COMPARATIVE ADVANTAGE, FIRM EFFICIENCY AND PRODUCTIVITY: A COMPARATIVE STUDY OF THE GARMENT INDUSTRY IN CAMBODIA, LAOS AND VIETNAM

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by

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For Khec, Nick, Emi and Yuri

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EXECUTIVE SUMMARY

Along with reforms initiated in the late 1980s (Laos[1], Vietnam) and resumption of international assistance in early 1990s (Cambodia) the governments of Cambodia, Laos and Vietnam (CLV) have gradually opened up the economy, liberalized trade and pursued industrialization. Taking these commitments, they have promoted private sector development, welcome foreign investors, and joined regional organizations and participated in free trade areas such as the ASEAN/AFTA and APEC, and become members (Cambodia, Vietnam) or observer (Laos) of the World Trade Organization, just to name some. These development activities have been argued to influence the path of the country's comparative advantages (CA) and industrial development. On top of this, the garment industry has been considered as having CA and potential for export and given priority for the initial phase of industrialization.

As a consequence of the reform, coupled with a production shift in the global garment industry to Southeast Asia, the garment industry in CLV has emerged and grown well for more than a decade. It also has contributed significantly to national output (exports) and employment, and indirectly to poverty reduction efforts of the governments. Yet, upon the MFA abolition and on the eve of the termination of the Safeguards on China, the future of this industry has been discussed more than ever among policy makers and researchers. In lieu of such a significant role, research on comparative advantage and the clothing industry in CLV is still limited, particularly quantitative study.

Recognizing such a need, this study explores the evolution of RCA in CLV for the period of 1985-2005 in the first place, and assesses the performance of the garment

[1] The official name of Laos is the Lao People's Democratic Republic (Lao PDR).

industry and its determinants at the firm level. To our knowledge, this is the first time these issues have been addressed at this comprehension, particularly for Cambodia and Laos. In addition, certain results on the garment industry from the macro-level analysis of RCA can be compared with those from the efficiency and productivity analysis at the firm level. In this regard, the two analyses provide evidence and support to each other and ascertain the findings in a more convincing manner.

By adopting an economy-wide approach, two indices of revealed comparative advantage (RCA), namely the RCA index and NEI index, are calculated for analyzing the structure of external trade, the trends of RCA and export diversification for all exported commodities at the 3-digit SITC level. Country's trade data from the Comtrade database are used for the analysis. In case of unavailability, data reported by trade partners are applied for all available commodities of the missing years. Based on their significance in the export markets of CLV, the trade partners are carefully selected: 47 countries for Cambodia, 38 for Laos, and 51 for Vietnam.

In addition to observing and comparing the value of the two indices of RCA, the study applies the ranking, the standard deviation of the indices of RCA, and Spearman Rank Correlation coefficient and the share of each product (group) in commodity exports to examine the issues and ascertain the findings. Results from this study, while being largely consistent with previous research, provide deeper insights on the CLV's economy, and thereby extend the scope of such research studies to transition economies in Southeast Asia.

It is found that Cambodia, Laos and Vietnam have largely been following the neoclassical path of comparative advantages, moving from agriculture to light and labor-intensive industry. Exports are still concentrated in some agricultural and fishery products (rice, coffee, crustaceans), crude materials (rubber, oil-seeds and fruit

extracts), natural resources (crude oils, copper, coal, wood), and light-industrial products (garment, footwear, wood products). In addition, some other products have gained competitiveness and shown potential for export development. They have registered positive indices of RCA or an upward trend in RCA, yet occupied a small share in exports. These include: (i) for Cambodia: agro-processing and manufacturing industries (fresh or dried fruits and nuts, tobacco products and made-up articles of textiles); (ii) for Laos: agricultural products (maize and cereal, vegetables, preserved fruits) and manufactures (furniture; footwear); and (iii) for Vietnam: crude materials (rubber), manufactured products (furniture and parts, travel goods and handbags), and more capital-intensive products like textiles, electric equipment, and motor cycles. These sectors/industries could be developed for export markets provided that appropriate promotion and sound policies are put in place. Moreover, a shift in exports to light and labor-intensive industrial products in the mid-1990s has been observed, partly reflecting the country's endowments and economic transition and trade liberalization efforts of the governments of CLV.

Overall, export diversification has been low. To some extent, structural changes in exports were evident prior to the shift (1985-1995), but little has been found in Cambodia and Laos since the mid-1990s. Also, intra-industry specialization in the wood processing and garment industry tends to occur in the simple and low value-added product groups. These findings would suggest that the participation in AFTA and the accession to WTO have so far not brought the expected positive effects to competitiveness of these two countries.

Vietnam, on the other hand, has been able to diversify her exports toward manufactured products in the late 1990s implying that reforms have induced positive development in competitiveness and industrialization. Given endowment in natural

resources and labor and her capacity, Vietnam is moving ahead of Cambodia and Laos in the industrialization process and is penetrating more capital-intensive industries such as electric equipment and parts for automobiles. The industrial sector has a much more solid foundation and consists of a wide range from mining, agro-industry, light and labor-intensive industries, some heavy industries, and some more capital-intensive industries.

Unlike some predecessors such as Korea (Lee, 1995), the industrialization process in CLV occurs rather gradually without strong push to capital-intensive industry, as they are still regarded as labor-abundant economies with relatively low labor cost. The exception includes some special large FDI investment projects which the host country does not have the capacity for undertaking like hydropower and large mining projects. The industrialization, as indicated by revealed comparative advantage dynamics, is still in the early stage with some focus on light and labor-intensive industry. This might be a consequence of the development occurring in other developing economies in the region, which have succeeded to move to newly industrialized economies. Industries in these economies have moved to a more capital- and technology-intensive level, and labor-intensive industries have shifted out to other economies with lower wage rates like Indochina. The three countries could use these industries as a base for industrialization. Yet, much still remains to be done to develop a solid base for the industry.

The results of the above analyses have, inter alia, highlighted a dynamic evolution of the garment industry with respect to export performance, competitiveness, and its role in industrial and economic development of the Indochinese countries. Clearly, these results indicate a need for further study on the clothing industry in detail. Consequently, in the second part, the research study evaluates the efficiency level

(technical, pure technical and scale efficiency) and its determinants, and examines total factor productivity (TFP) growth and its sources for garment firms in the production center of each country (Phnom Penh for Cambodia, Vientiane Capital for Laos, and Ho Chi Minh City for Vietnam). The study applies both nonparametric and parametric approaches (Data Envelopment Analysis, DEA-Regression, and Stochastic Frontier Analysis) for empirical analysis. The analysis makes use of secondary data and primary data from four field surveys in CLV.

As for the results, some common characteristics are apparent in Indochina. In particular, a comparable development stage is evident for Cambodia and Laos, although the difference in the industry's scale is large. On the other hand, the industry in Vietnam is rather more developed and has a better backward linkage and a significant domestic market.

Despite a continuing expansion, the Cambodia's and Lao garment industry is facing some difficulties to catch up with neighboring competitors in the post-MFA era in terms of efficiency. Within the domestic supply chain, local firms are struggling to catch up with foreign competitors. They also have many other common features. First, the dominance of foreign firms is pronounced in all aspects, including number of firms, employed labor, output and efficiency performance. Second, the current technological level appears to be out-of-date or there is a mismatch between technology and labor skills. Third, the role of human capital is evident in two aspects: (i) upgrading production technology should take into account the labor skill level in order to optimally utilize production equipment and new technologies; and (ii) the knowledge and skill level of local staff at the middle management level should be improved if firm efficiency enhancement and productivity augmentation are to be realized.

A specific characteristic for Cambodia is that the presence of foreign and expatriate workers, product variety and the agglomeration in Phnom Penh do not appear to contribute to efficiency enhancement. For Laos, efficiency improvement and productivity augmentation are evident at the firm level, while the opposite is observed at the industry level. There is an urgent need to enhance firm efficiency and productivity; in particular, there is much room for technical change or technical progress.

Turning to Vietnam, the industry has some specific characteristics in that firm ownership is classified in terms of legal status of enterprises or shareholding. There is no evidence of foreign dominance, but rather domestic firms are major players. For small and medium size enterprises non-state and foreign ownership give rise to firm efficiency enhancement, whereas state-ownership is of advantage for large-scale garment firms. Moreover, in the competition for government funding, more efficient SOEs have benefited from large-scale public investment, undergone and completed the privatization process ahead of their less efficient counterparts. Having advantage in state-of-the-art technologies, these larger firms should focus on higher value added garment products.

In summary, in terms of efficiency garment firms in Phnom Penh and surrounding areas are more widespread than firms in Ho Chi Minh City, but less than those in Vientiane Capital. In other words, the short-term dispersion of firm efficiency in Cambodia lies between that of firms in Vietnam and Laos. Recently, this efficiency gap in Laos has widened. The current garment supply in CLV mainly concentrates on simple products and the CMT-type operation. Investment in physical capital should go parallel with human resource development if the efficiency level is to be improved.

Foreign and private ownership would significantly contribute to efficiency augmentation.

In order to make use of the findings from the research, certain policy implications can be drawn for CLV as follows. CLV would need to build a solid base for industrialization, such as improving hard and soft infrastructure and enhancing human resource development, to accommodate successes and rapid development in real sectors. Export diversification should be fostered and accelerated to cover agricultural products and crude materials with rising CA in the mean time, and to gradually move to light and more capital-intensive industrial products in the longer term (e.g. electric equipment, parts for automobiles). To this end, appropriate and sound industrial and trade policies should be put in place to realize the potential of sectors and industries with CA, and thereby diversifying relatively concentrated exports and moving to higher value-added products.

With regard to the clothing industry, the formulation of industrial, trade and (vocational) education policy should be harmonized aimed at obtaining monetary and technological benefits from trade development and industrialization. Specifically, investment in human resources and labor skill development at the grass root level (e.g. tailored skill training, supporting Garment Industry Productivity Center) should be promoted and coordinated with the industry in order to capitalize on investment in physical capital and state-of-the-art technologies. Moreover, appropriate foreign direct investment should be stimulated to attract quality FDI and more efficient foreign enterprises so as to promote efficiency and productivity enhancement in the garment industry as a whole. Certainly, specific policies for individual countries are essential to adjust to the local context, and thereby maximize the benefits.

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ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
AFC	Asian Financial Crisis
AFTA	ASEAN Free Trade Area
ALGI	Association of Lao Garment Industry
APEC	Asian Pacific Economic Cooperation
ASEAN	Association of South East Asian Nations
ATC	Agreement on Textiles and Clothing (of WTO)
BCC	Banker, Charnes, Cooper (name of model developers and the model)
BTA	Bilateral Trade Agreement
CA	Comparative Advantage
CCR	Charnes, Cooper, Rhodes (name of model developers and the model)
CIF	Cost Insurance Freight
CLMV	Cambodia, Laos, Myanmar, Vietnam
CLV	Cambodia, Laos, Vietnam
CMDG	Cambodia's Millennium Development Goal
CMT	Cut-Make-Trim
CRS	Constant Returns to Scale
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
Doi Moi	Reform or transition policy adopted by Vietnam
EFFCH	Efficiency Change (catch-up)
EU	The European Union
FDI	Foreign Direct Investment
FOB	Free On Board
GATT	General Agreement of Tariffs and Trade
GDP	Gross Domestic Product
GMAC	Garment Manufacturers' Association in Cambodia
GMS	Greater Mekong Sub-Region
GSO	General Statistics Office (Vietnam)
GSP	Generalized System of Preferences
HCM	Ho Chi Minh City
JV	Joint Venture
KMR	Khmer Riel (currency of Cambodia)
Lao PDR	Lao People's Democratic Republic (known as Laos)
LDC	Least Developed Country
LKP	Lao Kip (currency of Laos)
LSE	Large Scale/Size Enterprise
LTA	Long-Term Agreement (on trade in cotton textile)
MFA	Multi-Fibre Agreement
MFN	Most Favored Nation
MI	Malmquist (Productivity) Index
NEI Index	Net Export Index, UNIDO-type Index, Trade Specification Index
NEM	New Economic Mechanism (reform policy adopted by Laos)
NIS	National Institute of Statistics (Cambodia)
NPRS	National Poverty Reduction Strategy
NSC	National Statistics Centre (Laos)
NSDP	National Strategic Development Plan

NTFP	Non-Timber Forest Product
NTR	Normal Trade Relations
OECD	Organization of Economic Cooperation and Development
OLS	Ordinary Least Squared
PEFFCH	Pure Efficiency Change
PIP	Public Investment Plan
PNH	Phnom Penh
PPC	Production Possibility Curve or Production Possibility Set
PTE	Pure Technical Efficiency
RCA	Revealed Comparative Advantage
RCA Index	Revealed Comparative Advantage Index, Balassa's Index, Export Performance Index, Revealed Export Competitiveness Index
RGC	Royal Government of Cambodia
RMG	Ready Made Garment
ROO	Rule of Origin
SCALECH	Scale Efficiency Change
SE	Scale Efficiency
SEA	Southeast Asia, Southeast Asian
SEDP	Socio-Economic Development Plan
SFA	Stochastic Frontier Analysis
SITC	Standard International Trade Classification (by the United Nations)
SME	Small and Medium Enterprise
SOE	State-Owned Enterprise
SRC	Spearman Rank Correlation or Spearman's Rho
STA	Short-Term Agreement (on trade in cotton textile)
T&G	Textile and Garment (industry)
TE	Technical Efficiency
TECH	Technical Change (frontier-shift)
TFP	Total Factor Productivity
TGF	Textile, Garment and Footwear (industries)
UN	United Nations
UNIDO	United Nations Industrial Development Organization
UNTAC	United Nations Transitional Authority for Cambodia
US	United States or United States of America
USAID	United States Agency for International Development
VITAS	Vietnam Textile and Apparel Association
VND	Vietnamese Dong (currency of Vietnam)
VRS	Variable Returns to Scale
WB	The World Bank
WTO	World Trade Organization

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF THE STUDY

In the contemporary world there is clear interdependence among groups, individuals and countries across borders. One indication of this interdependence is the large volume of export and import of goods among nations. As countries have different endowments, transactions among them are vital to accelerate economic development and meet the ever-growing need of their people. Hence, movement of goods and factors of production across national borders is indispensable to ensure efficient resource allocation and utilization at the global level. Trade across borders has led countries to diversify their production and specialize in producing goods, in which they have comparative advantage (CA) aiming at coping with competition in global markets. In other words, countries tend to produce goods, for whose production inputs are abundantly available, because a country's CA is related to her endowment. It is also said to be "the outcome of the interaction between factor endowment *(country characteristic)* and factor intensity *(industry/ product characteristic)*" (Hirsch, 1974).

Turning to Indochina[2], along with economic reform initiated in the late 1980s and resumption of international relations in early 1990s, the governments of Cambodia, Laos and Vietnam (CLV) have opened up the economy and carried out international trade commitments. This undertaking would have some impacts on their CA and influence the path of industrialization and economic development. In an increasingly globalized world of trade, CLV appear, at the first glance, to have little chance to compete with much larger and stronger competitors. However, in such a huge world of production there would be certain commodities, in which these economies would have

[2] In this dissertation, Indochina consists of three countries: Cambodia (Kingdom of Cambodia), Laos (Lao People's Democratic Republic) and Vietnam (Socialist Republic of Vietnam), which are called 'CLV'. Hence, throughout the dissertation, the term 'Indochina' and 'CLV' are used interchangeably to denote these three countries.

comparative advantage. Vollrath (1991) stated: “It is not unusual for a country to have a comparative disadvantage for a composite commodity and yet have a comparative advantage for a particular niche within this composite.”

With respect to industrialization, CLV have followed a rather gradual approach and emphasized such industries which utilize output of the agriculture or the country’s abundant resources. For example, the agro-processing and garment industry, which rely on agricultural output and cheap abundant labor, have been selected among priority sectors for the initial phase of the industrialization process. These industries are considered to possess some comparative advantage or potential for development.

Looking at the history of the textile and garment (T&G) industry, spinning and weaving are custom in many cultures and countries. Textiles and clothing have always been essential goods for human beings. This industry was a driving force of the Industrial Revolution in the late 18th century. It had absorbed large amount of labor released from the agriculture in the initial stage of industrialization. Since then T&G industry has widely been used as the base for this process. This occurred in many developed nations and the newly industrialized economies, and it continues to play a crucial role for Cambodia, Laos and Vietnam.

The production of textiles and clothing is very much diversified, starting from production of natural fibers (cotton, silk, wool) or synthetic and artificial fibers, to spinning (production of yarns), to weaving (production of fabrics), and to cutting and sewing to make final products (production of apparel and clothing). Along this supply chain the labor intensity and the number of firms tend to increase, especially in the production of fabrics and clothing (Nordås, 2004). T&G products range from very capital and knowledge intensive, like fashions and sport-wear, to very labor intensive, such as casual clothes. Following technological advancement, such as computerized weaving systems and automatic cutting machines, much of the spinning, weaving and cutting processes has been made automatically and has become relatively more capital

intensive. However, the garment industry (or subindutry) still uses a large amount of labor and it is considered labor-intensive sector flowing the agriculture. Hence, given endowment and technological level, countries can specialize in different areas and stages of the supply chain.

The second half of the 20th century has witnessed a shift of the garment industry from areas with rising and high wages to production areas with low labor costs, such as developing countries in Asia. Following this production shift, the garment industry in Indochina emerged in the latter half of the 1980s and the first half of the 1990s. Since then this industry has formed the backbone of the economy both in terms of output and employment.

Garment exports of CLV have grown remarkably over the decade and reached more than US$7 billion in 2005. For national economy, this industry contributes 15 to 83 percent of commodity exports depending on the country. In the global stage, the CLV's garment industry has played an increasingly important role in apparel and clothing supply in both value and share in the world markets. From a social point of view, the garment industry has also contributed a great deal to poverty reduction targets of the governments of CLV. The industry is the major non-agricultural sector providing job opportunities and income generation for the poor, mainly less educated girls from rural and remote areas. It employs 16 to 34 percent of the labor forces in industries in Indochina. Moreover, the remittances which these workers send back home for their families can sustain the daily life of an underprivileged portion of the population.

Following a prosperous decade, the future of the Cambodia's and Lao garment industry was subject to debate when the quantitative restrictions of T&G trade was put an end upon the Multi-Fiber Agreement (MFA) phase-out on 1 January 2005. Prior to this event there were many discussions on the looming future and the survival of the garment industry in the two countries with the most widely cited being the forecast in a WTO discussion paper (Nordås, 2004) that China and India would benefit from this

development and other small garment producers located far from major markets such as Cambodia and Laos would lose market shares. Also for Laos, it is argued that unless there are some initiatives to improve the situation many of the domestic enterprises and some Joint Venture companies would not survive, several thousands of jobs would be lost, foreign exchange earnings would drop and the national economy would suffer (Boutsivongsakd et al., 2002).

However, it has turned out that Cambodia, among some successful LDCs like Bangladesh, has survived the adverse price shocks and overturned the predictions, and emerged as a competitive garment exporter with relatively high profitability on average (Bargawi, 2005; Yamagata, 2007). Similarly, these harmful impacts have not yet been evident in the Lao garment industry (NSC, 2007a). Partly, because this favorable development is accompanied by the implementation of the Safeguard policy by the European Union (EU) and the United States on China's garment exports. Yet, amid such positive development trends, the competitiveness of the garment industry in Cambodia and Laos is still lower than that of many rival garment exporting countries in the region and elsewhere.

The situation for Vietnam is different. Indeed, the future of this industry looks even brighter after the country joined the World Trade Organization in 2007 and the normal trade relations and the bilateral trade agreement with the US have been established. Exports of textile and garment products are expected to take off in near future. The industry is undergoing a privatization and all state-owned enterprises (SOEs) will be transferred to private or Joint Stock companies by 2010. Yet, like China, despite being a labor abundant economy, the T&G industry in Vietnam has been facing serious labor shortage and wages are on the rise recently. The problem is more serious for factories located in urban areas (local labor shortage).

Derived from this, the more important long-term question for CLV is whether the garment industry can gain and retain competitiveness after the Safeguards on China

are lifted at the end of 2008. Cost savings, shaving of profit margins, (labor) productivity and efficiency improvement are deemed among the key factors to cope with price falls, enhance the competitiveness and further develop the industry (Bargawi, 2005; USAID, 2005; NSC, 2007a). Despite such importance, the pressing problems in the CLV's garment industry have not yet been sufficiently addressed. Published research studies on efficiency and productivity for CLV are rather limited in both number and scope, especially investigations at the firm-level. They are also often presented in form of qualitative studies, or trend analysis or project reports. In addition, there exists a lack of comprehensive study on comparative advantage covering the whole economy, particularly for Cambodia and Laos, to identify sectors/industries which possess CA for developing into exporting sectors/industries. This is also deemed necessary for risk management and export diversification.

In all, there exists an urgent need for analysis of comparative advantage at the national/industry level and the garment industry in more detail for CLV in order to address the aforesaid issues more comprehensively, identify relationships among such issues at two different levels and provide across-country comparison.

1.2 OBJECTIVES OF THE STUDY

In view of filling this study gap, the present dissertation intends to study the patterns of external trade and the evolution of revealed comparative advantages (RCA) over the period of 1985-2005, and look into possible relationship between the changes in RCA and the industrialization process in Cambodia, Laos and Vietnam in the first place. Then, based on the result, a specific industry with a significant role in the national economy, i.e. the garment industry, has been selected for further investigation in more detail. Hence, the second objective is to analyze firm efficiency and its determinants and to evaluate total factor productivity (TFP) growth and its sources for the garment industry in three countries.

The dissertation attempts to address such questions as: Do CLV follow the neoclassical path of comparative advantages, i.e. to move from agriculture to labor-intensive and then capital-intensive industries? Does trade liberalization including joining ASEAN/AFTA[3] induce changes in trade structures and RCA? What is the average efficiency level of the garment industry in CLV? How are garment firms distributed in terms of efficiency performance? To which extent firm's characteristics affect efficiency? Is there any change in TFP after the MFA phase-out and what are the sources? Are there any differences in efficiency and productivity among the types of ownership or nationalities? In addition, derived from the findings, attempt has been made to compare the path and stage of industrial development among CLV in general; and more specifically to figure out any unique characteristics of the garment industry in the three countries.

1.3 UNIQUENESS, SIGNIFICANCE AND LIMITATION

This dissertation possesses the uniqueness in the scope and approaches of the analysis and distinguishes itself from previous studies in some significant aspects. First and foremost, it covers three transition countries (CLV) with close relationship in political and socio-economic development and compatible development policies in the analysis. Hence, the issues under examination can be addressed in a regional context and a cross-country comparison is possible. Second, the analysis consists of two distinctive parts, namely a macro-level and a micro-level analysis. Results from the first part are reflected in the second part, thereby provide support to each other and sustain the arguments and policy implications.

Specifically, the macro-level analysis adopts an economy-wide approach, while looking at individual commodity groups (sub-industries) at the three-digit level of the Standard International Trade Classification (SITC) using two different indices of RCA.

[3] ASEAN stands for the Association of South East Asian Nations and AFTA for ASEAN Free Trade Area.

It examines the evolution of RCA for a period with significant changes in development policies and can shed some light on development path in CLV. To our knowledge, this study is the first of its kind at this comprehension level for such an extended period, particularly for Cambodia and Laos. Previous studies tend to cover shorter period or focused on selected commodities or employed only the two-digit SITC category without ranking the indices of RCA.

On the other hand, the firm-level analysis addresses the contemporary issues (efficiency and productivity) in a crucial sub-industry, the garment industry, with relatively homogenous enterprises with respect to operation, technology and other firm characteristics. In each country the analysis covers the major production center, i.e. an area with very high concentration of production and employment of the garment industry and could be considered as country representative. Hence, inferences from the analysis would be more persuasive in terms of statistical and economic aspects.

Despite high accuracy in modern empirical methods, the analyses in this dissertation face two limitations in data availability and reliability, which are beyond our control and the scope of study: (i) the use of commodity trade data reported partners might have some impact on the resulting value of indices of RCA; and (ii) data on capital and revenue of garment firms might be somewhat imprecise owing to lack of breakdown information. Nonetheless, given the relatively good data quality and careful data mining, efforts in collecting and/or estimating more precise information on the abovementioned variables would not alter the results and the conclusions of the analysis.

1.4 ORGANIZATIONAL STRUCTURE

In terms of organizational structure, the dissertation is laid out in the following manner: Chapter 1 introduces issues of comparative advantages; economic

development; and the garment industry in Indochina, and presents the objectives; significance and structure of the dissertation.

Chapter 2 reviews relevant research studies on revealed comparative advantage, introduces the methodology of measuring RCA applied in the dissertation, describes the data, and presents a brief overview on economic development in CLV with an emphasis on trade and industrial development. This chapter also analyzes structural changes in exports and imports of CLV.

Chapter 3 presents the macro-level analysis of revealed comparative advantages and their impacts on the industrialization process in CLV, and discusses the empirical results for each country in detail. The chapter not only identifies sectors and industries with dynamic development and competitiveness, but those with potential for further development as well.

Chapter 4, in recognizing the necessity of further study on the garment industry, gives an overview of the evolution of the global garment industry and illustrates recent trends in global and regional garment trade. In addition, relevant literature of efficiency and productivity studies is reviewed. It also describes the theoretical framework and the models of efficiency and productivity measurement.

Chapter 5 discusses recent development and relevant issues of the garment industry and describes the firm-data for the study. Then, it presents the analysis of efficiency and productivity using DEA and SFA and discusses the empirical results for each of the countries in detail.

Finally, Chapter 6 summarizes the main results from the macro- and micro-level analyses in Chapter 3 and Chapter 5. Conclusions, major policy implications and prospects for further study also are presented in this chapter. A bibliography is provided at the end of the dissertation.

CHAPTER TWO
LITERATURE REVIEW AND MEASUREMENT OF COMPARATIVE ADVANTAGE, DATA, AND ECONOMIC DEVELOPMENT IN INDOCHINA

2.1 REVIEW OF LITERATURE ON COMPARATIVE ADVANTAGE

In modern literature, the term 'comparative advantage (CA)' is often applied to denote 'competitive advantage or competitiveness' and these two terminologies are often used interchangeably. The latter has often been argued to be influenced by government policy or man-made issue. In this dissertation these two terms shall also be used interchangeably. In most cases, indicators employed to evaluate or determine comparative advantage and competiveness are equivalent or identical.

To date, there exist numerous explanations for and theories on why some countries are competitive and others not, but they are far from consistent. There is no single definition for 'competitiveness'. Instead, the issue can be interpreted in many different perspectives (firm-, industrial, national level etc.) and the approaches are also complex. For example, a scope of interpreting international competitiveness could include the following: producer and trade perspective; microeconomic and macroeconomic approach; development competitiveness; internal and external competitiveness; domestic welfare; utilization of local resources; static and dynamic competitiveness; and ability of a country (Bin Hamat, 2005, p. 68, Table 3.1). To reflect this complexity, Porter contended: 'I must explain why efforts to explain the competitiveness of *an entire nation* have been unconvincing, and …that understanding the reasons for the nation's firms to create and sustain competitive advantage in particular industries is addressing the right question, not only for informing company strategy but also for achieving national economic goals' (Porter, 1990, p. 3).

In this regard, comparative advantage, particularly at the industrial and national levels, is related to: (i) macroeconomic variables, such as interest rates, exchange rates, government deficits, and government policy and intervention; (ii) country's endowment like cheap and abundant labor; and (iii) management practices like labor-management relations (Porter, 1990).

Table 2-1: Summary of indices of competitiveness

Level	Indicators
Firm	1. Firm's profitability; 2. Unit cost of labor; 3. Total factor productivity (TFP)
Industry	1. Total factor productivity; 2. Cost; 3. Per capita manufactured value-added; 4. Per capita manufactured exports; 5. Medium and high tech activities in manufactured exports; 6. Share of medium and high tech activity in manufactured exports
Country	1. Trade performance; 2. Unit labor cost; 3. Real exchange rates

Source: Adapted from Bin Hamat (2005). Table 3.2, p. 71.

In view of evaluating the level of comparative advantage or competitiveness, several indicators have been developed in literature. Table 2-1 presents a summary of indices of international competitiveness. This study mainly follows the approach to measuring CA/competitiveness at the product-, industry- and country-level.

