An Empirical Study of Trade and Foreign Direct Investment in Laos

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Abstract

The integration process of Laos into the world economy started with the New Economic Mechanism (NEM) reforms in 1986 and has continued ever since. Between 1986 and 2010, the economy and society of Laos had been transformed. International trade had grown rapidly, foreign direct investment (FDI) inflows had continuously increased, and economic growth had been rapid. Income per capita had increased substantially and absolute poverty had been reduced gradually. Integration has been the main driver of Laos' economic and social development. The Lao PDR has shown a clear policy transition for foreign investment over time from an import-substitution regime to an export-oriented regime and has been pursuing different international trade and foreign investment policies at different times depending on the development objectives and economic situation in the country.

However, future gains for Laos may be facing a crucial set of policy questions: how can the country sustain high economic growth through higher productivity growth rates and more efficient capital investment that will lead to higher gross domestic product (GDP) per capita and further reductions in poverty?; and how can Laos prepare itself to reap full benefits that are potentially brought by the deepening economic integration in East Asia?

The main conceptual objectives of this dissertation are formulated on the premise of the long-term strategic significance of moving toward higher productivity levels and sustaining economic growth in Laos. First, the dissertation analyzes the fundamental factors characterizing the patterns of FDI-trade linkages in Laos. Second, it assesses the potential impact of free trade area in East Asia on Laos' trade. Finally, the dissertation evaluates the externalities of capital goods imports and FDI inflows on production efficiency in Laos.

The analysis of FDI-trade linkages in the Lao economy is based on two empirical models. The first model is the panel causality analysis which is used to test whether trade and inward FDI flows are complements or substitutes. The second model is the three-factor model which is used to investigate the fundamental determinants of FDI-trade linkages in Laos. A data set of balanced panel with 72 trade or FDI partners of Laos over the

period 1989–2009 is employed in this analysis. The panel causality regressions between FDI and trade show that the contribution of the rising FDI inflows to trade and vice versa is small, which is between 0.01% and 0.03% annually. The empirical results based on the three-factor model show that country's characteristics associated with increased trade with Laos are not necessary to be associated with increased inward FDI to Laos. Other things being equal, trade and FDI are complements with respect to changes in relative physical capital endowment and historical links, whereas they are substitutes with respect to transportation costs, relative human capital endowment, and relative labor endowment. With respect to country characteristics that have been ignored, trade and FDI are complements.

Furthermore, employing an unbalanced panel dataset of bilateral trade flows from 1992–2009 the dynamic gravity model is estimated to assess the potential impact of free trade area in East Asia on Laos' trade. The simulation analyses show that the formation of free trade area in East Asia could increase export of Laos by a considerable amount: 258.2% ($272.4 million) in the context of ASEAN+3 and 256.2% ($278.4 million) in the context of ASEAN+6. However, these integrations could harm the Laos' trade if all tariff barriers are completely removed due to its low competitiveness.

Finally, using an unbalanced panel dataset of 81 developing countries from 1995–2010 the stochastic frontier production model is applied to evaluate the impacts of capital goods imports and inward FDI flows on national efficiency in Laos. It is found that the Laos' production function is determined by physical capital, human capital, labor inputs, and foreign research and development. The results also show that trade and inward FDI flows can serve as carriers of knowledge accumulation from advanced countries to Laos and that the opening up of Lao economy through increased imports of capital goods contributes to production efficiency about 28%. However, the contribution of FDI inflows on production efficiency is only 0.23%, suggesting that there is still much progress to be made to enhance Laos' production efficiency through FDI inflows.

Key words: Lao economy; FDI-trade linkage; gravity model; three-factor model; ASEAN+6; production efficiency

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Table of Contents

List of Tables

List of Figures

Abbreviations

ACMECS	= Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy Organization
AFTA	= ASEAN Free Trade Area
AIA	= ASEAN Investment Area
AISP	= ASEAN Integrated System of Preference
APEC	= Asia Pacific Economic Cooperation
ASEAN	= Association of Southeast Asian Nations
BOL	= Bank of the Lao PDR
C.I.F	= Cost, Insurance, and Freight
CEPT	= Common Effective Preferential Tariff
CER	= Closer Economic Relations
CES	= Constant Elasticity of Substitution
CGE	= Computable General Equilibrium
CMEA	= Council for Mutual Economic Assistance
EAS	= East Asian Summit
EHP	= Early Harvest Program
EPA	= Economic Partnership Agreements
EU	= European Union
F.O.B	= Free On Board
FDI	= Foreign Direct Investment
FOF	= Flow of Funds
FTA	= Free Trade Area
GMM	= Generalized Method of Moment
GMS	= Greater Mekong Sub-Region
GSP	= Generalized System of Preferences
GTAP	= Global Trading Analysis
IL	= Inclusion List
KN	= Lao National Currency, kip
Lao PDR	= Lao People’s Democratic Republic
LDC	= Least Developed Country
LPI	= Logistics Performance Index
LR	= Likelihood Ratio

MFN = Most Favored Nation

MNE = Multinational Enterprises

MRC = Mekong River Commission

NEM = New Economic Mechanism

NPL = Non-performing Loans

OECD = Organization for Economic Co-operation and Development

OLS = Ordinary Least Squares

PPML = Poission Pseudo-Maximum-Likelihood

RTA = Regional Trade Agreement

RMSE = Root Mean Squares Error

SOCB = State Owned Commercial Bank

SOE = State Owned Enterprise

WTO = World Trade Organization

Map of the Lao PDR

Source: Obtained from http://www.worldatlas.com.

Key Economic Indicators for Lao PDR: 1981–2010

Key indicator	1981–1990	1991–2000	2001–2010
Population (million)*	4.2	5.3	6.2
Annual GDP growth (%)	4.6	6.2	7.1
Real GDP per capita (2000 US$)*	227	326	555
GDP by sector (%)			
Agriculture	61	56	41
Industry	14	20	26
Services	25	24	33
FDI inflows (annual average) (US$ million)	1	58	150
FDI inflows (% of GDP)	0.1	3.7	3.3
FDI inflows (% of gross fixed capital formation)	0.9	31.3	9.2
Exports of goods and services (% of GDP)	7.7	24.9	32.1
Imports of goods and services (% of GDP)	18.0	37.9	42.9

Notes: Simple annual averages over time period. * Data for 1990, 2000 and 2009 only.

Sources: World Development Indicators and Global Development Finance of the World Bank and UNCTADstat of the United Nations Conference on Trade and Development.

Introduction

International trade and foreign direct investment have often played a crucial though not necessarily favorable role in the development of least developed countries (LDC). Access to the markets of developed countries can provide a significant stimulus for the greater utilization of idle human and capital resources. Increased foreign-exchange earnings through improved export performance can also be used to finance their scarce physical and financial resources. FDI can be a source of direct capital financing and valuable technology and know-how while fostering linkages with local firms.

In view of the possible gains from trade and FDI, many developing countries have allocated many incentive schemes to promote trade and attract FDI. These FDI and trade promotion policies are particularly acute in the Lao People's Democratic Republic (subsequently Laos or Lao PDR), where trade and FDI barriers have been gradually removed. To further stimulate sustained economic growth, industrialization may be required. Policies to enhance international trade and promote FDI therefore seem a clear means to boost the domestic production and integrate the country into the regional and global economy, and thereby remove Laos from of the list of less developed country.

The integration process of Laos into the world economy started with the New Economic Mechanism reforms in 1986 and has continued ever since. At that time Laos was essentially a closed economy. The NEM reforms were undertaken unilaterally following the collapse of the Soviet Union and the withdrawal of the Council for Mutual Economic Assistance (CMEA) support, which resulted in a huge external push for the domestic reforms in the Lao economy and for changes in the trade and investment regime.[1]

During 1986–2010, the economy and society of Laos had been transformed. Trade had grown rapidly, FDI inflows had continuously

[1] The CMEA was established in 1949, agreed upon by the Soviet Union, Bulgaria, Czechoslovakia, Hungary, Poland, and Romania. Prior to 1985, the Lao PDR had intensively traded with members of CMEA countries, accounting for more than half of Laos' trade volume (Otani and Pham, 1996, p.27).

increased, and economic growth had been rapid. Per capita incomes had increased substantially and absolute poverty had been reduced gradually. Integration has been the main driver of Laos' economic and social development. The initial NEM reforms were followed by membership of Association of South East Asian Nations (ASEAN), by the preparation process of World Trade Organization (WTO) accession, and by participation in the ASEAN Free Trade Area (AFTA) and ASEAN plus agreements.

However, future gains for Laos may be more challenging. Over the last two decades (1990–2010), structural change has involved the gradual shift of workers from labor-intensive-low-productivity agriculture to labor-intensive manufacturing. The challenge for the future is how to move further up the value chain and to increase productivity levels by even more. Therefore, a crucial policy question for Laos is how the country can sustain high economic growth through higher productivity growth rates and more efficient capital investment that will lead to higher GDP per capita and further reductions in poverty.

The existing literature on Laos' trade and foreign direct investment is limited and the implications of promoting trade and FDI inflows for economic development have barely been explored. The discussion centers very much on whether the domestic investment climate should be improved so as to facilitate trade and investment, even though trade and FDI patterns are significantly influenced by economic conditions of FDI-source and trading-partner countries and geographical factors, especially distance. Moreover, increased trade and FDI inflows must not be analyzed solely in terms of whether they are advantageous given the present conditions, it is also important to ask whether and in what ways they are linked and can contribute to overcoming structures that present obstacles to economic development in Laos.

The main conceptual objectives of this dissertation are formulated on the premise of the long-term strategic significance of moving toward higher productivity levels and sustaining economic growth in Laos.

First, the dissertation analyzes the fundamental factors characterizing the patterns of FDI-trade linkages in Laos. More precisely, it first identifies characteristics of a country that are significant in determining the volume of bilateral trade and FDI between that country and Laos; then it investigates

the patterns of trade and FDI of Laos across the main regions in the world; and finally it evaluates how trade and inward FDI flows interact over time. This main objective is based on an argument that export earnings mostly generated from FDI activities in the mining sector provide a mechanism for Laos to acquire the hard currency needed to finance intermediate and capital goods imports. While changes in Lao exports reflect the instability in hard currency earnings and hence disruptions in economic planning goals, some of these changes also imply the flexibility on the part of Laos to adjust these earnings, when found necessary. In addition, changes in economic conditions of FDI-source and trading-partner countries can lead to a shortage of capitals and hence reduce investments and economic growth in Laos.

Second, the dissertation assesses the potential impact of ASEAN trade enlargement on Laos' trade. This argument is grounded on the fact that in landlocked countries, exporting low-value-added products coupled with poor infrastructure may actually have low competitiveness although tariff barriers in the export markets are lowered or removed. These problems are particularly acute in Laos, where primary-commodity exports account for more than 70% of its total exports. Given the possibility of ASEAN enlargement into ASEAN+3 or ASEAN+6, it is unclear whether the small country as Laos stands to gain from such enlargement.

Finally, the dissertation evaluates the externalities of capital goods imports and FDI inflows on production efficiency in Laos. The term 'externalities' refers to the importation of capital goods and FDI inflows that may affect domestic efficiency by influencing the absorptive capacity for foreign research and development (R&D) and the resource allocation and utilization across sector. This objective is formulated on the fact that capital goods imports embody knowledge of foreign technology and production know-how; the greater these imports the greater the scope for direct absorption of foreign innovations by the importing firms and for spillover of this knowledge to other firms. With greater absorption of foreign technology through capital imports the nearer a country can be to the production frontier and the lower the measured inefficiency. FDI inflows can improve the productivity resulting from increased domestic competition. The competition effects result from the increased numbers of firms (domestic and foreign)

operating within the market and the resulting improvements in quality and incentives to reduce slack.

Laos offers an interesting case study on trade and FDI for two reasons. First, among developing economies, Laos has experienced a high level of economic growth and also gradually attracted FDI inflows since 1988. Before the NEM reforms in 1986, the Lao economy was operating under a centrally planned system and studies on Laos are rare because of the lack of data. Second, the Lao government promulgated the Law of Foreign Investment in 1988 so as to attract FDI inflows as well as to stimulate technology transfer from foreign to domestic enterprises. Among other policies, the main purpose of this law is to promote innovation and boost productivity of domestic firms and thus increases the net exports. Consequently, a case study of Laos provides us insight about the effectiveness of government policies.

The research project is conceptually complex and empirically diverse with a number of implications of cognitive research and policy oriented recommendations. The expected outcomes can be formulated as follows:

First, the identification of the major static and dynamic factors that influence the trade and investment between Laos and the partner countries. A comprehensive statistical database are constructed covering the period 1989–2010 which can be used for future research in this area.

Second, extensive econometric analysis of trade and investment through the extension and modifications of the existing models and approaches. The analyses of the geographical structure of trade and investment in this area are followed by appropriate tests to verify which is the most productive and optimal composition of bilateral trade and investment.

Third, after the identification of the optimal trade and investment bilateral structure, the simulation analyses of the potentially changing trade structure are conducted. In particular, these are done on the basis of comprehensive analysis of the possible formation of free trade area in East Asia. The potential significant bilateral trade balances are considered with respect to various scenarios and the policy implications are provided.

Fourth, the results of the research can also contribute to a better design of the existing trade policy and investment climate so as to boost domestic

production and trade which in turn increases hard currency earnings and reduces poverty in the country.

Finally, the analysis sheds further light on the existing literature; provides a useful benchmark to assess the impact of the different trade and investment policy in order to sustain economic growth.

Several panel data sets have been constructed to achieve the research objectives. First, sample used to estimate the causality regression models and empirical three-factor models of Laos' FDI-trade linkages consists of 72 trading or investing partners over the period 1989–2009. Second, sample used to estimate the dynamic gravity model consists of sixteen countries, including ten ASEAN countries (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam), and its six counterparts (Australia, China, India, New Zealand, Japan, and South Korea) over the period 1992–2009. Third, sample used to estimate the stochastic frontier production model consists of 81 developing countries over the period 1995–2010. The starting dates of samples are chosen on the basis of the availability of data. Data on several macroeconomic variables, such as GDP, tariff rates, foreign direct investment, capital (physical and human), and trade have been mainly collected from international agencies, such as UN's World Investment Directory, World Bank database, and UN's Comtrade database.

Despite the potentially significant contribution of this research, there are limitations pertaining to the data set, the estimation techniques, and the variables used. The present analysis employed aggregate data which relate trade and FDI patterns to some country's characteristics implied by the three-factor model. At least in theory, there are potential incentives for trade and FDI to vary significantly across industries. Therefore, providing insight into the actual mechanisms of FDI-trade linkages requires the analysis of disaggregate data.

Furthermore, the multicollinearity problem in the empirical three-factor models specified in equation (4.7) in Chapter 4 occurred when Laos and trading partners' GDPs (combined GDPs) and all relative factor endowments were expressed as explanatory variables. To overcome the multicollinearity in the model, trade or FDI flows (dependent variables) were divided by the

combined GDPs. Although this approach solves the multicollinearity problem, it does not allow us to test the effects on trade and inward FDI flows of their market sizes.

Finally, the FDI-trade linkage models in this study do not explicitly consider political measures, government expenditures, inflation rate, exchange rate, unemployment rate, wage rate, and investment risks (implicitly accounted for by incorporating the year and region dummies). This is because this study focused on the fundamental economic relationships between Laos and its trading and investing partners. However, explicitly including them into the models can provide more realistic economic links.

The structure of this dissertation has been organized in the following way:

Chapter 1 provides with a historical overview of the developments of the Lao economy since the declaration of its independence in 1975. Here I address two aspects of Laos' economic system associated with foreign trade and investment: the economic structure and institutions, and the financial structure and flow of fund analysis.

In Chapter 2, I review the overall patterns of Laos' foreign trade and inward FDI flows in terms of the openness and the geographical distribution by partners, product group, and sector. Various factors affecting Laos' trade and inward FDI flows are investigated. The developments of Laos' regional economic integration are also described with special emphasis on international trade flows and the impediments to foreign trade.

Chapter 3 focuses on the theoretical background and the application of three theoretical models, namely foreign direct investment in general equilibrium, gravity models, and stochastic frontier models. I review the three-factor model of international trade proposed by Egger and Pfaffermayr (2004, 2005) in detail and pay special attention to some practical problems concerning the estimation of gravity models and the consequences of the single-country perspective applied in this dissertation. Moreover, the empirical approaches to assess the trade impact of free trade agreement (FTA) formation using the gravity models are discussed and the theoretical foundation of the gravity model proposed by Anderson and van Wincoop

(2003) is reviewed. Finally, I present the developments of efficiency analysis and the stochastic frontier model following Battese and Coelli (1995).

In Chapter 4, I extensively discuss the developments of empirical models for FDI-trade linkages and the analyses of free trade agreement and production efficiency. Their respective estimation methods are also provided. Finally, data used in the empirical analyses are described in the final section of this chapter.

Chapter 5 deals with my first major research focus: the quantitative analysis of FDI-trade linkages in Laos through two empirical models. First, the panel causality analysis is applied to test the causality relationship between foreign trade and inward FDI flows in the Lao economy. Second, the three-factor models are applied to investigate the bilateralism and regionalism associated with Laos' trade and inward FDI flows.

Chapter 6 focuses on the second and third major research objectives of this dissertation: the potential impact of East Asian free trade area on Laos' trade and the externalities of trade and inward FDI flows on production efficiency in Laos. The impact of East Asian free trade area on Laos' trade is investigated through the dynamic gravity model and the simulation analyses. The efficiency externalities of trade and FDI are evaluated through the translog stochastic frontier production model.

Finally, at the end of this dissertation, I summarize my findings and draw some final conclusions regarding the research questions and review the data and its sources used throughout the dissertation in appendices, which hopefully may prove useful for further empirical research.

Chapter 1 Economic System of Laos

1.1 Laos' Economic Structure and Institutions

Since 1975, the evolution of the economic system of Laos can be categorized into two types: a centrally planned economy (1975–1985) and a market-oriented economy (1986 up to now). From 1975 to 1985, the Lao government had reformed their economy by replacing the private sector with state enterprises and cooperatives; centralizing investment, production, trade, and pricing; and creating barriers to internal and foreign trade. However, they realized that such reforms could not be the effective means to stimulate growth and development. Therefore, the government introduced its New Economic Mechanism in 1986, designed to create conditions conducive to private sector activity.

1.1.1 Formation of Laos' Modern Economic System[2]

After the proclamation of the Lao PDR in 1975, the Lao government introduced the centrally planned economic system to their country. Nonetheless, the first few years of such socialist transformation had led to declining living standards, stagnant or decreasing production levels, growing financial instability, and increasing internal resistance. Factors behind this crisis included the sudden termination of U.S. aid; the disruption of cross-border trade resulting from the economic blockade of neighboring Thailand—the country's main trading partner; peasant resistance due to the introduction of taxation and the collectivization of agriculture; reduction in the number of traders, entrepreneurs, professionals, and capital due to increased regulations; high inflation resulted from an increasing fiscal deficit and dramatic monetary expansion; and the deteriorated balance of payment. As a result, further effort on comprehensive economic restructuring was required to tackle the nation's serious economic problem.

[2] Unless otherwise indicated, the content of this section is based on Otani and Pham (1996).

Early stage of economic reform took place in 1979. The new policies emphasized the necessity for increased efficiency and production, and the role of market forces and the private sector. Some key measures were implemented, including the removal of several constraints on domestic and international trade, the substantial devaluation of the kip (the kip or KN), and the dramatic adjustment of official prices, particularly agricultural ones. This reform was expected to lay the foundation for the country's First Five-Year Plan (1981–1985), aiming to achieve food self-efficiency and to stimulate a balanced and diversified agricultural structure.

Although efforts on economic reforms had been made in the first half of the 1980s, the major targets of the plan would not be achieved due to an unfavorable economic environment caused by the strict centrally planned economic system, a low-skilled labor force, a poor infrastructure, and the lack of an institutional and legal framework within the country (Rasphone, 2003, pp. 106). This entailed an introduction of a more ambitious economic reforms' plan, called the NEM in 1986 and thus, starting the economic transition process in the Lao PDR.

The introduction of the NEM in 1986 generated an initial step for moving the economy towards a more market-oriented economy. Major reforms have been done by removing price controls, abandoning socialist cooperative farming, unifying the exchange rate system, removing the government's monopoly on trade, reducing the number of state-owned enterprises (SOEs), promoting private-firm establishments, fiscal reform, and banking and financial reform.

Price liberalization resulted in the dramatic adjustments in official retail and wholesale prices, beginning with a nine-fold increase in the price for basic rice rations in 1985 and continuing with an average 360% increase in most other controlled prices throughout the rest of the year. The two-tier price system of market prices and generally much lower official prices lasted until 1989. The official prices were set on the basis of production costs plus margins, but in view of political and social considerations. The public sector pricing reform was made in 1987 to allow for market determination of prices, except those of a few utilities, public services, and several key industrial products (for a summary of the reform, see appendix A, Table A.1).

Exchange rate reform brought multi exchange rates into one in 1988. Seven different exchange rates prevailed in the Lao economy in the early 1986. These exchange rates consisted of a symbolic official rate of KN 10 per U.S. dollar; a commercial rate of KN 95 per U.S. dollar; and various rates close to the then-prevailing parallel market rate of roughly KN 400 per U.S. dollar. Thanks to the exchange rate reform, the exchange rates were brought down to four in September 1987 and to one in January 1988. In 1995, the managed floating exchange rate system was adopted within the framework of the Structural Adjustment Facility program supported by the IMF (Arshad, 2003, p. 92).

Trade reform significantly reduced constraints on domestic and international trade. Prior to 1987, both domestic and foreign trade had been controlled by the government. The Lao Trade Corporation was responsible for official and wholesale trade and rice distribution at the national level, while provincial offices were in charge of procurement and distribution operations at the local level. Moreover, an extensive network of state stores and cooperative shops was responsible for distributing goods at the retail level. As to foreign trade, both exports and imports were monopolized by the state, except trade made by joint public and private companies or a few state enterprises. However, the domestic and external trade system was liberalized in 1987, resulting in the elimination of most of these restrictions on trade in 1988.

Public enterprise reform substantially enhanced the operational freedom of SOEs. Prior to the implementation of the NEM in 1986, SOEs were run based on the standard model of a command economy. Product and input prices, salaries, investment, reinvestment, financing, product mix, and output targets were controlled by the government according to the plan or the budget. However, some degree of autonomy was granted to four of the most important centrally supervised enterprises in 1983. These enterprises included the tobacco and beer factories, the electricity company, and the Lao Wood Industry Corporation. By the end of 1987, a considerable degree of operational freedom was granted to approximately 75% of all SOEs.

Fiscal reform started in 1988 to adjust the revenue and expenditure system as financial autonomy was extended to a larger number of SOEs. As to the reform of revenue system, the new tax system was implemented,

resulting in several different tax rates. Based on the activity type, profit tax on commerce and industry was levied at rates ranging from 20% to 85% for profits obtained from domestic sales and ranging from 0% to 80% for profits obtained from exports. The turnover tax and the new import tariff system were levied with rates ranging from 1% to 15% and from 1% to 70%, respectively. As to the reform of expenditure system, expenditure priorities were reordered. Subsidies to civil servants and other consumer subsidies were gradually decreased, while public wages were raised.

Banking and financial sector reform began in 1988, resulting in the establishments of several commercial banks. Despite this reform, little change was made on interest rate policy, controlled by the cabinet of the Lao government. The originally low deposit rates were raised by 20–50%, and the lending rates were approximately doubled. Nonetheless, real interest rates remained negative. The reform also entailed the establishment of a two-tier banking system in 1990 with the establishment of the Bank of the Lao PDR (BOL) in accordance with the promulgation of the Central Bank Law. Moreover, the state-owned commercial banks (SOCBs) were recapitalized in 1994 due to increased competition in the banking sector.

In summary, building on pre- and post-reforms in 1986, the NEM has generated conditions conducive to private sector activity: prices set by market forces replaced government-determined prices; farmers were permitted to own land and sell crops on the open market; state firms were granted to increase decision making authority and were lost most of their subsidies and pricing advantages; and the government set the exchange rate close to real market levels, lifted trade barriers, replaced import barriers with tariffs, and gave private sector firms direct access to imports and credit. These structural and institutional reforms showed considerable progress in moving toward an open and market-oriented economy.

1.1.2 Major Developments in Economic System, 1991–2009

The Lao PDR began opening up to the world in the late 1980s. Sub-regionally, the country is an active partner in the emerging Greater Mekong Sub-Region (GMS) Economic Cooperation Program. The GMS program plays an important role on strengthening exports to neighboring countries, facilitating the development of transport corridors, and enhancing the

sustainable development and management of the Mekong River. Lao PDR also engages in the Mekong River Commission (MRC), which explores opportunities for regional cooperation in the Mekong River Basin.

On a broader regional and global level, Lao PDR was admitted into the Association of Southeast Asian Nations (ASEAN) in 1997 and joined the ASEAN Free Trade Area (AFTA) in 1998. The country applied for the WTO membership in 1997 and is currently in the process of accession. The membership of WTO will hasten the process of economic reform. Furthermore, it has also joined the Integrated Framework for Trade Related Technical assistance, aiming to strengthen its export competitiveness (United Nations in Lao PDR, 2011).

Further, in 1997 Laos signed a trade and cooperation agreement with the European Union, which strengthened trade and economic ties with Europe and provided Most Favored Nation (MFN) treatment to Laos. In 2005, Laos signed a Bilateral Trade Agreement with the United States, which has been a consequent rise in Lao exports to the United States.

Table 1.1: Major developments in economic system, 1991–2010

Key indicator	1991–2000	2001–2010
Population (million)*	5.3	6.2
Annual GDP growth (%)	6.2	7.1
Real GDP per capita (2000 US$)*	326	555
GDP by sector (%)		
Agriculture	56	41
Industry	20	26
Services	24	33
FDI inflows (annual average) (US$ million)	58	150
FDI inflows (% of GDP)	3.7	3.3
FDI inflows (% of gross fixed capital formation)	31.3	9.2
Exports of goods and services (% of GDP)	24.9	32.1
Imports of goods and services (% of GDP)	37.9	42.9

Notes: Annual averages over time period. * Data for 1990, 2000 and 2010 only.

Sources: World Bank (2011) and United Nations Conference on Trade and Development [UNCTAD] (2010).

Since the end of the 1980s and building on these open-door policies, Laos has achieved an impressive track record in sustaining high economic growth, transforming economic structure, attracting FDI, and promoting trade. Although Laos had experienced the huge challenges of transition and the sharp reduction in growth during the Asian financial crisis of 1997 to 1999, real GDP growth had an annual average rate of 6.2% during 1991–2000 and gradually increased to 7.1% during 2001–2010 (see Table 1.1).

Although Laos' economic growth has been driven by the resource sector such as mining and hydropower projects, it is going through a process of swift industrialization in addition to the transformation of its economy towards a more market-oriented one. Production structure has shifted from agriculture to industry; the annual average of output share in agricultural sector in percentage of GDP contracted from 56% during 1991–2000 to 41% during 2001–2010, whereas the output share in industrial sector increased from 20% during 1991–2000 to 26% during 2001–2010.

At the same time, the output share in service sector to GDP rose from 24% during 1991–2000 to 33% during 2001–2010. The large share of services in GDP has been due largely to tourism. In 2003, for example, tourism accounted about 8% of GDP and generated direct and indirect employment about 22,000 workers. Tourists visited Laos were mainly from Thailand (more than 70%) and from China, Japan, and Vietnam (ADB and the WB, 2007).The rapid expansion of the mining sector has been the major driving force behind the contribution of the industry sector to GDP, rising from 0.26% in 2002 to 6.7% in 2009.

Raising both private domestic and foreign investments has been a vital issue in Laos. After the promulgation of the FDI law in 1988 and its subsequent amendments, the annual average of FDI inflows increased almost three fold, from $58 million during 1991–2000 to $150 million during 2001–2010. However, the share of FDI inflows had decreased in terms of both GDP and gross capital formation in these periods.

International trade has gradually contributed to the Lao economy. Exports had improved, increasing from 25% during 1991–2000 to 32% during 2001–2010, while imports had risen from 38% to 43% over the same period. The rising import share of GDP indicates that the country has suffered from chronic trade deficit which occured since 1970.

1.2 Laos' Financial Structure and Flow of Funds

1.2.1 Financial Structure in the Fast Growth Period

After embarking on economic reform towards a more liberalized system, the Lao Government tried to bring the banking and finance system in line with the demands of the economy. Since 1988, periodic reforms have been made. In March 1988, the national bank was restructured into a two-tier system, with central banking separated from commercial banking. In June 1990, a law to establish the Bank of Lao PDR (BOL) was approved. It established BOL as the central bank, determined its role and functions of the bank under the new system. At the end of 2008, the financial sector in the Lao PDR was comprised of 21 commercial banks and 37 nonbanks and financial institutions.

Table 1.2: Market share of banking institutions in the Lao PDR

Descriptions	1991	1996	2005	2009
Assets (% of total assets)				
State-owned commercial banks	100.0	71.5	58.9	67.4
Joint-venture banks + Private banks	0.0	7.8	23.5	19.7
Branches of foreign banks*	0.0	20.7	17.5	12.9
Total assets	100.0	100.0	100.0	100.0
Deposits (% of total deposits)				
State-owned commercial banks	100.0	71.5	73.2	72.9
Joint-venture banks + Private banks	0.0	8.8	14.3	18.8
Branches of foreign banks*	0.0	19.7	12.5	8.3
Total deposits	100.0	100.0	100.0	100.0
Loans (% of total loans)				
State-owned commercial banks	100.0	73.9	68.7	63.0
Joint-venture banks + Private banks	0.0	7.4	14.9	22.3
Branches of foreign banks*	0.0	18.7	16.4	14.7
Total loans	100.0	100.0	100.0	100.0

Note: *including representative offices of foreign banks.

Source: Bank of Lao PDR [BOL] (2011).

Since 1991, the state owned commercial banks (SOCBs) have played an important role in the market of the financial institution. Table 1.2 shows the market share of the three banking institutions in the Lao PDR: SOCBs, joint-venture banks + private banks, and branches of foreign banks. In 2009, SOCBs accounted for about two third in terms of total assets and deposits,

and more than one half in terms of total loans. However, its market share has gradually decreased since 1991, while that of the joint-venture banks and private banks has gradually risen.

Table 1.3: Banking sector's contribution in the Lao PDR

Descriptions	1991	1996	2005	2009
Assets (% of GDP)				
State-owned commercial banks	14.1	18.8	14.0	26.6
Joint-venture banks + Private banks	0.0	2.0	5.6	7.7
Branches of foreign banks*	0.0	5.5	4.2	5.1
Total assets	14.1	26.3	23.7	39.4
Deposits (% of GDP)				
State-owned commercial banks	5.9	11.1	13.4	18.5
Joint-venture banks + Private banks	0.0	1.4	2.6	4.8
Branches of foreign banks*	0.0	3.1	2.3	2.1
Total deposits	5.9	15.6	18.4	25.4
Loans (% of GDP)				
State-owned commercial banks	5.5	8.9	6.0	11.7
Joint-venture banks + Private banks	0.0	0.9	1.3	4.1
Branches of foreign banks*	0.0	2.2	1.4	2.7
Total loans	5.5	12.0	8.7	18.6

Note: KN = kip, and *including representative offices of foreign banks.

Source: BOL (2011).

In terms of the percentage shares of the total assets, total deposits, and total loans in GDP, the SOCBs dominating the others (Table 1.3). Nonetheless, the total assets, total deposits, and total loans are relatively small to the size of the economy, accounting about 39%, 25%, and 19%, respectively, in 2009. This implies that the financial market in Laos is still at its early stage of the development, and relying on the banking sector as the only source of funding may not be sufficient to boost domestic investment.

Table 1.3 also indicates that saving in the Lao PDR is low. There are three main reasons for this. First, People have limited access to the banking sector in the rural areas (Kyophilavong, 2010). Second, they have low incomes (BOL et al., 2002). Finally, the majority of people living in the

rural areas save in the form of gold and silver (Toyoda and Kyophilavong, 2005).

There are three main reasons for the low ratio of credit to GDP expressed in Table 2.3: lack of skilled workers in the banking sector, discouraging corporate access to banking services due to distort price signals, and lack of strong legal enforcement of non-performing loans (NPLs) to prevent credit risk (Kyophilavong, 2010).

In summary, the state-owned commercial banks have played a crucial role in the financial market of the Lao PDR. Nonetheless, the financial market is still under developed and thus, providing limited supply of credit to private sector.

1.2.2 Capital Formation and Intersectoral Flow of Fund

In order to investigate the pattern of intersectoral financial flows in Laos, the Laos' flow-of-funds (FOF) accounts are constructed. Following Dawson (2004), I used data on the balance of payments, the banking sectors, and the government sector from the International Financial Statistics of IMF (2006a), ADB (2011), and UNCTAD (2010). All financial data are expressed in real terms using the Lao GDP deflator with 2000 as the base year. This simple FOF system provides an integrated view of the entire financial system.

Tables B.1 through B.7 (in Appendix B) are a set of worksheets that derived these FOF accounts for Laos for the years 1990–2005. The line references in the 'source' column on each worksheet provide some guides on how figures are derived. The worksheets are in the form of sector sources (S) and uses (U) of funds accounts, each headed by a sector's gross capital formation (U), gross saving (S), and net lending/borrowing (U/S). Then each sector's net lending/borrowing is analyzed into five financial market flows: foreign claims, interbank claims, central government debt, private credit, and money and quasi-money. Finally, the flows for 2005 are assembled into separate matrix format which is Table 1.4. The FOF matrix shown in Table 1.4 contained five sectors: central government, commercial banks, central bank, private sector, and foreign sector (rest of the world). The private sector includes provincial and local government, nonbank financial institutions, nonprofit institutions, all nonfinancial business including

Table 1.4: Laos Flow of Funds Matrix 2005 (Billions of Kip)

		Central Government		Commercial Banks		Central Bank		Private Sector		Rest of the World		Discrepancy Sources	Total	
	Account	U	S	U	S	U	S	U	S	U	S		U	S
2	**Gross capital formation**	**1,475**		**–**		**–**		**4,284**					**5,758**	
4	**Gross saving**		**682**		**–**		**–**		**3,834**		**1,242**			**5,758**
6	*Net lending (+) or borrowing (-)*	*–792*		**–**		**–**		*–450*		*1,242*			*0*	
9	**Δ Foreign claims, net**			**–41**		**179**					**96**	**42**	**138**	**138**
11	Δ Foreign assets			67		129					138	58	196	196
12	Δ Foreign liabilities				108		–49			42		–17	42	42
14	**Δ Interbank claims**			**–43**		**30**						**–73**	**–43**	**–43**
16	Δ Central bank credit to commercial banks				31	55						24	55	55
17	Δ Bank reserves			–12			85					–96	–12	–12
19	**Δ Central government debt**		**714**	**0**		**–11**		**–156**		**800**		**–81**	**633**	**633**
21	Δ Claims on central government		714	66		45		–156		800		41	755	755
22	Δ Central government deposits	0			65		56					–122	0	0
24	**Δ Private credit, net**	**–79**		**347**		**–226**			**221**	**179**			**221**	**221**
26	Δ Claims on nonbank financial institution			51		–226			–175				–175	–175
27	Δ Other private credit	–79		296					396	179			396	396
29	**Δ Money and quasi money**				**77**		**84**	**160**					**160**	**160**
31	Δ Currency and demand deposits				44		84	128					128	128
32	Δ Time, savings deposits				33			33					33	33
34	**Δ Miscellaneous & discrepancies, net**		**0**		**187**		**–172**		**232**	**359**		**112**	**359**	**359**
37	**Total sources and uses**	**1,396**	**1,396**	**264**	**264**	**–59**	**–59**	**4,288**	**4,287**	**1,338**	**1,338**	**0**		

Notes: The en-dash (–) indicates that data are unavailable.

S = Sources, which are equal to saving of each sector plus net incurrence of financial liabilities.

U = Uses, which are equal to capital formation and net acquisition of financial assets.

Source: Author's calculation based on data from IMF (2006a, 2010), ADB (2011), and UNCTAD (2010).

government enterprises, and households. This table will be the foundation for the analysis that follows.[3]

The 2005 gross capital formation of 5,758[4] (Table 1.4, line 2) is 33% of GDP (Table B.7, line 25), a moderately high ratio relative to other countries in the Mekong sub-region. The ratios of gross capital formation to GDP are 18% for Cambodia, 31% for Thailand, and 36% for Vietnam[5]. As we shall explore by means of the matrix, this high level of real investment in 2005 is financed by three means: first, a capital inflow from abroad; second, domestic savings; and third, private credit.

To investigate the inflow of capital from abroad we refer to the rest of the world account on the matrix and to the breakdown in the placement of its surplus, 1,242 (Table 1.4, line 6).[6] There are three main inflows from abroad: (1) a central government debt flow of 800 (line 21) received by the central government; (2) a private credit flow of 179 (line 27[7]) received by the private sector; and (3) a foreign claims flow of 42 (line 12) received by the commercial banks. The third of these flows becomes embedded in the intermediary process of the banking system.

During the 1990s the flow of private credit from the commercial banks had grown rapidly, reaching a peak of 717 in 1998 (Table B.4, line 24). In 2005, the banks decreased to supply a volume of private credit, 296 (line 27). Nonetheless, they were able to supply more credit as the central bank reduced the bank reserves of 12 (line 17). The growth in money and

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[3] In fact, the FOF matrix of recent years, 2006–2009, should also be generated. However, the author could not find complete data for such period. Nonetheless, the FOF matrix 2005 could at least provide some guide on how the Laos' financial system is interrelated.

[4] Unless otherwise indicated data are expressed in billions of kip.

[5] Data of Cambodia, Thailand, and Vietnam were obtained from UNCTAD (2010) in current US$. Then, the data were converted into real terms using GDP deflator obtained from the IMF (2011), and into national currency using exchange rate from ADB (2011).

[6] The surplus is the Lao current account deficit as viewed from a rest-of-world perspective.

[7] Except as noted, line references are to Table 1.4.

especially quasi-money of 77 (line 29) was the source of funds in the banking sector accounting for one-fifths of the private credit extension. But the banking sector was able to advance to the private sector much more than its deposit expansion, partly by means of its foreign borrowing, 108 (line 12), but also by an increase of foreign assets, 67 (line 11), and an expansion of its net holding of government debt, 0.2 (line 19). So, all told, a private credit total of 296 is provided (line 27). Together with the inflow of private credit from abroad, the private sector obtained the substantial total of 396 in private credit (line 27).

It is worth considering how the private sector financed its gross capital formation, 4284 (Table 1.4, line 2), and the role played by the large volume of private saving, 3834 (line 4). It is probable that this saving is the main source for household and business accumulation of cash balances, 160 (line 29). So perhaps about 3674 (3834 – 160) of saving remained available as business internal funds to finance most of the private gross capital formation. The rest of the capital formation might be financed by some of the 396 in private credit received by the private sector (line 27). About a third of this private credit came from abroad and about two-thirds from the banks (line 27). Here we see the small contribution of the private credit to capital formation.

Based on Table 1.4, we found the following conclusions. First, the foreign sector is a net lender to the government and private sectors in the Lao PDR; second, gross capital formation is largely financed by domestic sources of funds; third, the intersectoral flows are mostly not achieved through the banking system; and finally, the foreign sector did show some significant contribution as a source of capital for the government. Consequently, a shortfall in foreign finance can cause the government sector to cut down its investment dramatically. In contrast, there is no clear sign that the private sector would reduce its investment due to a shortfall in foreign finance because it is largely financed by domestic savings.

1.2.3 Enterprise Characteristics and Business Financing

According to the UN Lao-German Programme (2010), the surveyed enterprises are classified based on the average number of staff: (1) micro enterprises employ about 1–2 staff; (2) small enterprises employ about 3–19

staff; (3) medium-scale enterprises employ about 20–99 staff; and large enterprises employ at least 100 (Table 1.5). Total number of enterprises increased rapidly from 390 in 2005 to 728 in 2009, with the small enterprises dominating the others. Despite the fact that large enterprises accounted for only small amount of total enterprises, they generated about 50% of employment in the business sector. Nonetheless, the limited access to finance of enterprises is likely to impede their speed of growth and business development. The last three columns of Table 1.5 show that the trend of accessing to finance by total enterprises is decreasing, from 49% in 2005 to 31% in 2009. Among all types of enterprises, the large enterprises are severely limited to access to finance. Only 36% of total large enterprises in 2009 could access to finance, dropping by 40% from 2005.

Table 1.5: Characteristics of Lao enterprises

Type of enterprise	Definition by employees	Number of enterprises			% of employment in business sector			% of enterprises that can access to finance		
		2005	2007	2009	2005	2007	2009	2005	2007	2009
Micro	1–2	83	92	145	1.4	1.2	1.6	45.8	34.8	24.1
Small	3–19	223	305	441	19.3	20.7	22.9	43.5	45.2	28.6
Medium	20–99	64	73	111	28.8	24.1	28.1	62.5	63.0	50.5
Large	at least 100	20	20	31	50.5	54.0	47.3	75.0	85.0	35.5
Total		390	490	728	100.0	100.0	99.9	48.7	47.6	31.3

Source: UN Lao-German Programme [LGP] (2010).

Business financing in the Lao PDR is characterized by reliance on banking sector and informal finance. The latter consists of lending for small investments which is secured through a network of social relationships and peer-group monitoring, which is linked to trading and agriculture. As shown in Table 1.6, banks play an important role in financing all types of enterprises, especially the large ones. Other main sources of capital for micro, small, and medium enterprises are from family members and friends. These sources of financing confirm what was found by the flow of fund analysis that gross private capital formation is financed by domestic sources.

Insufficient domestic credits coupled with limited access to the sources of financing suggest that the early stage of development of business sector is likely to be associated with the underdeveloped financial markets in the Lao PDR. To solve this problem, Alba et al. (1998) suggested that improving the

accuracy and reliability of information, reducing the costs of contract enforcement, encouraging greater transparency, maintaining credible and consistent policies, and stabilizing industry regulation may help to bolster the evolution of enterprises along this financial life cycle.

Table 1.6: Sources of business financing in 2009

Source	% of enterprises that can access to finance			
	Micro	Small	Medium	Large
Banks	52.5	65.1	65.2	75.0
Suppliers	2.5	2.7	1.4	5.0
Money lenders	7.5	4.7	2.9	0.0
Relatives	2.5	3.4	4.3	0.0
Family members	17.5	12.8	10.1	5.0
Friends	10.0	2.7	5.8	0.0
Micro-credit schemes	2.5	2.0	1.4	0.0
Other sources	5.0	6.7	8.7	15.0
Total	100.0	100.0	100.0	100.0

Source: LGP (2010).

The improvement of the above-mentioned environments enhances a firm to grow in the following processes. First, it may start as a family-owned business, using the family's own resources as well as savings collected through a network of social contacts. It will then use its retained earnings and money from its suppliers as sources of funding. At some point, when it has established a sufficient business record, it may be able to get a loan only on a highly secured basis from a local bank. As it grows and expands its relationships, it will be able to attract funds from a wider circle of financial intermediaries, including other banks, venture capital and leasing companies. Over time, it may be accessible to the capital markets, first to the private placement markets; and later to organized, publicly traded bond and equity markets.

1.2.4 Institutions and Structure of Public Finance in Laos

Fiscal adjustment in Laos has been made following the introduction of the NEM in 1985. In order to transform the centrally planned economy toward the market-oriented one, the budget has been expected to play a crucial role in generating macroeconomic stability by mobilizing domestic revenue, restraining expenditure, and channeling foreign assistance. On the structural side, the tax system has been restructured in response to the

emergence of the market economy, including prioritization of expenditures; and enhancement of fiscal management via integrating central and provincial budgets into the national budget (Otani and Pham, 1996, p. 33).

As shown in Table 1.7, Laos ran a fiscal deficit since 1990 but gradually decreased, with an annual average of 3.9% of GDP.[8] In the 2000s, the deficit reached the peak at 5.7% of GDP in 2003 and hit the bottom at 2.2% in 2008. It hovered around 3.3% of GDP in 2009. The reduction in budget deficit was resulted from the previously implemented reforms, especially on taxes and the banking system. Such deficit has been largely financed by foreign borrowing.

Table 1.7: Developments of Laos' government budget, 1990–2009

(In percentage of GDP at current market prices)

	1990–99*	2000	2005	2009
Total revenue	10.6	13.1	11.7	14.8
Taxes	8.2	10.6	9.7	13.1
Nontaxes	2.4	2.5	2.0	1.7
Grants	4.2	3.7	1.7	2.4
Total expenditure	20.4	20.8	18.4	20.8
Current expenditure	9.5	8.1	10.0	13.5
Capital expenditure	10.9	12.6	8.4	7.3
Net lending	1.6	0.6	– 0.4	– 0.3
Overall balance	– 6.8	– 4.6	– 4.5	– 3.3
Financing	6.8	4.6	4.5	3.3
Domestic borrowing	0.8	– 1.1	0.2	0.8
Foreign borrowing	5.4	5.7	4.3	2.5
Use of cash balances	0.9	——	0.0	——

Notes: 1990–2009 are in fiscal year ending 31 December prior to 1993 and ending 30 September from 1993. * Figures from 1990–1999 are annual average.

Source: Asian Development Bank [ADB] (2011).

Government revenue as a percentage of GDP increased from 10.6% in 1990 to 14.8% in 2009, whereas government expenditure changed slightly, increasing from 20.4% to 20.8% in the same period. Government revenue depends primarily on taxes as its main source, up from 79% of total revenue in the 1990s to 88% of total revenue in 2009. Despite the widely dispersed population, tax collection has been continuously increased, partially due to

[8] Unless otherwise indicated, the figures in this section refer to those in Table 3.6.

the improvement in management of the collection process. In 2009, tax revenues were mainly from excise tax accounting for 23.1%, turnover tax for 22.6%, profit tax for 21%, and import duties for 11.7% of total tax revenue (not shown in the table).

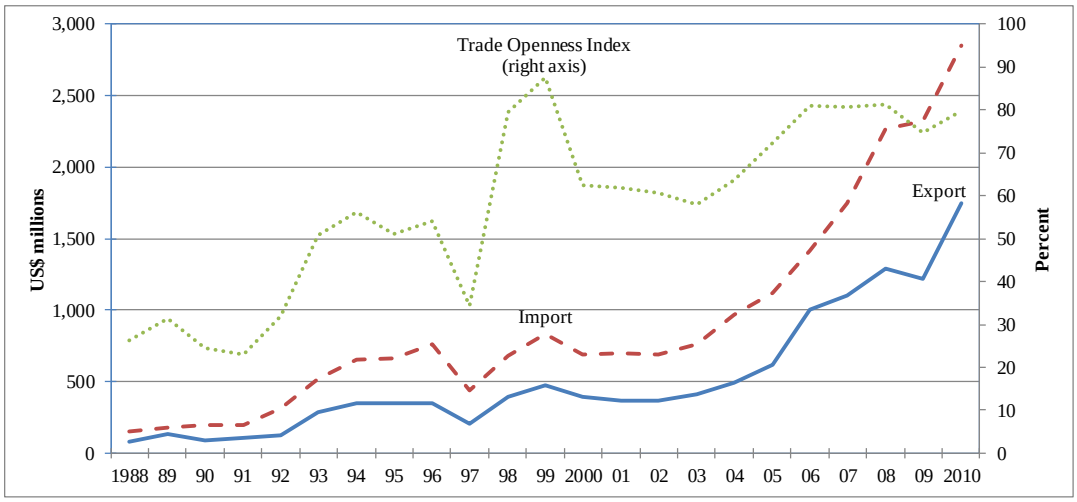
Current expenditures had gradually dominated capital expenditures. The current expenditures increased from 9.5% of GDP during 1990–1999 to 13.5% in 2009, while the capital expenditures decreased from 10.9% of GDP during 1990–1999 to 7.3% in 2009. Wages and salaries accounted for the largest portion of current expenditures, accounting for 43% of current expenditures in 2009 (not shown in the table).

Chapter 2 International Trade, Foreign Direct Investment, and Regional Trade Integration of Laos

2.1 Structure of Laos' Trade and Foreign Direct Investment

2.1.1 Aggregate Flows of Laos' Trade

Laos' trading patterns and trading volume have been influenced by two main sources: the implementation of the NEM in 1986 and regional trade agreements (NSC and UNDP, 2006, p. 21). The implementation of the NEM has resulted in the abolition of price controls and paved the way for further reforms in the trading system, such as rationalization of SOEs and gradual remove of their monopoly of foreign trade. In terms of regional trade agreements, Laos' trade has been influenced by membership in ASEAN and AFTA. Other sources include trading partners' policies, growing complementarities between the Lao economy and neighboring countries' economies, FDI, trade concessions from the EU, and expanding patterns of informal cross-border trade.



Sources: World Bank (2011a).

