

Final Report

**Resource Boom, Growth and Poverty in Laos
- What Can We Learn From Other Countries and Policy Simulations?-**

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Abstract

Laos is a small, open Least Developed Country (LDC) in Southeast Asia. Laos was ranked 130th out of 177 countries. 34 percent of the population lives below the poverty line. However, it is a resource-rich economy with over 570 mineral deposits identified. As a result, since 2003, Laos has experienced massive foreign capital inflows in terms of Foreign Direct Investment (FDI) in the mining and hydropower sectors. Resource sectors contributed about 2.5% of GDP during 2000-2007; resource sector revenues account for 18% of total tax revenue (2007). On the other hand, resource sectors also have a negative impact on economy through appreciation of the real exchange rate and declining non-resource sectors, which called “Dutch disease”.

Despite the significant potential for both positive and negative impacts from resource booms on the Lao economy, there is a gap in the research on this issue in Laos. Therefore, the main objective of this study is to quantify the possible impacts of resource booms on nation-wide economy and poverty using a Computable General Equilibrium (CGE) model and provide policy recommendation to mitigate the negative impact from Dutch disease effect. In order to investigate the impact of mining sector on Lao economy, we assumed that productivity and capital stock in mining sector increase. The result shows that increasing productivity and capital stock of mining sector lead to increase value added, output, export and investment of mining sector which lead to increase real value of GDP, output, export and investment. However, it also decline real output, value added of agriculture, industry and government services which reflect to Dutch disease effects. In conclusion, expansion of mining sector has positive and negative benefit on Lao economy. Mining sector can improve real GDP and overall output of Laos. But it has adverse affects on Lao economy, it lead to decline in output in agriculture sector which shows Dutch disease syndrome. Therefore, it is important to have appropriate macroeconomic management and prudent management of expenditure windfall from mining is needed.

According to experiences and lesson learn from other countries and characteristics of Lao economy, the policy recommendation to mitigate Dutch disease effect is as follows. Firstly, it is important for policy maker to make Balance Budget Principle. Expenditure should focus on promote tradable goods especially expenditure must focus on human resource development, infrastructure and health care. Secondly, reduce/maintain low level of foreign borrowing is important for Laos during booming sector. In addition, borrowing should spend on human resource and infrastructure and health care development projects. Thirdly, it is crucial to pay back debt as soon as possible during government has windfall from mining. Fourthly, it is important saving windfall for using when booming sector finishing. Setting up mining fund for saving or investment in emergency time and external shock are crucial.

1.0 Introduction

Resource booms are important sources of finance for low-income, developing countries. On the other hand, resource booms have adverse economic effects if they are directed predominantly to booming sectors, or if government budget revenues expand significantly due to sudden upsurges in production in these booming sectors. The resulting 'Dutch Disease' syndrome occurs when capital inflows give rise to an appreciation of the real exchange rate, which in turn has a negative effect on tradable goods production (Gregory, 1976; Corden and Neary, 1982). Tradable goods such as agricultural and industrial goods are the engines of long-term economic growth, and therefore a shrinking tradable sector leads to declining growth.

Laos' national development goal is to liberate the country from the group of least developed countries (LDCs) by the year 2020 (GoL, 2004). In order to overcome poor infrastructure development, human resources and productivity, the Government of Laos is enthusiastic about promoting FDI, which has become an increasingly prominent source of capital in Laos. In 2007, the actual FDI inflows were estimated at about US\$950 million, an increase of 60% from 2006. About 90% of FDI value is related to the resource industry, and since the implementation of the successful Sepon mine in 2003, mining has accounted for the greatest share of the increases in FDI. Mining now accounts for the second largest share (after hydropower) of accumulated registered capital, 18.3% of the total.

The mining sector has considerable consequences for Laos' economic development, directly affecting the economy via four main routes (Kyophilavong, 2009a). Firstly, this sector contributes to demand- and supply-side GDP through increased investment and capital stocks. Secondly, as the domestic market is small, most mining products are exported to other countries, which helps narrow trade deficits. Mining products are Laos' most significant exports, accounting for 37.4 % of total exports during 2004-2006. Thirdly, royalties and taxes collected from mining projects help narrow the government budget deficit. In 2006/2007, non-tax renewable resources, which include the mining sector, accounted for 17.1 % of total tax revenues; these revenues are expected to increase as other mining projects are completed. Fourthly, because mining development requires a large labor force, it generates employment. FDI in the mining sector also indirectly affects economic and social development in rural areas through the development of infrastructure, the spillover effects on Small and Medium Enterprises (SMEs), and the new business generated for agriculture, livestock farming, and retail trade.

However, the mining sector could have a negative impact on the Lao economy in the long term if non-booming sectors such as agriculture and industry contract due to an appreciation of the real exchange rate. A number of studies have examined the impact of resource booms and foreign capital inflows in the context of other developing countries (Levy, 2007; Devaranjan et al., 1993; Benjamin et al. 1989, Usui, 1996). Yet despite the massive impact of resource-sector foreign capital inflows in Laos, and Laos is facing resource booms, research is scarce. One exception is Warr (2006), who used a CGE model – 1-2-3 model framework with multi-households to investigate Dutch Disease from hydropower project development. As the repercussions of resource booms in the mining sector are not well understood, our main

objective in this study is to use CGE model to quantify the potential impact of resource boom on poverty and to look for evidence of Dutch Disease. The main objective of this study is to quantify the possible impacts of resource booms on the Lao economy using a Computable General Equilibrium (CGE) model.

2.0 Literature Reviews

Many empirical studies suggest that naturally resource-rich countries have suffered from low economic growth if compared with naturally resource-scare countries (Sachs and Warner, 1995; Papyrakis and Gerlagh, 2004; Leite and Weidmann, 1999). There are various reasons for failures to effectively transform natural resources to growth including the Dutch disease¹ (Corden 1981; 1982; 1984 and Corden and Neary, 1982).

