ECONOMY-WIDE IMPACT OF FOREST AND PLANTATION DEVELOPMENT IN LAOS USING A DYNAMIC GENERAL EQUILIBRIUM APPROACH

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ABSTRACT

This paper examines the economy-wide impact of forest and plantation development in Laos by using a recursive dynamic computable general equilibrium model. Analysis is focused on the Government of Laos' forest policies involving the doubling of the 2003 forest cover by the year 2020.

Simulation findings show that the forestry policy is likely to contribute a small but positive impact on the Lao economy by increasing the productivities of forestry and forestry related industries and also to stimulating the aggregate values of household consumption and savings.

Nevertheless, it can also lead to undesirable impacts on several service sectors as well as reductions in public consumption. Furthermore, the results also reveal that the government tax revenue, although experiencing a positive growth, appear to be negligible because of inefficient institutional agencies.

The Government of Laos will need to enforce forestry laws and other economic-related laws and implement supporting policies to ensure that all economic agents, particularly rural communities, benefit from these policy outcomes.

Keywords: Lao forest, plantation, forest policy, dynamic CGE model, Laos

INTRODUCTION

Over the past decade, the world has witnessed a major increase in the development of forest plantations. Despite the considerable number of studies that have been undertaken to examine the impact of forest plantation development, few studies have analysed the economy-wide impact of that development. Lao PDR represents a country with a recent dramatic increase of forest plantation development in the form of large-scale concessional projects owned by some of the largest global forestry companies. This rapid increase is driven by a number of policy tools and incentives developed by the Government. For instance, one of the main forest policies in the

Government's Forestry Strategy to the Year 2020 is to restore forest cover to 70% by the year 2020 by the mean of forest restoration and plantation development.

Previous economic analyses of this industry in Laos have only used investment analysis, and simple estimates of forest production, consumption, and trade. How this industry interacts with the macro-economy has been either overlooked or poorly understood.

Much remains unclear in regard to the links between forest management policies and the macro-economy. The main aim of this paper is to quantify the likely economy-wide impacts of forest and plantation development on the forestry sector and the macro-economy of Laos. Analysis is focussed on the Government of Laos' forest policies involving the doubling of the 2003 forest cover by the year 2020.

The rest of this article is organised as follows. After a brief overview of forestry policies and Lao economy, previous research regarding impact assessment methodologies is presented. Then the methodological framework employed to examine possible effects of forest and plantation development in Laos is presented. Finally, the results of the CGE analysis are presented and discussed and policy recommendation are advanced.

REVIEW OF THE LITERATURE

Forestry policies and Lao economy

Forest management in Laos has evolved through six stages of development (Phimmavong et al. 2009):

(1) Traditional forest use in Laos to 1893;
(2) Exploitive colonization of the Laos forest (1893-1975);
(3) Forest resource-based economy (1975-1986);
(4) Internationalisation of forest policy (1986-1996);
(5) Transitional phase of forest policy (1997-2001); to
(6) Privatisation of land and forestland (2001 to present).

From the traditional up to the current phase of development, the forestry sector has provided a significant contribution to the national economy as well as to the livelihood of local communities.

During the colonial period, Laos was significantly influenced by French colonialists and the economy was automatically connected to international market. The forestry policies in this period involved the harvesting of natural forests for exports. According to Lévy (1974) cited in (Gunn 1990: 27), about 12 000-15 000 teak logs, were exploited by the French entrepreneur (Compagnie de l'Est Asiatique Francaise) and these were floated down the Mekong and sold to the market in Saigon, Vietnam. However, from the Indochina War period up to the late 1980s, the Lao economy was extremely protected with little exposure to international competition and a limited degree of regional integration.

Starting in the late 1980s, Laos resumed opening its doors to international markets. A number of restrictions on the Lao economy were removed. These included progressive reduction of price controls; cessation of socialist cooperative farming; improvement of the finance system;

institutional reform and elimination of the government's monopoly on trade; reduction of state-owned enterprises; the introduction of defined property rights; integration of the Lao economy in global trade and competition; and the development of factor markets (Bourdet 1994; World Bank 2007). Many investment incentives and policy instruments have also been made in order to encourage foreign direct investment, and this has resulted in a large inflow of direct foreign investment (DFI), particularly since 2000.

Among the favoured investment options, the forestry sector, particularly tree plantations, is one of the options attracting many international forestry companies. The Ministry for Planning and Investment of Laos has recently reported that there has been an increasing number of applications and approvals of foreign direct investment in plantations. In total, 192 applications for foreign direct investment for agribusiness, with an investment value of about a quarter of the 2007 Gross Domestic Product (approximately US1.00 billion), have been approved or are being considered since 2000.

There are a number of reasons for the increase in forest plantations. For example, the forestry policy is to double the current forest area by the year 2020 as noted earlier. Other factors include the Land and Forest Allocation Programs to facilitate access to land for plantations; improved infrastructure resulting from the construction of the ASEAN highway; improvement in the business and investment environment; and many others.

Additionally, Laos commenced participation in the ASEAN Free Trade Area (AFTA) in 1997 and is currently looking forward to becoming a member of the World Trade Organisation. Other bilateral treaties that Laos negotiated include a Normal Trade Relation with the United States.