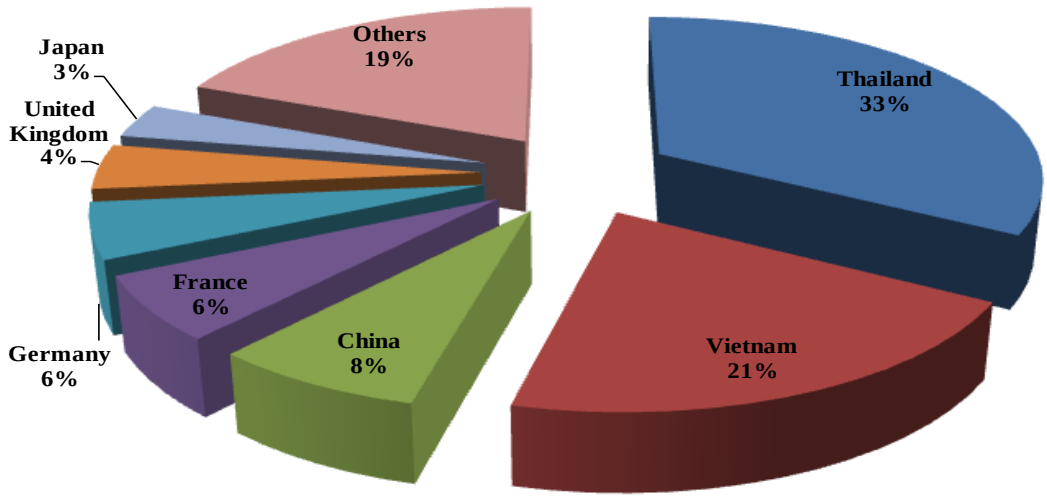
Figure 2.1: Real merchandise exports and imports, 1988–2010

The value of exports and imports during 1988–2010 is illustrated in Figure 2.1 and indicates a number of important trends. International trade is

rising. First, exports plus imports as percentage of GDP, a measure of the openness of the Lao economy, increased from 26% in 1988 to 80% in 2010. It reached the peak in 2007, hovering around 87.46%. Such peak partially resulted from the contraction of the Lao GDP caused by the negative impact of the Asian financial crisis and the growing exports and imports. Second, exports have been expanding more rapidly than imports. In the period 1988–2010, an average annual growth rate is 21% for exports and 17% for imports. However, imports still surpassed exports over the period and the trends of exports and imports seem to diverge. As a result, this chronic trade deficit has generated a balance of trade deficit. Such deficit is financed by large capital inflows and official development assistance (ODA).

2.1.2 Geographical Distribution of Laos' Trading Partners

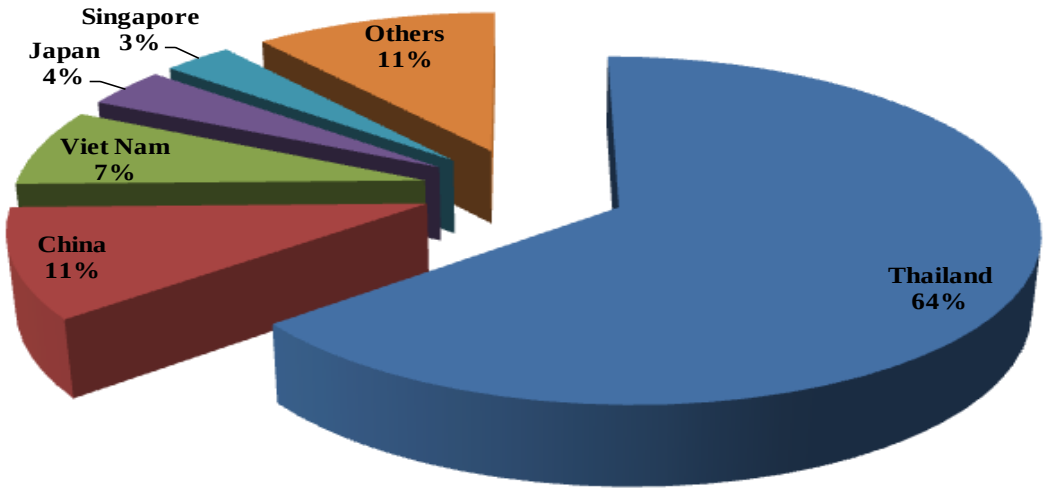
The Lao PDR's major trading partners during 1988–2009 are shown in Figure 2.2 for exports and Figure 2.3 for imports. Since more complete data on Lao trade is not available from Laos' side, it is derived from mirror data—that is, from its trading partners. Data on Lao exports and imports is gathered from the import data and export data of trading partners. Thus, the export and import figures are expressed at C.I.F price and F.O.B price, respectively.



Sources: ADB (2011), UNCTAD (2010), and IMF (2006b).

Figure 2.2: Laos' exports (real) by country of origin, 1988–2009 (in million US$)

There are both advantage and disadvantage of using these data. The advantage is that some trade is informal which is not totally recorded on the Lao side of the border, but is recorded on the other side, and therefore shows up in the mirror data but not in the Lao data. The disadvantage is that export figures at C.I.F price and import figures at F.O.B price contradict with the common sense of trade data, which usually refer to as exports at F.O.B price and imports at C.I.F price. Furthermore, they overestimate the export data, while underestimate the import data. Nonetheless, these data provide a broad indicator about Laos' trading partners and will be useful in analyzing international trade phenomenon of Laos in subsequent chapters.



Sources: ADB (2011), UNCTAD (2010), and IMF (2006b).

Figure 2.3: Laos' imports (real) by country of origin, 1988–2009 (in million US$)

Laos' trading partners are concentrated over the period 1988–2009. The top three importers of Lao goods include Thailand, China, and Vietnam (Figure 2.2), whereas the top three exporters to Laos include Thailand, China, and Vietnam (Figure 2.3). Among these, Thailand is the key player in Laos' trade, accounting for 34% of Laos' total exports and for 64% of Laos' total imports in 2009. However, trade between Laos and Thailand were seriously affected by the Asian financial crisis in 1997 but recovered later in two or three years. Exports from Laos to Thailand increased from $59

million during 1988–2000 to $374 million in 2009, while imports of Laos from Thailand also rose from $157 million during 1988–2000 to $1,328 million in 2009.

There could be two main reasons underlying the trade intensity between Laos and Thailand. These reasons include memberships of ASEAN and Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy Organization (ACMECS). Regarding the membership of ASEAN, the Lao PDR has benefited from AFTA under the CEPT scheme and from the ASEAN Integrated System of Preference (AISP). According to NSC and UNDP (2006, p. 37), simple average tariff rate for the period 2001–2003 is 4.53% for AFTA tariffs and 17.19% for Thailand's applied MFN tariff. Accessing the low AFTA tariffs entails completion of ASEAN Form D to confirm compliance with ASEAN origin requirements. However, the Lao PDR has benefited very little from the use of Form D for Lao exports and of the CEPT rate for Lao imports. In 2004, more than 300 exports from the Lao PDR to Thailand that are not on the Lao Inclusion List (IL) were granted by AISP preferences from Thailand, with tariff rates of zero to five percent. Preference was given to the following product categories: fruits and vegetables; coffee, tea and spices; tobacco and manufactured tobacco substitutes; salt, ores, slag and ash; leather and leather products; wood and articles of wood; furniture; manufactures of straw; and articles of apparel and clothing accessories. Regarding the membership of ACMECS, in 2004, Thailand granted nine agricultural exports from the Lao PDR under the agreement of a 'One Way Free Trade', with a zero tariff rate. These exports include feed corn, sweet corn, eucalyptus logs, cashew nuts, castor oil beans, soy beans, ground nuts, potatoes and pearl barley. In the future, the AISP and 'One Way Free Trade Agreement' preferences could play a crucial role to boost agricultural exports from Laos to Thailand. Their impacts on Laos' trade are different from those of the CEPT preferences because they apply to products that are not on the Lao IL.

China is also one of the most important trading partners of Laos. Exports from Laos to China grew from $8.6 million during 1988–2000 to $302.5 million in 2009, whereas imports of Laos from China grew from $32 million during 1988–2000 to $318 million in 2009. The principal reason behind the rise is the implementation of the Early Harvest Program (EHP) in 2004 to

accelerate tariff reductions on selected products—mainly agricultural and food items. It is part of the China-ASEAN FTA that will take effect in 2010 for most ASEAN countries and in 2015. China and the ASEAN countries started decreasing tariffs in 2005 and planned to gradually reduce or eliminate tariffs on 7,000 products. According to NSC and UNDP (2006, p. 39), China has high demand for Laos' raw agricultural products, especially for land intensive crops such as corn, sugar cane certificate of origin and watermelons. However, these products are excluded from the agreement. Nonetheless, the EHP could benefit many rural Lao families because it offers the promise of increased agricultural exports.

Trade between Laos and Vietnam has gradually intensified since 1988. Exports from Laos to Vietnam grew from $65 million during 1988–2000 to $177 million in 2009, whereas imports of Laos from Vietnam grew from $37 million during 1988–2000 to $118 million in 2009. The fundamental reasons behind the rise include bilateral trade agreement between Laos and Vietnam in 1999, called the 'Cua Lo Agreement'; the implementations of GMS agreements to facilitate trade; formation of economic zones; improvement of transport route along Laos-Vietnam border; and the offer of transit routes to the sea to Laos by Vietnam (NSC and UNDP, 2006).

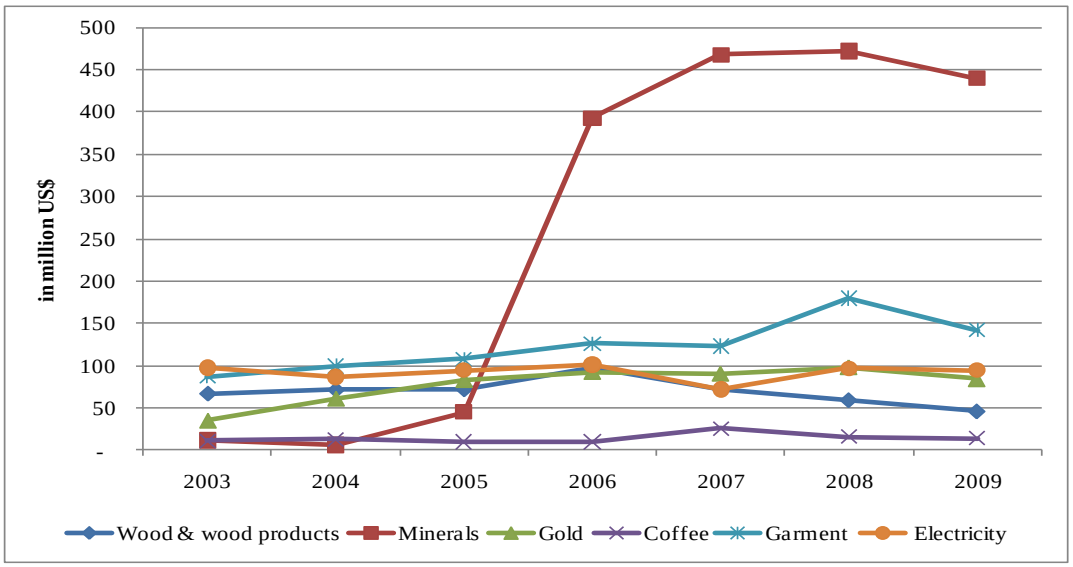
Other key trading partners for Laos are the EU countries, especially United Kingdom, Germany, and France. Exports from Laos to the combined market of these three countries increased from $41.5 million during 1988–2000 to $115 million in 2009, whereas imports of Laos from the three countries of EU rose from $17 million 1988–2000 to $58.5 million in 2009. The Lao PDR has been granted by the EU-GSP since the early 1990s (NSC and UNDP, 2006). Such preferences resulted in the rapid growth of garment production and exports. The granted EU-GSP, however, was not fully utilized in the early stage due to the Rule of Origin, but such problem has been relaxed since 1997. Under the 'Everything But Arms' initiative for exports from the Least Developed Countries (LDCs), most products from Laos are eligible for duty free export to all EU countries since 2002.

2.1.3 Foreign Trade Structure

The size and structure of Laos' foreign trade has been changed due to the continued domestic liberalization and growth, and the developments in

trading partners. Data by Otani and Pham (1996, p. 30) for the period 1979–1994 showed that the key products of Laos' exports include wood and wood products, coffee, hydroelectric power, and garments, while those of Laos' imports include rice and food stuffs, petroleum products, and machinery and raw materials. In the period 1979–1991, members of the CMEA, and in particular, the former Soviet Union, had been the key trading partners of Laos, accounting for roughly one third of Laos' total exports and half of Laos' total imports.

However, the bilateral trading agreements between members of CMEA and Laos were terminated in 1991 because of the collapse of the CMEA and the reorientation of the Eastern European economies toward market-based trade by Laos. This forced Laos to search for new export markets and supplies of fuel and production inputs from elsewhere. Meanwhile, Thailand, Vietnam, and China provided ready markets for many products due to their rapid economic liberalization and growth. Building on these developments and the continued domestic economic decentralization and the improvements in infrastructure and border access, exports had largely increased. Imports also increased dramatically, fueled by rising exports and high FDI inflows.



Source: Ministry of Industry and Commerce [MOIC] (2011).

Figure 2.4: Key export products of Laos, 2003–2009

To be more precise on the changing structure of Laos' exports, the values of major export products for the period 2003–2009 are illustrated in

Figure 2.2. The export of minerals rose sharply from 2005 to 2006 by almost eight-fold, and gradually increased until 2008. Nonetheless, its contribution to Laos' exports is unsustainable. The export of garment had slightly increased, whereas other products have been stable during this period. Most of these products were trending downward due to a severe global economic recession during 2008–2009.

Table 2.1: Laos' exports by country of origin and by product group in 2009

(In percentage of total exports)

Export product	Thailand	Vietnam	China	Japan	Korea*	Australia	USA	ASEAN	EU	Others	Total
Wood and wood products	2.0	2.4	0.2	0.1	0.0	0.0	0.1	4.4	0.0	0.0	4.8
Minerals	17.9	10.2	3.7	0.0	1.6	1.0	0.0	29.0	0.0	10.6	45.9
Gold	0.0	0.0	0.0	0.0	0.0	8.8	0.0	0.0	0.0	0.0	8.8
Coffee	0.0	0.8	0.0	0.2	0.0	0.0	0.0	0.8	0.5	0.0	1.5
Garment	0.3	0.0	0.0	0.3	0.1	0.0	0.5	0.3	12.9	0.7	14.8
Electricity	9.9	0.0	0.0	0.0	0.0	0.0	0.0	9.9	0.0	0.0	9.9
Others	5.7	2.6	3.4	0.5	0.0	0.0	0.0	8.3	0.5	1.7	14.3
Total	35.8	15.9	7.3	1.1	1.8	9.8	0.6	52.7	13.8	13.0	100.0

Note: * Republic of Korea.

Source: MOIC (2011).

The distribution of Laos' foreign trade is regionally asymmetric. Table 2.1 presents the geographical distribution of Laos' exports in percentage of total exports in fiscal year 2009 starting on 1 October and ending on 30 September, while Table 2.2 reports those for imports. Generally, exports and imports from eight regions, seven major groups of export and import products, are shown in the tables. These regions include Thailand, Vietnam, China, Japan, Republic of Korea, Australia, USA, ASEAN, and the EU. The seven groups of export products include wood and wood products, mining, gold, coffee, garment, electricity, and others. The seven groups of import products comprise fuel and gas, construction materials, vehicles and spare parts, raw materials, electricity, capital goods, and others.

Laos' exports highly concentrate in East Asian countries, shown in Table 2.1. Minerals were the largest export category, accounting for about 46% of total exports. They were mainly exported to Thailand, Vietnam, and China, accounting for about 18%, 10.2%, and 3.7%, respectively. Other major Lao export sectors included garment (exported to the EU), wood and wood products (exported to ASEAN), electricity (exported to Thailand), and gold (exported to Australia), accounting for about 14.8%, 4.4%, 9.9%, and 8.8%

of total exports, respectively. Laos' export products are less diversified and tend to be natural-abundant goods and unskilled-labour-produced goods.

Table 2.2: Laos' imports by country of origin and by product group in 2009

(In percentage of total imports)

Import product	Thailand	Vietnam	China	Japan	Korea*	ASEAN	EU	Others	Total
Fuel and gas	11.6	2.7	0.0	0.0	0.0	14.3	0.0	0.0	14.3
Construction materials	1.3	0.8	0.4	0.0	0.0	2.1	0.0	0.0	2.5
Vehicles and spare parts	11.7	1.3	1.6	0.1	1.7	12.9	0.0	0.0	16.3
Raw materials	2.9	0.4	0.5	0.0	0.0	3.7	0.0	0.5	4.7
Electricity	2.3	0.0	0.0	0.0	0.0	2.3	0.0	0.0	2.3
Capital goods	31.8	5.6	3.2	0.5	0.1	37.4	0.2	0.6	42.1
Other goods	8.6	3.2	4.2	0.1	0.1	12.3	0.7	0.4	17.8
Total	70.2	14.0	9.9	0.7	1.8	85.1	0.9	1.5	100.0

Note: * Republic of Korea.

Source: MOIC (2011).

Similarly, Laos' imports are much more regionally concentrated, illustrated in Table 2.2. Capital goods were the largest import category, accounting for about 42.1% of total imports. They were imported from Thailand (31.8%), Vietnam (5.6%), China (3.2%), Japan (0.5%), and the EU (0.2%). Petroleum and raw materials made up another 19% of total imports. That is, more than 60% of Lao imports can be explained by the fact that Laos has very limited physical capital and intermediate inputs.

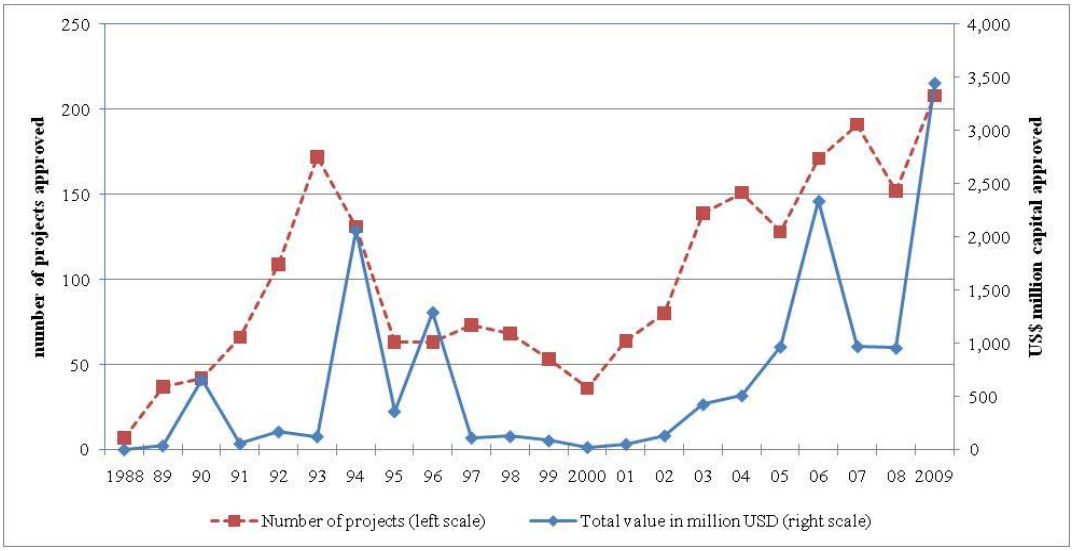
In summary, the following trade patterns emerge for Laos: the country exports mining, garment, and electricity to the rest of the world in exchange for capital goods, vehicle and spare parts, fuel and gas, and consumer goods.

2.1.4 Aggregate FDI Inflows in Laos

As clearly illustrated by Figure 2.2, Laos' FDI inflows rose and then declined during the 1990s and 2000s, both in terms of the number of projects approved and the total value of capital pledged. In the 1990s, 1993 was the peak year in terms of the number of FDI projects approved, with 153 licenses being issued, while 1994 was the peak year in terms of the capital approved, with almost $1.2 billion in FDI pledges licensed. Since then, foreign investment inflows—as measured by the number of projects and capital pledged/approved each year—have trended down but moderately fluctuated. Indeed, the decline in FDI inflows since 1994 has been almost as dramatic as

the rise in foreign investment inflows prior to 1994; but the fall of FDI is more skewed in 1996–1998. The IMF estimated that in 1997 actual FDI inflows dropped by 41% and new FDI inflow pledges decreased by 97% as the effects of the Asian financial crisis began to have an impact (Okomjo-Iweala et al., 1999). In 1999, there was only $258 million of FDI inflows with 43 approved FDI projects in the first ten months. FDI inflows had been stagnant during 1999–2002. The average size of FDI projects in Laos had also declined, from a peak of approximately $11 million in 1994–1998 to around $2 million in 1999–2002.

In the 2000s, 2009 was the peak year of both the number of FDI projects approved and the capital approved, with 208 licenses being issued and with almost $3.5 billion in FDI pledges licensed, respectively. The FDI inflows started to rise from $133 million with 80 approved projects in 2002 to around $3.5 billion with 208 approved projects in 2009. However, the trend has declined sharply since 2009, due partially to the impact of global financial crisis.



Sources: MPI (2011); Freeman (2001); and Gunawardan and Sisombat (2008).

Figure 2.5: Foreign direct investment approvals in Laos, 1988–2009

According to Freeman (2001), there are five main factors behind the initial rise in FDI inflows in the 1990s. These factors include: firstly, economic growth in old ASEAN countries (Indonesia, Malaysia, the Philippines, Singapore and Thailand); secondly, the ADB's ambitious GMS

programme on investment and trade facilitation, and envisaged a portfolio of transport, communications and power projects across the countries of the sub-region; thirdly, opening the virgin market (opening the country for the first time) of the Lao PDR; fourthly, privatization campaign of the early 1990s in Laos; and finally, optimistic of foreign investors on the opening of new market of FDI. Five key factors behind the fall of FDI inflows include: firstly, Asian financial crisis; secondly, deterioration of Laos' macroeconomic health in the aftermath of the Asian financial crisis; thirdly, slowdown in the economic reform programme in Laos; fourthly, the decline in the tolerance level of foreign investors for inadequacies in Southeast Asian host countries' economic and business environments since the aftermath of Asian financial crisis; and finally, the growing ability of the Lao government to assess foreign investment applications, and reject those that are unlikely to reach fruition.

Table 2.3: Laos' inward FDI stock by major country of origin, 1988–2009

Country	FDI approved			Actual FDI (BOP basis)*	
	Number of projects	Capital approved	% of total capital approved	Actual capital	% of total actual capital
Thailand	472	5275.55	34.38	160.86	28.88
China	405	2392.79	15.59	37.15	6.67
Vietnam	226	2133.97	13.91	6.49	1.17
USA	74	1092.16	7.12	4.65	0.83
Malaysia	62	873.63	5.69	97.17	17.45
France	154	865.14	5.64	12.37	2.22
Korea	186	637.93	4.16	110.10	19.77
Japan	65	449.16	2.93	19.42	3.49
Australia	73	365.99	2.39	0.08	0.01
India	9	353.96	2.31	0.72	0.13
Others	314	903.01	5.89	107.99	19.39
Total	2040	15343.30	100.00	557.00	100.00

Sources: Approved FDI were compiled from Gunawardan and Sisombat (2008) and MPI (2011) data. * Actual FDI were obtained from ASEAN Secretariat (2006) on the balance of payment (BOP) basis for the period 1995–2005.

Factors behind the rise of FDI in 2009 are likely to be the amendments of FDI policy, improvement of investment climate, and positive growth in major FDI's source countries. The downward trend of FDI during 2009–2010

can be resulted from the impact of the global financial crisis. Such crisis could lead the planned investment to decline over the medium term as the liquidity crisis continues and cost of borrowing rise against the backdrop of less stable macroeconomic situation in developing countries generally, and declining global demand and commodity prices.

2.1.5 Structure of Laos' Inward FDI by Country of Origin and by Sector

Laos' FDI stocks have unevenly distributed with respect to either investing partners or sector. In terms of FDI stock, as of 2009, Laos had officially approved around 2,040 foreign investment projects, with an aggregate registered capital of roughly $15 billion. The largest single investor in Laos by far has been neighboring Thailand (34% of total FDI inflows), followed by the China (16%), Vietnam (14%), the United States (7%), and Malaysia (6%) (see Table 2.3). Overseas Lao now living in the United States may be the major component of the US-sourced investment (Freeman, 2001).

Table 2.4: Laos' inward FDI stock by sector, 1988–2009

Sector	Number of projects	US$ million capital approved	% of total capital approved
Electricity generation	47	9,097.1	48.3
Agriculture	221	1,294.5	6.9
Mining	194	3,069.1	16.3
Industry and handicraft	263	1,024.5	5.4
Other services	240	1,495.0	7.9
Trading	144	364.2	1.9
Construction	43	319.8	1.7
Hotel and restaurant	84	748.7	4.0
Wood industry	49	286.0	1.5
Banking	24	236.9	1.3
Telecomunications	5	793.8	4.2
Garment	42	94.3	0.5
Consultancy	59	26.4	0.1
Total	1,415	18,850.2	100.0

Note: Values of FDI inflows from 1988–2000 include Lao shares.

Sources: Compiled from Gunawardan and Sisombat (2008); MPI (2011); Freeman (2001); and IMF (2002).

The actual FDI figures seem to be inconsistent with those of the approved FDI. According to these figures, Thailand is still the largest FDI source country of Laos, accounting for 29% of total actual capital, but the ranking of other key FDI source countries has been changed. In particular, the second and third FDI partners are Republic of Korea (19.8%) and Malaysia (17.5%), instead of China (6.7%) and Vietnam (1.2%). This is partly due to the delay of transferring capital from FDI source countries to Laos and missing and confidential data.

In terms of sectoral distribution of Laos's FDI stock, the electricity generation sector has been the largest recipient of foreign investment, by quite a wide margin. Although the approved licenses for the electricity generation sector were just 47 FDI projects, they account for roughly 48% of total approved foreign investment stock (Table 2.4). The anticipated demand from Thailand for additional electricity supplies has stimulated business interest in generating power in Laos.

Other major recipients of FDI inflows include the mining, other services (i.e., mostly tourism) and manufacturing sector (i.e., largely food processing). The garment industry had received relatively large FDI inflows during the 1990s. The expansion of the garment industry and FDI activity in this sector had been largely supported by GSP (generalized system of preferences) granted by the EU in 1997.

2.2 Regional Integration I: From NEM to ASEAN

From the NEM reform until the present, remarkable changes have occurred in the economy and society of Laos. Over two decades Laos has been integrating into the world economy. These changes have had dramatic implications for trade flows, investment flows, and for economic growth in Laos. The initiative launched in 1986 started the transition from a centrally-planned economy to a socialist-oriented market economy leading to a broad range of social, political and economic changes. Major reforms have been done by removing price controls, abandoning socialist cooperative farming, unifying the exchange rate system, removing the government's monopoly on trade, reducing the number of state-owned enterprises (SOEs), promoting private-firm establishments, fiscal reform, and banking and financial reform.

Laos joined ASEAN in 1997 for geopolitical and economic development reasons and has become engaged in ASEAN integration on a step by step basis. Initially Laos had limited commitments in the ASEAN FTA (AFTA) and in the ASEAN Framework Agreement on Services (AFAS).

Overall the regional integration process has proved moderately successful for Laos. As a result of the reforms over the last two decades, the Lao economy has become much more integrated into the world economy. Laos' trade openness (the sum of exports and imports in relation to GDP) increased from 33% in 1988 to 42% in 2009, with the exports' annual growth rate (14%) dominating the imports' annual growth rate (10.5%). With exports as the leading engine of growth, real GDP has increased on average by 7% a year during that period and poverty gradually fell from 45% in 1992–1993 to 30% in 2002–2003 and to 26.5% in 2009–2010 (Fane, 2006, p.215; MPI, 2010, p.5).

ASEAN integration has become significant over time for Laos. The agreement on the Common Effective Preferential Tariff (CEPT) scheme for AFTA required that tariff rates levied on a wide range of products traded within the region be progressively reduced to no more than 5% by 2003 for the six original members. A somewhat longer adjustment period was allowed for the four newer members, with Vietnam committed to reduce its CEPT to no more than 5% by 2006, Lao PDR and Myanmar by 2008, and Cambodia by 2010. All import duties are to be eliminated by 2010 for the former six countries and by 2015 for the latter four. ASEAN members also have the option of excluding products from the CEPT in three cases: temporary exclusions, sensitive agricultural products, and general exceptions.

By implementing the CEPT scheme for AFTA, ASEAN members have made significant progress in lowering intra-regional tariffs. However, the actual utilization by traders of AFTA preferential tariff rates is still limited. There is a lack of direct data on the utilization of AFTA tariff preferences, but there is considerable evidence of low utilization from firm surveys and other sources. According to Manchin and Pelkmans-Balaoing (2007, p.13), the utilization rate of FTA is only 5% of total trade. The low utilization of ASEAN tariff preferences could reflect several factors, including the perceived high costs of administrative compliance and documentation and a

list of sensitive products and exceptions that are not subject to the preferential rates.

Although ASEAN was established in August 1967, its commitment in pursuing regional economic integration in East Asia has been strengthened since the 1990s. The association has launched several economic integration initiatives, including the ASEAN Free Trade Area (AFTA), the ASEAN Framework Agreement on Services (AFAS), and the ASEAN Investment Area (AIA). The adoption of the ASEAN Vision 2020 by the ASEAN leaders in December 1997 envisioned ASEAN as outward looking, living in peace, stability, and prosperity, bonded together in partnership in dynamic development and in a community of caring societies. Furthermore, the ASEAN leaders endorsed the Declaration of ASEAN Concord II (Bali Concord II) in October 2003 to form an ASEAN Community by 2020, composing of three pillars, namely, ASEAN Security Community, ASEAN Economic Community, and ASEAN Socio-Cultural Community (Dean and Wignaraja, 2007).

2.3 Regional Integration II: From ASEAN to ASEAN Plus[9]

FTA plays an important role in East Asia, accounting for more than half of Asia's total FTA initiatives in 2009. There are four main factors underlying the spread of FTAs in East Asia: slow progress in the World Trade Organization (WTO) Doha Round of trade talks; deepening market-driven economic integration; European and North American economic integration; and the 1997–1998 Asian financial crisis (Kawai and Wignaraja, 2009). However, the proliferation of multiple and overlapping FTAs in East Asia might bring risks of going against the WTO Doha round and generating negative "noodle bowl" impacts. One possible option to mitigate such risks is whether East Asia should target at a single FTA based on ASEAN+3 or ASEAN+6.

ASEAN+3 was initiated in the informal ASEAN Leader's Meeting in December 1997. The East Asia Vision Group, established in 1999, had proposed the idea of forming an "East Asian Community". In November 2004, the ASEAN+3 Leaders agreed to establish an "East Asian Community"

[9] This section is drawn from Dean and Wignaraja (2007).

as a long-term objective and regarded ASEAN+3 as the main engine for this eventual formation. Its main purposes in terms of economic, trade, and investment integration, can be summarized as: establishment of an EAFTA and liberalization trade well ahead of the Asia Pacific Economic Cooperation (APEC) Bogor Goal[10]; enlargement of the Framework Agreement on an ASEAN Investment Area (AIA) to all of East Asia; advancement of development and technological cooperation among regional countries to provide assistance to less developed countries; and realization of a knowledge-based economy and establishment of a future-oriented economic structure.

ASEAN+6 was significantly developed since ASEAN leaders agreed in November 2004 in Vientiane to summon an East Asian Summit (EAS), suggested by the East Asia Vision Group. The first EAS meeting was held in Kuala Lumpur in December 2005 and the second one in Cebu in January 2007, with the participation of ten ASEAN and the 'plus six' countries. ASEAN+6 concentrates on energy and environmental issues.

East Asian economic community seems to evolve around the multiple agreements under the ASEAN, ASEAN+1, ASEAN+3, and ASEAN+6 processes.[11] It is now recognized that the heart of East Asian cooperation depends on ASEAN as the "driving force", with ASEAN+3 as the "main vehicle" for the realization of an eventual East Asian economic community, with ASEAN+6 as "an integral part of the overall evolving regional architecture."

2.4 Laos' Trade in ASEAN Plus

As has been explained, Laos' trade has been growing for more than two decades and will continue to grow due to two main reasons. First, Laos has entered into commitments in the ASEAN and ASEAN plus FTAs and is

[10] The APEC Bogor goal was declared in 1994 to set the goal of zero tariffs by 2010 for developed countries and by 2020 for developing countries.

[11] The ASEAN+1 processes consist of ASEAN+China, ASEAN+Japan, ASEAN+Korea, ASEAN+India, and ASEAN+CER largely in the form of FTAs or comprehensive economic partnership agreements (EPAs). CER stands for Closer Economic Relations of Australia and New Zealand.

preparing to be a member of the WTO which will be implemented according to schedules. Second, Laos' policy will continue to evolve either as a result of future negotiations or through policy adjustments. This section provides a brief overview of the current status of the regime for international exchange of goods in ASEAN+6.

2.4.1 Barriers to Laos' Trade in ASEAN plus

As a result of the NEM and unilateral liberalization, there have been significant changes in the tariff structure of Laos. The following tables present a summary of the applied tariffs (Table 2.5), applied tariffs by product groups (Table 2.6), and duties faced by Lao exporters in the export markets (Table 2.7) in 2008.

Table 2.5 shows that the simple average of the MFN applied tariffs rates for agricultural products in 2008 is more than twice higher than the non-agricultural products. About 50% of tariff lines for agricultural products have tariff rates lower or equal to 10%, while the rest 50% of tariff lines are in the range of tariff rates between 15% and 50%. About 90% of tariff lines for non-agricultural products have tariff rates not higher than 10%.

Table 2.5: Laos' tariffs (MFN applied) in 2008, summary and duty ranges

Summary	Total	Agriculture	Non-agriculture
Simple average	9.7	19.5	8.2

Frequency distribution	Tariff lines (in %)							
	Duty-free	0 <=5	5 <=10	10 <=15	15 <=25	25 <=50	50 <=100	> 100
Agricultural products	0	27.3	20.8	0	8.2	43.0	0	0
Non-agricultural products	0	59.0	33.2	0.1	4.9	2.8	0	0

Source: WTO, ITC, and UNCTAD (2010).

The tariff rates applied to product groups vary widely, as illustrated in Table 2.6. The Lao government imposed the highest tariff rate (31.3%) on beverages and tobacco and the lowest tariff rate (5.8%) on minerals and metals. It is also important to note that there is no duty free available for any product groups.

Table 2.6: Laos' tariffs (MFN applied) in 2008 by product groups

Product groups	MFN applied duties		
	Average	Duty-free in %	Max
Animal products	24.9	0	30
Dairy products	8.5	0	20
Fruit, vegetables, plants	30.3	0	40
Coffee, tea	24.2	0	40
Cereals and preparations	9.2	0	30
Oilseeds, fats and oils	12.0	0	30
Sugars and confectionery	12.5	0	30
Beverages and tobacco	31.3	0	40
Cotton	8.0	0	20
Other agricultural products	9.8	0	30
Fish and fish products	12.7	0	30
Minerals and metals	5.8	0	20
Petroleum	14.9	0	20
Chemicals	6.8	0	40
Wood, paper, etc.	14.1	0	40
Textiles	8.9	0	30
Clothing	10.0	0	10
Leather, footwear, etc.	11.0	0	30
Non-electrical machinery	6.0	0	40
Electrical machinery	6.8	0	20
Transport equipment	13.5	0	40
Manufactures, n.e.s.	10.3	0	40

Source: WTO, ITC, and UNCTAD (2010).

Table 2.7 illustrates values of Laos' exports to its major trading partners and duties faced in 2008. The European Union is the key market for Laos' agricultural products, recorded around $30 million, while Thailand is the key market for Laos' non-agricultural products, recorded around $581 million. A 100% of duty-free imports are offered by the United States for agricultural products and by the European Union for non-agricultural products. China and Thailand still maintain trade barriers to protect their domestic agricultural production, with simple averaged tariff rate of 21.7% and 22.6%, respectively.

An important set of challenges for Laos involves trade facilitation and logistics. Table 2.8 is drawn from the logistics performance index (LPI) in 2010 of the World Bank. In interpreting this table, a high score to a maximum of 5 denotes good performance in logistics and trade facilitation, while a low score indicates that there are impediments to logistics and a lack of trade facilitation. The countries are listed according to ascending order of LPI with Singapore at the top. The column on the left, the LPI for Logistics Performance Index, is an aggregation of the six components on the right.

Table 2.7: Laos' exports to major trading partners and duties faced in 2008

Major markets	Bilateral imports	Diversification 95% trade in number of		MFN average of traded tariff line		Preference margin	Duty-free imports	
	in million US$	HS 2-digit	HS 6-digit	Simple	Weighted	Weighted	Tariff line in %	Value in %
Agricultural products								
1. European Union	30	4	7	13.3	1.6	1.4	90.6	99.1
2. Thailand	28	9	19	22.6	26.9	25.4	81.2	45.7
3. China	17	7	12	21.7	29.7	7.2	39.1	44.0
4. Vietnam	12	11	14	23.0	18.4	15.8	47.3	49.4
5. United States	4	2	2	0.0	0.0	0.0	100.0	100.0
Non-agricultural products								
1. Thailand	581	8	17	12.0	2.6	2.4	76.5	95.2
2. Vietnam	196	4	11	17.8	1.1	0.7	42.7	97.1
3. European Union	170	4	41	7.5	11.8	11.8	100.0	100.0
4. China	117	7	13	6.5	2.3	0.3	63.1	86.3
5. Korea, Republic of	52	2	2	7.9	2.0	2.0	51.4	99.2

Source: WTO, ITC, and UNCTAD (2010).

The six components on the right of LPI include customs, infrastructure, international shipments, logistics competence, tracking and tracing, and timeliness. The index of customs measures the efficiency of the clearance process, such as speed, simplicity, and predictability of formalities, by border control agencies. The index of infrastructure measures the quality of trade and transport related infrastructure, such as ports, railroads, roads, and information technology.

Table 2.8: Comparison of the logistics performance index for Laos and other ASEAN+6 countries in 2010

Country	LPI	Customs	Infrastructure	International shipments	Logistics competence	Tracking & tracing	Timeliness
Singapore	4.1	4.0	4.2	3.9	4.1	4.2	4.2
Japan	4.0	3.8	4.2	3.6	4.0	4.1	4.3
Australia	3.8	3.7	3.8	3.8	3.8	3.9	4.2
New Zealand	3.7	3.6	3.5	3.4	3.5	3.7	4.2
Korea, Rep.	3.6	3.3	3.6	3.5	3.6	3.8	4.0
China	3.5	3.2	3.5	3.3	3.5	3.6	3.9
Malaysia	3.4	3.1	3.5	3.5	3.3	3.3	3.9
Thailand	3.3	3.0	3.2	3.3	3.2	3.4	3.7
Philippines	3.1	2.7	2.6	3.4	3.0	3.3	3.8
India	3.1	2.7	2.9	3.1	3.2	3.1	3.6
Vietnam	3.0	2.7	2.6	3.0	2.9	3.1	3.4
Indonesia	2.8	2.4	2.5	2.8	2.5	2.8	3.5
Lao PDR	2.5	2.2	2.0	2.7	2.1	2.5	3.2
Cambodia	2.4	2.3	2.1	2.2	2.3	2.5	2.8
Myanmar	2.3	1.9	1.9	2.4	2.0	2.4	3.3

Source: The World Bank (2011).

The index of international shipments measures ease of arranging competitively priced shipments. The index of logistics competence measures the competence and quality of logistics services, such as transport operators and custom brokers. The index of tracking and tracing measures the ability to track and trace consignments. The index of timeliness measures the timeliness of shipments in reaching destination within the schedule or expected delivery time.

As shown in Table 2.8, Laos lags far behind other ASEAN countries and its counterparts, except Cambodia and Myanmar, using the overall LPI. However, Laos is inferior to Cambodia in terms of custom clearance and to Myanmar in terms of shipment timeliness. Against this background, a key impediment to trading and investing across borders in Laos inadequate trade facilitation and logistics. Better logistics performance is often seen to lead to trade expansion, export diversification, ability to attract foreign direct investments, and economic growth.

2.4.2 Laos' Trade Flows in ASEAN Plus

This section reviews Laos' trade flows in the context of ASEAN and ASEAN plus. It introduces the current status of Laos' trade flows in ASEAN+6 by describing the main products that Laos trades with other ASEAN+6 countries. This could provide some basic information about how the ASEAN trade enlargement would have an impact on Laos' trade flows.

Table 2.9: Laos' exports by country of origin and by product group in 2009

(In percentage of total exports)

	Thailand	Vietnam	China	Japan	ASEAN	ASEAN+3	ASEAN+6	EU	Others	Total
Minerals	17.92	10.20	3.72	0.00	29.04	34.35	35.31	0.00	10.64	45.95
Garment	0.26	0.00	0.00	0.34	0.27	0.71	0.72	12.86	1.23	14.81
Electricity	9.86	0.00	0.00	0.00	9.86	9.86	9.86	0.00	0.00	9.86
Other agricultural products	3.99	1.73	3.05	0.01	5.73	8.78	8.78	0.04	0.02	8.84
Gold	0.00	0.00	0.00	0.00	0.00	0.00	8.78	0.00	0.00	8.78
Wood and wood products	2.04	2.39	0.16	0.09	4.43	4.69	4.69	0.03	0.08	4.81
Others	1.71	1.60	0.34	0.65	3.34	4.37	4.38	0.91	1.67	6.96
Total	35.78	15.92	7.27	1.08	52.65	62.76	72.52	13.84	13.64	100.00

Source: MOIC (2011).

Most of the Laos' trade flows have concentrated in East Asia. Table 2.9 shows that Laos exports intensively to ASEAN plus countries, accounting for 53% of its total exports in ASEAN and 72.5% in ASEAN+6 in 2009. The key

product of Laos' exports is minerals, accounting for 46% of its total exports and is mainly exported to Thailand (18%) and Vietnam (10%). Other key products of Laos' exports include garments (15%)—mainly exported to the EU and electricity (10%)—exported to Thailand.

Table 2.10: Laos' imports by country of origin and by product group in 2009

(In percentage of total imports)

	Thailand	Vietnam	China	Japan	ASEAN	ASEAN+3	ASEAN+6	EU	Others	Total
Capital goods	31.81	5.60	3.21	0.55	37.45	41.26	41.79	0.18	0.11	42.09
Vehicles and spare parts	11.68	1.26	1.56	0.10	12.94	16.27	16.27	0.01	0.01	16.29
Fuel and gas	11.61	2.65	0.00	0.00	14.26	14.28	14.28	0.00	0.00	14.28
Industrial goods	5.31	1.67	2.02	0.06	7.01	9.16	9.38	0.62	0.12	10.12
Garment and raw materials	2.94	0.40	0.47	0.03	3.66	4.19	4.23	0.02	0.44	4.70
Construction materials	1.29	0.80	0.43	0.00	2.09	2.52	2.52	0.00	0.00	2.52
Others	5.59	1.61	2.19	0.00	7.64	9.86	9.86	0.11	0.04	10.01
Total	70.22	13.99	9.89	0.74	85.06	97.53	98.33	0.94	0.73	100.00

Source: MOIC (2011).

ASEAN+6 countries are also the main sources of Laos' imports, accounting for 98% of Laos' total imports, as shown in Table 2.10. Thailand is the main source of Laos' imports, accounting for 63% of the total imports in 2009. The key product group of Laos' imports is the capital goods, accounting for 42% of its total imports and is mainly imported from Thailand (32%) and Vietnam (6%). Thailand is also the main source of Laos' imports in terms of vehicles and spare parts (12%) and fuel and gas (12%).

Chapter 3 Foreign Direct Investment in General Equilibrium Model, Gravity Models, and Stochastic Frontier Models

3.1 Theoretical and Empirical Approaches to FDI-Trade Linkages

3.1.1 A Causality Analysis between FDI and Trade

The problem of causality between FDI and trade has extensively been investigated by applying the time-series or panel-data approach. Some empirical analyses using the time-series approach include Pfaffermayr (1994) and de Mello and Fukasaku (2000). Using quarterly data on Austria's outward FDI flows, exports of goods and real OECD GDP from 1969 to 1991, Pfaffermayr (1994) investigated the causal relationship between FDI and exports based on the time-series approach of Granger causality and cointegration tests. The author found that there is a bi-directional causal link between FDI and exports, and that real OECD GDP, as an exogenous variable, has a significant impact on both FDI and exports. Applying the same analytical approach, de Mello and Fukasaku (2000) examined the causality between trade and FDI using annual data on total imports, manufactured exports and net FDI inflows for 16 selected Latin American and Pacific Asian countries from 1970 to 1994. They found that imports lead up to inward FDI is supported by several country cases, but the evidence is far from conclusive; and that the prevailing impact of FDI on the trade balance is negative in Pacific Asia over the full sample period (1970–1994) and in Latin America over the reduced sample period (1970–1984).

Some empirical analyses using the panel-data approach to investigate FDI-trade linkage include Pain and Wakelin (1998) and Hsiao and Hsiao (2006). Using the semi-annual panel data on manufactured exports and outward and inward FDI stocks for 11 OECD countries from 1971 to 1992, Pain and Wakelin (1998) estimated the dynamic export demand equations. They found that the trade effects of FDI differ in both sign and magnitude among the OECD countries under study; and that overall, a small negative impact of outward FDI on home-country export performance is offset by a corresponding positive impact from inward FDI on host-country export

performance. Hsiao and Hsiao (2006) applied the panel-data approach of Granger causality tests in the VAR model for the panel data on GDP, exports, and FDI of the group of eight rapidly developing East and Southeast Asian economies (China, Korea, Taiwan, Hong Kong, Singapore, Malaysia, Philippines, and Thailand) from 1984 to 1998. They found that FDI has unidirectional impacts on GDP directly and also indirectly through exports; and that there is bidirectional causality between exports and GDP for the group.

Following the existing literature, the panel causality analysis is adopted in this dissertation to test the causal relationship between FDI and trade in Laos. The empirical models are provided in Section 4.1.1 of Chapter 4.

3.1.2 A General Equilibrium Approach to FDI-Trade Linkages

The industrial-organization (IO) approach to new trade theory has combined features of increasing returns to scale, imperfect competition, and product differentiation into traditional general-equilibrium trade models. The theoretical developments of FDI incorporating multinational enterprises (MNEs) focus on maintaining facilities in more than one country. These multinationals are classified into horizontal MNEs, which produce the same goods and services in many countries, and vertical MNEs, which geographically fragment production by stages.

There are many factors determining the emergence of horizontal and vertical MNEs. For the horizontal MNEs, these factors include the presence of multi-plant economies of scale (Markusen, 1984); imperfections in contracting under uncertainty (Ethier, 1986); similarity in country size, similarity in relative factor endowments, and growth in world income (Markusen and Venables, 1998); and the reduction of trade costs (Markusen and Venables, 2000). For the vertical MNEs, the determinants include differences in factor endowments across countries and transportation costs (Helpman, 1984; Zhang and Markusen, 1999).

Combining both horizontal and vertical motives for direct investment into a single theoretical model are analytically difficult. The early model of vertical multinationals proposed by Helpman (1984) used the assumption of no trade costs, but in that case there is no motive for horizontal multinationals, given plant-level scale economies. For analytical simplicity,

the early model of horizontal multinationals proposed by Markusen (1984) assumed that headquarter services and plant production use factors in the same proportion or that there is only one factor of production. Nonetheless, this does not allow factor-price motive for vertical fragmentation across countries.

A new approach was developed in the 1990s, incorporating the models of vertical and horizontal multinationals. This approach is now known as the "knowledge-capital model" of the MNE, after the seminal works of Markusen et al. (1996) and Markusen (1997). Markusen (1997) argued that abundant factors in certain industries of a relatively skilled-labor-scarce economy could be exploited through knowledge-intensive producer services provided by direct investment. To clarify this issue, the author constructed a theoretical model which consisted of two homogeneous goods, two factors of production (unskilled labor and skilled labor), and two countries. One kind of goods is produced with constant returns under perfect competition, and another kind of goods is produced with increasing returns at both the firm and plant level. There are six possible firm types, each defined by the locations of plants and headquarters. These firm types include horizontal MNEs, vertical MNEs, and national firms. In equilibrium, only certain types of firms exist depending on difference in country size, difference in relative factor endowments, transport costs, and costs of MNE operation.

Using the constructed-general-equilibrium model, Markusen (1997) numerically simulated four scenarios. The first scenario with high protection of trade and FDI is used as the base case. In the base case, there are only national firms, but most of them locate in a large and skilled-labor-abundant country. The second scenario is trade liberalization which shows that all national firms locate in a small and unskilled-labor-abundant country are driven out. The third scenario is the investment liberalization which shows that horizontal MNEs exist. The emergence of horizontal MNEs expands production into a small and unskilled-labor-abundant country, and raises the real and relative price of skilled labor in both the home and host countries. The fourth scenario is the liberalization in both trade and investment which shows that the vertical MNEs exist as countries differ in relative endowments.

All in all, the knowledge-capital model allows both horizontal and vertical multinationals to arise endogenously, depending on country characteristics (such as market size, income level, and skill differentials) and the level of trade costs (such as transportation costs and tariffs). Following the "eclectic approach" proposed by Dunning (1977), this model differentiates the knowledge-based service activity of the MNE as a source of ownership advantage (referred to as "headquarters services") from the goods-producing activity. This differentiation allows these two activities to be geographically separable while remaining within a single firm. The headquarters services are also assumed to serve collectively in goods production as an input and are more skill-intensive than production.

Regarding the issue of FDI-trade linkages, the knowledge-capital model shows that horizontal FDI will substitute for exports, depending on the existence of the multi-plant scale economies relative to trade costs. On the contrary, vertical FDI will complement exports, because the home country supplies headquarters services and/or intermediate inputs to the host country. Eventually, which type of FDI will dominate is determined by country characteristics and trade costs (and other factors such as net of trade and government policies). Therefore, the knowledge-capital model of the MNE serves as a unified approach to international trade and production with testable hypothesis.

Carr et al. (2001) empirically tested the theoretical predictions of the knowledge-capital model and found that the volume of affiliates sales follows the theoretical predictions based on characteristics of both parent and host countries (such as economic size, economic size differences, trade and investment costs, and certain interactions among these variables as predicted by the theory). More precisely, their findings indicate that outward investment from a source country to affiliates in a host country is positively related to the sum of their economic sizes, their similarity in size, the relative skilled-labor abundance of the parent nation, and the interaction between size and relative endowment differences. This empirical result proves useful in future policy analysis. However, the fact that the theoretical model gives rise to the use of 'foreign affiliate sales data' instead of 'FDI data' makes it difficult for applied researchers to find the former data when developing countries are central of interest. As a result, the search for

theoretical model that allows researchers to directly use FDI data is still high on the research agenda.

