	7.22	6.35
17 BANK	0.82	0.96	0.89	0.66	0.58	0.48
18 ESTATE	2.71	2.72	2.72	2.69	2.67	2.64
19 GOVT	2.89	2.87	2.88	2.89	2.88	2.87
20 OTHSERV	2.87	3.33	3.10	2.24	1.89	1.49
Total	100	100	100	100	100	100

Source: Author's calculations.

Table 13 Effects on Poverty Incidence – Simulation Set A

(per cent change, except level of poverty incidence)

Real consumption expenditures, deflated by household-specific CPI (% change)

			A1	A2	A3	A4
Rural households	HR1		-6.54	-2.29	-8.63	-32.94
	HR2		9.77	4.16	-23.77	-42.77
	HR3		8.61	3.68	-19.88	-37.12
Total rural population			5.37	2.44	-18.23	-37.18
Total urban population	HU		11.59	4.82	-17.69	-30.55
Total population			8.11	3.50	-17.99	-34.30

Level of Poverty Incidence (% population concerned)

		Base				
Rural households	HR1	45.57	50.34	46.52	56.10	70.84
	HR2	36.05	28.99	33.65	55.98	65.76
	HR3	28.64	17.91	25.59	41.86	58.78
Total rural population		34.17	27.93	32.23	47.96	63.03
Total urban population	HU	23.64	18.05	20.82	36.60	48.25
Total population		31.40	25.34	29.23	44.98	59.14

Poverty Incidence (change)

Rural households	HR1	4.77	0.95	10.53	25.27
	HR2	-7.06	-2.40	19.93	29.71
	HR3	-10.73	-3.05	13.22	30.14
Total rural population		-6.24	-1.94	13.79	28.86
Total urban population	HU	-5.59	-2.82	12.96	24.61
Total population		-6.06	-2.17	13.58	27.74

Source: Author's calculations.

Table 14 Effects on Poverty Incidence – Simulation Set B

(per cent change, except level of poverty incidence)

			B1	B2	B3	B4	B5
Real consumption expenditures, deflated by household-specific CPI (% change)							
Rural households	HR 1		4.49	2.28	-7.26	-12.12	-19.01
	HR 2		5.77	2.87	-8.49	-13.78	-20.90
	HR 3		5.17	2.59	-7.86	-12.89	-19.83
Total rural population			5.12	2.57	-7.83	-12.87	-19.83
Total urban population	HU		4.88	2.43	-7.30	-11.97	-18.46
Total population			5.01	2.51	-7.59	-12.47	-19.22
Level of Poverty Incidence (% population concerned)							
		Base					
Rural households	HR 1	45.57	43.30	44.29	53.11	55.36	57.39
	HR 2	36.05	33.40	35.25	37.56	42.19	48.74
	HR 3	28.64	25.28	27.32	34.16	37.36	40.36
Total rural population		34.17	31.21	32.96	39.45	42.68	46.09
Total urban population	HU	23.64	22.01	22.60	24.95	27.43	34.23
Total population		31.40	28.79	30.23	35.64	38.67	42.98
Poverty Incidence (change)							
Rural households	HR 1		-2.27	-1.28	7.54	9.79	11.82
	HR 2		-2.65	-0.80	1.51	6.14	12.69
	HR 3		-3.36	-1.32	5.52	8.72	11.72
Total rural population			-2.96	-1.21	5.28	8.51	11.92
Total urban population	HU		-1.63	-1.04	1.31	3.79	10.59
Total population			-2.61	-1.17	4.24	7.27	11.58

Source: Author's calculations.

Table 15 Effects on Poverty Incidence – Simulation Set C

(per cent change, except level of poverty incidence)