Bin Hamat (2005) provides a comprehensive review of literature on international competitiveness with respect to approaches/definition, indicators (at three levels as in the above Table), determinants (internal, external), and measurement (cost, trade or market-share approaches), and impacts of FDI on competitiveness (p. 67-86). The remaining of this section reviews literature on the development and application of the revealed comparative advantage index (RCA index) and the net export index (NEI index), and Section 2.2 presents the definition of these indices and some other indicators applied in the empirical analysis.

2.1.1 Measuring Comparative Advantage

The history of the widely discussed 'comparative advantage' dates back to the trade theory developed by Ricardo, Heckscher and Ohlin. Comparative advantage in such theories is related to autarkic prices (or cost to produce a good in autarky) which are not observable in the real world. Researchers being left with post-trade prices have

long tried to infer real comparative advantage from nations' export performances that are revealed from the international trade. The measurement of comparative advantage practically started when Balassa (1965), in an attempt to study the long term effects of trade liberalization, formally introduced the concept of a 'revealed' comparative advantage (RCA). The author discussed various theoretical explanations of international trade and approaches to measuring RCA, and factors influencing the patterns of comparative advantages. He contended [ibid., p. 116]: "Comparative advantages appear to be the outcome of a number of factors, some measurable, others not, some easily pinned down, others less so." Balassa argued that individual countries' trade performance can reveal the comparative advantages because it reflects relative costs as well as differences in non-price factors. The proposed 'export performance index' – widely called in literature Balassa's index or revealed comparative advantage index (RCA index)[4] – was applied to 74 manufactured commodities of the Standard International Trade Classification (SITC) of 11 main industrial countries to analyze their revealed comparative advantage (Belgium, France, Italy, Luxembourg, Netherlands, West Germany, the United States, Canada, the United Kingdom, Sweden and Japan).

Since the 1970s empirical studies on international trade have focused on measuring the nations' comparative advantage and their positions in such a continuing scale of comparative advantages. Attempts have been made to quantify the RCA at different levels – enterprise, industry (sectoral) and national levels – by applying various approaches, such as cost; supply-demand (production-consumption); and trade (export-import) approaches (Donges and Riedel, 1977; Balassa, 1979; UNIDO, 1982; Marchese and De Simone, 1989). As a result, a number of indices of RCA have been developed. Following Balassa, Donges and Riedel (1977) constructed an index of RCA

[4] In this dissertation, the terms 'export performance index', 'RCA index' and 'Balassa's index' are used interchangeably.

(hereafter D-R index) to analyze the impacts of trade policy on export diversification of 15 least developed countries (LDCs), and found that semi-industrial developing countries exhibited RCA in labor-intensive, raw material-intensive and light manufacturing industries.

In a study on the patterns of comparative advantages in the world's trade of manufactures, UNIDO (1982) discussed various factors influencing a country's comparative advantages and offered two different interpretations of impacts of product cycles on comparative advantages. They regarded comparative advantage as a 'constant changing (dynamic) concept' and employed three measures of RCA – (a country's) share in total exports of manufactures, net export index[5] (NEI index), and export-performance ratio – for three possible ways of comparisons: across commodities/industries in a country, in an industry across countries, and one commodity/industry over time.

In another study, Bowen (1983) presented an alternative interpretation of Balassa's index in a statistical framework and concluded that interpretation of net export (trade intensity) index above/below unity as an indicator for comparative advantage/disadvantage is not appropriate. He then went further and introduced two indices of RCA: net trade intensity and production intensity index. However, the validity of his alternative indices was questioned by some researchers on different grounds (Ballance et al., 1985; Vollrath, 1991).

Out of the indices of RCA developed in literature, which measures are the most appropriate in reflecting a country's comparative advantages? In answering this question, a section of international trade literature has emphasized on evaluation and testing of indices of RCA in various aspects (Yeats, 1985; Ballance, Forstner and Murray, 1987; Vollrath, 1991). Hillman (1980), for instance, used Balassa's index to analyze the relationship between RCA and comparative advantages indicated by

[5] In trade literature the net export index is often referred to as UNIDO-type index.

autarkic prices; established theoretical discussions for cross-commodity and cross-country comparison; and developed the so-called Hillman condition for cross-country comparison. The author maintains that for small countries with (sufficient) export diversification the Hillman condition is generally satisfied and RCA is consistent with the comparative advantage indicated by pre-trade prices.

Ballance et al. (1987) classified indices of RCA into two types: trade-only indices (Balassa's index, net export ratio, D-R index) and production-cum trade index (Bowen's indices), and tested ten indices (3 trade-only indices, 7 production-cum trade indices) on their consistency in three aspects as cardinal, ordinal and dichotomous measures. Their empirical tests employed data on 25 commodities from about 32 countries at the 3-digit to 5-digit level of the SITC for the former and at the 6-digit level of the International Standard Industrial Classification (ISIC) for the latter. They found a high degree of consistency among the indices tested, particularly among trade-only indices, as ordinal and dichotomous measures, and suggested that these should be used as ordinal or dichotomous indicators in empirical models.

In a theoretical survey, Vollrath (1991) discussed and compared the theoretical underpinnings of alternative indices of RCA with a focus on global intensity measures. The survey examined ten indices which include export performance indices (Balassa type index[6]), net export index (UNIDO type index), D-R index, Bowen's alternative indices, and Vollrath's indices (these are indices proposed by him). Among three Vollrath's indices, the index of 'relative export advantage[7]' is a Balassa type index which eliminates the country and commodity double counting in the world's exports and is presented in natural logarithm. He concluded that the most satisfying measures are the relative export share measure (Balassa's index) and the three Vollrath's indices, particularly Balassa's index (RCA3) and the relative export advantage measure

[6] The 'enlarged' Balassa's index including exports from all countries is denoted by RCA3 in Vollrath (1991).
[7] This index is denoted by RCA9 in Vollrath (1991).

(RCA9) are preferable. Despite favoring the latter, he concluded that at the low levels of data (commodity) aggregation and/or for small countries in terms of share in world's commodity exports the difference between these two measures is negligible.

The application of the net export index as a measure of comparative advantage is occasionally criticized, because imports are significantly influenced by the system of protection used in a country (Balassa, 1979; Vollrath, 1991). However, this index has often been used in empirical studies in combination with other indices of RCA as it can cast some light on a country's trade performance, inter- and intra-industry trade (UNIDO, 1982). Based on this and other positive aspects, many empirical studies have applied export performance index and net export ratio for analyzing a country's comparative advantages and/or comparing RCA across countries and commodities (Hirsch, 1974; Petri, 1988; Lee, 1995; Hara and Shuto, 2005). For example, by analyzing the RCA trend in manufacturing industries for 1975-92 South Korea has been found to gain dynamic comparative advantage through the development of capital-intensive industry within a labor-surplus economy (Lee, 1995). On the other hand, in a study on North Korea's external trade, Lim (1997) argued that examining only exports might not reflect the whole picture of RCA since this ignores half of the trade behavior. He, in turn, employed net export index, index of revealed export comparative advantage (Balassa's index), and index of revealed import comparative advantage in analyzing the country's RCA for 1970-1992 and found that North Korea has achieved little success in moving form natural resource-based exports to more standard technology-based goods and that it would be difficult for the country to enter the more advanced stage. In another study, Bojnec (2001) moved from manufacturing and extended the scope of his research to regional trade of agricultural products for Europe, Oceania, Asia, Africa etc. He applied relative RCA index for exports and imports to calculate the relative RCA index for trade and suggested that, RCA index

using export data is less distorted by trade impediments, while indicators calculated from import flows are more subject to domestic protection policies.

2.1.2 Selected Studies of Trade and Comparative Advantage in CLV

Published empirical studies on comparative advantages for developing countries and CLV are still limited, especially for Cambodia and Laos. A remarkable work for Cambodia is the study on policy support by the Japan International Cooperation Agency (JICA), in which export share and RCA have been estimated for selected products (garment; footwear; frozen fish fillet; crustaceans; tapioca and derived products; palm oil; and automotive electrical equipment) for 2000-2020. It has been found that, despite maintaining the leading role over the period, the garment industry would slightly lose comparative advantage and percentage share in total exports towards 2010 and then increase again until 2020. Moreover, footwear, some processed agricultural products (cassava/tapioca and aqua-marine products) and frozen fish fillet show potential of becoming major export commodities, but other commodities would need longer time for development (JICA, 2007). The work, however, largely focuses on some specific commodity groups and could not provide an economy-wide comparison and the rankings of indices of RCA.

For Laos, the study by Hara and Shuto (2005) should be mentioned. The authors employed Balassa's index and NEI index[8] to evaluate Lao competitiveness structure and the changes of trade structure through experiences of some selected East Asian economies. The authors decomposed the net export index in a way that the country's net export ratio is the weighted average of the net export indices with individual trading partners with the weight being the share of the bilateral exports to the corresponding partners in the country's total exports. The authors found that (1) Laos has competitiveness in agricultural products, organic and handicraft products, and

[8] In their paper the net export index is also called the trade specification index (TSI).

natural 'Thamasat' products, such as coffee, wood and wood products, apparel, and live animals; and (2) the commodity competitive structure of Laos is similar to that of Thailand. In their analysis, however, the RCA and NEI indices for Laos were calculated as the average of 1999-2001 and 2003, and thereby ignoring the time trend. Also, conclusions on long term comparative advantage of Laos were drawn indirectly from the changing patterns in RCA of certain economies in the region.

A noticeable work on Vietnam's RCA is the study on trade regime and comparative advantage by Nguyen (2002). The author has evaluated Vietnam's trade reform policies and their consequences by analyzing the rates of protection, export similarity and RCA between Vietnam and six selected ASEAN members and concluded that (i) the country's export structure is closer to that of Indonesia, Malaysia and Thailand; (ii) the export structure would be more complementary with that of Malaysia, Singapore, and Thailand, and the country could be competitor of Indonesia and the Philippines in some commodities; and (iii) Vietnam has RCA in cereals, coffee, hides, oil-seeds, rubber, fish, coal, wood, crude oil, travel goods, textiles and garments, footwear, and furniture. Nevertheless, using trade data of 1995-1998 the analysis of RCA focuses merely on a short period after the Doi Moi[9] initiative at the two-digit level of the SITC. Also, the export similarity was examined for three years 1997-1999 for commodities in the Japanese markets.

Derived from this, there still exists much room for research in the area of comparative advantage for developing and least developed countries, particularly such that cover a longer study period and a wide range of economic sectors and industries. In an attempt to widen the research scope, this study includes all commodities in analyzing the RCA trend for CLV for 1985-2005. In addition, the study can provide a comparison of patterns of comparative advantages or competitiveness in a regional

[9] Doi Moi is the name of the open-door policy adopted by the Vietnamese government in order to transform its economy from a centrally planned to a market-oriented one.

context. Also, owing to the use of the 3-digit SITC the regional evaluation of RCA can be done at the product-level. In other words, it can observe whether there is strong similarity in patterns of CA among three countries. This is a very interesting issue, because Vietnam appears to be ahead of Cambodia and Laos in industrialization process and CLV have adopted more or less comparable economic development policy.

2.2 MEASUREMENT OF REVEALED COMPARATIVE ADVANTAGE

Following Balassa (1965) the concept of revealed comparative advantage refers to the relative export performance of a country in a particular commodity trade. Under the assumption that the trade pattern reflects relative costs and differences in non-price factors (differences in quality, goodwill and services etc.), the notation 'revealed' is derived from the concept that the commodity pattern of trade would 'reveal' the comparative advantage of trading countries. An alternative way to measure RCA is to consider revealed comparative advantage as an outcome of the interaction between an industry's exports and imports of the corresponding commodity group (UNIDO, 1982).

In view of inferring the comparative advantages of Laos, the study pursues the two afore-mentioned alternative concepts and uses the Balassa's export performance index and the net export index to examine the patterns of external trade and the dynamics of the country's RCA for the period of 1985-2005. Also, it would enable us to compare the behavior of the two indices and to assure the reliability of the results.

2.2.1 Revealed Comparative Advantage Index (RCA Index)

The revealed comparative advantage index, extended to all commodities, is defined as the ratio between (a) the share of a country's commodity exports in the commodity exports of the world, and (b) the share of the country's total exports in the total exports of the world, as shown in the following equations:

$$RCA_{i,j} = \frac{X_{i,j} / X_{w,j}}{X_{i,tot} / X_{w,tot}} \quad (2.1) \text{ or}$$

$$RCA_{i,j} = \frac{X_{i,j} / X_{i,tot}}{X_{w,j} / X_{w,tot}} \quad (2.2)$$

where $RCA_{i,j}$ is the revealed comparative advantage index of country *i* in commodity group *j*, $X_{i,j}$ denotes country *i*'s exports of commodity group *j*, $X_{w,j}$ the world's exports of commodity group *j*, $X_{i,tot}$ country *i*'s total exports, and $X_{w,tot}$ total exports of the world.

In this form the RCA index takes a non-negative value. An index of 1.2 means that the country's export share in commodity group *j* is 20% higher than its share in the total exports of the world. An RCA index above/below unity indicates the country's comparative advantage/disadvantage in the corresponding commodity group.

In literature this index is attached various names: RCA index, export performance index, Balassa's index, revealed export competitiveness index. In this study all these notions are used interchangeably to denote the revealed comparative advantage index.

As in Petri (1988) and Lee (1995), this paper reports the RCA index in common logarithm (logarithm base 10) for ease of interpretation. In this form the index can take a negative or positive value, or zero. For example, an RCA index of zero means that the export position of country *i* in a given commodity is as large as its share in total exports, and a value of -1.0 means that it is 1/10th as large. Therefore, an index of greater/less than 0.0 is regarded as 'high RCA'/'low RCA.'

2.2.2 Net Export Index (NEI Index)

The net export index is defined as the ratio of a country's net exports (exports minus imports) to the country's total trade (exports plus imports). The index is presented in the equation form as below:

$$NEI_{i,j} = \frac{\left(X_{i,j} - M_{i,j}\right)}{\left(X_{i,j} + M_{i,j}\right)} \tag{2.3}$$

where $NEI_{i,j}$ is the net export index of country *i* in commodity group *j*, $X_{i,j}$ country *i*'s exports of commodity group *j*, and $M_{i,j}$ country *i*'s imports of commodity group *j*.

The measure expresses the net exports of a country relative to its total trade and ranges between -1 and +1. The former corresponds to no exports of country *i* in commodity group *j* and the latter means that country *i* does not import any goods of commodity group *j*. Although the interpretation of this measure is subject to criticism due to the pronounced impacts of the protection structure on the levels of imports, this index contains important information about the trade performance of a country. Its absolute value $\left|NEI_{i,j}\right|$ represents the portion of inter-industry trade relative to the total trade of any commodity group, and $\left(1-\left|NEI_{i,j}\right|\right)$ consequently corresponds to the portion of intra-industry trade. Thus the measure illustrates the significance of the net exports/net flows in a commodity group.

Similar to the RCA index, the NEI index is referred to by various notions: the NEI index, UNIDO-type index, and trade specification index (TSI index). All these names are used interchangeably in this dissertation to denote the net export index.

2.2.3 Indicators of Dynamic Changes in RCA Trend

The assessment of the indices of RCA[10] in absolute terms illustrates the degree of a country's comparative advantage, and hence, one can classify industries or commodity groups into high RCA or low RCA category. However, solely relying upon the absolute terms could lead to misinterpretation of comparative advantage, because a certain commodity group could hardly increase its export share if it has already occupied large portion of the nation's exports. In addition, as the range of the export

[10] The notion 'indices of revealed comparative advantage' (indices of RCA) means the two indices (Balassa's index and the NEI index) applied in this study. On the other hand, the RCA index is only used to denote the Balassa's index.

commodities of a country becomes more diversified, it is more difficult for any commodity group to increase its share in this market (Lee, 1995). Therefore, in the analysis both the value and the ranking of the indices of RCA are considered, since they show the trends and the changes of RCA, and thereby illustrate the dynamics aspects of comparative advantages.

In addition, in order to examine various aspects of the trade patterns, such as the diversification and the similarities/differences of the export structures over time, three additional indicators are applied: (1) the share of high RCA cases (i.e. RCA and NEI index with value of greater than unity) in total ranked products; (2) the standard deviation of the indices of RCA; and (3) the Spearman Rank Correlation (SRC) coefficient are considered (Spearman, 1904). If the range of a country's export commodities becomes more diversified, the share of high RCA cases is expected to remain unchanged or increase and the standard deviation of the indices of revealed comparative advantage is expected to decline. In particular, the SRC coefficient deserves further explanations.

Spearman Rank Correlation Coefficient (Spearman's Rho)

The SRC coefficient is argues to be one of the oldest and best known of non-parametric procedures to test for independence between two variables (Zar, 1972). Given two random variables without tied ranks x_i and y_i, the Spearman rank correlation coefficient can be expressed as follows:

$$\rho_{SP} = 1 - 6\sum_{i=1}^{n} d_i^2 / (n^3 - n) \qquad (2.4)$$

where ρ_{SP} denotes the Spearman's Rho, n is the number of measurements in each of the variables x_i and y_i, and d_i is the ranked difference between the *i-th* measurements for the two variables. The test for significance is based on the Student's *t* distribution.

Possible values of SRC range between +1 and -1. A value of close to +1 (-1) indicates a strong positive (negative) rank correlation, whereas a value of zero implies absence of correlation. For the purpose of this analysis, a high rank correlation of RCA or NEI index indicates strong similarity in the commodity composition of exports and little change in comparative advantage. A low value of SRC coefficient implies a change in the commodity composition of exports and comparative advantage over time.

2.3 TRADE DATA FOR EMPIRICAL ANALYSIS

Like most cases of LDCs, empirical economic studies on CLV often face the problem of availability and reliability of statistical information. The issue is even more severe for research studies which include an economy-wide analysis and cover an extended period of time. To surmount these difficulties, instead of using data from domestic sources we opt to use commodity trade data available in the Comtrade database of the United Nations. To our knowledge, this is one of the most comprehensive databases for commodity trade. However, even in this database there are no trade data reported by Laos, while data of Cambodia and Vietnam are available for some years of the intended study period. Hence, a good option is to use the data reported by trade partners of CLV. The selection of trade partners to be included in the analysis is based on the importance of such economies in the individual country's export markets.

Derived from the availability of country's data in the Comtrade database, trade data reported by the respective country and their partner countries are applied. Table 2-2 summarizes the sources of data. First, for Cambodia, trade data reported by the country are available for 2000-2004 and data reported by trade partners are used for the other years covered under study namely 1985, 1990, 1995 and 2005. Second, in the case of Laos, data reported by trade partners have to be applied for the whole study period of 1985-2005 at a five-year interval. Finally, for Vietnam's case, partners' data

are employed for 1985, 1990, 1995, and country's data are available for 1997-2005. In this respect, the use of partners' data implies that CLV's exports are represented by *cif*-import data of these trading partners and imports of CLV are represented by *fob*-exports of these economies to CLV. The data do not include re-exports. The data for world commodity exports are collected from various issues of the United Nations International Trade Statistics Yearbook.

With regard to commodity classification, we include one- to three-digit categories of the SITC in the analysis. This has some advantage, because the three-digit level is considered to represent industries (UNIDO, 1982). Moreover, in many previous studies, indices of RCA are often calculated at this SITC level, which help ensure consistency in cross-commodity and cross-country comparisons. Due to the constraint by the world data, SITC Revision 2 is applied for 1985-1999 and SITC Revision 3 for 2000-2005.

Table 2-2: Data source and coverage for empirical analysis

Country	**Study Period: 1985-2005**		
Cambodia	1985-1995: Import data reported by partner countries	2000-2004: Cambodia's data	2005: Import data reported by partner countries
Laos	1985-2005: Import data of partner countries		
Vietnam	1985-1995: Import data reported by partner countries	1997-2005: Vietnam's data	

The commodity trade data are collected for 20 years (1985-2005) at different intervals depending upon the countries. Since our objective is to examine comparative advantages of CLV in all sectors/industries, we attempt to include as many commodities as possible. The choice of the study period has some merit in that it covers an era with some important economic events in Indochina, such as the rebuilding of peace and resumption of socio-economic development in Cambodia, the adoption of an open-door policy in the late 1980s in Vietnam and Laos, the accession to ASEAN and AFTA in the 1990s of CLV, and the accession to WTO of Cambodia and Vietnam. All these events are expected to exert some impacts on the RCA of CLV.

The selection of trade partners for individual countries is presented in this section. Particular attention is paid on Lao case owing to the use of partners' data for the whole period of investigation.

Cambodia: The selection includes 47 countries/economies: 14 Asian economies (Bangladesh; China; Hong Kong; India; Indonesia; Japan; Korea; Malaysia; Pakistan; the Philippines; Singapore; Sri Lanka; Thailand; United Arab Emirates; Vietnam[11] for 2005), 26 countries from Europe (Austria; Belgium; Bulgaria; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Luxembourg; Netherlands; Norway; Poland; Portugal; Romania; Russian Federation; Spain; Sweden; Switzerland; Turkey; Ukraine; United Kingdom;), 5 countries from North and Latin America (United States; Canada; Mexico; Argentina; Brazil), and Australia and New Zealand. Commodity trade with these partners covered about one third to half of the country's merchandise exports for 1985-1995, most probably because trade data of many countries of the former Eastern bloc and Vietnam are not available in Comtrade despite the fact that much of Cambodia's trade during that period was done with those countries. The ratio increased to more than 99% for the remaining years under study.

Laos: Totally 38 countries/economies are included in the analysis, namely 12 Asian economies (Cambodia; China; Hong Kong; India; Indonesia; Japan; South Korea; Malaysia; Philippines; Singapore; Thailand; Vietnam[12]), 22 countries from Europe (Austria; Belgium; Bulgaria; Czech Republic; Denmark; Finland; France; Germany; Hungary; Ireland; Italy; Luxembourg; Netherlands; Norway; Poland; Portugal; Romania; Russian Federation; Spain; Sweden; Switzerland; United Kingdom;), 2 countries from North America (United States; Canada), and Australia and New Zealand. Capturing trade with these economies would cover more than 95% of the country's exports and imports, and any inferences from these data would be

[11] Data of 2005 include Vietnam because trade data of Vietnam are available for 1997-2005.
[12] Data of 2000 and 2005 include Vietnam.

considered 'acceptable' (Table 2-3). It is, however, worth noting that the number of countries, which reported trade data with Laos in Comtrade database, differs from year to year. For example, for 1985 some countries in the sample reported only the value of total trade without commodity trade data at the SITC three-digit level.

Table 2-3: Lao exports and imports (as % share of total), FY2002-2006

	Share of exports (%)				**Share of imports (%)**			
Regions/partners	**02-03**	**03-04**	**04-05**	**05-06**	**02-03**	**03-04**	**04-05**	**05-06**
Asia	56.87	49.58	54.08	74.43	88.75	81.27	93.96	95.01
ASEAN	*52.05*	*46.91*	*50.52*	*67.20*	*69.25*	*63.87*	*78.68*	*79.27*
Europe	26.58	32.54	26.30	14.20	4.96	16.88	5.17	4.19
EU	*24.78*	*27.06*	*24.88*	*14.14*	*4.25*	*14.57*	*4.90*	*3.85*
Canada	0.84	0.87	1.15	0.41	0.03	0.48	0.00	0.01
USA	0.90	0.64	0.18	0.37	0.11	0.91	0.06	0.55
Australia	11.61	16.36	18.24	10.55	-	0.45	0.80	0.23
38 Selected economies	***95.36***	***95.22***	***98.79***	***98.42***	***93.77***	***98.03***	***98.17***	***99.19***
Total	100	100	100	100	100	100	100	100

Source: Author's calculations (data obtained from the Ministry of Industry and Commerce, Lao PDR).
Note: Lao Fiscal year (FY): 1 October – 30 September.

Vietnam: The number of trade partners is the largest among the three countries. In total, 51 countries/economies have been selected for the analysis: 18 Asian economies (Bangladesh; China; Hong Kong; India; Indonesia; Iran; Iraq; Japan; Korea; Kuwait; Malaysia; Pakistan; Philippines; Saudi Arabia; Singapore; Sri Lanka; Thailand; United Arab Emirates), 26 countries from Europe (Austria; Belgium; Bulgaria; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Ireland; Israel; Italy; Luxembourg; Netherlands; Norway; Poland; Portugal; Romania; Russian Federation; Spain; Sweden; Switzerland; Turkey; Ukraine; United Kingdom;), 5 countries from North and Latin America (Canada; United States; Mexico; Argentina; Brazil), and Australia, and New Zealand. For 1985-1990, commodity trade with the selected partners covered about 50-60% of the country's merchandise exports, mainly because trade data of many countries of the former Eastern bloc are not available in Comtrade despite the fact that much of Vietnam's trade during that period was done with those countries. The figure practically increased to 100% for the remaining years under examination.

It is worth noting that for the sub-period of 1985-1990, trade data of the following former Eastern European countries are applied in all cases: data of former Czechoslovakia are used for the Czech Republic; and data of the former Democratic Republic of Germany (East Germany) and the former Federal Republic of Germany (West Germany) for Germany (current Federal Republic of Germany).

Data obtained from international sources often show higher quality and reliability owing to their superior accuracy in the recording and compiling process. However, the use of trade data reported by partners has some disadvantages. The following limitations should be borne in mind when interpreting the results. First, although the sample of countries selected is not complete, it contains all significant trade partners of CLV. One exception for Cambodia and Laos is the lack of Vietnam's data for 1985-1995. Second, given the long border with neighboring countries, informal trade among the three countries and among CLV and their neighbors would represent an important part of their external trade[13]. However, given its nature neither CLV nor their partners could record this type of trade data. Third, due to the lack of data at the 3-digit level, many commodities are missing in the result list and RCA and NEI indices could show a difference in some cases. Finally, the aggregation of national data has some impacts on the RCA and NEI indices. Nevertheless, capturing informal trade and including more trade partners would not substantially alter the results and the conclusions of the study.

2.4 ECONOMIC DEVELOPMENT IN POST-WAR CLV

The recent economic history of Indochina virtually started after the Indochina-War ended in 1975. In the decade that followed, economic hardship and poverty were the major characteristics of these countries. In particular, Cambodia went into another

[13] For example, Fukase and Martin (1999) estimated informal trade between Laos and her neighbors to be between 20-30%.

period of total destruction in the late 1970s. The economic management system in this region was considered a centrally planned economy.

In parallel with the political and economic development in Eastern Europe, Vietnam and Laos initiated a transition to a market economy in the late 1980s, while Cambodia was able to fully concentrate on socio-economic development in early 1990s. Since then, CLV have achieved remarkable performance in many areas of socio-economic development. Table 2-4 summarizes selected macroeconomic statistics of CLV and the ASEAN for comparison.

Table 2-4: Selected statistics of ASEAN and CLV

	Indicator	**1990**	**1995**	**2000**	**2005**	**2006**
	ASEAN excluding Myanmar					
Total	GDP (US$ mil, 2000 prices)	355,632	513,431	589,256	743,651	790,314
Average	GDP growth (annual %)	5.49 [a]	6.36 [b]	3.79 [c]	4.92 [d]	6.60
Average	GDP per capita (US$, 2000)	4,917	5,167	5,526	6,055	6,342
Average	Merch. trade (% of GDP)	91.15	101.08	120.88	131.73	144.67
Total	Exports (U$ mil, 2000 prices)	302,967	420,872	506,340	444,775	488,763
Total	Imports(U$ mil, 2000 prices)	283,436	421,648	460,837	405,477	435,102
	Cambodia, Laos, Vietnam					
Total	GDP (US$ mil, 2000 prices)	15,961	26,133	36,578	52,800	57,234
Average	GDP growth (annual %)	1.87 [a]	4.61 [b]	4.83 [c]	6.01 [d]	7.20
Average	GDP per capita (US$, 2000)	229.1	268.3	339.9	454.0	486.5
Average	Merch. trade (% of GDP)	44.20	58.65	79.07	93.90	129.27
Total	Exports (U$ mil, 2000 prices)	2,442	8,126	19,499	41,446	50,597
Total	Imports(U$ mil, 2000 prices)	2,659	9,148	20,777	46,245	55,974
	% Share of CLV in ASEAN					
	GDP (% share)	4.49	5.09	6.21	7.10	7.24
	Exports (% share)	0.81	1.93	3.85	9.32	10.35
	Imports (% share)	0.94	2.17	4.51	11.41	12.86

Source: Author compiled; data are from World Development Indicators (2008), World Bank.
Notes: 1. Data of ASEAN do not include Myanmar due to unavailability or incompatibility (CLV joined ASEAN in the second half of the 1990s. But for comparison purposes, data of ASEAN in this table include CLV for the whole period under study). 2. Cambodia is not included in 1990 data due to unavailability, except for merchandise trade. 3. 'Exports' and 'Imports' denote exports and imports of goods and services, respectively. 4. The superscript denotes: a) average of 1986-1990; b) average of 1991-1995; c) average of 1996-2000; d) average of 2001-2005.