Corden (1984) conducted survey on resources boom and Dutch disease economies which was extensive references. Corden and Neary (1982) and Corden (1984) developed “core model” of Dutch disease economics. This core model defines three sectors: booming sector, tradables or lagging sector including exports and import-competing industries) and non-tradeable sector which includes services, utilities, transportation. The possible impact of Dutch-disease-type effects are (1) an improvement in technology of the booming sector; (2) an increase in foreign capital inflow; and (3) an increase in the price of the export commodity. There are two effects of booming in this core model, the “spending effect” and the “resource movement” effect. The booming lead to increase income and lead to increase spending on both tradeable and non-tradeable goods. As price of tradeable goods in determined by world market but price of non-tradeable good is determined by domestic. As a result, increase expenditure does not cause prices of tradeable goods but increase non-tradeable goods. Therefore, the prices of non-tradeable goods has trend to increase larger than tradeable goods which discourage the production of tradeable goods, which called ‘spending effects’. Moreover, during the boom- new resource discovery, the price of booming increase which move out factors from other sectors which called ‘resource movement effect’. These two effects contract tradeable goods which lead to de-industrialization (Corden and Neary 1982; Corden 1984).

There is a rich literature on Dutch disease in general and there are a number of economic tools for analyzing Dutch Disease. Firstly, Input-Output analysis is economic tool for evaluation the impact of mineral projects (Bocoum and Labys, 1993; Swisko, 1989) and others. Secondly, regression model is also popular econometric tools for analyzing the impact of resource boom on economic development (Sachs and Warner, 2001; Fardmanesh, 1991; Gylfasson, 2001; Brunnschweiler, 2007; Nyatepe-Coo, 1994) and others. Thirdly, macroeconomic modeling is also used for analyzing the impact of resource boom and policy simulation (Lawler, 1991; Usui, 1996; Kyophilavong and Toyoda, 2009) and others. Fourthly, Time Serial Data Analysis is also popular methodology for diagnosing Dutch Disease and the impact of government policy on economy (Al-Awadi and Eltony, 2001; Bjornland, 1998; Hutchison, 1994; Kutan and Wyzan, 2003; Oomes and Kalcheva, 2007 and

¹ Various empirical studies suggest, natural resource rich countries have suffered from low economic growth compared to natural resource scare countries (Sachs and Warner, 1995; Papyrakis and Gerlagh, 2004; Leite and Weidmann, 1999). There are six main factors for low economic growth in natural resources rich countries: (1) Dutch disease; (2) Insufficient economic diversification; (3) Rent seeking and conflicts; (4) Corruption and undermined political institutions; (5) Overconfidence and loose economic policies; and (6) Debt overhang.

Raju and Melo, 2003). The last economic tools is Computable General Equilibrium (CGE) Model which is very popular for analyzing the impact of resource booms².

However, we focus on the CGE model approach for an analysis of the Dutch disease. Devaranjan et al (1993) developed a 1-2-3 CGE model to estimate changes in the equilibrium real exchange rate in terms of trade shocks and changes in foreign capital flows. This model is popular and used to analyze Dutch disease. Benjamin et al (1989) used CGE model to examine the impact of an oil boom on Cameroon's economy. The results showed that one of the standard Dutch disease results can be reversed. Although the agricultural sector is most likely to be hurt, not all traded good sectors will contract, whereas and some of the manufacturing sectors will benefit. Benjamin (1990) added the investment dimension by incorporating a two-period optimization in a multisectoral computable general equilibrium (CGE) model for Cameroon. This model is used to test the impact of foreign-capital flow, tariff policy, and policy toward public firms. The simulation results showed the key role of import substitutes, specifically manufacturing in this case. Levy (2007) used a CGE model to study the impact of using Chad's annual oil revenue for public investment, which focused on development of road and irrigation infrastructure. The results showed that Dutch disease is not an unavoidable consequence of oil booms in Chad. There are a number of studies of Dutch disease using CGE model in other countries. Qiang (1999) and Clement, Ahammad and Qiang (1997) used CGE model to evaluate the impact of new mining and mineral processing projects in Western Australia on employment and the macro-economy. The analysis shows that both mining and mineral-processing projects will have substantial flow-on benefits to the Western Australia. Chand and Levantis (2000) used CGE model to investigate the mining of mineral boom in Papua New Guinea. The result confirmed that a resources boom will deliver a net welfare benefit, but far smaller than cost to equity.

However, there are very few studies in the Laos context on this phenomenon. Kyophilavong (2007) used a CGE model to analyze the impact of the ASEAN Free Trade Area (AFTA) on the Lao economy. This model is based on two sectors and represents a simple model which could usefully be updated in future. In addition, Kyophilavong and Toyoda (2008) used a macroeconomic model to investigate the impact of foreign capital inflow in the mining and hydro power sectors. Warr (2006) used a CGE model – 1-2-3 model framework with multi-households to investigate Dutch disease in Laos. This model is not adequate to identify Dutch disease; however there are some limitations with respect to government policy simulations. In addition, CIE(2010) used ORANI-G model to assessed the impact of Sepon mine project on Lao economy. However, this study did not explain clearly about model-setup and closure as well as simulation design.

These are vital questions as Laos develops its economy. Due to a lack of studies on the impacts of resource booms on the Lao economy and poverty, the above questions have yet to be answered properly. This research will address this knowledge gap.

² Bandara (1991) investigated Dutch-disease by developed a three-sector CGE model following 'core model' from Corden (1984) and Corden and Neary (1982). He confirmed that CGE model is well suited to analyzing Dutch-disease-type effect.

3.0. Lao Economy and Mining Sector

3.1. The current situation of Lao economy

Since introducing the New Economic Mechanism (NEM) in 1986,³ Laos has been in transition from a centrally planned economy to a more market-oriented economy. As a result, except during the Asia Financial Crisis of the 1990s, Laos has been achieving high rates of economic growth with low inflation. The average economic growth was about 6.53 % during 2001-2006, which increased from 6.18 % during 1996-2000.⁴ The average inflation rate was maintained at one digit during 2001-2006, which is a significant decline from the average rate of 57 % during 1996-2000. The exchange rate was also stable during 2001-2006 (Table 3-1). Of the nation's total GDP of US\$ 4,053 million in 2007, the agricultural sector accounted for 40.3 %, the industry sector for 34.1 % and the services sector for 25.6 % (World Bank, 2008). However, since 2003, the industry sector has grown more than 10%, which has caused the agricultural share of GDP to decline.