Survey of impact assessment methodologies

There are several approaches to the measurement of the economic impact of such developments in the economic literature. Selecting a suitable technique is dependent on the purpose of the study. If a researcher were seeking to differentiate costs and benefits of the forestry project impact at a given time period, a cost-benefit analysis approach would be preferred. An example which has utilised the cost-benefit analysis in their economic impact assessment in relation to forest plantation investments in Laos is Manivong & Cramb (2008). On the other hand, if the researcher were seeking to measure the Net Present Value (NPV) of the forestry project, the Faustmann formula provides a well-known model for estimating the present value of net monetary benefits generated by the forest under certain assumptions (Johansson & Loefgren 1985; Klemperer 1996; Samuelson 1976)

When we want to analyse the economy-wide impact of particular economic activity and focus on interdependencies between different sectors within an economy, several different models can be used. One of the most popular economic approaches is a partial equilibrium model. While this modelling approach is simple and focuses on one individual market, many researchers consider that it has major deficiencies in examining the economy-wide effects; and it requires a large amount of reliable time-series data to implement effectively. In addition, it lacks optimising capacity when several interdependent commodities exist (de Melo 1988).

Macro-econometric modelling is another approach used in this kind of analysis. However, this approach also needs comprehensive time series data that seldom exists in developing countries.

Furthermore, it suffers the same limitations as the partial general equilibrium approach. Kmenta & Ramsey (1981) and Wallis & Whitley (1991) provide detailed discussions of this approach

Other approaches used in impact assessment projects include: economic base models, Keynesian regional multipliers, and input-output analysis. Mandeville and Jensen (1978) provide a summary and comparison of these three approaches. All are severely limited by underpinning assumptions.

Computable General Equilibrium (CGE) models were developed to investigate the problems of market behaviour and substitution. As noted by Dixon (2006), CGE has been increasingly recognised as a sophisticated and powerful methodology to assist empirical research in economy-wide impact analysis. The development of this approach has taken place for over the last 50 years following the development of the first CGE model by Leif Johansen for Norway economy (Johansen 1960). In addition, as Shoven & Whalley (1984); Tumaneng-Diete *et al.* (2005) and other CGE researchers have shown, CGE can be very useful for policy evaluation and simulation - to evaluate the economy-wide impact of a policy intervention, to examine the benefit and cost of policy restrictions, to assess distributional effect under different policy scenarios and to rank policies. Hence, the CGE modelling approach was chosen to examine the economy-wide impact of forest and plantation development in Laos.

The CGE modelling approach is the most suitable technique in a Lao context for four reasons. First, it is now widely used to examine the economy-wide impact of exogenous demand changes (i.e. economic policies, new tax regimes) in developed and developing countries. De Melo (1988) pointed out that the CGE models are particularly appropriate for developing countries where reliable time-series data for longer periods do not exist. Even where the time series data are available, they are often not suitable for econometric approaches without some major adaptations to clear up inconsistencies. Second this approach was selected because governments in developing countries often introduce new policy regimes in response to the global economy. By using this approach, the complex interdependencies and feedback effects between policy interventions and sectors in an economy can be modelled in a general equilibrium framework. Third, the CGE has been chosen because it is considered by many economic researchers to be the 'best' technology currently available for policy evaluation and economic simulation analysis to deal with the complex interaction of a large number of economic sectors and agents (Dixon 2006). Finally, the CGE modelling approach has not yet been applied in Laos.

A RECURSIVE DYNAMIC CGE MODEL FOR LAOS

Model Description

The Lao Computable General Equilibrium Model (Lao CGE Model) developed for this study is a recursive multi-sector general equilibrium model for the Lao economy. The Lao CGE model, which was executed in the General Algebraic Modelling System (GAMS) was solved as a mixed complementary problem using the PATH solver.

The Lao CGE model, like other CGE models is based on the Walrasian theory that the equilibrium is determined by a function of relative prices of factors and commodities that clear all markets in the Lao economy. The behaviour of economic agents and their interdependences

with the macro-economy is comprehensively modelled in a system of simultaneous linear and non-linear equations, based on the assumption of profit-maximizing behaviour by economic agents. By clearing all markets, this means that market demand equals supply for all commodities as determined by the relative price and level of production in each sector in the economy.

Input-output theories and its extension to computable general equilibrium theory enable direct and indirect impacts to be estimated.

In this analysis, the economy of Laos is disaggregated into 20 industries or sectors, each of which produces a single commodity. These include three agricultural industries (crops, livestock (which includes poultry and fisheries) and forestry), 10 manufacturing industries and seven other service sectors (Table 1).

Table 1: Economic Sectors/Commodities of Lao PDR

	Economic activities/Commodities	Abbrevi-ation	Key activities
1	Crops	CROP	AGRICULTURE
2	Livestock, poultry & fisheries	LIVE	
3	Forestry	FORT	
4	Mining & quarrying	MINQ	MANUFACTURING
5	Food, beverage & tobacco products	FOOD	
6	Textiles, garments and leather products	TEXT	
7	Wood and paper products; publishing & printing	WOOD	
8	Chemical, rubber, plastic, petroleum products	PETR	
9	Non-metallic mineral products	MINE	
10	Metal products, machinery, equipt & spare parts	META	
11	Other manufactured goods	OTHR	
12	Electricity and water	ELEC	
13	Construction	CONS	SERVICE
14	Transportation	TRAN	
15	Communication	COMM	
16	Trade	TRAD	
17	Banking, insurance, business services	BANK	
18	Real estate & ownership of dwellings	REAL	
19	Public administration	ADMN	
29	Personal, social & community services	PERS	

The database used was a Lao SAM version2003, which was modified and elaborated from the Savannakhet input-output table of Laos. The Savannakhet (SVK) Input-output table is the only available input-output table in Laos and was produced by Asra *et al*. (2006) at the Asian Development Bank. The SVK table was converted into a national table by using a RAS method[1].

[1] Warr (2006, 2008) also used this method in his CGE analysis for Laos.

To do that, the value added totals of SVK table was mathematically adjusted to equalize those for the national accounts (Warr 2007). Thus, the resulting national input-output table for Laos has similar Leontief coefficients as SVK table, but has a similar industry structure to that shown in the 2003 National Accounts.