In lieu of some fluctuations in the late 1980s and the aftermath of the Asian financial crisis (AFC), Indochina's economy has been growing relatively well. During 1990-2006, the total gross domestic product (GDP) of CLV expanded from US$16 to US$57 billion. The major contribution is attributed to Vietnam owing to her size. Their five-year average growth rate has increased from 1.87% in the 1980s to 6.01% per

annum in the first half of this decade and surpassed the average of ASEAN since the AFC. In terms of trade integration and development, exports and imports increased significantly both in absolute amount (from bout US$2.4 to more than US$50 billion) and relative to the GDP (from 44.2% to 129.3%). However, their openness[14] is still less than the ASEAN average.

Overall, CLV have played an increasingly important role in the rise of the Southeast Asian (SEA) region as witnessed in their proportion in output, exports and imports of the ASEAN. The remaining of this section presents the economic development in individual countries with an emphasis on the structure of international trade, trade development, and to a lesser extent industrial development.

2.4.1 Trade and Industrial Development in Cambodia

a. Overview of the Cambodian economy

Following the rehabilitation in post-destruction era and upon resumption of external assistance in 1993, Cambodia has practically moved from rehabilitation to socio-economic development process. The first Socio-Economic Development Plan (SEDP) for 1996-2000 was designed to shape the country's medium-term development goals. The second SEDP for 2001-2005 was more comprehensive and paved the way for the adoption and implementation of the Public Investment Plan (PIP), National Poverty Reduction Strategy (NPRS) in 2002, and preparation of the Cambodia's Millennium Development Goals (CMDGs) in 2003. Also, at the beginning of the third term in 2004, the Royal Government of Cambodia (RGC) adopted a so-called 'Rectangular Strategy', which consists of 'Good Governance' as the core and four major components: (1) 'Peace, political and social order'; (2) 'Integration of Cambodia into the region and the world'; (3) 'Partnership in development'; and (4) 'Favorable macroeconomic and financial environment'. As for the third development plan, the

[14] In the literature on trade, the share of external trade to GDP is often uses as a proxy for openness.

implementation of the National Strategic Development Plan (2006-2010), which contains priority goals and strategies for rapid poverty reduction, and for achieving CMDGs and other socio-economic development goals, is ongoing with high expectation for success (RGC, 2005). Economic development in Cambodia in the next decade is characterized by FDI trend, export competition with neighboring economies, and oil development (JICA, 2007).

Table 2-5: Selected macro-indicators of Cambodia

Description	**1990**	**1995**	**2000**	**2005**	**2006**
GDP (mil US$, 2000 prices)	2,210 [d]	2,570	3,670	5,680	6,280
GDP per capita (US$, 2000 prices)	206 [d]	225.4	285.9	408.2	444.8
Average GDP growth (annual %)	N.A.	7.77 [a]	7.34 [b]	9.31 [c]	10.83
Trade/GDP (%)	18.93	77.73	111.56	139.01	N.A.
Exports/GDP (%)	6.15	31.18	49.85	64.24	68.79
Imports/GDP (%)	12.78	46.58	61.76	72.92	76
Exports (mil US$, 2000 prices)	343 [d]	857	1,821	3,984	4,754
Imports (mil US$, 2000 prices)	706 [d]	1,275	2,257	4,525	5,225
Average export growth (annual %)	N.A.	58.76 [a]	19.11 [b]	17.09 [c]	19.32
Average import growth (annual %)	N.A.	34.37 [a]	13.07 [b]	14.98 [c]	15.46
Gross saving/GDP (%)	5.62	5.35	13.19	14.42	N.A.
Gross investment/GDP (%)	8.17	13.91	18.30	17.57	N.A.
External debt/GDP (%)	166.67	66.28	71.66	56.87	N.A.
Total population	14.36 million (as of 1 July 2007)				

Source: Author compiled; data are from Key Indicators (2008), Asian Development Bank; World Development Indicators (2008), the World Bank.
Notes: 1. 'N.A.' means the data were not available. 2. The superscript denotes: a) average of 1994-1995; b) average of 1996-2000; c) average of 2001-2005; and d) value of 1993.

Notwithstanding some fluctuations, Cambodian economy with a population of 14.3 million has been growing steadily since the mid-1990s with an average growth rate of about 8% per annum for 1993-1995 rising to over 9% for 2000-2005. Recently, it has achieved two-digit growth rate, namely 11% in 2006 (Table 2-5). Other macroeconomic indicators presented in the table, such as GDP and GDP per capita, trade, and saving, also suggest a remarkable economic performance over the last 15 years. GDP growth is mainly attributed to rapid expansion in industrial and service sectors, while growth in agriculture is fluctuating between positive and negative rates (Key Indicators, 2008, ADB).

With respect to sectoral development, Cambodia is moving from an agriculture-based economy to the industrial and service sector. The agricultural sector is on the

declining trend since the early 1990s with its share in GDP decreasing from 56% in 1990 to just 32% in 2007. Over the same period, the industrial and service sectors achieved an expansion from 11% to 27%; and from 33% to 41%, respectively (Key Indicators, 2008).

b. Trade development in Cambodia

1. Trade liberalization

The second pillar of the Rectangular Strategy expresses the commitment of the government to link the country with the regional and international community, and thereby implies the inclusion of external trade development in the strategy. In the 1990s, the RGC rapidly implemented the privatization and liquidation of state-owned enterprises (SOEs), such that only a few SOEs remain to date. In addition, the government has stabilized the economy and built a basis for a market economy by means of macroeconomic and structural reforms, which encompass the restructuring of the financial sector; ratification of the investment and tax laws; the establishment of a land titling regime; improvement in accounting and auditing standards; the adoption of commercial code; and contract enforcement (MIME, 2003). These efforts have been recognized by the international community, for example, upon signing a trade agreement the US Congress extended the Normal Trade Relation (NTR) status to Cambodia in 1996.

Cambodia made a major step in trade liberalization by joining the ASEAN on 30 April 1999 as the 10th member and implicitly participating in AFTA. Under AFTA, Cambodia shall complete the Common Effective Preferential Tariff (CEPT) scheme, which was designed to drive down tariffs on manufactured and processed agricultural products to 0-5 percent, by 2010. Moreover, by applying for WTO accession, RGC has gone even further in liberalizing its trade regime, and in July 2003 Cambodia submitted the acceptance of the terms and conditions for membership in access protocol. In

October 2004 Cambodia became the 148th member of the WTO and the second LDC to join this organization. In 2007, the Ministry of Commerce and UNDP Cambodia launched a Diagnostic Trade Integration Strategy (DTIS 2007) to support the government efforts in strengthening and diversifying the export basket, removing common and specific bottlenecks, mainstreaming clear linkage between trade sector development and human development and poverty reduction, and facilitating the formulation of trade sector development priorities (MOC and UNDP Cambodia, 2007).

With the accession to ASEAN and WTO external trade has been gradually liberalized and tariffs streamlined. The tariffs are lower and less dispersed. To date, the country has MFN/GSP status granted by 28 countries and signed Bilateral Trade Agreements (BTA) with nine countries and the EU.

2. Structure of Cambodia's international trade

Commodity and country composition of exports

Table 2-6: Commodity composition of Cambodia's exports (% share of total)

Description	SITC	1985	1990	1995	2000	2005
Food and live animals	0	9.80	4.61	3.22	0.72	1.87
Beverages and tobacco	1	1.16	-	0.10	0.20	0.58
Crude materials, inedible, except fuels	2	48.98	89.72	72.84	2.92	5.38
Mineral fuels, lubricants	3	-	-	0.00	0.00	0.00
Animal and vegetable oils and fats	4	-	-	0.32	-	0.04
Chemicals and related products, n.e.s.	5	1.12	0.25	0.34	0.01	0.12
Manufactured goods (by material)	6	10.66	0.89	1.75	3.15	1.44
Machinery and transport equipment	7	2.19	0.39	0.57	0.70	0.56
Miscellaneous manufactured articles	8	5.51	2.90	20.23	91.78	88.61
Other commodities and transactions	9	3.24	1.15	0.63	0.52	1.40
Total (mil. US$, at current prices)		*28.1*	*39.6*	*1,299.2*	*1,438.8*	*3,244.7*
Total (mil. US$, 2000 prices)		*454.2*	*468.3*	*2,123.0*	*1,438.8*	*1,557.8*

Source: Author compiled (data are from UN Comtrade online database)
Notes: 1. For 1985-1995 and 2005, trade data are reported by trade partners. 2. Real value is based on Export Value Index (base year=2000) (WDI, 2007). 3. '-' implies that the data were not reported by trade partners.

During the period of 1985-2005, Cambodia's exports grew steadily from US$28 million to US$3.2 billion (Table 2-6). It can be observed that over the last 20 years exports of Cambodia have concentrated in some sectors and the composition has moved from crude materials to manufactures. In 1985, 'food and live animals' (SITC

0), 'crude materials without fuels' (SITC 2), and some 'manufactured goods' (SITC 6) dominated the exports, as they made up nearly 70% of the country's exports. The representative products for 'food and live animals' are cereals (SITC 04) with 7.9%, oil-seeds and oleaginous fruits (SITC 222) 6% and rubber (STIC 232) 26% for 'crude materials, inedible, except fuels', and iron (SITC 672) 9% for 'manufactured goods'.

Table 2-7: Country composition of Cambodia's exports (% share of total)

No.	Trade Partners	1985	1990	1995	2000	2005
1	USA	5.41	0.18	1.79	54.02	57.77
2	Germany	16.84	11.21	6.21	4.82	10.04
3	United Kingdom	1.50	0.24	3.81	5.97	4.98
4	Viet Nam	-	-	-	1.43	4.94
5	Canada	2.27	-	0.17	0.36	3.35
6	Japan	5.50	8.35	2.34	0.79	3.25
7	Singapore	17.31	-	13.55	1.32	3.09
8	France	0.08	2.21	2.40	2.03	2.62
9	Spain	-	0.24	0.82	0.46	1.76
10	Thailand	0.08	27.94	51.33	1.67	0.97
11	China	8.48	0.43	1.84	1.74	0.84
12	Turkey	8.98	-	-	0.03	0.29
13	Hong Kong	0.01	0.89	3.96	19.17	0.27
14	Malaysia	5.74	39.37	4.61	0.72	0.26
15	Poland	3.84	0.13	-	0.02	0.21
16	Czech Republic	17.33	2.06	0.00	0.01	0.17
17	Hungary	4.75	1.10	0.01	0.01	0.00
	Subtotal 1-17	*98.13*	*94.34*	*92.84*	*94.54*	*94.81*
	Other partners	0.93	5.60	7.16	4.42	5.19

Source: Author compiled (data are from UN Comtrade online database)
Notes: 1. For 1985-1995 and 2005, trade data are reported by trade partners. 2. For 1985, data of former West Germany are used for Germany and data of former Czechoslovakia for Czech Republic. 3. For 1990, data of former East and West Germany are used for Germany. 4. '-' implies that the data were not reported by trade partners.

Over the following decade, the garment and footwear industry slowly emerges, while other sectors are on declining trend except for rubber. It is also apparent that garment and footwear products started to take a considerable share in the mid-1990s and have dominated the exports since 2000. By 2005, garment and footwear products (SITC 84, 85) accounted for more than 88% of the commodity exports, whereas crude materials only covered 5.4% and other commodities shared less than 2%. One very interesting observation here is that the degree of concentration of Cambodia's exports in garment products is much stronger than Laos and Vietnam.

In terms of export markets, destination countries have shifted from Singapore and former Socialist countries of Eastern Europe to the US and EU member countries (Table 2-7). Specifically, in 1985 most of cereals were exported to former East Germany, and rubber to Singapore and Czechoslovakia. In 2005, however, the US accounted for about 58% of exports, Germany 10%, and the UK 5%, which mainly imported garment products from Cambodia. It is also worth noting that Vietnam, with an upward export trend since 2000, is among the leading export markets, but little can be said about the period of 1985-1995 due to the absence of export data.

Commodity and country composition of imports

Table 2-8 presents the commodity composition of Cambodia's imports at the one-digit SITC. The table reveals that most of the country's imports are material inputs and equipment, and fuels for production. Cambodia mainly imports oil-seeds (SITC 122); petroleum oils (SITC 333); textile yarn and fabrics (SITC 65); iron and steel (SITC 67); industrial machinery and telecommunication equipment (SITC 74, 76); electrical machines (SITC 77); and road vehicles (SITC 78). Unlike exports where high shares can be found at the three-digit level, imports are much more widespread except for petroleum oils (SITC 334) with a share of 13% in 2005.

Table 2-8: Commodity composition of Cambodia's imports (% share of total)

Description	**SITC**	**1985**	**1990**	**1995**	**2000**	**2005**
Food and live animals	0	1.98	2.44	6.02	3.22	6.85
Beverages and tobacco	1	10.15	29.40	18.16	5.77	4.88
Crude materials, inedible, except fuels	2	1.30	3.72	1.66	3.56	1.24
Mineral fuels, lubricants	3	2.62	-	4.42	12.69	13.52
Animal and vegetable oils and fats	4	0.03	0.06	1.25	0.47	0.40
Chemicals and related products, n.e.s.	5	12.19	13.44	6.13	6.69	7.73
Manufactured goods (by material)	6	47.86	10.45	20.60	40.14	38.66
Machinery and transport equipment	7	20.89	33.39	35.74	16.20	17.42
Miscellaneous manufactured articles	8	2.85	5.51	4.55	8.18	7.65
Other commodities and transactions	9	0.13	1.05	1.27	3.08	1.62
Total (mil. US$, at current prices)		*39.4*	*39.6*	*1,299.2*	*1,438.8*	*3,556.0*
Total (mil. US$, 2000 prices)		*636.5*	*468.3*	*2,123.0*	*1,438.8*	*1,752.5*

Source: Author compiled (data are from UN Comtrade online database)
Notes: 1. For 1985-1995 and 2005, trade data are reported by trade partners. 2. Real value is based on Export Value Index (base year=2000) (WDI, 2007). 3. '-' implies that the data were not reported by trade partners.

In terms of suppliers, Cambodia mainly imports from Asia, such as ASEAN member countries and East Asian economies. In particular, Thailand and Hong Kong are the major suppliers over the last decade, while China and Vietnam have been increasing their share and recently taken a considerable position in this market. For example, in 2005 Thailand accounted for a quarter of commodity imports, whereas China, Vietnam and Hong Kong shared about 15% each. In the 1980s, Cambodia mainly imported from former East European socialist countries (Poland, Czechoslovakia, Hungary). However, since the beginning of the 1990s Cambodia's imports have shifted to Asian economies (Table2-9).

Table2-9: Country composition of Cambodia's imports (% share of total)

No.	Trade Partners	1985	1990	1995	2000	2005
1	Thailand	2.15	2.14	25.71	15.62	25.73
2	Viet Nam	-	-	-	6.46	15.63
3	China	0.06	4.65	3.97	7.96	15.07
4	Hong Kong	0.21	4.14	3.01	17.94	13.96
5	Singapore	2.76	-	38.52	7.47	8.52
6	Korea (South)	-	-	-	5.42	4.06
7	Malaysia	0.61	0.29	5.88	4.53	3.07
8	Indonesia	-	26.28	6.16	4.83	2.64
9	Japan	3.81	11.33	5.94	4.12	2.20
10	Other Asia, nes	-	-	-	12.34	-
11	USA	0.04	0.08	2.08	2.30	1.95
12	France	4.77	6.62	4.66	2.76	1.57
13	Australia	1.74	3.24	0.79	0.39	1.01
14	Germany	3.34	23.64	0.84	0.54	0.36
15	Italy	6.23	0.41	0.16	0.70	0.27
16	Poland	50.39	0.42	-	0.00	0.26
17	Czech Republic	12.24	3.24	0.07	0.00	0.01
	Subtotal 1-17	*88.35*	*86.48*	*97.78*	*93.39*	*96.32*
	Other partners	11.65	13.52	2.22	6.61	3.68

Source: Author compiled (data are from UN Comtrade online database)
Notes: 1. For 1985-1995 and 2005, trade data are reported by trade partners. 2. For 1985-1990, data of former Czechoslovakia are used for the Czech Republic, and the data of former East and West Germany are used for Germany. 3. Four more countries which together accounted for 8.52% of 1985-imports, but lost their role in the following years, are: Canada, Hungary, Spain and Sweden. 4. '-' implies that the data were not reported by trade partners.

c. Industrial development in Cambodia

At the beginning of the decade, the Cambodia's industrial structure was still dominated by the primary sector. For example, in 2001 subsistence agriculture and

fishery accounted for 40% of the GDP and employed about 80% of the labor force, while manufacturing was on the rise and shared about 20% (Yamamura, 2003).

At the current stage of development, the Cambodia's industrial sector largely consists of labor-intensive and light industries, such as garment industry, food processing industry, wood processing industry etc. Since early 1990s the industrial sector has achieved stable growth, particularly remarkable growth in the garment subindustry. Specifically, during the period of 1990-2007 the industrial sector has grown at an average growth rate of 13.6% per annum, as compared to 4.1% and 8.3% for the agricultural and service sector, respectively (Key Indicators, 2008, ADB). Consequently, the contribution of this sector to the country's output has increased from 11% in 1990 to 27% in 2007.

Table 2-10: Basic statistics of Cambodia's industry, 1998-2005

	Description	**1998**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
A	*All industries*							
1	Number of enterprise	*24,364*	*25,746*	*27,475*	*27,256*	*26,356*	*28,546*	*29,230*
	LSE	267	340	320	336	371	415	483
	SME	24,097	25,406	27,155	26,920	25,985	28,131	28,747
2	Labor (persons)	*156,756*	*220,491*	*274,476*	*316,918*	*331,419*	*386,240*	*410,470*
	LSE	98,721	151,151	204,688	240,550	260,061	306,460	331,023
	SME	58,035	69,340	69,788	76,368	71,358	79,780	79447
3	Production (US$ mil.)	*609.3*	*1,393.0*	*1,402.2*	*1,693.4*	*1,902.6*	*2,378.6*	N.A.
	LSE	550.2	1,268.7	1,199.1	1,479.9	1,711.6	1,902.4	N.A.
	SME	59.1	124.3	203.1	213.5	191.0	476.2	585.0
B	*Textiles, wearing apparel, leather industry*							
	Number of enterprise	179	256	240	255	283	320	374
	Labor (persons)	85,008	137,048	190,000	228,340	247,533	290,562	315,405
	Production (US$ mil.)	391.5	1,092.0	1,122.8	1,430.0	1,665.0	N.A.	N.A.
C	*Gross value added (billion Riel and %share)*							
	Industry total	*1958.4*	*3,078.0*	*3,497.4*	*4,096.1*	*4,664.9*	*5,536.1*	*6,412.2*
	TGF industries	584.1	1,297.1	1,680.9	1,973.1	2,293.7	2,847.5	3,158.3
	Textiles (% of TGF)	10.43	6.21	6.32	6.05	5.51	4.70	4.78
	Apparel (% of TGF)	86.77	90.98	91.03	91.05	91.72	92.59	92.47
	Footwear (% of TGF)	2.81	2.81	2.65	2.90	2.76	2.72	2.75

Source: Statistical Yearbook, 2006, National Institute of Statistics (Ministry of Planning, Cambodia)
Notes: 1. LSE denotes large scale enterprise. 2. SME stands for small and medium enterprise. 3. 'TGF' or 'TGF industries' denotes Textile, Garment, Footwear industries.

Table 2-10 presents some selected statistics of the Cambodia's industry for 1998-2005. The increase in number of establishments, employment, and output reflect steady growth over the period. In regard to firm structure, of some 25,000-30,000

establishments, more than 98% are small- and medium-sized enterprises (SMEs). However, large scale enterprises (LSEs) employ 63-81% of the labor force and share 80-92% in output of the industrial sector. SMEs also show some positive signs in terms of output. Comparing among LSEs, the textiles, garment and footwear industry is by far the leader in generating employment and value added in the industrial sector.

With respect to industrial policy, government efforts largely focused on promoting and supporting the garment and tourism industry in various aspects (legislation, distribution, export negotiations, human resource development, etc.). In addition, RGC also promotes the development of natural resources and primary industries (agriculture, forestry, fisheries, etc.), and processing industries for export and foreign currency earnings. 'Apart from this, the country does not seem to have a hard-hitting industrial strategy as such applied for industrialization in other Asian countries or developed countries' (JICA, 2007, p 4-1).

Notwithstanding this, a pragmatic approach to policy making and an industrial development strategy have been proposed. The government should mainly provide infrastructure and streamlined institutional environments conducive to private sector initiatives and entrepreneurship, while the private sector should be a dominant player. In addition, based on the current stage and development perspectives of the industrial sector, four sectors have been proposed as strategic sectors: (1) natural resource-based industry; (2) large exporting industry; (3) industry with strong domestic linkage; and (4) FDI.

The first two sectors exist to some extent and include: rubber plantation and processing, rice millers, fish sauce, crude palm oil, handicraft and the like for the first sector; and the second sector the textile, garment and footwear (TGF) industries which are the main exporters at the moment and will retain this leading role for the foreseeable future. The latter two are rather weak and need more development. Metal processing has been featured for the third sector, whereas FDI should be attracted to

the afore-mentioned sectors, particularly those without domestic expertise (Yamamura, 2003).

2.4.2 Trade and Industrial Development in Laos

a. Overview of the Lao economy

Laos, with a population of 5.6 million in 2005, is traditionally an agriculture-based economy. In 2005 the agricultural sector accounted for 46% of GDP, while the industrial and service sector contributed 28% and 26%, respectively (World Development Indicators, 2007). With regard to employment, of roughly 2.7 million people in the labor force in 2003, almost 80% were engaged in agriculture, 9% in industry and 8% in services (ADB, Key Indicators, 2006).

Table 2-11: Selected macro-indicators of Laos

Description	1985	1990	1995	2000	2005
GDP (Mn US$, 2000 prices)	765	943	1,290	1,740	2,350
Per capita GDP (US$, 2000 prices)	211.4	228.2	274.6	328.7	396.2
GDP annual growth rate (%)	5.05	4.43[a]	6.42[b]	6.17[c]	6.23[d]
Trade/GDP (%)	8.25	36.53	60.55	64.57	58.93
Exports/GDP (%)	2.43	11.83	23.22	30.13	27.56
Imports/GDP (%)	5.81	24.70	37.33	34.44	31.37
Exports (Mn US$, 2000 prices)	N.A.	428	435	523	564[h]
Imports (Mn US$, 2000 prices)	N.A.	898	699	598	741[h]
Export growth rate (%)	N.A.	8.19[e]	33.65[b]	1.70[c]	12.58[d]
Import growth rate (%)	N.A.	-1.84[e]	29.56[b]	-1.36[c]	12.84[d]
Gross saving/GDP (%)	1.31	-3.65[f]	15.18	20.09	1.50
Gross investment/GDP (%)	7.04	13.50[f]	N.A.	21.80[g]	16.70
External debt/GDP (%)	26.12	204.39	122.73	143.68	82.73[h]
Total population	5.622 million (as of 1 July 2005)				

Source: Author compiled; data are from Key Indicators (2006), Asian Development Bank; World Development Indicators (2007), World Bank.
Notes: 1. 'N.A.' means the data were not available. 2. The superscript denotes: a) average of 1986-1990; b) average of 1991-1995; c) average of 1996-2000; d) average of 2001-2005; e) average of 1988-1990; f) value of 1988; g) value of 2001; and h) value of 2004

Since the late 1980s, the Lao economy has been growing steadily. Table 2-11 summarizes some economic indicators for the period of 1985-2005. On average, GDP has grown at an annual rate of over 6 percent over the last 15 years as compared to 4.43% in the second half of the 1980s. Over the same time span, GDP tripled and reached US$2.35 billion in 2005. Per capital GDP increased from US$211 in 1985 to US$396 in 2005. In terms of sectoral contribution, for example in 2005, the GDP

growth rate of 6.97 percent was the result of growth of 2.6% in the agricultural, 16% in the industry and 5.6% in the service sector (WDI, 2007).

b. Trade development in Laos

1. Trade liberalization

With the introduction of the New Economic Mechanism (NEM) in 1986, Laos also started to liberalize her trade. The government of Lao PRD (GOL) has gradually removed price controls in retail trade and agricultural procurement, and gave more autonomy to state-owned-enterprises (SOEs) in making business decisions. Despite being dispersed, the rates of import duties are relatively low for a developing country. The country's level of protection is deemed relatively low with tariff rates having a simple average of 9.6 percent and weighted average of 14.7 percent point (Fukase & Martin, 1999, p. 3). The country underwent several reforms in the following years and by 1995 the maximum rate was reduced from 100 to 40 percent and the number of import duty bands were reduced to just six: 5%; 10%; 15%; 20%; 30%; and 40% (Fane, 2003).

A major step in trade liberalization process was the accession to the ASEAN[15] in July 1997 and the participation in AFTA in January 1998. Under AFTA, Laos shall complete the Common Effective Preferential Tariff (CEPT) scheme, which was designed to drive down tariffs on manufactured and processed agricultural products to 0-5 percent, by 2008. Therefore, tariffs on various imported products have gradually been reduced; system of export licensing simplified; and export licensing to protect domestic producers abolished. Also under CEPT quantitative restrictions on products and non-tariff barriers are to be eliminated. Tariffs are now low and not dispersed.

Although it is still early for a conclusion, the liberalization has brought about some positive development on trade. External trade, as share of GDP, has increased

[15] Laos (together with Myanmar) officially became a full member of the ASEAN on 23 July 1997.

from about 8% in 1985 to almost 60% in 2005. Exports and imports of goods and services have grown well at an average rate of 13 percent for the last five years, and recorded a value of US$564 million and US$741 million in 2004, respectively (Table 2-11). Evidence could also be found in the investigation as the number of exported product groups[16] increased from 39 in 1985 to 178 in 2005.

2. Structure of international trade of Laos

Commodity and country composition of exports

Commodity exports of Laos grew steadily over the study period, from US$18 million in 1985 to US$594 million in 2005. Table 2-12 presents the share of export commodity groups defined at the one-digit SITC. It is apparent that over the last 20 years Laos' exports have concentrated in some sectors and the structure has basically not changed. In 1985, 'food and live animals' (SITC 0) and 'crude materials without fuels' (SITC 2) dominated the exports, as they made up approximately 93% of the country's exports. Although their relative significance is declining over the years, these two commodity groups still accounted for more than one third of the total exports in 2005. The main export item of 'food and live animals' is coffee (SITC 071), although its share in total exports has declined from 24% to 3% over the period under study. The representative products for 'crude materials, inedible, except fuels' are wood and wood products (SITC 247; 248) with a share decreasing from about 58% in 1990 to 26% in 2005. It can also be observed from the table that in the mid-1990s exports of miscellaneous manufactured goods (SITC 8) increased remarkably and since then have made up a large portion of exports (31% in 2005). The main products of this category are apparel and clothing (SITC 84) with a share increasing from less than one percent in 1985 to 29% in 2005.

[16] In this dissertation, products or product groups are understood as 3-digit SITC categories.