Simulation			**C1**	**C2**	**C3**	**C4**	**C5**
Real consumption expenditures, deflated by household-specific CPI (% change)							
Rural households	HR 1		3.65	1.81	-5.28	-8.61	-13.37
	HR 2		4.80	2.34	-6.35	-10.06	-15.06
	HR 3		4.26	2.09	-5.83	-9.36	-14.23
Total rural population			4.21	2.07	-5.80	-9.31	-14.18
Total urban population	HU		3.96	1.93	-5.36	-8.61	-13.13
Total population			4.10	2.01	-5.60	-9.00	-13.71
Level of Poverty Incidence (% population concerned)							
		Base					
Rural households	HR 1	45.57	43.65	44.61	51.09	53.50	55.60
	HR 2	36.05	33.76	35.44	36.90	37.99	43.03
	HR 3	28.64	26.08	27.71	32.55	34.47	37.71
Total rural population		34.17	31.82	33.29	37.92	39.80	43.09
Total urban population	HU	23.64	22.23	22.74	24.62	25.44	27.85
Total population		31.40	29.30	30.52	34.42	36.03	39.09
Poverty Incidence (change)							
Rural households	HR 1		-1.92	-0.96	5.52	7.93	10.03
	HR 2		-2.29	-0.61	0.85	1.94	6.98
	HR 3		-2.56	-0.93	3.91	5.83	9.07
Total rural population			-2.35	-0.88	3.75	5.63	8.92
Total urban population	HU		-1.41	-0.90	0.98	1.80	4.21
Total population			-2.10	-0.88	3.02	4.63	7.69

Source: Author's calculations.

Table 16 Effects on Inequality – Simulation Set A

Gini coefficient of inequality

		Base	A1	A2	A3	A4
Rural households	HR1	0.42	0.40	0.41	0.46	0.49
	HR2	0.37	0.37	0.37	0.40	0.43
	HR3	0.37	0.36	0.36	0.39	0.41
Total rural population		0.43	0.43	0.43	0.45	0.47
Total urban population	HU	0.36	0.35	0.35	0.36	0.38
Total population		0.38	0.38	0.38	0.41	0.44

Gini coefficient of inequality (change)

Rural households	HR1		-0.01	-0.01	0.05	0.07
	HR2		-0.01	0.00	0.03	0.06
	HR3		-0.01	0.00	0.02	0.05
Total rural population			0.00	0.00	0.02	0.05
Total urban population	HU		-0.01	0.00	0.01	0.02
Total population			-0.01	0.00	0.03	0.06

Source: Author's calculations.

Table 17 Effects on Inequality – Simulation Set B

Gini coefficient of inequality

		Base	B1	B2	B3	B4	B5
Rural households	HR 1	0.42	0.42	0.42	0.41	0.41	0.41
	HR 2	0.37	0.37	0.37	0.37	0.37	0.37
	HR 3	0.37	0.37	0.37	0.36	0.36	0.36
Total rural population		0.43	0.43	0.43	0.43	0.42	0.42
Total urban population	HU	0.36	0.36	0.36	0.35	0.35	0.34
Total population		0.38	0.38	0.38	0.38	0.38	0.38

Gini coefficient of inequality (change)

Rural households	HR 1	0.00	0.00	0.00	0.00	0.00
	HR 2	0.00	0.00	0.00	0.00	-0.01
	HR 3	0.00	0.00	0.00	-0.01	-0.01
Total rural population		0.00	0.00	0.00	0.00	0.00
Total urban population	HU	0.00	0.00	-0.01	-0.01	-0.02
Total population		0.00	0.00	0.00	0.00	-0.01

Source: Author's calculations.