The model can be used as a framework to answer a number of questions for Laos relating to trade, taxation, and environmental issues. For example, it could be used to investigate the impact of economic policies or external shocks such as ASEAN Free Trade Area (AFTA), China-ASEAN FTA (CAFTA), and the like.

The technique used for constructing a multi-sector general equilibrium model and expositions of different models have been elucidated by Robinson *et al* (1999), Lofgren, Harris & Robinson (2002), and others, and will not be laboured here. Rather, the major components of the model, namely production, consumption, and the incorporation of key dynamic features, are described to reveal the key characteristics of the Lao CGE Model.

Production

The production structure of the model is summarized in Figure 1. One of key features is the underlying assumption used to characterize optimising behaviour of the economic activities.

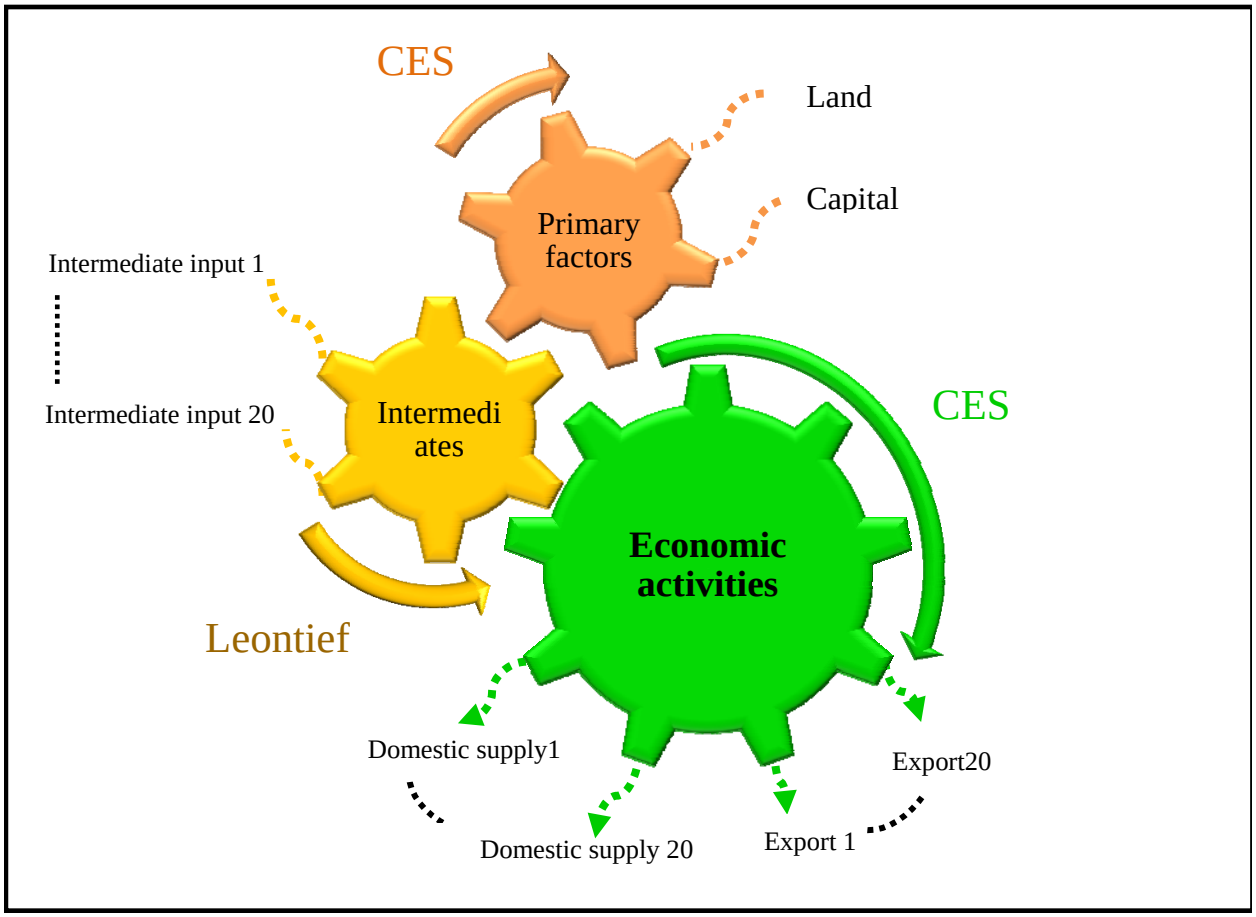


Figure 1: Production Structure

Under this assumption, the economic activity or sector is required to maximise outputs, supplied to either domestic or foreign markets by minimising inputs, i.e. the input levels of intermediate inputs and primary factors need to be determined, subject to production technology constraints. To achieve this requirement, the model distinguishes two types of production function: the Leontief production function (Leontief 1936) and the Constant Elasticity of Substitution (CES) production function (Arrow et al. 1961).

The former is devised to determine the optimal allocation between inputs and outputs. The later enables economic sectors to be equipped with a constant elasticity of substitution (CES) for the model variables including primary factors, domestic supply and export. In other words, these variables are nested in CES production function so that it allows their flexibility or substitution capabilities. In this case, there are two factors of production: land and capital. The labor factor is combined with the capital factor, so the capital/labour ratio is fixed. Given the time and resources to collect the data in Laos, separation of labour could be separated but this was not possible for this study. In addition, production price is equal to average and marginal costs, which imply that with constant returns to scale production function, the economic sector produces to satisfy consumption demand, utilizing the factor input mix through the condition of cost minimization and zero profit.

It should be noted that in Laos, economic activities such as transportation, construction sectors and other service sectors have no exports. Therefore, the value of their domestic production equals their domestic supply.