Table 2-12 also reveals another interesting issue namely a sharp increase in mineral fuels category (SITC 3) and basic manufactured goods (SITC 6). The increase in the former is attributable to inclusion of electricity exports (SITC 351), while the hike in the latter is due to export of copper (SITC 682) in recent years. It is worth noting that, although Laos has long been exporting electricity to Thailand, the world data for this item has first been reported only in Revision 3 of the Comtrade database. Due to the lack of world and country data, the RCA and NE indices could be calculated for 2005 only and would suppress the trends of other commodities. Therefore, this commodity (SITC 351) was excluded from the empirical analysis.

Table 2-12: Commodity composition of Lao exports (% share of total)

Description	**SITC**	**1985**	**1990**	**1995**	**2000**	**2005**
Food and live animals	0	54.82	4.31	10.14	7.33	5.92
Beverages and tobacco	1	-	-	0.41	0.06	0.21
Crude materials, inedible, except fuels	2	37.93	77.04	40.49	33.94	29.69
Mineral fuels, lubricants	3	-	0.05	0.25	0.40	11.25
Animal and vegetable oils and fats	4	-	-	0.00	0.00	0.00
Chemicals and related products, n.e.s.	5	0.10	0.08	1.74	0.04	0.28
Manufactured goods (by material)	6	4.01	7.43	8.68	1.21	16.05
Machinery and transport equipment	7	0.91	0.98	0.26	18.16	1.43
Miscellaneous manufactured articles	8	1.13	10.11	37.45	36.81	31.40
Other commodities and transactions	9	1.11	1.43	0.30	2.01	3.14
Total (mil. US$, at current prices)		*18.0*	*64.7*	*237.7*	*349.1*	*594.3*
Total (mil. US$, 2000 prices)		*110.4*	*271.7*	*252.5*	*349.1*	*355.0*

Source: Author compiled (data are from UN Comtrade online database)
Notes: 1. Real export value is based on the Export Value Index with 2000 base year (WDI, 2007). 2. For 1985, some partners reported only the total value of bilateral trade with Laos. Hence, the value of total exports used for calculating the shares was lower than those reported here. However, the composition was assumed to persist

In regard to export destinations, Lao leading export markets are Thailand and Vietnam, which, respectively, comprised bout 38% and 16% of the country's exports in 2005 (Table 2-13). Other major partners are some EU member countries, China, Malaysia, Japan and Australia. As discussed in Section 2.3, data for Vietnam are available only for year 2000 and 2005. Hence, the country composition of exports of these years differs significantly from earlier years covered here. It is interesting to note that the increase in exports to EU countries is due to a significant increase in garment exports to this region. It can be expected that the country composition of Lao exports

for recent years would be similar to that of 2000 and 2005[17], but the commodity composition would not differ from the pattern presented in Table 2-12.

Table 2-13: Country composition of Lao exports (% share), 1985-2005

	Trade Partners	1985	1990	1995	2000	2005
1	Thailand	6.50	68.55	29.34	21.43	38.16
2	Viet Nam	N.A.	N.A.	N.A.	30.29	16.41
3	France	0.46	4.17	12.45	10.20	8.75
4	United Kingdom	0.04	0.15	9.29	4.61	7.26
5	Germany	4.04	2.95	7.89	6.56	5.86
6	China	49.93	9.61	2.71	1.84	4.30
7	Belgium	-	-	-	4.31	2.93
8	Netherlands	0.04	0.38	6.88	3.34	2.40
9	Malaysia	0.03	0.23	0.00	0.01	2.17
10	Italy	0.13	0.54	1.54	2.83	1.63
11	Poland	2.26	0.12	0.29	0.02	1.36
12	Japan	7.40	7.22	12.45	3.43	1.35
13	Australia	5.28	0.06	0.05	0.15	1.14
	Subtotal 1-13	*76.10*	*93.98*	*82.88*	*89.02*	*93.73*
	Other partners	23.90	6.02	17.12	10.98	6.27

Source: Author compiled (data are from UN Comtrade online database)
Notes: 1. 'N.A.' indicates that the data were not available. 2. '-' means that the data was not reported by the respective trade partner, and hence, it is assumed that Laos did not export to such countries. 3. For 1985-1995, Germany included former East Germany and West Germany.

Commodity and country composition of imports

Table 2-14 presents the commodity composition of imports defined at the SITC one-digit level. We can observe from the table that most of Lao imports are material inputs and equipment, and fuels for production. The country's imports mainly consist of petroleum oils (SITC 334); textile yarn and fabrics (SITC 65); non-metallic minerals (SITC 66); iron and steel (SITC 67); machinery and industrial machines (SITC 72; 74); electrical machines (SITC 77); and road vehicles (SITC 78). Among consumer goods, beverage (SITC 11) shows a higher share. Unlike exports where high shares can be found at the three-digit level, imports of Laos are much more widespread except for petroleum oils (SITC 334) with a share of 17% in 2005.

[17] Owing to availability of Vietnam's trade data in the Comtrade database, we have calculated the country composition of Lao exports for 1997-2005. It revealed that Vietnam's share in exports of Laos increased from 18% (Thailand=19%) in 1997 and surpassed that of Thailand, and peaked at 47% in 1999. Since then, however, it has decreased and leveled at about 17%. The share of exports to Thailand, on the other hand, first decreased in the years following the financial crisis, but started to rise in 2000 and surpassed the share of Vietnam in 2001. The average share of Thailand and Vietnam over the period is 24% and 23%, respectively. Hence, the aforesaid argument on country composition of exports of year 2000 and 2005 being representative can be justified.

Table 2-14: Commodity composition of Lao imports (% share of total)

Description	SITC	1985	1990	1995	2000	2005
Food and live animals	0	6.56	10.08	8.68	6.89	8.67
Beverages and tobacco	1	0.74	0.83	8.88	6.86	5.27
Crude materials, inedible, except fuels	2	0.14	0.25	0.25	2.38	0.83
Mineral fuels, lubricants	3	19.55	5.57	7.83	11.70	18.35
Animal and vegetable oils and fats	4	0.06	0.23	0.26	0.28	0.30
Chemicals and related products, n.e.s.	5	10.06	8.76	6.53	6.39	7.60
Manufactured goods (by material)	6	22.55	18.79	21.62	22.94	20.98
Machinery and transport equipment	7	28.80	46.86	35.27	35.82	29.93
Miscellaneous manufactured articles	8	8.26	6.79	6.11	4.92	5.20
Other commodities and transactions	9	3.28	1.88	4.62	1.67	2.75
Total (mil. US$, at current prices)		*49.7*	*115.5*	*560.3*	*601.9*	*1,121.7*
Total (mil. US$, 2000 prices)		*137.9*	*334.3*	*509.3*	*601.9*	*680.8*

Source: Author compiled (data are from UN Comtrade online database)
Note: Real import value is based on the Import Value Index with 2000 base year (WDI, 2007).

Table 2-15: Country composition of Lao imports (% share), 1985-2005

	Trade partners	1985	1990	1995	2000	2005
1	Thailand	39.35	56.94	63.25	63.26	68.87
2	China	N.A.	6.90	8.52	5.69	9.26
3	Viet Nam	N.A.	N.A.	N.A.	11.42	6.20
4	Singapore	20.01	-	7.27	4.94	3.58
5	Japan	23.51	16.76	5.01	3.53	1.75
6	Australia	0.09	1.11	3.63	0.65	1.62
7	Korea	-	-	-	0.74	1.25
8	Belgium	-	-	-	0.22	1.01
9	France	2.84	2.50	4.31	2.76	0.96
10	Germany	3.42	1.06	0.85	0.54	0.92
	Subtotal 1-10	*89.22*	*85.26*	*92.84*	*93.76*	*95.41*
	Other partners	10.78	14.74	7.16	6.24	4.59

Source: Author compiled (data are from UN Comtrade online database)
Notes: 1. 'N.A.' indicates that the data were not available. 2. '-' means that the data was not reported by the respective trade partner, and hence, it is assumed that Laos did not import from such countries.

With respect to suppliers, the country composition of imports is relatively similar to that of exports. Thailand, China and Vietnam have been the main suppliers for Laos[18], followed by partner countries in East Asia, Australia and the EU (Table 2-15). Particularly, Thailand has maintained a share of more than 60% over the last decade. It is worth noting that the share of Japan and Singapore, which together was about 44% in 1985, decreased to less than 6% in 2005. The share of China has been fluctuating, increasing from 7% in 1990 to a peak at 14% in 2003 and falling to 9% in

[18] Similar to the case of exports, the composition of Lao imports for 1997-2005 also revealed that Thailand was the main supplier, followed by Vietnam and China. On average, Thailand supplied 63%, Vietnam 13% and China 7% in Lao import markets. Hence, the composition of year 2000 and 2005 could be regarded as representative.

2005. Like the case of exports, the import structure of 2000 and 2005 is quite different from the other years covered here owing to the availability of Vietnam's trade data.

c. Industrial development in Laos

At the current stage of development, the industrial sector of Laos mainly consists of natural resource-based and labor-intensive industries. Among the leading sub-sectors are mining, hydropower, processing and garment industry. Despite some fluctuations the industrial sector has recorded remarkable growth and surpassed the agricultural and service sector since the early 1990s. Specifically, the average growth rate during the period of 1990-2005 was almost 12 percent per annum, as compared to 4.4% and 5.8% for the agricultural and service sector, respectively. As a result, the contribution of this sector to the country's output has increased from 15% in 1985 to 28% in 2005. With respect to firm structure, most of enterprises in Laos are SMEs. As can be seen in Table 2-16, more than 95 percent of firms in Laos are small-sized enterprises. However, the industrial sector employs about 100,000 people (3.7%) out of 2.7 million in the labor force.

Table 2-16: Basic statistics of enterprises in Laos

No.	Description	2002	2003	2004	2005
1	Number of enterprises	24,742	25,607	26,200	23,420
	Large size	112	119	207	144
	Medium size	604	614	722	775
	Small size	24,026	24,874	25,271	22,501
2	Production value ('billion Kip)	1,423	2,314	2,911	N.A.
3	Labor	91,034	98,557	103,021	101,945

Source: Ministry of Industry and Handicraft, Vientiane, Lao PDR
Note: Enterprises with 100 employees and above are classified as large, between 10 and 99 medium, and less than 10 small.

With respect to industrialization policy, the GOL has emphasized industries with a comparative advantage and potential for export as the base of the nation's industry. It has also implemented a step-wise industrialization and modernization strategy. The development of infrastructure is also seen as a mean to facilitate and promote the industrialization. In the five-year industrial and handicraft development

plan (2006-2010) the GOL has formulated a regional development strategy for the northern, central and southern part based on their physical conditions and potential: (1) for the north, the goals are to develop small-sized industries, which mainly rely on raw materials from the agriculture, and tourism-related industries; (2) for the central region, the goals are to develop high value-added industries, industries with potential for export, tourism-related industries, special economic zones and industrial zones in Vientiane Capital, Khammouane and Savannakhet provinces; and (3) for the southern part, the goals are to develop medium- and small-sized agro-processing industries, hydropower, tourism-related industries, mining industry, and economic triangle with Cambodia and Vietnam.

2.4.3 TRADE AND INDUSTRIAL DEVELOPMENT IN VIETNAM

a. Overview of the Vietnam's economy

The path of Vietnam's economic development from the 1950s can be viewed in three periods: the period of war (1946-1975), the period of macroeconomic crisis (1976-1985), and the period of reform (1986-present) (Harvie and Tran, 1997). This study mainly focuses on developments in the transition period. In fact, some macroeconomic reforms were introduced in the early 1980s with some degree of autonomy being given to industrial enterprises and farmers. The actual transition began in 1986 with the approval and initial implementation of the Renovation Program (*Doi Moi Policy*). The Doi Moi program recognizes multi-ownership and encompasses reforms in many areas, such as macroeconomic stabilization; agricultural sector reform; private sector development and SOE reform; trade, investment and banking sector reform; and labor market reform. Early successes stimulated acceleration of the transition process and gave rise to the adoption of a comprehensive reform package in 1989.

Further successes upon launching the radical reform package are evident. Table 2-17 presents main macroeconomic indicators for the period of 1985-2006. With a population of over 85 million, Vietnam has been growing steadily with an average rate of about 6.8% per annum. Five-year average breakdowns show an increase in growth rates since the early 1990s, in which annual growth averaged around 6.9%-8.2% as compared to 4.8% for 1985-1990. GDP increased fourfold from US$12 billion to US$48 billion, and GPD per capita tripled and reached US$576 in 2006. Other macroeconomic indicators presented in the table, such as GDP and GDP per capita, trade, and saving, also suggest a remarkable economic performance over the last 2 decades.

Table 2-17: Selected macro-indicators of Vietnam

Description	**1985**	**1990**	**1995**	**2000**	**2005**	**2006**
GDP (mil US$, 2000 prices)	11,889	15,018	22,276	31,173	44,769	48,426
GDP per capita (US$, 2000 prices)	202.0	226.9	305.2	401.5	538.7	575.8
Average GDP growth (annual %)	3.81 [e]	4.79 [a]	8.21 [b]	6.96 [c]	7.51 [d]	8.17
Trade/GDP (%)	23.22 [f]	81.32	74.72	112.53	145.22	N.A.
Exports/GDP (%)	6.62 [f]	36.04	32.81	55.03	69.36	73.46
Imports/GDP (%)	16.60 [f]	45.28	41.91	57.50	73.54	76.80
Exports (mil US$, 2000 prices)	N.A.	2,030	6,834	17,155	36,994	45,381
Imports (mil US$, 2000 prices)	N.A.	2,045	7,274	17,923	41,179	50,015
Average export growth (annual %)	N.A.	12.93 [a]	28.19 [b]	21.73 [c]	16.94 [d]	22.67
Average import growth (annual %)	N.A.	-4.50 [a]	31.06 [b]	20.97 [c]	18.43 [d]	21.46
Gross saving/GDP (%)	N.A.	-2.28	19.24	30.45	33.55	N.A.
Gross investment/GDP (%)	N.A.	13.17 [g]	25.42	27.65	33.07	N.A.
External debt/GDP (%)	0.43	359.56	122.63	41.14	36.45	N.A.
Total population	85.15 million (as of 1 July 2007)					

Source: Author compiled; data are from Key Indicators (2008), Asian Development Bank; World Development Indicators (2008), World Bank.
Notes: 1. 'N.A.' means the data were not available. 2. The superscript denotes: a) average of 1986-1990; b) average of 1991-1995; c) average of 1996-2000; d) average of 2001-2005; e) value of 1985; f) value of 1986; and g) value of 1989.

Sectoral decomposition suggests that GDP growth is mainly attributed to rapid expansion in industry and service sectors, especially the former has achieved two-digit growth for much of the period of 1990-2007 (Key Indicators, 2008, ADB). Vietnam is moving from an agriculture-based economy to the industrial and service sector at a relatively high pace. The agricultural sector is on the declining trend since the early 1990s with its share in GDP decreasing from 39% in 1990 to just 20% in 2007. Over

the same period, the industrial sector registered an expansion from 23% to 42%, while services remained pretty constant at 38% despite fluctuations (Key Indicators, 2008).

b. Trade development in Vietnam

1. Trade liberalization

'Trade, investment and banking sector reform' is a very important component of the Doi Moi program. Indeed, trade reform was initiated among the first macroeconomic reforms introduced in the early 1980s, i.e. decentralization of foreign-trade sector in 1981. Substantial trade liberalization was launched in 1989 with the removal of import duties on industrial inputs and adoption of real-exchange-rate policy, followed by the introduction of export processing zone in 1991. Major development is evident after Vietnam entered into a preferential trade agreement with the EU in 1992 and the US lifted the trade embargo in February 1994.

Trade development has been intensified when the country joined the ASEAN in July 1995 and the Asian Pacific Economic Cooperation (APEC) in 1998. Vietnam signed a bilateral trade agreement (BTA) with the US in 2000 and has been granted NTR status since 2002. It has become the 150th member of the WTO since January 2007. To date, Vietnam has trade agreements with about 60 countries and trade relations with some 150 countries around the world.

The liberalization has brought about remarkable successes on trade development and overall economic performance. During 1990-2007 exports and imports have grown markedly at an average rate of 20% per annum, from US$2 billion to US$45 billion and US$50 billion, respectively. Trade as percentage of GDP increased from 23.2% in 1986 to 145.2% in 2005 (Table 2-17). Apart from economic growth, trade appears to have contributed to poverty reduction, as illustrated in the declining incidence from 58% in 1993 to 37% in 1998 based on total poverty line (the

corresponding figures based on food poverty line are 25% and 15%) (Pham and Vo, 2003, figure 9.1).

2. Structure of Vietnam's international trade

Commodity and country composition of exports

During the period under study Vietnam's exports expanded steadily from US$369 million to US$32.5 billion. Table 2-18 reveals that until 1990 exports of Vietnam were concentrated in some sectors, such as 'food and live animals' (SITC 0); 'crude materials without fuels' (SITC 2); and to a lesser extent 'manufactured goods' (SITC 8), which together accounted for about 65-81%. An observation at the 3-digit level of 1985-exports shows that major export items were: marine products (SITC 036) 28%; vegetables (SITC 054) 3%; spices (SITC 075) 3%; oil-seeds and oleaginous fruits (SITC 222) 10%; crude animal and vegetable materials (SITC 291, 292) 9%; and garment products (SITC 84) 6%.

Table 2-18: Commodity composition of Vietnam's exports (% share of total)

Description	SITC	1985	1990	1995	2000	2005
Food and live animals	0	46.31	37.61	32.46	24.42	19.52
Beverages and tobacco	1	1.61	0.1	0.08	0.12	0.46
Crude materials, inedible, except fuels	2	24.65	18.29	5.33	2.62	3.77
Mineral fuels, lubricants	3	4.7	28.5	21.70	26.41	25.76
Animal and vegetable oils and fats	4	1.8	0.3	0.97	0.43	0.05
Chemicals and related products, n.e.s.	5	0.78	0.38	0.57	0.96	1.64
Manufactured goods (by material)	6	3.41	4.79	5.07	5.39	6.64
Machinery and transport equipment	7	0.59	0.59	1.62	8.67	9.65
Miscellaneous manufactured articles	8	10.09	8.64	31.62	27.77	32.06
Other commodities and transactions	9	0.81	0.82	0.48	3.21	0.44
Total (mil. US$, at current prices)		*369.3*	*1,376.7*	*5,244.8*	*14,482.7*	*32,447.1*
Total (mil. US$, 2000 prices)		*7,638.6*	*8,274.3*	*13,907.8*	*14,482.7*	*14,451.3*

Source: Author compiled (data are from UN Comtrade online database)
Notes: 1. For 1985-1995, trade data are reported by trade partners. 2. Real value is based on Export Value Index (base year=2000) (WDI, 2007).

Since the mid-1990s, however, the composition has shifted to oils and manufactures, such as 'mineral fuels and lubricants' (SITC 3); 'manufactured goods' (SITC 6, 8); 'machinery and transport equipment (SITC 7)', which increased the share from 61% in 1997 to 74% in 2005. For example, major representative products of

2005-exports are: crude petroleum oils and oil-minerals (SITC 333) 23% and apparel products (SITC 84) 15%. Export commodities of groups (SITC6 and 7) are more widespread without a dominant product.

Table 2-19: Country composition of Vietnam's exports (% share of total)

	Trade partners	**1985**	**1990**	**1995**	**2000**	**2005**
1	USA	0.01	-	3.94	5.06	18.27
2	Japan	15.40	41.15	32.30	17.78	13.38
3	China	0.08	0.24	6.24	10.61	10.01
4	Australia	1.65	1.01	3.99	8.79	8.39
5	Singapore	14.68	-	8.43	6.12	5.91
6	Germany	12.83	12.85	10.65	5.04	3.35
7	Malaysia	3.26	3.17	2.36	2.86	3.17
8	United Kingdom	0.54	0.17	3.16	3.31	3.13
9	Thailand	0.14	6.56	0.81	2.57	2.66
10	Philippines	-	7.85	0.81	3.30	2.55
11	Korea	-	-	3.64	2.45	2.05
12	Netherlands	0.06	0.53	2.13	2.70	2.03
13	France	2.02	2.24	5.81	2.64	2.02
14	Cambodia	-	-	-	0.98	1.71
15	Belgium	-	-	-	2.15	1.68
16	Italy	0.40	0.61	-	1.51	1.45
17	Indonesia	1.58	3.01	2.94	1.72	1.44
18	Spain	0.06	0.34	1.43	0.95	1.27
19	Canada	0.38	0.94	1.04	0.68	1.10
20	Hong Kong	23.55	11.29	3.26	2.18	1.09
	Subtotal 1-20	*76.62*	*91.97*	*92.95*	*83.39*	*86.64*
	Other partners	23.38	8.03	7.05	16.58	13.36

Source: Author compiled (data are from UN Comtrade online database)
Notes: 1. For 1985-1995, trade data are reported by trade partners. 2. For 1985 and 1990, data of former West Germany and former East Germany are used for Germany and data of former Czechoslovakia for Czech Republic. 3. For 1980, Czechoslovakia, Hungary and Poland shared 20% of Vietnam's exports, but their significance has decreased to just 0.5% in 2005. 4. '-' implies that the data were not reported by trade partners.

On the other hand, despite a decreasing trend, 'food and live animals' (SITC 0) remains an important export commodity group with an average share of 25% for 1997-2005. Similarly, the representative products of 2005-exports are: fish and marine products (SITC 034, 036) 7% and fresh and dried fruits and nuts (SITC 057) 2%. In particular, two agricultural products – rice (SITC 042) and coffee (SITC 071) – increased its share to about 10% and 5% in the late 1990s, and have since declined and stabilized at about 4% and 2%, respectively. In comparison to Cambodia and Laos, exports of Vietnam are more diversified as they compose of unprocessed and processed

agricultural products, mining and mineral extracts, and light and heavy industrial products.

With respect to export markets, destination countries have shifted from East Asian economies and Eastern European countries to the US, China, and EU member countries, whereas Japan has maintained its position despite a fall in significance (Table 2-19). For example, in 1985 most agricultural products and crude materials were exported to Japan, Hong Kong, Singapore, and Malaysia, while apparel items were sold to Japan, Singapore, Australia, Hungary and Poland. In 2005, however, the US shared about 18% of exports, Japan 13%, China 10%, Australia 8% and Singapore 6%.

Commodity and country composition of imports

Table 2-20: Commodity composition of Vietnam's imports (% share of total)

Description	**SITC**	**1985**	**1990**	**1995**	**2000**	**2005**
Food and live animals	0	3.94	6.44	3.89	3.99	5.30
Beverages and tobacco	1	0.23	1.11	5.41	0.65	0.48
Crude materials, inedible, except fuels	2	1.89	1.88	2.16	3.76	4.40
Mineral fuels, lubricants	3	15.58	0.8	9.58	13.51	14.60
Animal and vegetable oils and fats	4	0.06	0.03	0.95	0.55	0.51
Chemicals and related products, n.e.s.	5	15.49	16.46	16.09	15.30	14.39
Manufactured goods (by material)	6	24.52	22.35	22.02	21.67	27.53
Machinery and transport equipment	7	24.26	37.27	33.35	30.01	25.07
Miscellaneous manufactured articles	8	3.23	4.98	4.94	7.26	5.12
Other commodities and transactions	9	4.02	8.16	0.83	3.28	2.60
Total (mil. US$, at current prices)		*592.0*	*947.6*	*8,231.7*	*15,636.5*	*36,761.1*
Total (mil. US$, 2000 prices)		*4,984.6*	*5,384.6*	*15,784.4*	*15,636.5*	*15,546.3*

Source: Author compiled (data are from UN Comtrade online database)
Notes: 1. For 1985-1995, trade data are reported by trade partners. 2. Real value is based on Export Value Index (base year=2000) (WDI, 2007). 3. '-' implies that the data were not reported by trade partners.

Unlike exports, the commodity composition of Vietnam's imports has not changed much during the period covered (Table 2-20). It is apparent the country largely imports equipment, material inputs and fuels for production. Main components of imports are: products of petroleum oils (SITC 334); organic chemicals (SITC 51); medical and pharmaceutical products (SITC 54); plastics in primary forms (SITC 57); chemical materials (SITC 59); leather (SITC 611); textile products (SITC 65); iron and steel (SITC 67); metal manufactures (SITC 69); industrial machines and equipment

(SITC 72, 74, 77); and vehicles (SITC 78). In contrast to exports where high shares can be found at the three-digit level, imports are much more widespread except for products of petroleum oils (SITC 334) with an average share of 9%.

Table 2-21: Country composition of Vietnam's imports (% share of total)

	Trade partners	**1985**	**1990**	**1995**	**2000**	**2005**
1	China	-	0.41	8.75	8.96	16.05
2	Singapore	21.83	-	21.76	17.23	12.19
3	Other Asia	-	-	-	12.02	11.71
4	Japan	25.14	22.97	11.20	14.72	11.08
5	Korea	-	-	16.41	11.21	9.78
6	Thailand	0.05	1.94	5.68	5.19	6.46
7	Malaysia	0.09	0.68	3.26	2.49	3.42
8	Hong Kong	9.41	21.47	7.74	3.82	3.36
9	Switzerland	0.19	0.24	0.33	0.75	2.43
10	USA	3.36	0.79	3.07	2.33	2.35
11	Russian Federation	-	-	-	1.54	2.09
12	Indonesia	0.90	4.05	3.49	2.21	1.90
13	Germany	9.15	19.59	2.88	1.89	1.80
14	India	1.91	1.81	1.51	1.14	1.62
15	Australia	0.31	1.93	1.38	1.88	1.36
16	France	3.82	9.86	3.91	2.14	1.22
17	Kuwait	-	-	0.11	0.72	0.98
18	Netherlands	0.38	1.02	0.53	0.54	0.85
19	Italy	2.26	1.52	1.27	1.09	0.78
20	United Kingdom	0.45	1.10	0.99	0.96	0.50
	Subtotal 1-20	*79.24*	*89.36*	*94.25*	*92.82*	*91.92*
	Other partners	20.76	10.64	5.75	7.18	8.08

Source: Author compiled (data are from UN Comtrade online database)
Notes: 1. For 1985-1995, trade data are reported by trade partners. 2. For 1985 and 1990, data of former West Germany and former East Germany are used for Germany and data of former Czechoslovakia for Czech Republic. 3. For 1980, Czechoslovakia, Hungary and Poland shared 17% of Vietnam's exports, but their significance has decreased to just 0.2% in 2005. 4. '-' implies that the data were not reported by trade partners.

With regard to sources, Vietnam mainly imports from Asian economies, such as East Asian economies and ASEAN member countries. Specifically, Japan and Singapore are the major suppliers over study period, while China and Malaysia have been increasing their share and recently taken a considerable position in this market. On the other hand, Hong Kong and Korea have lost their share over the last decade. For example, in 1985 Singapore, Japan and Hong Kong accounted for more than 56% of the imports. In 2005, China is leading the list with 16%, followed by Singapore 12%; Japan 11%; Korea 10% and other Asian countries 12% (Table 2-21).

c. Industrial development in Vietnam

At the beginning of the 1990s, the economic structure was still characterized by the primary sector. For example, in 1991 the agricultural sector accounted for 41% of the GDP and employed about 72% of the 30 million employed labor forces, while the industrial sector contributed 24% and 8% in terms of output and employment, respectively (Key Indicators, 2008).

During 1990-2007, the economic structure has steadily transformed to an industry-based economy. The industrial sector has achieved noticeable growth averaging to 10.4% per annum, while the corresponding figures for the agricultural and service sectors are 4.9% and 7.4%, respectively. To date, the agricultural share is only 20.3%, while industry and service contribute 41.6% and 38.1%, respectively. In terms of employment, roughly half of 44 million labor forces are engaged in the agricultural sector and about 14% are employed in the manufacturing industries (Key Indicators, 2008).