Since then, the knowledge-capital model was modified to allow for the use of FDI data. This modified model is now called the "three-factor model" of trade and FDI, after the works of Egger and Pfaffermayr (2004, 2005), among others. An important feature of this theoretical model is that the authors explicitly distinguish between internationally mobile physical capital in terms of FDI and immobile human capital. The theoretical model suggests a specification, which differs from Carr et al. (2001) and Markusen and Maskus (1999, 2002) in two respects: firstly, it accounts for both relative physical and human capital endowments; and secondly, the left-hand-side variable is represented by FDI stocks rather than affiliate sales (or foreign production), because the theoretical model emphasizes the role of physical capital and supports the analysis of FDI figures.

Recently, Bergstrand and Egger (2007, 2010) derived the theoretical rationale for estimating the gravity models for bilateral flows of trade, FDI, and foreign affiliate sales. That is, the bilateral flows of trade, FDI, and foreign affiliate sales can be explained by two countries' GDPs, distance, and cultural and historical links. Based on a general equilibrium approach, Suvannaphakdy (2011) presented a review of five theoretical models of foreign direct investment. These theoretical models are: MacDouglas–Kemp model (1), horizontal FDI model (2), vertical FDI model (3), knowledge-capital model (4), and gravity model (5). The paper shows that these five prominent theoretical models emerged in direct supplement from the earliest model to the latest one. Therefore, they can be represented by a single model, this model being the Gravity Model of FDI. Nonetheless, for the purpose of this dissertation, the three-factor model is a better choice because it allows us to explain the general patterns of FDI and trade linkages.

In summary, investigating FDI-trade linkages can be done by considering which type of FDI dominates. FDI will substitute for exports if horizontal FDI dominates, whereas FDI will complement exports if vertical FDI dominates. This hypothesis can be empirically investigated by using the three-factor model.

3.1.3 Theoretical Foundation of the Three-Factor Model

This subsection reviews the theoretical background of the three-factor model, following Egger and Pfaffermayr (2004, 2005). This model resulted from the extension of the knowledge-capital capital model by including the physical capital as an additional factor of production. The resulting model then puts special emphasis on the role of distance on both trade costs and plant set-up costs at a possibly different intensity.

By emphasizing the role of distance, the model gains more attraction because the role of transport costs, empirically represented by distance, has become one of the most deeply analyzed topics in theoretical and empirical economics of international trade, with the gravity model of trade as a key example. Furthermore, the endowment and economies of scale-based models of trade and multinational enterprises supports the gravity model for the analysis of FDI. Some examples of gravity models on trade include Bergstrand (1985, 1989), Rose (2004), and Helpman et al. (2008). Gravity models on affiliate sales include Markusen and Maskus (1999, 2002), Carr et al. (2001), Hanson et al. (2001), and Blonigen et al. (2002). Gravity models on both trade and FDI include Graham (1997) and Brenton et al. (1999).

The theoretical model proposed by Egger and Pfaffermayr (2004, 2005) is basically a 2×1×3 model, with two countries (home and foreign), one horizontally differentiated good, and three factors of production (low-skilled labor, L, high-skilled labor, H, and physical capital, K). The good is produced by foreign or domestic exporters, horizontal or vertical MNEs. Both exporters and MNEs serve their home market. The vertical MNEs locate production plants in the relatively-rich country and operate their headquarters in the other, whereas horizontal MNEs produce in each country and do not engage in goods trade. Since there are two countries, there are six possible firm types:

- horizontal MNE with the headquarters in the Home country, and the plant in both countries;
- horizontal MNE with the headquarters in the Foreign country, and the plant in both countries;
- national firm with both the headquarters and the plant in the Home country;

- national firm with both the headquarters and the plant in the Foreign country;
- vertical MNE with the headquarters in the Home country and the plant in the Foreign country; and
- vertical MNE with the headquarters in the Foreign country and the plant in the Home country.

Egger and Pfaffermayr assume that both exports and outward FDI are determined by factor endowments, trade costs, and fixed costs of establishing a plant abroad; and that *H* is the only input required for a blueprint invention, and *K* is the only input required for a plant set-up. The input coefficients for both the invention of blueprints and for plant set-up are, for the sake of simplicity, rescaled to one. The proposed model consists of four main components: factor markets, demand side, first-order and zero-profit conditions, and balance of payments.

The factor market clearing requires:

$$L_i = a_{Lx}(w_i)[(n_i + m_i^h + m_j^h + m_j^v)x_{ii} + (n_i + + m_j^v)x_{ij}]$$

$$H_i = a_{Hx}(w_i)[(n_i + m_i^h + m_j^h + m_j^v)x_{ii} + (n_i + + m_j^v)x_{ij}] + n_i + m_i^h + m_i^v \quad (3.1)$$

$$K_i = a_{Kx}(w_i)[(n_i + m_i^h + m_j^h + m_j^v)x_{ii} + (n_i + + m_j^v)x_{ij}] + n_i + (2+\gamma)m_i^h + (1+\gamma)m_i^v$$

where $a_{Lx}(w_i)$, $a_{Hx}(w_i)$, and $a_{Kx}(w_i)$ are input coefficients for the production of one unit of output, determined by the vector of domestic factor rewards (w_i). n_i denotes to the number of pure exporters, m_i^h to horizontal MNEs, and m_i^v refers to vertical MNEs headquartered in country *i*. x_{ii} denotes the production for a firm's home market, while x_{ij} denotes a firm's exports from country *i* to *j*, either by a country *i*'s exporters or a country *j*'s vertical MNEs producing in *i*. x_{ij} contains iceberg trade costs, melting at a rate of $t - 1$, when goods cross the border.

Due to differences in the cultural, political or economic environment, Egger and Pfaffermayr assume that distance (δ) raises both pure trade costs (*t*) and a foreign plant's set-up costs $(1+\gamma)$. Trade costs are defined as country-specific iceberg transport costs $(t = t_0 + \delta)$. Establishing a foreign plant requires higher fixed costs than a domestic plant $(\gamma = \gamma_0 + \rho\delta)$. Plant set-up costs are also iceberg-type, where γ is measured in terms of physical

capital. Therefore, both horizontal and vertical MNEs have to send $1+\gamma_0+\rho\delta$ units of capital so as to supply one unit of capital, required for establishing foreign plant.

Demand is derived from a CES Dixit and Stiglitz (1977) utility function and expressed as:

$$x_{ii} = p_i^{-\varepsilon} s_i^{\varepsilon-1} E_i; \qquad x_{ij} = p_i^{-\varepsilon} t_j^{1-\varepsilon} s_j^{\varepsilon-1} E_j \tag{3.2}$$

where ε is the elasticity of substitution, E_i is domestic factor income, and s_i is the price aggregator defined as

$$s_i = [(n_i + m_i^h + m_j^h + m_j^v) p_i^{1-\varepsilon} + (n_j + m_i^v)(t_i p_j)^{1-\varepsilon}]^{1/(1-\varepsilon)} \tag{3.3}$$

Under monopolistic competition, first-order conditions give a constant markup over marginal costs. x_{ii}, x_{ij}, x_{ji}, and $x_{jj} > 0$ as long as first-order conditions hold with equality. Profits (π) for both exporters (superscript x) and MNEs (superscript m^h, m^v) are driven to zero by free entry. The equilibrium configuration of active firms is determined by the following set of inequalities with the number of firms as the complementary slackness:

$$\pi_i^x = p_i x_{ii} + p_i x_{ij} - d_i x_{ii} - d_i x_{ij} - w_{Hi} - w_{Ki} \geq 0 \quad (n_i)$$

$$\pi_i^{m^h} = p_i x_{ii} + p_j x_{jj} - d_i x_{ii} - d_j x_{jj} - w_{Hi} - (2+\gamma) w_{Ki} \geq 0 \quad (m_i^h) \tag{3.4}$$

$$\pi_i^{m^v} = p_j x_{jj} + p_j x_{ji} - d_j x_{jj} - d_j x_{ji} - w_{Hi} - (1+\gamma) w_{Ki} \geq 0 \quad (m_i^v)$$

where $d_i = a_{Lxi} w_{Li} + a_{Hxi} w_{Hi} + a_{Kxi} w_{Ki}$.

The balance of payments ensures the balance between goods trade flows and the sum of trade in invisibles (headquarter services) and capital flows across border (FDI). The sum of the two corresponds to the profits of the MNEs' affiliates:

$$(n_i + m_j^v) p_i x_{ij} + (1-\theta) p_j x_{jj} (m_i^h + m_i^v) = (n_j + m_i^v) p_j x_{ji} + (1-\theta) p_i x_{ii} (m_j^h + m_j^v) \tag{3.5}$$

where θ denotes the mark-up. Empirically, exports and outward FDI are measured in real terms, corresponding to $(n_i + m_j^v)x_{ij}$ and $(m_j^h + m_j^v)(1+\gamma)$, respectively.

Because of the nonlinearities induced by iceberg transport costs, the model cannot be solved analytically. Instead, numerical simulations are used to derive the comparative statics of the system for particular values (see the appendix of Egger and Pfaffermayr, 2004). Only small changes in the factor endowments and parameters are considered so as to ensure that these changes do not alter the equilibrium configuration of firm types. These comparative static results are summarized in Table 3.1.

Table 3.1: The comparative statics for exports and outward FDI

Exogenous variables	Horizontal MNEs		Vertical MNEs	
	Exports (X)	FDI (F)	Exports (X)	FDI (F)
Sum of bilateral GDP	+	+	+	+
Similarity in country size	+	+/−	+	+
Relative physical capital endowment	−	+	−	+
Relative human capital endowment	+	+	+	+
Relative labor endowment	+	+	+	−
Distance:				
low ρ	−	+	−	+
medium ρ	+	−	−	+
high ρ	+	−	+	+

Source: Adapted from Table I of Egger and Pfaffermayr (2004).

Table 3.1 shows that both exports and outward FDI of either horizontal MNEs or vertical MNEs are positively affected by the sum of bilateral GDP. The impact of the similarity in country size on outward FDI may be either positive or negative (Markusen and Maskus, 2002). Regardless of the type of MNEs, both outward FDI and exports are substitutive with respect to changes in the relative physical capital endowment, defined as $k = K_i / K_j$. That is, a ceteris paribus increase in K_i increases the number of country i's MNEs and its FDI, causing a decrease in the number of exporters and also of aggregate exports. In contrast, outward FDI and exports are complementary with respect to changes in relative human capital endowments, defined as $h = H_i / H_j$. That is, a ceteris paribus increase in H_i increases country i's

comparative advantage in brand invention. In horizontal and vertical MNEs, outward FDI and exports are substitutive with respect to changes in the relative labor endowment, defined as $l = L_i / L_j$. That is, a ceteris paribus increase in L_i increases a comparative advantage in goods production, which raises real exports, but decreases real outward FDI.

There are two key factors behind the effect of distance on outward FDI and exports. These factors are the difference in physical capital to labor ratios between economies and the relative importance of distance for foreign investment as compared to trade, measured by the parameter ρ. The severity of the impact of distance on costs of foreign plant establishment increases with ρ. As can be seen from Table 3.1, outward FDI and exports for horizontal and vertical MNEs are substitutive with respect to changes in distance with small to medium level of ρ. With high level of ρ, outward FDI and exports with horizontal MNEs dominance are substitutive with respect to distance, while they are complementary with vertical MNEs dominance.

In summary, using the three-factor model Egger and Pfaffermayr (2004) derive the theoretical model on how distance might have an impact on costs of foreign plant establishment. Controlling for country size and relative factor endowments, the impact of distance on outward FDI and exports varies with respect to the type of MNEs dominating and the relative importance of distance on FDI relative to trade.

3.2 Empirical Analysis of Free Trade Agreement

3.2.1 Assessing the Impacts of Free Trade Agreement on Trade Flows

Theoretical and empirical literature analyzing the economics of free trade emphasize that it creates both winners and losers. The literature indicates that the goods trade provisions of regional trade agreements (RTAs) can promote trade among members, whereas it is at the cost of trade among non-members. Consequently, whether free trade benefits a country to join a RTA depends on the cost structures in partner countries, relative to those in non-members. According to Viner (1950), RTA generates either trade creation or trade diversion. Trade creation exists when the importing country substitutes a lower cost source of supply within the area for a more costly source and hence, benefits to the member countries and the world as

whole. On the contrary, trade diversion exists when the importing country substitutes a higher cost source of supply within the area for a less costly source of supply outside the area.

Many studies have analyzed trade impacts and welfare impacts of the formation of RTA. While all of these studies argue that formulating RTA could enhance trade flows of its members, the effects of RTA formation typically vary from country to country involving in the trading bloc. As result, the trade impact of RTA formation is an empirical issue. My dissertation, especially in Chapter 6, is concerned with the evaluation of trade impacts.

Modeling international trade flows and FTA effects could be made by applying either the computable general equilibrium (CGE) model or the gravity model. The CGE model of trade is based on the simulations to calculate the impact of changes in inputs on the structure of trade flows. While it has been criticized that pre-determining a number of parameters for doing simulation in the CGE model leads to obtain results with unknown statistical properties (World Bank, 2005, p. 61), it has been confirmed that its results are robust, particularly those obtained from the investigation of FTA impacts (Hertel et al., 2007).

Both the CGE and gravity models have been applied to examine various issues affecting trade flows. Nonetheless, the gravity model has gained its popularity over the CGE model due to its robust performance and relatively unrestricted parameter assumptions (Filippini and Molini, 2003). Since the analysis of international trade phenomenon is extremely complex, research on developing the gravity model's theoretical foundation is still going on.

The gravity model of trade, introduced by Tinbergen (1962), is based on the econometric methods in specifying and estimating the parameters of its model. The fundamental assumption of the gravity model of trade is that trade flows between two countries relate positively to their GDPs, and inversely to the distance between them.

The early empirical works by Tinbergen (1962), Pöyhönen (1963), and Linnemann (1966) confirmed the empirical success of the gravity model in explaining trade flows, but were lack of a sound theoretical foundation which could not convince theorists. Since the lack of theoretical foundation introduces a certain degree of subjectivity in the interpretation of the

estimated coefficients, it diminishes the credibility of a model (Piermartini and Teh, 2005, pp. 37). As a result, the search for a sound micro-foundation for the model started since then.

Economists have derived the gravity model from several international trade theories such as product differentiation (Anderson, 1979), new trade theory (Helpman and Krugman, 1985; Bergstrand, 1990), Hecksher-Ohlin (H-O) theory (Bergstrand, 1989; Deardorff, 1998), and Linder hypothesis (Bergstrand, 1989). Anderson and van Wincoop (2003) introduced a method to deal with the complicated price terms by extending the works of Anderson (1979), Bergstrand (1985, 1989, 1990). They not only derive a theoretical gravity model, but also suggest a consistent and efficient estimation method for such model. Therefore, their work has become the main reference for subsequent work on the gravity model.

According to Kepaptsoglou et al. (2010), the gravity model has been applied to examine trade flows and related policies over the last ten years (1999–2009). These issues include trade flows between regions in general or flows of specific products; the effects of RTAs, currency unions, and common markets; and trade policy implications and factors that affect trade, such as natural border effects, domino effects, FDI, the rules-of-origin, transport costs, and trade facilitation. Of these, there are 24 empirical studies applying the gravity model to analyze the impacts of RTAs, accounting for 46% of their reviewed empirical studies on trade flows and related policies. This indicates that empirical research on the formation of RTA is still high on the research agenda.

In summary, evaluating the trade impact of RTA formation is an empirical issue. The gravity model plays an important role in this area due to its rigorous theoretical foundation, its robustness to econometric specification, and its robustness to empirical results.

3.2.2 Theoretical Foundations of the Gravity Model

This section illustrates the derivation of the theoretical gravity model, following Anderson and van Wincoop (2003). A standard CES utility function for country *j* is represented as

$$U_j = \left(\sum_i \beta_i^{\frac{1-\rho}{\rho}} C_{ij}^{\frac{\rho-1}{\rho}} \right)^{\frac{1}{\rho-1}} \tag{3.6}$$

which is maximized by consumers subject to

$$Y_j = \sum_i p_{ij} C_{ij} \tag{3.7}$$

where β_i is the CES share parameter; C_{ij} is the consumption of goods from *i* by consumers in *j*; Y_j is the nominal income of consumers in *j*; and p_{ij} is the CIF price of goods from *i* in region *j*.

Applying the Lagrangean method to the maximization problem, equation (3.6) and (3.7) can be written as

$$L(C_{ij}, \lambda) = \left(\sum_i \beta_i^{\frac{1-\rho}{\rho}} C_{ij}^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} + \lambda (Y_j - \sum_i p_{ij} C_{ij}) \tag{3.8}$$

The first order condition with respect to C_{ij} is

$$\frac{\partial L}{\partial C_{ij}} = \beta_i^{\frac{1-\rho}{\rho}} C_{ij}^{-\frac{1}{\rho}} \left(\sum_i \beta_i^{\frac{1-\rho}{\rho}} C_{ij}^{\frac{\rho-1}{\rho}} \right)^{\frac{1}{\rho-1}} - \lambda p_{ij} = 0$$

and the solution to the maximization problem becomes

$$C_{ij} = \beta_i^{1-\rho} \frac{Y_j}{p_{ij}^{\rho} \sum_i (p_{ij} \beta_i)^{1-\rho}} \tag{3.9}$$

Now, assume that prices differ between locations due to transportation costs, and define p_i as the exporter F.O.B price and $t_{ij} > 1$ as the trade cost factor between *i* and *j*, so that $p_{ij} = t_{ij} p_i$. This is the 'iceberg' cost model of transportation costs, where a fraction $(t_{ij} - 1)$ of each unit shipped 'melts'

along the way. This formulation implies that the C.I.F value of exports from *i* to *j* is composed of two parts: value of production at the origin (F.O.B value) and the shipment cost. The total income of an exporting country *i* under market clearance is therefore

$$Y_i = \sum_j X_{ij} = \sum_j p_{ij} C_{ij} = \sum_j (p_{ij} C_{ij} + (t_{ij} - 1) p_i C_{ij}) = \sum_j p_i t_{ij} C_{ij} \tag{3.10}$$

where X_{ij} is the exports from *i* to *j* valued at importer's prices, such that

$$X_{ij} = p_i t_{ij} C_{ij} \tag{3.11}$$

Inserting equation (3.9) into (3.11) yields the solution for bilateral exports

$$X_{ij} = p_i t_{ij} \beta_i^{1-\rho} \frac{Y_j}{p_{ij}^{\rho} \sum_i (p_{ij} \beta_i)^{1-\rho}} = \frac{(p_i t_{ij} \beta_i)^{1-\rho}}{\sum_i (p_{ij} \beta_i)^{1-\rho}} Y_j \tag{3.12}$$

Specifying the aggregate price index as

$$\Pi_h = \left(\sum_i (p_{ij} \beta_i)^{1-\rho} \right)^{\frac{1}{1-\rho}} \tag{3.13}$$

Substituting equation (3.13) into (3.12) results in

$$X_{ij} = \left(\frac{p_i t_{ij} \beta_i}{\Pi_h} \right)^{1-\rho} Y_j \tag{3.14}$$

We can now re-write the market-clearing condition in the first part of equation (3.9) as

$$Y_i = \sum_j X_{ij} = \sum_j Y_j \left(\frac{p_i t_{ij} \beta_i}{\Pi_h} \right)^{1-\rho} = (\beta_i p_i)^{1-\rho} \sum_j Y_j \left(\frac{t_{ij}}{\Pi_h} \right)^{1-\rho} \tag{3.15}$$

In order to derive the gravity equation, we use equation (3.15) to solve for the scaled prices $\beta_i p_i$ and insert the solution into equation (3.14). Re-arranging terms in equation (3.15), we obtain:

$$(\beta_i p_i)^{1-\rho} = Y_i \left(\sum_j Y_j \left(\frac{t_{ij}}{\Pi_h} \right)^{1-\rho} \right)^{-1} \tag{3.16}$$

Substituting equation (3.16) into (3.14) we get

$$X_{ij} = \frac{Y_i Y_j}{\sum_j Y_j \left(\frac{t_{ij}}{\Pi_h} \right)^{1-\rho}} \left(\frac{t_{ij}}{\Pi_h} \right)^{1-\rho} \tag{3.17}$$

Denoting world income $Y_w = \sum_j Y_j$ and dividing both the numerator and denominator of the right-hand side of equation (3.17) by Y_w, we obtain

$$X_{ij} = \frac{Y_i Y_j}{Y_w} \frac{1}{\sum_j \frac{Y_j}{Y_w} \left(\frac{t_{ij}}{\Pi_h} \right)^{1-\rho}} \left(\frac{t_{ij}}{\Pi_h} \right)^{1-\rho} \tag{3.18}$$

Define a price index P_j such that

$$P_j = \left(\sum_j \frac{Y_j}{Y_w} \left(\frac{t_{ij}}{\Pi_h} \right)^{1-\rho} \right)^{\frac{1}{1-\rho}} = \left(\sum_j \theta_j \left(\frac{t_{ij}}{\Pi_h} \right)^{1-\rho} \right)^{\frac{1}{1-\rho}} \tag{3.19}$$

where θ_j denotes share of country *j*'s income to the world income.

Substituting equation (3.19) into (3.18) yields

$$X_{ij} = \frac{Y_i Y_j}{Y_w} \left(\frac{t_{ij}}{\Pi_h P_j} \right)^{1-\rho} \tag{3.20}$$

Notice that the price index, Π_h, in equation (3.13) can be re-written as

$$\Pi_h = \left(\sum_i (p_{ij}\beta_i)^{1-\rho} \right)^{\frac{1}{1-\rho}} = \left(\sum_i (p_i t_{ij}\beta_i)^{1-\rho} \right)^{\frac{1}{1-\rho}} = \left(\sum_i \frac{Y_i t_{ij}^{1-\rho}}{\sum_j Y_j \left(\frac{t_{ij}}{\Pi_h} \right)^{1-\rho}} \right)^{\frac{1}{1-\rho}}$$

and dividing both the numerator and denominator by Y_w, we have

$$\Pi_h = \left(\sum_i \frac{Y_i}{Y_w} \frac{t_{ij}^{1-\rho}}{\sum_j \frac{Y_j}{Y_w} \left(\frac{t_{ij}}{\Pi_h} \right)^{1-\rho}} \right)^{\frac{1}{1-\rho}} = \left(\sum_i \theta_i \frac{t_{ij}^{1-\rho}}{\sum_j \theta_j \left(\frac{t_{ij}}{\Pi_h} \right)^{1-\rho}} \right)^{\frac{1}{1-\rho}}$$

$$\Rightarrow \Pi_h = \left(\sum_i \theta_i \left(\frac{t_{ij}}{P_j} \right)^{1-\rho} \right)^{\frac{1}{1-\rho}} \tag{3.21}$$

where θ_i denotes share of country *i*'s income to the world income.

Assuming that trade costs are symmetric $(t_{ij} = t_{ji})$ or, alternatively, allowing $t_{ij} = t_{ji}$ to represent the average trade costs in both directions, leads to a simplification $\Pi_h = P_i$. Therefore, we can re-write equation (3.21) as

$$P_i = \left(\sum_i \theta_i \left(\frac{t_{ij}}{P_j} \right)^{1-\rho} \right)^{\frac{1}{1-\rho}} \tag{3.22}$$

which gives us the gravity equation

$$X_{ij} = \frac{Y_i Y_j}{Y_w} \left(\frac{t_{ij}}{P_i P_j} \right)^{1-\rho} \tag{3.23}$$

The final step in arriving at an empirically testable version of the gravity equation is to specify a relationship between the unobservable trade cost factor t_{ij} and distance between trading partners *i* and *j*. Assume that trade costs are proportional to distance so that

$$t_{ij} = (D_{ij})^{\sigma_{ij}} \prod_{k}^{K} z_{ij}^{k} \tag{3.24}$$

where D_{ij} is the bilateral distance and the vector z_{ij} is a set of parameters controlling for all other factors that may affect trade costs between *i* and *j*. Substituting equation (3.24) into (3.23), writing the resulting equation in natural logarithms, and expressing world income as a constant $\omega = -\ln Y_w$, we derive the final version of the gravity equation as shown in equation (3.25).

$$\ln X_{ij} = \omega + \ln Y_i + \ln Y_j + \sigma_{ij}(1-\rho)\ln D_{ij} + (1-\rho)\sum_{k=1}^{K} \ln z_{ij}^{k} \tag{3.25}$$

$$-(1-\rho)\ln P_i - (1-\rho)\ln P_j$$

3.2.3 Survey of Previous Studies

This section reviews the empirical studies on international trade flows in East Asia in order to see the possibility of ASEAN+3 or ASEAN+6 formations. These literatures include Suvannaphakdy et al. (2011a), Kien (2009), Hapsari and Mangunsung (2006), Elliott and Ikemoto (2004), and Dean and Wignaraja (2007). It also reviews the empirical studies on trade flows in Laos. These literatures include Record and Nghardsaysone (2010), Onphanhdala and Suruga (2010), Fane (2006), and Kyophilavong and Ko (2010).

Recent literature on the analysis of ASEAN trade enlargement using the gravity model includes Suvannaphakdy et al. (2011a) who apply the dynamic gravity model to evaluate the potential impact of the formation of ASEAN+6. Their simulation results based the estimated dynamic gravity model show that establishing the free trade area in ASEAN+6 is important for promoting intraregional trade by about 39.3% ($66.6 billion), and that a new economic community of the “6” countries together with ASEAN promotes mutual trade.

Kien (2009) employs Hausman-Taylor estimations to investigate the determinants of ASEAN exports in the panel data framework of 39 countries for the period 1988–2002. The author finds that bilateral exports are

proportional to GDPs, and that AFTA has generated trade flows among its members. Hapsari and Mangunsung (2006), however, estimating panel data of 19 countries including five ASEAN and ASEAN's trading partners from 1993–2003 using pooled OLS, point out that AFTA might be causing some trade diversion and shifting trade from countries outside the trade bloc to possibly less efficient countries inside the trade bloc. In addition, Shepherd and Wilson (2008) examine the impacts of trade facilitation reform in ASEAN at the aggregate level using the gravity model. Their simulation results suggest a reform program on two areas: transport infrastructure and information technology. Their results also show that reducing applied tariffs to the regional average would raise intra-regional trade by about 2% ($6.3 billion).

Furthermore, Elliott and Ikemoto (2004) investigate whether the Asian financial crisis has a positive or negative impact on intra-ASEAN trade. Estimating the panel data on 34 countries from 1983–1999, Elliott and Ikemoto (2004) conclude that Asian economic crisis generates a stronger desire to source imports from within the region. Lee and Park (2005) and Lee and Shin (2006), using their gravity model, show that most East Asian RTAs will create more intra-bloc trade but will not divert extra-bloc trade.

Among others, Dean and Wignaraja (2007) examine the economic impact of forming various types of FTAs in East Asia, such as ASEAN+1's, ASEAN+3, and ASEAN+6, using a CGE model. They find that consolidation of multiple and overlapping FTAs into a single East Asian FTA can reduce the damaging "noodle bowl" effects of different rules of origin and standards, and that the integration at the ASEAN+6 level would yield the largest gains to East Asia among plausible regional trade arrangements.

Record and Nghardsaysone (2010) examined export performance in the Lao PDR over the period 1985–2006 and found that the rate of export discovery into new products has been high. However, they indicated that the Lao export basket is still undiversified, relatively unsophisticated, and dominated by low value added products with few linkages to high value added products. Moreover, they also pointed out that the sophistication of Lao export basket lags behind that of regional neighbors. The authors concluded that the export discovery and survival process could be enhanced by accelerating investment climate reforms in the Lao PDR. Onphanhdala

and Suruga (2010) assessed the impact of investment climate on firms' performance, using firm level data in 2009. They found that regulatory framework is not a major constraint, but improving the investment climates in terms of tax rates, access to finance, and labor skills are required to promote FDI.

The literature survey by Fane (2006) on trade liberalization, economic reform, and poverty reduction in the Lao PDR showed that the reduction in the barriers to international trade and in the government's direct controls over the economy could have stimulated growth. The distribution of the benefits of growth has been biased toward the non-poor and inequality has widened. Nonetheless, Fane indicated that poverty incidence had fallen from about 45% in 1992–1993 to 30% in 2002–2003.

Using the Global Trading Analysis (GTAP) model, Kyophilavong and Ko (2010) evaluated the potential gains of Laos' WTO accession. They found that the Laos' WTO accession will raise the real GDP by about 0.5%, raise the welfare by $1 million, increase trade deficit, and reduce output in some sectors, such as gains and crops, livestock and meat products, mining and extraction, processed food, light manufacturing, and heavy manufacturing. While acknowledging the potentially dynamic gains from trade in the long run, the authors concluded that the Lao PDR will gain very little from WTO accession.

In summary, the literature reviews in East Asia show potential gains from regional integration, either in the form of ASEAN+3 or ASEAN+6. The literature reviews on Laos' trade show low competitiveness of Lao export basket relative to countries in the region, but indicate gains to the country as a whole from trade liberalization and WTO accession. Therefore, assessing the impact of East Asian trade enlargement on Laos' trade is an empirical issue and is conducted in Chapter 6. The empirical analysis is conducted with close reference to Suvannaphakdy and Toyoda (2011a, 2011b) and Suvannaphakdy et al. (2011a, 2011b).

3.3 Analysis of Production Efficiency

3.3.1 Developments of Efficiency Analysis

To gain a better understanding about how efficiency can be analyzed, it is useful to start with the definition of efficiency, followed by the origin of efficiency measurement, and finally the efficiency analysis at the macroeconomic level, especially with respect to trade and FDI.

Productivity growth has been a desirable goal of economic development for many countries. It consists of two mutually exclusive and exhaustive components: technological change (TC) and efficiency change (EC). In the context of a production possibilities frontier (PPF), the former causes a shift of the PPF, whereas the latter gives rise to a movement of a country towards or away from the PPF. That is, TC involves changes to the potential output, while EC involves changes to the gap between the potential and actual outputs. Both TC and EC can be estimated in the frontier production function.

The frontier production function is an extension of the regression model based on the theoretical assertion that a production function represents an ideal, the maximum output attainable given a set of inputs. The frontier functions are econometrically estimated so as to be consistent with the underlying theoretical proposition that no observed agent can exceed the ideal. In practice, the frontier function model is the estimation of a regression model such that all observations lie within the theoretical extreme. Measurement of (in)efficiency is, then, the empirical estimation of the extent to which observed agents (fail to) achieve the theoretical ideal. My interest in the study of production efficiency in Laos is in the latter function. The estimated model of production serves as a tool to the objective of measuring inefficiency. Intuitively, it is a formal analysis of the residuals from the production model. The theory of production provides a description of the ultimate source of deviations from this theoretical model.

The literature on frontier production functions and the calculation of efficiency measures starts with Debreu (1951) and Farrell (1957). Farrell (1957) suggested the analysis of technical efficiency in terms of deviations from an idealized frontier isoquant. This approach conforms to an econometric approach in which the inefficiency is identified with

disturbances in a regression model. Following Farrell's argument, the contemporary line of research on econometric models starts with seminal papers of Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977), who proposed the stochastic frontier models that applied researchers now use to combine the underlying theoretical propositions with a practical econometric framework.

In the areas of international trade and FDI, researchers investigate the externalities of trade and FDI as sources of the technological change and technical efficiency. In particular, building on the theoretical work of Grossman and Helpman (1991) and Rivera-Batiz and Romer (1991), recent studies by Coe and Helpman (1995), Coe et al. (1997), Keller (2000) and Eaton and Kortum (1999) have shown the significance of foreign R&D and international trade to domestic productivity growth. The argument is that technical progress embodied in new materials, intermediate manufactured products, capital equipment, are traded on international markets thus permitting countries to import the R&D investments made by others.

Several studies suggest that trade and FDI inflows enhance national efficiency. Iyer et al. (2008) apply a stochastic frontier approach using a panel data set of 20 OECD countries over the period 1982–2000. The results show that greater trade openness increases efficiency, and FDI inflows enhance efficiency in countries with a larger relative investment in R&D and more developed financial markets. Using a panel data set of 57 countries (both developed and developing countries) over the period 1988–2001, Ciruelos and Wang (2005) find that both FDI and trade can serve as important channels of international technology diffusion. Henry et al. (2009) analyze the production frontier for 57 developing countries over the period 1970–1998 applying the stochastic frontier approach. The result indicates that trade volume and trade policy play an important role in raising output both through technology improvements embodied in imported capital goods and by inducing efficiency improvements. Blomstrom and Sjoholm (1999) examine the effects on technology transfer and spillovers deriving from ownership sharing of foreign multinational affiliates using unpublished Indonesian micro data. Their results show that domestic establishments benefit from spillovers. Using panel data on Venezuelan plants, Aitken and Harrison (1999) investigate technology spillovers from foreign to domestic

firms. They find that small plants (employing fewer than 50 workers) with higher foreign ownership tend to exhibit positive productivity gains, but foreign ownership has a negative effect on the productivity of domestic firms in the same industry.

It is recognized that having access to leading edge technologies through technology transfers may not of itself lead to productivity improvements if these technologies are not absorbed and utilized efficiently. In view of this, the absorptive capacity and technical efficiency of a country is a critical factor in its ability to catch up with countries at the technological frontier. For developing countries this is even more of vital importance. Consequently, this dissertation employs a stochastic frontier analysis to consider the effects of both technology transfer and absorptive capacity on the output levels of Laos in a panel data framework. The production frontier refers to the maximum technically feasible output attainable from a given set of inputs. Countries (the producers of output for given inputs) then either operate on or within this frontier. The first outcome represents a technically efficient outcome while the latter admits to some level of technical inefficiency. In a panel data set of developing countries, Laos is viewed as one of the producers of output. It is this panel data that allows us to estimate the efficiency for each country over time. The empirical analysis of the production efficiency with respect to trade and FDI is conducted with a close reference Suvannaphakdy et al. (2012).

3.3.2 Stochastic Frontier Model for Efficiency Analysis

The stochastic frontier approach formulates an efficient frontier by imposing a common production technology across all countries in the sample. Deviations from the frontier are decomposed into two components: inefficiency and noise. Introducing a disturbance term to represent noise reduces the volatility in the temporal patterns of efficiency measures.

Following Battese and Coelli (1995), the stochastic frontier production function is specified as

$$Y_{it} = \exp(X_{it}\beta + v_{it} - u_{it}) \tag{3.26}$$

where Y_{it} denotes the output quantity of country *i* at period *t*; X_{it} represents a (1 × *K*) vector whose values are functions of input quantities and time, to

capture technological shifts in the frontier; β is a (K × 1) vector of unknown parameters to be estimated; v_{it} and u_{it} jointly comprise the error term, with v_{it} representing the random noise and u_{it} representing technical inefficiency.

The technical inefficiency component of the error structure is assumed to be distributed as a truncated normal random variable. The mean of the technical inefficiency component is determined by a number of explanatory variables included in the vector z_{it} below. Consequently, the error-term components include

$$v_{it} \sim N(0, \sigma_v^2) \tag{3.27}$$

$$u_{it} \sim N^{+}(m_{it}, \sigma_u^2) \tag{3.28}$$

$$m_{it} = z_{it}\delta \tag{3.29}$$

where z_{it} is a (1 × M) vector of observable exogenous explanatory variables and δ is an (M × 1) vector of unknown parameters to be estimated. Equation (3.27) indicates that the stochastic part of the frontier, v_{it}, could be either positive or negative, whereas equation (3.28) implies that the technical inefficiency, u_{it}, must be non-negative. This ensures that, for a given level of technology and input quantities, the observed maximum output is equal to the potential output.

Given the specifications in equations (3.26)–(3.29), the technical efficiency (*TE*) of production for country *i* at period *t* is defined as

$$TE_{it} = \exp(-u_{it}) \tag{3.30}$$

Given the model assumptions, the conditional expectation provided by Battese and Coelli (1993) is used to predict the technical efficiencies. This is done by replacing the unknown parameters by their maximum likelihood (ML) estimates.

The calculation of efficiency change (*EC*) between two adjacent periods is defined by equation (3.31).

$$EC_{it} = (TE_{it} - TE_{i,t-1}) / TE_{i,t-1} \tag{3.31}$$

In summary, technical efficiency demonstrates how far a country under investigation lags behind the best practice as represented by the production frontier, and efficiency demonstrates the change in technical efficiency over time.

Chapter 4 FDI-Trade Linkages and the Analysis of Free Trade Agreement and Production Efficiency—Empirical Models

4.1 Developments of Empirical Models for FDI-Trade Linkages

4.1.1 Analysis of Causality between Inward FDI and Trade Flows

The causality relation between FDI and trade has extensively been investigated by applying the time-series (e.g., Pfaffermayr, 1994; de Mello and Fukasaku, 2000) or panel-data approach (e.g., Pain and Wakelin, 1998; Hsiao and Hsiao, 2006). Following these literature, the panel causality test is applied to investigate the relationship between FDI and trade using the unbalanced panel data with 23 partners from 1989 to 2009. Since the available panel data has a relatively short time period, it is unlikely that foreign trade and FDI are found cointegrated. Focusing on the Granger test, if one finds that the past values of process *Z* can significantly explain the variation of the present value of *W*, one can argue that *Z* Granger causes *W*. According to Pfaffermayr (1994), GDP can affect both FDI and trade and hence, should be included as the third variable for Granger causality tests in order to avoid the omitted variable bias. In our case, we control this variable by using the ratio of trade/FDI to GDP. As a result, the causality regressions can be expressed as follows:

$$\ln \tilde{X}_{ij,t} = \mu_{1i} + \sum_{k=1}^{K} \delta_{1k} \ln \tilde{X}_{ij,t-k} + \sum_{h=1}^{H} \alpha_{1h} \ln \tilde{F}_{ij,t-h} + \varepsilon_{1ij,t} \tag{4.1}$$

$$\ln \tilde{M}_{ij,t} = \mu_{2i} + \sum_{k=1}^{K} \delta_{2k} \ln \tilde{M}_{ij,t-k} + \sum_{h=1}^{H} \alpha_{2h} \ln \tilde{F}_{ij,t-h} + \varepsilon_{2ij,t} \tag{4.2}$$

$$\ln \tilde{F}_{ij,t} = \mu_{3i} + \sum_{k=1}^{K} \delta_{3k} \ln \tilde{F}_{ij,t-k} + \sum_{h=1}^{H} \alpha_{3h} \ln \tilde{X}_{ij,t-h} + \varepsilon_{3ij,t} \tag{4.3}$$

$$\ln \tilde{M}_{ij,t} = \mu_{4i} + \sum_{k=1}^{K} \delta_{4k} \ln \tilde{M}_{ij,t-k} + \sum_{h=1}^{H} \alpha_{4h} \ln \tilde{X}_{ij,t-h} + \varepsilon_{4ij,t} \tag{4.4}$$

$$\ln \tilde{F}_{ij,t} = \mu_{5i} + \sum_{k=1}^{K} \delta_{5k} \ln \tilde{F}_{ij,t-k} + \sum_{h=1}^{H} \alpha_{5h} \ln \tilde{M}_{ij,t-h} + \varepsilon_{5ij,t} \tag{4.5}$$

$$\ln \tilde{X}_{ij,t} = \mu_{6i} + \sum_{k=1}^{K} \delta_{6k} \ln \tilde{X}_{ij,t-k} + \sum_{h=1}^{H} \alpha_{6h} \ln \tilde{M}_{ij,t-h} + \varepsilon_{6ij,t} \tag{4.6}$$

where $\tilde{X}_{ij,t}$, $\tilde{M}_{ij,t}$, and $\tilde{F}_{ij,t}$ denote the ratio of real exports from Laos to foreign countries, real imports of Laos from foreign countries, and real inward FDI flows to Laos to the multiplicity of two countries' GDP, respectively, in year *t*. The variable μ_i denotes the time-invariant unobserved effect that is specific to each country pair, but is the same for every year within each country pair. $\varepsilon_{ij,t}$ is the log-normal distributed error term. Equations (4.1) and (4.2) can be used to test whether inward FDI causes exports and/or imports, respectively. Equations (4.3) and (4.4) can be used to test whether exports causes inward FDI and/or imports, respectively. Equations (4.5) and (4.6) can be used to test whether imports causes inward FDI and/or exports, respectively.

According to Nickell (1981), estimating the dynamic panel data model by the generalized least squares (GLS) would be biased because the lagged endogenous variable is correlated with the lagged error term. The magnitude of bias decreases as the time dimension of the panel increases. In our case, applying the GLS is likely to suffer from this bias because there are only 18 years available in the panel data. Therefore, the system GMM proposed by Arellano and Bover (1995) and Blundell and Bond (1998) is applied to estimate the dynamic panel data models expressed in equations (4.1) to (4.6).

However, the results of the time-series and panel-data approach can lead to the question of endogeneity. For instance, it is difficult to separate the effect of FDI on trade from other factors that can affect both FDI and trade simultaneously, because changes in FDI are not exogenous. As noted by Amiti and Wakelin (2003), the problem of causality test between trade and FDI is not only one of endogeneity, but also the conceptual issue about what it means economically for the partial derivative of one endogenous variable to be positively or negatively associated with another. As a result, we move toward the application of a unified approach, called the 'knowledge-capital model' of MNE, after the seminal work of Markusen et al. (1996) and Carr et al. (2000). This modeling approach is explained in the next section.

4.1.2 Specification of the Three-Factor Model

Based on both theoretical and empirical literature of the three-factor model, real exports (*X*), real imports (*M*), and inward FDI (*F*) are determined

by two countries' GDP, relative factor endowments ($k = K_{Foreign} / K_{Laos}$, $h = H_{Foreign} / H_{Laos}$, $l = L_{Foreign} / L_{Laos}$), and distance (*R*), which represents both country-specific transport costs and fixed foreign plant set-up costs. Egger and Pfaffermayr (2004) suggest an interaction term between distance and the physical capital to labor ratio in order to capture the impact of distance on costs of foreign plant establishment. Two dummy variables are also included. They are dummies of common colonizer (*C*) and colonial relationship (*N*). Below, index *i* refers to Laos, *j* refers to Laos' trading partner (or capital source countries for FDI) and *t* to time.

A system of three equations (exports, imports, and inward FDI) is specified with unobserved time-varying effects (λ_t) and region effects (μ_i). λ_t captures any unobserved time-varying effect, such as business cycles affecting both exporter and importer. μ_{ij} captures all unobserved time-invariant effects, such as legal or cultural influences affecting country pair. The system of three equations is specified as follows:

$$\ln V_{ijt} = D_T \lambda_t^V + D_R \mu_{ij}^V + \beta_0^V + \beta_1^V \ln Y_{it} + \beta_2^V \ln Y_{jt} + \beta_3^V \ln R_{ij} \qquad (4.7)$$

$$+ \beta_4^V (\ln R_{ij}) \left| \ln k_{ijt} - \ln l_{ijt} \right| + \beta_5^V \ln k_{ijt} + \beta_6^V \ln h_{ijt}$$

$$+ \beta_7^V \ln l_{ijt} + \beta_8^V C_{ij} + \beta_9^V N_{ij} + \varepsilon_{ijt}^V$$

for $V = X, M, F$. Here the error term, ε_{ijt}^V , is assumed to be normally distributed associated with the dependent variable *V*. λ_t^V and μ_{ij}^V denote the column vectors of coefficients of the dummy variables for region and time, respectively.

Equation (4.7) is specified based on the theoretically motivated three-factor model. However, it is econometrically argued that directly estimating

equation (4.7) could suffer from the multicollinearity of incomes (Y_{it} and Y_{jt}) and factor endowments (k_{ijt} , h_{ijt} , and l_{ijt}). This problem is solved by restricting the coefficients of income in country *i* and country *j* equal to 1 and move them to the right-hand side of the equation. The restricted form of equation (4.1) is shown in (4.2).

$$\ln \widetilde{V}_{ijt} = D_T \widetilde{\lambda}_t^V + D_R \widetilde{\mu}_{ij}^V + \widetilde{\beta}_0^V + \widetilde{\beta}_1^V \ln R_{ij} + \widetilde{\beta}_2^V (\ln R_{ij}) \left| \ln k_{ijt} - \ln l_{ijt} \right| \qquad (4.8)$$

$$+ \widetilde{\beta}_3^V \ln k_{ijt} + \widetilde{\beta}_4^V \ln h_{ijt} + \widetilde{\beta}_5^V \ln l_{ijt} + \widetilde{\beta}_6^V C_{ij} + \widetilde{\beta}_7^V N_{ij} + \varepsilon_{ijt}^V$$

where $\widetilde{V}_{ijt}$ is the ratio of the bilateral flows (exports, imports, and FDI) to the multiplication of two countries' incomes, defined by $\widetilde{V}_{ijt} = V_{ijt} / (Y_i \times Y_j)$. The predicted signs of all exogenous variables are summarized in Table 4.1.

Table 4.1: Predicted signs of the determinants of Laos' exports, imports, and inward FDI

Variable	Description	Exports (X)	Imports (M)	Inward FDI (F)
R_{ij}	Distance	–	–	+/–
$R_{ij} \left\| k_{ijt} - l_{ijt} \right\|$	Distance × absolute difference in capital-labor ratios	–	–	+/–
k_{ijt}	Relative physical capital endowment	+	+	+
h_{ijt}	Relative human capital endowment	–	+	+
l_{ijt}	Relative labor endowment	–	+	–
C_{ij}	Common colonizer after 1945	+	+	+
N_{ij}	Colonial relationship after 1945	+	+	+

In order to explain the predicted sings in Table 4.1, it is important to note about the assumptions of the three-factor model and the stylized fact of Laos. In the context of the three-factor model, Laos is assumed to have a relatively low capital-labor ratio compared to foreign countries. In this case, there exist only three kinds of economic activities, which include Laos'

exports, Laos' imports, and inward FDI. That there is no outward FDI from Laos reflects the fact that the country is lack of knowledge capital and physical capital. In other words, since Laos is relatively labor-abundant, it has a comparative advantage in goods production in the home country and serves the foreign market by exports.

The data on Laos' imports and inward FDI reflect the collective behavior of foreign exporters and foreign investors. Inward FDI flows to Laos have been relatively low compared to other countries, such as Thailand and Vietnam. They tend to be constrained by three factors. The first factor is the direct factor requirements for multinational operation, involving local skilled labor, ranging mainly from managers, to technicians and engineers, and to accountants. The second factor is the indirect factor requirements for multinational operation, involving public or private infrastructure which range from utilities to telecommunications, to transport services to legal systems. The third factor is the small market size which is unable to absorb the large volume of affiliate production by multinationals if they were to exist in Laos. Therefore, the country could have attracted only small fraction of FDI from foreign countries.

This empirical issue suggests the adjustment of the hypothesis for Laos' imports and inward FDI with respect to relative physical capital endowment in the three-factor model. This hypothesis should be restated as Laos' imports and inward FDI need not be substitutive with respect to relative physical capital endowment because an increase in inward FDI to Laos does not necessarily reduce the capital stocks in foreign countries and hence does not significantly affect goods production of foreign exporters. Furthermore, the predicted signs of other exogenous variables are unlikely to hold because our empirical model employs data on aggregate trade and FDI flows while the theoretical model emphasizes data on trade and FDI in final goods. However, these issues will be clarified in the next chapter. For now, it is assumed that firstly, distance captures the effects of trade and investment costs. It could have either positive or negative impact on Laos' inward FDI, depending on whether vertical or horizontal FDI dominates. Distance has a negative impact on Laos' inward FDI if the vertical FDI dominates, while it

has a positive impact on FDI if the horizontal FDI dominates. Distance always has a negative impact on trade flows.

Secondly, the interaction term between distance and the physical capital to labor ratio captures the relevance of distance as a barrier to establishing foreign plant as compared to exporting. A zero coefficient of this variable indicates that distance is substantially more important for trade and horizontal FDI dominates. In contrast, the non-zero coefficient of this variable indicates that vertical FDI exists.

Thirdly, the relative physical capital endowment has a positive impact on both Laos' imports and inward FDI. That is, a larger endowment in physical capital of foreign countries, other things being equal, increases the number of foreign countries' MNEs and their FDI. They would tend to serve the local markets in Laos through both exports and FDI. This follows from the small market assumption of the Lao PDR as the destination for foreign investors. Given the small market size of Laos, foreign investors would serve not only domestic market, but also foreign markets and hence stimulate exports. Therefore, Laos' trade and inward FDI are complementary with respect to changes in relative physical capital endowment.

Fourthly, the relative human capital endowment has a positive impact on both Laos' imports and inward FDI. That is, an increase in h_{ijt} enhances foreign countries' comparative advantage in the brand invention. With reference to the Dixit and Stiglitz (1977) love-for-variety preferences, the home market bias associated with transportation costs becomes smaller for a high degree of product diversity, so that Laos' imports and inward FDI increase simultaneously in h_{ijt} . The same reason applies to Laos' exports with the reverse sign of the coefficient of h_{ijt} .

Fifthly, the relative labor endowment has a positive impact on Laos' imports and FDI inflows, but has a negative impact on its exports. That is, an increase in l_{ijt} enhances foreign countries' comparative advantage in labor-intensive goods production, which increases real exports, but reduces real outward FDI from foreign countries.

Finally, the historical links (common colonizer and colonial relationship after 1945) have a positive impact on both trade and FDI.

4.1.3 Estimation Method for the Three-Factor Model

An important problem with the analysis of bilateral flows of trade and FDI is the occurrence of zero bilateral flows of trade and FDI. By inspecting our sample, zero flows account for 29% of total observations for exports, 43% of total observations for imports, and 76% of total observations for inward FDI. This can be caused by rounding errors, missing observations or truly zero flows of trade and FDI. Following Linnemann (1966), the standard procedure in empirical studies is to drop the zero flows from the sample, or add a small constant to all trade and FDI flows in order to be able to estimate a log-linear equation. However, dropping zero flows out of the sample could lose useful information when the sample is small, especially in our sample. If zero is viewed as a censored observation, ordinary least-squares (OLS) regression will not yield consistent parameter estimates because the censored sample is not representative of the population.