Consumption

Figure 2 depicts two types of inputs: domestic demand from domestic producers and imports which are consumed in order to bring about the so called "the composite commodities" by utilising the mean of CES production functions. These commodities are then absorbed by different stakeholders of the Lao economy, namely household and government consumption, investment, and intermediate consumption.

There is one representative consumer who maximises a Cobb–Douglas utility function[2]. The consumer is assumed to purchase goods from domestic and foreign markets in an optimal amount of composite level of demand under the budget constraint. On the income side, the consumer generates his/her income from factor market: land and capital while, on expenditure side, the consumer is responsible for the payments of the following costs: income taxes, private consumption, and savings.

The behaviour of government consumption and investment is similar to that of the household in the way that they also maximise a Cobb-Douglas utility function.

The demand of the Government of Laos is obtained from an exogenously fixed amount of requirements purchased from the public administration sector because the Government only consumes goods from this sector. On the income side, the Government collects income taxes

[2] Cobb Douglas is a special case of CES production function. In addition, a Stone-Geary (Linear Expenditure System) utility function is not used here because some data (income elasticities of demand for each commodity and Frisch value) do not exist for Laos.

from consumers, production taxes from economic activities and import duties. Therefore, the difference between government revenue and expenditure represents the government saving.

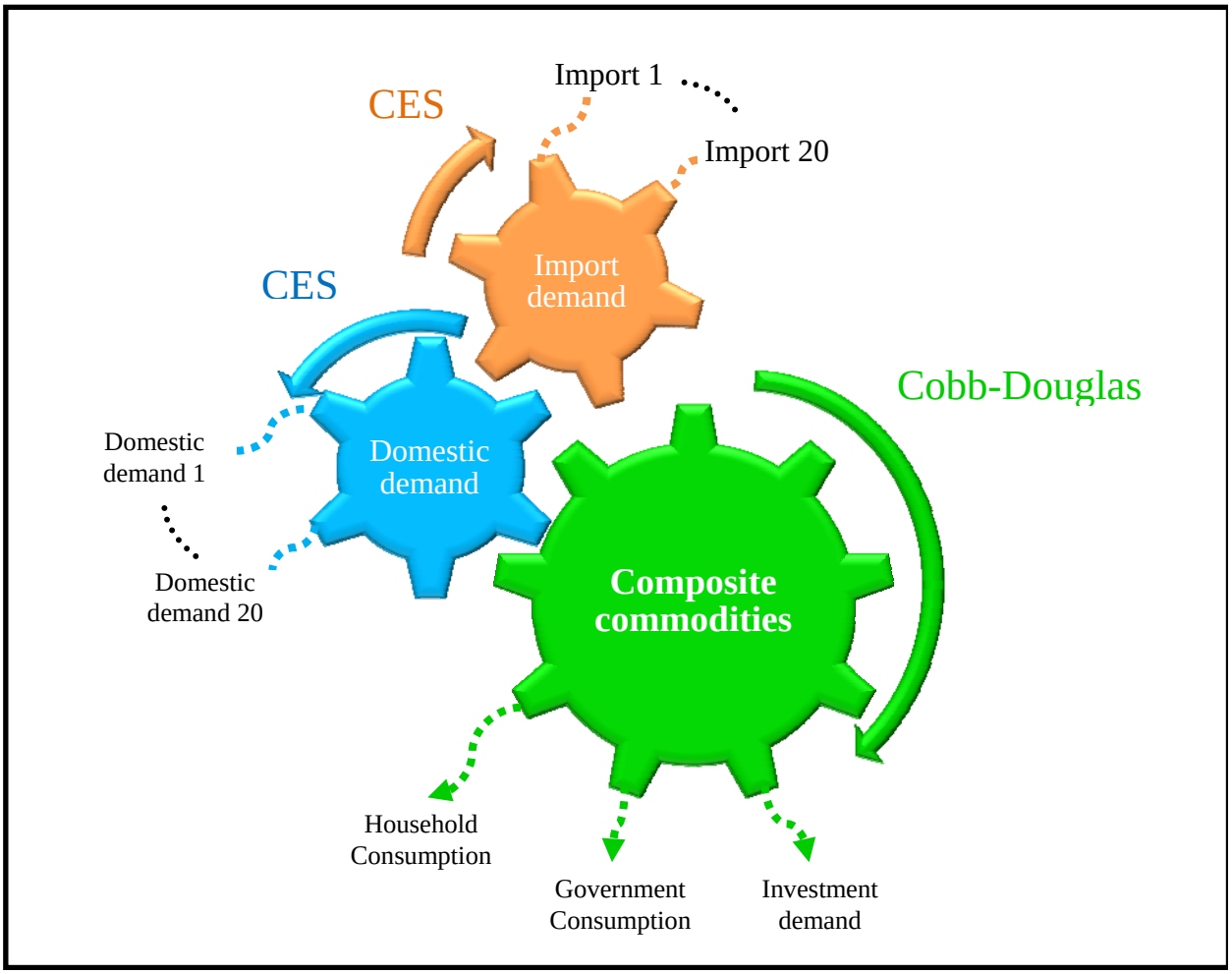


Figure 2: Commodity structure

The value of the total investment is equivalent to the value of the total savings (including foreign savings). The investment value in each sector is treated the same as the total value of capital goods consumed in that sector. In addition, it should be noted that investment demand by each sector is a fixed proportion of the total investment (Leontief production function).