Table 18 Effects on Inequality – Simulation Set C

Gini coefficient of inequality

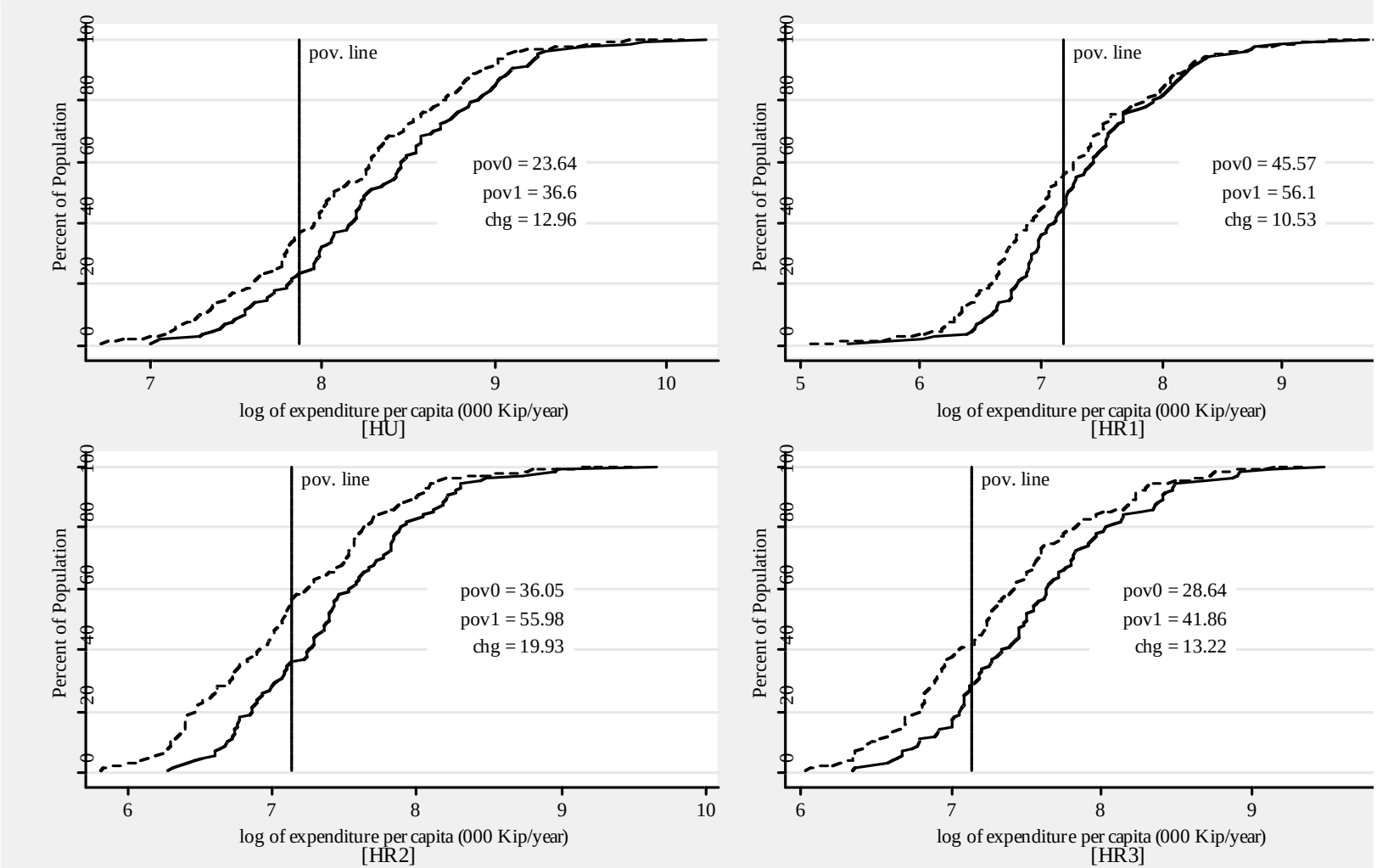
		Base	C1	C2	C3	C4	C5
Rural households	HR 1	0.42	0.42	0.42	0.41	0.41	0.41
	HR 2	0.37	0.37	0.37	0.37	0.37	0.37
	HR 3	0.37	0.37	0.37	0.36	0.36	0.36
Total rural population		0.43	0.43	0.43	0.43	0.42	0.42
Total urban population	HU	0.36	0.36	0.36	0.35	0.35	0.34
Total population		0.38	0.38	0.38	0.38	0.38	0.38

Gini coefficient of inequality (change)

Rural households	HR 1		0.00	0.00	0.00	0.00	0.00
	HR 2		0.00	0.00	0.00	0.00	-0.01
	HR 3		0.00	0.00	0.00	-0.01	-0.01
Total rural population			0.00	0.00	0.00	0.00	0.00
Total urban population	HU		0.00	0.00	-0.01	-0.01	-0.01
Total population			0.00	0.00	0.00	0.00	-0.01