Searching for the best estimator for handling zero trade flows and heteroskedasticity is difficult because the data-generating-process that generates zero trade flows is likely to differ from country to country. This is because there are different firm theories underpinning for zero trade provided in Baldwin and Harrigan (2007), Hallak (2006), Eaton and Kortum (2002), and Helpman et al. (2008). Furthermore, the empirical studies of Hummels and Klenow (2005) and Hillbery and Hummels (2008) show that the occurrence of zero trade flows is caused by trade restrictions and trade fixed costs.

An early attempt to address zero trade flows is Bikker (1982, pp. 399–411) who applies the Tobit model to international trade. [12] This econometrical solution is correct if the zero flows are randomly distributed; nonetheless, if they are not random, it introduces selection biases. This problem can be solved by means of sample selection correction. To do so, Helpman et al. (2008) introduce a theoretical model rationalizing the zero trade flows and then apply the sample selection models to estimate such model. Furthermore, Santos Silva and Tenreyro (2006) argue that the method of Poission Pseudo-Maximum-Likelihood (PPML) can be used to deal with both zero trade flows and heteroskedasticity in the error terms.

[12] Quoted from the footnote 17 of van Bergeijk and Brakman (2010, p. 13).

Martin and Pham (2008) utilize Monte Carlo analysis to examine the robustness of estimators to deal with both heteroskedasticity and limited-dependent variables. The estimators include the PPML proposed by Santos Silva and Tenreyro (2006), Heckman sample-selection model employed by Helpman et al. (2008), threshold-Tobit model employed by Eaton and Tamura (1994), and Poison-Tobit model. The authors generate the data for Monte Carlo analysis based on the Tobit model and Heckman sample-selection model. The simulation results show that the PPML estimator solves the heteroskedasticity-bias problem when this is the only problem, but it provides considerably biased estimates when trade flows contain large proportion of zero. It also performs poorly when the data are generated based on a Tobit model and on a Heckman sample-selection model. The threshold-Tobit estimator performs better than the PPML estimator in a Tobit-based data generating process if the heteroskedasticity is reasonably accounted for. However, it provides significant bias in a Heckman-based data generating process.

The threshold-Tobit estimator is employed to estimate the three-factor models of trade and FDI. The heteroskedasticity problem is solved by using the robust standard errors following White (1982) which are heteroskedasticity-consistent. Following Carson and Sun (2007), the unknown threshold is set to equal the minimum of uncensored trade or FDI flows and proceed as if the threshold is known. Carson and Sun (2007) show that this procedure provides consistent estimates of the Tobit model.

More precisely, for each dependent variable $\tilde{V}$ specified in equation (4.8), where $\tilde{V} = \tilde{X}, \tilde{M}, \tilde{F}$, the logarithm of $a^{v} + \tilde{V}_{ijt}$ is linear homogeneous in the logarithms of the explanatory variables, where a^{v} is an intercept parameter that is estimated. Therefore, a positive value of a^{v} implies that the function of the explanatory variables for $\tilde{V}$ must achieve a minimum threshold value as a precondition for the existence of strictly positive values of $\tilde{V}$. Equation (4.8) can be rewritten and estimated as follows.

$$\tilde{V}_{ijt} = \max[-a^{v} + \tilde{\beta}_0^{v} R_{ij}^{\tilde{\beta}_1^{V}} P_{ijt}^{\tilde{\beta}_2^{V}} k_{ijt}^{\tilde{\beta}_3^{V}} h_{ijt}^{\tilde{\beta}_4^{V}} l_{ijt}^{\tilde{\beta}_5^{V}} \exp(\tilde{\beta}_6^{V} C_{ij}$$

$$+ \tilde{\beta}_7^{V} N_{ij} + D_T \tilde{\lambda}_t^{V} + D_R \tilde{\mu}_{ij}^{V} + \varepsilon_{ijt}^{V}), 0],$$

where $P_{ijt} = R_{ij} + \left| \frac{k_{ijt}}{l_{ijt}} \right|$. The error term ε_{ijt}^{V} is assumed to be normally distributed in relation to dependent variable $\widetilde{V}$ and, $\widetilde{\lambda}_{t}^{\nu}$ and $\widetilde{\mu}_{ij}^{\nu}$ are the column vectors of coefficients of the dummy variables for time and region, respectively. For each dependent variable the model parameters are estimated, namely the intercept a^{ν}, the constant $\widetilde{\beta}_{0}^{\nu}$, the distance coefficient $\widetilde{\beta}_{1}^{V}$, the coefficient of the interaction term between distance and the physical capital ratio $\widetilde{\beta}_{2}^{V}$, the relative physical capital coefficient $\widetilde{\beta}_{3}^{V}$, the relative human capital coefficient $\widetilde{\beta}_{4}^{V}$, the relative labor coefficient $\widetilde{\beta}_{5}^{V}$, the common colonizer coefficient $\widetilde{\beta}_{6}^{V}$, and the colonial relationship coefficient $\widetilde{\beta}_{7}^{V}$. The equations are estimated by the maximum likelihood. To do so, let the variable $\widetilde{V}^{*}$ be defined as

$$\widetilde{V}_{ijt}^{*} = -a^{\nu} + \widetilde{\beta}_{0}^{\nu} R_{ij}^{\widetilde{\beta}_{1}^{V}} P_{ijt}^{\widetilde{\beta}_{2}^{V}} k_{ijt}^{\widetilde{\beta}_{3}^{V}} h_{ijt}^{\widetilde{\beta}_{4}^{V}} l_{ijt}^{\widetilde{\beta}_{5}^{V}} \exp(\widetilde{\beta}_{6}^{V} C_{ij}$$

$$+ \widetilde{\beta}_{7}^{V} N_{ij} + D_{T} \widetilde{\lambda}_{t}^{V} + D_{R} \widetilde{\mu}_{ij}^{V} + \varepsilon_{ijt}^{V})$$

Therefore,

$$\widetilde{V}_{ijt} = \widetilde{V}_{ijt}^{*} \text{ if } \widetilde{V}_{ijt}^{*} > 0$$

$$\widetilde{V}_{ijt} = 0 \text{ otherwise.}$$

Rearranging this relationship and taking natural logarithms of each side yield

$$\ln(\widetilde{V}_{ijt}^{*} + a^{\nu}) = \widetilde{\beta}_{0}^{V} + \widetilde{\beta}_{1}^{V} \ln R_{ij} + \widetilde{\beta}_{2}^{V} \ln P_{ijt} + \widetilde{\beta}_{3}^{V} \ln k_{ijt} + \widetilde{\beta}_{4}^{V} \ln h_{ijt} + \widetilde{\beta}_{5}^{V} \ln l_{ijt}$$

$$+ \widetilde{\beta}_{6}^{V} C_{ij} + \widetilde{\beta}_{7}^{V} N_{ij} + D_{T} \widetilde{\lambda}_{t}^{V} + D_{R} \widetilde{\mu}_{ij}^{V} + \varepsilon_{ijt}^{V} \equiv W_{ijt}' \psi^{\nu} + \varepsilon_{ijt}$$

The density function for $\tilde{V}_{ijt}^{*}$ is

$$f(\tilde{V}_{ijt}^{*}) = f(\varepsilon_{ijt})\left|\frac{\partial \varepsilon_{ijt}}{\partial \tilde{V}_{ijt}^{*}}\right| = f(\varepsilon_{ijt})\frac{1}{\tilde{V}_{ijt}^{*} + a^{\nu}}.$$

It is assumed that $\varepsilon_{ijt} \sim N(0, \sigma^2)$. Therefore,

$$\Pr(\tilde{V}_{ijt} = 0) = \Pr(\varepsilon_{ijt} \geq \ln a^{\nu} - W_{ijt}'\psi^{\nu}) = 1 - F_{ijt}$$

$$\Pr(\tilde{V}_{ijt} > 0) \cdot f(\tilde{V}_{ijt} \mid \tilde{V}_{ijt} > 0)$$

$$= F_{ijt}\frac{f(\cdot)}{F_{ijt}} = \frac{1}{\tilde{V}_{ijt}^{*} + a^{\nu}}$$

$$\cdot \frac{1}{(2\pi\sigma^2)^{1/2}} \exp\left\{-\frac{\left[\ln(V_{ijt} + a^{\nu}) - W_{ijt}'\psi^{\nu}\right]^2}{2\sigma^2}\right\},$$

where F is the normal cumulative density function. The log-likelihood function is therefore

$$\ln L(\tilde{V}, W'; \psi^{\nu}, a^{\nu})$$

$$= \sum_{\tilde{V}=0}(1 - F_{ijt}) - \sum_{\tilde{V}>0}\left\{-\ln(\tilde{V}_{ijt} + a^{\nu})\right.$$

$$\left. -\frac{1}{2}(\ln 2\pi + \ln\sigma^2) - \frac{1}{2\sigma^2}[\ln(\tilde{V}_{ijt} + a^{\nu}) - W_{ijt}'\psi^{\nu}]^2\right\}.$$

The maximum likelihood estimates of a^{ν} and ψ^{ν} maximize the log-likelihood function $\ln L(\tilde{V}, W'; \psi^{\nu}, a^{\nu})$.

4.2 Developments of the Dynamic Gravity Model

4.2.1 Conceptual Framework

The so-called gravity equation of trade is now known to be consistent with a rigorous theoretical derivation. The standard gravity framework predicts that the volume of trade between two countries is positively related to their GDPs and negatively related to trade barriers between them. To investigate the impact of ASEAN trade enlargement on Laos' trade, we

employ the theoretical gravity model of Anderson and van Wincoop (2003) as explained in Section 3.2.2 of Chapter 3.

From basic microeconomic principles, Anderson and van Wincoop (2003) derive a gravity-like model of exports from country *i* to country *j* at time *t*:

$$X_{ijt} = \frac{Y_{it}Y_{jt}}{Y_{wt}}\left(\frac{t_{ijt}}{\Pi_{it}P_{jt}}\right)^{1-\sigma} \tag{4.9}$$

where X_{ijt} is the value of exports from country *i* to country *j* at time *t*; $Y_{it}(Y_{jt})$ denote income of exporter (importer) at time *t*; and Y_{wt} is the aggregate (world) income at time *t*. σ is the elasticity of substitution between all goods; and t_{ijt} denotes the unobserved trade costs facing exports from country *i* to country *j* at time *t*. $(P_{jt})^{1-\sigma} = \sum_{i=1}^{n} \Pi_{it}^{\sigma-1}\theta_{it}t_{ijt}^{1-\sigma}$, it is the inward resistance which captures the fact that *j*'s imports from *i* depend on trade costs across all suppliers. $(\Pi_{it})^{1-\sigma} = \sum_{j=1}^{n} \Pi_{jt}^{\sigma-1}\theta_{jt}t_{ijt}^{1-\sigma}$, it is the outward resistance which captures the dependence of exports from country *i* to country *j* on trade costs across all importers. θ_{it} (θ_{jt}) denotes country *i*'s income share (country *j*'s income share) in the world income.[13]

In order to estimate the gravity equation in (4.9), we first take the natural logarithm to both sides of it. However, the bilateral trade costs, t_{ijt}, cannot be observed and hence the multilateral resistance terms (Π_{it} and P_{jt})

[13] In Anderson and van Wincoop (2003), Π_{it} and P_{jt} are referred to as multilateral resistance terms (or prices) as they depend on all bilateral resistances (t_{ijt}).

cannot be estimated too. Anderson and van Wincoop (2003) solved this problem by making an additional assumption of symmetrical trade costs and a custom programmed system of non-linear equation. Alternatively, using the same assumption as Anderson and van Wincoop (2003), Baier and Bergstrand (2010) apply first-order Taylor-series expansion to the multilateral resistance terms, and substitute these into equation (4.9). Therefore, taking all steps together, equation (4.9) can be rewritten as

$$\ln X_{ijt} = \beta_0 + \ln(Y_{it}Y_{jt}) - (\sigma - 1)\ln t_{ijt} \tag{4.10}$$

$$+ (\sigma - 1)\left[\left(\sum_{j=1}^{N}\theta_{jt}\ln t_{ijt}\right) + \left(\sum_{i=1}^{N}\theta_{it}\ln t_{ijt}\right) - \sum_{i=1}^{N}\sum_{j=1}^{N}\theta_{it}\theta_{jt}\ln t_{ijt}\right] + u_{ijt}$$

where $\beta_0 = -\ln Y_{wt}$ is constant across country pairs for each time t, as is $\sum_{i=1}^{N}\sum_{j=1}^{N}\theta_{it}\theta_{jt}\ln t_{ijt}$.

For estimation purposes, Baier and Bergstrand (2010) centered the Taylor-series expansion around the symmetric trade costs and economic sizes. By doing so, the first-order log-linear Taylor expansion of the multilateral price equations yields a reduced-form similar to (4.10) that replaces the income-share weights (θ_{it}, θ_{jt}) with equal weights (1/N). Consequently, equation (4.10) can be rewritten as

$$\ln X_{ijt} = \beta_0 + \ln(Y_{it}Y_{jt}) - (\sigma - 1)\ln t_{ijt} \tag{4.11}$$

$$+ (\sigma - 1)\left[\frac{1}{N}\left(\sum_{j=1}^{N}\ln t_{ijt}\right) + \frac{1}{N}\left(\sum_{i=1}^{N}\ln t_{ijt}\right) - \frac{1}{N^2}\sum_{i=1}^{N}\sum_{j=1}^{N}\ln t_{ijt}\right] + u_{ijt}$$

To implement equation (4.11) empirically we need to replace the unobservable theoretical trade-cost variable (t_{ijt}) with some observed variables. These variables contain factors enhancing and impeding trade. This task is carried out in the next section.

4.2.2 Model Specification

In order to put the gravity equation (4.11) into work in panel data framework, further modifications are needed. First, assume that the log of the observed trade flow ($\ln X_{ijt}$) is equal to the log of the true trade flow plus a composite error term ($u_{ijt} = \lambda_t + \mu_i + \varepsilon_{ijt}$), where λ_t is the time-specific fixed effects, μ_i is the country-pair fixed effects, and ε_{ijt} is a log-normally distributed error term. To capture the time-specific fixed effects, dummy variables of time (D_T) are included in the gravity model. Hereafter, D_T represents a row vector of time, whereas λ_t represents a column vector of time-specific fixed effects. Second, $Y_{it}(Y_{jt})$ can be represented empirically by observable $GDP_{it}(GDP_{jt})$. Third, we need to specify bilateral trade costs t_{ijt} in terms of observable variables. This can be done by specifying trade costs as a function of distance (a proxy for transport costs) and tariff rates. Substituting these observed variables into equation (4.11) and making some algebraic manipulation yield the basic gravity model as follows:

$$\ln X_{ijt} = \beta_0 + D_T\lambda_t + \beta_1 G_{ijt} + \beta_2 S_{ijt} + \beta_3 R_{ij} + \beta_4 E_{ijt} + \beta_5 T_{ijt} \qquad (4.12)$$

$$- \beta_6 MWRD_{ijt} - \beta_7 MWRT_{ijt} + e_{ijt}$$

where $\ln X_{ijt}$ denotes the natural logarithm of real bilateral exports of country *i* to country *j* in year *t*, and β_0 is the constant. e_{ijt} is the composite error term, containing μ_i and ε_{ijt} . G_{ijt} is the overall economic size, defined as $G_{ijt} = \ln(GDP_{it} + GDP_{jt})$. The interpretation of G_{ijt} is that the larger the overall economic size, the higher the volume of trade. The coefficient on G_{ijt} should therefore be positive.

R_{ij} is the natural logarithm of distance used as a proxy for transportation costs. Since higher transportation costs between two countries lower trade flows between them, the coefficient on R_{ij} should be negative. S_{ijt} denotes the similarity in country size, defined as

$$S_{ijt} = \ln\left(1 - \left(\frac{GDP_{it}}{GDP_{it} + GDP_{jt}}\right)^2 - \left(\frac{GDP_{jt}}{GDP_{it} + GDP_{jt}}\right)^2\right)$$

Following differentiated product trade theory, the variable S_{ijt} is intended to capture the contribution of intra-industry trade to total trade. Its coefficient is expected to be positive.

E_{ijt} denotes the absolute differences in GDP per capita of importers and exporters, defined as

$$E_{ijt} = \left|\ln\left(\frac{GDP_{it}}{capita_{it}}\right) - \ln\left(\frac{GDP_{jt}}{capita_{jt}}\right)\right|$$

The variable E_{ijt} is used to capture the differences in relative factor endowments. The positive coefficient on E_{ijt} means that trade patterns are explained by the Heckscher-Ohlin-Samuelson (HOS) model. That is, trade is of an inter-industry nature. The negative coefficient on E_{ijt}, however, illustrates that the trade patterns are explained by the Linder's hypothesis. This implies that the more dissimilar two countries are in terms of relative factor endowments, the smaller the trade volumes between them.

The multilateral and world resistances (MWRs) of distance and tariff rates are, respectively, denoted as $MWRR_{ij}$ and $MWRT_{ijt}$. They have the opposite signs of their corresponding normal variables. $MWRR_{ij}$, for

example, has the positive sign, meaning that an increase in the multilateral and world resistance of distance relative to the bilateral distance ($\ln R_{ij}$) raises the bilateral trade flows. These MWRs are defined as follows:

$$MWRR_{ij} = \left[\frac{1}{N}\left(\sum_{j=1}^{N} \ln R_{ij} \right) + \frac{1}{N}\left(\sum_{i=1}^{N} \ln R_{ij} \right) - \frac{1}{N^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} \ln R_{ij} \right) \right]$$

$$MWRT_{ijt} = \left[\frac{1}{N}\left(\sum_{j=1}^{N} T_{ijt} \right) + \frac{1}{N}\left(\sum_{i=1}^{N} T_{ijt} \right) - \frac{1}{N^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} T_{ijt} \right) \right]$$

where *N* is the number of country pairs in the sample. According to Baier and Egger (2010), adding MWR terms to the gravity model provides the same result as adding country-pair fixed effects. Therefore, μ_i is dropped out of (4.12). Furthermore, the theoretical model obtained by Baier and Egger (2010, pp. 105) suggests that coefficient estimates for MWRs ($MWRR_{ij}$, $MWRT_{ijt}$) and their corresponding original variables (R_{ij}, T_{ijt}, respectively) are restricted to have identical but oppositely signed coefficient values. Imposing these restrictions on (4.12), we have

$$\ln X_{ijt} = \beta_0 + D_T\lambda_t + \beta_1 G_{ijt} + \beta_2 S_{ijt} + \beta_3 E_{ijt} + \beta_4 R^*_{ij} + \beta_5 T^*_{ijt} + \varepsilon_{ijt} \qquad (4.13)$$

where $R^*_{ij} = R_{ij} - MWRR_{ij}$ and $T^*_{ijt} = T_{ijt} - MWRT_{ijt}$.

Basically, the gravity equation is an ex-post analysis which is not suitable to apply for the analysis of regional trading bloc that has not yet formally been established. However, one of the important tasks of the economic integration is to bring down or eliminate import tariffs of its members. Hence, explicitly including import tariffs in the gravity model specification provides us an indicator of the potential effect of tariffs on trade flows. Unlike other continuous variables (total bilateral country size, distance, similarity in country size, and differences in GDP per capita) which enter the model in natural logarithmic form, the variable of import

tariffs enters the model in percentage of a level form. Since tariff barriers impede trade flows across international borders, we expect its coefficient to be negative. The statistical significance and negative sign of import tariffs' coefficient in the gravity model implies that further reduction in tariff rates is necessary to increase trade flows and hence the formation of regional economic integration could play an important role to achieve this goal.

The specification of the gravity model in equation (4.13) is motivated by the international trade theory. According to Krugman (1980) or Helpman and Krugman (1985), the two determinants characterizing New Trade Theory (N-T-T) are economies of scale combined with product differentiation and transportation costs. Helpman (1987), Bergstrand (1990) and Hummels and Levinsohn (1995) put forward early explanations of the N-T-T in the gravity model framework. According to these literatures, the key determinants of international trade consist of overall bilateral country size, similarity in bilateral country size, and transportation costs. In addition, the inequality between per capita incomes of exporters and importers is included to capture the relative factor endowment differences.

It is important to note about the use of the inequality between per capita incomes as a proxy variable of the relative factor endowment differences. Bergstrand (1990) formally derives the gravity model for explaining the effects of differences in national incomes, per capita incomes, capital-labor ratios, and tariffs on the degree of intra-industry trade between trading partners. According to one of the propositions, Bergstrand (1990, p. 1221) states that greater difference in per capita incomes leads to lower the share of intra-industry trade due to a greater divergence in tastes. There are two possible channels about how per capita income affects the volume and pattern of trade. These are supply and demand sides. For the former, national income is ultimately characterized by either capital or labor in the long-run. That is, the greater capital-labor endowment ratio must be associated with higher per capita income. For the latter, greater inequalities between two countries' per capita incomes potentially decrease the share of intra-industry trade by widening taste differences, as suggested by Linder (1961).

Following the 2×2×2 model illustrated in Helpman and Krugman (1985) and Helpman (1987), where one good is differentiated and the other is homogeneous, the total volume of trade of each country could be represented

as the sum of inter- and intra-industry trade volumes. The reduced form for evaluating the volume of world trade can then be expressed as in equation (4.13).

By using equation (4.13), we can explain the international trade phenomenon in terms of New Trade Theory. This trade phenomenon is captured by the effect of the overall economic size (G_{ijt}), the relative economic size (S_{ijt}), and the transportation costs (R_{ij}^{*}). Moreover, if the coefficient of the difference in GDP per capita of exporters and importers (E_{ijt}) is positively statistical significance, part of trade pattern seems to be explained by the HOS model. On the other hand, if the coefficient of the differences in GDP per capita of exporters and importers is negatively statistical significance, part of trade pattern seems to be explained by the Linder's hypothesis. Finally, import tariffs, (T_{ijt}^{*}), serve as an indicator to evaluate the potential enhancement of the proposed trading blocs on trade flows of its members. The next section shows how this static gravity model of trade can be modified to be a dynamic one.

4.2.3 Dynamic Gravity Model

The implication of the coefficients estimated from the static gravity model is that bilateral trade (exports) responds contemporaneously to any of its explanatory variables. In other word, it adjusts to the equilibrium within one period. There are at least three reasons behind the motivation of formulating the dynamic gravity model to investigate trade impact of FTA on Laos' trade. First, past trade patterns influence current trade flows due to sunk costs invested by the exporting countries in the importing countries (Eichengreen and Irwin, 1998). Bun and Klaassen (2002) support this idea by estimating the dynamic panel gravity model. The authors confirm that lagged trade plays an important role in formulating dynamic gravity model. Furthermore, Zarzoso et al. (2009) show that the results from the dynamic gravity models are significant and robust in explaining RTAs. Second, producers may find it difficult to adjust their levels of production due to

wage rigidity. Third, the dynamic model is known to perform better than the static one in forecasting.

There are many different alternatives in formulating the dynamic panel gravity model. Some authors directly introduce lagged bilateral exports (trade) into the static panel gravity model (i.e., Eichengreen and Irwin, 1998; Zarzoso et al., 2009); and some specify the model based on the autoregressive distributed lag model (i.e., Bun and Klaassen, 2002; Siah et al., 2009). Instead of following these literatures, this paper provides an alternative way to construct the dynamic panel gravity model. That is, we formulate it based on the partial adjustments hypothesis.

The partial adjustments hypothesis is typically used to formulate the adjustment of a variable to desired level. It can be considered as how the producers adjust their levels of production if when some changes in demand for their products or other trade determinants have been anticipated. In our gravity model, assume that the log of the real bilateral exports, $\ln X_{ijt}$, follows the partial adjustments hypothesis. Then, the gravity model (4.13) is rewritten as

$$\ln X_{ijt}^{*} = \beta_0 + D_T\lambda_t + \beta_1 G_{ijt} + \beta_2 S_{ijt} + \beta_3 E_{ijt} + \beta_4 R_{ij}^{*} + \beta_5 T_{ijt}^{*} + \varepsilon_{ijt} \qquad (4.14)$$

where $\ln X_{ijt}^{*}$ is the logarithm of the desired level of export. In the gravity model, firms in country *i* have to adjust their level of production exporting to country *j*, denoted by $\ln X_{ijt}$. But the process of adjustment cannot be completed immediately. Defining $\ln X_{ijt}^{*} - \ln X_{ij,t-1}$ is the desired change. The partial adjustment model states that the actual change is only a fraction of the desired change. Therefore, the partial adjustments process is typically specified as

$$\ln X_{ijt} - \ln X_{ij,t-1} = (1-\theta)(\ln X_{ijt}^{*} - \ln X_{ij,t-1}) + \varepsilon_{ijt} \qquad (4.15)$$

where θ denotes the speed of adjustment and is between zero and one. Combining the two relations, equations (4.14) and (4.15), produces the

desired level of ASEAN+3 or ASEAN+6 bilateral export flows, which is appropriate to the levels of incomes of the exporting and importing countries, and trade costs. The resulting gravity model can be expressed as

$$\ln X_{ijt} = \beta_0(1-\theta) + D_T\lambda_t(1-\theta) + \theta \ln X_{ij,t-1} + \beta_1(1-\theta)G_{ijt} + \beta_2(1-\theta)S_{ijt}$$

$$+ \beta_3(1-\theta)E_{ijt} + \beta_4(1-\theta)R^*_{ij} + \beta_5(1-\theta)T^*_{ijt} + \varepsilon_{ijt}$$

or

$$\ln X_{ijt} = \phi_0 + D_T\gamma_T + \phi_1 \ln X_{ij,t-1} + \phi_2 G_{ijt} + \phi_3 S_{ijt} \qquad (4.16)$$

$$+ \phi_4 E_{ijt} + \phi_5 R^*_{ij} + \phi_6 T^*_{ijt} + \varepsilon_{ijt}$$

where $\gamma = \lambda_T(1-\theta)$ is a vector of coefficients of year dummies; and $\phi_0 = \beta_0(1-\theta)$, $\phi_1 = \theta$, $\phi_2 = \beta_1(1-\theta)$, $\phi_3 = \beta_2(1-\theta)$, $\phi_4 = \beta_3(1-\theta)$, $\phi_5 = \beta_4(1-\theta)$, and $\phi_6 = \beta_5(1-\theta)$. Equation (5.10) is the dynamic gravity model based on the partial adjustments hypothesis.

4.2.4 Method of Estimation

To estimate the dynamic gravity model (4.16), we need to employ the estimation methods used in dynamic panel-data models. Linear dynamic panel-data models include *p* lags of the dependent variable as covariates and contain unobserved panel-level effects, fixed or random. By construction, the unobserved panel-level effects are correlated with the lagged dependent variables, making standard estimators inconsistent. Arellano and Bond (1991) derive a consistent generalized method-of-moments (GMM) estimator for this model. They suggest transforming the model either by first differences or orthogonal deviations, to remove the unobserved fixed effects and to run it by using the two-step GMM estimator. The second and higher lags of the endogenous variable in levels are suitable instruments to solve the estimation problem. However, the Arellano and Bond estimator has three drawbacks. First, it can perform poorly if the autoregressive parameters are too large or the ratio of the variance of the panel-level effect to the variance of idiosyncratic error is too large. Second, it cannot be used to estimate

model containing time-invariant variables. Finally, the instruments using second and higher lags of the endogenous variable become weak when data are highly persistent.

Building on the work of Arellano and Bover (1995), Blundell and Bond (1998) developed a system estimator that uses additional moment conditions. The system estimator is referred to as 'system GMM estimator'. This method assumes that there is no autocorrelation in the idiosyncratic errors and requires the initial condition that the panel-level effects be uncorrelated with the first difference of the first observation of the dependent variable. This estimator adds a system of equations in levels to that in first differences. The simulation results in Blundell and Bond (1998) suggest that the combined or system GMM estimator is more robust than difference GMM to weak instrument biases, and this method has become increasingly popular in the cross-country empirical literature. Consequently, the system GMM developed by Arellano and Bover (1995) and Blundell and Bond (1998) is applied to estimate the dynamic gravity model expressed in equation (4.16).

More precisely, equation (4.16) can be rewritten in a general form as

$$\ln X_{ijt} = \phi \ln X_{ij,t-1} + \alpha Z_{ijt} + \varepsilon_{ijt} \tag{4.17}$$

$$E(Z_{ijt}\varepsilon_{ijs}) = 0 \quad \text{for all } t, s = 1, 2, \ldots, T.$$

where Z_{ijt} is defined by $Z'_{ijt} = [G_{ijt} \quad S_{ijt} \quad E_{ijt} \quad R^*_{ij} \quad T^*_{ijt}]$ and α is a 1 × 5 vector of coefficients. The standard Arellano-Bond (1991) estimator assumes the following standard moment restrictions:

$$E(\ln X_{ijs}\Delta\varepsilon_{ijt}) = 0 \quad \text{for } s = 1, 2, \ldots, T\text{-}2 \tag{4.18}.$$

Equation (4.18) suggests that almost all lagged values of the endogenous variable can be used as instrument. The system GMM estimator utilizes not only transformed but also level equations and therefore is more efficient than the Arellano-Bond estimator. The additional restrictions include:

$$E(\Delta \ln X_{ij,t-1}\varepsilon_{ijt}) = 0 \tag{4.19}.$$

Moreover, a set of standard instruments from the vector of exogenous variables can be supplied to the system GMM estimation as follows:

$$E(\Delta Z_{ijt}\Delta\varepsilon_{ijt}) = 0 \qquad (4.20).$$

To summarize, the system GMM estimator utilizes instruments from equations (4.18)–(4.20) to estimate the dynamic gravity model, specified in equation (4.16).

4.2.5 Simulation Method

In order to make the analysis more realistic, it can be helpful to construct monetary estimates of the trade gains that could be associated with reduced import tariffs in East Asia. Attention is restricted to trade between the Lao PDR and other members in ASEAN and the 'plus six' countries. Following Wilson et al. (2005), the estimated coefficients from the gravity model are used as the basis for counterfactual simulations which can be analyzed comparatively. Note that this approach is only intended to provide a broad idea of the relative impacts of different policy reforms, and is subject to several technical issues.

The simulation analyses consist of three scenarios. In *Scenario 1*, the simulation involves a cut in the tariff rates to the current regional average of 10.16% so that no country sets its tariff rates over this threshold. The economic rationale behind this scenario is that if the integration occurs, some countries that set tariff rates higher than the regional average should reduce them to the specified threshold. By doing so, countries that have tariff rates lower than the threshold are likely to gain from export, but leave some countries that have higher tariff rates to become markets of the proposed integration. Another option is provided in scenario 2. *Scenario 2* performs the same exercise for 50% reduction in tariff rates of all countries. In this case, all member countries have to reduce their tariff rates by the specified threshold. By doing so, the integration is likely to boost mutual trade. In order to fully gain from free trade, the integration may move forward to completely remove the tariff barriers of all its members. This case is provided by scenario 3. *Scenario 3* considers the elimination of tariff barriers of all members.

The simulations are conducted by recalculating the tariff rates with the condition that those countries over regional average for 1999–2009 have their rates reduced to that threshold. Here years 1999–2009 are taken as the

base years.[14] By doing so, the percentage change in the tariff rate can be calculated for each country pair, which is mapped to an approximate trade impact using the gravity model elasticities. The annual average value is used as a measure of trade value. The annual average value of trade for each country pair is defined as the sum of trade of such country pair over time divided by the number of years that they actually trade. In order to derive aggregate trade value of a particular country at a particular period, trade flows between a country and its trading partners are averaged.

4.3 Developments of the Stochastic Frontier Model

4.3.1 Technical Frontier Model

The stochastic frontier approach constructs an efficient frontier by imposing a common production technology across all countries in the sample. Deviations from the frontier are decomposed into two components: inefficiency and noise. Representing noise by a disturbance term reduces the volatility in the temporal patterns of efficiency measures. In this study, it is assumed that output, *Y*, is a function of the production technology specified as

$$Y_{it} = f(K_{it}, L_{it}, HC_{it}, TRD_{it}, FRD_{it}, T)e^{\eta_{it} - u_{it}} \quad , i = 1, 2, \ldots N; t = 1, 2, \ldots T \quad (4.21)$$

where *Y* is output (GDP), $f(.)$ is a suitable functional form, *K* is the stock of physical capital, *HC* is a measure of the stock of human capital, *L* is the labor supply, *TRD* is the stock of foreign technical knowledge via capital goods imports, *FRD* is the stock of foreign technical knowledge via FDI inflows, *T* is a time trend and is included to capture technical progress over time, η_{it} is a symmetric random error component used to capture random variations in output level due to external shocks, and u_{it} represents the technical inefficiency used to capture technical inefficiency. Finally, *i* indexes country and *t* indexes time.

[14] Since the panel data are imbalanced, it is impossible to take one year as the base year. Instead, the years 1999 to 2009 are used because data are mostly available in this period.

To allow for a flexible functional form, a translog production function is adopted to characterize the production frontier facing developing countries. Equation (4.21) can be expressed in log-linear form to give

$$\ln Y_{it} = \beta_0 + \sum_{j=1}^{4} \beta_j \ln X_{jit} + \beta_t T + \frac{1}{2}\sum_{j}^{4}\sum_{k=1}^{4} \beta_{jk} \ln X_{jit} \ln X_{kit} + \frac{1}{2}\beta_{tt} T^2 \qquad (4.22)$$

$$+ \sum_{j}^{4} \beta_{jt} \ln X_{jit} T + \sum_{r=1}^{3} \gamma_r D_r + \beta_t T + \varepsilon_{it} - v_{it}$$

where Y_{it} is the output of country i in time t, X_{jit} is the jth factor input used by the ith country in time t to produce Y. Five factors of production are included, namely physical capital, labor, human capital, trade-weighted stock of industrial R&D, and FDI-weighted stock of industrial R&D. Equation (4.22) also contains regional dummies (D_r) for Asia, America, and Africa. These capture differences in the initial level of technology for these regions and are preferred to country-specific fixed effects (Temple, 1999). The variable T proxies for technological progress and is used to capture elements of domestic technological progress not captured by foreign R&D. The β's are parameters to be estimated. Finally, $\varepsilon_{it} = \ln \eta_{it}$ and $v_{it} = \ln u_{it}$ [from equation (4.21)], with $\varepsilon_{it} \sim \text{iid}\, \text{N}(0, \sigma_\varepsilon^2)$ being the random noise error component and $v_{it} \geq 0$, the technical inefficiency error component.

Regarding the inputs into the production function, there are contradicting views over the role of human capital in economic growth. Mankiw et al. (1992) advocate the inclusion of human capital as a separate term in the production function. In contrast, Islam (1995) and Pritchett (2001) argue that human capital influences growth indirectly through its effect on TFP. The analysis in this dissertation chooses to follow Griliches (1969) and Mankiw et al. (1992) and allow for possible complementarity between human and physical capital by including the former as a separate input in the production function. Moreover, output is assumed to be a function of the total stock of knowledge in country i at time t. Following Grossman and Helpman (1991), it is assumed that this depends on the stock of R&D. Given that most developing countries undertake little domestic R&D, the stock of knowledge is assumed to depend on the stock of foreign R&D transferred into developing countries through trade and inward FDI. The measure of technology transfer used in this paper builds on that found

from Lichtenberg and van Pottelsberghe de la Potterie (1998). They measure foreign R&D spillovers on the domestic economy as the sum of bilateral imports share in trade partners' GDP weighted by R&D capital stocks of trade partners. Following this literature, we measure the stock of frontier technology as the stock of industrial R&D in 21 OECD countries. To capture the spillover of foreign technology to developing countries, this stock of knowledge is weighted by the share of a developing country's capital goods imports in each OECD country's GDP and by the share of a developing country's FDI inflows in each OECD country's GDP. The stock of foreign industrial R&D spillovers (*TRD*) via imports by developing country *i* from the foreign OECD country *j* is therefore given by

$$TRD_i = \sum_{j \neq i} \frac{CGI_{ij}}{Y_j} RD_j \quad . \tag{4.23}$$

Similarly, the stock of foreign industrial R&D spillovers (*FRD*) via FDI inflows to developing country *i* from the foreign OECD country *j* is therefore given by

$$FRD_i = \sum_{j \neq i} \frac{FDI_{ij}}{Y_j} RD_j \quad , \tag{4.24}$$

where CGI_{ij} is capital goods imports of developing country *i* from developed country *j*, FDI_{ij} is FDI inflows to country *i* from country *j*, RD_j is real capital stock of industrial R&D, and *Y* is the GDP of the developed country.

4.3.2 Inefficiency Effects Model

Countries may differ in their level of productivity. This productivity difference is captured by the term η in equation (4.22). A country is fully efficient if the term η is equal to one. Otherwise, there are some impediments to absorption that will cause the country to produce below the frontier. Following Battese and Coelli (1995), the inefficiency effects are obtained as truncations at zero of the normal distribution $N(m_{it}, \sigma_v^2)$, where $v = -\eta$. Inefficiency is therefore specified as

$$m_{it} = z_{it}\theta \tag{4.25}$$

where m_{it} are technical inefficiency effects in the SFA framework and are assumed to be independently, but not identically distributed; z_{it} is a vector

of variables which may influence the technical efficiency of a country, and θ is a vector of parameters to be estimated.

The mean level of inefficiency for our empirical analysis is specified as

$$m_{it} = \theta_0 + \theta_1 AY_{it} + \theta_2 CGI_{it} + \theta_3 FDI_{it} + \theta_4 FMD_{it} \qquad (4.26)$$

where *AY* refers to the share of agriculture in GDP, *CGI* is capital goods imports from OECD countries, *FDI* is FDI inflows from OECD countries, and *FMD* is financial market development.

The specification of equation (4.26) is based on previous literature. Geroski (1995) and Cameron et al. (2005) argue that investment in imitative or adaptive research activities plays a crucial role in adopting foreign technology. Using human capital and R&D to capture these effects, Griffith et al. (2004) find strong empirical support for this argument in the context of OECD countries. In our empirical study, human capital is already included in the technical frontier model [equation (4.22)].

Given a relatively low R&D capacity in developing countries, their absorptive capacity for foreign R&D is captured by their importation of capital goods and FDI inflows. Capital goods imports embody knowledge of foreign technology and production know-how; the greater these imports the greater the scope for direct absorption of foreign innovations by the importing firms and for spillover of this knowledge to other firms. With greater absorption of foreign technology through capital imports the nearer a country can be to the production frontier and the lower the measured inefficiency. FDI inflows can improve the productivity resulting from increased competition. The competition effects result from the increased numbers of firms (domestic and foreign) operating within the market and the resulting improvements in quality and incentives to reduce slack.

Following Henry et al. (2009, p. 242), the share of agriculture in GDP is included in the inefficiency model. Other things being equal, higher agricultural intensity is expected to increase distance from the production frontier. Developing countries are characterized by lower average food output per unit input due to backward farming method. However, the wider domestic diffusion of existing know-how and by greater commercialization of agricultural activity can raise a country's output for given national

resources. By raising efficiency and productivity in agriculture, the scope for an agricultural surplus and for releasing resources from agriculture to higher productivity activities increases.

Finally, the financial market can play a significant role in the channeling the contributions of FDI to economic growth. This argument is supported by Alfaro et al. (2004). Therefore, other things being equal more developed financial market increases production efficiency.

In conclusion, if capital goods imports, FDI inflows, and financial market development promote the absorption of technology, we would expect to find negative coefficients on θ_2, θ_3, and θ_4, respectively; that is they reduce the distance from the frontier. On the contrary, if a higher share of agriculture in GDP increases inefficiency (or the distance from the frontier) then θ_1 would be positive.

4.3.3 Estimation Method for the Stochastic Frontier Model

Since the pioneering work of Aigner et al. (1977) and Meeusen and van den Broeck (1977), over time a number of studies have produced many innovations in the specification and estimation of their model. Panel data applications have kept pace with other types of developments in the literature. Many of these estimators have been centered on familiar fixed and random effects formulations of the linear regression model.

Among several alternative approaches to estimating the stochastic frontier model in panel data framework, the Battese and Coelli (1995) method is preferred since it allows the estimation of efficiency and inefficiency determinants using a one-stage approach rather than the traditional two-stage approach.[15] Under the two-stage approach, efficiency scores are estimated in stage one, and the efficiency scores are then regressed on a set of variables in stage two. This approach suffers from two problems. Firstly, in stage on the efficiency scores are assumed to be normal, independent and identically distributed; however, in stage two the same efficiency scores are assumed to be not identically distributed. Secondly, the efficiency scores obtained from stage one suffer from under-

[15] The issue of the explanation of the inefficiency effects was raised in the early empirical papers, including Pitt and Lee (1981) and Kalirajan (1981).

dispersion due to the omission of the efficiency changing variables, and this results in the obtained estimates from the second stage regressions to be biased downwards (Wang and Schmidt, 2002).

Following Battese and Coelli (1995), the parameters of the models defined by equations (4.22) and (4.26) were estimated simultaneously by maximum likelihood. Moreover, to interpret the coefficients of the coefficients of the translog production function, the elasticities of output with respect to each of the inputs are calculated as follows:

$$E_m = \frac{\partial y}{\partial x_m} = \beta_m + \sum_n \beta_{mn} x_{nit} \quad , \quad m = K, L, HC, TRD, FRD \tag{4.27}$$

Returns to scale (elasticity of scale) is calculated from the sum of the input elasticities as

$$RTS = \sum_m E_m \tag{4.25}$$

Following Coelli et al. (1999), the contribution of trade or FDI can be calculated as the difference between gross efficiency and efficiency net of the contribution of 'trade' or 'FDI', where gross efficiency is found using the conditional expectation of $\exp(-v_{it})$, given the random variable η_{it}

$$\begin{aligned} EE_{it} &= E[\exp(-v_{it}) \mid \eta_{it}] \\ &= \left[\exp\left(-\omega_{it} + \frac{1}{2}\tilde{\sigma}^2 \right) \right] \times \left[\Phi\left(\frac{\omega_{it}}{\tilde{\sigma}} - \tilde{\sigma} \right) \Big/ \Phi\left(\frac{\omega_{it}}{\tilde{\sigma}} \right) \right] \end{aligned} \tag{4.28}$$

where $\Phi(\cdot)$ denotes the distribution function of the standard normal variable

$$\omega_{it} = (1-\gamma)\left[\theta_0 + \sum_{m=1}^{M} \theta_m z_{it} \right] - \gamma\eta_{it}, \quad \tilde{\sigma}^2 = \gamma(1-\gamma)\sigma^2, \text{ and } \gamma = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_\varepsilon^2}$$

The operational predictor for the efficiency of country *i* at time *t* is calculated by replacing the unknown parameters in equation (4.28) with the maximum likelihood predictors. Net efficiency of trade or FDI (efficiency level excluding trade or FDI) is calculated by replacing $[\Sigma_{m=1}^{M} \theta_m z_{it}]$ with $[\Sigma_{m=1}^{M} \theta_m z_{it} - \theta_{trd} TRD]$ or $[\Sigma_{m=1}^{M} \theta_m z_{it} - \theta_{frd} FRD]$, respectively, and then re-calculating the efficiency predictions. Similar procedure is applied to calculate the net efficiency of the combination of trade and FDI.

4.4 Data Description

In the empirical analyses, three econometric models are estimated, namely the empirical three-factor model of Laos' FDI-trade linkages in global context, the dynamic gravity model of Laos' trade in regional context, and the stochastic frontier production model in the context of developing countries. Their data set are described below.

4.4.1 Panel Data for the Three-Factor Model

Sample used to estimate the empirical three-factor model of Laos' FDI-trade linkages consists of 72 countries. Hereafter, this sample is referred to as FDI-trade sample. The sample covers the period 1989–2009. To conduct the panel causality analyses, the subsample of the FDI-trade sample is employed, covering 23 partners over the period 1990–2009 after adjusting for lag one year of the dependent variable. This subsample of panel data has 224 observations and is highly unbalanced due to the zero trade and FDI flows.

It may be useful to provide a statistic of unbalancedness, proposed by Ahrens and Pincus (1981). According to Baltagi et al. (2002, p. 488), the measure of unbalancedness as given by Ahrens and Pincus (1981) is defined as

$$r = \frac{N}{\bar{T}\sum_{i=1}^{N}\left(\frac{1}{T_i}\right)}, \qquad \text{where } \bar{T} = \sum_{i=1}^{N}\left(\frac{T_i}{N}\right)$$

Note that r is the degree of unbalancedness, taking value between 0 and 1. It takes the value 1 when the data are balanced, but takes on smaller values as the data pattern becomes more unbalanced. N is the number of individuals. T_i is the number of years in each individual. $\bar{T}$ is the average number of periods in the panel data set. Using the above formula, we calculate the Ahrens-Pincus statistic for the subsample of the FDI-trade sample which is 0.31, suggesting that the subsample panel data is substantially unbalanced.

The nominal values of bilateral exports and imports were obtained from the Direction of Trade Statistics (DOTS) of IMF CD (2006) and from the United Nations Commodity Trade Statistics Database (UNComtrade). The data for the US CPI and nominal GDPs in USD were taken from the World

Economic Outlook (WEO) database of the IMF. The value of bilateral exports and GDPs were converted into constant price USD using the US CPI with 2000 as the base year. The data for approved inward FDI flows to Laos was obtained from Freeman (20001), IMF (2002), Gunawardan (2008), and MPI (2011).

The data for relative factor endowments were obtained from several sources. The data for relative labor endowment is approximated by the ratio of two countries' total labor force, obtained UNCTAD (2010). The data for relative human capital endowment was approximated by the ratio of two countries' mean years of schooling for adult, obtained from UNDP (2010). The data for relative physical capital endowment was approximated by the ratio of two countries' capital stock. The data on capital stock is not available, but it was estimated by the perpetual inventory method assuming the initial period's (1989) capital stock as

$$K_{1989} = 2*(I_{1987} + I_{1988} + I_{1989} + I_{1990} + I_{1991})$$

where I_t is the gross fixed capital formation, obtained from UNCTAD (2010). Furthermore, it is assumed that the capital stock is depreciated with a constant and identical rate of 10% in order to derive real capital stock in the other years as

$$K_t = 0.90*K_{t-1} + I_t$$

The data for the population was collected from IMF (2006a, 2011). Distance was used as a proxy variable of transport costs calculated according to the distance in kilometers between the capitals of the exporter and importer. The data for distance and historical links were taken from CEPII (2010). The data for import tariffs of all products was derived from the World Bank. The tariff data is the simple average of tariff rates for most favored nation.

The definitions and basic sources of the key variables are summarized in Table 4.2. The flows of trade and FDI are expressed as ratios of GDP. Three factors of endowments, namely physical capital, human capital, and labor, are defined as the ratios of those for Laos to those for foreign countries. Most data were obtained from international organizations' online databases.

Table 4.2: Variable definitions and sources used in the three-factor model

Variable	Definition	Source
$\ln \tilde{X}_{ijt}$	Ratio of real bilateral exports to GDP of Laos (country i) and its partner (country j) for year t. Converted to logarithms.	IMF (2006a) and UNSD (2011b)
$\ln \tilde{M}_{ijt}$	Ratio of real bilateral imports to GDP of Laos (country i) and its partner (country j) for year t. Converted to logarithms.	IMF (2006a) and UNSD (2011b)
$\ln \tilde{F}_{ijt}$	Ratio of approved FDI flows to GDP of Laos (country i) and its partner (country j) for year t. Converted to logarithms.	Freeman (2001), IMF (2002), Gunawardan (2008), and MPI (2011)
R_{ij}	Distance is the geographical distance between the capitals of country i and country j, measured in kilometers. Converted to logarithms.	CEPII (2010)
k_{ijt}	Relative physical capital endowment is defined the ratio of physical capital in foreign country (country i) to physical capital in Laos (country j). Converted to logarithms.	UNCTAD (2010)
h_{ijt}	Relative human capital endowment is defined the ratio of the mean years of schooling of adults in foreign country (country i) to the mean years of schooling of adults in Laos (country j). Converted to logarithms.	UNDP (2010)
l_{ijt}	Relative labor endowment is defined the ratio of total labor force in foreign country (country i) to total labor force in Laos (country j). Converted to logarithms.	UNCTAD (2010)
A_{ijt}	Dummy variable equal to 1 if countries i and j have a free trade agreement for year t, and zero otherwise.	WTO (2011)
C_{ij}	Dummy variable equal to 1 if countries i and j have had a common colonizer after 1945, and zero otherwise.	CEPII (2010)
N_{ij}	Dummy variable equal to 1 if countries i and j have had colonial relationship after 1945, and zero otherwise.	CEPII (2010)
D_R	A region dummy, equal to 1 if a country is located in a particular region classification, and 0 otherwise.	UNSD (2011a)
D_T	A time dummy, equal to 1 if it is year t, and 0 otherwise.	Author

Source: Author's compilation.

Table 4.3 shows the statistics of Laos' trade and FDI and their explanatory variables over the period 1989 to 2009. These statistics include number of observations, standard deviation, minimum, and maximum. The total number of country-pairs is 72, which could generate 1,512 observations. Due to the unavailability of data on relative human capital endowment and zero trade and FDI flows for some country pairs, however, the number of country pairs is reduced from 72 to 67 for bilateral export, 61 for bilateral import, and 41 for inward FDI (not shown in the table). Nonetheless, the panel data are still balanced because each country pair contains the same number of years (21 years). Data on factor endowments are provided in Appendix C.