Dynamic updating

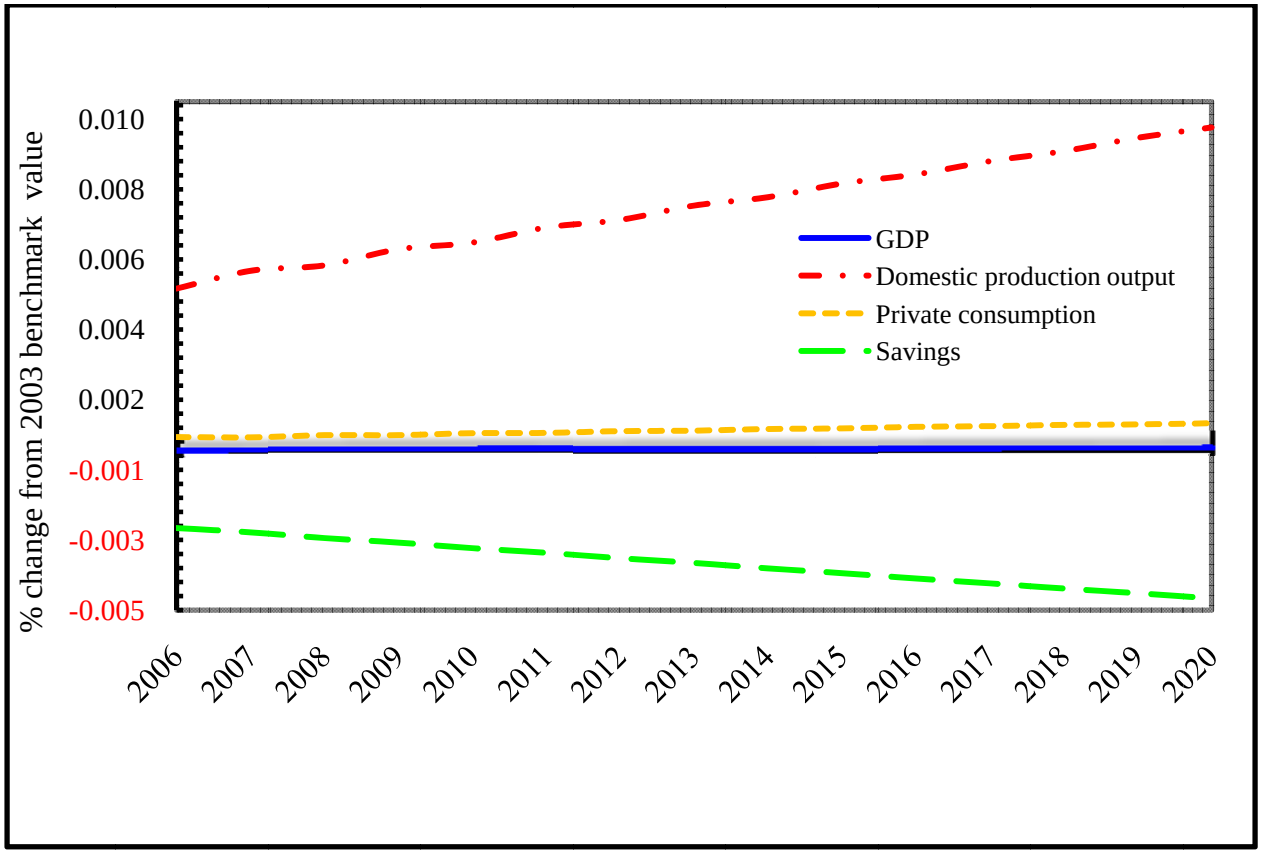
In going from a static to a dynamic CGE model, it is important to incorporate a key dynamic feature concerning investment and capital accumulation into the framework of the static CGE model. To do this, the capital stock in each sector was adjusted for investment and depreciation per annum and then updated automatically between periods. Investment and capital accumulation in individual sectors are determined by their expected rates of returns. Technically, the net rate of return on capital goods in year t + 1 is equal to the ratio of the present value of the net revenue to the cost of the capital goods in year t.

SIMULATION RESULTS

Impact on the macro-economy of Laos

The policy scenario for this analysis was based on the proposed establishment of 500,000 hectares of tree plantation, in addition to the overall forest restoration plan of 6 million hectares, by the year 2020. In order to examine the impacts, the supply of land[3] was increased exogenously in the forestry sector. The impacts are shown in the following sequence of figures that summarize the changes from the 2003 benchmark levels to those in 2020.

Figure 3 shows that, despite a doubling of the land supply in the forestry sector the Gross Domestic Product of Laos is likely to grow very slowly. This is because the forestry sector continues to make a very small contribution to the national economy, representing only 3.2% of the GDP in 2003. The revenue generated from forestry exports was also very low, compared to the actual value of exports.



The Committee for Planning and Investment *et al.* (2006) reported that although the export of logs from natural forests was officially banned a decade ago, the actual value of the exports, which were calculated from mirror data, in fact, more than doubled between 2000 and 2004 and contributed more than a quarter of the total national export earnings, compared to the official Lao

[3] The supply of land for the period 2003- 2010 was based on the actual growth rate of forest cover, while that for the period 2011-2020 was based on the estimated growth rate.

figures[4] of only 0.5% in 2003.

Simulation results also show that the total savings (including foreign savings) tends to drop quite significantly because of the decreasing amount of public savings whilst the aggregate value of private consumption, on the other hand, is likely to enjoy a slight positive growth. The aggregate value of the domestic production outputs is also projected to rise more quickly than any other indicators, rising from 0.005 % to approximately 0.01 %.

The aggregate value of exports is also likely to grow moderately and would reach 6,120 billion Kip in 2020, which is a growth of 0.4 per cent. Most of this growth is driven by an increase in all agriculture and two manufacturing sectors (MINQ and FOOD). This increase in sectoral outputs tends to be associated with an increase in import demand, in part because of the increasing demand of inputs and materials for industrialization to enhance the production of domestic produced-commodities in the home market.

Figure 4 shows that the aggregate value of investment demand is likely to fall from just below 40 trillion Kip in 2006 to approximately 39 trillion in 2020, which is an overall reduction of about 2 per cent.