Even though Laos has been maintaining high economic growth with low inflation and a stable exchange rate, it still has serious macroeconomic issues to overcome. Firstly, Laos is basically facing chronic twin deficits in both government spending and international trade. The average ratio of budget deficit to GDP was 4.4% during 2001-2006. The average ratio of current account balance deficit to GDP was 9.24 % during the same period.⁵ These deficits are mainly financed by Official Development Assistant (ODA), Foreign Direct Investment (FDI), and remittances. The fiscal issue is particularly serious in Laos. If the budget deficit continues to expand, it might cause an accelerating inflation rate and the devaluation of the kip (Lao currency), and could lead to economic instability like during the period of the Asian Financial Crisis. Secondly, there is a huge gap between savings and investment. The savings rate is low because of low average incomes—GDP per capita was about US\$580 in 2007 (World Bank, 2008)—and because financial sectors are underdeveloped. The banking sectors are occupied by the state commercial banks, which are unable to perform full banking functions.⁶ Thirdly, Laos is also facing a high burden of external debts. The external debt accumulation was more than 60 % of GDP in 2007. If Laos becomes too dependent upon foreign finance, especially to meet its debt obligations, this could cause a foreign debt crisis and might lead to macroeconomic instability. As a result, recent resource booms are playing crucial factors on macroeconomic management in Laos.

³ After establishing the Lao People's Democratic Republic in 1975, the Lao government adopted a planned economy, following other socialist countries.

⁴ The engine of growth during this period was capita inflows of Foreign Direct Investment (FDI) in the mining and hydropower sectors and mining production and exports. For a more detailed discussion of the impact of FDI in the mining and hydropower sectors on the Lao economy see Kyophilavong and Toyoda (2008).

⁵ It is important to note that trade data which is used for this analysis is based on data from international organizations. The Lao government claimed that the trade deficit became a surplus in 2006.

⁶ More details about financial issues, monetary and exchange rate policies in Laos are discussed in Kyophilavong (2010).

Table 3-1 Key macroeconomic indicators

Macroeconomic indicators	2001-2006	1996-2000	1990-1995
Population (million. person)*	5.46	4.86	4.40
Population growth (%)	2.12	2.06	2.52
GDP (current million US\$) **	2,416	1,618	1,276
GDP growth (%)	6.53	6.18	6.46
GDP per capita (constant 2000 US\$) **	379	307	248
GDP per capita growth (%)	4.04	3.68	3.80
Reserve Money (M2) (million US\$)*	450,981	270,728	148,280
Money supply (M2) (%)*	21.14	65.99	30.92
Inflation -CPI (%)	9.73	57.00	15.27
Trade Deficit (million. US\$)***	-219.91	-263.21	-174.92
Trade Deficit /GDP (%)	-9.24	-16.06	-13.14
Foreign reserve (million. US\$)***	220	127	48
External debt (million US\$) *	2,640	2,410	1,965
External debt /GDP (%)	115	152	161
Budget Deficit (including grants)(million US\$)	-104	-58	-100
Budget Deficit /GDP (%)	-4.42	-3.60	-7.61
Budget Deficit (exclude grants)(million US\$)	-149	-121	-145
Budget Deficit /GDP (%)	-6.29	-7.58	-11.21
Exchange Rate (kip/US\$) Official Rate***	10,163	4,094	727

Sources:

* Asian Development Bank (ADB), *Key Indicators for Asia and the Pacific 2008* www.adb.org/statistics

** World Bank, *World Development Indicators CD-ROM (2005)* and

*** International Monetary Fund, *International Financial Statistics CD-ROM August 2008*

3.2. Mining sectors

FDI has induced to Laos since Laos has induced market mechanism since 1986. From 1989 to 2008, there were 1547 FDI projects with 9,525.8 million US\$ (Kyophilavong, 2009). FDI has increased sharply since 2003, of which FDI in the mining sector has the highest share. In terms of registered capital accumulation, the energy (hydropower) sector has the highest share, about 54.4 % of total capital. The mining sector share is 18.3% of total capital, which shows that FDI in the mining sector accounts for the second largest share of accumulated registered capital after the energy sector.

Thailand has the largest investment share, which accounts for 26.5% of total capital.⁷ The second largest investor is France, which accounts for 18.2 % of total capital, and the third is Vietnam (Kyophilavong, 2009). Mining development in Laos was not well-recognized until Sepon Mine⁸ was implemented in 2003. As of October 2008, there are 127 domestic and foreign companies (213 projects) involved in the prospecting period, exploration period and feasibility study period. 42 companies are domestic investors and 85 companies are foreign investors. Foreign companies consist of 48 Chinese (56.5%), 19 Vietnamese (22.4%), 6 Thai (7.1%), 4 Australian (4.7%), 2 Russian (2.4%), 2 North Korean (2.4%), Canadian (1%), 1 South Korean (1.2%), and 1 Polish (1.2%) companies.

The main drivers for natural resource boom could explain as follows. Firstly, Laos is poor country with generally unfavorable social indicators, per capita GDP in 2008 was \$887 as compared with a regional average (East Asia and Pacific) of \$3070. the national development goal of Lao government is to escape from Least Developed Country (LDC) by 2020, in order to achieve this goal, promotion foreign direct investment including mining and hydropower sector are top priority (GoL, 2004; 2008). Secondly, Laos is a resource-rich economy with over 570 mineral deposits identified (DOG, 2008). In addition, Laos has successful mining project which called Sepon mining. It has started to produce and export gold and copper. Thirdly, it has an increasing mineral price before Global Financial Crisis also are the main driver for resource boom in Laos. As a result, since 2003, Laos has experienced massive foreign capital inflows in terms of Foreign Direct Investment (FDI) in the mining sector. As of October 2008, there are 127 domestic and foreign companies (213 projects) and 85 companies are foreign investors (Kyophilavong, 2009).

There are about 35 working mines in Laos which include the Sepon and Phubia mines. Of the 35 working mines, only 2 working projects have modern production systems. There are 13 mines belonging to the Lao government: 7 mines managed by the Ministry of Energy and Mines, 5 mines managed by Ministry of Defence, and one mine managed by the Ministry of Industry and Commerce. Foreign investors manage 12 mines, of which China has 6, Thailand

⁷ There are three main reasons that Thailand has the largest share of investment in Laos. First is a geographical reason, as Laos shares a long border with Thailand. The second reason is cultural, as both countries share similar customs and culture. The third reason is due to capital, technology, and know-how, as Thailand is more developed than other countries in this region and so has increased capacity to invest in Laos.

⁸ For more details of the project, see Sepon Gold Mine (<http://www.ozminerals.com/Operations/Mining-Operations/Sepon-Gold.html>).

has 3 and Vietnam has 2. It shows that production and export from mining sector will highly increase in near future when those mining projects finish.