Table 4.3: Summary statistics of data used in the three-factor model

Variable	Obs.	Mean	Std. Dev.	Min	Max
$\ln \tilde{X}_{ijt}$	1073	− 34.32	2.30	− 43.89	− 26.09
$\ln \tilde{M}_{ijt}$	862	− 34.16	2.63	− 45.17	− 26.17
$\ln \tilde{F}_{ijt}$	360	− 33.61	2.70	− 41.13	− 26.41
R_{ij}	1511	8.76	0.85	6.17	9.87
$R_{ij}\|k_{ijt} - l_{ijt}\|$	1511	30.08	13.28	0.09	53.22
k_{ijt}	1511	4.29	2.03	− 0.93	9.26
h_{ijt}	1407	0.73	0.35	− 0.30	1.40
l_{ijt}	1511	1.04	2.17	− 4.70	8.50
C_{ij}	1511	0.06	0.23	0	1
N_{ij}	1511	0.01	0.12	0	1
D_{R1}: South-Eastern Asia	1511	0.11	0.31	0	1
D_{R2}: America	1511	0.18	0.38	0	1
D_{R3}: Eastern Asia	1511	0.07	0.25	0	1
D_{R4}: Southern Asia	1511	0.06	0.23	0	1
D_{R5}: Western Asia	1511	0.08	0.28	0	1
D_{R6}: Eastern Europe	1511	0.08	0.28	0	1
D_{R7}: Northern Europe	1511	0.14	0.35	0	1
D_{R8}: Western Europe	1511	0.08	0.28	0	1
D_{R9}: Oceania	1511	0.04	0.2	0	1
D_{R10}: Africa	1511	0.06	0.23	0	1

Source: Author's calculation.

For the dependent variables, bilateral export ($\ln \tilde{X}_{ijt}$), import ($\ln \tilde{M}_{ijt}$), and inward FDI ($\ln \tilde{F}_{ijt}$) are negative because they are expressed as the natural logarithm of the ratio of bilateral flows to GDP. The standard variation of the inward FDI flows is the highest among these three variables. Among continuous explanatory variables (R_{ij}, $R_{ij}|k_{ijt} - l_{ijt}|$, k_{ijt}, h_{ijt}, and l_{ijt}), the interaction term between distance and the physical capital ratio ($R_{ij}|k_{ijt} - l_{ijt}|$) has the highest variation, whereas the relative human capital endowment has the lowest variation.

For discrete explanatory variables, the mean of C_{ij} shows that only 6% of the 1,511 observations have had a common colonizer after 1945 with the Lao PDR. Similarly, as indicated by the mean of N_{ij}, 1% of the 1,511 observations have had a colonial relationship after 1945 with the Lao PDR. Furthermore, as indicated by the region dummies (D_R), most trading partners

of the Lao PDR are in America (18%), Northern Europe (14%), and South-Eastern Asia (11%).

4.4.2 Panel Data for the Dynamic Gravity Model

Sample used to estimate the dynamic gravity model consists of sixteen countries, including ten ASEAN countries (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam), and its six counterparts (Australia, China, India, New Zealand, Japan, and South Korea). Hereafter, this sample is referred to as trade sample. The sample is from 1992 to 2009.

Table 4.4: Variable definitions and sources used in the dynamic gravity model

Variable	Definition	Source
lnX_{ijt}	Real bilateral exports of country i to country j for year t. Converted to logarithms.	IMF (2006b) and UNSD (2011b)
G_{ijt}	Sum of bilateral country size is defined by the sum of GDP in country i and country j for year t. Converted to logarithms.	IMF (2011)
S_{ijt}	Similarity in bilateral country size is defined by one minus the squares of the relative size (GDP) of country i (country j) to bilateral GDP for year t. Converted to logarithms.	IMF (2011)
R_{ij}	Distance is the geographical distance between the capitals of country i and country j, measured in kilometers. Converted to logarithms.	CEPII (2010)
E_{ijt}	Differences in relative factor endowment are defined by the absolute value of the differences in the logarithms in GDP per capita between country i and country j for year t.	IMF (2011)
T_{ijt}	Tariff rate is the simple average of tariff rates for most favored nation, applied to imports of country i from country j for year t.	World Bank (2011)
D_T	A time dummy, equal to 1 if it is year t, and 0 otherwise.	Author

Source: Author's compilation.

The trade sample is unbalanced, mainly due to the availability of tariff rates. More precisely, it produces the unbalanced panels of 1651 observations. The unbalancedness of panel data is due to zero trade flows and missing data on trade flows and on import tariffs. Following the formula for calculating the Ahrens-Pincus statistic in Subsection 4.3.1, we calculate the unbalancedness statistic, which is 0.81 for the sample of pre-adjustment for lag-dependent variable and 0.62 for the sample of post-adjustment for lag-dependent variable. This indicates that the former is moderately

unbalanced, whereas the latter is highly unbalanced in terms of observations for each year of data.

Table 4.5: Panel summary statistics of ASEAN+6

Variable	ASEAN+6									
	Before lag adjustments					After lag adjustments				
	Obs.	Mean	Std. Dev.	Min	Max	Obs.	Mean	Std. Dev.	Min	Max
lnX_{ijt}	2442	19.73	3.10	8.94	25.33	1721	20.02	2.98	8.94	25.33
G_{ijt}	2442	27.11	1.39	22.39	29.71	1721	27.26	1.39	22.43	29.71
S_{ijt}	2442	− 2.10	1.41	− 7.35	− 0.69	1721	− 2.13	1.44	− 7.35	− 0.69
R_{ij}	2442	8.16	0.76	5.75	9.45	1721	8.21	0.74	5.75	9.45
E_{ijt}	2442	2.10	1.44	0.00	6.17	1721	2.11	1.46	0.00	6.17
T_{ijt}	2442	10.16	8.71	0.00	55.84	1721	8.18	6.41	0.00	39.08

Source: Author's calculation.

Table 4.5 summarizes the statistics of the dependent variable and explanatory variables for ASEAN+6 countries, averaged from 1992 to 2009. There are 237 country pairs (not shown in the table). Due to the unavailability of tariff data, the panel data are unbalanced, with the total number of observations 2442 for the pre-adjustment of lag-dependent variable and 1721 for the post-adjustment of lag-dependent variable. After the lag adjustment, the number of observations has dramatically decreased by 721 observations due to the unbalanced panel data.

In the empirical analysis of Chapter 5, the sample of pre-adjustment of lag-dependent variable is employed to construct the multilateral and world resistance terms. The average of intra-regional tariff rate is also drawn from this sample, which is 10.16%.

Mean of the log of bilateral exports is slightly higher in the post-adjusted sample (20.02) than in the post-adjusted sample (19.73), with equal minimum (8.94) and equal maximum (25.33). Among other explanatory variables, it is important to note that the maximum tariff rate increases dramatically from 39.08% in the pre-adjusted sample to 55.84% in the post-adjusted sample, whereas the mean of the latter (10.16%) is lower than that of the former (8.18%).

4.4.3 Panel Data for the Stochastic Frontier Model

One of our goals is to estimate the technical efficiency which indicates how far a sample country lags behind the best practice as represented by the

production frontier. A panel data set is needed. In the application, sample consists of 81 developing countries, including Algeria, Argentina, Bahrain, Bangladesh, Barbados, Belarus, Bolivia, Brazil, Bulgaria, Cameroon, Chile, China, Colombia, Republic of Congo, the Democratic Republic of the Congo, Costa Rica, Croatia, Cyprus, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Gabon, Georgia, Ghana, Guatemala, Honduras, Hong Kong, India, Indonesia, Iran, Israel, Jamaica, Jordan, Kazakhstan, Kenya, Korea, Kuwait, Laos, Latvia, Lebanon, Libya, Lithuania, Malaysia, Mali, Malta, Mauritius, Mexico, Morocco, Mozambique, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Qatar, Romania, Russia, Saudi Arabia, Senegal, Singapore, Slovenia, South Africa, Sri Lanka, Thailand, Togo, Trinidad and Tobago, Tunisia, Uganda, Ukraine, United Arab Emirates, Uruguay, Venezuela, Vietnam, Yemen, and Zambia.[16]

Table 4.6: Variable definitions and sources used in the stochastic frontier model

Variable	Definition	Source
Y	Output (real GDP)	UNCTAD (2010)
	Factor inputs	
K	Capital stock	UNCTAD (2010)
L	Total labor force	UNCTAD (2010)
HC	Human capital	World Bank (2011)
TRD	Trade-weighted R&D stock	UNComtrade and ANBERD Database
FRD	FDI-weighted R&D stock	UNComtrade and ANBERD Database
T	Time trend	Author
Asia	Asia	UNSD (2011a)
America	America	UNSD (2011a)
Africa	Africa	UNSD (2011a)
	Inefficiency effect determinants (z_{it})	
CGI	Capital goods imports	UNComtrade
FDI	FDI inflows	UNCTAD (2010)
FMD	Financial market development	World Bank (2011)
AY	Share of agriculture in GDP	World Bank (2011)

Source: Author's compilation.

[16] Less developed or developing countries referred to in this study include 81 countries and OECD countries include 21 countries. These labels are somewhat misleading because some developing countries have similar or higher levels of GDP per capita or other indicators of development than some OECD countries.

This study covers the period 1995–2010 and produces the unbalanced panel of 1041 observations. The unbalancedness of panel data is due largely to zero and missing data on FDI inflows. The Ahrens-Pincus statistic for unbalancedness is 0.92, indicating that the data set is slightly unbalanced in terms of observations for each year of data.

Data on GDP, FDI inflows, labor force, and physical capital investment were taken from UNCTAD for the period 1995–2010. Data on GDP and physical capital investment are in constant 2005 US$. The capital stock data were constructed using the perpetual inventory method. To avoid the problem of initial conditions, initial capital stocks were constructed for 1995. Data on human capital measured by mean years of schooling in the population aged 25 and over, the share of agriculture, and the indicator of financial market development measured by the ratio of M2 to GDP were obtained from the World Development Indicator (WDI).

Table 4.7: Summary statistics of variables for stochastic frontier model

Variable	Mean	Std. Dev.	Min	Max
lnY	24.40	1.56	21.13	28.99
lnK	24.81	1.68	20.29	29.83
lnL	15.54	1.68	11.85	20.50
lnHC	1.86	0.46	− 0.22	2.49
lnTRD	32.63	1.64	28.30	36.99
lnFRD	17.28	2.46	11.49	22.33
T	8.76	4.63	1	16
Asia	0.35	0.48	0	1
America	0.27	0.44	0	1
Africa	0.24	0.43	0	1
Europe	0.15	0.36	0	1
lnCGI	20.97	1.60	16.46	25.09
lnFDI	5.51	2.45	− 1.36	10.55
FMD	0.54	0.44	0.0046	3.24
AY	0.12	0.11	0.0004	0.60

Source: Author's calculation.

Industrial R&D investment data for the 21 OECD countries were taken from the OECD's ANBERD Database. OECD countries include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States. Similar to the

physical capital stock, the stock of R&D was computed using the perpetual inventory method.

Data on capital goods imports for the sample of developing countries were extracted from the United Nations' COMTRADE Database. Following the United Nations (2003, p. 6), classification of capital goods is based on the broad economic categories. Table 4.6 describes definitions of variables and their respective data sources.

Table 4.7 presents descriptive statistics for GDP, factor inputs, trade and FDI-weighted foreign R&D, capital goods imports and FDI inflows from OECD countries, financial market development, share of agriculture in GDP, as well as region dummies. There is considerable variation in the log of human capital across countries, ranging from −0.22 for Yemen to 2.49 for Georgia. The log of inward FDI variable also ranges extensively from −1.36 for United Arab Emirates to 10.55 for Singapore. Finally, the financial development indicator measured by the ratio of M2 to GDP ranges from 0.0046 for Democratic Republic of Congo to 3.24 for Hong Kong.

Chapter 5 FDI-Trade Linkages—Empirical Analysis

5.1 Analysis of Causality between Inward FDI and Trade Flows

The purpose of our empirical analysis in this chapter is to examine not only the nature and extent of causality relation between inward FDI and trade flows but also with the fundamental determinants responsible for them. A simple panel-causality analysis is adopted in this section to establish the basic patterns in the data. The pros and cons of this strategy will be discussed in the next section.

A number of literature on trade and multinational enterprise identified negative relationship between international trade and FDI. Trade frictions—namely commercial policy, geographical distance, and transportation costs—motivate producers to jump trade barriers by establishing similar plants in different markets. Such investment patterns are referred to as horizontal FDI. In contrast, cost differences may motivate producers to fragment the production process, putting labor intensive stages of production in low wage countries, and the more capital intensive stages of production—namely R&D, assembly, and headquarter services—in advance countries. Such investment patterns are referred to as vertical FDI. A distinguishing feature of these two patterns deals with the relationship between trade and FDI: horizontal FDI tends to substitute trade, while vertical FDI tends to create trade. Economic reasoning indicates that vertical FDI are more pronounced between the industrialized and developing countries, while horizontal FDI are more pronounced among the industrialized countries. In practice, multinationals may choose both vertical and horizontal mixture and hence create hybrid patterns.

It is interesting to investigate which pattern of FDI and trade relationship will dominate in the Lao economy. Table 5.1 presents the estimated panel data for Granger causality test in the first-order vector autoregression [VAR(1)] between FDI and trade using models specified in (4.1)–(4.6) in Chapter 4. They are estimated by the system generalized method of moment (GMM) using the unbalanced panel from 1989–2009.

Table 5.1: Results of the Granger causality test

	$FDI^{in} \rightarrow$exports	exports$\rightarrow FDI^{in}$	$FDI^{in} \rightarrow$imports	imports$\rightarrow FDI^{in}$	exports$\rightarrow$imports	imports$\rightarrow$exports
δ_1	0.595***	0.097	0.275	0.051	− 0.036	0.690***
	(0.208)	(0.106)	(0.206)	(0.104)	(0.327)	(0.239)
α_1	0.115*	0.411*	0.328**	0.622***	0.685**	0.184
	(0.056)	(0.201)	(0.142)	(0.127)	(0.329)	(0.157)
Number of observations	224	224	224	224	224	224
Number of instruments	22	22	22	22	22	22
AR(1)	$Z = -1.83$*	$Z = -3.08$***	$Z = -2.59$**	$Z = -3.02$***	$Z = -1.58$	$Z = -1.90$*
AR(2)	$Z = 1.14$	$Z = 0.64$	$Z = 0.33$	$Z = -0.61$	$Z = 0.56$	$Z = 0.73$
Hansen test of over-identification restrictions	*Chi2* (19) = 15.25	*Chi2* (19) = 14.58	*Chi2* (19) = 15.54	*Chi2* (19) = 14.82	*Chi2* (19) = 14.61	*Chi2* (19) = 10.94
Exclusion *F*-test of the α coefficient	*F* (1, 22) = 4.16*	*F* (1, 22) = 4.21*	*F* (1, 22) = 5.33**	*F* (1, 22) = 24.19***	*F* (1, 22) = 4.33**	*F* (1, 22) = 1.37

Note: Robust standard errors are reported in parentheses. *** denotes significance at the 1% level; **, at the 5% level; and *, at the 10% level.

Source: Author's estimation.

Since the system GMM for dynamic panel data model is very complex and the obtained results could be invalid if some assumptions fail, it is important to interpret the results starting with the model diagnostics. Consequently, testing for the validity of instruments is crucial in testing the statistical properties of this model. Some key statistical tests for system GMM include the test of no autocorrelation in the twice-lagged residuals and the test of over-identification restrictions.[17] As indicated by the statistics of AR(2), none of the second-order serial correlation in the residuals are found to be statistically significant at any conventional levels, suggesting that the model specifications are valid. Similarly, as indicated by the statistics for over-identifying test, none of these statistics are found to be statically significant at any conventional levels. These tests suggest that the models have valid instrumentation. According to the various statistical tests that have been implemented, it may be reasonable to say that there is enough evidence to conclude that the examined statistical tests satisfy the principle assumptions of system GMM estimation and that these models are appropriate statistical generating mechanism. The *F*-tests of exclusion restriction have also been conducted in all causality regressions and found that they provide similar results as those in the full models.

[17] More comprehensive tests for diagnostic statistics are provided in the next section.

Four interesting causality relations between trade and inward FDI are found in the Lao economy. These can be summarized as follows. First, for the equations of exports (equations (4.1) and (4.6) in Chapter 4), two unidirectional causalities are found: inward FDI causes exports and imports also cause exports. This causality relation indicates that the large amount of inward FDI and imports are the principal forces in promoting exports for the Lao economy.

Second, for the equations of imports (equations (4.2) and (4.4) in Chapter 4), two unidirectional causalities are found: inward FDI causes imports and exports also cause imports. These causality relations indicate that FDI inflows and exports join together to increase imports for the Lao economy.

Third, for the equations of FDI (equations (4.3) and (4.5) in Chapter 4), two unidirectional causalities are found: exports cause inward FDI and imports also cause inward FDI. These causality relations indicate that exports and imports are the two vital forces in promoting inward FDI for the Lao economy.

Finally, the bidirectional causality between exports and inward FDI are found from the exports and FDI equations together, while the bidirectional causality between imports and inward FDI are found from the imports and FDI equations together. These findings verify that inward FDI can be crucial and significantly benefit the growth of GDP through increased exports, for example, by opening the export-oriented industrial processing zones for inward FDI in the Lao economy. At the same time, inward FDI also leads to an increase in imports. Since the Lao economy has intensively imported capital goods, an increase in imports can be regarded as benefit as well because it can stimulate growth in the long run.

It is found that exports have reinforcing effects on inward FDI: exports not only have strong direct impact on imports, but also indirectly increase inward FDI through imports by interactive relations between imports and inward FDI. Inward FDI, in turn, stimulates both exports and imports. It is important to note that FDI inflows have contributed to exports directly and indirectly via imports. Our result is consistent with Hsiao and Hsiao (2006) who found the causality between FDI and exports in a group of eight Asian economies.

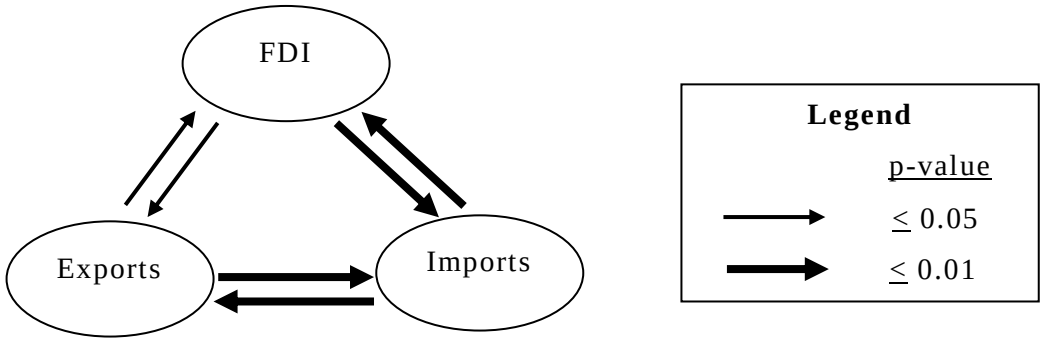
Table 5.2: Long-run impacts of causality relations

Long-run impact	FDI^{in} →exports	exports→FDI^{in}	FDI^{in} →imports	imports→FDI^{in}	exports→imports	imports→exports
$\alpha_1/(1-\delta_1)$	0.283*	0.456**	0.453***	0.656***	0.661***	0.592***
	(0.152)	(0.205)	(0.120)	(0.085)	(0.176)	(0.179)

Note: Standard errors are reported in parentheses.

Source: Author's estimation.

It is also useful to provide the long-run impacts for the empirical results in Table 5.1. The long-run impacts between trade and FDI show the cumulative effect of their determinants on the respective variable, and illustrated in Table 5.2. More precisely, the rising FDI inflows to the Lao economy contributed about 0.01% to exports and 0.02% to imports annually on average in the period 1989–2009. The growing exports contributed about 0.02% to inward FDI and 0.03% to imports annually on average in the same period. The growing imports of the Lao economy had the same impact on both inward FDI and exports, about 0.03% annually on average in the same period.



Source: Author's compilation from Table 5.2.

Figure 5.1: Direction of Granger causality relations between inward FDI and trade flows in Laos

To gain better understanding on the pattern of FDI-trade linkages in the Lao economy, Figure 5.1 graphically shows the relationship between FDI and trade in terms of the level of statistical significance. Figure 5.1 has been generated using the data from Table 5.2. It shows that there exist strong bidirectional causalities between FDI and imports, and between exports and imports relative to the bidirectional causality between exports and FDI. The

pattern of FDI-trade linkages is consistent with the empirical evidence in the Lao economy since the Lao government is implementing the FDI promotion policy as a basis for industrialization and promoting exports. According to the empirical result, the weak bidirectional causality between FDI and exports implies that the FDI promotion policy has not been fully achieved.

However, due to the reinforcing effects of exports further participation in the deepening regional economic integration is crucial for Laos to attract more FDI and hence, promote economic growth. Moreover, as indicated by the bidirectional causality between inward FDI and exports, the Lao government has successfully opened its economy for inward FDI under the export promotion regime since 1988, and then the interaction between exports and inward FDI could have stimulated economic development. Nonetheless, it is important to note that any increase of either inward FDI or exports or both could raise the volume of imports and thus, results in the deterioration of the balance of payment. To gain a better understanding about the factors characterizing FDI-trade linkages in Laos, the three-factor model is utilized.

5.2 Empirical Results from the Three-Factor Models

Although the panel causality analysis adopted in the previous section can be simply applied to investigate FDI-trade linkages, it can lead to the question of endogeneity. The three-factor model can overcome this problem. Following the three-factor model specified in equation (4.8) in Chapter 4, several specifications of the Tobit forms of gravity models on the exports, imports, and inward FDI for the Lao PDR are estimated to investigate FDI-trade linkages using data over the period 1989–2009. These results are presented in Table 5.3 and Table 5.4 in terms of the marginal effect at the mean of the explanatory variables. The estimated results for region dummies are also used to indicate the trade and investment positions of Laos' trade and investment partners, the results of which are summarized in Table 5.5. Finally, FDI-trade linkages are examined in terms of unobserved factors using the residual interactions of trade and FDI, the results of which are summarized in Table 5.6, Figure 5.2, and Figure 5.3.

Table 5.3: Panel regression results for Laos' bilateral exports, imports and inward FDI (real figures and variables in logs), 1989–2009

Explanatory variables	Exports		Imports		Inward FDI	
	Model I.a	Model I.b	Model II.a	Model II.b	Model III.a	Model III.b
Distance	− 1.999***	− 1.176***	− 1.719***	− 2.490***	− 0.646***	− 0.859***
	(0.359)	(0.202)	(0.268)	(0.187)	(0.079)	(0.043)
Distance × absolute difference in capital-labor ratios	− 0.247***	− 0.049	− 0.224***	0.002	0.014	0.029***
	(0.055)	(0.051)	(0.046)	(0.047)	(0.009)	(0.009)
Relative physical capital endowment	3.987***	2.581***	3.852***	2.160***	0.298***	0.155**
	(0.457)	(0.438)	(0.377)	(0.397)	(0.069)	(0.073)
Relative human capital endowment	− 2.373***	− 0.409	− 1.344**	0.496	0.422**	0.927***
	(0.675)	(0.486)	(0.531)	(0.475)	(0.164)	(0.135)
Relative labor endowment	− 2.630***	− 1.42***	− 2.089***	− 0.576	0.105	0.267***
	(0.452)	(0.438)	(0.366)	(0.394)	(0.072)	(0.076)
Common colonizer after 1945	2.695***	3.536***	3.094***	1.646*	0.567***	0.537***
	(0.862)	(0.900)	(0.947)	(0.881)	(0.178)	(0.155)
Colonial relationship after 1945	− 0.055	1.789***	− 0.218	0.865***	1.112***	1.327***
	(0.284)	(0.295)	(0.258)	(0.233)	(0.224)	(0.185)
D_{R1}: South-Eastern Asia	− 3.113***	—	0.471	—	1.281***	—
	(0.550)	—	(0.691)	—	(0.427)	—
D_{R2}: America	− 0.685	—	0.185	—	1.122***	—
	(0.437)	—	(0.410)	—	(0.293)	—
D_{R3}: Eastern Asia	− 2.923***	—	− 0.721	—	0.524**	—
	(0.433)	—	(0.501)	—	(0.248)	—
D_{R4}: Southern Asia	− 4.490***	—	− 1.159**	—	0.442	—
	(0.386)	—	(0.561)	—	(0.305)	—
D_{R5}: Western Asia	− 2.442***	—	− 1.612***	—	0.048	—
	(0.384)	—	(0.454)	—	(0.235)	—

Table 5.3 (continued)

Explanatory variables	Exports		Imports		Inward FDI	
	Model I.a	Model I.b	Model II.a	Model II.b	Model III.a	Model III.b
D_{R6}: Eastern Europe	− 0.533	—	− 0.598	—	0.843***	—
	(0.510)	—	(0.503)	—	(0.272)	—
D_{R7}: Northern Europe	1.575***	—	3.094***	—	1.007***	—
	(0.359)	—	(0.459)	—	(0.243)	—
D_{R8}: Western Europe	1.852***	—	2.149***	—	0.743***	—
	(0.351)	—	(0.456)	—	(0.229)	—
D_{R9}: Oceania	0.266	—	5.152***	—	1.984***	—
	(0.426)	—	(0.622)	—	(0.419)	—
D_{R10}: Africa	− 1.612***	—	− 2.879***	—	—	—
	(0.531)	—	(0.470)	—	—	—
Observations	1407	1407	1407	1407	1407	1407
Model degree of freedom	37	27	37	27	36	27
Residual degree of freedom	1370	1380	1370	1380	1371	1380
Pseudo R^2	0.140	0.119	0.184	0.153	0.288	0.259
Wald tests:						
Regional effects: F (k, residual df)	17.66***	—	25.27***	—	10.57***	—
Time effects: F (20, residual df)	17.97***	20.18***	12.92***	14.05***	9.91***	9.75***
LM tests:						
Normality: *Chi2* (2)	480.28***	482.64***	791.50***	683.23***	1406.99***	1345.48***
Homoskedasticity: *Chi2* (model df)	594.55***	587.32***	842.96***	702.02***	1406.99***	1361.55***
F -statistic (model df, residual df)	44.15***	50.40***	55.30***	61.86***	26.45***	32.39***

Notes: Reported standard errors in parentheses and test-statistics are heteroskedasticity-consistent following White (1982). *** denotes significance at the 1% level; **, at the 5% level; and *, at the 10% level. k are the number of restrictions, equal to 10 for exports and imports and 9 for FDI.

Table 5.3 reports the results for the Laos' exports, imports, and inward FDI using equation (4.8) with full specification (Models I.a–III.a, respectively) and without region dummies (Models I.b–III.b, respectively). By comparing these two specifications, two remarkable changes in estimated coefficients can be observed. First, in the export regression result the coefficient of 'colonial relationship after 1945' is negative and statistically insignificant in Model I.a, but becomes positive and statistically significant after omitting region dummies, shown in Model I.b. Second, the coefficient of 'relative human capital endowment' is negative and statistically significant in Models I.a and II.a, but becomes statistically insignificant in Models I.b and II.b. Since region dummies might capture country specific effects such as culture, national policies, and legal system, they play an important role in determining international trade and FDI flows as well. Consequently, ignoring them could lead to omitting variable bias.

Table 5.4 reports the results for the Laos' exports, imports, and inward FDI using equation (4.8) without distance variable (Models I.c–III.c, respectively) and without relative-factor-endowment variables (Models I.d–III.d, respectively). Models I.c–III.c are used to illustrate how distance manipulates itself into the region dummies when it is omitted, whereas Models I.d–III.d are used to illustrate that the gravity model is a special case of the three-factor model when the relative-factor-endowment variables are omitted. Since the fully specified models (I.a–III.a) are assumed to capture well the factors determining international trade and FDI flows relative to other specifications, the investigation of FDI-trade linkage and policy implications would be mainly drawn from them.

According to Table 5.3, the regression models for Laos' exports, imports, and inward FDI contains seven key variables (distance, interaction term between distance and the physical capital to labor ratio, relative physical capital endowment, relative human capital endowment, relative labor endowment, common colonizer, and colonial relationship after 1945). The marginal effects and the corresponding robust-standard errors, in parentheses, are reported in Table 5.3. The regression result without region dummies is also reported side by side of each model.

Our findings are the following: first and as indicated by the pseudo R-squares, the three gravity models can explain the relatively low variations in

Table 5.4: Panel regression results for Laos' bilateral exports, imports and inward FDI without relative factor endowments, 1989–2009

Explanatory variables	Exports		Imports		Inward FDI	
	Model I.c	Model I.d	Model II.c	Model II.d	Model III.c	Model III.d
Distance	—	− 0.845*	—	− 0.634*	—	− 0.747***
	—	(0.440)	—	(0.366)	—	(0.138)
Distance × absolute difference	—	0.140***	—	0.137***	—	0.042***
in capital-labor ratios	—	(0.015)	—	(0.014)	—	(0.005)
Relative physical capital endowment	1.988***	—	2.0678***	—	0.408***	—
	(0.141)	—	(0.125)	—	(0.037)	—
Relative human capital endowment	− 2.605***	—	− 1.597***	—	0.329*	—
	(0.682)	—	(0.540)	—	(0.175)	—
Relative labor endowment	− 0.717***	—	− 0.397***	—	0.003	—
	(0.161)	—	(0.142)	—	(0.041)	—
Common colonizer after 1945	3.186***	− 0.255	3.676***	− 1.574***	1.515***	− 0.296**
	(0.913)	(0.591)	(0.963)	(0.505)	(0.302)	(0.145)
Colonial relationship after 1945	− 0.115	1.697***	− 0.261	1.869***	1.099***	2.697***
	(0.273)	(0.315)	(0.251)	(0.295)	(0.216)	(0.330)
D_{R1}: South-Eastern Asia	1.346***	2.141**	6.050***	7.524***	5.173***	1.997***
	(0.489)	(0.969)	(0.587)	(1.164)	(0.561)	(0.602)
D_{R2}: America	− 1.881***	− 1.481***	− 0.831**	− 0.521	0.823***	1.494***
	(0.352)	(0.432)	(0.365)	(0.455)	(0.248)	(0.315)
D_{R3}: Eastern Asia	0.358	1.174	3.127***	5.201***	2.266***	3.043***
	(0.460)	(0.855)	(0.584)	(1.021)	(0.432)	(0.562)
D_{R4}: Southern Asia	− 2.385***	0.014	2.305***	5.864***	1.919***	1.081**
	(0.523)	(0.916)	(0.715)	(1.266)	(0.554)	(0.465)
D_{R5}: Western Asia	− 1.690***	− 1.368***	− 0.892*	− 1.191**	0.281	− 0.512**
	(0.410)	(0.419)	(0.499)	(0.471)	(0.294)	(0.239)

Table 5.4: (continued)

Explanatory variables	Exports		Imports		Inward FDI	
	Model I.c	Model I.d	Model II.c	Model II.d	Model III.c	Model III.d
D_{R6}: Eastern Europe	0.380	0.980*	0.313	1.245**	1.217***	1.529***
	(0.519)	(0.506)	(0.549)	(0.595)	(0.330)	(0.368)
D_{R7}: Northern Europe	1.718***	0.653*	3.265***	1.676***	1.312***	0.757***
	(0.354)	(0.369)	(0.464)	(0.450)	(0.282)	(0.254)
D_{R8}: Western Europe	1.730***	2.736***	2.055***	3.433***	1.018***	1.276***
	(0.346)	(0.427)	(0.450)	(0.532)	(0.266)	(0.321)
D_{R9}: Oceania	0.312	− 0.889**	5.217***	1.754***	2.570***	1.758***
	(0.421)	(0.420)	(0.600)	(0.633)	(0.509)	(0.435)
D_{R10}: Africa	− 1.444***	1.443**	− 2.751***	− 0.619	—	—
	(0.531)	(0.694)	(0.485)	(0.666)	—	—
Observations	1407	1511	1407	1511	1407	1511
Model degree of freedom	35	34	35	34	34	33
Residual degree of freedom	1372	1477	1372	1477	1373	1478
Pseudo R^2	0.133	0.074	0.177	0.079	0.269	0.176
Wald tests:						
Regional effects: F (k, residual df)	18.77***	20.62***	56.52***	18.03***	46.15***	16.14***
Time effects: F (20, residual df)	18.28***	12.34***	13.07***	4.92***	8.99***	3.86***
LM tests:						
Normality: *Chi2* (2)	451.96***	898.58***	771.29***	987.83***	1362.43***	1486.82***
Homoskedasticity: *Chi2* (model df)	608.63***	1094.48***	833.04***	1095.78***	1371.24***	1489.44***
F -statistic (model df, residual df)	45.53***	30.71***	51.27***	32.90***	23.95***	27.70***

Notes: Reported standard errors in parentheses and test-statistics are heteroskedasticity-consistent following White (1982). *** denotes significance at the 1% level; **, at the 5% level; and *, at the 10% level. *k* are the number of restrictions, equal to 10 for exports and imports and 9 for FDI.

the bilateral export flows, bilateral import flows, and bilateral inward FDI flows of Laos, around 14%, 18%, and 29%, respectively. For those without region dummies are slightly lower than those with region dummies, about 12% for export, 15% for import, and 26% for FDI. The fact that pseudo R-square is higher in the model of FDI flows than that of bilateral trade flows indicates that the former outperforms that latter. Second, in the *Wald*-test in each model, any of the time and regional-fixed effects is significant at conventional levels. Accordingly, investigating the determinants of bilateral trade and FDI flows in panel data framework, one should account for these unobserved-fixed effects.

Third, the LM tests show that the three gravity models exhibit non-normality and heteroskedasticity in the error terms. Thus, estimating these models by the quasi-maximum likelihood, with robust standard error, is one possible option to obtain correct statistical inference for the parameter estimates. This is applied to our results.

Fourth, as expected, distance between the capital cities of Laos and each of its trading partners is negative and statistically significant in all models. This indicates that distance has an adverse effect not only on the bilateral trade flows of Laos, but also on its inward FDI, with the former dominating the latter. The marginal effect of the coefficient for distance is 2 for exports, 1.7 for imports, and 0.7 for FDI. These estimated coefficients say that a 1% increase in the distance between two countries is associated with a fall of 2% in Laos' exports, 1.7% in Laos' imports, and 0.7% in Laos' inward FDI. Under developed infrastructure and telecommunication network are likely to be the main causes for this drop. Since Laos is a landlocked country, land transportation with poor route condition increases trade costs. Limited access to the internet and insufficient information on the websites could increase the costs of gathering information for doing business in Laos by foreign investors.

Our results for the impact of distance on bilateral trade flows are consistent in sign with Egger and Pfaffermayr (2004) study in which they use an unbalanced panel data of bilateral exports and outward FDI between the two economies (U.S. and Germany) and their trading partners over the period 1989–1999 and found the negative estimate of the coefficient for distance in export equation is 1.4 for exports of the U.S. More precisely, the

estimated coefficient of distance in Laos' export model is larger than that of the U.S, implying that Laos' export is more sensitive to the location of its trading partners than the U.S exports. Nonetheless, the difference in coefficient's magnitude could be partially resulted from the method of estimation (Egger and Pfaffermayr (2004) applied Hausman-Taylor SUR to their empirical models). In terms of the sign of the coefficient for distance in the FDI model, our result is inconsistent with that of Egger and Pfaffermayr (2004), but is consistent with that of Carr et al. (2001, p. 702) whose result shows the negative impact of distance on FDI. All in all, distance has smaller impact (in absolute term) on Laos' inward FDI relative to Laos' trade. This result coupled with the statistical insignificance of the estimate of the interaction term between distance and the physical capital to labor ratios in the FDI model indicate that distance is considerably more important for trade and horizontal MNEs dominate.

With respect to relative factor endowments, our estimation results are unlikely to be comparable with the previous studies for two reasons. First, the currently employed theoretical framework clearly distinguishes between internationally mobile physical capital in terms of FDI and immobile human capital. Because the model accounts for both relative physical and human capital endowments, it is specified differently from the previous works, such as Blonigen et al. (2002), Hanson et al. (2001), and Markusen and Maskus (1999, 2002). Second, the dependent variable is represented by FDI flows rather than affiliate sales (or foreign production) because the employed theoretical model concentrates on the role of physical capital and supports the analysis of FDI figures.

Laos' exports, imports, and inward FDI are complements with respect to changes in relative physical capital endowment (k). Our estimated model shows that a ceteris paribus increase in k (i.e., a rise in the physical capital endowments of the partner countries relative to Laos) boosts exports, imports, and inward FDI to Laos. More precisely, a 1% increase in the relative physical capital endowment is associated with a rise of 4% in Laos' exports, 3.9% in Laos' imports, and 0.3% in Laos' inward FDI. This empirical result explains the phenomenon in which inward FDI flows to Laos have been concentrated on the resource sector (i.e., electricity and mining) which induce imports of capital goods, and then stimulate exports of goods

from the resource sector to foreign countries. However, Laos' inward FDI and Laos' exports and imports are substitutes with respect to changes in relative human capital and relative labor endowments. More precisely, a 1% increase in the relative human capital endowment is associated with a fall of 2.4% in Laos' exports and 1.3% in Laos' imports, and a rise of 0.4% in Laos' inward FDI, whereas a 1% increase in the relative labor endowment is associated with a fall of 2.6% in Laos' exports and 2.1% in Laos' imports, and a rise of 1.1% (not statistical significance) in Laos' inward FDI These imply that the Lao PDR is trading more with and attracting more FDI from physical-capital-abundant countries on the one hand, and is trading less with and attracting more FDI from human-capital-abundant and unskilled-labor-abundant countries on the other hand.

I additionally include two time-invariant variables, common colonizer and colonial relationship, to identify the impact of historical links on Laos' trade and inward FDI. The positive and statistical significance of the common colonizer's coefficient in all three models of the bilateral flows indicates that for countries which have had a common colonizer with Laos after 1945 trade more and export more capital to Laos than those otherwise. These countries include Algeria, Cambodia, and Vietnam. Furthermore, the coefficient of the colonial relationship is positive and statistically significant in the model of inward FDI flows. There is only France in our sample that has had colonial relationship with Laos after 1945. These results suggest that historical links between Laos and its partners help shape the patterns of trade and inward FDI in Laos. Therefore, any policy aiming to promote trade and inward FDI could be more effective when taking these historical links into account.

5.2.1 Regional Patterns

The literature of international trade and FDI shows that countries trade and invest more with other countries in the same region. The similar result was also found in the empirical work of Eaton and Tamura (1994). However, our empirical result is inconsistent with the previous literature because the geographical distance is included in our models. Table 5.5 illustrates the exponentials of the coefficients of the regional dummy variables, $exp(\mu_i)$, in each of the three models. These coefficients are reported in descending order

Table 5.5: Regional rankings for the FDI-trade linkages with or without factor endowments or distance

With relative factor endowments					
Real bilateral exports		Real bilateral imports		Real bilateral flows of inward FDI	
D_{R8}: Western Europe	5.374	D_{R9}: Oceania	171.773	D_{R9}: Oceania	6.272
D_{R7}: Northern Europe	3.831	D_{R7}: Northern Europe	21.066	D_{R1}: South-Eastern Asia	2.601
D_{R9}: Oceania	0.305	D_{R8}: Western Europe	7.575	D_{R2}: America	2.071
D_{R6}: Eastern Europe	− 0.413	D_{R1}: South-Eastern Asia	0.602	D_{R7}: Northern Europe	1.736
D_{R2}: America	− 0.496	D_{R2}: America	0.203	D_{R6}: Eastern Europe	1.322
D_{R10}: Africa	− 0.801	D_{R6}: Eastern Europe	− 0.45	D_{R8}: Western Europe	1.102
D_{R5}: Western Asia	− 0.913	D_{R3}: Eastern Asia	− 0.514	D_{R3}: Eastern Asia	0.688
D_{R3}: Eastern Asia	− 0.946	D_{R4}: Southern Asia	− 0.686	D_{R4}: Southern Asia	0.556
D_{R1}: South-Eastern Asia	− 0.956	D_{R5}: Western Asia	− 0.801	D_{R5}: Western Asia	0.049
D_{R4}: Southern Asia	− 0.989	D_{R10}: Africa	− 0.944		
Without relative factor endowments					
Real bilateral exports		Real bilateral imports		Real bilateral flows of inward FDI	
D_{R8}: Western Europe	14.424	D_{R1}: South-Eastern Asia	1851.485	D_{R3}: Eastern Asia	19.962
D_{R1}: South-Eastern Asia	7.505	D_{R4}: Southern Asia	351.160	D_{R1}: South-Eastern Asia	6.368
D_{R10}: Africa	3.233	D_{R3}: Eastern Asia	180.491	D_{R9}: Oceania	4.800
D_{R3}: Eastern Asia	2.234	D_{R8}: Western Europe	29.975	D_{R6}: Eastern Europe	3.612
D_{R6}: Eastern Europe	1.665	D_{R9}: Oceania	4.777	D_{R2}: America	3.455
D_{R7}: Northern Europe	0.922	D_{R7}: Northern Europe	4.342	D_{R8}: Western Europe	2.582
D_{R4}: Southern Asia	0.014	D_{R6}: Eastern Europe	2.472	D_{R4}: Southern Asia	1.947
D_{R9}: Oceania	− 0.589	D_{R2}: America	− 0.406	D_{R7}: Northern Europe	1.133
D_{R5}: Western Asia	− 0.745	D_{R10}: Africa	− 0.462	D_{R5}: Western Asia	− 0.401
D_{R2}: America	− 0.773	D_{R5}: Western Asia	− 0.696		
Without distance					
Real bilateral exports		Real bilateral imports		Real bilateral flows of inward FDI	
DR8: Western Europe	4.641	DR1: South-Eastern Asia	423.282	DR1: South-Eastern Asia	175.454
DR7: Northern Europe	4.575	DR9: Oceania	183.346	DR9: Oceania	12.066
DR1: South-Eastern Asia	2.843	DR7: Northern Europe	25.175	DR3: Eastern Asia	8.637
DR6: Eastern Europe	0.462	DR3: Eastern Asia	21.803	DR4: Southern Asia	5.813
DR3: Eastern Asia	0.431	DR4: Southern Asia	9.029	DR7: Northern Europe	2.715
DR9: Oceania	0.366	DR8: Western Europe	6.811	DR6: Eastern Europe	2.376
DR10: Africa	− 0.764	DR6: Eastern Europe	0.368	DR8: Western Europe	1.769
DR5: Western Asia	− 0.816	DR2: America	− 0.564	DR2: America	1.276
DR2: America	− 0.848	DR5: Western Asia	− 0.590	DR5: Western Asia	0.324
DR4: Southern Asia	− 0.908	DR10: Africa	− 0.936		

Source: Author's calculation.

of magnitude. Since Southern Europe is the excluded region in each case, the exponential of its coefficient is equal to 1. The magnitudes of the coefficients can be interpreted as approximately the factor by which trade or investment with that region exceeds that with Southern Europe, once income, distance, factor endowments, and historical links are taken into account.[18]

[18] Income (log of the multiplication of country *i*'s GDP and country *j*'s GDP) is implicitly accounted for because its coefficient is restricted to one and moved to

For example, value of 5.374 in the row for Western Europe (which rises to 14.424 when relative factor endowments are omitted) in the column for exports means that Laos exports more than five times (more than fourteen times) as much to Western Europe as it does to Southern Europe once country characteristics are taken into account.

The main implications from Table 5.5 are the following. Our result indicates that Laos' trade and inward FDI relationships are strongest with Western Europe and Oceania. If regionalism were to play a crucial role in Laos' trade and FDI, South-Eastern Asia should be ranked the first in both trade and investment. Instead, in the upper panel of Table 5.3 it is ranked the ninth for Laos' exports, the fourth for imports, and the second as a source of FDI. Correcting for the effects of income, distance, factor endowments, and historical links Laos' exports are several times greater with countries in Europe than with countries elsewhere, while its imports is mainly from Oceania than with countries elsewhere. Laos' imports are much more regionally concentrated than its exports. As a source of FDI, Oceania also strongly dominates, with Western Europe and South-Eastern Asia far behind.

The East Asian economies, including South-Eastern Asian and Eastern Asian economies, are intensively linked, through both trade and investment with the Lao PDR. However, taking into account income, distance, factor endowments, and historical links, these economies are ranked far behind Western Europe for exports and Oceania for imports. Nonetheless, they are the important sources of Laos' inward FDI in addition to Oceania.

Western European countries are on average more important to Laos as trading partners than other countries. In particular, correcting for the effects of income, distance, factor endowments, and historical links, Laos exports almost eight times more to the average Western European country than the average Oceania country. However, Oceania is much more important as a source of imported goods and FDI.

When the distance is omitted as shown in the lower panel of Table 5.3, South-Eastern Asian are the top key partners for Laos' imports and inward Laos' exports in the model specified with and without distance? Second, why

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left-hand side of equation (4.8). This allows us to express the dependent variable as the ratio of trade or investment to bilateral income.

doesn't Laos export intensively to South-Eastern Asia because it has also been a member of ASEAN since 1997? The answer to these questions is that the Laos' garment exports to the European market have been granted GSP by the EU.[19] The garment industry in the Lao PDR has been benefited more from the GSP granted by the EU than the AFTA because of its low competitiveness. Nonetheless, this industry should be strengthened in order to survive in the competitive global market. This implies that the benefits provided by the GSP outweigh the costs brought by the geographical distance or transport costs.

5.2.2 FDI-Trade Linkages Suggested by Observed Characteristics

The empirical results (based on Models I.a–III.a) explained at the beginning of this chapter provide some insight about the relationship between trade and FDI in two aspects. The first aspect is that country characteristics including income, distance, factor endowments, and historical links have different impacts on trade and investment relationships. These key results for trade and investment relationship suggest that Laos tends to import more from relative physical-capital-abundant countries and to attract more FDI from such countries, while it imports less from relative human-capital-abundant countries but attracts more FDI from those countries. This finding suggests that at least some inward FDI is associated with larger Laos' imports from relative physical-capital-abundant countries and with smaller Laos' imports from relative human-capital-abundant countries. Foreign investors in Laos, for example, may develop these resources and supply in the local market in Laos. Here inward FDI is associated with larger importing rather than larger exporting.

Furthermore, the estimated elasticities of relative human capital endowment of inward FDI is lower than that of imports and exports (in absolute value) with the latter higher the former. This relationship indicates that foreign investors tend to export more than invest to serve local markets in Laos as their workers are better educated, meanwhile exports from Laos to

[19] Garment is one of the most important products for exports, accounting for 14.8% of total exports in 2009. Almost all of the garment production was exported to the EU, accounting for 12.9% of total exports in 2009.

its trading partners decrease. It also indicates that the tendency of developed countries (i.e., countries that are well endowed with human capital) to be more closed to Laos' exports and imports applies less strongly to Laos' inward FDI.

The second aspect is that the rankings of the various regions as trading partners and as sources of FDI, shown in Table 5.5, are considerably correlated. These correlations indicate that region factors that serve to increase exports and imports also tend to attract FDI and vice versa.

5.2.3 FDI-Trade Linkages Suggested by Residuals

Our empirical results show that the empirical models of trade and FDI have low pseudo R-square. This suggests that other country characteristics, such as national policies and legal system, that we have not accounted for could play an important role in explaining trade flows and investment positions. These uncontrolled factors would induce correlations among the observed errors in our estimated equations. It is, therefore, interesting to examine the extent of the correlations among trade and FDI generated by the unobserved country characteristics.[20]

Table 5.6: Correlation of residuals

	Exports	Imports	Inward FDI
With region dummies			
Exports	1.000	0.426	0.233
Imports	0.426	1.000	0.481
Inward FDI	0.233	0.481	1.000
Without region dummies			
Exports	1.000	0.452	0.241
Imports	0.452	1.000	0.486
Inward FDI	0.241	0.486	1.000

Source: Author's estimation.

Table 5.6 shows the correlation matrix among the (generalized) residuals in the models of Laos' exports, imports, and inward FDI with and without region dummies included as explanatory variables. The off-diagonal elements show the expected impact of a one-standard-deviation shock in one

[20] This question was raised by Eaton and Tamura (1994, p. 502).

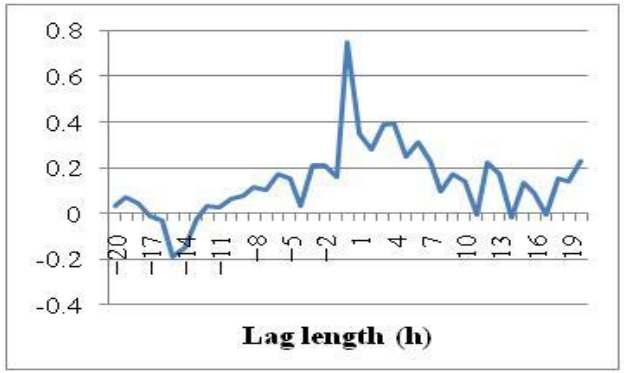
of the variables corresponding to that element on the other variable corresponding to that element, in proportion to its standard deviation. Minus one indicates the minimum possible value, while (positive) one indicates the maximum possible value. A zero value indicates no impact. Therefore, in the upper panel of Table 5.6 the value of 0.233 in the column for inward FDI and the row for exports indicates that a one-standard-deviation increase in exports is associated with one-fourth a standard deviation increase in inward FDI. Similarly, the value of 0.426 in the column for imports and the row for exports indicates that a one-standard-deviation increase in exports is associated with almost half a standard deviation increase in imports.

The estimated models show the following results: first, exports, imports, and inward FDI are positively and highly correlated with each other. An implication is that, despite after scale, income, distance, factor endowments, historical links, and region are accounted for, there is still sizeable bilateralism in economic relationships in these various types of economic interactions that are highly correlated with other by country and over time. More exporting means more importing and means more inward FDI flows.