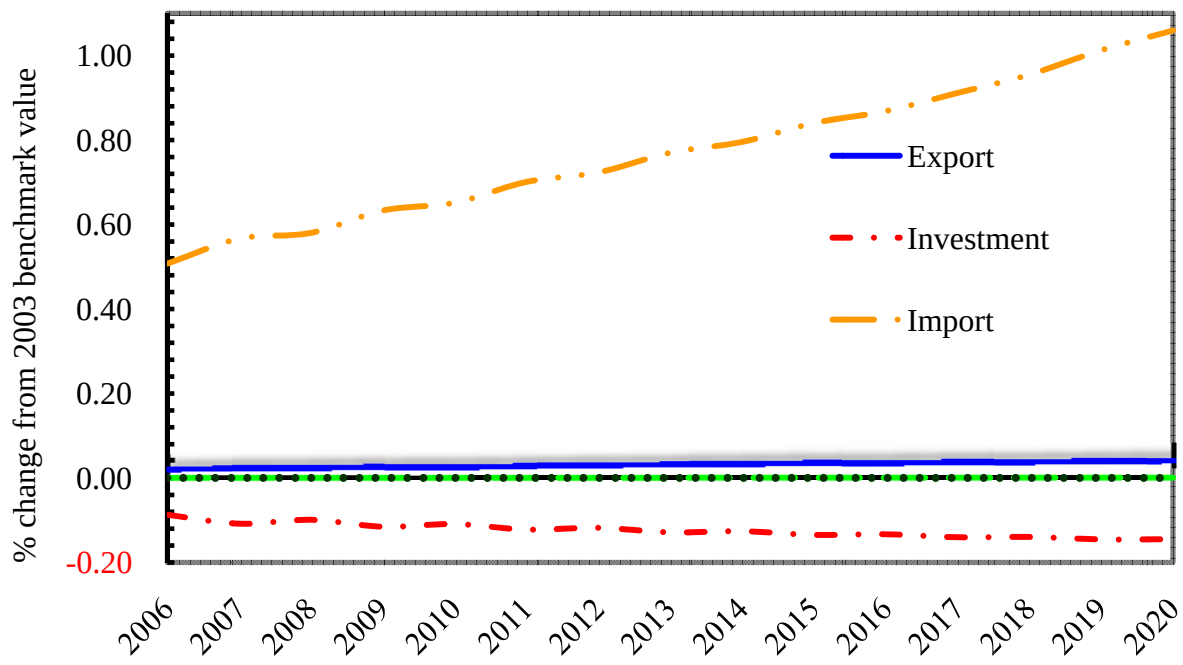


Figure 4: Simulated growth rates of selected aggregate indicators: 2006-2020

While investment demand for all agricultural commodities and several commodities of service sectors has a tendency to diminish, that of their manufacturing counterparts tends to climb

[4] The official data were used in this study.

steadily. Increasing productivities in several sectors increase the aggregate value of both household savings and private consumption.

In spite of the negative growth rates in public consumption and the diminishing demand for investment, the tree plantation policy is likely to boost the productivities of various forestry related industries (Table 1). The forestry sector is projected to enjoy the biggest growth among its counterparts. As might be expected, the growing forestry sector stimulates other forestry-related industries such as crops, livestock, and several manufacturing industries. Nevertheless, a few manufacturing and all service sectors suffer negative growth rates, partly because these sectors have neither export commodities nor consumption expansion. However, the magnitudes of the effects measured seem small.

Table 1: Forecast Percentage Change in Production, Consumption, Factor and Trade for Individual Sectors: 2020

	Sectoral output		**Percent Change**					
	Billion Kip	%	Consumption(C)	Gross fixed investment	Land (L)	Capital (K)	Export (E)	Import (M)
CROP	3,165	0.03	0.004	-0.00	0.04	0.02	0.17	0.018
LIVE	6,230	0.02	-0.041	-0.04	0.03	0.02	0.67	
FORT	389	0.26	-0.260	-0.26	0.59	0.13	2.05	
MINQ	3,897	0.03	-	-1.64	0.19	0.02	0.01	
FOOD	11,605	0.00	0.001	-0.00		-0.04	0.22	0.022
TEXT	252	0.00	0.011	0.01		0.01	-0.01	0.008
WOOD	1,590	0.00	0.011	0.01		-0.01	-0.00	0.005
PETR	2	-1.64	0.011	0.01		-11.42	-8.71	0.012
MINE	499	-0.01	0.039	0.03		0.01	-0.47	
META	179	-0.00	0.012	0.01		-0.02	-0.17	
OTHR	315	-0.01	0.014	0.01		0.01	-0.09	0.004
ELEC	878	-0.00	-0.013	-0.02		0.00		-0.003
CONS	1,800	-0.00	0.004	-0.00		-0.00		
TRAN	118	-0.09	0.010	0.01		0.01		0.010
COMM	309	-0.01	-0.001	-0.01		0.01		
TRAD	2,521	-0.00	-0.004	-0.01		-0.01		
BANK	333	-0.00	-0.003	-0.01		0.01		
REAL	626	-0.00	-0.000	-0.00		0.00		
ADMN	2,119	-0.00	-0.000	-0.00		-0.01		
PERS	3,232	-0.00	-0.001	-0.01		-0.01		

Higher agriculture and manufacturing outputs lead to higher requirement for production factors used in their production as well as a significant expansion in export performance and consumption growth in several individual sectors. The growth rate of forestry exports increases more than other commodities over the next ten years, largely because of a rapid growth in forest cover by the year 2020, together with a rapidly increasing wood consumption in neighboring

countries, namely China and Vietnam. As Table 1 shows, the forestry sector will require a higher proportion of land and capital inputs, increasing to 0.59% and 0.13% respectively, and this will also stimulate production factors of other sectors: crop (0.04% and 0.02 %), livestock (0.03% and 0.02%), mining (0.19% and 0.02 %), as well as many other manufacturing and service sectors because of their strong mutual linkages in the economy.