3.3. Contribution of mining sector

Since the NEM was introduced in 1986, Laos has been in transition from a centrally planned economy to a more market-oriented economy. As a result, with the exception of a period of negative growth following the Asia financial crisis of 1997, Laos had generally been achieving high rates of economy growth with low inflation. Average economic growth was about 7 % during 2000-2010. Inflation has been maintained below double digits since 2005, about 5.4 % in 2010 (IMF, 2011). Since 2005 the exchange rate has appreciated, 8,291 kip per US\$ in 2010 compared to 10,767 kip per US\$ in 2005 which appreciated about 23%. The share of agriculture sector to GDP has been declined from 35% in 2005 to 30% in 2010. In on other hand, industry sector have been increased from 21% in 2005 to 26% in 2010 (table 3-2).

Even though Laos has been maintaining high economic growth with low inflation and a stable exchange rate, there are still serious macroeconomic issues to overcome. Laos is basically facing chronic twin deficits in both government spending and international trade deficit. Deficit financing is mainly depended on foreign sources. Budget deficit to GDP was 4.9 % and current account deficit to GDP was about 10% in 2010 (World Bank, 2010). In addition, Laos also face high external debt. It shows that macroeconomic condition is weak in Laos.

As Lao economy is constraints by demand and supply side, resources sector play important role to economic development. Firstly, resources sector contribute to demand and supply-side GDP though increasing investment and capital stock. As FDI from resources sector flow to Laos, it lead to increase demand-side GDP; at the same time, the capital stocks also increase which leads to an increase in supply-side GDP. According to the World Bank (2010), resource sector contribute about 2.5% of the growth rate during 2005 to 2010. Secondly, resources sector also contribute to increase exports. As domestic market is small, most of resources sector export their product to foreign countries, which lead to narrow trade deficit for Laos. Resources sector contribute about 70% of total export share in 2010 and it is expected to increase as hydropower and mining sector development increase in future. Thirdly, as Laos face chronic budget deficits, resource sector contributes to narrowing the government deficit though increasing royalties and taxes. The share of revenues from resources sector to total revenues have been increasing, it was about 2.6% in GDP in 2010. And it is expected to increase as resources sector development and activities will increase in near future.

Table 3-2. Lao PDR: Macroeconomic and Financial Indicators (2005 to 2010)

	2005	2006	2007	2008	2009	2010
GDP and Price (percentage change)						
Real GDP growth	6.8	8.6	7.8	7.8	7.6	7.7
of which: resources*	2.9	2.6	0.2	1.9	2.8	3.7
CPI (Annual average)	7.2	6.8	4.5	7.6	0	5.4
Public finances(inpercentage of GDP)						
Revenue	12.1	12.5	13.9	14.4	14.9	15.5
Of which: resource	0.9	2	2.7	3.3	2.3	2.6
Grants	1.8	2	1.7	1.6	2.3	2.1
Expenditure	18.3	17.4	18.3	18.7	24.4	22.5
Current(includes contingency and discrepancy)	10.2	10.1	10.2	11.5	12.9	12.6
Capital and net lending	8.1	7.2	8	7.2	11.5	9.9
Overall balance(including grants)	-4.4	-2.9	-2.7	-2.8	-7.2	-4.9
Domestic financing	-0.1	-1.2	-1.1	-0.3	5	3.1
External financing	4.5	4.1	3.8	3	2.2	1.8
Balance of payments						
Exports(in millions of US dollars)	697	1133	1321	1605	1485	2125
In percent change	30.1	62.6	16.6	21.5	-7.5	43.1
Of which: resource	309	632	663	865	912	1459
share in total export (%)	44.3	55.8	50.2	53.9	61.4	68.7
Imports (in million US dollars)	1270	1602	2158	2829	2720	3031
In percent change	20.3	26.1	34.7	31.1	-3.9	11.5
Current account balance (in million US dolla	-492	-398	-672	-985	-984	-647
In percent of GDP	-18.1	-11.2	-15.9	-18.5	-17.6	-10.2
Gross official reserves (inmillion of US dolla	238	336	528	636	632	555
In moths of protective goods and	2.2	2.5	2.8	3.3	2.8	2
service imports						
External public debt and debt service						
Extenal public debt						
In million US	2203	2351	2521	2949	3109	3270
In percent of GDP	80.8	66	59.7	55.5	55.5	51.6
External public debt service						
In percent of Exports	7.4	3.6	4	4.3	5	4.8
Exchange rate						
Official exchange rate(kip per US end of perio	10767	9655	9341	8466	8476	8291

Source: IMF(2011) and World Bank (2010).

3.4 Dutch Disease Hypothesis, Its Syndrome and Policy Responds

There are mainly two effects of Dutch disease; (1) spending effects; and (2) resources movement effect. Spending effect refers to increasing government spending on non-tradable sector when government gain high windfall from booming sector. By increasing government expenditure on non-tradable sector, it leads to excess demand for non-tradable sector and

increase the price of non-tradable sector relative to price of tradable sector⁹. As a result, it leads to appreciation of real exchange rate. The resource movement effect refers to the movement of resources of tradable sectors including labors and capital to booming sectors because it increase profitability in booming sector and lead to increase price of factor products of booming sector. As a result, tradable sector is contracted due to reducing factor products.

Basically there are four syndrome for detecting Dutch Disease; (1) appreciation of the real exchange rate; (2) declining input factors of non-booming sectors; (3) declining exports and output of non-booming sectors; and declining real GDP (Corden, 1984 and Corden and Neary,1982). Due to data constraints, we will detect Dutch disease syndrome in term of appreciation of real exchange rate, declining labor productivity.

Real exchange rate¹⁰ has trend to be appreciated in Laos recently. We divide data from 1989 to 2006 in to three period followed Warr (2005). Period 1: from 1989- 1994 is called “post-reform adjustment”, period 2: 1995-1999 is called “hyperinflation and exchange rate depreciation, and period 3: 2000-2006 is called “sustained growth and foreign capital inflows”. Period 1 (1989-1994) was period of beginning economic reforms in Laos. The first investment law was adopted in 1988. Thereafter, foreign capital inflows in terms of FDI and ODA increased sharply. As a result, during this period, real exchange rate was appreciated about 4.3%. Period 2 (1995-1999) was a period of macroeconomic turmoil in Laos and Asia countries. Due to the Asia crisis which caused in Thailand in 1997, Laos experienced macroeconomic instability, hyperinflation, and nominal exchange rate chaos. Real exchange rate depreciation in this period was mainly caused by high deprecation of nominal exchange rate. During that period, the degree of the Lao currency, kip, was highest among the affected currencies by the Asian crisis. Period 3 (2000-2006) is categorized as the high growth period with huge foreign capital inflows. Price and nominal exchange rate became stable. The massive FDI of mining and hydroelectricity sectors has flowed to Laos. There are several mining and hydropower project are under way (Kyophilavong, 2009).For one of the biggest projects in hydroelectric power development in Laos, called “Nam Theun 2”, total investments is about US\$ 1.03 billion (about 35% of GDP in 2005). For mining sector, the most successful project is called “Sepon Mining Project” in the south of Laos. This project has been operated by Oxiana Resources Ltd of Australia¹¹. From massive inflows of foreign capital during this period, real exchange rate appreciated was about 3.3 % per year. The trend of appreciation of real exchange rate continues to increase. In 2007, real exchange rate appreciated about 5% and about 15% in 2008. From appreciation of real exchange rate perspective¹², Laos might be affected by Dutch disease¹³.