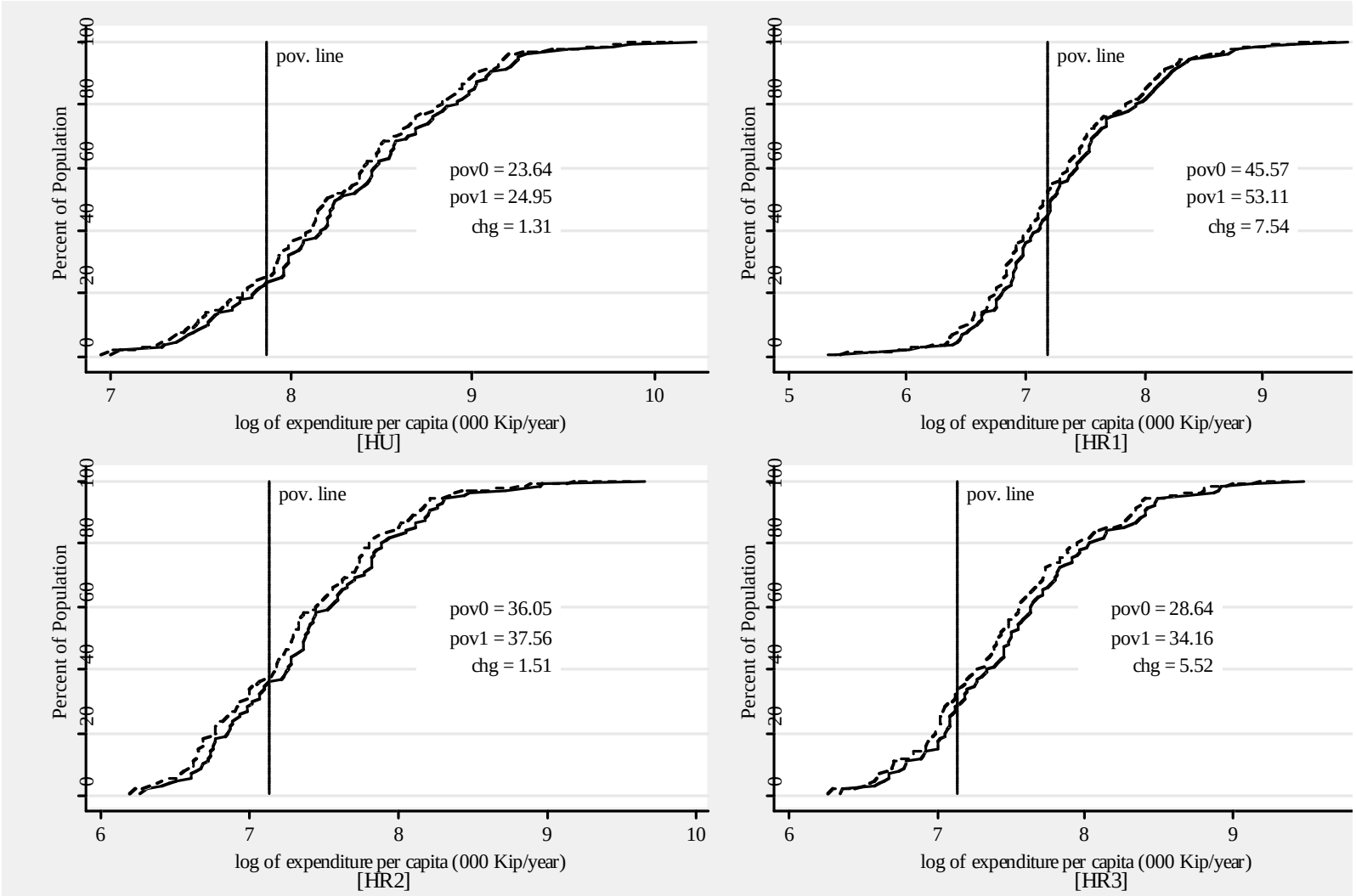
Source: Author's calculations.

Figure 1 Changes in the cumulative distribution of real expenditures in Simulation A3