The unprecedented expansion of forest and plantations in the next ten years will tend to modify the current prices of goods and services. While all agriculture and some manufacturing sectors (textiles, garments and leather products and other manufacturing sectors) as well as almost all service sectors (transportation and communication sectors) face increases in the prices of their composite commodities, other sectors face decreases.

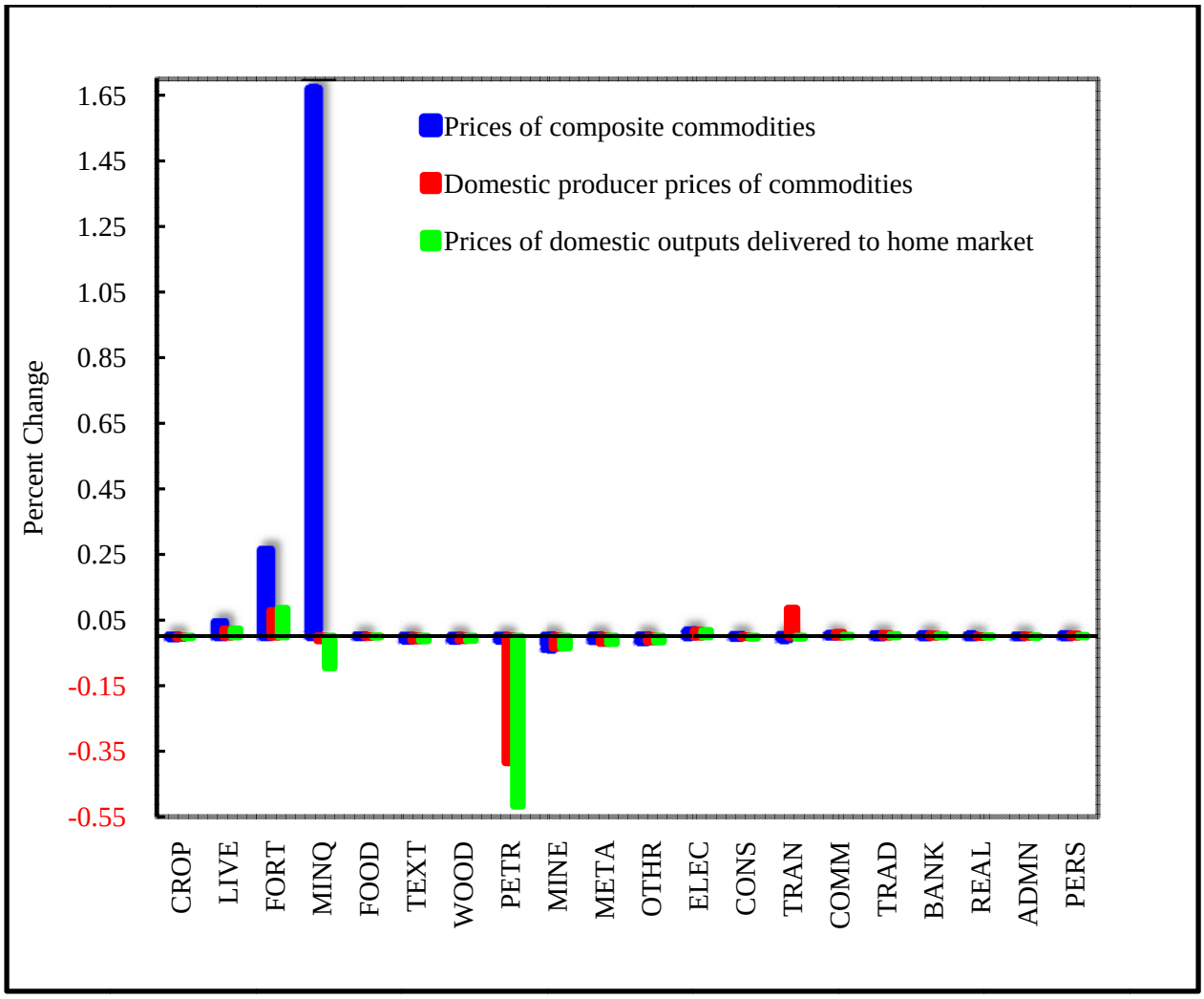


Figure 5: Projected growth rates of prices: 2020

Rates of growth in prices of sectoral outputs and domestic production for individual industries are likely to have similar profiles (Figure 5). For instance, the prices of forestry commodities are higher for composite commodities (0.261%), domestic production (0.077%) and domestic commodities (0.085%). On the other hand, the crop sector will enjoy a drop of 0.002 % for domestic commodities and 0.004 % for prices of composite and production prices. Overall, the

majority of service industries, together with various industries, namely livestock, forestry and electricity sectors will face a higher growth rate, especially the prices of mining and forestry commodities, whilst other counterparts are projected to enjoy declining prices. Likewise, both imports and exports of all commodities in all sectors will face a slight decrease in their prices.

Government effects

The effects of forestry policy are projected to increase the government revenue from import duties and income tax by 0.02% and 0.01 % respectively. This increase is driven by an increase in an increasing volume of export and household income.