⁹ In this context, real exchange rate defines as the price of non-tradable sector relative to tradable sector.

¹⁰ Due to data constraints, we could not obtain price of tradable and non-tradable good for estimating real exchange rate. The real exchange rate define as nominal exchange*world price / domestic price. See more details in Kyophilavong and Toyoda (2008).

¹¹ In June 2009, Oxiana was sold MinMetals Group (MMG), a subsidiary of China MinMetals Corporation.

¹² It is important to note that recent appreciation of real exchange rate might be come from other factors such as weak US dollar itself; government policy for de-dollarization and increase growth and increase term of trade.

¹³ According to WB (2010),the real effective exchange rate appreciated by 50% between 2001 and 2009.

By comparing with other countries (the same income group), labor productivity in Laos is stagnated between 2005 and 2006 (World Bank, 2010). In addition, manufacturing exporter are less profitable than non-exports because exporter face higher labor cost and trade cost. The real wage in private and public sector have grown recently. It shows that natural resources boom has negative impact on labor productivity especially in manufacturing exporter. The sign of Dutch disease will be more clearer when the revenues from resource sector increase in middle term. As agriculture and manufacturing sector are sources of long run economic growth in Laos and there are high share of population belong to these sectors. If two sectors decline from effects of Dutch disease, it will contract long run economic development in Laos and the goal for escaping from LDC by 2020 might be difficult to achieve. However, Dutch disease can be avoided though various policy such as fiscal policies, exchange rate policy and foreign borrowing strategies, exchange rate policy (Usui,1996; Pinto, 1987, Larsen, 2006, Coden, 1981;1982;1984). However, unfortunately there are still no comprehensive policy and strategy to avoid the negative impact of booming sector from Lao government yet¹⁴. Therefore, it is important for Lao government to consider comprehensive and appropriate policy and strategy to cope with Dutch disease effects.

¹⁴ NT2 project have regulation and mechanism to allocate its revenues to economic sector such as environment and conservation, education and health and others but it is important to note that it is project based mechanism.

4.0. Methodology

4.1. Lao CGE model

In order to analyze the potential impact of resource booms on the Lao economy, a CGE model approach is used. We use PEP-1-1 model- Single-country static version which developed by Decaluwe et al (2009a).

The characteristics of the model are explained as follows:

(1) Static CGE model, single-country, 5-sectors including mining, agriculture, industry, private service and public service; (2) Multi-stage, constant-return to scale production technologies with substitution between inputs, including intermediate inputs, CES value added production function, investment demand distinguishes between gross fixed capital formation (GFCF) and changes in inventories. (3) Imperfect substitution between domestic and foreign commodities on both the import and export side (Armington assumption); (4) Competitive markets, neoclassical macro-closure, small country assumption; (5) Factor product is from labor, capital and natural resource for mining sector; (6) Mining sector has specific production function which including natural resource input in factor product.

In order to consider three categories in CGE model, we modified standard PEP model to match with Lao economic situation which based on assumption as follows. First is modification on labor market. About 80% of population in Laos belongs to agriculture sector. Labor from agriculture shifts to other sector such as manufacturing and services when off-farming season. When harvesting or farming season, labor will shift back to agriculture sector. As this circumstance, we assume that labor used in agriculture sector defined as informal labor. Labor used in manufacturing, public services, private services and mining define as formal labor. The relationship between informal labor and formal labor can express by equation as follow:

$$LD_{FOR} = \sum_i LD_{FOR} \quad (1)$$

$$\overline{LS} - \sum_i LD_{FOR} = LS_{INF} \quad (2)$$

$$LS_{INF} = LD_{AGR} \quad (3)$$

$$LS_{INF} = LD_{INF} \quad (4)$$

Where \overline{LS} denotes total labor supply. $\sum LD_{FOR}$ denotes total labor in formal sector (in manufacturing, public services, private service and mining). LS_{INF} is total informal labor supply. LD_{INF} are labor demand in agriculture sector.

Second is modeling natural resources in mining sector. Mining production is treated as specific sector which has three factors: labor, capital and natural resources¹⁵. We assume that

¹⁵ In previous study, they did not include natural resources as production factors for mining (For example see in Corden and Neary (1982); Benjamin, Devarajan, and Weiner (1989); Devarajan

natural resources in Laos is abundant in short-run which refer to supply of natural resources infinity, and the price of natural resources is fixed which equal to 1 (see figure 1). However, we assume that natural resources is limited in long-run which mean that price of natural resource will rise due to increasing of quantity of natural resources.

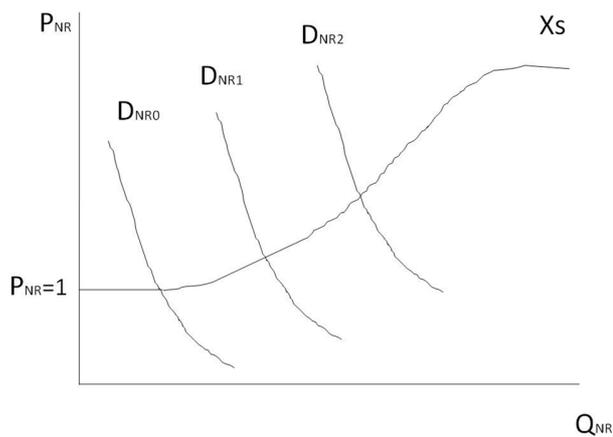
$$XS_{MIN} = f(L_{MIN}, K_{MIN}, NR_S) \quad (5)$$

$$NR_S = \text{infinite (in short-run)} \quad (6)$$

$$NR_S = NR_D \quad (7)$$

Where XS_{MIN} denotes output of mining. L_{MIN} is labor supply in mining sector. K_{MIN} is capital in mining sector. NR_S is supply of natural resources. NR_D is demand of natural resources. Here, it important to note that we assume that NR_S is infinity in the short-run reflecting that Laos has abundant natural resources.