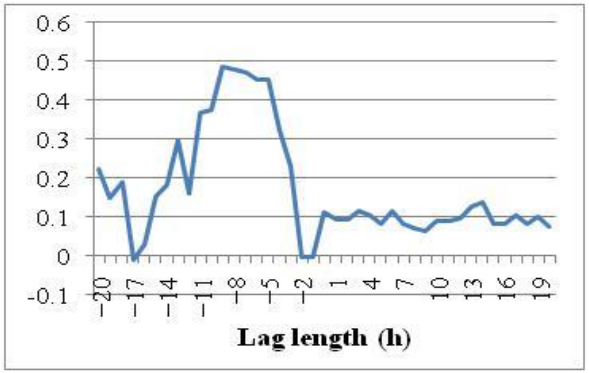
Second, correlation for exports and imports rises by 6.1% when regional impacts are omitted, shown in the lower panel, suggesting that regional patterns add to the extent of overall bilateralism.[21] The correlation for exports and inward FDI and the correlation for imports and inward FDI remain unchanged or change slightly even if regional impacts are excluded, suggesting that regional patterns have no or small impact on the extent of

[21] The economic rationale behind the residual correlations of the gravity model with the inclusion and exclusion of region dummies is that the residuals of gravity model without region dummies are expected to contain unobserved fixed effects (i.e., cultural factors, national policies, etc.) that are not controlled for. Once regional impacts are accounted for by including region dummies into the gravity model, the correlation of estimated residuals for trade and FDI should be smaller than that without region dummies if the regional impacts positively affect trade and FDI interaction, and should be larger than that without region dummies if the regional impacts negatively affect trade and FDI interaction. As a result, the difference between residuals with and without region dummies indicates the net impact of region.

a. Corr{X(t), M(t−h)}



b. Corr{X(t), F(t−h)}



c. Corr{M(t), F(t−h)}

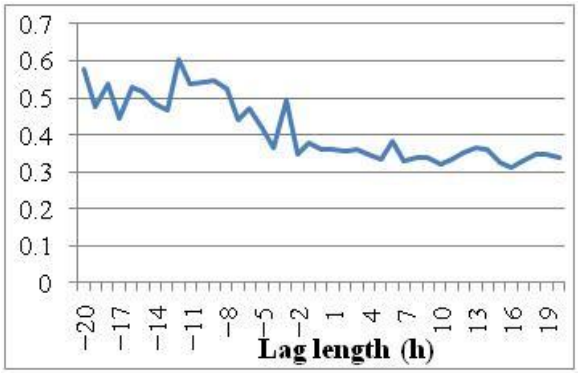
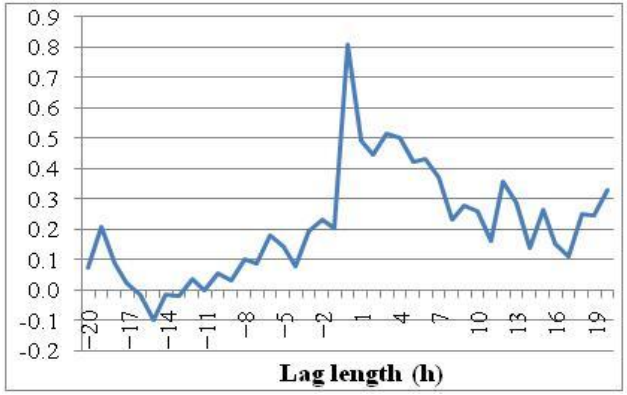
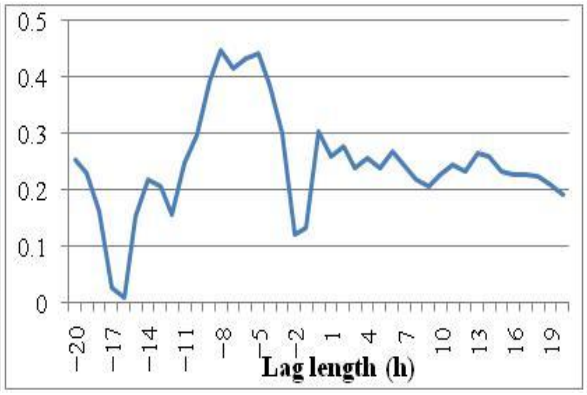


Figure 5.2: Time patterns of residual correlations with region dummies

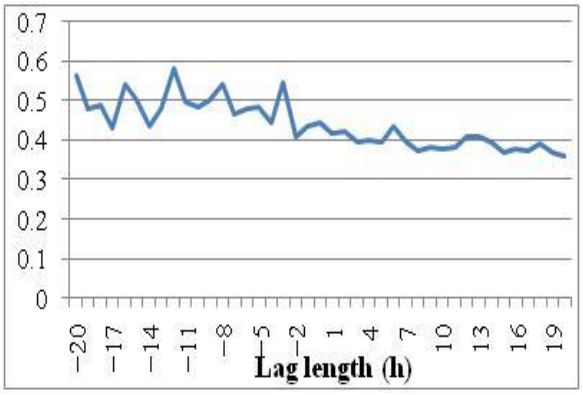
a. Corr{X(t), M(t−h)}



b. Corr{X(t), F(t−h)}



c. Corr{M(t), F(t−h)}



Source: Author's estimation.

Figure 5.3: Time patterns of residual correlations without region dummies

overall bilateralism. Among these three correlations, the correlation for imports and exports is the most sensitive to regional impact.

Third, in the upper panel of Table 5.6 the correlation for inward FDI and imports (0.48) is positive and it is half higher than the correlation for inward FDI and exports (0.23). The analysis, therefore, suggests that inward FDI is associated with a larger trade deficit than with trade in general. This implies that policies that bring down investment barriers in Laos will increase trade with FDI-source countries, and can have a significant impact on the trade balance with them.

The asymmetry in results on the relationships between inward FDI and exports, on one hand, and inward FDI and imports, on the other, reflects the membership of Laos in the large group of countries that serve as the destinations of FDI in the world. Because the home countries for FDI flows to Laos represent a large portion of the countries with whom Laos trade, there is much likely for inward FDI to have an impact on trade patterns.

5.2.4 Timing of Residual Correlations

The contemporaneous correlations between trade and investment residuals were discussed in the previous section. Investigating their correlations across periods can provide additional insights about timing among them. Figures 5.2 and 5.3 illustrate the correlations across different periods between each pair of variables. The correlations have been generated across 21 periods, covering all period in the sample under investigation. Each panel depicts the correlation between the estimated residuals of the two variables demonstrated in the title of the panel, with the second variable listed lagging the first by the number indicated on the horizontal axis. Figure 5.2 reports correlations from regressions that include region dummies, whereas Figure 5.3 excludes them.

Panel b of Figure 5.2 indicates that inward FDI is highly correlated with earlier export. This result suggests that export leads to subsequent inward FDI from the country where it exported.

As shown in panel c of Figure 5.2, the positive correlation for the residuals of imports and inward FDI is moderately high and persistent over time. Hence this panel indicates that the timing of interactions is strong.

This implies that foreign producers serve the local markets in Laos through both trade and investment, each of which could induce one another.

As expected, time patterns of residual correlations without region dummies, shown in panels a–c of Figure 5.3, exhibit the similar patterns, but are slightly higher than those in panels a–c of Figure 5.2. In panel b of Figure 5.3, for example, the correlations for the current value of exports and the current and past values of inward FDI are stable around 0.25, which are higher than those in panel b of Figure 5.2 which are stable around 0.1. Similarly, in panel c of Figure 5.3, the correlations for the current value of imports and the current and past values of inward FDI are stable around 0.4, which are higher than those in panel b of Figure 5.2 which are stable around 0.35. This implies that regionalism increases the likelihood of trade and FDI interaction over time.

5.3 Policy Implications

Market oriented economic reforms together with trade liberalization and massive inflow of FDI during the last two decades have substantially contributed to growth in Laos' trade volume. Due to lack of data, there have not yet any empirical studies on Laos' FDI-trade linkages. In this chapter, the panel causality analysis and the three-factor model are applied to investigate the Laos' FDI-trade linkages using panel data over the period 1989–2009. Both of these analytical tools confirm that there exists positive causality between FDI and trade for the Lao economy.

Four implications can be drawn from the empirical results. One is that a country's characteristics associated with increased trade with the Lao PDR are not necessary to be associated with increased inward FDI flows to the Lao PDR. Trade and FDI are complements with respect to changes in relative physical capital endowment and common colonizer after 1945, whereas they are substitutes with respect to transportation costs, relative human capital endowment, and relative labor endowment. With respect to country characteristics that have been ignored, trade and FDI are complements.

The second implication is related to factors that are linked to Laos' increased exports to a country are also linked to increased imports from that country. Country characteristics, such income, factor endowments, distance, and historical links, affect both exports and imports in the same direction,

resulting in a positive correlation. Although these country characteristics have been accounted for, such correlation remains large. This result indicates that there are other underlying factors resulting in bilateralism in trade relationships that could not be explained by the three-factor model.

The third implication is that neighbor countries are not necessarily the largest trade and investment partners of Laos. Correcting for the effects of income, distance, factor endowments, and historical links Laos' exports are several times greater with countries in Europe than with countries elsewhere, while its imports is mainly from Oceania than with countries elsewhere. Laos' imports are much more regionally concentrated than its exports. As a source of FDI, Oceania also strongly dominates, with Western Europe and South-Eastern Asia far behind. This implies that there is some room to boost trade and attract more FDI from East Asian countries.

The fourth implication is related to trade and FDI promotion policies in the Lao PDR. As indicated by the coefficient of distance, trade costs have a larger negative impact on trade flows than on inward FDI flows. High trade costs coupled with poor logistic performance index in Laos suggest the importance of removing beyond-the-border impediments to trade and investment. It is not enough that Laos opens its markets for foreign investors. What's more critical is to keep them in the country particularly if the intention is to attract export oriented foreign investment. Building the necessary infrastructure support for investment is still crucial. This involves credible efforts to provide an operating environment conducive for transnational operations and reduce high transaction costs associated with inefficiencies in infrastructure. In this regard, launching initiatives on public-private partnerships (PPP) for infrastructure in Laos is encouraging. That is, the collaboration between public and private sectors with clear agreement on shared objectives for delivery of public infrastructure can serve as the key engine of facilitating trade and investment. By doing so, the Lao PDR will be able to enhance not only the competitiveness of domestic firms, but also to attract FDI seeking for the production base. As trade costs become lower, the small country size is no longer the FDI constraint because affiliate production by multinationals could be exported to foreign countries, especially ASEAN countries.

Finally, as indicated by the coefficients of the relative physical capital endowment and relative human capital endowment in the FDI model, the multinationals are physical capital and skilled labor intensive. This suggests that Laos needs to pursue the reform on legal environment relating to FDI and to invest more on human resource development. Further improvements in the legal environment can potentially make Laos a more attractive foreign investment destination. In particular, the Lao government should provide a long-term and consistent policy environment for foreign investors. That is, the favorable environment must be absolutely free from frequent changes. Formulating a single legal framework for regulating all forms of investments and removes discriminatory treatment could provide favorable business climate to prospective investors. Regarding the human capital development, training and re-training of the labor force should continue to be high on the agenda. A number of skilled workers must be trained with well qualified instructors coupled with modern training facilities, which might be done through the co-operation with domestic and foreign expertise. Therefore, improving legal environment and developing human resources are extremely important to reap the full benefits from inward FDI.

However, it is important to note that stimulating exports and inward FDI is associated with an increase in imports because there are causalities between exports, imports, and inward FDI for the Lao economy. This can result in more serious trade deficits which can lead to a depletion of international monetary reserves, currency instability, and a slowdown in economic growth. Consequently, prudent macroeconomic-policy designs are required to pave the way for export-led growth in the Lao economy.

Chapter 6 Impact of Free Trade Agreement in East Asia and Production Efficiency in Laos—Empirical Analysis

6.1 Empirical Analysis of ASEAN+6 Free Trade Area on Laos' Trade

6.1.1 Estimation Results of Trade Determinants in ASEAN+6

To evaluate the potential impact of the formation of ASEAN+6 on Laos' trade, the gravity model of regional trade flows is estimated. Since Laos has intensively traded with East Asian countries, estimated parameters obtained from such gravity model could provide a good approximation on the changing determinants of Laos' trade as well of other countries involved. Table 6.1 reports the dynamic gravity model results of ASEAN+6 in terms of the short-run and long-run impacts.[22] The short-run gravity model is estimated by the one-step system generalized method of moment (system GMM), based on the model specified in equation (4.10) in Chapter 4. Robust standard errors from this estimation are generated on the assumption that there are correlations within each country pair, but not across them. It is, therefore, necessary to estimate the model with time dummies in order to account for universal time-related shocks from the errors (Roodman, 2006, p. 26). The estimated gravity model contains five key variables (sum of bilateral GDP, similarity in country size, distance, difference in relative factor endowment, and tariff rate), and one lagged bilateral export.

Since the system GMM for dynamic panel data model is very complicated and the obtained results could be invalid if some assumptions fail, it is important to interpret the results starting with the model diagnostics. The approach of the system GMM assumes linearity and that the disturbance terms are not serially correlated; that is, the applied instruments in the model are exogenous. As a result, testing for the validity of instruments is crucial in testing the statistical properties of this model. The statistical tests for the system GMM include the following diagnostics. First,

[22] The estimation results of the dynamic gravity models for ASEAN+3 are provided in Table D.1 of Appendix D.

Table 6.1: Dynamic regression results for real bilateral exports of all members in ASEAN+6

Dependent variable: bilateral export	ASEAN+6	
Explanatory variables:	Short-run	Long-run impacts
Constant	− 14.576***	—
	(3.732)	—
Lag one year of bilateral export	0.561***	—
	(0.104)	—
Sum of bilateral country size	0.785***	1.789***
	(0.197)	(0.091)
Similarity in country size	0.548***	1.248***
	(0.134)	(0.079)
Difference in relative factor endowment	− 0.095**	− 0.216***
	(0.041)	(0.075)
Distance	− 0.313***	− 0.712***
	(0.108)	(0.198)
Tariff rate	− 0.088**	− 0.202**
	(0.039)	(0.088)
Number of observations		1721
Number of groups		230
Model degrees of freedom		22
Residual degrees of freedom		229
Number of instruments		39
Wald test for time effects:		
F (16, residual df)		5.34***
F (model df, residual df)		203.63***
RMSE		0.76
Arellano-Bond test for AR(1) in first differences H_0: *There is no first-order serial correlation in residuals*		Z = − 2.95***
Arellano-Bond test for AR(2) in first differences H_0: *There is no second-order serial correlation in residuals*		Z = − 0.66
Hansen J-test of overidentifying restrictions H_0: *Model specification is correct and all overidentified instruments are exogenous*		*Chi2* (16) = 17.67
Difference-in-Hansen tests of exogeneity of GMM instrument subsets: Hansen test excluding system GMM instruments (i.e., the differenced instruments) H_0: *GMM differenced-instruments are exogenous*		*Chi2* (1) = 3.62*
Difference-in-Hansen tests of exogeneity of GMM instrument subsets: H_0: *system-GMM instruments are exogenous and they increase Hansen J-test*		*Chi2* (15) = 14.05
Difference-in-Hansen tests of exogeneity of standard "IV" instrument subsets: *H0: GMM instruments without "IV" instruments are exogenous*		*Chi2* (5) = 4.76
Difference-in-Hansen tests of exogeneity of standard "IV" instrument subsets: H_0: *standard "IV" instruments are exogenous and they increase Hansen J-test*		*Chi2* (11) = 12.90

Notes: *** denotes significance at the 1% level; **, at the 5% level; and *, at the 10% level.

Source: Author's estimation.

the system GMM assumes that there are no serial correlations in the twice-lagged residuals. Autocorrelation in the error terms is, therefore, subject to be tested. According to Arellano and Bond (1991), the GMM estimator requires that there is first-order serial correlation, but that there is no second-order serial correlation in the residuals. Because the null hypotheses are that there is no first-order or second-order serial correlation, it means that one needs to reject the null hypothesis for the test of first-order serial correlation, but not to reject it for the test of second-order serial correlation to get appropriate diagnostics. As shown Table 6.1, those tests support the validity of the model specification.

Second, the *Hansen J-statistic* tests the null hypothesis of correct model specification and over-identifying restrictions (Baum and Schaffer, 2003, p. 16). A rejection of the null hypothesis indicates that either or both assumptions are questionable. Our result of the Hansen test of over-identifying restrictions in Table 6.1 does not reject the null at any conventional level of significance, suggesting that the model has valid instrumentation.

Third, estimating a model with a large set of excluded instruments, the Hansen-Sargan tests for over-identification, used to evaluate the entire set of over-identifying restrictions, may have very little power (Baum and Schaffer, 2003, p. 18). Consequently, it is important to test the validity of subsets of instruments (i.e., levels, differenced, and standard IV instruments). To do so, one can use a difference-in-Sargan/Hansen test, also known as the *C-test*. It is computed as the difference between two Sargan or two *J*-statistics obtained from the model with and without a subset of suspect instruments, enabling investigation of the validity (i.e., exogeneity) of any subset of instruments, as well as their contribution to "the increase in *J-test*" (Roodman, 2007, p. 11). The null hypothesis of the *C-test* assumes that the specified variables are valid instruments, i.e. that the set of examined instruments is exogenous. As illustrated in Table 6.1, the null hypothesis of exogeneity of any GMM instruments could not be rejected, except for the test of the exogeneity of GMM differenced-instruments in 10% level of significance. This suggests that levels and differenced instruments, as well as the standard IV instruments are valid at 5% or 1% level of significance.

Fourth, according to Roodman (2006, p. 26) estimating the model with time dummies could remove universal time-related shocks from the errors and thus, there is no cross-section dependence. Sarafidis et al. (2009) test this by using a combination of the tests of second-order serial correlation in the residuals and difference-in-Hansen. That is, this method investigates whether error cross section dependence is remained after adding time dummy variables into the model. Its null hypothesis is that the cross section dependence is homogenous across pairs of cross section units. Based on our estimated model diagnostics, these two tests fail to reject the null of homogenous cross-section dependence. In contrast, if the same regression is run without time dummies (see Table D.2), the model diagnostics are much worse, indicating evidence of potential heterogeneous cross-section dependence. Furthermore, the *F*-test for time effects is statistically significant. Consequently, inclusion of time dummies in our specification have improved the statistical diagnostics and removed universal time-related shocks from the error term.

Fifth, a large collection of instruments generated by the difference and system GMM estimators can be collectively invalid in finite samples because they overfit endogenous variables and hence, cause bias estimates. Moreover, they reduce the power of the Hansen test of overidentifying restrictions, which is usually used to check instrument validity (Roodman, 2007). To control for the number of instruments, researchers have applied two principle techniques. The first technique is to use only certain lags rather than all available lags for instruments. The second technique is to combine instruments through addition into smaller sets. We have applied the second technique in our analysis because it has the potential advantage of retaining more information as all lags are kept, and there is only one lag in our specification so that the first technique cannot be applied to reduce the number of moments. However, there are no exact rules to determine how many instruments is regarded as "too many" (Roodman, 2006; 2007). Some rules of thumb suggest that the number of instruments should not exceed the number of observations, which is our case (39 instruments are less than 1721 observations). Furthermore, the p-value of Hansen *J*-statistic should have a higher value than the conventional 0.05 or 0.10 levels, at least 0.25 is suggested by Roodman (2007, p. 11). In our model, the Hansen *J*-test reports

a p-value of 0.40, which satisfies this rule. Finally, a regression with non-collapsing the set of instruments has been estimated, but this alternative worsens the diagnostics (see Table D.3). In particular, this procedure leads to a lower Hansen p-value, indicating that this number of instruments is optimal.

Finally, the *F*-statistics in the short-run impact is statistically significant at conventional levels, indicating that our model can be used to determine bilateral trade flows in ASEAN+6.

According to the various statistical tests that have been implemented, it may be reasonable to say that there is enough evidence to conclude that the examined statistical tests satisfy the principle assumptions of system GMM estimation and that this model is an appropriate statistical generating mechanism.

The results for the short-run impacts obtained from the dynamic gravity model can be interpreted as follows: First, all variables have the expected signs. Second, the model shows a significant positive impact of the N-T-T variables (sum of bilateral GDP, similarity in country size) on bilateral trade. Third, our model supports Linder's hypothesis, captured by the variable of differences in GDP per capita, which states that two countries trade less if they have different levels in GDP per capita and hence different tastes. Fourth, the highly statistical significance of import tariffs indicates that further reduction of tariff barriers can increase trade flows in the proposed trading bloc.

More precisely, the variable of interest (tariff rate) is statistically significant and exerts an economically substantial influence on bilateral trade flows in East Asia. Since this variable is specified as a linear independent variable (without logarithm), while the dependent variable is in logarithmic form, its interpretation is that a one unit reduction in the intra-regional tariff rate causes bilateral trade flows to increase by (0.088*100) = 8.8%, on average, other variables being equal. Or a ten-unit decrease in tariff rate is associated, on average, with an 88% rise in the bilateral trade flows in ASEAN+6.

In comparison to some other dynamic gravity models (e.g., Eichengreen and Irwin, 1998; Bun and Klaassen, 2002; Zarzoso et al., 2009), in our model the speed of adjustment is 2.28, calculated as 1/(1 − 0.561). This

means that it takes more than two years for bilateral trade flows in ASEAN+6 to respond to a change of one variable, holding other variables constant. In other words, the time-horizon over which the determinants of trade change does matter. Consequently, the reduction of tariff rate, for instance, in ASEAN+6 would not come as a stimulus to the performance of bilateral trade flows overnight.

According to many empirical studies utilizing the gravity model to evaluate trade flows, the variable 'distance'—a proxy variable for transport costs—has a negative effect on bilateral trade flows and hence reduces trade flows. In the context of economic integration, especially in this chapter, bilateral trade flow increases by 3.1% for a 10% decrease in transportation costs in ASEAN+6. This evidence suggests that regional trade can be improved by means of comprehensive development of the land transport infrastructure, especially among least developed ASEAN economies.

Using the delta method, both coefficients and standard errors are estimated for the long-run effects in a dynamic panel data model, reported in the second column of Table 6.1. The long-run effect of a covariate is defined to be the sum of the current coefficient divided by one minus the sum of the lagged coefficient on the dependent variable. The long-run impact of income elasticity of exports is 1.79 for ASEAN+6, meaning that bilateral exports are growing faster than income. This international trade phenomenon is explained by New Trade Theory (see Helpman, 1987, p. 69).

Furthermore, long-run impact of the elasticity of the differences in relative factor endowment of exports exhibits negative impact on bilateral export flows and is about 0.22. Nevertheless, it is relatively small. Similarly, the coefficient on the similarity in country size also confirms the importance of similarities of countries involved in the regional trading bloc. This implies that the economic integration can fully be achieved when all member countries have similar level of GDP per capita. Such income convergence cannot automatically be achieved. Rather it requires the transfer of resources from the rich countries to the poor countries and/or the coordination of macroeconomic policies among countries in the region. Eventually, political

integration is required as the main driver of the deepening regional integration in East Asia in the form of monetary union.[23]

Finally, the coefficient of tariff variable is negative and statistically significant at any conventional level. The statistical significance and negative sign of tariff coefficient indicate that a reduction in tariff barrier can increase trade flows. More precisely, the long-run impact of import tariffs is 20.2%. This implies that the regional trade integration would enhance trade flows and monetary integration in East Asia.[24] That is, the expansion in regional trade is expected to produce market pressures for stabilizing bilateral exchange rates of East Asian currencies and thus could lead to the search for a collective exchange rate mechanism.

6.1.2 Robustness Analysis for Gravity Models of ASEAN+6

In order to confirm the empirical results in Section 6.1.1, three robustness analyses have been conducted in terms of both dynamic and static models. These analyses use three estimators for panel data analyses, including the ordinary-least-squares (OLS) estimator, the fixed-effects estimator, and the random-effects estimator.

First, Table 6.2 provides the results from re-estimating the model in Table 6.1 applying the OLS instead of the system GMM to equation (4.10) in Chapter 4; note that the dynamic gravity model estimated by the OLS does

[23] Some literatures on the monetary integration in East Asia include Kenen and Meade (2008), Aminian (2005), Nasution (2005), Hamada et al. (2009), and Rana et al. (2011).

[24] In light with the comments of an anonymous referee of the Asian Economic Journal, the author also conducted alternative model specifications including the financial variables, such as the bilateral exchange rate of countries in ASEAN+6. The estimated results show that the exchange rate is not statically significant when year dummies are included, whereas it becomes significant when year dummies are excluded. A possible explanation for the former is that year dummies—proxy variables for business cycle effects—absorb the excluded time-varying variables, including exchange rate. Other estimated coefficients are invariant to the inclusion or exclusion of the exchange rate. The author, therefore, follows the standard approach by including the year dummies.

not involve the transformation using first differencing so that the adjusted sample for the OLS is larger than that for the system GMM. Table 6.2 shows the results from OLS estimation in terms of both the dynamic and static models. The results for all variables' coefficient estimates are robust to this alternative estimation procedure, with tariff rate now having a statistically insignificant effect on bilateral trade flows in the dynamic specification.

Table 6.2: Sensitivity analysis I, ordinary least squares estimation

Dependent variable: bilateral export	OLS	
Explanatory variables:	Dynamic	Static
Constant	− 2.508***	− 37.200***
	(0.721)	(1.348)
Lag one year of bilateral export	0.930***	—
	(0.016)	—
Sum of bilateral country size	0.118***	1.822***
	(0.025)	(0.033)
Similarity in country size	0.081***	1.279***
	(0.018)	(0.029)
Distance	− 0.041*	− 0.837***
	(0.022)	(0.070)
Difference in relative factor endowment	− 0.025***	− 0.199***
	(0.009)	(0.026)
Tariff rate	− 0.031	− 0.140***
	(0.021)	(0.043)
Number of observations	1721	2442
Model degrees of freedom	22	22
Residual degrees of freedom	1698	2419
Wald test for time effects:		
F (19, residual df)	2.32***	7.72***
F (model df, residual df)	2022.92***	205.07***
Adjusted R-squares	0.97	0.72

Source: Author's estimation.

Second, the distance included may not represent all potential trade costs. Gravity-equation analyses have often replaced bilateral distance with country-pair fixed effects. The second and third columns of Table 6.3 present the results of applying country-pair fixed effects, which do not eliminate the distance variable due to the transformation of multilateral resistance term. The result from the static model is also reported side by side of the dynamic model. It is important to note that once again our coefficient estimates in the dynamic model are robust to using country-pair fixed effects, whereas those in the static model provide the correct signs of

parameter estimates, with the exception that the coefficient estimates of difference in relative factor endowment, distance and tariff rate become statistically insignificant.

Table 6.3: Sensitivity analysis II, fixed-effects and random-effects estimations

Dependent variable: bilateral export	Fixed-effects Estimator		Random-effects Estimator	
Explanatory variables:	Dynamic	Static	Dynamic	Static
Constant	− 6.964***	− 21.410***	− 2.855***	− 34.077***
	(3.417)	(7.223)	(0.766)	(2.525)
Lag one year of bilateral export	0.594***	—	0.919***	—
	(0.044)	—	(0.017)	—
Sum of bilateral country size	0.536***	1.581***	0.141***	1.987***
	(0.133)	(0.287)	(0.033)	(0.089)
Similarity in country size	0.035	0.401**	0.095***	1.135***
	(0.146)	(0.248)	(0.022)	(0.088)
Difference in relative factor endowment	− 0.193*	− 0.337	− 0.027*	− 0.225**
	(0.109)	(0.131)	(0.010)	(0.079)
Distance	0.037	0.141	− 0.056**	− 0.193
	(0.075)	(0.097)	(0.027)	(0.106)
Tariff rate	− 0.005*	− 0.032	− 0.038	− 0.046
	(0.030)	(0.031)	(0.026)	(0.031)
Number of observations	1721	2442	1721	2442
Model degrees of freedom	21	21	22	22
Residual degrees of freedom	229	236	229	236
Wald test for time effects:				
$F(q$, residual df)	3.10***	2.97***	283.01***	87.85***
F (model df, residual df)	175.86***	46.46***	—	—
Wald Chi2 (model df)	—	—	58521.53***	1418.43***
R-squares (overall)	0.92	0.55	0.97	0.69

Notes: q equals 15 for the dynamic model of fixed-effects estimator, whereas it equals 16 for the static model fixed-effects estimator and for the static and dynamic models of random-effects estimator.

Source: Author's estimation.

Third, the random-effects estimation is applied to examine whether the gravity equation is still robust when country-pair fixed effects are implicitly accounted for. These results are illustrated in the fourth and fifth columns of Table 6.3. The result from the static model is also reported side by side of the dynamic model. The results for all variables' coefficient estimates are robust to this alternative estimation procedure, with the exception that

tariff's coefficient estimate for both the dynamic and static models become statically insignificant.

6.1.3 Simulation Results for Laos' Trade

In order to make the analysis more realistic, it can be useful to construct monetary estimates of the trade gains that could be associated with reduced import tariffs in East Asia. Attention is restricted to trade between Laos and other members in ASEAN and the 'plus six' countries. To do so, the approach proposed in Wilson et al. (2005) is adopted in this study, in which the estimated coefficients from the gravity model are used as the basis for counterfactual simulations which can be analyzed comparatively. Note that this approach is only intended to provide a broad idea of the relative impacts of different policy reforms, and is subject to several technical issues.

The analysis consists of three possible scenarios. The first scenario involves a cut in the tariff rates to the current regional average of 10.16% so that no country sets its tariff rates over this threshold. This scenario is theoretically considered as if the integration occurs, some countries that set tariff rates higher than the regional average should reduce them to the specified threshold. By doing so, countries that already had tariff rates lower than the threshold are likely to gain from trade, but left some countries that had higher tariff rates to become markets of the proposed integration.

Another option is provided in scenario 2. Scenario 2 performs the same exercise as in scenario 1 for 50% reduction in tariff rates of all countries. In this case, all member countries have to reduce their tariff rates by the specified amount, say 50% of the original tariff rates, regardless the existing tariff rates. By doing so, the integration is likely to boost mutual trade. In order to fully gain from free trade, the integration may move forward to completely remove the tariff barriers of all members. This case is provided by scenario 3 which considers the elimination of tariff barriers of all members. In this case, the ASEAN+6 countries agree to form the free trade agreement in East Asia.

The simulations are conducted as follows. Using 1999–2009 as the base years[25], the tariff rates are recalculated with the condition that those countries over regional average for 1999–2009 have their rates reduced to that threshold. The percentage change in the tariff rate for each country pair can be calculated, and is mapped to an approximate trade impact using the gravity model elasticities. The values of trade are calculated in terms of the annual average value. The annual average value of trade for each country pair is defined as the sum of trade of such country pair over time divided by the number of years that they actually trade.

Table 6.4: Simulation results for trade gains of Laos in the context of ASEAN+6, scenario 1

(In million US$ and percentage change of baseline)

Country	Import Gain	%	Export Gain	%	Trade Balance	%
Cambodia	0.00	0.00	0.00	0.00	0.00	0.00
Indonesia	0.00	0.00	0.00	0.00	0.00	0.00
Malaysia	0.00	0.00	0.00	0.00	0.00	0.00
Philippines	0.00	0.00	0.00	0.00	0.00	0.00
Singapore	0.00	0.00	0.00	0.00	0.00	0.00
Thailand	0.00	0.00	20.50	68.33	20.50	− 11.45
Vietnam	0.00	0.00	30.50	78.61	30.50	− 240.16
China	0.00	0.00	4.90	27.22	4.90	− 5.98
Japan	0.00	0.00	0.00	0.00	0.00	0.00
Korea, Republic of	0.00	0.00	0.00	0.00	0.00	0.00
Australia	0.00	0.00	0.00	0.00	0.00	0.00
India	0.00	0.00	1.41	136.28	1.41	− 15.91
New Zealand	0.00	0.00	0.00	0.00	0.00	0.00
	RMSE = 14%					

Source: Author's estimation.

Results for the three simulations are presented in Tables 6.4–6.6, and are compared in Table 6.7. Root mean squared error (RMSE) associated with each scenario is also reported, which gradually increases with the gradual reduction of the tariff rate. Values of trade flows in these tables are measured by the annual average. Table 6.4 shows the simulation results from

[25] Since our panel data are imbalanced, we cannot take one year as the base year. Instead, we start from 1999 to 2009 because data are mostly available in this period.

scenario 1 for evaluating trade gains of Laos in the context of ASEAN+6. It is important to note that trade impacts estimated using elasticities from the short-run model in Table 6.4 and that sample includes all listed countries (Brunei and Myanmar excepted), for the base years 1999–2009. Simulation involves the cut of tariff rates to the regional average of 10.16%. The results from scenario 1 show that by reducing the tariff rate to the regional average, Laos can benefit from an increase in trade volume by about $57.31 million. This gain is necessarily resulted from an increase in exports to Vietnam, Thailand, China, and India, which improves the trade balance with members of this trading bloc by 15.31% (Table 6.8).

Table 6.5: Simulation results for trade gains of Laos in the context of ASEAN+6, scenario 2

(In million US$ and percentage change of baseline)

Country	Import Gain	%	Export Gain	%	Trade Balance	%
Cambodia	1.35	53.11	0.00	0.00	− 1.35	53.11
Indonesia	3.61	53.19	0.51	36.95	− 3.10	57.38
Malaysia	3.96	54.01	0.60	44.66	− 3.36	56.12
Philippines	1.07	53.63	0.07	25.56	− 1.01	57.85
Singapore	11.00	53.66	0.00	0.07	− 11.00	57.31
Thailand	112.00	53.59	31.00	103.33	− 81.00	45.25
Vietnam	27.60	53.59	42.40	109.28	14.80	− 116.54
China	53.10	53.15	13.40	74.44	− 39.70	48.47
Japan	17.40	53.70	3.00	20.83	− 14.40	80.00
Korea, Republic of	11.60	53.46	0.00	0.00	− 11.60	53.46
Australia	8.80	53.01	0.36	20.98	− 8.44	56.67
India	5.28	53.21	1.46	140.96	− 3.82	42.97
New Zealand	0.96	53.54	0.08	19.54	− 0.88	63.66
	RMSE = 17%					

Source: Author's estimation.

More precisely, the sources of an increase in Laos' exports in this scenario are mainly from its neighboring countries, accounting for 53.2% ($30.5 million) from Vietnam, 35.8% ($20.5 million) from Thailand, and 8.5% of total export gains ($4.9 million) from China. According to the World Bank Group (2010), the simple average of the most-favored-nation tariff rate for primary products in 2006 is 17.7% for Vietnam, 16.1% for Thailand, and 10.7% for China. This indicates that the key export products, namely minerals, coffee, wood and wood products, and garments, from Laos

to these three countries have been impeded and hence further reduction in tariff rates for primary products can generate intra-regional trade gains.

Table 6.5 shows the simulation results from scenario 2 for evaluating trade gains of Laos in the context of ASEAN+6. By reducing the tariff rate by 50%, Laos can benefit from an increase in trade volume by about $351 million. However, it is important to note that import gains exceed export gains, which worsen trade balance between Laos and other member countries by 44.16%. Major sources of Laos' export gains are Vietnam ($42.4 million), Thailand ($31 million), China ($13.4 million), Japan ($3 million), and India ($1.46 million). Major sources of Laos' import gains are Thailand ($112 million), China ($53.1 million), Vietnam ($27.6 million), Japan ($17.4 million), Singapore ($11 million), and Korea ($11.6 million). In this scenario, the bilateral trade balance between Laos and its trading partner will be substantially improved with Vietnam by 105.6%, whereas it will be severely worsened with Japan by 74.6%. As the Lao economy involves in deeper industrialization process, Japan can be an important source of capital goods to Laos.

Table 6.6: Simulation results for trade gains of Laos in the context of ASEAN+6, scenario 3

(In million US$ and percentage change of baseline)

Country	Import Gain	%	Export Gain	%	Trade Balance	%
Cambodia	3.43	134.44	0.00	0.00	− 3.43	134.44
Indonesia	9.21	135.67	1.22	87.65	− 7.99	148.06
Malaysia	9.96	135.79	1.47	109.26	− 8.49	141.75
Philippines	2.73	136.04	0.15	57.72	− 2.57	147.78
Singapore	27.90	136.10	0.00	0.14	− 27.90	145.37
Thailand	284.00	135.89	94.00	313.33	− 190.00	106.15
Vietnam	69.50	134.95	131.20	338.14	61.70	− 485.83
China	136.10	136.24	37.90	210.56	− 98.20	119.90
Japan	44.00	135.80	6.50	45.14	− 37.50	208.33
Korea, Republic of	29.50	135.94	0.00	0.00	− 29.50	135.94
Australia	22.50	135.54	0.79	46.50	− 21.71	145.70
India	13.48	135.87	4.99	480.62	− 8.49	95.61
New Zealand	2.44	135.75	0.18	42.97	− 2.27	163.37
	RMSE = 57%					

Source: Author's estimation.

In order to fully gain from free trade, the integration may move forward to completely remove the tariff barriers of all members. This case is provided by scenario 3. As shown in Table 6.6, Laos can significantly benefit from an increase in trade volume by about $933 million. Again, it is important to note that import gains exceed export gains, which worsen trade balance with members of the trading bloc by 100.8%. Major sources of Laos' export gains are Vietnam ($131.2 million), Thailand ($94 million), China ($38 million), Japan ($6.5 million), and India ($5 million). Major sources of Laos' import gains are Thailand ($284 million), China ($136.1 million), Vietnam ($69.5 million), Japan ($44 million), Singapore ($27.9 million), and Korea ($29.5 million). In this scenario, the bilateral trade balance between Laos and its trading partners will be substantially improved with Vietnam by 485.83%, whereas it will be severely worsened with Japan by 208%. As in scenario 2, Laos will demand more capital goods from Japan to support its industrialization process.

Table 6.7: Comparison of simulation results for trade gains of Laos in the context of ASEAN+3 and ASEAN+6, scenarios 1–3

(In million US$ and percentage change of baseline)

Scenario	ASEAN+3				ASEAN+6			
	Trade Gain	%	Trade Balance	%	Trade Gain	%	Trade Balance	%
Scenario 1	55.90	10.00	55.90	− 16.06	57.31	9.70	57.31	− 15.35
Scenario 2	333.69	59.67	− 151.72	43.58	350.63	59.36	− 164.86	44.16
Scenario 3	888.77	158.94	− 343.88	98.77	933.15	157.98	− 376.35	100.81

Notes: Sample includes all listed countries (Brunei and Myanmar excepted), for the base years 1999–2009. Scenario definitions are as set out above.

Source: Author's estimation.

It may also be useful to aggregate trade gains of Laos in the context of ASEAN+3 and ASEAN+6. The simulation results from scenarios 1–3 are compared in Table 9. Our results indicate that the expected intraregional trade gains from reduced import tariffs for Laos are large. Laos stands to gain from reducing tariffs to the regional average in ASEAN+3 and ASEAN+6 by about 10% ($55.9 million) and 9.7% ($57.3 million), respectively. In this case, trade deficit between Laos and its partners is reduced by 16.1% for ASEAN+3 and 15.35% for ASEAN+6. This implies

that under the current state of the Lao economy, the ASEAN enlargement will bring small static trade gains to Laos. Furthermore, reducing the current regional tariffs by 50% would increase trade gains to Laos in ASEAN+3 by 59.7% ($333.7 million) and by 59.4% ($350.6 million) in ASEAN+6. Finally, eliminating tariffs could increase exports of Laos by a considerable amount: 258.2% ($272.4 million) for ASEAN+3 and 256.2% ($278.4 million) for ASEAN+6. The ASEAN enlargement from ASEAN+3 to ASEAN+6 provides small static gains to Laos' exports because bilateral trade relations between Laos and the three countries, namely, India, New Zealand and Australia, are low relative to other ASEAN+6 countries. In the last two cases, however, trade deficit between Laos and its partners increases by a substantial amount.

6.1.4 Policy Implications

In this section, the dynamic gravity model is estimated using an unbalanced panel of bilateral export flows from ASEAN 10 countries, Australia, China, India, Japan, New Zealand, and South Korea over the period 1992–2009. The bilateral trade determinants of ASEAN+6 are identified on the basis of the New Trade Theory, including overall bilateral country size, relative factor endowment differences, similarity in country size, and transportation costs. The model is also extended to include an additional variable, such as import tariffs. After controlling for time effects, we find that bilateral trade flow is positively related to the overall bilateral country size and similarity in country size, and is inversely related to the relative factor endowment differences, transportation costs, and rates of import tariffs. The empirical results not only support the N-T-T and Linder's hypothesis, but also highlight the importance of reducing gaps in GDP per capita of the member countries to ensure that the full benefit of regional economic integration can be reaped.

The simulation results of this study reinforce the need for ASEAN members and its six counterparts to continue decreasing their tariffs along with their ongoing integration in the regional markets. The formation of East Asian Free Trade Area may be one possible option to bring such substantial gains from trade to its members. However, given the low competitiveness of

the Lao PDR, too much trade liberalization can lead to severe trade deficit between the Lao PDR and other ASEAN+6 countries.

It is important to emphasize that our simulation results, as is the case for all simulation results, are subject to numerous technical caveats as noted by Shepherd and Wilson (2008). One caveat is that the simulated trade impacts take account only of intra-regional effects, but not of potential extra-regional effects. Another caveat is that the fact that the elasticities on which our simulations are based remain constant before and after the policy shock is unlikely to hold for substantial regime shifts.

6.2 Empirical Analyses of Efficiency Externalities of Trade and Foreign Direct Investment in Laos

6.2.1 Specification of Stochastic Frontier Model

The stochastic frontier model for 81 developing countries reduces to a traditional production function model (production function without inefficiency term) if technical inefficiency effects are not present; that is, u_{it} in equation (4.18) in Chapter 4, do not exist in the model. It is possible to test for the absence of the technical inefficiency effects in the model. The test procedure employs a likelihood ratio (LR) statistic. The functional form of the stochastic frontier model can be of Cobb-Douglas or a more flexible translog form. This is also tested applying a LR test. Finally, LR tests are also employed to investigate the presence and nature of technical change modeled through the incorporation of a time trend in the production function. Results of the hypotheses tests are reported in Table 6.8. Critical values for the hypotheses tests are obtained from the appropriate Chi-square distribution.

Table 6.8: Likelihood-ratio tests of null hypotheses in the stochastic frontier production function

Null hypothesis (H_0)	LR-test statistic	Critical value (0.01)	Decision
No inefficiency effects	117.59	16.81	Reject H_0
A Cobb-Douglas function is adequate	288.10	38.93	Reject H_0
There is no technical change	258.75	18.48	Reject H_0
Technical change is Hicks neutral	235.09	16.81	Reject H_0

Source: Author's estimation.

The rejection of the null of no inefficiency effects provides support for the specification of the stochastic frontier model. The translog production frontier is chosen based on the rejection of the Cobb-Douglas function as adequate. This implies that the input and substitution elasticities vary across countries. The hypotheses of no technical change and Hicks neutral technical change are also rejected. As a result, a time trend and its cross-products with conventional factor inputs in the production function are included.

6.2.2 Stochastic Frontier Results: Technical Frontier

The results of the translog stochastic frontier production function for 81 developing countries over the period 1995–2010 are reported in Table 6.9. A total of 19 out of the 30 coefficients (excluding the constant) included in the frontier function are significantly different from zero at the 5% level. Five of the six direct effects, two squared terms, 11 cross-products, and one region dummy have coefficients significantly different from zero. This further indicates the restrictiveness of the Cobb-Douglas specification in this case. Moreover, estimates from many nested models are reported. Whereas the results are quite robust across the alternative specifications, the nested models are rejected based on LR tests. The nested models are, however, useful as auxiliary models to show the robustness of the reported results and to shed light on whether the omission of specific variables is likely to cause bias in the coefficient of others.

The coefficient on the trend variable indicates that the technological progress in terms of non-R&D aspect is decreasing. The coefficient of time squared is positive but not statistically significant, indicating that there is no non-R&D aspect of technical change through time. The coefficient of time interacted with the physical capital stock (K) is positive and statistically significant, suggesting that the non-R&D aspect of technological progress has been physical-capital-saving over this period. In contrast, the coefficients of time interacted with the labor (L) and human capital (HC) are negative and statistically significant, suggesting that the non-R&D aspect of technological progress has been labor-using and human-capital-using over this period. Visually, this indicates that the isoquant shifting inwards at a faster rate over time in the labor-intensive and human-capital-intensive parts of the input space. This is most likely a consequence of the increasing

Table 6.9: Maximum likelihood estimates for the stochastic frontier model

	Main model	Nested models		
		A	B	C
Frontier function[a]				
Constant	2.760***	28.218***	− 2.551	− 9.460**
	(0.764)	(6.517)	(7.091)	(3.997)
K	− 2.389***	− 2.817***	− 2.230***	− 2.457***
	(0.384)	(0.429)	(0.418)	(0.444)
L	2.210***	2.477***	2.309***	2.512***
	(0.253)	(0.251)	(0.252)	(0.252)
HC	0.963	1.631	1.599*	1.692*
	(0.940)	(0.931)	(0.846)	(0.877)
TRD	1.170***	0.012	1.033	1.555***
	(0.236)	(0.505)	(0.638)	(0.453)
FRD	0.558***	0.841***	0.744***	0.828***
	(0.152)	(0.176)	(0.209)	(0.201)
T	− 0.291***	− 0.305***	− 0.334***	− 0.342***
	(0.060)	(0.061)	(0.061)	(0.062)
Cross-product terms				
0.5 K × K	− 0.021	− 0.015	− 0.061	− 0.016
	(0.043)	(0.043)	(0.042)	(0.043)
0.5 L × L	0.140***	0.135***	0.126***	0.133***
	(0.017)	(0.018)	(0.017)	(0.017)
0.5 HC × HC	0.104	0.105	0.269***	0.278***
	(0.101)	(0.107)	(0.097)	(0.100)
0.5 TRD × TRD	− 0.106***	− 0.076***	− 0.089***	− 0.092***
	(0.019)	(0.025)	(0.031)	(0.028)
0.5 FRD × FRD	0.0023	0.0048	0.0094	0.022***
	(0.0064)	(0.0068)	(0.0069)	(0.0081)
0.5 T × T	0.0009	− 0.0007	0.0017*	0.0012
	(0.0009)	(0.001)	(0.001)	(0.0009)
K × L	− 0.092***	− 0.090***	− 0.058**	− 0.074***
	(0.024)	(0.024)	(0.023)	(0.024)
K × HC	− 0.160***	− 0.172***	− 0.168***	− 0.177***
	(0.055)	(0.056)	(0.054)	(0.055)
K × TRD	0.169***	0.179***	0.182***	0.170***
	(0.027)	(0.028)	(0.028)	(0.029)
K × FRD	− 0.020	− 0.025*	− 0.027**	− 0.037***
	(0.013)	(0.013)	(0.013)	(0.014)
K × T	0.014***	0.012***	0.019***	0.017***
	(0.0039)	(0.0042)	(0.0042)	(0.0042)
L × HC	0.194***	0.239***	0.208***	0.243***
	(0.034)	(0.035)	(0.034)	(0.034)
L × TRD	− 0.087***	− 0.098***	− 0.115***	− 0.119***
	(0.019)	(0.019)	(0.018)	(0.019)
L × FRD	0.037***	0.039***	0.041***	0.052***
	(0.0065)	(0.0065)	(0.0065)	(0.0069)
L × T	− 0.011***	− 0.0087***	− 0.013***	− 0.011***
	(0.0022)	(0.0022)	(0.0022)	(0.0022)
HC × TRD	− 0.04	− 0.083	− 0.065	− 0.081
	(0.059)	(0.059)	(0.053)	(0.056)
HC × FRD	0.078***	0.091***	0.073***	0.077***
	(0.020)	(0.021)	(0.020)	(0.021)
HC × T	− 0.026***	− 0.021***	− 0.027***	− 0.027***
	(0.0057)	(0.0058)	(0.0057)	(0.0057)
TRD × FRD	− 0.024**	− 0.033***	− 0.030***	− 0.038***
	(0.010)	(0.010)	(0.011)	(0.012)

Table 6.9 (continued)

	Main model	Nested models		
		A	B	C
Frontier function[a] (continued)				
TRD × *T*	0.0048	0.0061	0.0029	0.004
	(0.0038)	(0.0039)	(0.004)	(0.004)
FRD × *T*	− 0.00037	− 0.00074	− 0.0007	− 0.00024
	(0.0018)	(0.0017)	(0.0018)	(0.0018)
Asia	0.020	− 0.081**	0.017	− 0.096***
	(0.035)	(0.034)	(0.035)	(0.034)
America	0.050	0.076**	0.053	0.048
	(0.035)	(0.036)	(0.036)	(0.034)
Africa	0.127***	0.037	0.179***	0.109***
	(0.040)	(0.043)	(0.042)	(0.041)
Inefficiency model[b]				
Constant	1.689**	9.677***	− 2.022*	− 4.709
	(0.662)	(1.316)	(1.178)	(3.134)
CGI	− 0.077***	− 0.402***	0.109*	0.245*
	(0.028)	(0.058)	(0.060)	(0.144)
FDI	− 0.0025	− 0.015	− 0.038*	− 0.379*
	(0.024)	(0.015)	(0.022)	(0.208)
FMD	0.228***	—	0.243***	—
	(0.024)	—	(0.030)	—
AY	1.256***	1.416***	—	—
	(0.090)	(0.185)	—	—
Variance parameters				
sigmaSq	0.065***	0.067***	0.069***	0.253*
	(0.0027)	(0.0032)	(0.0048)	(0.141)
gamma	0.000000068	0.779***	0.215*	0.787***
	(0.00000028)	(0.118)	(0.124)	(0.124)
Log likelihood	− 26.59	− 36.84	− 49.12	− 73.97
LR test[c]	—	20.49***	45.06***	94.75***

Notes: Standard errors are in parentheses. [a] All continuous variables in the frontier function are in natural logarithms, except the time trend. [b] A negative sign on the coefficient of a z_{it} vector variable represents a reduction in inefficiencies. [c] Compares the log-likelihood of the nested model with that of the main model.

Source: Author's estimation.

relative cost of employing skilled labor as the process of development continues in developing countries. The coefficient of time at the sample mean for all developing countries and at the sample mean for Laos is −0.01 and −0.05, respectively, indicating that the decline of non-R&D aspect of technical progress over the sample period is 1% per year for the developing countries and 5% per year for Laos.