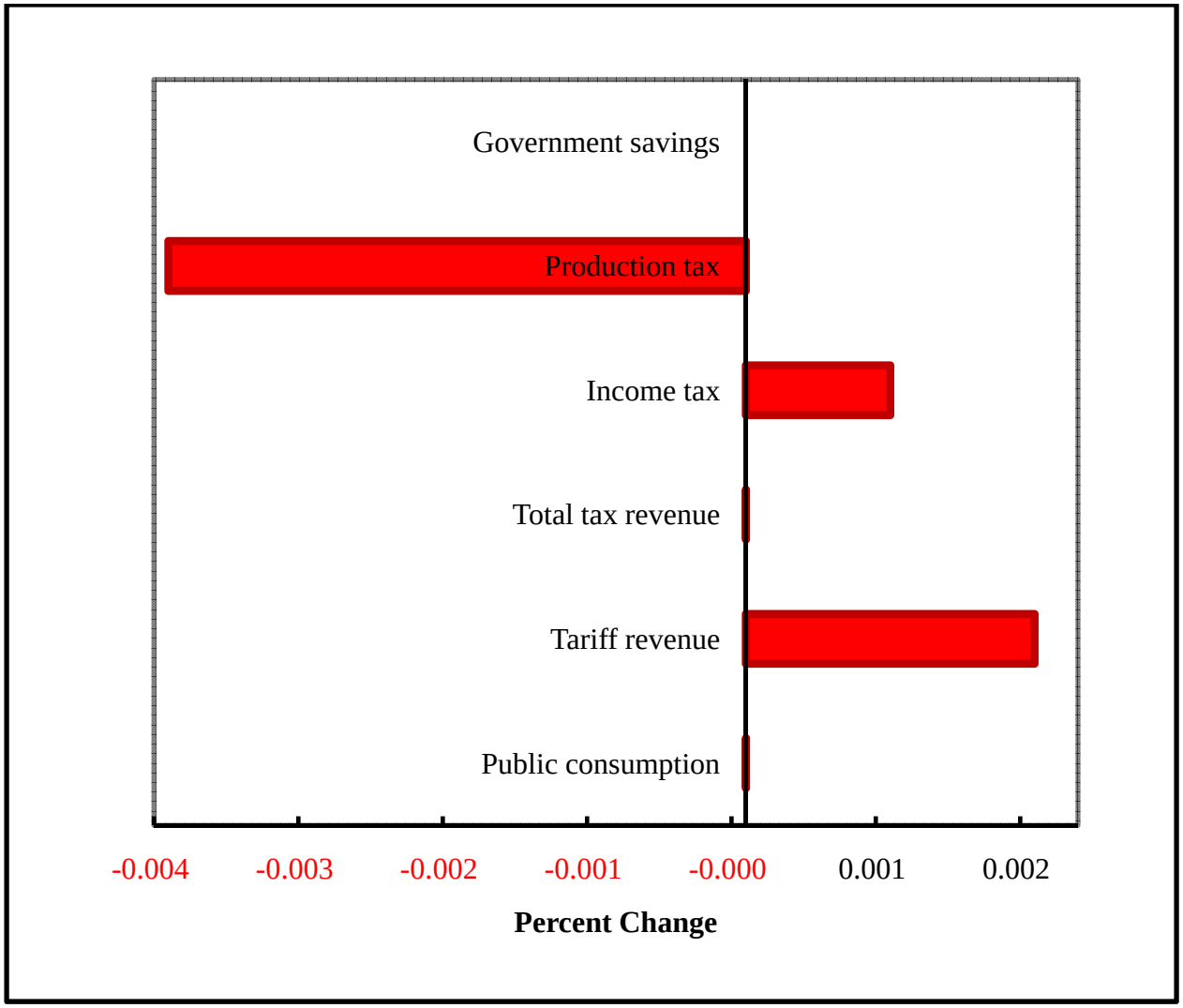


Figure 5: Projected growth rates of government indicators: 2006-2020

However, the total tax revenue, although positive, is relatively low, mainly because of the following reasons. First, the total tax revenue collected from land rent, particularly from the forestry sector, is extremely low, compared to regional and international land tax rate. The total land tax revenue contributed just below 0.01 percent of the 2003 Gross Domestic Product (Keith

et al. 2006). In addition, Laos lacks effective and efficient institutions such as taxation and finance-related agencies to maximize the income from tax collection in a systematic and accountable manner, leading to a relative highly cost of administration and corruption.

CONCLUSION

This study is the first endeavour to use a recursive CGE model to examine the economy-wide impact of forest and plantation development in Laos. The strength of this model is due to its comprehensive general equilibrium framework, which allows us to understand the complex interdependencies and feedback effects between policy interventions and sectors in an economy and is thus the suitable technique for this study.

Results from simulations reveal that the forestry policy is likely to contribute a small but positive impact on the Lao economy. It is likely to increase the productivities of forestry and forestry related industries, and also to stimulate the aggregate values of household consumption and savings. Nevertheless, it tends to negatively affect various service sectors which do not have export commodities or consumption expansion.

The results indicate that the government tax revenue is likely to experience positive growth, but it is very small because of inefficient institutional agencies.

Overall, this policy will increase the prices of forestry and livestock commodities and those of several service goods. The prices of crop and nearly all manufacturing commodities will enjoy a negative growth rate as a result of a rapidly growing forestry sector.

Though the result of the analysis show that this forestry policy is likely to have positive outcomes for the macro-economy of Laos, stimulating sectoral outputs in the majority of industries and improving trade performance. However, plantation and forestry sector expansion can also lead to negative impacts on several service sectors as well as reductions in public consumption. In order to maximize the benefits from this policy and minimise the adverse impact, the Government of Laos will need to enforce forestry laws and other economic-related laws and implement supporting policies to ensure that all economic agents, particularly rural communities, benefit from these policy outcomes. Furthermore, because there is the lack of communication amongst various Ministries, agencies and administrations at local and national levels, it is imperative to ensure that this coordination transparent and effective. Finally, the government should improve the current economic institutions, in particular taxation and finance institutions, in order to take advantages of this policy outcome.

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