Table 2-22: Basic statistics of Vietnam's industry

Description	**2000**	**2002**	**2003**	**2004**	**2005**
Total number of operating enterprises	42288	62908	72012	91755	112952
State owned enterprise (% share)	*13.62*	*8.53*	*6.73*	*5.01*	*3.62*
Non-state enterprise (% share)	*82.78*	*87.81*	*89.60*	*91.55*	*93.11*
FDI enterprise (% share)	*3.61*	*3.67*	*3.67*	*3.44*	*3.27*
Employees in industry (1000 persons)	3537	4658	5175	5770	6241
State owned enterprise (% share)	*59.05*	*48.52*	*43.77*	*38.99*	*32.70*
Non-state enterprise (% share)	*29.43*	*36.65*	*39.61*	*42.90*	*47.74*
FDI enterprise (% share)	*11.52*	*14.84*	*16.62*	*18.11*	*19.56*
Output in billion VND (1994 prices)	198,326	261,092	305,080	355,624	416,563
State owned enterprise (% share)	*41.80*	*40.26*	*38.56*	*37.02*	*33.88*
Non-state enterprise (% share)	*22.26*	*24.31*	*25.66*	*26.93*	*28.84*
FDI enterprise (% share)	*35.94*	*35.43*	*35.78*	*36.04*	*37.29*

Source: Statistical Yearbook of Vietnam, 2006. General Statistical Office (GSO)
Notes: 1. Statistics are as of 31 December of the year. 2. Average exchange rate of 2007 is 16178.90 VND per US$ (Key Indicators, 2008)

SOE reform was among the first components of Doi Moi program to be implemented. SOE managers were given more autonomy in decision making on production and distribution in the early stage of the transition, while direct budgetary subsidies from the government were eliminated and further credits were restricted

owing to higher real interest rates. The first phase took place during 1899-1994 and the second phase started around the middle of 1998. SOEs making losses and running unfeasible production have been liquidated. In parallel with this, the private sector has been recognized and encouraged, and several measures have been taken to promote its participation in the production and distribution of output. Moreover, a legal framework has been formulated for investment and operation of private businesses, foreign direct investment (FDI), and the corporate sector as a whole. Consequently, during 1990-1994 the number of SOEs and state workers was reduced significantly. Also, during 1990-2000 the number of SOEs decreased from 12,000 to 5,300 and SOEs' share in industrial output declined from 62% to 42% (Harvie and Tran, 1997; Pham and Vo, 2003; WB, ADB, and UNDP, 2001)

Table 2-22 illustrates the changing structure of the Vietnam's industrial sector for 2000-2005 in more detail. Strong growth of the industrial sector can be confirmed by a drastic increase in the number of enterprises from 42,288 to 112,952; in employment from 3.54 million to 6.24 million; and in output from 198,326 billion to 416,563 billion VND. It is also apparent that the ongoing privatization has resulted in the declining role of the state sector and the rise of the non-state and foreign invested sectors with respect to all three indicators. One interesting point revealed from the table is that remaining SOEs tend to be large, because their percentage share in employment and output is still dominant (about 33% in 2005) as compared to the share enterprise number (less than 4% in 2005).

In regard to industrial policy, the government intends to (i) maintain high growth and simultaneously maintain improvement in industrial product quality and production efficiency, (ii) enhance the competitiveness of the industrial sector in order to sustain and expand domestic and international market shares; (iii) give priority the development of key industries that manufacture critical production materials to serve the country's industrialization, modernization, and development of auxiliary industries;

(iv) maintain supply-demand balance for essential industrial products (electricity, coal, steel etc.); and (v) attempt to achieve average annual growth in industrial output of 15.2-15.5% and in value added of 9.5-10.2% (MPI, 2006). Overall, emphasis has been given to energy and steel industry, major manufacturing industries, such as fertilizers and chemicals, paper, plastics, T&G and footwear, electronics, information and telecommunications, and beverages.

CHAPTER THREE
REVEALED COMPARATIVE ADVANTAGE AND INDUSTRIALIZATION IN CLV

This chapter presents the empirical study on revealed comparative advantage of Cambodia, Laos and Vietnam, and the discussions of the results. The analysis applies the RCA index and the NEI index defined in Chapter 2 on trade data from the Comtrade database and the International Trade Statistics Yearbook of the United Nations. The analysis covers all commodity groups under the SITC category given the availability of the data. The RCA index is calculated using equation (2.2) and the NEI index by means of equation (2.3) for individual countries at the three-digit level. The analysis is mainly based on the commodity classification at this level, because the commodity groups have higher substitution elasticity (Lee, 1995) and are widely applied in empirical trade literature. It should also be noted that the product items at the four-digit or higher levels included in the product groups (three-digit level) might differ from one another in some cases owing to the changes in the revisions of the SITC applied for the study (Revision 2 for 1985, 1990, 1995; Revision 3 for 2000-2005).

3.1 RCA AND INDUSTRIAL DEVELOPMENT IN CAMBODIA

In order to examine the trends of Cambodia's comparative advantages, the Balassa's index and net export index are calculated for 1985, 1990, 1995, and 2000-2005 at the three-digit SITC. In regard to behavior, the two indices seem to move together and identify similar products with comparative advantage/disadvantage. The Spearman rank correlation coefficients between the RCA and NEI indices are relatively high and statistically significant at the 1% level for all cases (Table 3-1).

In addition, in order to assure the appropriateness of the results for cross-commodity (*cross-country*) comparison, the Hillman condition has been tested for garment and footwear products, since they account for a large portion of exports. The

test results indicate that the RCA is consistent with the comparative advantage indicated by pre-trade prices as indicated in Hillman (1980).

Table 3-1: Correlation between RCA and NE index (Cambodia)

RCAxNEI	1985	1990	1995	2000	2005
SRC Coefficient	0.649	0.764	0.787	0.780	0.820
Sample size	35	59	118	151	176

Notes: 1. Spearman rank correlation coefficients are applied. 2. All coefficients are statistically significant at the 1% level.

3.1.1 Trends of Revealed Comparative Advantages in Cambodia

The summary of the RCA and NEI indices of selected product groups are presented in Table 3-2 and Table 3-3, respectively, for 1985-2005 at the five year interval owing to space limitation. The indices are missing for many products for the period of 1985-1990. This could be explained by the fact that during the turbulent period commodity trade data were not reported to Comtrade system or Cambodia was more isolated and exports were actually very limited to some rubber and crude materials, and clothing products. The latter seems to be more likely, because prior to the restoration of peace and normalized relations with the international community, trade was less developed and liberalized.

The two tables show the trends of Cambodia's revealed comparative advantages in absolute terms. Overall, the export performance and net export indices reveal very similar products with comparative advantage. Once again, the tables reveal a high concentration of the country's exports. During the 1980s, agricultural products, such as oil-seeds and fruit extracts (SITC 222); rubber (SITC 232); crude animal and vegetable materials (SITC 291, 292), recorded high RCA and NEI indices, but they have lost their competitiveness and by 2005 most of these commodities recorded negative indices of RCA. Only certain simple wood products, i.e. wood in rough or squared and simply worked wood (SITC 247, 248), appeared to have maintained their comparative advantage over the period under study despite some fluctuations.

Table 3-2: Trends of RCA index for selected product groups (Cambodia)

Product	SITC	1985	1990	1995	2000	2005
Fried, salted, smoked fish	035	-	0.844	0.557	-0.202	-0.238
Crustaceans, molluscs etc.	036	-	-0.779	0.134	-0.212	0.109
Fish, crustaceans, molluscs, etc.	037	-	-0.672	-2.195	-	0.585
Rice	042	-	-	0.868	-0.212	-0.088
Unmilled maize (excl. sweet corn)	044	-	0.637	0.688	-1.865	-0.481
Fresh or dried fruit and nuts	057	-0.642	-1.573	-0.424	-1.717	0.183
Tobacco (unmanufactured or refuse)	121	-	-	-0.095	-0.369	0.208
Tobacco products	122	-	-	-2.092	-0.275	0.409
Raw hides and skins (excl. furskins)	211	-	1.166	-0.229	-0.578	-0.229
Oil-seeds and oleaginous fruits extract.	222	1.114	1.317	-0.440	-1.693	0.063
Natural rubber and gums (unprocessed)	231	-	-	-	0.953	1.394
Synthetic and reclaimed rubber	232	2.109	2.426	0.196	1.255	-
Fuel wood and wood charcoal	245	-	1.689	1.534	-3.448	-0.828
Wood in rough or squared	247	-	1.700	2.242	-	-1.020
Simply worked wood	248	-	0.778	1.585	0.033	0.799
Worn clothing and textile articles; rags	269	-	-0.571	0.291	0.538	1.145
Crude animal materials	291	0.466	-0.804	-1.163	-1.541	-0.619
Crude vegetable materials	292	1.252	0.534	0.396	-1.675	-0.594
Veneers, plywood, etc.	634	-	-	0.613	0.869	-0.446
Wood manufactures	635	-0.946	-0.479	-0.615	-0.929	-1.371
Made-up articles of textiles	658	-	-1.341	-2.004	0.033	0.191
Men's, boys' clothing, not knitted	841	-	-	-	0.760	1.335
Women's, girls' clothing, not knitted	842	-0.504	-0.036	0.761	0.794	1.521
Men's, boys' clothing, knitted	843	0.145	-0.198	0.713	2.021	1.633
Women's, girls' clothing, knitted	844	0.826	0.480	0.848	1.785	1.737
Articles of textile apparel	845	-0.952	-1.431	0.953	1.419	1.565
Clothing accessories, of textile fabrics	846	0.648	-0.337	0.894	-0.084	-0.153
Non-textile clothing, headgear	848	-	-	-1.554	0.392	0.313
Footwear	851	-	-1.533	-0.474	0.448	0.895
Printed matter	892	-0.157	-1.588	-1.102	1.660	-1.753
Gold, non-monetary (excl. gold ores)	971	-	-	-	0.096	0.503

Source: Author's calculations (data are from UN Comtrade online database)
Notes: 1. The RCA index is in common logarithm (logarithm base 10). 2. '-' means that the data was not reported by any of the trade partners.

On the other hand, garment and footwear products have steadily gained competitiveness over the study period. Specifically, in 1985 only two garment items not-knitted undergarment (SITC 843) and knitted outwear (SITC 844) recorded positive Balassa's index, but by 2005 most of garment products and footwear registered highly positive indices of RCA.

Apart from those mentioned above, Cambodia does not appear to have comparative advantages in product items of beverages and tobacco (SITC 1), mineral fuels and lubricants (SITC 3), animal and vegetable oils (SITC 4), chemical products (SITC 5), and vehicle and transport equipment (SITC 7). It is also apparent that while

having gained comparative advantage in apparel and clothing, the country seems to lose comparative advantage in clothing accessories of textile product (SITC846). These results suggest that Cambodia would specialize in some specific or niche products in an industry or a subindustry.

Table 3-3: Trends of NEI index for selected product groups (Cambodia)

Product	SITC	1985	1990	1995	2000	2005
Fresh, chilled or frozen fish	034	-	0.988	0.931	0.980	0.201
Fried, salted, smoked fish	035	-	1.000	0.840	0.998	0.892
Crustaceans, molluscs etc.	036	-	-	0.407	0.996	-0.003
Fish, crustaceans, molluscs, etc.	037	-	-	-0.999	-	0.007
Rice	042	-	-	-0.711	-0.692	-0.422
Unmilled maize (excl. sweet corn)	044	-	1.000	1.000	-0.735	0.199
Fresh, chilled, or frozen vegetable	054	-0.679	-	0.145	-0.871	0.568
Fresh or dried fruit and nuts	057	-	-0.424	-0.610	-0.933	0.557
Spices	075	-	-	-	-0.909	0.549
Tobacco (unmanufactured or refuse)	121	-	-	-0.039	-0.852	-0.168
Tobacco products	122	-	-	-1.000	-0.948	-0.730
Raw hides and skins (excl. furskins)	211	-	1.000	1.000	0.519	0.986
Oil-seeds and oleaginous fruits extract.	222	1.000	1.000	0.905	-0.016	0.976
Oil-seeds and oleaginous fruits	223	-	-	-	-0.038	0.836
Natural rubber and gums (unprocessed)	231	-	-	-	0.969	0.950
Synthetic and reclaimed rubber	232	1.000	1.000	0.645	0.969	-
Fuel wood and wood charcoal	245	-	1.000	1.000	0.220	-0.273
Wood in rough or squared	247	-	1.000	1.000	-	0.995
Simply worked wood	248	-	0.979	1.000	1.000	0.987
Crude animal materials	291	0.923	-	-0.650	0.159	0.215
Crude vegetable materials	292	0.758	1.000	0.774	-0.678	0.618
Veneers, plywood, etc.	634	-	-	0.868	0.989	0.465
Made-up articles of textiles	658	-	-0.870	-0.986	0.532	0.474
Travel goods, handbags	831	-	-	-0.829	0.707	0.147
Men's, boys' clothing, not knitted	841	-	-	-	0.989	0.995
Women's, girls' clothing, not knitted	842	-	-	0.895	0.998	0.999
Men's, boys' clothing, knitted	843	0.913	0.915	0.969	0.996	0.988
Women's, girls' clothing, knitted	844	0.925	0.864	0.844	1.000	0.997
Articles of textile apparel	845	0.599	0.351	0.823	0.998	0.902
Clothing accessories, of textile fabrics	846	1.000	0.606	0.831	-0.804	-0.641
Non-textile clothing, headgear	848	-	-	-0.805	0.115	0.353
Footwear	851	-	-0.245	-0.695	0.528	0.846
Printed matter	892	-0.490	-0.897	-0.916	0.852	-0.983
Works of art, collectors' pieces, antiques	896	-	0.642	-0.909	-0.398	0.833
Jewellery, gold and silver wares	897	-0.205	-	-0.533	0.208	0.435
Gold, non-monetary (excl. gold ores)	971	-	-	-	-0.706	1.000

Source: Author's calculations (data are from UN Comtrade online database)
Note: '-' implies that the data was not reported by any of the trade partners.

Notwithstanding this, at the three-digit level some commodities of agro-processing and manufacturing industries show a potential for development for export. For example, fresh or dried fruits and nuts (STIC 057), tobacco products (STIC 121, 122), and made-up articles of textiles (STIC 658) have improved competitiveness,

although the RCA index is yet to turn positive and the share is still less than one percent. Given appropriate development and promotion strategies, these subindustries could be candidates for export in foreseeable future.

3.1.2 Ranking of Indices of RCA in Cambodia

The value of RCA and NEI indices in absolute terms enables a product classification into high and low RCA categories, but this could be misleading if their RCA rankings are ignored. As discussed previously, a product with an initial large share in exports can hardly increase its share and thereby increasing the value of its RCA and NEI index, as more products enter the export markets over time. Hence, in addition to the value, we should consider the ranking of the indices of revealed comparative advantage and observe the trends in comparative advantages in major export sectors or industries. Table 3-4 and Table 3-5 present the first ten major export commodities in terms of their competitiveness and importance in the export markets. These are products with a high RCA index and NEI index, i.e. index value of greater than zero, and a share in total exports of one percent or greater.

At the level of sector[19] (subsector) or industry, rubber products (synthetic and reclaimed rubber, natural rubber and gums) have maintained high ranks for the whole study period, while exports of other crude agricultural products (crude vegetable materials, oil-seeds and fruit extracts) dominated the rankings until mid-1990s. Also, some agricultural commodities and wood products can enter the rankings for some years. On the other hand, apparel and clothing industry entered the top-10 list in 1985 and has gradually dominated the rankings, particularly after 2000.

At the three-digit level of the SITC, however, the features are more flexible. The following analysis is largely based on the export performance index (RCA index)

[19] In this dissertation, the notion 'sector' is used for three countries to distinguish the agricultural product groups, such as rice, from those of mining and manufacturing industries such as apparel articles and the like.

with reference to NEI index. Despite some differences in the rankings of commodities, the net export index shows very similar trends of comparative advantages in commodity exports.

Representing the agro-industrial sector, synthetic and reclaimed rubber was the leader of the rankings until the early 1990s, with the largest share of 26% in 1985 and 34% in 1990. However, throughout the study period, natural rubber has maintained its position among the top-ten products with a share of less than 2%, whereas synthetic rubber has gradually lost its competitiveness and was driven out the rankings after 2000. Three other products of this sector (crude vegetable; oil-seeds; and raw hides and furskins) also dominated the top-10 list until 1990 and accounted for about 10% of the commodity exports. They, too, have lost competitiveness and disappeared from the top-ten list since mid-1990s.

The wood industry has been in the top-ten rankings in terms of competitiveness and export share since the early 1990s. For example, in 1990 two representatives, wood in rough or squared and simply worked wood, ranked third and seventh, respectively, and together shared 17%. In 1995, they ranked first and second and shared about 57% of the country's commodity exports. But, since 2000 they have lost their significance in terms of export share, while processed wood products like veneers and ply wood have entered the rankings and gained some competitiveness. This might be attributable to a shift in policy to promote processed wood products.

The garment and footwear industries are the only industries which have steadily gained competitiveness and dominated Cambodia's export markets during the period under study. In 1985, three garment products (knitted and not-knitted undergarment, and not knitted women's outwear) were among the top-ten with just 3% share, whilst other garment products recorded a negative RCA index. Since early 1990s the apparel and clothing industry has slowly gained competitiveness and by 1995 five out of the

Table 3-4: The top-10 high ranking RCA products with share ≥1% (Cambodia)

Rank	1985	1990	1995	2000	2005
1	Synthetic and reclaimed rubber (25.92)	Synthetic and reclaimed rubber (33.70)	Wood in rough or squared (36.22)	Knitted men's and boys' clothing (17.83)	Knitted women's and girls' clothing (13.42)
2	Iron/steel in primary form (8.98)	Ferrous waste and scrap (13.27)	Simply worked wood (20.93)	Knitted women's and girls' clothing (17.17)	Knitted men's and boys' clothing (6.04)
3	Crude vegetable materials (5.46)	Wood in rough or squared (13.67)	Outwear, knitted, nonelastic (6.14)	Printed matter (19.61)	Articles of textile apparel (32.08)
4	Oil-seeds and oleaginous fruit extracts (5.74)	Non-ferrous metal waste (4.45)	Undergarment, knitted (3.89)	Articles of textile apparel (26.03)	Not-knitted women's and girls' clothing (20.55)
5	Undergarment, not knitted (1.21)	Oil-seeds and oleaginous fruit extracts (6.06)	Rice (1.07)	Synthetic and reclaimed rubber (1.78)	Natural rubber and gums (2.24)
6	Undergarment, knitted (1.04)	Raw hides and skins, excl. furskins (2.58)	Undergarment, not knitted (1.87)	Veneers, plywood, etc. (2.04)	Not-knitted men's and boys' clothing (10.68)
7	Insecticides, rodenticides, etc. (0.94)	Simply worked wood (3.56)	Men's outwear, not knitted (3.33)	Not-knitted women's and girls' clothing (4.26)	Footwear (4.90)
8	Household-type equipment (1.51)	Unmilled maize, excl. sweet corn (1.25)	Women's outwear, not knitted (4.27)	Not-knitted men's and boys' clothing (3.81)	Simply worked wood (2.14)
9	Special transactions and commodities (3.24)	Crude vegetable materials (1.16)	Unmilled maize, excl. sweet corn (1.07)	Footwear (2.07)	Non-monetary gold, excl. gold ores(1.14)
10	Women's outwear, not knitted (0.92)	-	Veneers, plywood, etc.(1.24)	-	-
Total%	54.95	79.69	80.03	94.61	93.20
V1%	US$4.63 million	US$6.76 million	US$5.11 million	US$13.89 million	US$15.58 million

Source: Author's calculations (data are from UN Comtrade online database)

Notes: 1. Percentage share is in parentheses. 2. High RCA products are commodities which have an RCA index of zero or greater. 3. Total%=total share of commodities listed in this table. 4. V1%=value of 1% share in million US$ at 2000 prices.

Table 3-5: The top-10 high ranking NEI products with share ≥1% (Cambodia)

Rank	1985	1990	1995	2000	2005
1	Oil-seeds and oleaginous fruit extracts (5.74)	Unmilled maize, excl. sweet corn (1.25	Unmilled maize, excl. sweet corn (1.07)	Knitted women's and girls' clothing (17.17)	Non-monetary gold, excl. gold ores(1.14)
2	Synthetic and reclaimed rubber (25.92)	Raw hides and skins, excl. furskins (2.58)	Wood in rough or squared (36.22)	Articles of textile apparel (26.03)	Not-knitted women's and girls' clothing (20.55)
3	Undergarment, knitted (1.04)	Oil-seeds and oleaginous fruit extracts (6.06)	Simply worked wood (20.93)	Not-knitted women's and girls' clothing (4.26)	Knitted women's and girls' clothing (13.42)
4	Undergarment, not knitted (1.21)	Synthetic and reclaimed rubber (33.70)	Women's outwear, not knitted (4.27)	Knitted men's and boys' clothing (17.83)	Not-knitted men's and boys' clothing (10.68)
5	Crude vegetable materials (5.46)	Wood in rough or squared (13.67)	Men's outwear, not knitted (3.33)	Not-knitted men's and boys' clothing (3.81)	Knitted men's and boys' clothing (6.04)
6	Household-type equipment (1.51)	Ferrous waste and scrap (13.27)	Veneers, plywood, etc.(1.24)	Veneers, plywood, etc. (2.04)	Simply worked wood (2.14)
7	Special transactions and commodities (3.24)	Non-ferrous metal waste (4.45)	Undergarment, not knitted (1.87)	Synthetic and reclaimed rubber (1.78)	Natural rubber and gums (2.24)
8	Iron/steel in primary form (8.98)	Crude vegetable materials (1.16)	Undergarment, knitted (3.89)	Printed matter (19.61)	Articles of textile apparel (32.08)
9	-	Simply worked wood (3.56)	Outwear, knitted, nonelastic (6.14)	Footwear (2.07)	Footwear (4.90)
10	-	Special transactions and commodities (1.15)	-	-	-
Total%	53.09	80.85	78.96	94.61	93.20
V1%	US$4.63 million	US$6.76 million	US$5.11 million	US$13.89 million	US$15.58 million

Source: Author's calculations (data are from UN Comtrade online database)

Notes: 1. Percentage share is in parentheses. 2. High NEI products are commodities which have an NEI index of zero or greater. 3. Total%=total share of commodities listed in this table. 4. V1%=value of 1% share in million US$ at 2000 prices.

top-ten rankings were garment products with 20% share. Five years later this industry fully dominated the country's exports with five representatives in the first ten rakings and comprised roughly 70%. Cambodia's exports have since then shifted to garment products with four or five representative items in the top-ten list each year. Particularly, since 2000 two products 'knitted women's girls' clothing' and 'knitted men's and boys' clothing' have been maintaining the leading positions and in 2005 five products of this industry ranked among the first six items in the ranking list. During the study period, all garment products share about 70-83% of the country's exports. Similarly, the footwear industry, which still registered a negative Balassa's index up to 1995, has steadily gained competitiveness and significance. Specifically, since 2000 the footwear industry has turned to positive RCA index and accounted for about 2% of the commodity exports. Its ranking has also improved from 9th to 7th and its share increased to 5% in 2005.

During the period considered here, some other products, such as insecticides, maize, rice and printed matter, could enter the top-ten rankings, but their competitiveness was rather short-lived, and they quickly disappeared from the list.

It is noted that some minor differences between the export performance and net export measure in some items are due to the fact that these products are sensitive in trade negotiations and/or under protection. For example, for 1990 the NEI index revealed ten high NEI products with, but the RCA index yielded only nine items. Similar differences can also be found for the rank of individual commodities within the top-ten list.

3.1.3 Diversification of Exports in Cambodia

As discussed in Section 2.2.3, the ratio of products with comparative advantage to overall exported products, the standard deviation of the indices of RCA, and Spearman Rank Correlation coefficients are applied to study the patterns and

diversification of Cambodia's exports. Table 3-6 presents the first indicator – the ratio of products with RCA and NEI index of greater than zero to the total number of ranked products and the percentage share of products with comparative advantage for 1985-2005.

As can be observed in the first half of the table, the Balassa's index revealed no significant change in the number of products with comparative advantage (15-19 items), while the number of exported commodities increased from 40 to 177. Consequently, the resulting ratio decreased over the study period. On the other hand, according to the UNIDO-type index, the number of products with comparative advantage doubled (from 15 to 34 items) and the resulting ratio decreased until 1995 and since then remained relatively unchanged. Although the change in the number of high RCA products was less considerable, these products comprise 83% to 98% of the country's exports (except for 1985). These results suggest that exports of Cambodia tend to concentrate in some commodities over the last 20 years despite more and more items being exported.

Table 3-6: Number of products with high RCA and NEI Index (Cambodia)

	1985	**1990**	**1995**	**2000**	**2005**
RCA index					
High RCA products (A)	18	16	19	17	19
Total ranked products (B)	40	77	123	152	177
Ratio of high RCA products to total (A)/(B)	0.45	0.21	0.15	0.11	0.11
Share of high RCA products (% share)	58.89	82.94	83.30	97.23	96.94
Net export index					
High NEI products (A)	15	28	21	28	34
Total ranked products (B)	35	59	118	151	177
Ratio of high NEI products to total (A)/(B)	0.43	0.47	0.18	0.19	0.19
Share of high NEI products (% share)	56.23	84.89	81.96	97.06	96.60

Source: Author's calculations (data are from UN Comtrade online database)
Note: RCA or NEI index is classified as high if its value is greater than 0.0 (RCA, NEI>0).

At the one-digit level of the SITC, high RCA products, evaluated by both measures, mainly occurred in the category of 'food and live animals' (SITC 0), 'inedible crude materials – except fuels' (SITC 2), and 'manufactured goods' (SITC 6 and 8). However, this numbers have changed from 'crude materials except fuels' (STIC 2) to 'miscellaneous manufactured articles' (SITC 8) during 1995-200, indicating a

shift in exports from crude materials to manufactured goods (mainly garments). Hence, one can observe that in spite of an increasing trend in export commodities, exports of Cambodia were still concentrated in those sectors/industries illustrated above, and that the export composition diversified from agricultural to industrial products in mid-1980s.

The second indicator of export diversification is presented in Table 3-7. As illustrated in Section 2.2.3, if the range of a country's export commodities becomes more diversified, the standard deviation of the indices of RCA is expected to decline. For Cambodia, the standard deviation of the net export index decreased only slightly from 0.76 to 0.66, while that of the Balassa's index increased from 0.87 to 1.36. Therefore, it can be said that the Cambodia's exports have not diversified in the last two decades.

Table 3-7: Standard deviation of RCA and NEI Index (Cambodia)

	1985	**1990**	**1995**	**2000**	**2005**
RCA index	0.868	1.172	1.133	1.411	1.359
Sample size	40	77	123	152	177
NEI Index	0.763	0.792	0.694	0.653	0.655
Sample size	35	59	118	151	177

Source: Author's calculations (data from UN Comtrade database)

The third issue is to measure the similarities/differences in the export composition between two periods. To this end, using equation (2.4) the Spearman Rank Correlation (SRC) coefficients for RCA and NEI index have been calculated for 1985-2005 (Table 3-8). If the export diversification occurred over time, the correlation coefficients would become smaller, the longer the time lags. For both indices, the SRC correlation coefficient showed a decreasing trend from 0.7 to 0.5 for shorter time lags (until 1995), but remained largely stable for the period after 1995. This result indicated that the export composition of 1985-1990 differs greatly from that of 1990-2005.

All the three indicators suggest that export diversification was considerable until the mid-1990s, but remained low since then. Also, there was a significant change in export composition between the period before and after 1995. These and other

findings point to a structural shift in exports from agricultural commodities (rubber, oil-seeds, wood) to light industrial products (apparel, footwear) in the mid-1990s.

Table 3-8: Rank correlation coefficient, 1985-2005 (Cambodia)

RCA*x*RCA	**1985**	**1990**	**1995**	**2000**	**2005**
1985	1.000	0.712***	0.348**	0.286**	0.179
1990		1.000	0.574***	0.434***	0.538***
1995			1.000	0.532***	0.589***
2000				1.000	0.655***
2005					1.000
NEI*x*NEI	**1985**	**1990**	**1995**	**2000**	**2005**
1985	1.000	0.682***	0.599***	0.582***	0.425**
1990		1.000	0.706***	0.538***	0.605***
1995			1.000	0.582***	0.645***
2000				1.000	0.713***
2005					1.000
RCAxNEI	**1985**	**1990**	**1995**	**2000**	**2005**
	0.649	0.764	0.787	0.780	0.820

Notes: 1. Spearman rank correlation coefficients are applied. 2. *, **, *** denotes statistical significance at the 1%, 5%, and 10% level.