Figure 1. Natural resources supply curve



Third is capital (K) in mining production equation is mobile¹⁶. Fourth is neglect firm in our model. Because GTAP database does not include firm and data on firm is limited in Laos. In addition, we also follow studies of Warr (2006) and Warr, Menon and Yusuf (2010) which neglect firm in model.

The closure of model needs to reflect real economic situation of Laos and objectives of this simulation. We made closure as follow. First, Laos uses managed-floating exchange rate

Lewis, and Robinson, 1990). They did not include natural resources in mining production factors for Lao CGE model (Warr, 2006; CIE, 2010).

¹⁶ However, capital stock in mining is fixed in some studies from Cook and Lees, 1984; Higgs and Powell, 1984; Benjamin, Devarajan and Weiner, 1989 and Clement, Ahammad, and Qaing (1997) treated capital stock in industry fixed.

regime, the Bank of Lao PDR issues reference rate to make commercial bank to follow (Kyophilavong, 2010). Therefore, we make the numeraire is the nominal exchange rate¹⁷. Second, current account balance is fixed¹⁸. Third, minimum consumption of commodity by household is fixed. Fourth, Lao economy is small that it does not have a significant impact of the rest of the world. World price of export and import product is exogenous. Fifth, inventory change is exogenous. Sixth, total investment expenditure is determined by the saving.

Parameters are one of the most important considerations in a CGE model. Some studies have found that different parameters lead to different policy results (Abler et al, 1999). Basically, some parameters for this study are calibrated from SAM. However, some parameters for the CGE model are not available in Laos. Therefore, we use free parameters are from existing studies from Warr(2006), Warr et al (2010) and CIE (2010)¹⁹.

4.2. Data requirements and sources

In order to build a CGE model, a CGE model data set, Social Account Matrix (SAM), is needed. However, there is no existing Social Account Matrix (SAM), Input- Output table, and National Account for the Lao economy. Therefore, we had to build the Lao SAM from various data sources. First, we extract Lao SAM from GTAP data base²⁰ (version 7) following by McDonald and Thierfelder (2004) and PEP(2011).Secondly, Lao SAM (2004) was updated to 2009 by using various sources of data such as National Statistic Center (NSC)²¹, IMF, ADB, and the World Bank (NSC (2008); IMF(2011); ADB(2011); WB(2011)). However, in order to use a standard PEP model from Decaluwe et al (2009), the above Marco SAM must be adjusted to follow the standard PEP model's SAM. The Lao Macro-SAM (2009) is shown in appendix 4-1.

In order to use SAM in a CGE model, it is important to disaggregate macro-SAM from micro-SAM. There is no unique way of disaggregating and organizing the data in micro-SAM. The number of accounts in each category depends on the objectives of the study and the data conditions. In this study, due to data limitations, several assumptions will be made in order to build a micro-SAM for the Lao CGE model for analyzing the impact of mining on

¹⁷ Levy (2007) also treated nominal exchange rate as exogenous and Benjamin, Devarajan, and Weiner (1989) used nominal exchange rate as the numeraire. In addition, core model of Dutch-disease-effect model of Corden, W. M. and Neary, J. P. (1982), Corden, W. M. (1982) used the exchange rate as numeraire. However, Dervis, Melo and Rosinson (1982) used nominal exchange rate as endogenous.

¹⁸ Levy, S. (2007) and Dervis, K., de Melo, J., and Rosinson, S. (1982) treats trade balance is not constraints, trade imbalance is made adjustment through real exchange rate adjustment.

¹⁹ CIE (2010) used parameters from Thailand and Vietnam for their studies.

²⁰ The Lao SAM in GTAP data base was extension of Savannakhet input-output table which built by ADB(2005).

²¹ Because the National Account for Laos is not well organized, we used several data sources from international organizations such as the World Bank and Asian Development Bank for building Macro-SAM.

Lao economy. Due to the different data sources, the micro-SAM is unbalanced²². We balanced SAM by hand-using simple technique.

4.3. Basic Structure of Lao Economy from SAM

4.3.1 Household

The main source of household income is from wage income and capital income. Household spend most of their expenditure to industry sector and private services (table 4.1).

Table 4.1. Sources of household income and expenditure

	Income		Expenditure
Wage income	38.8	Direct tax	4.1
Capital income	43.9	Consumption	
Land rent	12.0	Agriculture	11.8
Natural resources	5.4	Industry	55.6
Total	100.0	Private services	24.8
		Government services	0.7
		Mining	0.0
		Saving	3.0
		Total	100.0

Sources: authors' computations.

4.3.2 Factor of production

As mentioned in previous section, there are two main sources of household income (wage income and capital). Therefore, the impact of mining on these factors has important effects on their welfare. In order to understand this, we examine production factors from each sector.

Labor is remunerated primarily by the agriculture, industry, private services, and government services, but capital income is derived mainly from industry, private services and mining (table 4.2). If the impact of mining sector leads to expand the agriculture sector, it will increase land lent relative to other factor (capital).

²² There are various methods can be used to balance the micro-SAM (Fofana et at, 2005; Corong 2007). However, it might effect on important value in SAM.

Table 4.2 Sectoral factor remuneration and factor market share

	Agriculture	Industry	Private services	Government services	Mining	Total
Wage income	20.9	7.9	38.3	32.5	0.4	100.0
Capital income	16.3	14.6	54.5	0.0	14.5	100.0
Land rent	100.0					100.0
Natural resources					100.0	100.0
Wage income	0.4	5.0	7.8	60.3	2.4	
Capital income	24.9	67.6	64.1	0.0	26.2	
Land rent	37.1	0.0	0.0	0.0	0.0	
Natural resources					71.4	
Total (value added)	100.0	100.0	100.0	100.0	100.0	

Sources: authors' computations.

4.3.3 Consumption and output

The impact of mining on household consumption mostly depends on household consumption share and consumer price changes. Industry has a highest share of consumption among sector (table 4.3). Therefore, the price effects of mining sector will change consumption patterns of household. The mining output shares about 10% of total output, and most of output of mining sector is for export.