In contrast, the coefficients on the trade and FDI weighted R&D indicate that the R&D aspect of technological progress is rapid. The coefficient of

TRD at the sample mean for all developing countries and at the sample mean for Laos is 0.10 and 0.11, respectively, indicating that the rise of R&D aspect of technical progress with respect to trade over the sample period is 10% per year for the developing countries and 11% per year for Laos. Similarly, the coefficient of *FRD* at the sample mean and at the sample mean for Laos is 0.03 and 0.10, respectively, indicating that the rise of R&D aspect of technical progress with respect to FDI inflows over the sample period is 3% per year for the developing countries and 10% per year for Laos. Taken together the impact of trade and FDI, R&D aspect of technological progress is 13% per year for the developing countries and 21% per year for Laos.

Since the overall technological progress is equal to the sum of non-R&D and R&D aspects, there is rapid technical change. More precisely, the annual average of technological progress is 12% for the developing countries and 16% per year for Laos. Interestingly, it is the contribution of the stock of foreign technical knowledge that explains this positive technological progress.

Table 6.10: Input elasticities of output and elasticity of scale

	K	*L*	*HC*	*TRD*	*FRD*	*RTS*
All countries (1995–2010)	0.630***	0.152***	0.027	0.100**	0.025*	0.934
	(0.052)	(0.034)	(0.100)	(0.043)	(0.019)	
Laos (1995–2010)	0.292***	0.444***	0.242***	0.110***	0.103***	1.191
	(0.037)	(0.029)	(0.080)	(0.028)	(0.018)	
Laos (1995–2000)	0.261***	0.538***	0.442***	− 0.023	0.112***	1.330
	(0.063)	(0.038)	(0.097)	(0.033)	(0.025)	
Laos (2001–2005)	0.248***	0.452***	0.223***	0.169***	0.106***	1.198
	(0.036)	(0.031)	(0.093)	(0.033)	(0.019)	
Laos (2006–2010)	0.394***	0.295***	− 0.035	0.235***	0.085***	0.974
	(0.039)	(0.030)	(0.083)	(0.043)	(0.019)	

Note: standard errors are in parentheses.

Source: Author's estimation.

There is only the coefficient on the region dummy of Africa that is statistically significant. Since the region dummy of Europe was left out of the model, the estimated region dummies are interpreted relative to the developing countries in Europe. The coefficient on the Africa dummy is

0.127, indicating that the developing countries in Africa have higher initial level of technology than those in Europe by about 13%.

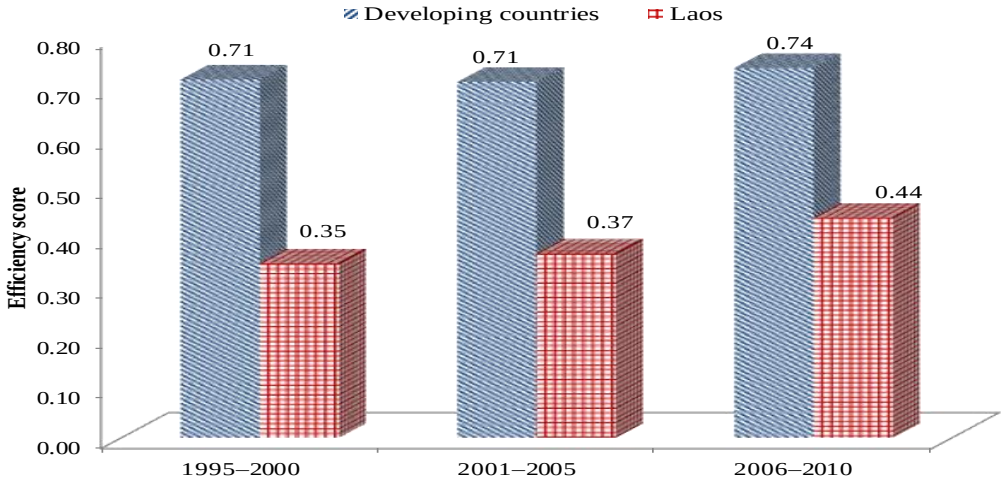
It is convenient to interpret the estimated coefficients of the technical frontier in terms of the input elasticities, and these and returns to scale calculated for all countries and for Laos are presented in Table 6.10. Row 1 of Table 6.10 reports the elasticities evaluated at the mean of the data for the entire period and all countries, while rows 2–5 report them for Laos. The results appear plausible and compare well with those from the previous literature. At the mean for the entire sample the elasticity of output with respect to physical capital is 0.63, for labor 0.15, and for human capital 0.03. The estimated capital elasticity is within the range estimated for developing countries by Koop et al. (1999) and Henry et al. (2009). However, the estimated labor elasticity and returns to scale are lower than that found by Henry et al. (2009). But this difference may result from different group countries and period under examination.

Table 6.10 also shows that Laos receives the large technological contribution to output from foreign R&D through trade and FDI. The contribution of trade is estimated to be 10 percentage points higher than the size of that received for the entire sample of countries as a whole, whereas the contribution of inward FDI is estimated to be substantially higher than that of the entire sample. To gain better understanding on the contribution of foreign R&D to Laos' output, the input elasticities are evaluated at the actual observations for Laos over sub-sample periods. It is found that foreign R&D embodied in capital goods imports contributes to Laos' output the most in the period 2006–2010, whereas that embodied in FDI inflows is quite stable. Indicated by the elasticity of scale, the Laos' production function is characterized by increasing returns to scale. This means that accessing to larger market can bring greater benefit to its entire economy.

6.2.3 Stochastic Frontier Results: Inefficiency Model

To gain better understanding of the efficiency determinants for developing countries, it is important to investigate the inefficiency model. The results are shown in Table 6.9. Because the explained variable in the model is inefficiency, a negative sign on the coefficient of an explanatory variable represents an increase in efficiency. It is found that all variables

have the expected sign, the exception being the variable *FMD* (financial market development). The coefficient on *CGI* is −0.077, indicating that other things being equal, a 10% increase in capital goods imports decreases the inefficiency by 7%. This result points to an influence of international trade on the absorption of and efficiency with which foreign technology is utilized. In particular, an increase in actual levels of machinery imports is shown to raise national efficiency scores. The result is consistent with those of Griffith et al. (2004), Kneller (2005) and Kneller and Stevens (2006) for OECD countries and Henry et al. (2009) for developing countries. The coefficient on *FDI* is not statistically significant but shows a sign of reducing inefficiency. In the case of *AY*, a 10% increase in the share of agriculture in GDP raises the inefficiency score by 12.6%. This confirms the argument that other things being equal, higher agricultural intensity increases distance from the production frontier.



Source: Author's estimation.

Figure 6.1: Comparison of average efficiency score between Laos and developing countries

The estimated coefficient on *FMD* is positive. The negative effect of financial development on growth is also found in Akinlo (2004) who applies an error-correction model to investigate the causality between financial development and growth in Nigeria. This implies that countries with a larger financial market will be less efficient than those that have a smaller financial market, possibly resulting from high capital flight that the financial

market generates. This result suggests that steps to equalize the legal and administrative playing field for domestic investors and to promote a stable macroeconomic environment could contribute to stemming capital flight.

6.2.4 Stochastic Frontier Results: Efficiency Level

Efficiency levels for all developing countries and for Laos can be estimated using equation (4.26) in Chapter 4 and are illustrated in Figure 6.1. As shown in Figure 6.1, the Laos' efficiency score increases from 0.35 for the period 1995–2000 to 0.44 for the period 2006–2010, whereas the efficiency score for all developing countries rises from 0.71 to 0.74 over the same period. It is noticeable that a positive change in production efficiency is rapid since 2000. Based on our estimated efficiency, the technical efficiency change for Laos is about 1.96% per year over the sample period. Among neighboring countries, this performance compares favourably with Thailand (−0.83%, decline per year), Vietnam (−0.2%, decline per year), and China (0.17% increase per year). The Lao rate of technical efficiency improvement is clearly encouraging. Sustaining it over an extended period will also sustain economic growth.

6.2.5 Contribution of Trade and Foreign Direct Investment to Production Efficiency in Laos

Since trade and inward FDI can contribute to efficiency, their contributions are worth considering. Trade in this context is defined to include the influences of trade via changes in the volumes of capital goods imports on efficiency. Similarly, FDI is defined to include the influences of inward FDI on efficiency.

Table 6.11: Contribution of trade and FDI to Laos' production efficiency (%)

Contribution channel	Estimated contribution to efficiency (%)			
	1995–2000	2001–2005	2006–2010	1995–2010
Trade	25.57 (0.87)	26.75 (2.86)	32.46 (2.33)	27.80 (3.54)
FDI inflows	0.20 (0.04)	0.27 (0.11)	0.22 (0.07)	0.23 (0.08)
Trade and FDI inflows	25.62 (0.85)	26.82 (2.88)	32.52 (2.31)	27.86 (3.54)

Note: Standard deviations are in parentheses.

Source: Author's estimation.

Table 6.11 reports the contribution of trade and inward FDI to Laos' production efficiency. Over the period 1995–2010, efficiency score is estimated to be 0.38 and largely contributed by trade (25.6%) relative to the contribution of FDI inflows (0.2%). That is for Laos with a gross efficiency score of 38% over the period 1995–2010, efficiency would be 27.4% were it not for the positive effect that trade has on efficiency levels. Table 5 also identifies the average contribution of trade and FDI for sub-sample periods. There is a suggestion from Table 6.12 that the effect of trade on efficiency has increased with the general tendency for Laos to have become more open to international trade over time. The effect of international trade on Laos' efficiency rose from 25.6% during 1995–2000 to 26.8% during 2001–2005 and to 32.5% during 2006–2010. Consequently, the influence of trade on efficiency and technology transfer is non-negligible, and indicates the important role of trade in enhancing productivity growth in Laos.[26]

However, the effect of inward FDI on Laos' production efficiency is small, estimated to be 0.23% over the sample period. The combined effect of trade and inward FDI on national efficiency in Laos is also small relative to the individual effect of trade. This suggests that the urgent reform is needed to improve the country's absorptive capacity and to attract more FDI inflows.

6.2.6 Policy Implications

Between 1995 and 2010, production efficiency in Laos increased by 31.3% from 0.35 in 1995 to 0.46 in 2010. This occurred even though some of the macroeconomic conditions in Laos worked against the interests of Lao people. The analysis of the relationship between the combined effect of trade and FDI and production efficiency provided in this section suggests that approximately 28% of the average efficiency over the period 1995–2010 can be attributed to opening up a country for international trade and FDI.

Imports of capital goods and FDI inflows grew significantly over the period 1995–2010, but trade balance has been in deficit and most FDI inflows have concentrated on the hydropower and mining sectors. The

[26] See Appendix E for the causality analysis of import-led growth hypothesis in Laos.

analysis provided in this section suggests that this strategy had a high pay-off in terms of improved efficiency and that additional FDI inflows offer the opportunity for further enhancing production efficiency. Furthermore, there is now a high return to allowing capital goods imports for domestic production.

The benefits of increases in capital goods and in inward FDI, measured in terms of efficiency improvement, must of course be compared with its costs. Nevertheless, the results of this study confirm that in a country like Laos, where physical and knowledge capital are primitive, either expanding international trade or attracting FDI or some combination of the two alternatives are effective ways of improving production efficiency.

To some extent, the short-term nature of the analysis of this section produces estimates of the efficiency-increasing effects of trade and FDI that should be regarded as lower bounds. The longer-term dynamic effects of allowing international trade expansion and attracting FDI would include impacts not fully captured by the analysis of this section. Large production efficiency at the national level would be affected. The effects would include the access of a larger variety of intermediate products and capital equipment by many rural people, which enhances the productivity of their own resources. The structure of domestic production would be affected as trade and FDI provide channels of communication that stimulate cross-border learning of production methods, product design, organization methods, and market conditions. The flow of market-related information would be greatly facilitated and economic efficiency would improve. The existence of technological and knowledge externalities embodied in capital goods imports and inward FDI can counterbalance the effects of diminishing returns to capital accumulation and lead to sustained economic growth. Finally, trade and FDI can raise the productivity in the development of new technologies or the imitation of foreign technologies, thereby indirectly affecting the productivity level of the entire economy.

Unfortunately, not all of the effects of increases in trade and FDI would necessarily be positive. In Laos, small and medium-sized enterprises (SMEs) in the manufacturing sector are being set up and can be weakened or forced to go out of the market as FDI increases domestic competition. Furthermore,

since most FDI inflows concentrate on the mining and hydropower, they can lead to the scarcity of water resources for rural people through increased use for mining activities and hydropower development. In addition, importing more capital goods can lead to more severe trade deficit which could result in more macroeconomic vulnerability. Finally, an export-oriented strategy of growth, particularly when a large proportion of minerals export earnings accrue to foreign investors, may not only bias the structure of the economy in the wrong directions by not serving to the real needs of Lao people, but also increase the internal and external dualistic and inegalitarian character of that growth. While the expansion of trade and FDI in Laos has the potential to raise production efficiency, it can cause some forms of macroeconomic instability, environmental deterioration, and income inequality if more prudent macroeconomic policies are not designed and standards of governance are not raised simultaneously.

Conclusions

As a start, the key question is how large FDI affects trade and vice versa, and whether FDI affects exports and imports differently and vice versa. The empirical data provided in Chapter 1 suggest that Laos needed foreign capital to support the national industrialization processes and promote exports. Due to the lack of physical capital, the surge in inward FDI and exports could have led to a dramatic increase in imports as well. In Chapter 5, I conducted the panel causality test between trade and FDI and found that there exist the bidirectional causalities between trade and FDI.

Conclusion 1:

The results of long-run impacts from the panel causality regressions indicate that the contribution of the rising FDI inflows into the Lao economy to trade and vice versa is small, in the range about 0.01% and 0.03% annually on average in the 1989–2009 period.

The knowledge-capital model provides a unified approach to investigate FDI-trade linkages because it allows researchers to identify such linkages through country characteristics and trade costs (JBIC, 2002, p. 48). For this purpose, a three-factor model which is the extension of the knowledge-capital model is adopted in this dissertation. The empirical three-factor model is specified similar to the gravity model, which has become a standard tool of empirical trade analysis during the three decades. Three empirical models for inward FDI, exports, and imports for Laos were formulated on the basis of the theoretical three-factor model. These models were then estimated by the threshold-Tobit method separately using the balanced panel data between Laos and its 67 trading and investing partners in the period 1989–2009. The empirical results suggest the following conclusions:

Conclusion 2:

A country's characteristics associated with increased trade with Laos are not necessary to be associated with increased inward FDI to Laos. Other things being equal, trade and FDI are complements with respect to changes

in relative physical capital endowment and common colonizer after 1945, whereas they are substitutes with respect to distance, relative human capital endowment, and relative labor endowment. With respect to country characteristics that have been ignored, trade and FDI are complements.

It is generally assumed that countries trade more with others in the same region. Our results confirm this view but provide contradicting evidence as the geographical distance is taken into account.

Conclusion 3:

Laos does not necessarily trade more with countries in the same region than others in different regions. Laos' trade and inward FDI relationships are strongest with Western Europe and Oceania. A group of South Eastern Asian countries is ranked the ninth for Laos' exports, the fourth for imports, and the second as a source of FDI, among ten regions.

The empirical results of this dissertation provide some challenges on the theoretical three-factor model as its theoretical explanatory variables could explain only small variations in trade and FDI flows. It left some important variables in the residuals.

Conclusion 4:

Exports, imports, and inward FDI are positively and highly correlated with each other in the cross regression residuals. An implication is that, despite after scale, income, distance, factor endowments, historical links, and region are accounted for, there is still sizeable bilateralism in economic relationships in these various types of economic interactions that are highly correlated with other by country and over time.

The dynamic gravity model for ASEAN+6 performs very well as it provides the correctly predicted signs and all variables are statistically significant.

Conclusion 5:

A dynamic gravity model is an appropriate empirical tool of modeling regional trade flows.

Since the pattern and volume of Laos' trade flows are mainly influenced by regional economic integration, the dynamic gravity model for ASEAN+6 was estimated and the simulations were conducted to evaluate the potential impacts of the deepening economic integration in East Asia, in the context of ASEAN+3 and ASEAN+6.

Conclusion 6:

Bilateral trade flow in East Asia is positively related to the overall bilateral country size and similarity in country size and inversely related to the relative factor endowment differences, transportation costs, and import tariffs.

Conclusion 7:

The formation of free trade area in East Asia could increase export of Laos by a considerable amount: 258.2% ($272.4 million) in the context of ASEAN+3 and 256.2% ($278.4 million) in the context of ASEAN+6. However, these integrations could harm the Laos' trade if all tariff barriers are completely removed due to its low competitiveness.

To further stimulate sustained economic growth, policies to enhance international trade and promote FDI seem a clear means to boost the domestic production and integrate the country into the regional and global economy, and thereby remove Laos from of the list of less developed country. The fact that greater trade openness and more FDI inflows benefit the host country is the theory, but does it actually work in Laos?

Conclusion 8:

International trade and inward FDI flows can serve as carriers of knowledge accumulation from advanced countries to Laos and that the opening up of Lao economy through increased imports of capital goods contributes to

national production efficiency about 28%. However, the contribution of FDI inflows on national production efficiency is only 0.23%, suggesting that there is still much progress to be made to enhance Laos' production efficiency through FDI inflows.

Regarding the policy implications for promoting trade and attracting more foreign direct investment, the empirical results suggest as follows.

Conclusion 9:

In order to enhance trade flows and attract substantial FDI, Laos needs to upgrade infrastructure, develop human resources, and improve legal environment relating to FDI.

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Appendices

Appendix A

Table A.1: Chronology of important economic reforms in the Lao PDR

Year	Stabilization Program		Liberalization Program					
	Fiscal Policy	Monetary Policy	Agricultural Sector	Pric/Exchange Rate (EXR)	Trade	Investment	State-Owned Enterprise & Private Sector	Financial Sector
1979–85			- Collective system discontinued but strengthened later (79).	- Easing control on price and EXR (79).	- Partial elimination of internal trade control (79).		- Easing restriction on private participation (79).	
			- Permission of farmer direct sale to market (79).	- Agricultural procurement price raised (79).	- Abandoning of retail subsidy (79).		- Strenthening and reconstructing SOEs (81+).	
				- Introduction of new EXR for private transactions (85).			- Granting autonomy to SOEs in terms of production levels, investment, employment, and wages (85–88).	
							- Permission on trade granted to mixed and private companies (85–88).	
1986–94	- Implementation of first major tax reform (88).	- Tightening monetary policy (89+).	- Dismantling of cooperatives (87).	- Devaluation of EXR (87).	- Liberalization of internal and external trade system (86+).	- Promulgation of first foreign investment law (88).	- Authorization of private sector to participate in the production and distribution of most goods and services (87–88).	- Establishment of two-tier banking system (88).
	- Expenditure control (88+).		- Strengthening of land right (long term lease) (92+).	- Removal of most retail price control (88).	- Elimination of quantitative restrictions and specific licensing requirements for most goods (91).	- Establishment of FIMC (89).	- Establishment of private sector rights on long-term land rental, autonomy of private firms, and the retention of after-tax profits (88).	- Authorization was provided to state bank to determine and manage the official exchange rate for foreign exchange (89).
	- Implementation of second major tax reform (89).			- EXR unification (88).		- First amendment of foreign investment law (94).	- Privatization of 60 SOEs (89–94).	- Establishment of the central bank (90).
	- Centralized tax and treasury administration (91+).							- Recapitalization of six SOCBs (94).
	- Establishment of national treasury (91).							

Table A.1 (continued)

Year	Stabilization Program		Liberalization Program					
	Fiscal Policy	Monetary Policy	Agricultural Sector	Pric/Exchange Rate (EXR)	Trade	Investment	State-Owned Enterprise & Private Sector	Financial Sector
1995–99	- Expansionary fiscal policy (98).	- Credit expansion (95).		- Adoption of managed floating EXR system with devaluation of domestic currency (95+).	- Membership of ASEAN (97).			
					- Joined AFTA (98+).			
					- Observer of WTO (98+).			
2000+	- Resuming expenditure control (00+).	- Adoption of stabilization program (00+).			- Introduction of one-stop service at cross border checkpoint (03+).	- Second amendment of foreign investment law (04).		
		- Tightening monetary policy (00).			- NTR was granted by the USA (04).	- Third amendment of domestic and foreign investment law (09).		

Note: '+' indicates that the event continues to the present time.

Sources: Compiled from Otani and Pham (1996), Insisienmay (2008), and various papers.

Appendix B

Table B.1: Laos FOF K1: Central government (Billions of Kip)

		Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	Central government																	
3	Gross capital formation	5-6	820	680	740	534	1,037	1,571	973	900	1,414	1,465	1,633	1,885	1,574	1,820	1,160	1,475
5	Capital expenditure, total	ADB	820	680	740	534	1,037	1,571	973	900	1,414	1,465	1,633	1,885	1,574	1,820	1,160	1,475
8	Gross saving	3+11	157	249	342	314	71	363	402	349	652	1,151	1,045	1,280	1,089	942	736	682
11	Surplus/deficit	13+14	− 664	− 432	− 398	− 220	− 966	− 1208	− 572	− 552	− 762	− 314	− 588	− 605	− 485	− 878	− 424	− 792
13	Deficit (-) or surplus		− 664	− 432	− 398	− 220	− 966	− 1434	− 791	− 716	− 924	− 396	− 660	− 459	− 369	− 766	− 349	− 714
14	Lending minus repayments		0	0	0	0	0	226	219	164	162	82	72	− 146	− 116	− 112	− 75	− 79
19	Δ Central government debt, net source	21+22+14-23	664	432	398	220	966	1,434	791	716	924	396	660	459	369	766	349	714
21	Net borrowing: foreign		673	291	351	230	401	745	586	549	608	479	736	435	471	799	603	759
22	Net borrowing: domestic		57	190	43	123	39	238	− 14	2	154	− 166	− 148	170	14	80	− 179	33
23	Δ Central government deposits, asset	reverse sign	66	49	− 4	133	− 526	− 226	0	0	0	0	0	0	0	0	0	0
24	Δ Claims on central government, liability	21+22+14	730	480	394	352	440	1,208	791	716	924	396	660	459	369	766	349	714
26	Δ Private credit, use		0	0	0	0	0	226	219	164	162	82	72	− 146	− 116	− 112	− 75	− 79
30	Δ Miscellaneous and discrepancy source		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
33	Total uses	3+26	820	680	740	534	1,037	1,797	1,193	1,064	1,576	1,547	1,704	1,739	1,458	1,708	1,085	1,396
34	Total sources	8+19+30	820	680	740	534	1,037	1,797	1,193	1,064	1,576	1,547	1,704	1,739	1,458	1,708	1,085	1,396

Sources: Author's calculation based on data from IMF (2006a, 2010), ADB (2011), and UNCTAD (2010).

Table B.2: Laos for K2 (Billions of Kip)

1	Rest of world	Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2	Gross saving	Current account deficit, reverse sign	874	795	718	844	1,601	1,829	1,843	1,862	1,348	1,048	67	671	− 26	474	1,308	1,242
4	Surplus/deficit	2	874	795	718	844	1,601	1,829	1,843	1,862	1,348	1,048	67	671	− 26	474	1,308	1,242
7	Δ Foreign claims, net sources	9-14	− 951	− 1098	− 675	− 527	− 856	− 769	− 714	− 2271	− 1893	− 2476	145	− 299	542	301	414	96
9	Rest of world sources	10+11+12	− 958	− 1103	− 683	− 571	− 952	− 788	− 767	− 2491	− 2078	− 2508	193	− 237	564	524	501	138
10	Monetary authorites, reserves	Reserve assets, reverse sign	− 994	− 867	− 787	− 833	− 1006	− 796	− 842	− 2250	− 2282	− 2882	342	− 32	484	165	135	116
12	Banks, other investment assets	reverse sign	36	− 236	104	262	54	8	75	− 241	205	374	− 149	− 205	80	359	366	22
14	Rest of world uses	15+16	− 7	− 5	− 8	− 45	− 96	− 19	− 53	− 219	− 185	− 32	49	62	22	223	87	42
15	Monetary authorities, other investment liabilities, nie		0	0	0	0	0	− 81	− 93	− 111	− 227	0	0	0	57	2	− 44	− 46
16	Banks, other investment liabilities, nie		− 7	− 5	− 8	− 45	− 96	62	40	− 109	42	− 32	49	62	− 34	222	131	88
18	Δ Central government debt (rest of the world, use)	20+21	− 58	− 83	− 58	− 56	− 47	0	0	0	0	0	530	644	589	892	813	800
20	Ceneral government, other investment assets		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	Ceneral government, other investment liabilities		− 58	− 83	− 58	− 56	− 47	0	0	0	0	0	530	644	589	892	813	800
23	Δ Private credit (rest of the world, use)	25+26+27	212	124	150	236	334	502	849	0	0	0	267	195	37	148	117	179
25	Direct investment in republic economy, net		47	48	50	181	334	502	849	0	0	0	267	195	37	148	117	179
26	Porfolio investment liabilities, net		0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0
27	Other sectors, other investment liabilities nie, net		165	69	92	55	0	0	0	0	0	0	0	0	0	0	0	0
29	Δ Miscellaneous and discrepancy uses	31+32	− 231	− 345	− 50	138	458	558	280	− 409	− 545	− 1428	− 585	− 466	− 110	− 264	792	359
31	Net errors and omissions		− 317	− 416	− 105	80	405	488	94	− 613	− 932	− 1428	− 585	− 466	− 110	− 264	792	359
32	Capital account, nie		86	72	55	58	54	70	186	204	387	0	0	0	0	0	0	0
35	Total uses	18+23+29	− 77	− 303	42	317	745	1,060	1,130	− 409	− 545	− 1428	212	373	516	775	1,722	1,338
36	Total sources	2+7	− 77	− 303	42	317	745	1,060	1,130	− 409	− 545	− 1428	212	373	516	775	1,722	1,338

Sources: Author's calculation based on data from IMF (2006a, 2010), ADB (2011), and UNCTAD (2010).

Table B.3: Laos FOF K3: monetary authorities (Billions of Kip)

1	Monetary authorities:	Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
9	Δ Foreign claims, net asset	11 − 12	5	97	29	89	− 73	107	401	124	250	226	399	102	569	111	132	179
11	Δ Monetary authorities, foreign assets		4	186	77	138	− 11	271	424	663	501	390	347	108	656	114	87	129
12	Δ Monetary authorities, foreign liabilities		− 1	89	48	49	62	163	23	539	251	164	− 52	6	87	2	− 45	− 49
14	Δ Interbank claims, net source	17 − 16	187	29	30	− 51	45	− 19	77	144	271	− 44	151	99	221	116	− 30	30
16	Δ Monetary authorities, claims on deposit money banks		− 187	6	33	165	19	63	33	27	61	270	144	− 89	− 106	− 58	− 4	55
17	Δ Monetary authorities, bank reserve liabilities	18 − 19	0	35	63	113	64	43	111	171	332	226	295	10	115	58	− 34	85
18	Δ Reserve money		19	41	96	201	106	65	117	221	358	244	285	51	210	181	141	168
19	Δ Currency outside deposit money banks		19	6	33	88	42	22	6	50	27	18	− 10	41	95	123	174	84
21	Δ Central government debt, net use	23 − 24	− 11	− 73	− 30	− 99	36	− 39	− 342	− 3	105	− 101	− 435	105	− 323	101	− 37	− 11
23	Δ Claims on central government		− 13	0	44	− 16	25	− 52	0	2	236	131	− 40	24	44	− 4	− 32	45
24	Δ Central government deposits + Δ Government lending funds		− 2	73	75	83	− 11	− 13	342	5	131	232	394	− 81	368	− 105	5	56
26	Δ Private credit, net uses	28+29	− 106	− 37	5	11	38	57	43	353	237	222	122	136	84	− 47	34	− 226
28	Δ Claims on nonfinancial public enterprises		− 92	− 24	− 1	− 5	8	34	22	235	145	135	122	130	64	− 31	34	− 210
29	Δ Claims on Private Sector		− 14	− 13	7	16	30	23	20	118	92	87	0	7	20	− 16	0	− 16
30	Δ Money and quasi-money, source	32	19	6	33	88	42	22	6	50	27	18	− 10	41	95	123	174	84
32	Δ Currency liabilities		19	6	33	88	42	22	6	50	27	18	− 10	41	95	123	174	84
34	Δ Miscellaneous and discrepancy sources	36+37	− 319	− 48	− 59	− 36	− 86	123	19	281	294	374	− 54	203	15	− 73	− 16	− 172
36	Δ Monetary authorities, capital accounts		37	4	− 4	− 4	11	74	− 7	320	221	346	6	221	108	42	37	− 321
37	Δ Monetary authorities, other items, net liabilities		− 356	− 52	− 55	− 31	− 97	49	26	− 39	73	27	− 60	− 18	− 93	− 116	− 54	149
39	Total uses	9+21+26	− 112	− 12	4	1	1	125	102	475	591	347	87	344	330	165	129	− 59
40	Total sources	14+30+34	− 112	− 12	4	1	1	125	102	475	591	347	87	343	330	165	129	− 59

Sources: Author's calculation based on data from IMF (2006a, 2010), ADB (2011), and UNCTAD (2010).

Table B.4: Laos FOF K4: deposit money banks (Billions of Kip)

	Deposit money banks	Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
9	Δ Foreign claims, net asset	11 − 12	7	− 79	97	218	− 41	21	53	206	489	705	− 135	− 215	183	178	210	− 41
11	Δ Deposit money banks, foreign assets		23	− 230	105	263	55	141	94	353	739	842	− 67	− 191	581	98	364	67
12	Δ Deposit money banks, foreign liabilities		16	− 151	8	45	96	120	41	147	251	137	67	24	398	− 80	154	108
14	Δ Interbank claims, net use	17 − 16	209	73	29	− 15	3	5	46	78	284	− 52	110	120	291	185	− 39	− 43
16	Δ Deposit money banks, credit from monetary authorities, liabilities		− 191	− 42	41	159	43	45	41	11	82	284	175	− 96	− 107	− 63	− 44	31
17	Δ Deposit money banks, reserves, assets		18	31	70	143	45	51	87	89	367	232	286	23	184	122	− 83	− 12
19	Δ Central government debt, net use	21 − 22	2	126	− 24	− 4	188	− 67	79	− 64	− 191	− 207	164	46	44	153	− 2	0
21	Δ Claims on central government		6	0	0	0	211	− 49	114	8	− 8	− 32	− 4	20	32	184	21	66
22	Δ Central government deposits		4	− 126	24	4	23	18	36	71	183	175	− 167	− 26	− 12	31	22	65
24	Δ Private credit, net uses	26+27	157	− 2	119	232	214	207	166	679	717	462	421	465	11	− 125	150	347
26	Δ Claims on nonfinanical public enterprises		126	− 166	− 22	9	− 15	34	31	168	136	135	75	211	31	− 118	14	51
27	Δ Deposit money banks, other claims on private sector		31	164	141	223	229	174	135	511	581	326	346	254	− 21	− 7	136	296
30	Money and quasi-money, source	32+33	31	65	195	332	274	157	292	729	1,225	809	717	243	695	388	422	77
32	Δ Deposit money banks, demand deposit, liabilities		− 7	26	31	59	29	16	43	− 29	216	43	131	− 14	83	57	65	44
33	Δ Deposit money banks, time, savings, etc. liabilities		37	39	164	273	244	141	250	758	1,010	766	586	256	612	331	356	33
35	Δ Miscellaneous and discrepancy source	37+38	344	54	25	98	89	10	50	170	74	98	− 156	173	− 167	2	− 103	187
37	Δ Deposit money banks, capital accounts		29	16	63	161	107	60	57	292	243	294	63	49	− 71	− 206	− 92	80
38	Δ Deposit money banks, other items, net		316	38	− 38	− 63	− 18	− 50	− 7	− 122	− 169	− 196	− 219	124	− 96	209	− 11	108
40	Total uses	9+14+19+24	375	119	221	430	363	167	343	899	1,299	907	561	416	528	390	319	264
41	Total sources	30+35	375	119	221	430	363	167	342	899	1,299	907	561	416	528	390	319	264

Sources: Author's calculation based on data from IMF (2006a, 2010), ADB (2011), and UNCTAD (2010).

Table B.5: Laos FOF K5: discrepancy estimates (Billions of Kip)

		Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	Δ Foreign claims, discrepancy source, net	3+8	963	1,116	801	833	742	897	1,167	2,601	2,631	3,407	120	185	210	− 11	− 72	42
3	Δ Foreign assets, discrepancy source	4+5− 6	985	1,059	865	972	996	1,199	1,284	3,507	3,318	3,740	86	153	673	− 312	− 50	58
4	Monetary authorities, Δ foreign assets	K3/11	4	186	77	138	− 11	271	424	663	501	390	347	108	656	114	87	129
5	Deposit money banks, Δ foreign assets	K4/11	23	− 230	105	263	55	141	94	353	739	842	− 67	− 191	581	98	364	67
6	Rest of world, Δ foreign liabilities	K2/9	− 958	− 1103	− 683	− 571	− 952	− 788	− 767	− 2491	− 2078	− 2508	193	− 237	564	524	501	138
8	Δ Foreign liabilities, discrepancy source	11 − 9 − 10	− 22	57	− 63	− 139	− 253	− 302	− 117	− 905	− 687	− 333	33	32	− 463	301	− 23	− 17
9	Monetary authorities, Δ foreign liabilities	K3/12	− 1	89	48	49	62	163	23	539	251	164	− 52	6	87	2	− 45	− 49
10	Deposit money banks, Δ foreign liabilities	K4/12	16	− 151	8	45	96	120	41	147	251	137	67	24	398	− 80	154	108
11	Rest of world, Δ foreign assets	K2/14	− 7	− 5	− 8	− 45	− 96	− 19	− 53	− 219	− 185	− 32	49	62	22	223	87	42
13	Δ Interbank claims, discrepancy source	15+19	22	44	− 1	36	− 43	25	− 32	− 66	14	− 7	− 41	21	70	69	− 9	− 73
15	Δ Monetary authorities, credit to deposit money banks, discrepancy	16 − 17	4	48	− 8	6	− 24	17	− 8	16	− 21	− 14	− 32	7	1	5	40	24
16	Monetary authorities, credit to deposit money banks, use	K3/16	− 187	6	33	165	19	63	33	27	61	270	144	− 89	− 106	− 58	− 4	55
17	Deposit money banks, credit from monetary authorities, source	K4/16	− 191	− 42	41	159	43	45	41	11	82	284	175	− 96	− 107	− 63	− 44	31
19	Δ Bank reserves, discrepancy source	21 − 20	18	− 4	7	30	− 19	7	− 24	− 82	35	6	− 9	14	69	64	− 49	− 96
20	Monetary authorities, bank reserves, source	K3/17	0	35	63	113	64	43	111	171	332	226	295	10	115	58	− 34	85
21	Deposit money banks, bank reserves, use	K4/17	18	31	70	143	45	51	87	89	367	232	286	23	184	122	− 83	− 12
23	Δ Central government debt, discrepancy source	25+29	− 666	− 271	− 512	− 240	− 985	− 975	− 963	− 625	− 921	− 887	− 433	316	− 238	167	182	− 81
25	Δ Claims on central government, discrepancy source	27 − 26	− 730	− 374	− 409	− 286	− 447	− 745	− 586	− 549	− 608	− 479	− 206	209	118	93	210	41
26	Central government, net borrowing, foreign	K1/21	673	291	351	230	401	745	586	549	608	479	736	435	471	799	603	759
27	Rest of the world, central government debt, use	K2/18	− 58	− 83	− 58	− 56	− 47	0	0	0	0	0	530	644	589	892	813	800
29	Δ Central government deposits, discrepancy source	30 − 31 − 32	64	103	− 103	46	− 538	− 231	− 378	− 76	− 313	− 407	− 227	107	− 356	74	− 28	− 122
30	Δ Central government deposits, asset	K1/23	66	49	− 4	133	− 526	− 226	0	0	0	0	0	0	0	0	0	0
31	Δ Monetary authorities, central government deposits, liabilities	K3/24	− 2	73	75	83	− 11	− 13	342	5	131	232	394	− 81	368	− 105	5	56
32	Δ Deposit money banks, central government deposits, liabilities	K4/22	4	− 126	24	4	23	18	36	71	183	175	− 167	− 26	− 12	31	22	65
34	Δ Miscellaneous and discrepancy source	minus (1+13+23)	− 319	− 889	− 288	− 629	286	54	− 172	− 1910	− 1724	− 2513	354	− 522	− 42	− 225	− 100	112
37	Total sources	1+13+23+34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sources: Author's calculation based on data from IMF (2006a, 2010), ADB (2011), and UNCTAD (2010).

Table B.6: Laos FOF K6: private sector[1] (Billions of Kip)

	Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1 Private sector																	
2 Gross capital formation, private Sector	4 − 5	− 47	133	42	310	− 84	− 556	148	288	− 194	− 169	1,090	1,815	2,229	2,516	4,118	4,284
4 Gross capital formation, total	UNCTAD	774	813	782	844	953	1,015	1,122	1,188	1,221	1,296	2,723	3,700	3,802	4,336	5,277	5,758
5 Gross capital formation, central government	K1/3	820	680	740	534	1,037	1,571	973	900	1,414	1,465	1,633	1,885	1,574	1,820	1,160	1,475
7 Gross saving, private sector	9 − 10 − 11 − 12	− 257	− 230	− 278	− 314	− 719	− 1177	− 1123	− 1023	− 779	− 903	1,611	1,748	2,740	2,920	3,234	3,834
9 Gross saving, total	4	774	813	782	844	953	1,015	1,122	1,188	1,221	1,296	2,723	3,700	3,802	4,336	5,277	5,758
10 Gross saving, rest of world	K2/2	874	795	718	844	1,601	1,829	1,843	1,862	1,348	1,048	67	671	− 26	474	1,308	1,242
11 Gross saving, central government	K1/8	157	249	342	314	71	363	402	349	652	1,151	1,045	1,280	1,089	942	736	682
12 Gross saving, monetary authorities + deposit money banks	K3/4+K4/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14 Surplus/deficit, private sector	7 − 2	− 211	− 364	− 319	− 624	− 636	− 621	− 1271	− 1311	− 586	− 734	521	− 66	511	404	− 884	− 450
17 Δ Central government debt, private sector, use	19	64	190	− 1	139	− 196	564	91	157	88	− 182	− 32	− 20	− 178	− 213	− 243	− 156
19 Δ Claims on central government, private sector, use	21+25 − 22 − 23 − 24	64	190	− 1	139	− 196	564	91	157	88	− 182	− 32	− 20	− 178	− 213	− 243	− 156
21 Δ Claims on central government, central government liabilities	K1/24	730	480	394	352	440	1,208	791	716	924	396	660	459	369	766	349	714
22 Δ Claims on central government, monetary authorities	K3/23	− 13	0	44	− 16	25	− 52	0	2	236	131	− 40	24	44	− 4	− 32	45
23 Δ Claims on central government, deposit money banks	K4/21	6	0	0	0	211	− 49	114	8	− 8	− 32	− 4	20	32	184	21	66
24 Δ Claims on central government, rest of world	K2/18	− 58	− 83	− 58	− 56	− 47	0	0	0	0	0	530	644	589	892	813	800
25 Δ Claims on central government, discrepancy source	K5/25	− 730	− 374	− 409	− 286	− 447	− 745	− 586	− 549	− 608	− 479	− 206	209	118	93	210	41
27 Δ Private credit, private sector source, net	35+29	263	86	275	479	585	993	1,277	1,196	1,115	766	882	650	16	− 137	226	221
29 Δ Bank claims on nonbank financial institutions, private sector source	31+32	20	− 203	− 17	20	23	91	74	522	373	357	197	347	115	− 165	48	− 175
31 Δ Monetary authorities claims on nonbank financial institutions, use	K3/(28+29)	− 106	− 37	5	11	38	57	43	353	237	222	122	136	84	− 47	34	− 226
32 Δ Deposit money banks claims on nonbank financial institution, use	K4/26	126	− 166	− 22	9	− 15	34	31	168	136	135	75	211	31	− 118	14	51
35 Δ Other private credit, private sector source	37+38+39	243	289	291	459	563	902	1,203	675	743	409	685	303	− 99	28	179	396
37 Δ Private credit, central government use	K1/26	0	0	0	0	0	226	219	164	162	82	72	− 146	− 116	− 112	− 75	− 79
38 Δ Private credit, deposit money banks use	K4/27	31	164	141	223	229	174	135	511	581	326	346	254	− 21	− 7	136	296
39 Δ Private credit, rest of world use	K2/23	212	124	150	236	334	502	849	0	0	0	267	195	37	148	117	179

Note: [1]The private sector includes the entire economy other than the sectors enumerated on K1 to K4. It thus includes provincial and local government, nonbank financial institutions, nonprofit institutions, all nonfinancial business including government enterprises, and households.

Sources: Author's calculation based on data from IMF (2006a, 2010), ADB (2011), and UNCTAD (2010).

Table B.7: Laos FOF K7: private sector (Billions of Kip)

		Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	Δ Money and quasi-money, private sector use	3+8	50	71	228	420	316	179	298	779	1,252	827	707	284	789	510	596	160
3	Δ Currency and demand deposits	5+6	13	32	64	147	72	38	48	21	242	61	121	27	177	180	240	128
5	Δ Currency and demand deposits, monetary authorities liabilities	K3/32	19	6	33	88	42	22	6	50	27	18	− 10	41	95	123	174	84
6	Δ Currency and demand deposits, deposit money banks liabilities	K4/32	− 7	26	31	59	29	16	43	− 29	216	43	131	− 14	83	57	65	44
8	Δ Time, savings, etc. deposits, deposit money banks liabilities	K4/33	37	39	164	273	244	141	250	758	1,010	766	586	256	612	331	356	33
11	Δ Miscellaneous and discrepancy, private sector source	minus (13+14+15+16-17)	62	538	272	704	169	372	384	1,050	811	613	− 729	− 320	84	31	1,011	232
13	Δ Miscellaneous and discrepancy, central government source	K1/30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Δ Miscellaneous and discrepancy, monetary authorities source	K3/34	− 319	− 48	− 59	− 36	− 86	123	19	281	294	374	− 54	203	15	− 73	− 16	− 172
15	Δ Miscellaneous and discrepancy, deposit money banks source	K4/35	344	54	25	98	89	10	50	170	74	98	− 156	173	− 167	2	− 103	187
16	Δ Miscellaneous and discrepancy, source	K5/34	− 319	− 889	− 288	− 629	286	54	− 172	− 1910	− 1724	− 2513	354	− 522	− 42	− 225	− 100	112
17	Δ Miscellaneous and discrepancy, rest of world use	K2/29	− 231	− 345	− 50	138	458	558	280	− 409	− 545	− 1428	− 585	− 466	− 110	− 264	792	359
20	Total uses, private sector	K6(2+17)+K7/1	68	394	269	869	35	187	538	1,224	1,147	476	1,765	2,079	2,840	2,814	4,471	4,288
21	Total sources, private sector	K6(7+27)+K7/11	68	394	269	869	35	187	538	1,224	1,147	475	1,765	2,079	2,840	2,814	4,471	4,287
25	Memo: Lao gross domestic product, constant prices (2000=100)	IMF	7171	7458	7980	8448	9137	9781	10455	11177	11667	12149	12918	13515	14442	15339	16416	17527
26	Lao GDP deflator	IMF	0.09	0.1	0.11	0.12	0.13	0.15	0.17	0.21	0.37	0.82	1	1.1	1.22	1.39	1.53	1.65

Sources: Author's calculation based on data from IMF (2006a, 2010), ADB (2011), and UNCTAD (2010).