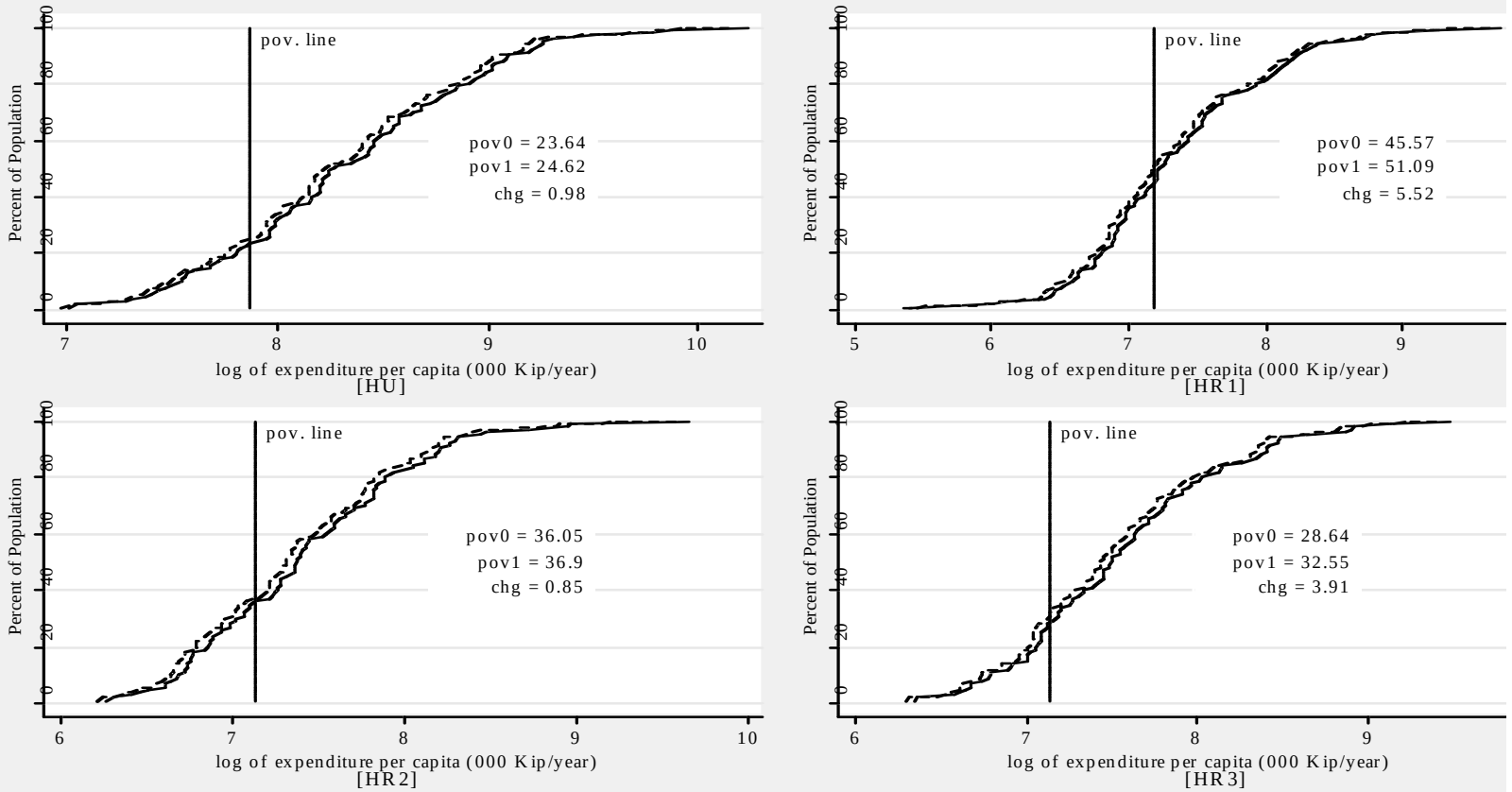
Note: [HU] urban [HR1] rural no-road [HR2] rural dry season [HR3] rural all season

Figure 2 Changes in the cumulative distribution of real expenditures in Simulation B3



Note: [HU] urban [HR1] rural no-road [HR2] rural dry season [HR3] rural all season

Figure 3 Changes in the cumulative distribution of real expenditures in Simulation C3



Note: [HU] urban [HR1] rural no-road [HR2] rural dry season [HR3] rural all season

Appendix Table 1 The *LaoGEM* Model: List of Industries

Crops	1 CROPS
Livestock and poultry	2 LVSTK
Forestry and logging	3 FOREST
Mining and quarrying	4 MINING
Food, beverage and tobacco	5 FOOD
Textiles, garments & leather products	6 TEXTILE
Wood & paper products; printing/publishing	7 WOOD
Petroleum and chemical products	8 PETROLEUM
Non-metallic mineral products	9 MINERAL
Metal prods, machinery, equipment, spare parts	10 METAL
Other manufactured goods	11 OTHMAN
Electricity and water supply	12 ELECWAT
Construction	13 CONSTR
Transportation	14 TRANSP
Post and telecommunication	15 POSTEL
Wholesale and retail trade	16 TRADE
Banking, insurance, business services	17 BANK
Real estate & ownership of dwellings	18 ESTATE
Public administration	19 GOVT
Personal, social & community services	20 OTHSERV

Appendix Table 2 The *LaoGEM* Model: Cost Structure of Domestic Industries (Million Kip)