3.1.4 Trends of Major Sectors and Industries in Cambodia

Table 3-9: Export share of Cambodia's major sectors and industries (% share)

Sector	**SITC**	**1985**	**1990**	**1995**	**2000**	**2005**
Non-marine fish and preparations	03	-	2.96	1.66	0.43	1.01
Cereals and cereal preparations	04	7.85	1.25	1.29	0.07	0.11
Vegetables and fruit	05	0.17	0.02	0.23	0.02	0.71
A.. Subtotal of Section 0	***0***	***8.02***	***4.22***	***3.18***	***0.52***	***1.83***
Hides, skins and furskins, raw	21	-	2.58	0.08	0.02	0.03
Oil-seeds and oleaginous fruits	22	6.35	7.32	0.09	0.04	0.24
Crude rubber (synthetic and reclaimed)	23	35.80	42.11	14.37	2.33	2.24
Cork and wood	24	1.02	18.01	57.33	0.43	2.15
B. Subtotal of Section 2	***2***	***43.17***	***70.02***	***71.87***	***2.82***	***4.67***
Articles of apparel and clothing accessories	84	3.65	1.92	19.64	69.81	83.31
Footwear	85	-	0.02	0.28	2.07	4.90
Printed matter	892	0.33	0.01	0.04	19.61	0.01
C. Subtotal of Section 8	***8***	***3.98***	***1.96***	***19.96***	***91.50***	***88.22***
Subtotal (A+B+C)		**55.17**	**76.21**	**95.00**	**94.84**	**94.72**

Source: Author's calculations (data are from UN Comtrade online database)
Note: The share of the one-digit level (SITC section) is the sum of the share of the two- and three-digit items presented here.

In this section we will look into the industrial development process in more detail and analyze the trends in comparative advantages of major sectors and industries. These are 'crude material (oil-seeds and oleaginous fruits (SITC 22), crude rubber (STIC23))'; 'wood products (SITC 24)'; and 'garment and footwear industry (SITC 84, 85)'. Table 3-9 shows the percentage share of these sectors and industries with some

agricultural products for comparison. In 1985 and 1990 they, respectively, accounted for about 55% and 76% of the exports, and since 2000 they share about 95%. Hence, they could be considered as major sectors and industries of Cambodia. Table 3-10 and Table 3-11 present the RCA and NEI index and the (raw) rankings[20]. Also for the purpose of comparison among sub-periods, the ranks of the two indices have been adjusted, i.e. these would be the ranks when the total number of ranked commodities was assumed to be 177 for RCA and NEI measure.

a. Crude materials (raw hides, oil-seeds, rubber)

Products of crude materials being exported are mainly raw hides and furskins (SITC 211), oil-seeds and oleaginous fruit extracts (SITC 222), and rubber (SITC 231, 232). They have been exported to Asian economies (China; Hong Kong; Malaysia; Singapore; Thailand), European countries (France; Germany; Hungary; Italy; Norway; Poland; the UK; etc.), Australia, and the U.S. The export value (in nominal terms) increased steadily from US$2.7 million in 1985 to US$81.6 million in 2005. As Cambodia expanded and shifted her exports to light manufactured products over the study period, they lost the role in this markets and the share decreased from a peak of 50.7% in 1990 to just 2.5% in 2005.

In terms of RCA and NEI rankings, their ranks have decreased drastically over the two decades (Table 3-10). For example, 'oil-seeds and oleaginous fruit extracts' (SITC 222) ranked fourth in 40 exported commodities in 1985 (1/35 for NEI index). But it lost its competitiveness and ranked 60th out of 152 commodities in 2000 (29/151 for NEI index), before moving upward again to 19/177 in 2005 (9/177 for NEI Index). If the rankings were adjusted to 177 products, its RCA ranking decreased from 18th to 70th for Balassa's index (from 5/177 to 34/177 for NEI index) during 1985-2000, and increased again to 19/177 in 2005 (9/177 for NEI Index). Similarly, 'synthetic and

[20] The raw and adjusted rankings in Table 3-10 and 3-11 are different from those of Table 3-4 and 3-5, because in this case all exported commodities are taken into account regardless of their share in exports.

reclaimed rubber' (SITC 232) lost its rank from 18/177 in 1985 to 26/177 in 1995 (10/177 to 26/177 for NEI index), but could gain some competitive and rose to 6/177 in 2005 (14/177 for NEI index). Other products also showed a comparable ranking trend.

A special case is 'printed matter' (SITC 892), which gained CA and significance in exports during 1985-2004, but then lost both its competitiveness and role in 2005. Specifically, this commodity increased the share from 0.33% in 1985 to 21.88% in 2004, but decreased to 0.01% in 2005. The RCA index rose from -0.157 to 1.731 and fell again to -1.753 for corresponding years.

b. Wood industry

Two representatives of cork and wood products (SITC 24) are 'wood in rough or squared' (SITC 247) and 'simply worked wood' (SITC 248). The export markets for these products are mainly Asian countries (Malaysia; India; Japan; Thailand) and some European countries like Hungary and Norway. The export value (percentage share) increased from less than one million (1.0%) in 1985 to a peak at US$179 million (57.3%) in 1995 and then fell to US$70 million (2.1%) in 2005.

The first commodity, 'wood in rough or squared' (SITC 247), recorded a very high RCA index of 2.242 and ranked 4/77 (adjusted ranking: 9/177) in 1995, but lost its competitiveness over the years and recorded an RCA index of -1.020 and ranked 48/177 in 2005. The other product, 'simply worked wood' (SITC 248), performs much better with an RCA index of 0.778 in 1985 and 0.799 in 2005 despite fluctuations. The corresponding NEI index remained practically 1.000 over the period. The rankings (adjusted rankings) actually increased from 10/77 (23/177) to 9/177 (9/177) over the same period. The figures for NEI index are 12/59 (36/177) for 1985 and 7/177 (7/177) for 2005 (Table 3-10).

c. Garment and footwear industry

Products of the apparel and clothing industry include: not-knitted men's and women's cloth (SITC 841, 842); knitted men's and women's cloth (SITC 843, 844); articles of textile apparel (SITC 845); textile clothing accessories (SITC 846); and non-textile clothing and headgear (SITC 848)[21]. Combined with footwear products (SITC 851), their export value increased sharply from a quarter million dollar in 1985 to US$2.86 billion in 2005, and comprised more than 88 percent of the country's commodity exports. The garment industry is the most dynamic industries in the last two decades, which has steadily gained competitiveness with an RCA index of the industry (SITC 84) rising from 0.24 in 1985 to 1.48 in 2005. In 1985 Cambodia exported five of six garment product groups, and they ranked 5th and 34th out of 40 (22 and 150 out of 177 for adjusted rankings). As the exports of Cambodia shifted to this industry in the mid-1990s, garment products have been leading the export list since then. For example, in 2000 all garment items, except for 'textile and clothing accessories' (SITC 846), recorded an RCA index between 0.8 and 2.0 (NEI index equals 1.00) and ranked between 1/152 and 9/152 (1/177 and 15/177 for adjusted rankings). In 2005 all these commodities achieved an RCA index of 1.34-1.4 (1.00 for NEI) and ranked between 1/177 and 13/177 (Table 3-11).

At the three-digit level, one can observe different trends in comparative advantage of garment products during the study period. Specifically, while most of garment products show an upward trend in revealed comparative advantage, 'textile and clothing accessories' (SITC 846) has practically lost its competitiveness over the period under study. The RCA (NEI) index decreased from 0.65 (1.00) in 1985 to -0.15 (-0.64) in 2005. However, the adjusted ranking improved from 27/177 to 23/177 (for

[21] SITC Revision 2 description includes: men's outwear, not knitted (SITC 842); women's outwear, not knitted (SITC 843); undergarment, not knitted (SITC 844), non-elastic outwear, knitted (SITC 845); undergarment, knitted (SITC 846); textile clothing accessories (SITC 847); and non-textile clothing and headgear (SITC 848)

Table 3-10: RCA and NEI ranking trends of crude and other materials (Cambodia)

Industry/Commodity	**SITC**	**1985**			**1990**			**1995**			**2000**			**2005**		
RCA Index		**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**
Raw hides and skins (excl. furskins)	211	-	-		1.17	8/77	18/177	-0.23	23/123	33/177	-0.58	30/152	35/177	-0.23	27/177	27/177
Oil-seeds and oleaginous fruits extract.	222	1.11	4/40	18/177	1.32	7/77	16/177	-0.44	27/123	39/177	-1.69	60/152	70/177	0.06	19/177	19/177
Natural rubber and gums (unprocessed)	231	-	-		-	-		-	-	-	0.95	6/152	7/177	1.39	5/177	5/177
Synthetic and reclaimed rubber	232	2.11	1/40	4/177	2.43	1/77	1/177	0.20	18/123	26/177	1.26	5/152	6/177	-	-	-
Wood in rough or squared	247	-	-	-	1.70	4/77	9/177	2.24	1/123	1/177	-	-	-	-1.02	48/177	48/177
Simply worked wood	248	-	-	-	0.78	10/77	23/177	1.59	2/123	3/177	0.03	16/152	19/177	0.80	9/177	9/177
Printed matter	892	-0.16	21/40	93/177	-1.59	61/77	140/177	-1.10	41/123	59/177	1.66	3/152	3/177	-1.75	82/177	82/177
NEI Index		**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**
Raw hides and skins (excl. furskins)	211	-	-	-	1.00	3/59	9/177	1.00	2/118	3/177	0.52	20/151	23/177	0.99	8/177	8/177
Oil-seeds and oleaginous fruits extract.	222	1.00	1/35	5/177	1.00	4/59	12/177	0.91	9/118	14/177	-0.02	29/151	34/177	0.98	9/177	9/177
Natural rubber and gums (unprocessed)	231	-	-	-	-	-	-	-	-	-	0.97	13/151	15/177	0.95	11/177	11/177
Synthetic and reclaimed rubber	232	1.00	2/35	10/177	1.00	5/59	15/177	0.65	19/118	29/177	0.97	12/151	14/177	-	-	-
Wood in rough or squared	247	-	-	-	1.00	7/59	21/177	1.00	4/118	6/177	-	-	-	0.99	5/177	5/177
Simply worked wood	248	-	-	-	0.98	12/59	36/177	1.00	5/118	8/177	1.00	2/151	2/177	0.99	7/177	7/177
Printed matter	892	-0.49	22/35	111/177	-0.90	50/59	150/177	-0.92	50/118	75/177	0.85	15/151	18/177	-0.98	112/177	112/177

Source: Author's calculations (data are from UN Comtrade online database)

Notes: 1. The raw ranking of the commodity in this table is different from that of the corresponding commodity in the top-ten list of Table 3-4 and Table 3-5, because in this calculation all possible commodities are taken into account regardless of their share. 2. The adjusted rankings (adj. rank) are the rankings that would prevail when the total number of ranked items was assumed to be 177 for both RCA and NE indices.

Table 3-11: RCA and NEI ranking trends of apparel and footwear products (Cambodia)

Industry/Commodity	SITC	1985			1990			1995			2000			2005		
RCA Index		**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**
Apparel and clothing	***84***	***0.24***			***-0.23***			***0.79***			***1.34***			***1.48***		
Men's, boys' clothing, not knit	841	-	-	-	-	-	-	-	-	-	0.76	9/152	10/177	1.34	6/177	6/177
Women's, girls' clothing, not knit	842	-0.50	26/40	115/177	-0.04	17/77	39/177	0.76	9/123	13/177	0.79	8/152	9/177	1.52	4/177	4/177
Men's, boys' clothing, knitted	843	0.14	14/40	62/177	-0.20	21/77	48/177	0.71	10/123	14/177	2.02	1/152	1/177	1.63	2/177	2/177
Women's, girls' clothing, knitted	844	0.83	5/40	22/177	0.48	13/77	30/177	0.85	7/123	10/177	1.79	2/152	2/177	1.74	1/177	1/177
Articles of textile apparel	845	-0.95	34/40	150/177	-1.43	54/77	124/177	0.95	4/123	6/177	1.42	4/152	5/177	1.56	3/177	3/177
Textile clothing accessories	846	0.65	6/40	27/177	-0.34	24/77	55/177	0.89	5/123	7/177	-0.08	20/152	23/177	-0.15	23/177	23/177
Non-textile clothing, headgear	848	-			-			-1.55	64/123	92/177	0.39	13/152	15/177	0.31	13/177	13/177
Footwear	851	-			-1.53	57/77	131/177	-0.47	28/123	40/177	0.45	12/152	14/177	0.90	8/177	8/177
NEI Index		**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**
Apparel and clothing	***84***	***0.82***			***0.81***			***0.81***			***0.94***			***0.94***		
Men's, boys' clothing, not knit	841	-	-	-	-	-	-	-	-	-	0.99	8/151	9/177	1.00	4/177	4/177
Women's, girls' clothing, not knit	842	-	-	-	-	-	-	0.90	10/117	15/177	1.00	4/151	5/177	1.00	2/177	2/177
Men's, boys' clothing, knitted	843	0.91	8/35	40/177	0.92	14/59	42/177	0.97	7/117	11/177	1.00	6/151	7/177	0.99	6/177	6/177
Women's, girls' clothing, knitted	844	0.92	5/35	25/177	0.86	15/59	45/177	0.84	13/117	20/177	1.00	1/151	1/177	1.00	3/177	3/177
Articles of textile apparel	845	0.60	13/35	66/177	0.35	24/59	72/177	0.82	16/117	24/177	1.00	3/151	4/177	0.90	12/177	12/177
Textile clothing accessories	846	1.00	3/35	15/177	0.61	20/59	60/177	0.83	15/117	23/177	-0.80	54/151	63/177	-0.64	49/177	49/177
Non-textile clothing, headgear	848	-			-			-0.81	41/117	62/177	0.12	26/151	30/177	0.35	27/177	27/177
Footwear	851	-			-0.25	29/59	87/177	-0.70	32/117	48/177	0.53	19/151	22/177	0.85	14/177	14/177

Source: Author's calculations (data are from UN Comtrade online database)

Notes: 1. The raw ranking of the commodity in this table is different from that of the corresponding commodity in the top-ten list of Table 3-4 and Table 3-5, because in this calculation all possible commodities are taken into account regardless of their share. 2. The adjusted rankings (adj. rank) are the rankings that would prevail when the total number of ranked items was assumed to be 177 for both RCA and NE indices.

NEI index decreased from 15/177 to 49/177) most probably due to the increasing concentration of exports.

The footwear industry also proves a very dynamic industry with high potential for development and export. In 1990, footwear recorded an RCA index of -1.53 and a rank of 57/77 (131/177). However, during the period of study this industry has gained competitiveness and reached a positive RCA index in 1995 and by 2005 it ranked 8th in 177 ranked products with an RCA index of 0.90.

3.2 RCA AND INDUSTRIAL DEVELOPMENT IN LAOS

Table 3-12: Correlation between RCA and NEI index (Laos)

RCAxNEI	1985	1990	1995	2000	2005
SRC Coefficient	0.754	0.840	0.874	0.799	0.824
Sample size	30	77	91	111	175

Notes: 1. Spearman rank correlation coefficients are applied. 2. All coefficients are statistically significant at the 1% level.

Similar to the case of Cambodia, the RCA index and NEI index are calculated for 1985, 1990, 1995, 2000, and 2005 at the three-digit level of the SITC. With respect to performance for the Lao case, the two indices also seem to move together and show a similar behavior in identifying products with comparative advantage/disadvantage. The rank correlation coefficients between these indices are relatively high ranging from 0.75 to 0.87 and statistically significant at the 1% level for all cases (Table 3-12).

3.2.1 Trends of Revealed Comparative Advantages in Laos

The summary of the RCA and NE indices for selected product groups are presented in Table 3-13 and Table 3-14, respectively. It is apparent that for the early years of the study period the two indices were missing for many products. This could be explained by the fact that commodity trade data were not reported to Comtrade system or Laos' exported commodities were actually very limited to some agricultural products, wood and wood products and clothing. The second reason seems to be more likely because prior to the introduction of the NEM trade in Laos was less liberalized

and the export sector was much smaller as can be observed in terms of export value (see Table 2-12).

Table 3-13: Trends of RCA index for selected product groups (Laos)

Product	SITC	1985	1990	1995	2000	2005
Live animals (other than division 03)	001	0.219	-0.156	-1.198	1.044	0.759
Rice	042	-	-1.336	-0.558	-1.094	0.813
Unmilled maize (excl. sweet corn)	044	-	-1.585	-1.150	-1.080	0.746
Unmilled cereals	045	-	-	-	-0.383	1.611
Fresh, chilled, or frozen vegetable	054	-	-0.971	-1.771	-1.076	0.401
Vegetables, roots and tubers	056	-	-	-	-0.612	-0.009
Preserved fruits (excl. juices)	058	-0.628	-	-1.371	-0.194	0.171
Coffee and coffee substitutes	071	1.514	1.199	1.432	1.445	1.258
Raw hides and skins (excl. furskins)	211	-0.030	0.819	0.367	0.081	0.042
Oil-seeds and oleaginous fruits extract.	222	-1.327	-0.027	-0.921	-0.621	0.203
Natural rubber and gums (unprocessed)	231	-	-	-	-0.497	0.942
Fuel wood and wood charcoal	245	-	1.193	0.946	1.506	1.000
Wood in chips or particles	246	-	0.232	-0.297	-0.897	-0.542
Wood in rough or squared	247	1.644	1.726	1.744	2.186	1.794
Simply worked wood	248	0.882	1.866	1.684	1.504	1.830
Silk	261	-	-	-	-0.076	1.831
Jute and other textile bast fibres	264	-	-	0.118	1.173	1.856
Stone, sand and gravel	273	-	-	-	1.017	1.021
Ores and concentrates of base metals	287	-	-	-	0.940	0.521
Crude vegetable materials	292	0.730	0.913	0.511	0.474	0.540
Coal, not agglomerated	321	-	-	-	0.173	0.231
Veneers, plywood, n.e.s., etc.	634	-	0.797	0.522	0.233	0.726
Wood manufactures, n.e.s.	635	-	-0.023	0.993	0.324	0.186
Copper	682	-	-2.212	0.762	-	1.377
Motor cycles, motorized and not	785	-1.433	-	-2.415	1.721	-3.059
Furniture and parts thereof	821	-0.939	-1.791	-1.230	-1.137	-0.696
Travel goods, handbags	831	-	-1.018	-1.457	-1.516	-1.313
Men's, boys' clothing, not knitted	841	-	-	-	1.295	1.315
Women's, girls' clothing, not knitted	842	-	0.798	1.295	0.682	0.829
Men's, boys' clothing, knitted	843	-0.881	0.427	0.850	1.283	1.380
Women's, girls' clothing, knitted	844	-	0.213	1.258	0.474	0.769
Articles of textile apparel, n.e.s.	845	-	0.444	1.056	1.176	1.191
Clothing accessories, of textile fabrics	846	-	0.482	1.118	-0.241	-0.234
Non-textile clothing, headgear	848	-	-0.838	-1.388	-0.509	-1.312
Footwear	851	-	-1.464	-0.550	0.126	0.310
Office and stationery supplies	895	-	-1.204	-0.572	-	0.002

Source: Author's calculations (data are from UN Comtrade online database and UN International Trade Statistics Yearbook, various issues)
Notes: 1. The RCA index is in common logarithm (logarithm base 10). 2. '-' means that the data was not reported by any of the trade partners included in this study, and hence, it is assumed that Laos did not export such commodities.

The two tables show the trends of Laos' revealed comparative advantages in absolute terms. Overall, the export performance and net export indices reveal very similar products with comparative advantage. In the period under study, some products like live animals (SITC 001); coffee (SITC 071); wood and simple wood products

(SITC 245-248); crude vegetable materials (SITC 292); industrial wood products (SITC 634, 635); and apparel and clothing (SITC 841-846) have maintained high RCA. Also Laos appears to have high comparative advantage in natural rubber (SITC 231), coal (SITC 321), but since the data were available for only the last two years in the study, the trend of RCAs of these products are less apparent[22].

Table 3-14: Trends of NEI index for selected product groups (Laos)

Product	SITC	1985	1990	1995	2000	2005
Live animals (other than division 03)	001	0.956	0.817	-0.902	0.586	0.580
Unmilled maize (excl. sweet corn)	044	-	-0.489	-0.507	-0.511	0.933
Unmilled cereals	045	-	-	-	0.755	0.949
Fresh, chilled, or frozen vegetable	054	-	-0.053	-0.978	-0.906	0.881
Preserved fruits (excl. juices)	058	0.009	-	-0.912	0.174	0.356
Coffee and coffee substitutes	071	0.998	0.997	0.985	0.883	0.508
Spices	075	0.946	-	-0.418	-0.515	0.890
Raw hides and skins (excl. furskins)	211	1.000	1.000	1.000	1.000	1.000
Oil-seeds and oleaginous fruits extract.	222	-	0.738	-0.505	-0.965	0.651
Oil-seeds and oleaginous fruits	223	-	-	-	-0.158	0.486
Natural rubber and gums (unprocessed)	231	-	-	-	-	0.028
Fuel wood and wood charcoal	245	-	0.961	0.968	-	0.992
Wood in chips or particles	246	-	-	0.926	-	0.936
Wood in rough or squared	247	1.000	1.000	1.000	1.000	1.000
Simply worked wood	248	0.998	0.997	1.000	0.993	1.000
Pulp and waste paper	251	-	-	0.705	0.929	0.289
Silk	261	-	-	-	-0.986	-0.032
Jute and other textile bast fibres	264	-	-	-	0.994	-
Stone, sand and gravel	273	-	-	-	0.849	0.223
Other crude minerals	278	-	-	-	0.193	0.386
Crude animal materials	291	-	-	-	0.779	0.689
Crude vegetable materials	292	0.789	0.922	0.901	0.638	0.763
Veneers, plywood, n.e.s., etc.	634	-	0.970	0.804	0.759	0.853
Wood manufactures, n.e.s.	635	-	-0.044	0.948	0.784	0.639
Copper	682	-	-0.933	0.901	-	0.992
Travel goods, handbags	831	-	-0.751	-0.596	-0.370	-0.518
Men's, boys' clothing, not knitted	841	-	-	-	0.992	0.977
Women's, girls' clothing, not knitted	842	-	0.719	0.962	0.908	0.933
Men's, boys' clothing, knitted	843	-0.978	0.733	0.881	0.808	0.956
Women's, girls' clothing, knitted	844	-	1.000	1.000	0.876	0.702
Articles of textile apparel, n.e.s.	845	-	0.383	0.947	0.949	0.883
Clothing accessories, of textile fabrics	846	-	0.434	0.987	-0.604	-0.664
Textile clothing accessories, n.e.s.	847	-	-	-	-	-
Non-textile clothing, headgear	848	-	-0.827	-0.922	0.155	-0.858
Footwear	851	-	-0.977	-0.756	0.198	0.151

Source: Author's calculations (data are from UN Comtrade online database)
Note: '-' means that the data was not reported by any of the trade partners included in this study, and hence, it is assumed that Laos did not export such commodities

[22] Electricity (SITC 351) is a major export item of Laos. However, since RCA index for this commodity was available only for 2005, this could significantly affect the interpretation of the results. Hence, it has been excluded from RCA calculation.

In addition, we can observe that a number of products have gained comparative advantages over the years: maize and cereal (SITC 044; 045); vegetables (SITC 054); preserved fruits (SITC 058); copper (SITC 682); furniture (SITC 821); footwear (SITC 851); and office stationery supplies (SITC 895). These product groups have shown an increasing trend in RCAs. Some of them have moved from a negative to a positive index of revealed comparative advantage, while others are still having disadvantages. However, they could be regarded as products with potential for exports.

Apart from those mentioned above, the country does not appear to have comparative advantages in product items of beverages and tobacco (SITC 1), chemical products (SITC 5), and vehicle and transport equipment (SITC 7). It is also interesting to observe that while having gained comparative advantage in apparel and clothing, Laos seems to lose comparative advantage in travel goods and hand bags (SITC 831), and non-textile clothing and headgear products (SITC 848). This implies that a country could specialize in some specific or niche products in a subindustry (Vollrath, 1991).

3.2.2 Ranking of Indices of RCA in Laos

As discussed in Section 2.2.3, a product with an initial large share in exports, such as coffee with a share of 24% in 1985, can hardly increase its share and thereby increasing the value of its RCA and NEI index, as more products enter the export markets over time. Hence, in this case we should also consider the ranking of the indices of RCA and observe the trends in comparative advantages in major export sectors or industries. Table 3-15 and Table 3-16 present the first ten major export commodities in terms of their competitiveness and importance in the export markets. These are products with a high RCA index and NEI index and a share in total exports of one percent or greater.

At the level of sector (subsector) or industry, agriculture and wood processing maintained high ranks for the whole study period, while crude material exports

dominated the list until early 1990s. On the other hand, apparel and clothing industry entered the top-ten list in early 1990s and since then has dominated the rankings. In recent years the mining industry has occupied a significant share in exports and has been among the top-ten products in terms of revealed comparative advantage. At the three-digit level of the SITC, however, the features were more flexible. The following analysis is largely based on the export performance index with reference to the net export index. Despite some differences in the rankings of commodities, the net export index shows very similar trends of comparative advantages in commodity exports.

Representing the agricultural sector, coffee and live animals were among the high RCA/NEI products. 'Coffee', with the largest share of 24%, ranked second in the 1985-list. Although its ranks in the top-ten products varied over time, coffee was among the nation's leading export products. On the other hand, despite a positive RCA index, 'live animals' did not occupy a significant portion of exports until 2000, in which year it ranked eighth. Export of live animals lost their comparative advantage in the 1990s, but could regain some competitiveness in the following years.

The wood industry is the leader of the ranking list for the whole period covered here in terms of both competitiveness and percentage share, and in each year at least two products of this industry are among the top-ten. Two representatives, 'simply worked wood' and 'wood in rough or squared', are among the top-three high RCA products for the whole period under study. Specifically, in 1990 these two commodities made up nearly 60% of the country's exports, and between 1995 and 2005 they accounted for 30 to 38%. Other wood products among the top-ten include 'veneers and plywood' and 'wood manufactures', which have played a role in the exports since the 1990s. With a somewhat lower rank 'fuel wood and wood charcoal' was still among high RCA products, but with a share of less than 0.2% it is less of significance in the export markets.

Table 3-15: The top-10 high ranking RCA products with share ≥1% (Laos)

Rank	1985	1990	1995	2000	2005
1	Wood in rough or squared (10.97)	Simply worked wood (43.65)	Wood in rough or squared (11.51)	Wood in rough or squared (18.80)	Simply worked wood (22.97)
2	Coffee and coffee substitutes (24.14)	Ferrous waste and scrap (10.43)	Simply worked wood (26.29)	Motor cycles, motorized and not (17.85)	Wood in rough or squared (6.58)
3	Simply worked wood (4.03)	Wood in rough or squared (14.53)	Coffee and coffee substitutes (8.73)	Simply worked wood (12.68)	Men's, boys' clothing, knitted (3.38)
4	Crude vegetable materials (1.64)	Non-ferrous metal waste (3.54)	Men's outwear, not knitted (11.38)	Coffee and coffee substitutes (5.08)	Copper (14.55)
5		Coffee and coffee substitutes (4.00)	Undergarment, not knitted (4.82)	Not-knitted men's, boys' clothing, (13.08)	Men's, boys' clothing, not knitted (10.23)
6		Crude vegetable materials (2.77)	Undergarment, knitted (6.52)	Men's, boys' clothing, knitted (3.27)	Coffee and coffee substitutes (2.76)
7		Raw hides and skins (1.16)	Outwear, knitted, nonelastic (7.78)	Articles of textile apparel (14.90)	Articles of textile apparel (13.58)
8		Men's outwear, not knitted (3.42)	Wood manufactures (2.68)	Live animals (1.59)	Women's, girls' clothing, not knitted (4.18)
9		Veneers, plywood, etc (1.80)	Women's outwear, not knitted (5.85)	Not-knitted women's, girls' clothing (3.29)	Knitted women's, girls' clothing, (1.45)
10		Flat-rolled iron/ steel, not clad (1.60)	Copper (4.20)	Footwear (0.99)	Veneers, plywood, etc. (1.53)
Total%	40.79	87.51	89.75	73.67	81.21
V1%	US$ 0.21 mil	US$0.63 mil	US$2.01 mil	US$3.49 mil	US$5.83 mil

Notes: 1. Percentage share is in parentheses. 2. Total%=total share of commodities listed in this table. 3. V1%=value of 1% share in million US$ at 2000 prices.