Appendix C

Table C.1: Mean years of schooling of adults, 1989–2009

No.	Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	Algeria	3.1	3.3	3.5	3.7	3.8	4.0	4.3	4.5	4.7	5.0	5.2	5.5	5.7	5.8	6.0	6.2	6.4	6.6	6.7	6.9	7.1
2	Argentina	7.8	7.9	8.0	8.0	8.1	8.2	8.2	8.3	8.4	8.5	8.5	8.6	8.7	8.7	8.8	8.8	8.9	9.0	9.0	9.1	9.2
3	Australia	11.7	11.7	11.7	11.7	11.8	11.8	11.8	11.8	11.8	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	12.0	12.0	12.0	12.0
4	Austria	8.2	8.3	8.4	8.5	8.5	8.6	8.7	8.8	8.9	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.6	9.6	9.7	9.7
5	Bangladesh	2.8	2.9	3.0	3.0	3.1	3.2	3.3	3.4	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.7
6	Barbados	7.9	8.1	8.2	8.2	8.3	8.3	8.4	8.5	8.5	8.6	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.2	9.2	9.3	9.3
7	Belgium-Luxembourg	9.0	9.1	9.2	9.2	9.3	9.4	9.5	9.5	9.6	9.7	9.8	9.9	9.9	10.0	10.1	10.2	10.3	10.3	10.3	10.3	10.4
8	Brazil	3.2	3.3	3.5	3.7	3.8	4.0	4.3	4.5	4.7	5.0	5.2	5.5	5.7	5.9	6.1	6.4	6.6	6.7	6.8	6.9	7.1
9	Bulgaria	8.9	9.0	9.0	9.1	9.1	9.2	9.2	9.3	9.3	9.4	9.4	9.5	9.5	9.6	9.6	9.7	9.7	9.7	9.8	9.8	9.9
10	Cambodia	5.3	5.3	5.3	5.4	5.4	5.5	5.5	5.5	5.6	5.6	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.8
11	Canada	10.2	10.3	10.4	10.5	10.5	10.6	10.7	10.8	10.9	10.9	11.0	11.1	11.1	11.2	11.2	11.3	11.3	11.4	11.4	11.4	11.5
12	Chile	7.9	8.1	8.2	8.2	8.3	8.4	8.4	8.5	8.6	8.7	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.5	9.6
13	China	4.8	4.9	5.0	5.2	5.4	5.5	5.7	5.9	6.0	6.2	6.4	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.3	7.4
14	Colombia	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.4	6.5	6.6	6.6	6.6	6.7	6.7	6.7	6.9	7.0	7.2	7.3
15	Costa Rica	6.7	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.7	7.8	7.9	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.1	8.2	8.3
16	Cyprus	8.5	8.7	8.7	8.7	8.8	8.8	8.8	8.8	8.8	8.9	8.9	8.9	8.9	8.9	9.0	9.0	9.0	9.2	9.4	9.5	9.7
17	Denmark	9.5	9.6	9.6	9.7	9.7	9.8	9.8	9.8	9.9	9.9	10.0	10.0	10.0	10.0	10.1	10.1	10.1	10.2	10.2	10.2	10.3
18	Dominican Republic	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.9	6.0	6.1	6.2	6.3	6.3	6.4	6.5	6.6	6.6	6.7	6.8
19	Egypt	3.3	3.5	3.6	3.7	3.8	3.9	4.1	4.2	4.3	4.4	4.6	4.7	4.9	5.0	5.2	5.4	5.6	5.8	5.9	6.1	6.3
20	Estonia	9.2	9.3	9.5	9.7	10.0	10.2	10.4	10.7	10.9	11.2	11.4	11.7	11.7	11.8	11.8	11.9	11.9	11.9	11.9	12.0	12.0
21	Finland	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.6	8.9	9.3	9.8	10.2	10.2	10.2	10.2	10.3
22	France	7.0	7.1	7.3	7.5	7.7	7.9	8.1	8.3	8.6	8.8	9.1	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0	10.2	10.3
23	Germany	7.8	8.1	8.3	8.5	8.8	9.0	9.2	9.5	9.7	10.0	10.2	10.5	10.8	11.2	11.5	11.9	12.3	12.2	12.2	12.2	12.2
24	Greece	7.8	7.9	8.0	8.0	8.1	8.2	8.2	8.3	8.4	8.5	8.5	8.6	8.8	9.1	9.3	9.5	9.8	9.9	10.1	10.2	10.4
25	Hong Kong	8.3	8.5	8.4	8.4	8.3	8.2	8.1	8.1	8.0	7.9	7.9	7.8	8.1	8.4	8.7	9.1	9.4	9.5	9.7	9.8	9.9

Table C.1 (continued)

No.	Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
26	Hungary	8.9	8.9	9.1	9.3	9.5	9.8	10.0	10.2	10.5	10.7	10.9	11.2	11.3	11.3	11.4	11.4	11.5	11.5	11.5	11.6	11.6
27	Iceland	8.3	8.4	8.5	8.6	8.7	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.7	9.8	9.9	10.0	10.1	10.2	10.3
28	India	2.9	3.0	3.1	3.1	3.2	3.2	3.3	3.3	3.4	3.5	3.5	3.6	3.7	3.8	3.8	3.9	4.0	4.1	4.1	4.2	4.3
29	Indonesia	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.6	3.9	4.3	4.7	5.1	5.2	5.3	5.4	5.6
30	Ireland	10.3	10.4	10.5	10.6	10.6	10.7	10.8	10.9	11.0	11.0	11.1	11.2	11.2	11.3	11.3	11.4	11.4	11.4	11.5	11.5	11.6
31	Israel	10.7	10.8	10.9	11.0	11.0	11.1	11.2	11.3	11.4	11.4	11.5	11.6	11.7	11.7	11.8	11.8	11.9	11.9	11.9	11.9	11.9
32	Italy	7.7	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.7	8.8	8.9	9.0	9.0	8.9	8.9	8.8	8.8	9.0	9.2	9.4	9.5
33	Japan	9.8	9.9	10.0	10.1	10.1	10.2	10.3	10.4	10.5	10.5	10.6	10.7	10.8	10.9	10.9	11.0	11.1	11.2	11.3	11.3	11.4
34	Korea, Republic of	8.7	8.9	9.1	9.2	9.4	9.5	9.7	9.9	10.1	10.2	10.4	10.6	10.7	10.8	10.9	11.0	11.1	11.2	11.3	11.4	11.5
35	Kuwait	5.4	5.5	5.6	5.6	5.7	5.7	5.8	5.9	5.9	6.0	6.0	6.1	6.1	6.1	6.0	6.0	6.0	6.0	6.0	6.1	6.1
36	Laos	3.0	3.1	3.2	3.2	3.3	3.4	3.5	3.6	3.6	3.7	3.8	3.9	4.0	4.0	4.1	4.1	4.2	4.3	4.4	4.4	4.5
37	Latvia	7.5	7.6	7.8	7.9	8.1	8.3	8.5	8.6	8.8	9.0	9.2	9.4	9.5	9.7	9.8	10.0	10.1	10.2	10.2	10.3	10.3
38	Lithuania	8.1	8.3	8.4	8.6	8.8	8.9	9.1	9.2	9.4	9.6	9.7	9.9	10.0	10.2	10.3	10.5	10.6	10.7	10.7	10.8	10.8
39	Macedonia, FYR	6.4	6.5	6.5	6.6	6.6	6.7	6.7	6.8	6.8	6.9	6.9	7.0	7.1	7.2	7.4	7.5	7.6	7.7	7.8	7.9	8.0
40	Malaysia	6.3	6.6	6.7	6.9	7.0	7.2	7.3	7.5	7.6	7.8	7.9	8.1	8.3	8.4	8.6	8.7	8.9	9.1	9.2	9.3	9.4
41	Malta	8.2	8.3	8.4	8.4	8.5	8.6	8.6	8.7	8.8	8.9	8.9	9.0	9.1	9.2	9.4	9.5	9.6	9.7	9.7	9.8	9.9
42	Myanmar	2.3	2.4	2.5	2.5	2.6	2.7	2.7	2.8	2.9	2.9	3.0	3.1	3.2	3.3	3.3	3.4	3.5	3.6	3.7	3.8	3.9
43	Netherlands	10.1	10.2	10.3	10.3	10.4	10.4	10.5	10.6	10.6	10.7	10.7	10.8	10.8	10.9	10.9	11.0	11.0	11.0	11.1	11.1	11.1
44	New Zealand	11.7	11.7	11.7	11.8	11.8	11.9	11.9	11.9	12.0	12.0	12.1	12.1	12.1	12.2	12.2	12.3	12.3	12.3	12.4	12.4	12.5
45	Nigeria	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
46	Norway	10.6	10.8	10.9	10.9	11.0	11.1	11.1	11.2	11.3	11.4	11.4	11.5	11.7	12.0	12.2	12.5	12.7	12.7	12.7	12.7	12.6
47	Pakistan	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.5	3.7	4.0	4.2	4.5	4.6	4.7	4.7	4.8
48	Panama	7.1	7.3	7.4	7.5	7.7	7.8	7.9	8.1	8.2	8.3	8.5	8.6	8.7	8.8	8.8	8.9	9.0	9.1	9.2	9.2	9.3
49	Peru	7.2	7.4	7.5	7.7	7.8	8.0	8.1	8.3	8.4	8.6	8.7	8.9	9.0	9.0	9.1	9.1	9.2	9.2	9.3	9.4	9.5
50	Philippines	7.0	7.1	7.2	7.3	7.4	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.1	8.2	8.2	8.3	8.4	8.5	8.5	8.6

Table C.1 (continued)

No.	Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
51	Poland	*8.4*	8.5	*8.6*	*8.7*	*8.8*	*8.9*	*9.0*	*9.1*	*9.2*	*9.3*	*9.4*	9.5	*9.5*	*9.6*	*9.6*	*9.7*	9.7	9.7	9.8	9.8	9.9
52	Portugal	*6.0*	6.2	*6.3*	*6.4*	*6.5*	*6.6*	*6.7*	*6.8*	*7.0*	*7.1*	*7.2*	7.3	*7.3*	*7.3*	*7.2*	*7.2*	7.2	7.4	7.5	7.7	7.9
53	Romania	*8.9*	9.0	*9.1*	*9.2*	*9.2*	*9.3*	*9.4*	*9.5*	*9.6*	*9.6*	*9.7*	9.8	*9.9*	*9.9*	*10.0*	*10.0*	10.1	10.2	10.3	10.4	10.5
54	Russian Federation	*8.0*	8.1	*8.1*	*8.2*	*8.2*	*8.3*	*8.3*	*8.4*	*8.4*	*8.5*	*8.5*	8.6	*8.6*	*8.6*	*8.7*	*8.7*	8.7	8.8	8.8	8.8	8.8
55	Saudi Arabia	*5.4*	5.5	*5.6*	*5.7*	*5.8*	*5.9*	*6.0*	*6.1*	*6.2*	*6.4*	*6.5*	6.6	*6.7*	*6.8*	*7.0*	*7.1*	7.2	7.3	7.5	7.6	7.7
56	Singapore	*5.5*	5.8	*6.0*	*6.1*	*6.3*	*6.5*	*6.6*	*6.8*	*7.0*	*7.2*	*7.4*	7.6	*7.7*	*7.8*	*7.9*	*8.0*	8.1	8.3	8.4	8.6	8.7
57	Slovenia	*8.0*	8.2	*8.3*	*8.3*	*8.4*	*8.4*	*8.5*	*8.6*	*8.6*	*8.7*	*8.7*	8.8	*8.8*	*8.8*	*8.9*	*8.9*	8.9	8.9	8.9	9.0	9.0
58	South Africa	*6.3*	6.5	*6.6*	*6.6*	*6.7*	*6.8*	*6.8*	*6.9*	*7.0*	*7.1*	*7.1*	7.2	*7.3*	*7.4*	*7.5*	*7.6*	7.7	7.8	7.9	8.0	8.1
59	Spain	*5.5*	5.6	*5.9*	*6.2*	*6.5*	*6.8*	*7.1*	*7.5*	*7.9*	*8.3*	*8.7*	9.1	*9.2*	*9.4*	*9.5*	*9.7*	9.8	9.9	10.0	10.1	10.2
60	Sri Lanka	*6.8*	6.9	*7.0*	*7.0*	*7.1*	*7.2*	*7.2*	*7.3*	*7.4*	*7.5*	*7.5*	7.6	*7.7*	*7.7*	*7.8*	*7.8*	7.9	8.0	8.0	8.1	8.1
61	Sweden	*9.9*	10.0	*10.1*	*10.2*	*10.3*	*10.4*	*10.5*	*10.6*	*10.7*	*10.8*	*10.9*	11.0	*11.1*	*11.3*	*11.4*	*11.6*	11.7	11.7	11.7	11.7	11.6
62	Switzerland	*9.7*	9.7	*9.7*	*9.8*	*9.8*	*9.8*	*9.8*	*9.9*	*9.9*	*9.9*	*10.0*	10.0	*10.0*	*10.0*	*10.0*	*10.0*	10.0	10.1	10.1	10.2	10.2
63	Thailand	*4.5*	4.6	*4.7*	*4.7*	*4.8*	*4.9*	*5.0*	*5.1*	*5.1*	*5.2*	*5.3*	5.4	*5.5*	*5.6*	*5.7*	*5.8*	5.9	6.0	6.2	6.3	6.4
64	Turkey	*4.3*	4.5	*4.6*	*4.7*	*4.8*	*4.9*	*5.0*	*5.1*	*5.2*	*5.3*	*5.4*	5.5	*5.6*	*5.7*	*5.8*	*5.9*	6.0	6.1	6.2	6.3	6.4
65	Ukraine	*8.9*	9.1	*9.2*	*9.4*	*9.6*	*9.7*	*9.9*	*10.0*	*10.2*	*10.4*	*10.5*	10.7	*10.8*	*10.9*	*10.9*	*11.0*	11.1	11.2	11.2	11.2	11.2
66	United Kingdom	*8.3*	8.3	*8.3*	*8.4*	*8.4*	*8.5*	*8.5*	*8.6*	*8.6*	*8.7*	*8.7*	8.8	*8.9*	*8.9*	*9.0*	*9.0*	9.1	9.2	9.2	9.3	9.4
67	United States	*12.1*	12.3	*12.4*	*12.5*	*12.6*	*12.7*	*12.7*	*12.8*	*12.9*	*13.0*	*13.1*	13.2	*13.0*	*12.9*	*12.7*	*12.6*	12.4	12.4	12.4	12.4	12.4
68	Vietnam	*4.0*	4.0	*4.0*	*4.1*	*4.1*	*4.2*	*4.2*	*4.3*	*4.3*	*4.4*	*4.4*	4.5	*4.6*	*4.7*	*4.7*	*4.8*	4.9	5.0	5.2	5.3	5.4

Note: Figures in italic are those estimated by the author using either interpolation or extrapolation or some combination of the two approaches.

Source: United Nation Development Programme (2011).

Table C.2: Real physical capital, 1989–2009

(Unit: US$ billion)

No.	Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	Algeria	155	155	151	149	148	145	142	139	136	135	133	131	131	132	135	142	151	163	182	211	238
2	Argentina	209	208	215	231	253	279	298	317	342	368	382	390	389	362	346	340	346	361	389	426	448
3	Australia	774	776	773	772	770	784	800	825	851	865	888	894	898	921	977	1,062	1,169	1,281	1,441	1,602	1,728
4	Austria	345	350	357	369	377	389	407	424	431	439	445	447	446	447	459	477	495	514	543	582	607
5	Bangladesh	44	46	46	46	47	49	51	54	57	61	65	69	72	76	80	86	91	97	104	113	123
6	Barbados	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	5	5	5	6	6
7	Belgium- Luxembourg	376	385	392	403	409	417	436	452	462	472	483	488	492	496	512	539	572	606	655	715	752
8	Brazil	708	719	708	696	696	732	800	861	927	977	971	983	979	964	952	963	1,008	1,086	1,216	1,400	1,523
9	Bulgaria	45	45	42	39	37	34	33	31	29	28	27	26	26	26	28	30	35	40	48	61	67
10	Cambodia	1	1	1	2	2	2	2	2	2	3	3	3	4	4	5	5	6	7	8	9	10
11	Canada	1,139	1,149	1,152	1,145	1,132	1,125	1,117	1,115	1,130	1,139	1,156	1,180	1,202	1,225	1,273	1,347	1,454	1,595	1,758	1,924	2,019
12	Chile	69	70	71	75	80	86	96	106	118	127	130	132	134	135	136	141	152	165	181	204	219
13	China	1,121	1,110	1,113	1,156	1,272	1,345	1,461	1,604	1,757	1,926	2,102	2,301	2,527	2,801	3,168	3,638	4,217	4,926	5,817	7,093	8,569
14	Colombia	115	115	113	114	118	128	140	150	160	166	163	159	156	154	154	159	172	189	216	256	286
15	Costa Rica	12	12	12	13	13	14	15	16	16	18	19	20	21	22	23	24	25	27	30	34	37
16	Cyprus	12	12	12	13	13	13	14	14	14	15	15	15	15	16	16	18	19	21	24	27	29
17	Denmark	243	245	247	249	248	250	258	267	274	283	289	293	295	300	311	328	346	371	404	435	449
18	Dominican Republic	16	16	16	16	16	17	18	19	20	23	25	27	29	31	31	31	33	37	41	45	47
19	Egypt	92	91	90	89	89	90	92	97	102	109	115	121	123	126	127	127	131	139	152	173	192
20	Estonia	7	7	7	7	8	8	8	9	9	10	11	11	11	13	14	17	19	24	29	33	33
21	Finland	308	316	314	305	289	277	271	267	264	263	262	260	260	259	264	274	286	299	322	348	360
22	France	2,289	2,329	2,362	2,402	2,405	2,417	2,461	2,498	2,498	2,514	2,537	2,544	2,552	2,571	2,655	2,789	2,940	3,117	3,364	3,652	3,834
23	Germany	3,203	3,275	3,368	3,518	3,619	3,742	3,922	4,051	4,101	4,152	4,194	4,183	4,144	4,100	4,127	4,196	4,262	4,369	4,555	4,794	4,906
24	Greece	167	170	174	178	180	181	185	192	197	204	213	219	225	236	258	283	303	328	360	390	407
25	Hong Kong	176	178	184	194	206	225	246	270	302	322	331	343	351	353	351	351	353	360	365	371	378

Table C.2 (continued)

(Unit: US$ billion)

No.	Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
26	Hungary	79	79	78	78	78	79	80	82	84	87	89	91	95	101	109	121	135	146	161	178	187
27	Iceland	12	12	12	12	12	12	12	12	12	13	14	14	14	15	15	17	20	24	27	28	27
28	India	711	721	717	715	709	715	740	761	783	803	833	859	890	924	985	1,101	1,256	1,438	1,702	1,971	2,208
29	Indonesia	271	277	284	291	304	322	347	380	403	387	377	372	367	368	377	397	425	471	531	619	725
30	Ireland	69	71	72	74	74	76	80	86	94	103	115	126	137	150	170	199	233	270	311	338	339
31	Israel	105	105	111	117	122	129	139	150	159	166	172	178	182	183	185	187	191	197	208	224	233
32	Italy	2,134	2,172	2,215	2,262	2,229	2,203	2,198	2,219	2,224	2,238	2,252	2,253	2,257	2,287	2,367	2,488	2,610	2,745	2,924	3,111	3,202
33	Japan	9,229	9,289	9,467	9,680	9,989	10,347	10,781	11,016	11,096	10,984	10,998	11,074	10,977	10,791	10,676	10,654	10,649	10,603	10,547	10,631	10,615
34	Korea, Republic of	779	799	839	877	921	984	1,079	1,180	1,247	1,227	1,237	1,273	1,291	1,327	1,383	1,456	1,554	1,672	1,805	1,899	1,950
35	Kuwait	32	32	33	33	33	33	34	35	35	36	37	37	38	41	44	49	56	66	84	103	108
36	Laos	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	4	6	7	8
37	Latvia	5	5	5	5	5	5	6	6	6	7	8	9	11	12	13	16	19	24	31	38	40
38	Lithuania	25	25	25	24	23	22	21	21	21	22	22	22	22	23	24	27	30	35	42	50	52
39	Macedonia	4	4	4	4	4	4	5	5	5	5	5	5	5	5	6	6	6	7	8	9	10
40	Malaysia	122	125	131	140	153	168	191	216	239	235	229	230	230	231	232	235	240	249	264	281	292
41	Malta	5	5	5	6	6	6	6	6	7	7	7	7	7	7	8	8	8	9	10	10	10
42	Myanmar	6	6	6	7	7	7	7	8	8	8	8	8	8	8	9	9	10	11	12	13	15
43	Netherlands	592	600	607	620	627	637	660	684	701	720	742	753	762	774	801	836	873	919	984	1,065	1,110
44	New Zealand	86	86	85	83	83	86	91	97	101	102	104	104	105	107	115	127	141	153	168	179	184
45	Nigeria	42	43	43	43	43	42	40	38	37	36	35	35	35	36	39	41	43	51	61	72	82
46	Norway	254	253	252	251	249	249	253	260	269	280	287	289	291	296	306	322	346	378	426	480	513
47	Pakistan	88	88	89	92	95	98	102	105	108	109	109	110	109	110	112	115	122	136	152	167	179
48	Panama	6	6	6	6	7	8	9	10	11	13	14	15	15	15	16	17	18	19	22	26	29
49	Peru	64	63	63	62	63	66	72	77	84	89	91	93	93	94	96	99	103	111	123	144	160
50	Philippines	81	83	84	87	91	97	104	113	122	123	125	129	129	129	130	131	132	135	143	153	161

Table C.2 (continued)

(Unit: US$ billion)

No.	Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
51	Poland	148	147	147	147	147	151	160	175	193	215	235	252	266	277	289	306	331	365	420	496	538
52	Portugal	174	177	181	189	191	194	202	210	219	230	242	250	258	266	278	293	308	323	342	364	373
53	Romania	123	118	111	103	98	94	92	91	89	88	86	84	84	85	90	97	111	131	170	218	237
54	Russian Federation	2,140	2,149	2,105	2,011	1,902	1,800	1,704	1,612	1,525	1,416	1,303	1,216	1,153	1,099	1,069	1,070	1,099	1,172	1,328	1,565	1,672
55	Saudi Arabia	205	207	213	219	226	229	233	237	243	249	255	263	270	277	289	302	324	354	397	451	497
56	Singapore	102	103	107	114	123	135	149	170	190	202	210	218	221	222	222	225	228	236	253	280	303
57	Slovenia	24	24	24	24	24	25	27	29	31	33	36	37	39	40	43	47	52	57	64	74	78
58	South Africa	189	192	193	194	194	195	200	203	207	210	209	208	205	201	207	221	240	264	295	328	359
59	Spain	1,050	1,077	1,107	1,135	1,128	1,121	1,138	1,157	1,166	1,188	1,221	1,249	1,283	1,335	1,441	1,590	1,763	1,965	2,211	2,446	2,553
60	Sri Lanka	16	16	17	17	18	19	21	22	24	26	27	29	29	30	30	32	35	38	42	48	53
61	Sweden	472	481	486	486	469	456	451	451	446	443	444	444	441	440	449	466	486	512	551	594	607
62	Switzerland	589	598	605	606	602	605	618	624	620	622	620	615	613	612	619	634	652	674	702	740	768
63	Thailand	267	274	288	303	322	347	382	418	427	410	394	382	370	362	360	366	380	401	426	458	476
64	Turkey	350	358	368	378	400	400	410	426	446	463	464	472	456	449	456	490	543	607	685	762	789
65	Ukraine	356	351	342	329	313	295	277	258	243	227	210	195	183	173	166	164	167	177	198	226	225
66	United Kingdom	1,777	1,807	1,816	1,817	1,791	1,783	1,796	1,820	1,864	1,937	2,005	2,058	2,100	2,161	2,249	2,391	2,533	2,698	2,928	3,079	3,090
67	United States	9,605	9,653	9,659	9,715	9,852	10,081	10,382	10,763	11,229	11,791	12,452	13,201	13,873	14,429	15,015	15,744	16,634	17,605	18,510	19,245	19,400
68	Vietnam	8	8	8	9	11	14	18	23	27	32	36	41	47	53	61	70	80	93	110	131	150

Source: Author's calculation based on data from UNCTAD (2010).

Table C.3: Labor force, 1989–2009

(Unit: thousand persons)

No.	Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	Algeria	6,682	7,023	7,382	7,754	8,146	8,553	8,971	9,403	9,830	10,224	10,654	11,107	11,560	11,986	12,377	12,790	13,197	13,650	14,077	14,486	14,842
2	Argentina	13,273	13,531	13,619	13,712	13,884	14,062	14,381	14,746	15,122	15,506	15,894	16,283	16,671	17,060	17,451	17,851	18,261	18,683	18,866	19,073	19,596
3	Australia	8,282	8,499	8,551	8,627	8,691	8,848	9,054	9,146	9,214	9,325	9,429	9,626	9,780	9,937	10,124	10,256	10,555	10,757	10,961	11,128	11,241
4	Austria	3,473	3,524	3,567	3,642	3,680	3,793	3,853	3,835	3,822	3,848	3,869	3,878	3,870	3,963	3,995	3,949	4,079	4,160	4,252	4,293	4,295
5	Bangladesh	47,848	49,519	51,292	52,473	53,683	54,921	56,185	57,475	58,788	60,116	61,446	62,770	64,658	66,496	68,290	70,052	71,790	73,497	75,165	76,801	78,636
6	Barbados	138	136	135	137	138	140	141	140	140	140	140	140	141	142	143	146	147	148	150	151	152
7	Belgium- Luxembourg	4,082	4,091	4,184	4,226	4,247	4,310	4,337	4,349	4,369	4,407	4,522	4,576	4,478	4,528	4,565	4,660	4,813	4,832	4,911	4,943	4,965
8	Brazil	60,954	62,594	65,981	69,470	71,059	72,970	74,920	74,781	77,403	79,222	81,925	83,418	84,866	87,609	89,372	91,982	94,450	96,974	97,932	99,957	101,506
9	Bulgaria	4,211	4,143	4,076	4,008	3,937	3,869	3,804	3,745	3,690	3,640	3,589	3,535	3,478	3,443	3,379	3,428	3,371	3,495	3,581	3,653	3,556
10	Cambodia	4,202	4,334	4,447	4,558	4,676	4,793	4,930	5,084	5,268	5,470	5,683	5,903	6,132	6,362	6,592	6,824	6,977	7,148	7,325	7,534	7,836
11	Canada	14,490	14,669	14,747	14,719	14,807	14,931	15,024	15,162	15,384	15,644	15,946	16,213	16,462	16,937	17,360	17,601	17,759	17,982	18,340	18,639	18,992
12	Chile	4,916	5,003	5,091	5,301	5,527	5,626	5,629	5,718	5,854	6,000	6,112	6,082	6,191	6,265	6,413	6,705	6,765	6,967	7,271	7,686	7,517
13	China	635,206	647,676	658,308	667,167	675,244	682,954	690,726	698,339	705,748	713,271	720,934	728,656	736,626	744,505	752,059	759,256	765,995	772,161	777,742	783,855	791,719
14	Colombia	10,830	11,166	11,540	11,889	12,270	12,617	12,974	13,375	13,762	14,194	14,704	15,127	15,575	16,030	16,461	16,896	17,313	17,706	18,084	18,561	18,954
15	Costa Rica	1,126	1,164	1,189	1,205	1,256	1,307	1,366	1,365	1,474	1,555	1,586	1,600	1,717	1,762	1,806	1,824	1,930	1,980	2,055	2,112	2,130
16	Cyprus	292	302	305	308	316	321	325	335	341	347	354	362	378	385	399	408	412	420	431	438	446
17	Denmark	2,881	2,912	2,912	2,918	2,895	2,782	2,822	2,830	2,852	2,841	2,876	2,861	2,875	2,889	2,869	2,897	2,898	2,927	2,923	2,944	2,925
18	Dominican Republic	2,843	2,926	3,004	3,078	3,154	3,233	3,313	3,393	3,475	3,556	3,638	3,721	3,808	3,894	3,983	4,073	4,160	4,247	4,335	4,425	4,506
19	Egypt	16,438	16,847	17,269	17,699	18,135	18,585	19,050	19,530	20,026	20,539	21,082	21,653	22,248	22,864	23,490	24,108	24,702	25,330	25,743	26,338	27,411
20	Estonia	886	855	824	793	762	731	703	696	691	676	661	656	656	643	665	668	669	691	693	701	696
21	Finland	2,632	2,624	2,580	2,534	2,515	2,496	2,477	2,463	2,510	2,526	2,653	2,675	2,692	2,702	2,694	2,674	2,627	2,661	2,689	2,715	2,701
22	France	25,712	25,728	25,691	25,879	26,016	26,109	26,272	26,600	26,589	26,778	27,066	27,234	27,306	27,636	28,218	28,473	28,753	28,894	29,132	29,354	29,406
23	Germany	37,577	38,785	39,955	39,780	39,566	39,905	39,829	39,831	40,091	40,178	40,388	40,298	40,367	40,442	40,631	40,540	41,560	41,877	42,232	42,448	42,470
24	Greece	4,162	4,185	4,127	4,251	4,306	4,430	4,532	4,650	4,682	4,808	4,882	4,915	4,860	4,919	4,981	5,074	5,079	5,128	5,139	5,157	5,146
25	Hong Kong	2,825	2,852	2,912	2,925	2,960	3,013	3,083	3,138	3,195	3,261	3,321	3,375	3,429	3,498	3,522	3,559	3,585	3,619	3,708	3,722	3,710

Table C.3 (continued)

(Unit: thousand persons)

No.	Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
26	Hungary	4,576	4,536	4,508	4,565	4,395	4,265	4,173	4,092	4,021	4,072	4,144	4,166	4,148	4,149	4,221	4,201	4,266	4,301	4,291	4,261	4,265
27	Iceland	149	151	153	156	156	157	160	159	160	165	170	174	175	174	178	177	179	185	191	196	199
28	India	314,833	322,257	329,845	337,590	345,493	353,556	360,403	367,347	374,380	381,485	388,641	395,831	403,744	411,694	419,684	427,720	437,025	446,617	456,406	466,270	474,611
29	Indonesia	73,625	75,187	76,740	78,282	80,089	81,822	84,614	87,362	89,191	90,047	95,461	97,240	98,951	100,593	102,539	104,796	107,058	109,049	110,989	112,855	115,596
30	Ireland	1,327	1,345	1,366	1,356	1,391	1,434	1,465	1,512	1,550	1,623	1,697	1,760	1,804	1,859	1,911	1,970	2,073	2,145	2,204	2,226	2,280
31	Israel	1,604	1,638	1,706	1,790	1,898	2,001	2,076	2,146	2,207	2,282	2,357	2,430	2,484	2,527	2,591	2,660	2,721	2,792	2,885	3,039	2,958
32	Italy	23,842	23,836	24,021	23,271	23,150	22,976	22,832	22,932	22,945	23,067	23,228	23,315	23,503	23,852	24,224	24,702	24,611	24,783	24,805	25,119	25,211
33	Japan	62,463	63,725	64,841	65,792	66,232	66,572	66,873	67,385	67,961	67,953	67,715	67,513	67,406	66,896	66,715	66,369	66,442	66,470	66,718	66,612	65,537
34	Korea, Republic of	18,674	19,212	19,657	20,016	20,276	20,806	21,226	21,638	22,105	21,734	21,982	22,385	22,635	23,018	23,005	23,451	23,653	23,862	24,106	24,183	24,484
35	Kuwait	845	865	867	856	839	833	847	884	942	1,014	1,090	1,162	1,227	1,289	1,347	1,390	1,428	1,465	1,502	1,528	1,566
36	Laos	1,883	1,935	1,990	2,044	2,098	2,149	2,202	2,254	2,307	2,364	2,417	2,473	2,531	2,590	2,651	2,714	2,781	2,850	2,923	3,000	3,091
37	Latvia	1,513	1,462	1,410	1,359	1,307	1,256	1,207	1,162	1,154	1,147	1,121	1,092	1,103	1,135	1,120	1,129	1,130	1,160	1,184	1,211	1,192
38	Lithuania	1,940	1,916	1,892	1,869	1,845	1,818	1,790	1,760	1,729	1,709	1,712	1,685	1,651	1,641	1,709	1,635	1,607	1,586	1,592	1,594	1,557
39	Macedonia	818	817	816	815	814	814	815	817	817	819	825	828	847	848	860	833	862	887	901	905	904
40	Malaysia	6,695	7,006	7,234	7,455	7,676	7,907	8,155	8,423	8,707	8,996	9,279	9,726	10,007	10,257	10,498	10,734	10,979	11,226	11,473	11,726	12,006
41	Malta	129	130	131	132	135	136	140	144	146	147	151	156	160	161	163	162	165	167	171	173	170
42	Myanmar	20,177	20,672	21,213	21,608	22,056	22,506	22,968	23,466	23,992	24,510	24,903	25,187	25,443	25,634	25,764	25,899	26,054	26,242	26,468	26,826	27,002
43	Netherlands	6,711	6,895	6,997	7,086	7,160	7,284	7,368	7,481	7,685	7,826	7,967	8,146	8,275	8,402	8,445	8,515	8,573	8,671	8,840	8,976	9,011
44	New Zealand	1,633	1,658	1,682	1,702	1,733	1,787	1,830	1,878	1,889	1,893	1,916	1,942	1,990	2,041	2,065	2,117	2,175	2,226	2,264	2,291	2,328
45	Nigeria	28,670	29,365	30,145	30,993	31,893	32,872	33,848	34,828	35,879	36,984	38,137	39,222	40,382	41,605	42,651	43,706	44,906	46,110	47,330	48,613	49,998
46	Norway	2,216	2,217	2,185	2,184	2,180	2,201	2,231	2,288	2,350	2,391	2,393	2,413	2,432	2,456	2,437	2,452	2,462	2,500	2,562	2,637	2,610
47	Pakistan	32,252	33,180	34,045	34,829	35,259	36,379	36,552	38,101	39,837	41,155	42,844	44,601	45,927	47,371	49,329	51,354	53,949	56,653	57,915	59,528	61,881
48	Panama	906	928	949	993	1,036	1,070	1,120	1,149	1,178	1,224	1,247	1,279	1,310	1,342	1,377	1,418	1,455	1,466	1,509	1,598	1,579
49	Peru	7,995	8,306	8,591	8,894	9,183	9,418	9,672	9,966	10,237	10,561	10,876	11,178	11,499	11,786	12,079	12,360	12,623	12,870	13,099	13,312	13,628
50	Philippines	23,436	24,114	24,772	25,631	26,199	26,875	28,090	28,819	29,539	30,580	31,285	31,477	33,070	33,856	34,655	35,283	35,526	36,064	36,829	37,866	38,826

Table C.3 (continued)

(Unit: thousand persons)

No.	Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
51	Poland	18,235	18,070	17,932	17,821	17,812	17,645	17,438	17,394	17,241	17,231	17,126	17,427	17,658	17,438	17,353	17,306	17,570	17,366	17,385	17,637	17,390
52	Portugal	4,764	4,783	4,918	4,783	4,798	4,837	4,835	4,891	4,981	5,116	5,157	5,218	5,315	5,406	5,446	5,454	5,529	5,588	5,636	5,653	5,670
53	Romania	11,669	11,753	11,862	11,920	11,925	11,915	11,889	11,881	11,940	11,772	11,767	11,671	11,442	10,459	10,177	10,131	9,853	10,023	9,961	9,883	9,450
54	Russian Federation	75,903	75,336	74,769	74,203	73,636	73,028	72,360	71,736	71,712	71,670	71,597	72,438	73,083	73,550	73,802	73,854	74,434	75,146	76,079	75,767	75,355
55	Saudi Arabia	4,870	5,048	5,181	5,306	5,447	5,593	5,765	5,951	6,167	6,407	6,684	6,952	7,265	7,601	7,893	8,191	8,473	8,750	9,002	9,234	9,481
56	Singapore	1,486	1,539	1,596	1,652	1,681	1,731	1,740	1,840	1,880	1,933	2,001	2,059	2,098	2,128	2,157	2,193	2,244	2,313	2,394	2,489	2,564
57	Slovenia	802	809	816	824	831	929	950	937	956	979	965	960	968	982	960	1,008	1,017	1,022	1,033	1,031	1,025
58	South Africa	10,472	10,862	11,320	11,841	12,377	12,901	13,401	13,857	14,294	14,731	15,172	15,595	16,028	16,450	16,875	17,218	17,587	17,975	18,372	19,024	19,153
59	Spain	15,326	15,557	15,711	15,820	16,000	16,283	16,375	16,619	16,892	17,130	17,478	18,059	18,042	18,761	19,469	20,095	20,752	21,324	21,721	22,213	22,412
60	Sri Lanka	6,722	6,837	6,948	7,055	7,170	7,239	7,156	7,306	7,397	7,935	7,795	7,776	7,858	7,946	8,035	8,093	8,126	8,346	8,273	8,256	8,301
61	Sweden	4,716	4,745	4,730	4,645	4,586	4,562	4,592	4,574	4,546	4,498	4,550	4,512	4,621	4,645	4,688	4,717	4,821	4,864	4,936	4,988	5,004
62	Switzerland	3,781	3,827	3,896	3,938	3,954	3,938	3,940	3,934	3,940	3,985	4,002	3,997	4,055	4,092	4,142	4,151	4,171	4,226	4,271	4,324	4,289
63	Thailand	31,690	32,131	32,233	32,236	32,141	31,945	32,630	33,248	33,660	33,708	33,639	34,304	34,955	35,504	36,072	36,723	37,313	37,507	38,136	38,503	38,685
64	Turkey	20,588	20,706	21,151	21,341	20,450	21,973	22,301	22,710	22,761	23,390	23,916	23,135	23,550	23,897	23,741	24,411	24,718	24,574	24,982	25,766	25,612
65	Ukraine	25,510	25,375	25,239	25,104	24,969	24,827	24,626	24,387	24,113	23,822	23,533	23,255	22,991	22,990	22,901	22,910	23,130	23,072	23,005	22,962	22,850
66	United Kingdom	28,930	29,034	28,889	28,730	28,514	28,469	28,447	28,555	28,736	28,809	29,088	29,325	29,313	29,642	29,909	30,148	30,519	30,916	31,070	31,412	31,610
67	United States	132,019	133,031	133,692	135,647	136,928	139,148	141,091	143,253	145,900	148,021	150,076	152,172	153,286	154,417	155,286	156,523	158,414	160,513	161,892	163,792	164,437
68	Vietnam	30,364	31,091	31,837	32,597	33,375	34,182	35,023	35,905	36,251	37,040	38,017	38,342	39,775	40,519	41,418	42,138	43,069	44,036	45,015	46,045	47,017

Source: UNCTAD (2010).

Appendix D

Table D.1: Dynamic regression results for real bilateral exports of ASEAN+3, 1992–2009

Dependent variable: bilateral export	ASEAN+3	
Explanatory variables:	Short-run	Long-run impacts
Constant	− 10.190***	—
	(3.115)	—
Lag one year of bilateral export	0.678***	—
	(0.085)	—
Sum of bilateral country size	0.592***	1.839***
	(0.169)	(0.117)
Similarity in country size	0.445***	1.383***
	(0.126)	(0.104)
Difference in relative factor endowment	− 0.049	− 0.152
	(0.034)	(0.099)
Distance	− 0.125	− 0.388
	(0.102)	(0.310)
Tariff rate	− 0.090**	− 0.281**
	(0.039)	(0.120)
Observations	1046	—
Model degrees of freedom	22	—
Residual degrees of freedom	145	—
Number of instruments	39	—
Wald test for time effects:		
F (16, residual df)	4.65***	—
F (model df, residual df)	325.40***	—
Arellano-Bond test for AR(2):	*Z* = − 1.07	—
Overidentification restrictions tests:		
Sargan test:	*Chi2* (16) = 25.74*	—
Hansen test:	*Chi2* (16) = 16.66	—
RMSE	0.67	—

Notes: *** denotes significance at the 1% level; **, at the 5% level; and *, at the 10% level. Robust standard errors of one-step system GMM for the short-run specification are reported in parentheses. The standard errors of the long-run effects are computed by the delta-method.

Source: Author's estimation.

Table D.2: Dynamic regression results without time dummies for ASEAN+6, 1992–2009

Dependent variable: bilateral export Explanatory variables:	ASEAN+6
Constant	− 14.033*** (3.921)
Lag one year of bilateral export	0.500*** (0.126)
Sum of bilateral country size	0.867*** (0.228)
Similarity in country size	0.615*** (0.158)
Difference in relative factor endowment	− 0.116** (0.049)
Distance	− 0.260** (0.106)
Tariff rate	0.012* (0.007)
Number of observations	1721
Number of groups	230
Model degrees of freedom	6
Residual degrees of freedom	229
Number of instruments	23
F (model df, residual df)	384.49***
RMSE	0.86
Arellano-Bond test for AR(1) in first differences H_0: *There is no first-order serial correlation in residuals*	Z = − 2.64***
Arellano-Bond test for AR(2) in first differences H_0: *There is no second-order serial correlation in residuals*	Z = − 0.53
Hansen *J*-test of overidentifying restrictions H_0: *Model specification is correct and all overidentified instruments are exogenous*	*Chi2* (16) = 67.15***
Difference-in-Hansen tests of exogeneity of GMM instrument subsets: Hansen test excluding system GMM instruments (i.e., the differenced instruments) H_0: *GMM differenced-instruments are exogenous*	*Chi2* (1) = 0.59
Difference-in-Hansen tests of exogeneity of GMM instrument subsets: H_0: *system-GMM instruments are exogenous and they increase Hansen J-test*	*Chi2* (15) = 66.56***
Difference-in-Hansen tests of exogeneity of standard "IV" instrument subsets: *H0: GMM instruments without "IV" instruments are exogenous*	*Chi2* (5) = 53.43***
Difference-in-Hansen tests of exogeneity of standard "IV" instrument subsets: H_0: *standard "IV" instruments are exogenous and they increase Hansen J-test*	*Chi2* (11) = 13.72

Source: Author's estimation.

Table D.3: Dynamic regression results with non-collapsing instruments for ASEAN+6, 1992–2009

Dependent variable: bilateral export Explanatory variables:	ASEAN+6
Constant	− 5.378***
	(1.569)
Lag one year of bilateral export	0.845***
	(0.041)
Sum of bilateral country size	0.272***
	(0.077)
Similarity in country size	0.189***
	(0.054)
Difference in relative factor endowment	− 0.039**
	(0.016)
Distance	− 0.109**
	(0.049)
Tariff rate	− 0.070**
	(0.032)
Number of observations	1721
Number of groups	230
Model degrees of freedom	22
Residual degrees of freedom	229
Number of instruments	174
Wald test for time effects:	
F (16, residual df)	14.03***
F (model df, residual df)	1267.72***
Arellano-Bond test for AR(1) in first differences H_0: *There is no first-order serial correlation in residuals*	Z = − 3.21***
Arellano-Bond test for AR(2) in first differences H_0: *There is no second-order serial correlation in residuals*	Z = − 0.56
Hansen J -test of overidentifying restrictions H_0: *Model specification is correct and all overidentified instruments are exogenous*	*Chi2* (151) = 179.03*
Difference-in-Hansen tests of exogeneity of GMM instrument subsets: Hansen test excluding system GMM instruments (i.e., the differenced instruments) H_0: *GMM differenced-instruments are exogenous*	*Chi2* (16) = 15.41
Difference-in-Hansen tests of exogeneity of GMM instrument subsets: H_0: *system-GMM instruments are exogenous and they increase Hansen J-test*	*Chi2* (135) = 152.57
Difference-in-Hansen tests of exogeneity of standard "IV" instrument subsets: *H0: GMM instruments without "IV" instruments are exogenous*	*Chi2* (5) = 2.14
Difference-in-Hansen tests of exogeneity of standard "IV" instrument subsets: H_0: *standard "IV" instruments are exogenous and they increase Hansen J-test*	*Chi2* (146) = 176.89**

Source: Author's estimation.

Appendix E: Imports and economic growth in the presence of endogenous structural breaks in Laos

1. Introduction

Enhancing economic growth through the adoption of foreign technology embodied in imports has become one of the key strategic trade policies in developing economies. However, empirical analysis of the causal direction between imports and economic growth provides mixed results. Increased trade produces more income, and more income facilitates more trade. The two-way causal relationship between imports and growth is supported by Ramos (2001) who analyzed the Granger-causality between exports, imports, and economic growth in Portugal over the period 1865–1998. Furthermore, Rodrik (1995) argued that it is an increase in investment that causes the rapid growth in East Asian economies and in turn induces imports. In this case, the causality runs from growth to imports. The empirical study by Awokuse (2007) for the Czech Republic also supports this argument. Finally, some studies suggest a one-way causality, running imports to growth. Hakan and Salih (2009) investigated the relationships between export, import and economic growth for the 13 transition economies and find that there is a unidirectional causality from economic growth to exports, and that growth is rather shaped by increase in import demand. Using Chinese data from 1964 to 2004, Herrerias and Orts (2011) examined the impact of imports and investment on labor productivity and output and find that both imports and investment encourage output and labor productivity in the long run.

The present supplementary note is an attempt to test the import-led growth hypothesis in the Lao economy. More precisely, it investigates the contribution of the increased capital goods imports and total imports of goods and services have made to improvement of output in Laos over the period 1970–2010. It also aims to identify the characteristic and causal directions between imports and output. So far, there is no empirical evidence analyzing the role played by imported goods as a source of long-run growth in Laos, and this study aims to fill in this gap.

This study contributes to the existing literature in two aspects. The first aspect is that most of the earlier literature has applied standard unit root

tests for stationarity, which are biased towards accepting the null hypothesis of a unit root in the presence of structural breaks (Herzer and Nowak-Lehmann, 2006). To overcome this issue, we have applied an innovative outlier unit-root test proposed by Perron (2006) which allows for two break points under the null and alternative hypotheses.

The second aspect is that the existing literature has shown some mixed results, implying that the causal relationship between imports and economic growth is conceptually complex and remains inconclusive. Few attempts have been made to investigate the influence of capital goods imports on long-run growth of GDP for transition economies. In addition, there is apparently no empirical evidence on the role played by imports on economic growth in Laos. Therefore, examining the interrelationships and the direction of causality between imports and economic growth provides an interesting outcome from the academic and the policy-makers perspective, and can contribute more insightful information to the design of economic policies in transition economies. This issue will be empirically analyzed in the subsequent sections.

2. Theoretical framework, methodology and empirical results

2.1 Theoretical framework

To investigate the differences in growth rates across countries and the sources of faster growth in some countries than others for some time, different theoretical frameworks have been developed and applied, ranging from the neoclassical growth models to the endogenous growth models. It is technological progress that plays an important role in promoting long-run growth in both approaches, but technological progress is assumed to be exogenous in the neoclassical growth models and endogenous in the endogenous growth models.

Grossman and Helpman (1991) developed a unifying framework for two strands of R&D-based endogenous growth models, including the varieties model and the quality ladders model. In a closed economy, the creation of new products sustains growth in the varieties model through an increase the knowledge stock, which then decreases the costs of innovation. As more products are developed, producers face lower costs of inventing new

products and profits due to increased competition. As to the quality ladders model, consumers are assumed to willingly pay a premium for higher-quality products, which provides an incentive to firms to improve their product quality. Growth in this model is sustained through the gradual development of product quality based on the attributes of the newly invented product. In other words, the knowledge embodied in new product generates the so called 'knowledge spillovers', which allow other firms to produce a higher-quality version of the same product.

Since R&D-based models of growth assumes that new ideas lead to the invention of new products, trade in goods could help transmit knowledge internationally. In developing countries that have low R&D expenditure, they rely on imported machinery and equipment from R&D intensive countries to support the industrialization process. In this case, imports can have both direct and indirect effect on growth. As to the direct effect of imports on growth, increased imports lead to more competition between domestically produced goods and imported goods, thereby improving the production efficiency. As to the indirect effect of imports, it provides greater access to foreign technology via greater importation of capital goods, resulting in larger physical capital accumulation for production. Therefore, in the present note we use two measures of real imports—namely, total imports and capital goods imports—as well as real GDP and real investment to examine the potential impact of imports on growth in Laos.

2.2 Data description

Our dataset comprises real GDP (*GDP*), real investment (*INV*), total imports of goods and services (*MM*), and capital goods imports (*CGM*). All variables are in natural logarithmic forms. We utilized annual data for the period 1970–2010 from two sources. There were two reasons for starting the analysis from 1970. The first reason was availability of data. The second reason was the stability of Lao economy prior to the revolution of the Lao People Revolutionary Party (communist party) in 1975.

An important source for variables used in this study is the United Nations Conference on Trade and Development's (UNCTAD's) database, which provides data for imports of goods and services in million US dollar at constant prices of year 2005 for the period 1970–2010. Data for labor

productivity were obtained from Heston et al.'s (2012) Penn World Table Version 7.1. Using the United Nations' (UN's) COMTRADE database, we aggregated five-digit Standard International Trade Classification (SITC) trade flows into capital goods imports according to the UN's Classification by *Broad Economic Categories* (2003). We deflated nominal imports which were measured in US dollar by GDP deflator of the United States.

Despite the continuous efforts to improve the Lao national accounts, there are some concerns about the accuracy and the quality of the statistics prior to 1975 as the former Lao government might use different methods of compiling national statistics. Given the revision for the whole period following international standards, the employed data are more reliable and consistent. Moreover, Holz (2005, p. 10) indicated that some certain levels of data inaccuracies are not a problem for the analysis of long-run trends. Finally, the period of study covered both the pre-reform and post-reform period, which deserve careful scrutiny by performing appropriate structural break tests.

2.3 Perron's (2006) Unit root tests

It is widely accepted that using a series with long time span increases the accuracy of unit root tests. However, the longer the series is, the more structural breaks it contains. Zivot and Andrews (1992) argued that ignoring the presence of structural breaks can bias tests towards the acceptance of the unit root hypothesis. Following Perron (2006), the model which allows for simultaneous changes in both the intercept and the slope can be represented as in equation (1):

$$\Delta y_t = \alpha + \beta t + c_1 B_{1t} + c_2 B_{2t} + c_3 D_{1t} + c_4 D_{2t}$$

$$+ c_5 DT_{1t} + c_6 DT_{2t} + \rho y_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta y_{t-i} + \varepsilon_t \qquad (1)$$

where $D_{jt} = 1$ for $t \geq T_{Bj} + 1$, j = 1, 2, and 0 otherwise; T_{Bj} represents the break date; $B_{jt} = 1$ for $t = T_{Bj} + 1$, j = 1, 2, and 0 otherwise; $DT_{jt} = t - T_{Bj}$ for $t \geq T_{Bj} + 1$, j = 1, 2, and 0 otherwise; and ε_{jt} denotes a white noise process, such that $\varepsilon_{jt} \sim NIID(0, \sigma^2)$.

Testing unit root in equation (1) is to test whether ρ is equal to one (the presence of unit root or nonstationary series). The optimal lag length k is selected on the basis of the significance of the t-statistic of the last lag. Beginning with maximum lag length of eight, equation (1) is sequentially estimated to search for the two break points T_{b1} and T_{b2} over the range of the sample $(0.1T, 0.9T)$, where T is the number of observations. Values of T_{b1} and T_{b2} are chosen so as to minimize the t-statistic on the level autoregressive parameter ρ. The t-statistic, the break dates, and the number of lags are reported in Table 1.

Table E.1: Perron's (2006) unit root test with structural breaks in mean and trend, 1970–2010

Variables	Test-statistic	Break dates	Lags
GDP	−8.522	1991; 2004	8
INV	−8.806	1985; 1996	1
MM	−8.466	1982; 1986	0
CGM	−7.348	1982; 1997	1

Notes: The number in square brackets indicates the optimal number of lagged first-differenced terms included in the unit root test to correct for serial correlation. 5% critical value of t-statistics for testing unit root with one structural break is −5.59, taken from Perron (1997).

Source: Author's estimation.

The estimated break points can be roughly classified into two periods: (a) mid-1980s and 1991, implementing the New Economic Mechanism for moving towards an open and market-oriented economy; (b) 1997, experiencing the Asian financial crisis. Comparing the t-statistic to the finite sample critical values, it is clear that the unit root null hypothesis is rejected at the 5% level for all four series, namely, (logs of) real GDP, real investment, total imports, and capital goods imports. Note that the finite-sample critical values for testing $\rho = 0$ in equation (1) with the two-break case will be higher, in absolute terms, than those provided in Perron (1997) for the one-break case. Nonetheless, our estimated t-statistics are much lower than those reported in Perron (1997). Approximately, for *GDP*, t_ρ is smaller by 52%, for *INV* by 58%, for *MM* by 51%, and for *CGM* by 31%. Therefore, the four series are found to be stationary with two breaks in the deterministic trend.

The rejection of unit root hypothesis implies that differencing data to achieve stationarity is neither necessary nor appropriate. Rather, the data should be de-trended using the procedure presented in Fernandez (1997) while taking into account structural breaks. To do so, each series is estimated using the following equation:

$$y_t = \alpha + \beta t + c_1 B_{1t} + c_2 B_{2t} + c_3 D_{1t} + c_4 D_{2t} + c_5 DT_{1t} + c_6 DT_{2t} + y_t^* \quad (2)$$

where B_{it}, D_{it}, and DT_{it} are now defined by the estimated break dates in Table 1. The de-trended series, y_t^*, are the residuals from the OLS regression and are employed in the causality analysis. The results from the trivariate causality tests using two to eight lags are reported in Table 2.

Table E.2: Granger causality in trivariate VAR model, 1970–2010

	Lag-length in VAR						
	2	3	4	5	6	7	8
Causality test in VAR model: CGM, GDP, INV							
CGM → GDP	0.74	0.91	3.06	10.69*	8.84	15.07**	17.56**
CGM → INV	0.40	1.65	0.67	3.03	2.97	2.95	2.33
GDP → CGM	1.93	2.62	3.72	3.56	12.87**	14.72**	15.26*
GDP → INV	2.50	2.77	4.93	9.55*	7.57	6.68	5.45
INV → CGM	0.66	2.35	1.70	1.48	12.25*	15.71**	14.85*
INV → GDP	0.13	0.64	0.77	13.67**	6.82	13.41*	14.57*
Causality test in VAR model: MM, GDP, INV							
MM → GDP	0.02	1.03	1.04	0.58	1.14	1.66	1.56
MM → INV	1.86	3.11	2.83	3.83	4.78	3.87	2.41
GDP → MM	0.06	0.78	1.29	11.40**	16.96***	33.44***	27.28***
GDP → INV	2.56	4.28	4.74	7.49	6.97	4.64	3.67
INV → MM	0.16	1.65	2.02	14.77**	21.48***	40.67***	22.76***
INV → GDP	0.12	1.41	1.53	6.78	3.74	3.79	2.91

Note: *, **, *** denotes the 10, 5, 1% critical value, respectively.

Source: Author's estimation.

Test results show three interesting aspects. First, there is two-way causality between capital goods imports and GDP, running from capital goods imports to GDP and vice versa, while there is one-way causality between total imports and GDP, running from GDP to imports. The impact of one variable on another in both cases takes at least five years to materialize. Therefore, the import-led growth hypothesis is not strongly supported in the Lao economy.

Second, imports have no any impact on investment, indicating that there is no indirect effect of imports on GDP through investment. But investment itself drives imports. Our results are consistent with those found in Rodrik (1995) who argued that an increase in investment causes the rapid growth in East Asian economies and in turn induces imports.

3. Conclusion

This supplementary note examines the causal relationship between imports and economic growth in Laos over the period 1970–2010. The study applies the newly developed unit root test in the presence of endogenous structural breaks. The empirical results indicate that real GDP, real investment, total imports of goods and services, and capital goods imports have multiple breaks approximately categorized around 1985–1991 and 1997 which are consistent with Laos' macroeconomic development, and that the hypothesis of import-led growth is weakly supported.

The results of this study deserve further scrutiny. The endogenous growth theory states that higher imports lead to higher productivity growth, thereby stimulating economic growth. A country's productivity growth is therefore a crucial indicator of how much increased foreign technology can be expected from an exogenous increase in imports. However, for the Lao economy, the rise in foreign direct investment inflows and expansion of financial sector can play an important role in enhancing productivity growth. Consequently, rather than only imports, other factors do have a significant effect on economic growth, resulting in a weak effect of capital goods imports on real GDP. The findings imply that Laos' macroeconomic policies have not been very effective in ensuring the absorptive capacity of foreign technology embodied in imports in the long run.

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