Industry	1 Intermediate Domestic	2 Intermediate Imported	3 Margin	4 Indirect Tax	5 Labor	6 Capital	7 Land	8 Production Tax	Total
1 CROPS	242,954	100,077	22,661	3,719	2,745,382	1,766,305	883,152	1	5,764,251
2 LVSTK	1,386,197	150,889	120,191	15,107	844,254	1,519,619	759,808	1	4,796,067
3 FOREST	20,760	13,988	4,861	1,359	241,079	199,710	99,855	1	581,613
4 MINING	416,239	1,430,354	219,600	24,821	31,996	35,120	17,560	1	2,175,692
5 FOOD	6,426,728	264,542	457,400	86,018	885,301	1,806,187	-	1	9,926,175
6 TEXTILE	116,471	56,690	21,104	1,870	64,003	134,604	-	1	394,744
7 WOOD	418,414	140,440	88,632	29,851	30,608	72,898	-	1	780,844
8 PETROLEUM	2,879	16,105	2,392	205	261	796	-	1	22,641
9 MINERAL	49,160	53,510	16,252	1,956	37,046	70,513	-	1	228,438
10 METAL	23,424	124,715	19,445	1,476	17,235	33,163	-	1	219,459
11 OTHMAN	11,879	114,847	18,745	907	43,859	118,104	-	1	308,343
12 ELECWAT	209,009	67,005	26,488	12,016	133,952	348,218	-	1	796,690
13 CONSTR	352,785	511,014	163,392	9,271	159,856	229,981	-	1	1,426,301
14 TRANSP	72,942	116,749	21,399	2,458	465,901	463,261	-	1	1,142,711
15 POSTEL	19,644	39,002	6,172	658	54,258	84,834	-	1	204,569
16 TRADE	171,540	242,173	56,453	7,797	563,077	1,073,985	-	1	2,115,025
17 BANK	31,194	2,839	7,887	986	12,295	133,455	-	1	188,656
18 ESTATE	43,086	609	1,220	1,278	87,633	391,718	-	1	525,546
19 GOVT	252,489	123,958	32,813	6,389	510,126	1	-	1	925,777
20 OTHSERV	330,197	826,517	177,493	12,534	192,129	316,125	-	1	1,854,996
Total	10,597,991	4,396,025	1,484,601	220,675	7,120,254	8,798,596	1,760,376	20	34,378,536

Appendix Table 3 The *LaoGEM* Model: Sales Structure of Domestic Industries and Commodities (Million Kip)

	1 Intermediate	2 Investment	3 Households	4 Export	5 Government	6 Stocks	7 Margins	8 Total	9 Imports	Total
1 CROPS	2,754,562	488,542	2,190,597	330,549	0	1	0	5,764,251	224,806	11,753,308
2 LVSTK	4,087,407	647,224	28,763	32,670	0	1	0	4,796,067	0	9,592,132
3 FOREST	456,644	66,678	29,999	28,291	0	1	0	581,613	0	1,163,227
4 MINING	130	695	0	2,174,866	0	1	0	2,175,693	0	4,351,385
5 FOOD	984,019	717,400	8,217,420	7,334	2	1	0	9,926,176	372,004	20,224,356
6 TEXTILE	106,344	25,497	226,109	36,793	0	1	0	394,744	238,884	1,028,371
7 WOOD	35,259	1,423	5,496	738,665	0	1	0	780,844	117,941	1,679,629
8 PETROL'M	12,919	1	1,132	8,589	0	-1	0	22,641	2,292,650	2,337,932
9 MINERAL	221,442	1	5,310	1,685	0	-1	0	228,438	0	456,875
10 METAL	142,370	40,577	24,751	11,759	0	1	0	219,459	2,324,624	2,763,543
11 OTHMAN	180,407	16,862	78,087	32,986	0	1	0	308,343	28,193	644,880
12 ELECWAT	625,640	1	171,050	0	0	-1	0	796,690	0	1,593,380
13 CONSTR	67,154	1,346,019	13,127	0	0	1	0	1,426,301	0	2,852,601
14 TRANSP	0	1	0	0	0	-1	1,142,711	1,142,711	132,988	2,418,410
15 POSTEL	122,301	1	82,267	0	0	-1	0	204,569	0	409,137
16 TRADE	124,399	13,657	73,446	0	1	1	1,903,522	2,115,025	0	4,230,051
17 BANK	180,052	1	8,604	0	0	-1	0	188,656	0	377,313
18 ESTATE	65,233	1	460,313	0	0	-1	0	525,546	0	1,051,092
19 GOVT	0	1	121,949	0	803,828	-1	0	925,777	0	1,851,555
20 OTHSERV	431,707	1	1,423,289	0	1	-1	0	1,854,996	0	3,709,992
Total	10,597,991	3,364,582	13,161,709	3,404,187	803,832	2	3,046,233	34,378,540	5,732,091	74,489,168