Table 3-16: The top-10 high ranking NEI products with share ≥1% (Laos)

Rank	1985	1990	1995	2000	2005
1	Wood in rough or squared (10.97)	Ferrous waste and scrap (10.43)	Undergarment, not knitted (4.82)	Wood in rough or squared (18.80)	Simply worked wood (22.97)
2	Coffee and coffee substitutes (24.14)	Wood in rough or squared (14.53)	Wood in rough or squared (11.51)	Simply worked wood (12.68)	Wood in rough or squared (6.58)
3	Simply worked wood (4.03)	Non-ferrous metal waste (3.54)	Simply worked wood (26.29)	Men's, boys' clothing, not knitted (13.08)	Copper (14.55)
4	Crude vegetable materials (1.64)	Raw hides and skins (1.16)	Undergarment, knitted (6.52)	Articles of textile apparel (14.90)	Men's, boys' clothing, not knitted (10.23)
5		Simply worked wood (43.63)	Coffee and coffee substitutes (8.73)	Not-knitted women's and girls' clothing (3.29)	Men's, boys' clothing, knitted (3.38)
6		Coffee and coffee substitutes (4.00)	Men's outwear, not knitted (11.38)	Coffee and coffee substitutes (5.08)	Women's, girls' clothing, not knitted (4.18)
7		Veneers, plywood , etc. (1.80)	Wood manufactures (2.68)	Men's, boys' clothing, knitted (3.27)	Articles of textile apparel (13.58)
8		Crude vegetable materials (2.77)	Outwear, knitted, nonelastic (7.78)	Live animals (1.59)	Veneers, plywood, etc. (1.53)
9		Women's outwear, not knitted (2.21)	Copper (4.20)	Footwear (0.99)	Women's, girls' clothing, knitted (1.45)
10		Men's outwear, not knitted (3.42)	Women's outwear, not knitted (5.85)		Coffee and coffee substitutes (2.76)
Total%	40.79	87.51	89.75	73.67	81.21
V1%	US$ 0.21 mil	US$0.63 mil	US$2.01 mil	US$3.49 mil	US$5.83 mil

Notes: 1. Percentage share is in parentheses. 2. Total%=total share of commodities listed in this table. 3. V1%=value of 1% share in million US$ at 2000 prices.

The apparel and clothing industry started to gain competitiveness in 1990 with one product (men's outwear, not knitted) ranking 8th in the list with just 3% share. Other four commodities of this industry (not knitted women's outwear, knitted and not knitted undergarment, knitted non-elastic outwear) ranked 14th to 17th in the high RCA-list, but together they shared only 6% of the country's exports. In the years that follow this industry has dominated the exports of Laos with four or five garment products ranking among the first ten high RCA items. From 1995 to 2005, products of the garment industry accounted for 33 to 36% of the total exports. It is interesting to observe that at the three-digit level commodities of the same industry showed very different trends in RCA.

Two other products among the top-10 rankings until 1990 were 'crude vegetable materials' (6th) and 'raw hides and skins' (7th). However, while maintaining their comparative advantage, they were losing the ranks and share significantly and fell to 20th and 32nd in 2005, respectively. It is also interesting to observe that 'zoo animals and pets' was among items with comparative advantage in the 1985-list, but it quickly disappeared from the list, because in that year there were unusually large imports of this type of animals by the USA.

With regard to export items, the 2000-list is also somewhat unusual, since 'motor cycles' (STIC 785) with an unusually large share of 18% ranked second, but quickly disappeared in the following year. This short-lived change in RCA trends was caused by temporarily large exports to Vietnam. In addition, between 2000 and 2005 there were some new comers in the high RCA-product list, namely 'jute and textile bast fibres'; 'stone, sand and gravel'; and 'copper', which noticeably gained competitiveness. Copper (SITC 682), with an index of -2.21 and an insignificant share, was among the lowest RCA products in 1990. In 1995 it achieved a positive RCA index and 4% share, and in 2005 copper accounted for 15% and ranked 4th among the major items. 'Jute and textile bast fibres' (SITC 264), one of non-timber forest

products being exported to Thailand, has steadily gained competitiveness since the mid-1990s. Similarly, 'stone, sand and gravel' (SITC 273) has gained competitiveness since 2000. But these two products are less significant in terms of export share.

The differences between the export performance and net export measure in some items were due to the fact that these products are sensitive in trade negotiations and/or under protection. For example, for 2005 the NEI index revealed 'wood in chips or particle' and 'crude animal materials' with high comparative advantage, while RCA index showed a negative value. Similar trends were also found for other crude minerals, oil-seeds and oleaginous fruits, etc. Nevertheless, these differences are minor.

3.2.3 Diversification of Exports in Laos

One of the objectives is to study the changes in the patterns of Lao exports over time. Again, the three indicators (share of high RCA products, standard deviation, SRC coefficient) are applied for this purpose. Table 3-17 shows the number of products with high RCA and NEI index – i.e. RCA and NEI index of greater than zero, the total number of ranked products and the percentage share of products with comparative advantage for 1985-2005.

It is apparent that, by any indices, the number of products with comparative advantage increased remarkably (from 8 to 33 for RCA index and from 11 to 34 for NEI index). Over the same period, the total ranked products, reflecting the number of exported items, also increased from 39 to 178 for the former and from 30 to 175 for the latter. However, for the RCA index the ratio between them remained roughly unchanged at an average of 0.21, whilst in the case of NE measure the ratio decreased steadily from 0.37 to 0.19. The concentration of the exports is also revealed in this table. Except for 1985, despite being small in number the high RCA and NEI products comprise 90% to 96% of the country's exports.

At the one-digit level of the SITC, the increase in the number of high RCA products, evaluated by both measures, mainly occurred in the category of food and live animals (SITC 0), inedible crude materials – except fuels (SITC 2), and manufactured goods (SITC 6 and 8). In other categories, there was no or one product with RCA index and/or NEI index above zero, and this is often a special commodity. For example, in mineral fuels-lubricants category (SITC 3) there was only one high RCA product in 2005, i.e. coal (SITC 321). Hence, one can observe that in spite of an increasing trend in export commodities, Laos' exports were still concentrated in those sectors/industries illustrated above.

Table 3-17: Number of products with high RCA and NEI index (Laos)

	1985	1990	1995	2000	2005
RCA index					
High RCA products (A)	8	20	23	22	33
Total ranked products (B)	39	86	98	116	178
Ratio of high RCA products to total (A)/(B)	0.21	0.23	0.23	0.19	0.19
Total share of high RCA products (% share)	42.20	96.20	96.03	96.50	93.12
Net export index					
High NEI products (A)	11	24	26	25	34
Total ranked products (B)	30	78	92	111	175
Ratio of high NEI products to total (A)/(B)	0.37	0.31	0.28	0.23	0.19
Total share of high NEI products (% share)	42.16	94.67	95.20	77.82	89.24

Source: Author compiled (data are from UN Comtrade online database)
Note: RCA or NEI index is classified as high if its value is greater than 0.0 (RCA, NEI>0).

The second indicator is again the standard deviation of the indices of revealed comparative advantage (Table 3-18). If export diversification occurs, the standard deviation of the indices of RCA would decline. For Laos, the standard deviation of the net export index remained largely unchanged at 0.7, while that of the Balassa's index increased from 0.95 to 1.4 over the period under study. Therefore, it can be inferred that the exports of Laos have not diversified in the last two decades.

Table 3-18: Standard deviation of RCA and NEI index (Laos)

	1985	1990	1995	2000	2005
RCA index	0.947	1.072	1.300	1.390	1.366
Sample size	39	86	98	116	178
NEI index	0.847	0.779	0.794	0.724	0.669
Sample size	30	78	92	111	175

Source: Author's calculations (data are from UN Comtrade online database)

The next issue to address is the similarities/differences in the export composition between two periods. To measure this we calculated the Spearman rank correlation coefficients for RCA and NEI index for 1985-2005 (Table 3-19). If export diversification occurred over time, the correlation coefficients would become smaller, the longer the time lags. In the case of Balassa's index, the correlation coefficient showed a decreasing trend from 0.7 for shorter time lags (5 to 10 years) to 0.5 for longer time lags (15 years or longer). For the net export measure, a similar trend could be observed with a somewhat higher range of the correlation coefficient (0.8 – 0.6). Overall, this result indicated that despite showing a diversification trend the export patterns between two periods were still highly correlated and quite similar to each other, even for a longer time lag. All the three indicators lent support to our argument that the export patterns of Laos have been largely unchanged and diversification was not significant during the study period.

Table 3-19: Rank correlation coefficient, 1985-2005 (Laos)

RCA*x*RCA	**1985**	**1990**	**1995**	**2000**	**2005**
1985	1.000	0.615	0.710	0.408*	0.478
1990		1.000	0.669	0.665	0.490
1995			1.000	0.750	0.654
2000				1.000	0.755
2005					1.000
NEI*x*NEI	**1985**	**1990**	**1995**	**2000**	**2005**
1985	1.000	0.718	0.643	0.600	0.666
1990		1.000	0.681	0.726	0.622
1995			1.000	0.736	0.729
2000				1.000	0.789
2005					1.000

Notes: 1. Spearman rank correlation coefficients are applied. 2. All coefficients are statistically significant at the 1% level, except those with asterisk are significant at the 5% level.

3.2.4 Trends of Major Sectors and Industries in Laos

This section looks into the industrialization process in more detail and analyzes the trends in comparative advantages of major sectors and industries. These are 'coffee, tea, spices'; 'wood, metalliferous ores, crude materials'; 'wood manufactures, iron and steel, copper'; and 'garment and footwear industry'. Between 1990 and 2005 these

sectors and industries together comprised about 76 to 96 percent of Laos' exports (Table 3-20). Hence, they could be considered as major sectors and industries of Laos. Table 3-21 and Table 3-22 present the RCA and NEI index, raw and adjusted rankings of these sectors and industries. The standardized rankings are those when the total number of ranked items/products were assumed to be 178 for RCA index and 175 for NEI index.

Table 3-20: Export share of major sectors and industries in Laos (% share of total)

Sector	SITC	1985	1990	1995	2000	2005
Cereals and cereal preparations	04	-	0.01	0.06	0.04	1.85
Vegetables and fruit	05	0.06	0.08	1.23	0.57	1.20
Coffee, tea, cocoa, spices	07	25.43	4.01	8.80	5.12	2.82
A. Subtotal of 'food and live animals' (SITC 0)	***0***	***25.50***	***4.09***	***10.09***	***5.73***	***5.87***
Cork and wood	24	15.00	58.34	37.86	31.64	29.62
Metalliferous ores and metal scrap	28	0.26	14.13	1.13	0.75	0.61
Crude animal and vegetable materials, n.e.s.	29	1.69	2.88	0.99	0.69	0.76
B. Subtotal of 'crude materials' (SITC 2)	***2***	***16.96***	***75.35***	***39.98***	***33.08***	***30.99***
Cork and wood manufactures (excl. furniture)	63	-	2.32	3.69	0.95	1.84
Iron and steel	67	0.44	4.39	0.06	0.01	0.01
Copper	682	-	0.00	4.20	N.A.	14.55
C. Subtotal of 'manufactured goods' (SITC6)	***6***	***0.44***	***6.72***	***7.94***	***0.95***	***16.39***
Articles of apparel and clothing accessories	84	0.36	9.39	36.36	35.70	32.92
Footwear	851	-	0.03	0.23	0.99	1.28
D. Subtotal of misc. manuf. articles (SITC 8)	***8***	***0.36***	***9.42***	***36.59***	***36.69***	***34.20***
Subtotal (A+B+C+D)		**43.25**	**95.58**	**94.61**	**76.46**	**87.45**

Source: Author's calculations (data are from UN Comtrade online database)
Notes: 1. The share of the one-digit level (SITC section) is the sum of the share of the two- and three-digit items presented here. 2. The unusually low share of 2000 is due to the fact that 'motor cycles' (SITC 785) with 18% share is not included here.

a. Coffee exports

Coffee (SITC 071) is a traditional export item, which has been exported to many countries, including ASEAN members; Japan; USA; Eastern Europe and EU members. In 2005, out of 38 countries in the sample 17 imported coffee from Laos. The export value increased steadily from US$4.4 million in 1985 to US$14.7 million in 2005. As Lao exports expanded significantly during this period, its share has declined from 24 percent to just 3 percent. However, coffee is the only agricultural product which has retained high competitiveness and been among the top-ten products for the whole study period. Its RCA ranking varies between third in 39 items and 9th in 178

products (4/30 and 25/175 for NEI index). If the rankings were adjusted to 178 products for RCA index (175 for NEI index), its RCA ranking actually increased from 14th to 9th (decrease for NEI index) (Table 3-21).

b. Mining industry

The representative for the mining industry is copper (SITC 682). In 2005, with an export value of US$77.3 million this commodity comprised about 15% the country's total exports and was exported to China, Japan, Malaysia, Poland, Singapore, Thailand and Vietnam. Copper has steadily gained competitiveness, with its RCA and NEI index actually turning positive in 1995 (0.76 and 0.90, respectively). Its ranks improved from 83/86 (53/78 for NEI) in 1990 to 7/178 (5/175 for NEI) in 2005. In terms of standardized rankings, copper's ranks improved from 172/178 (119/175) in 1990 to 7/178 (5/175) in 2005, for RCA and NEI index respectively (Table 3-21). The recent sharp increase in copper exports is an outcome of the investment project of an Australian enterprise in Laos to extract gold and copper in Savannakhet Province. To date, the contribution of this industry to exports is even more prominent owing to the recent start of copper exportation. As a consequence, the country's trade balance of 2007 has turned positive for the first time in decades.

c. Wood processing industry

Wood and wood products have long been among the main export commodities in Laos. The industry mainly consists of fuel wood and wood charcoal (SITC 245), wood in chips or particles (SITC 246), wood in rough or squared (SITC 247) and simply worked wood (SITC 248). The export markets for these products are largely Asian economies (China; Japan; Korea; Thailand; Vietnam), and some European countries like Austria, Belgium, Bulgaria, France, Ireland, Italy and the UK. The value of exports steadily increased from US$2.7 million in 1985 to US$157.4 million in 2005.

Table 3-21: RCA and NEI ranking trends of wood and selected products (Laos)

Industry/Commodity	**SITC**	**1985**			**1990**			**1995**			**2000**			**2005**		
RCA Index		**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**
Coffee and coffee substitutes	071	1.51	3/39	14/178	1.20	5/86	10/178	1.43	3/98	5/178	1.44	5/116	8/178	1.26	9/178	9/178
Copper	682	-	-	-	-2.21	83/86	172/178	0.76	11/98	20/178	-	-	-	1.38	7/178	7/178
Cork and wood	***24***	***1.31***			***1.80***			***1.68***			***1.75***			***1.79***		
Fuel wood and wood charcoal	245	-	-	-	1.19	6/86	12/178	0.95	9/98	16/178	1.51	3/116	5/178	1.00	12/178	12/178
Wood in chips or particles	246	-	-	-	0.23	16/86	33/178	-0.30	26/98	47/178	-0.90	39/116	60/178	-0.54	49/178	49/178
Wood in rough or squared	247	1.64	2/39	9/178	1.73	3/86	6/178	1.74	1/98	2/178	2.19	1/116	2/178	1.79	4/178	4/178
Simply worked wood	248	0.88	4/39	19/178	1.87	1/86	2/178	1.68	2/98	4/178	1.50	4/116	6/178	1.83	3/178	3/178
NE Index		**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**
Coffee and coffee substitutes	071	0.99	4/30	23/175	0.99	7/78	16/175	0.99	7/92	13/175	0.88	11/111	17/175	0.51	25/175	25/175
Copper	682	-	-	-	-0.93	53/78	119/175	0.90	15/92	29/175	-	-	-	0.99	5/175	5/175
Cork and wood	***24***	***0.99***			***0.99***			***1.00***			***0.99***			***1.00***		
Fuel wood and wood charcoal	245	-	-	-	0.96	5/68	13/174	0.97	8/92	15/175	-	-	-	0.99	5/175	5/175
Wood in chips or particles	246	-	-	-	-	-	-	0.93	12/92	23/175	-	-	-	0.94	10/175	10/175
Wood in rough or squared	247	1.00	1/30	6/175	1.00	1/78	2/175	1.00	1/92	2/175	1.00	1/111	2/175	1.00	1/175	1/175
Simply worked wood	248	0.99	5/30	29/175	0.99	6/78	13/175	1.00	1/92	2/175	0.99	6/111	9/175	1.00	1/175	1/175

Source: Author's calculations (data are from UN Comtrade online database)

Notes: 1. The raw ranking of the commodity in this table is different from that of the corresponding commodity in the top-ten list of Table 3-15 and Table 3-16, because in this calculation all possible commodities are taken into account regardless of their share. 2. The adjusted rankings (adj. rank) are the rankings that would prevail when the total number of ranked items were assumed to be 178 for RCA index and 175 for NEI index.

Table 3-22: RCA and NEI ranking trends of apparel and footwear products (Laos)

Industry/Commodity	**SITC**	**1985**			**1990**			**1995**			**2000**			**2005**		
RCA Index		**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**
Apparel and clothing	***84***	***-0.77***			***0.46***			***1.06***			***1.05***			***1.08***		
Men's, boys' clothing, not knit	841	-	-	-	-	-	-	-	-	-	1.30	6/116	9/178	1.32	8/178	8/178
Women's, girls' clothing, not knit	842	-	-	-	0.80	9/86	19/178	1.30	4/98	7/178	0.68	13/116	20/178	0.83	14/178	14/178
Men's, boys' clothing, knitted	843	-0.88	23/39	105/178	0.43	14/86	29/178	0.85	10/98	18/178	1.28	7/116	11/178	1.38	6/178	6/178
Women's, girls' clothing, knitted	844	-	-	-	0.21	17/86	35/178	1.26	5/98	9/178	0.47	14/116	21/178	0.77	16/178	16/178
Articles of textile apparel	845	-	-	-	0.44	13/86	27/178	1.06	7/98	13/178	1.18	8/116	12/178	1.19	10/178	10/178
Textile clothing accessories	846	-	-	-	0.48	12/86	25/178	1.12	6/98	11/178	-0.24	27/116	41/178	-0.23	42/178	42/178
Non-textile clothing, headgear	848	-	-	-	-0.84	39/86	81/178	-1.39	56/98	102/178	-0.51	30/116	46/178	-1.31	76/178	76/178
Footwear	851	-	-	-	-1.46	59/86	122/178	-0.55	28/98	51/178	0.13	20/116	31/178	0.31	24/178	24/178
NE Index		**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**
Apparel and clothing	***84***	***-0.93***			***0.41***			***0.91***			***0.92***			***0.88***		
Men's, boys' clothing, not knit	841	-	-	-	-	-	-	-	-	-	0.99	7/111	11/175	0.98	7/175	7/175
Women's, girls' clothing, not knit	842	-	-	-	0.72	17/78	38/175	0.96	9/92	17/175	0.91	10/111	16/175	0.93	12/175	12/175
Men's, boys' clothing, knitted	843	-0.98	27/30	158/175	0.73	16/78	36/175	0.88	16/92	30/175	0.81	14/111	22/175	0.96	8/175	8/175
Women's, girls' clothing, knitted	844	-	-	-	1.00	1/78	2/175	1.00	1/92	2/175	0.88	12/111	19/175	0.70	20/175	20/175
Articles of textile apparel	845	-	-	-	0.38	21/78	47/175	0.95	11/92	21/175	0.95	8/111	13/175	0.88	14/175	14/175
Textile clothing accessories	846	-	-	-	0.43	20/78	45/175	0.99	6/92	11/175	-0.60	40/111	63/175	-0.66	56/175	56/175
Non-textile clothing, headgear	848	-	-	-	-0.83	40/78	90/175	-0.92	48/92	91/175	0.16	25/111	39/175	-0.86	67/175	67/175
Footwear	851	-	-	-	-0.98	63/78	141/175	-0.76	37/92	70/175	0.20	22/111	35/175	0.15	32/175	32/175

Source: Author's calculations (data are from UN Comtrade online database)

Notes: 1. The raw ranking of the commodity in this table is different from that of the corresponding commodity in the top-ten list of Table 3-15 and Table 3-16, because in this calculation all possible commodities are taken into account regardless of their share. 2. The adjusted rankings (adj. rank) are the rankings that would prevail when the total number of ranked items were assumed to be 178 for RCA index and 175 for NEI index.

This industry has maintained high competitiveness with its export performance index varying between 1.31 and 1.80 (NEI index is almost 1.00 for the whole period). Two products of this industry, wood in rough or squared and simply worked wood, have been in the top-five rankings for 20 years. Another product (fuel wood and wood charcoal (SITC 245)) is also among the first ten high RCA products for much of the period, although its absolute RCA index has decreased and its adjusted rank has varied between 5/178 and 16/178. However, the other commodity, wood in chips or particles (SITC 246), has lost its competitiveness. Its RCA index decreased from 0.23 in 1990 to -0.54 in 2005 and its adjusted RCA ranks dropped from 33/178 to 49/178 (Table 3-21).

d. Garment and footwear industry

Products of the apparel and clothing industry (SITC 84) include 7 product groups at the 3-digit level (see Section 3.1.4. c for details and changes in descriptions). Together with footwear products (SITC 851), their export value increased by more than 2000-fold from US$64,412 in 1985 to US$180 million in 2005, and comprised more than 34 percent (31% if electricity is taken into account) of the country's total exports. The garment industry is one of the most dynamic industries in the last two decades. In 1985 there was only not-knitted women's outwear (SITC 843) in the rankings with an RCA index of -0.88 and a rank of 23/39. Five years later, five products of this industry recorded a positive RCA index and ranked between 9th and 17th in 86 products. The year 1995 marked a peak year for the garment industry with five products: not knitted men's and women's outwear (SITC 842, 843); knitted and not knitted undergarment (SITC 846, 844); and knitted non-elastic outwear (SITC 845); ranking between 4th and 10th in the high RCA-list. In the following years, however, this industry has lost some competitiveness. In 2000 and 2005, only three garment products: knitted men's and boys' cloth (SITC 841), not-knitted men's and boys' cloth (SITC 843), and articles of apparel (SITC 845) were among the top-10 items.

At the three-digit level, one can observe different trends in comparative advantage of garment products during the study period. Specifically, in lieu of some fluctuations, not-knitted and knitted women's and men's clothing (SITC 841-844), and articles of apparel (SITC 845) are shown to steadily gain competitiveness. Their comparative advantage (in absolute terms, raw rankings and adjusted rankings) has improved during this period. In contrast, the textile clothing accessories (SITC 846) and non-textile clothing and headgear (SITC 848) have lost their competitiveness with RCA index in absolute terms decreasing from 0.48 and -0.84 to -0.23 and -1.31, respectively. In terms of rankings, they dropped from 12/86 and 39/86 in 1990 to 42/178 and 76/178 in 2005 (Table 3-22).

The footwear industry also proves a very dynamic industry with high potential for development and export. In the early 1990s, these products recorded an RCA index of -1.46 and a rank of 59/86 (122/178). However, during the period of study this industry has achieved an upward trend in comparative advantage and reached a positive RCA index in 2000 and by 2005 it ranked 24th in 178 ranked products. The exports have risen from roughly US$19,000 in 1990 to US$6.8 million in 2005.

3.3 RCA AND INDUSTRIAL DEVELOPMENT IN VIETNAM

Similar to the case of Cambodia and Laos, the export performance index and net export index are calculated for 1985, 1990, 1995, and 1997-2005 at the three-digit SITC. Also here, the two indices show comparable behavior and identify similar products with comparative advantage/disadvantage. The Spearman Rank Correlation coefficients between the RCA and NEI indices are relatively high (0.81-0.91) and statistically significant at the 1% level for all cases (Table 3-23).

In addition, in order to assure the appropriateness of the results for cross-commodity and cross-country comparison, the Hillman condition has been tested for petroleum, garment and footwear products, since they account for a large portion of

exports. The test results indicate that the RCA is consistent with the comparative advantage indicated by pre-trade prices as indicated by Hillman (1980).

Table 3-23: Correlation between RCA and NE index (Vietnam)

RCAxNEI	1985	1990	1995	2000	2005
SRC Coefficient	0.892	0.914	0.869	0.838	0.816
Sample size	102	149	207	198	249

Notes: 1. Spearman rank correlation coefficients are applied. 2. All coefficients are statistically significant at the 1% level.

3.3.1 Trends of Revealed Comparative Advantages in Vietnam

Table 3-24 and Table 3-25 show, respectively, the RCA and NEI indices of selected product groups for 1985-2005 at the five year interval. The indices of RCA are missing for some commodities in the earlier years. This is attributable to the use of partners' data or the trade regime during that period. Overall, the RCA index and net export index reveal very similar products with comparative advantage. It can be observed that Vietnam has mainly achieved revealed comparative advantages in some groups: agricultural commodities, mineral fuels, machinery, and garment and footwear products.

During the study period, some commodities of 'fish and preparations' (SITC 03) and 'coffee, tea, cocoa, spices' (SITC 07) have shown high RCA, although there is a mixture of upward and downward trends. In particular, crustaceans and marine products (SITC 036), rice (SITC 042), and coffee (SITC 071) have maintained high comparative advantage, even though their share in exports has declined substantially.

Among mineral fuel products, coal (SITC 321) and crude petroleum oils (SITC 333) show a relatively constant RCA trend and make up a considerable portion of commodity exports. Especially, crude oil is the top export commodity and accounts for 16-28% of the country's merchandise exports. In the same vein, apparel and clothing (SITC 84) and footwear (SITC 85) have gained both comparative advantage and significance in export markets. Specifically, most of garment products and footwear achieved positive Balassa's index in the mid-1990s and have since maintained a

positive index, while their NEI index is positive over the whole period. In terms of significance, during the study period apparel products have steadily increased the share from about 6% to 15% and footwear has grown from less than one percent to nearly 10%.

Table 3-24: Trends of RCA index for selected product groups (Vietnam)

Product	SITC	1985	1990	1995	2000	2005
Fresh, chilled or frozen fish	034	0.068	0.149	0.561	0.550	0.783
Crustaceans, molluscs etc.	036	1.981	1.712	1.372	1.492	1.469
Fish, crustaceans, molluscs, etc.	037	-0.023	0.684	0.737	-0.057	0.827
Rice	042	0.605	1.883	1.561	1.653	1.699
Coffee and coffee substitutes	071	0.194	1.011	1.581	1.280	1.182
Tea and maté	074	1.184	0.676	0.534	0.958	0.900
Spices	075	1.594	1.023	1.346	1.413	1.241
Edible products and preparations	098	0.249	0.087	-0.043	0.195	0.021
Oil-seeds and oleaginous fruits extracts	222	1.363	0.950	0.786	0.195	-0.261
Oil-seeds and oleaginous fruits	223	1.580	-0.604	-0.745	-0.144	0.798
Natural rubber and gums (unprocessed)	231	-	-	-	1.273	1.386
Synthetic and reclaimed rubber	232	0.770	1.055	0.977	-	0.104
Crude animal materials	291	1.559	0.975	0.453	0.200	-0.247
Crude vegetable materials	292	1.294	0.691	0.264	0.148	-0.297
Coal, not agglomerated	321	-	-	-	0.385	0.673
Briquettes, lignite and peat	322	0.813	0.233	0.626	-0.244	-1.542
Crude petroleum oils and oil-minerals	333	-	0.678	0.681	0.610	0.466
Textile yarn	651	-1.681	-0.675	-0.561	-0.040	0.242
Made-up articles of textiles	658	0.296	0.371	0.682	0.383	0.436
Equipment for distributing electricity	773	-	-2.054	-1.250	0.116	0.434
Motor cycles, motorized and not	785	-	-2.256	-0.435	0.153	0.322
Furniture and parts thereof	821	-0.934	-0.912	0.213	0.215	0.666
Travel goods, handbags	831	-2.720	-0.358	0.964	0.642	0.631
Men's, boys' clothing, not knitted	841	-	-	-	0.929	0.919
Women's, girls' clothing, not knitted	842	-	0.219	0.961	0.610	0.774
Men's, boys' clothing, knitted	843	-0.779	0.275	0.712	0.183	0.961
Women's, girls' clothing, knitted	844	0.545	0.469	0.856	0.131	0.880
Articles of textile apparel	845	-0.949	-0.407	0.497	0.441	0.517
Clothing accessories, of textile fabrics	846	-0.597	-0.158	0.534	0.421	0.156
Non-textile clothing, headgear	848	-0.429	-1.197	0.349	0.054	0.269
Footwear	851	-0.264	-0.758	1.058	1.138	1.182

Source: Author's calculations (data are from UN Comtrade online database)
Notes: 1. The RCA index is in common logarithm (logarithm base 10). 2. '-' implies that the data was not reported by any of the trade partners.