Table 4.3 Consumption share and output share

	Consumption share	Output share	Import	Export	Import/ consumption	Export/ output
Agriculture	12.7	17.6	31.6	4.3	8.6	4.6
Industry	59.8	20.3	6.3	0.9	1.7	0.9
Private services	26.7	43.7	12.1	1.7	3.3	1.8
Government services	0.8	8.2	0.0	0.0	0.0	0.0
Mining	0.0	10.2	50.0	93.1	13.7	99.6
Total	100.0	100.0	100.0	100.0		

Sources: authors' computations.

4.3.4 Government

Mining sector is important source of government revenues in term of tax, royalty and dividend. About 50% of sources of government income is from import duties and about 20% of total income is from income tax and production tax (table 4.4).By expansion of mining activities, it might affect government income. Government spends most of its income to government services sector.

Table 4.4 Sources of government income and expenditure

	Income		Expenditure
Income taxes	22.5	Agriculture	0.0
Production taxes	21.0	Industry	20.4
Imports duties	56.5	Private services	2.4
Export tax	0.1	Government services	76.2
Total	100.0	Mining	1.0
		Total	100.0

Sources: authors' computations.

5.0 Simulation Design and Results

5.1 Simulation

There are various channels of impact of mining on economy, its impact mainly divided into two phases: construction phase and production phase²³. However, in this simulation, we focus on production phase. In order to capture the impact of mining sector on Lao economy, we do simulation design as follows.

Simulation 1: Increase capital in mining

As mentioned above, our simulation focus on production phase and make assumption that mining expand investment²⁴. Following by Clements et al. (1996), we do not distinct between mining and mineral process in our study²⁵. However, in our simulation, we assume that construction phase capital stock do not switch on- productive capacity of mining industry does not enhanced and we assume that capital stock expand during production period. We assume that capital supply in mining sector will increase about 10%.

Simulation 2: Increase productivity

Mining investment are mainly from foreign direct investment (FDI). Recent investment come from neighbouring countries which have low technologies (Kyophilavong, 2009). However, Lao government gives green light to the European Union and developed countries such as Japan, Australia and Canada to invest in mining sector. FDI from advanced countries has high technology, know-how and experiences rather than domestic mining firm and neighbouring countries investor²⁶. Therefore we assume that total factor productivity will increase 5%.

Simulation 3: Impact of mining

The simulation 3 is combine simulation 1 and 2. We assume that increase the mining of capital inflows from advanced countries which have high technology in mining. This simulation refer to the impact of mining sector on Lao economy²⁷. The summary of simulation design is shown in table 5-1.

²³ Some of the studies considered both construction phase and production phase (Cook and Lees, 1984; Clement, Ahammad, Qaing, 1997; Higgs and Powell, 1984).

²⁴ The assessment of the impact of mining through increase capital stock also find in Lay, Thiele, and Wiebelt (2006).

²⁵ However, there are some studies distinction between mining and mineral process (Qiang, 1999). In addition, Higgs and Powell (1992) simulated the impact of mining project by distinguishing the construction phase from the production phase in a typical year.

²⁶ The simulation of the impact of mining sector on Lao economy and poverty though increase resource input and TFP improvement in mining sector (Chand and Levantis, 2000).

²⁷ There is also mineral price effect from mining sector. Mineral price is fluctuated more than 30% (Davis and Tilton, 2005). For instant, mineral price dropped sharply during the Global Financial Crisis and it has negative impact on Lao economy. Therefore, we neglect price effect in this study.

Table 5-1. Simulation design

	Capital inflow	Total factor productivity
Simulation 1	increase 10%	
Simulation 2		Increase 5%
Simulation 3	increase 10%	increase 5%

Source: the authors.

5.2 Results

We focus result of the simulation 2 which combines simulation 1 and 2 and it refers to impact of mining sector (booming) on Lao economy. The impact of mining on macroeconomic variables is shown in [table 5.1](#). Mining sector has positive impact on real GDP, real output, real export and real investment. The impact of mining sector leads to increase about 2% of GDP, 5% of investment, and 4% of import. In on the other hand, mining sector has negative impact on overall real consumption and real output. The real consumption declined 4%, and real output decline about 0.2%. This result is consistent with previous studies (Benjamin, Devarajan and Weiner, 1989; Higgs and Powell, 1992).

The impact of mining sector on sectoral effects is shown in [table 5.2](#). Due to increase productivity and capital stock in mining sector, it leads to increase output of mining, agriculture and private services. But it leads to decline in agriculture and government services. The output of mining sector increase about 10% comparing to industry sector (0.5%), and private service sector (2%). It shows that increasing output of mining sector is large but increasing of output of industry and private service sector is relatively small²⁸. The main reason for this is the linkage between mining sector and industry and private services is not weak. The declining of agriculture also refers to factor movement effects in Dutch disease hypothesis (Corden and Neary, 1982; Corden, 1984).

²⁸ This result of this study is consistent with result from Bandara (1991).

Table 5.1 Macro effects (percent change from base case).

	Simulation 1	Simulation 2	Simulation 3
	Increase capital in mining sector 10%	Increase total productivity of mining sector 5%	Simulation 1+2
Price			
GDP deflator	-1.763	-0.943	-2.706
Consumer price index	0.820	0.445	1.265
Investment price index	-1.658	-0.904	-2.562
Export price	0.344	0.183	0.527
Import price	0.000	0.000	0.000
Output	1.267	0.681	1.948
Value added price	-10.113	-5.524	-15.637
Real variables			
GDP	1.107	0.633	1.740
Consumer	-2.818	-1.478	-4.296
Investment	3.812	2.082	5.894
Export	0.059	-0.018	0.041
Import	3.131	1.691	4.822
Output	-0.162	-0.085	-0.248
Value added	11.218	6.120	17.338

Source: authors' computations from model.

Table 5.2 Sectoral effects (Percent change from base case).

	Simulation 1	Simulation 2	Simulation 3
	Increase capital in mining sector 10%	Increase total productivity of mining sector 5%	Simulation 1+2
Output			
Agriculture	-0.817	-0.433	-1.251
Industry	0.292	0.164	0.456
Private services	1.239	0.677	1.916
Government services	-1.966	-1.061	-3.027
Mining	6.775	3.634	10.408
Value added			
Agriculture	-0.817	-0.433	-1.251
Industry	0.292	0.164	0.456
Private services	1.239	0.677	1.916
Government services	-1.966	-1.061	-3.027
Mining	6.775	3.634	10.408
Total intermediate demand			
Agriculture	0.199	0.114	0.314
Industry	5.506	2.955	8.461
Private services	5.068	2.720	7.788
Government services	2.914	1.568	4.483
Mining	2.830	1.523	4.353
Consumption household			
Agriculture	-1.883	-0.993	-2.876
Industry	-2.071	-1.066	-3.137
Private services	-2.697	-1.415	-4.112
Government services	-2.998	-1.575	-4.573
Mining	-0.342	-0.119	-0.460
Investment			
Agriculture	1.080	0.597	1.677
Industry	2.405	1.315	3.719
Private services	1.281	0.710	1.991
Government services	1.022	0.576	1.598
Mining	4.982	2.692	7.673
Export			
Agriculture	-1.917	-1.042	-2.959
Industry	-1.556	-0.845	-2.401
Private services	-1.879	-1.018	-2.896
Government services	6.962	0.000	6.962
Mining		3.732	3.732
Import			
Agriculture	2.849	1.560	4.409
Industry	3.962	2.138	6.100
Private services	6.720	3.594	10.314
Government services	1.891	1.020	2.911
Mining	0.236	0.140	0.376

Source: authors' computations from model.

The impact of mining sector leads to decline rental rate of capital in mining sector. The rental rate of mining sector declined about 90%. But it leads increase rental rate of capital in agriculture, industry, private services, and government services²⁹. The rental rate of agriculture, industry, private sector and government services increase about 2%, 5%, 8%, and 2% relatively. In addition, the impact of mining sector leads to increase wage rate (table 5.3).

The mining sector has negative impact on income of household. The income of household declined about 2% because capital income decline about 6% which is more than increasing of labor income (increase about 4%). However, it has positive impact on government income, government income increase about 4%. As declining of income of household lead to declining of household saving (table 5.4).

Table 5.3 Effect on rental rate of capital and wage rate

	Simulation 1	Simulation 2	Simulation 3
	Increase capital in mining sector 10%	Increase total productivity of mining sector 5%	Simulation 1+2
Rental rate			
Agriculture	1.107	0.610	1.717
Industry	3.218	1.736	4.955
Private services	4.977	2.674	7.651
Government services	1.291	0.694	1.985
Mining	-62.751	-31.065	-93.816
Wage rate			
Agriculture	2.578	1.381	3.960
Industry	2.593	1.389	3.983
Private services	2.600	1.393	3.993
Government services	2.640	1.413	4.054
Mining	2.592	1.388	3.980

Source: authors' computations from model.

²⁹ It is important to note that we assume that capital stock is mobilized in all sector.

Table 5.4 Effects on income

	Simulation 1	Simulation 2	Simulation 3
	Increase capital in mining sector 10%	Increase total productivity of mining sector 5%	Simulation 1+2
Income			
Total income of households	-1.420	-0.714	-2.134
Capital income	-3.970	-2.051	-6.021
Labor income	2.601	1.393	3.994
Total government income	2.774	1.505	4.279
Saving			
Household savings	-1.420	-0.714	-2.134
Government savings	58.444	31.713	90.157

Source: authors' computations from model.

6.0 Conclusion and policy recommendation

The mining sector is booming in Laos. Despite its benefits, mining sector also has adverse impact on Lao economy which called Dutch disease. Due to limitation of studies on this issue, the impact of mining sector on Lao economy is not well understood. Therefore, the main objective of this paper is attempted to assess the impact of mining sector on Lao economy using CGE model and provide policy recommendation to mitigate the negative impact of mining sector. The booming of mining sector has positive impact on Lao economy in term of increase real value of GDP, real export and real investment. Booming of mining sector contribute to increase about 20% of real GDP. Booming of mining sector expand output, value added, and consumption of mining itself, but it also decline output, value added and consumption of agriculture and government services. It shows Dutch disease syndrome which refer to factor movement effects. Inclusion, booming of mining sector has positive and negative benefit on Lao economy. Mining sector can improve real GDP but it has adverse affects on Lao economy, it lead to decline in output in other sectors which shows Dutch disease syndrome.

However, this study is characterized by several weaknesses which need to improve for future studies. Firstly, this model is static CGE model which do not reflect investment flows from mining investment. Secondly, there are various impact of mining sector on Lao economy, this study focuses only on increasing capital stock and productivity in mining sectors, without considering other factors. Thirdly, this approach does not capture feedback from externalities of mining (Bridge, 2004; McColl, 1980). For instance, increased pollution from mining sector has an inverse impact on the productivity of firms and decreasing household utilities (Xie and Saltzman, 2000). Fourthly, It is important to capture winner and loser from the impact of mining by spilt the household to various categories. Fifthly, It is important to focus on windfall management (transfer) because it is crucial for sustainable economic growth and poverty reduction (Same, 2008; Warr, 2006).

There are various policies available³⁰ in order to mitigate Dutch disease (Hausmann and Rigobon, 2002; Rosenberg and Saavalainen, 1998). The impact of fiscal policies, exchange rate policy, foreign borrowing strategies was discussed in Usui (1996) in the case of Indonesia. Larsen (2006) examined various policies in Norway to avoid the Dutch disease. Tax policy and subsidies, as well as exchange rate protection were discussed in Coden (1981;1982;1984).

Based on lesson learned from other countries and situation of macroeconomic in Laos. We give four points in order to mitigate or avoid Dutch Disease in Laos. Firstly, it has a evidence that increasing expenditure from windfalls lead to accelerate appreciation of the real exchange rate which will contract non-booming sector. Therefore, it is important for policy maker to make Balance Budget Principle. Expenditure should focus on promote tradable goods especially expenditure must focus on human resource development, infrastructure and health care. Secondly, countries with booming sectors are attractive to donors. Increasing

³⁰ These policy recommendations do not come from this empirical results. But it was based on literature reviews and experiences in some resources-rich countries.

foreign borrowing during booming period will have severe impact on tradable goods through appreciation of the real exchange rate. Therefore, reduce/maintain low level of foreign borrowing is important for Laos during booming sector. In addition, borrowing should spend on human resource and infrastructure and health care development projects. Thirdly, Laos is facing high external debt, as increase domestic expending will lead to appreciation of real exchange rate which will contract non-booming sector. Therefore, it is crucial to pay back debt as soon as possible during government has windfall from mining. Fourthly, windfall from booming sector will finish one day in future. Therefore, it is important saving windfall for using when booming sector finishing. Setting up mining fund for saving or investment in emergency time and external shock are crucial.

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