In addition, natural rubber and gums (SITC 231), synthetic and reclaimed rubber (SITC 232), textile yarn (SITC 651), made-up articles of textile (SITC 658), equipment for distributing electricity (SITC 773), motorcycles (SITC 785), furniture and parts (SITC 821) and travel goods and handbags (SITC 831) show high potential for exports. Their indices of revealed comparative advantages turned positive in the

mid- or late 1990s and have since then remained largely positive despite some variations. However, they still occupy less than one percent of the exports, except of electric generators and natural rubber with a share of more or less than 2% in recent years.

Table 3-25: Trends of NEI index for selected product groups (Vietnam)

Product	SITC	1985	1990	1995	2000	2005
Fresh, chilled or frozen fish	034	0.979	0.995	0.948	0.979	0.751
Fried, salted, smoked fish	035	0.988	0.991	0.971	0.922	0.925
Crustaceans, molluscs etc.	036	0.999	1.000	0.995	0.957	0.891
Fish, crustaceans, molluscs, etc.	037	0.561	0.984	0.963	0.975	0.982
Rice	042	0.997	1.000	0.993	0.957	0.964
Fresh, chilled, or frozen vegetable	054	0.999	0.972	0.665	0.645	0.544
Coffee and coffee substitutes	071	1.000	0.995	0.992	0.994	0.990
Tea and maté	074	0.998	0.958	0.728	0.938	0.927
Spices	075	0.998	0.997	0.994	0.989	0.947
Tobacco products	122	0.041	-0.873	-0.989	-0.809	0.313
Oil-seeds and oleaginous fruits extract.	222	1.000	0.997	0.969	0.964	0.865
Oil-seeds and oleaginous fruits	223	1.000	0.967	0.265	0.475	0.972
Synthetic and reclaimed rubber	232	1.000	1.000	0.504	-	-0.373
Crude animal materials	291	0.984	0.985	0.507	-0.128	-0.518
Crude vegetable materials	292	0.964	0.907	0.479	0.454	-0.034
Briquettes, lignite and peat	322	0.870	0.999	0.996	-	0.548
Crude petroleum oils and oil-minerals	333	-	1.000	1.000	1.000	1.000
Textile yarn	651	-0.994	-0.572	-0.850	-0.544	-0.274
Made-up articles of textiles	658	0.503	0.515	0.635	0.949	0.948
Electric power machinery and parts	771	-0.986	-0.942	-0.834	-0.088	0.103
Equipment for distributing electricity	773	-	-0.969	-0.946	0.438	0.294
Furniture and parts thereof	821	-0.625	-0.053	0.551	0.960	0.938
Travel goods, handbags	831	-0.986	0.854	0.968	0.994	0.972
Men's, boys' clothing, not knitted	841	-	-	-	0.996	0.997
Women's, girls' clothing, not knitted	842	-	0.924	0.984	0.994	0.998
Men's, boys' clothing, knitted	843	0.444	0.954	0.920	0.995	0.995
Women's, girls' clothing, knitted	844	0.998	0.989	0.979	1.000	0.997
Articles of textile apparel	845	-0.322	0.533	0.961	0.984	0.982
Clothing accessories, of textile fabrics	846	0.760	0.172	0.951	-0.690	-0.520
Non-textile clothing, headgear	848	0.409	-0.029	0.629	0.355	0.260
Footwear	851	0.247	0.116	0.985	0.657	0.834

Source: Author's calculations (data are from UN Comtrade online database)
Note: '-' implies that the data was not reported by any of the trade partners.

On the other hand, products of 'oil-seeds and oleaginous fruit extracts' (SITC 222) and 'crude animal and vegetable materials' (SITC 29) have lost their competitiveness and share in exports. The indices of RCA have turned negative in recent years and the share has decreased from about 10% to less than one percent in 2005.

Apart from commodities mentioned above, Vietnam does not appear to have comparative advantages in product items of beverages and tobacco (SITC 1), animal and vegetable oils (SITC 4), and chemical products (SITC 5).

3.3.2 Ranking of Indices of RCA in Vietnam

Analogous to the above two cases, this section looks into the RCA trends of major export sectors or industries in more detail by means of the ranking of the indices of RCA. Table 3-26 and Table 3-27 present the first ten major export commodities in terms of their competitiveness and importance in the export markets. These are products with a high RCA index and NEI index, i.e. index value of greater than zero, and a share in total exports of 1.5% or greater.

At the level of sector or industry, fishery and agricultural products (marine products, rice, coffee, spices) have maintained high ranks for the whole study period, while oil seeds/fruits and crude materials (oil-seeds and oleaginous fruit extracts, crude animal and vegetable materials) dominated the rankings only until the early 1990s. On the other hand, the energy sector (crude oil, briquettes and lignite), and the garment and footwear industry entered the top-10 list in 1990 and have gradually dominated the rankings, particularly after the year 2000. Other commodities which could enter the top-rankings for separate years include rubber, wood products, furniture and parts, travel goods and hand bags, and miscellaneous manufactured products and metal scraps. These and some other products (excluding metal scraps), which have achieved the positions immediately next to the first ten rankings, show great potential and opportunity for export.

At the three-digit level of the SITC, however, the trends are more flexible. It is also worth noting that while the two indices have revealed similar products in the top-10 list, the actual rakings of individual commodities differ from one another. For example, according to NEI index, sine the early 1990s crude oil and apparel

commodities are the leaders in the rankings followed by agricultural and fishery products. These differences are mainly attributable to the inclusion of import data in the NEI index. Again here, the following analysis is largely based on Balassa' index with reference to the UNIDO-type index.

Representing the fishery and agricultural sector, rice and crustaceans have maintained the first and second position of the rankings over the whole study period. Some other agricultural products, like coffee, spices, fruits and nuts, and un-milled maize, were also dominant among the top rankings in the mid-1980s. However, only coffee is able to retain competitiveness and is among the top-five over the period, whereas spices have gradually lost the share despite maintaining competitiveness. Maize, on the other hand, has lost both competitiveness and export share. For example, in 1985 marine products alone accounted for 28% of the exports, but they have lost their share to only 5.4% in 2005. Rice and coffee experienced an upward trend until a peak in the mid-1990s (11% in 1998 and 12% in 1995, respectively), but have since then declined to 4% and 2% in 2005, respectively. In sum, together the above-mentioned products accounted for 34% of the 1985-exports, but their share has been declining to just 13% as the country moves to industrialization. To date, these products are among major export items and Vietnam is among the world's leaders in some commodities, for example rice and shrimps.

Some other agricultural products for industry were also dominant in the rankings until the early 1990s. Specifically, 'crude animal and vegetable materials' and 'extracts of oil seeds and fruits' ranked third to fifth in 1985. Five years later only 'extracts of oil seeds and fruits' and 'crude vegetable materials' were among the top rankings. Then, they have lost both competitiveness and the indices of RCA have eventually turned negative. Their share declined from 18.7% in 1985 to just 0.3% in 2005.

Table 3-26: The top-10 high ranking RCA products with share ≥1.5% (Vietnam)

Rank	1985	1990	1995	2000	2005
1	Crustaceans, mollusks etc. (28.13)	Rice (8.37)	Coffee and coffee substitutes (12.30)	Rice (4.61)	Rice (4.34)
2	Spices (2.52)	Crustaceans, molluscs etc. (18.20)	Rice (5.30)	Crustaceans, molluscs etc. (8.52)	Crustaceans, molluscs etc. (5.36)
3	Crude animal materials (2.55)	Ferrous waste and scrap (3.40)	Crustaceans, molluscs etc. (8.39)	Coffee and coffee substitutes (3.47)	Unprocessed natural rubber and gums (2.20)
4	Extracts of oil-seeds and oleaginous fruits (10.18)	Wood in rough or squared (3.87)	Footwear (9.43)	Footwear (10.16)	Coffee and coffee substitutes (2.31)
5	Crude vegetable materials (6.01)	Coffee and coffee substitutes (2.59)	Travel goods and handbags (2.72)	Not-knitted men's and boys' clothing (5.62)	Footwear (9.49)
6	Ferrous waste and scrap (1.57)	Extracts of oil-seeds and oleaginous fruits (2.60)	Not-knitted women's and girls' clothing (5.27)	Fresh or dried fruits and nuts (2.33)	Not-knitted men's and boys' clothing (4.10)
7	Miscellaneous manufact. articles (1.90)	Crude vegetable materials (1.66)	Knitted women's and girls' clothing (1.91)	Not-knitted women's and girls' clothing (2.79)	Knitted women's and girls' clothing (1.87)
8	Fresh, chilled or frozen vegetable (3.11)	Crude petroleum oils and oil-minerals (27.56)	Knitted men's and boys' clothing (4.26)	Crude petroleum oils and oil-minerals (24.19)	Fresh, chilled or frozen fish (1.99)
9	Unmilled maize excl. sweet corn (1.90)	Fresh or dried fruits and nuts (2.25)	Crude petroleum oils and oil-minerals (19.84)	Articles of textile apparel (2.74)	Not-knitted women's and girls' clothing (3.68)
10	Fresh or dried fruits and nuts (1.90)	Knitted men's and boys' clothing (1.56)	Briquettes, lignite and peat (1.65)	Furniture and parts thereof (1.60)	Furniture and parts thereof (4.32)
Total	59.54	71.95	71.06	66.02	39.65
V1.5%	US$114.58 million	US$124.11 million	US$208.62 million	US$217.24 million	US$216.77 million

Source: Author's calculations (data are from UN Comtrade online database)

Notes: 1. Percentage share is in parentheses. 2. Total=total share of commodities listed in this table. 3. V1.5%=value of 1.5% share in million US$ at 2000 prices. 4. For 2005 'Crude petroleum oils and oil-minerals' ranks 13th in this classification with 22.72% share and its inclusion would increase the share to 58.06%.

Table 3-27: The top-10 high ranking NEI products with share ≥1.5% (Vietnam)

Rank	1985	1990	1995	2000	2005
1	Ferrous waste and scrap (1.57)	Crude petroleum oils and oil-minerals (27.56)	Crude petroleum oils and oil-minerals (19.84)	Crude petroleum oils and oil-minerals (24.19)	Crude petroleum oils and oil-minerals (22.72)
2	Unmilled maize excl. sweet corn (1.90)	Rice (8.37)	Crustaceans, molluscs etc. (8.39)	Not-knitted men's and boys' clothing (5.62)	Not-knitted women's and girls' clothing (3.68)
3	Extracts of oil-seeds and oleaginous fruits (10.18)	Wood in rough or squared (3.87)	Coffee and coffee substitutes (12.30)	Not-knitted women's and girls' clothing (2.79)	Knitted women's and girls' clothing (1.87)
4	Fresh or dried fruits and nuts (1.67)	Crustaceans, molluscs etc. (18.20)	Footwear (9.43)	Coffee and coffee substitutes (3.47)	Not-knitted men's and boys' clothing (4.10
5	Fresh, chilled or frozen vegetable (3.11)	Ferrous waste and scrap (3.40)	Not-knitted women's and girls' clothing (5.27)	Articles of textile apparel (2.74)	Coffee and coffee substitutes (2.31)
6	Crustaceans, molluscs etc. (28.13)	Simply worked wood (2.17)	Knitted women's and girls' clothing (1.91)	Furniture and parts thereof (1.60)	Articles of textile apparel (2.88)
7	Spices (2.52)	Extracts of oil-seeds and oleaginous fruits (2.60)	Travel goods and handbags (2.72)	Crustaceans, molluscs etc. (8.52)	Rice (4.34)
8	Crude animal materials (2.55)	Fresh or dried fruits and nuts (2.25)	Articles of textile apparel (2.15)	Rice (4.61)	Furniture and parts thereof (4.32)
9	Crude vegetable materials (6.01)	Coffee and coffee substitutes (2.59)	Clothing accessories of textile fabrics (1.70)	Fresh or dried fruits and nuts (2.33)	Coal, not agglomerated (2.06)
10	Briquettes, lignite and peat (4.71)	Knitted men's and boys' clothing (1.56)	Knitted men's and boys' clothing (4.26)	Footwear (10.16)	Crustaceans, molluscs etc. (5.36)
Total	62.35	72.46	67.96	66.02	53.64
V1.5%	US$114.58 million	US$124.11 million	US$208.62 million	US$217.24 million	US$216.77 million

Source: Author's calculations (data are from UN Comtrade online database)

Notes: 1. Percentage share is in parentheses. 2. Total=total share of commodities listed in this table. 3. V1.5%=value of 1.5% share in million US$ at 2000 prices. 4. For 2005 'Footwear' ranks 11th in this classification with 9.49% share and its inclusion would increase the total share to 63.13%.

Representing the energy sector, 'crude petroleum oils and oil-minerals' have been among the top rankings for much of the period under study. They vary in the bottom half of the top-10 list in terms of Balassa's index, but they comprise 13-28% of the country's exports. To date, crude petroleum oils are the top export commodity in terms of foreign currency earnings. Other products of this sector (coal, briquettes, lignite, peat, coke) have gained some competitiveness, but their proportion in exports is yet to increase if investment and development occur in this sector. For example, since 2000 exports of coal have increased from less than one percent to 2%. In view of building the base for industrialization, these are potential export commodities. However, along with industrialization domestic demand for energy would increase, and at certain stage of industrialization Vietnam might reduce export of or import of oil or other fuel products.

The garment and footwear industries are the only manufacturing subindustries which have steadily gained competitiveness and significance in Vietnam's export markets over the last decade. In 1990, only apparel product (not-knitted undergarment) could make to the top-ten list with just 1.6% share, while other garment products recorded a negative RCA index or insignificant share. Since the mid-1990s the apparel and clothing industry has slowly gained competitiveness with three products among the top-10 rankings (not knitted men's and women's outwear, not knitted undergarment) and accounting for 11.4% in 1995. During 1995-2005, on average two or three garment products are among the first ten rankings with a share of about 10%. In 2005, three apparel products (knitted and not knitted women's and girls' clothing, and not-knitted men's and boys' clothing) ranked between sixth and ninth place and comprised 10.7% of the exports. Similarly, the footwear industry, which registered a negative Balassa's index and a share of below one percent until 1990, has continuously gained competitiveness and significance. Specifically, since 1995 the footwear industry not only has turned to positive RCA index, but jumped to fourth place in the top-10

rankings and accounted for about 9.5% of the commodity exports. Over the decade, footwear has ranked among the first five products with a share of 10-12%. In combination, products of the garment and footwear industries in the rankings comprise about 20% of the commodity exports over the study period.

Apart from the commodities described above, there are some products which have gained competitiveness and entered the top-10 rankings: wood products, furniture and parts, and natural rubber. These commodities could enter the list for some years, but could not sustain competitiveness. Hence, further investment and development in such sectors and industries would enhance their competitiveness and significance and sustain the exportation of these products in future.

3.3.3 Diversification of Exports in Vietnam

The next part of the analysis deals with structural changes of exports using three indicators. The first indicator is presented in Table 3-28 – the ratio of products with Balassa's and net export index of greater than zero to the total number of ranked products and the percentage share of products with comparative advantage for 1985-2005.

Table 3-28: Number of products with high RCA and NEI index (Vietnam)

	1985	**1990**	**1995**	**2000**	**2005**
RCA index					
High RCA products (A)	39	41	44	46	53
Total ranked products (B)	112	158	209	202	249
Ratio of high RCA products to total (A)/(B)	0.35	0.26	0.21	0.23	0.21
Share of high RCA products (% share)	78.88	88.33	91.41	87.77	84.60
NEI index					
High NEI products (A)	52	60	56	60	67
Total ranked products (B)	102	150	209	198	249
Ratio of high NEI products to total (A)/(B)	0.51	0.40	0.27	0.30	0.27
Share of high NEI products (% share)	79.84	91.04	92.15	85.91	85.85

Source: Author's calculations (data are from UN Comtrade online database)
Note: RCA or NEI index is classified as high if its value is greater than 0.0 (RCA, NEI>0).

Observing the first half of the table reveals that the number of commodities with high Balassa's index have increased steadily during the last two decades (from 39 to 53 items), and, in parallel, the number of exported commodities increased from 112

to 249. However, with the exception of 1985 and 1990, the resulting ratio remained fairly unchanged over the study period. Similarly, based on the net export index the number of products with comparative advantage rose from 52 to 67 and that of the total ranked products from 102 to 249. The resulting ratio, once again except for the first two years, shows a quite stable trend over the study period. Despite a somewhat constant ratio, the high RCA and NEI products comprise 64% to 92% of the country's exports. These results would imply that to certain extent Vietnam's exports tend to concentrate in some sectors or industries over the last two decades.

In addition, evaluating the occurrence of high RCA products at the one-digit SITC reveals that there was a sharp increase in the number of high RCA commodities in the group of 'inedible crude materials excluding fuels' (SITC 2) and 'manufactured articles' (SITC 6 and 8) during 1999-2000, whilst the figure in other categories remains roughly unchanged.

Table 3-29: Standard deviation of RCA and NE index (Vietnam)

	1985	**1990**	**1995**	**2000**	**2005**
RCA index	1.392	1.340	1.108	0.938	1.149
Sample size	112	158	209	202	249
NEI index	0.844	0.844	0.738	0.717	0.677
Sample size	102	150	209	198	249

Source: Author's calculations (data are from UN Comtrade online database)

The next measure applied for the examination was the standard deviation of the two indices of RCA (Table 3-29). In the case of Vietnam, the standard deviation of the RCA and NEI indices has declined until 1998-1999 and increased slightly in the following sub-period to a level, which is still below the initial level. The volatility of the indices measured by the coefficient of variation also shows a similar trend. Therefore, it can be said that the Vietnam's exports have diversified in the period under examination, but the degree of diversification is somewhat fluctuating.

The third measure involves the similarities/differences in the export composition between two periods. For this purpose, once again, the Spearman Rank Correlation coefficients for RCA and NEI index have been calculated for 1985-2005. If

the export diversification occurred over time, the correlation coefficients would become smaller, the longer the time lags. Table 3-30 reveals that the SRC correlation coefficients for both indices have decreased steadily from 0.8 to 0.4 over the study period without any abrupt movement, which implies that the pattern of Vietnam's exports has changed gradually.

Table 3-30: Rank correlation coefficient, 1985-2005 (Vietnam)

RCA*x*RCA	**1985**	**1990**	**1995**	**2000**	**2005**
1985	1.000	0.736	0.651	0.570	0.399
1990		1.000	0.648	0.468	0.395
1995			1.000	0.711	0.672
2000				1.000	0.791
2005					1.000
NEI*x*NEI	**1985**	**1990**	**1995**	**2000**	**2005**
1985	1.000	0.820	0.692	0.530	0.422
1990		1.000	0.732	0.458	0.405
1995			1.000	0.724	0.671
2000				1.000	0.812
2005					1.000

Notes: 1. Spearman rank correlation coefficients are applied. 2. All coefficients are statistically significant at the 1% level.

All three indicators suggest that over the last two decades export diversification occurs, but the trend is rather smooth. This result – combined with the findings from Section 3.3.1 and 3.3.2 – would imply that in terms of competitiveness Vietnam's exports have diversified toward crude materials and manufactured goods, especially during 1999-2000, and that manufacturing industries have dominated the country's export composition in terms of earnings. Also, it should be noted that the occasional difference in the indices of RCA between the period of 1985-1995 and 1997-2005 might be referred to the use of partners' data in the former sub-period and Vietnam's data in the latter and the change in the SITC categories to Revision 3 since 2000.

3.3.4 Trends of Major Sectors and Industries in Vietnam

This section provides an examination on the industrial development process in Vietnam in more detail and analyzes the changes in comparative advantages of major sectors and industries. These are 'agricultural products' including marine products (SITC 22); rice (SITC 042); coffee (SITC 071), crude rubber (STIC23), 'oil-seeds and

oleaginous fruits (SITC 222)'; 'crude petroleum oils and oil-minerals' (SITC 333); and 'garment and footwear industry (SITC 84, 85)'. Table 3-31 shows the percentage share of these sectors and industries, and some commodities of manufacturing industries with potential for exports. During 1985-2005 they accounted for 63%-74% of the exports depending upon the years. Table 3-32 and Table 3-33 present the RCA and NEI indices, raw and standardized rankings [23] of these indices (the total number of ranked commodities were assumed to be 249).

Table 3-31: Export share of Vietnam's major sectors and industries (% share of total)

Sector/Industry	SITC	1985	1990	1995	2000	2005
Crustaceans, molluscs etc.	036	28.13	18.10	8.39	8.52	5.36
Rice	042	0.66	8.37	5.30	4.61	4.34
Coffee and coffee substitutes	071	1.16	2.59	12.30	3.47	2.31
A. Subtotal of Section 0	***0***	***29.94***	***29.07***	***25.98***	***16.60***	***12.01***
Oil-seeds and oleaginous fruits extract.	222	10.18	2.60	1.48	0.34	0.11
Natural rubber and gums (unprocessed)	231	-	-	-	1.15	2.20
Crude vegetable materials	292	6.01	1.66	0.55	0.32	0.11
B. Subtotal of Section 2		***16.18***	***4.26***	***2.03***	***1.81***	***2.43***
Briquettes, lignite and peat	322	4.71	0.96	1.65	0.01	0.00
Crude petroleum oils and oil-minerals	333	-	27.56	19.84	24.19	22.72
C. Subtotal of Section 3		***4.71***	***28.52***	***21.49***	***24.19***	***22.72***
D. Textile yarn, fabrics, made-up articles	65	1.81	1.52	2.60	2.06	2.24
Data processing machines, etc.	752	-	0.07	0.01	-	1.27
Parts of machines of 751, 752	759	0.00	0.00	0.01	3.36	1.48
Equipment for distributing electricity	773	-	0.00	0.03	0.89	1.60
Road vehicles (air-cushion vehicles)	78	0.00	0.18	0.22	0.51	1.10
E. Subtotal of Section 7		***0.00***	***0.26***	***0.26***	***4.76***	***5.45***
Articles of apparel and clothing	84	5.70	6.35	16.29	12.57	14.43
Footwear	85	0.66	0.66	9.43	10.16	9.49
Miscellaneous manufactured articles	89	3.58	1.36	1.46	1.94	2.36
F. Subtotal of Section 8	***8***	***9.94***	***8.37***	***27.18***	***24.68***	***26.27***
Subtotal (A+B+C+D+E+F)		**62.58**	**71.99**	**79.55**	**74.10**	**71.12**

Source: Author's calculations (data are from UN Comtrade online database)
Note: The share of the one-digit level (SITC section) is the sum of the share of the two- and three-digit items presented here.

a. Agricultural products

The most prominent agricultural export commodity is crustaceans and molluscs. To date, these marine products including shrimps are exported to 19 countries, such as Japan, the US, Korea, China, Australia, member countries of the EU and ASEAN. The export value increased steadily from US$103 million in 1985 to US$1.74 billion in

[23] The raw and adjusted rankings in Table 3-32 and 3-33 are different from those of Table 3-26 and 3-27, because in this case all exported commodities are considered regardless of their share in exports.

2005. The share, however, has declined from 28.1% to 5.4%, as Vietnam's exports expanded significantly over the same period. However, marine products have maintained the competitiveness and a position among the top export commodities for two decades with an RCA ranking between first and third place. If these rankings were adjusted they would rank between first and fourth out of 249 products. The NEI rankings, on the other hand, have deteriorated from 9/102 (22/249) to 25/249 (Table 3-32).

Another very important agricultural export commodity is rice. Rice farming is a part of Vietnamese tradition and it has been exported to about 20 countries/economies throughout the world, including the US, Japan, major members of the EU and ASEAN, and Cambodia. Its export value increased during the period under examination from US$2.4 million to US$1.4 billion. The percentage share, however, recorded a fluctuating trend from less than one percent to a peak at 12.3% in 1995, and then declined to 4.3% in 2005. In lieu of such fluctuations, rice has been among the export leaders in terms of competitiveness. Its RCA ranking improved from 18/112 (40/249 for normalized rankings) in 1985 to the first rank out of 249 items in 2005, and the corresponding figures for NEI rankings are 13/102 (32/249) for 1985 and 16/249 for 2005.

The next product under examination is coffee, which has been exported to about 19 countries/economies (the US, Japan, EU member countries, ASEAN members, Australia etc.). Similar to rice, during the last 20 years its monetary value augmented steadily from US$4.3 million to US$749.9 million, whilst its share rose to a peak at 12.3% in 1995 and fell back to 2.3% in 2005. Coffee has gained comparative advantage over the study period, and its ranking has improved from 29/112 (64/249) to 5/249 for RCA index. The NEI rank, on the other hand, has declined from 2/102 (5/249) to 9/249.

We saw in Section 3.3.1 that Vietnam's exports have diversified toward crude materials, but the trends in CA and the share of individual product groups at the three-digit SITC are very different from one another depending upon the commodity. Specifically, 'oil-seeds and oleaginous fruits (SITC 222)' and 'crude vegetable materials (SITC 292)' have lost both competitiveness and significance in exports. During 1985-2005, although exports of oil-seeds have remained at US$37 million, the share has decreased from 10.2% to less than 1% and the ranking has dropped from 11/249 (15/249 for NEI index) to 78/249 (28/249 for NEI index). Similarly, despite an increase in value from US$22 million to US$36 million, crude vegetable materials have lost their export share from 6% to 0.1% and ranking from 13/249 (56/249 for NEI index) to 82/249 (72/249 for NEI index). To date, they are exported to 16-19 countries/economies, such as Japan; Korea; China; Hong Kong; ASEAN member countries and the EU. On the other hand, 'unprocessed natural rubber and gums (SITC 231)[24]' have gained both competitiveness and export significance. Export value and share increased from US$166 million to US$714 million and from 1.15% to 2.20%, respectively. Their ranking also improved from 7/249 (36/249 for NEI index) to 3/249 (35/249 for NEI index). This is one of the products with high potential for export expansion in future.

b. Crude oil

Crude oil has been one of Vietnam's leading export products for more than a decade. It has maintained high competitiveness over the period under consideration, although the RCA ranking varied between 32/249 and 26/249 (Table 3-32). In terms of NEI index it has jumped from 10/249 to the first rank. The export value rose by more than 18 times from US$379 million to US$7.4 billion during the period under

[24] This commodity group (SITC 231) is available only in the third revision of SITC starting from 2000. Hence, the trend of RCA and NEI indices and share is available for the sub-period (2000-2005).

Table 3-32: RCA and NEI ranking trends of agricultural products, crude materials and manufactured equipment (Vietnam)

Industry/Commodity	**SITC**	**1985**			**1990**			**1995**			**2000**			**2005**		
RCA Index		**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**
Crustaceans, molluscs etc.	036	1.98	1/112	2/249	1.71	2/158	3/249	1.37	3/209	4/249	1.49	2/202	2/249	1.47	2/249	2/249
Rice	042	0.60	18/112	40/249	1.88	1/158	2/249	1.56	2/209	2/249	1.65	1/202	1/249	1.70	1/249	1/249
Coffee and coffee substitutes	071	0.19	29/112	64/249	1.01	9/158	14/249	1.58	1/209	1/249	1.28	5/202	6/249	1.18	5/249	5/249
Oil-seeds & oleaginous fruits extracts	222	1.36	5/112	11/249	0.95	13/158	20/249	0.79	14/209	17/249	0.19	33/202	41/249	-0.26	78/249	78/249
Unprocessed natural rubber and gums	231	-	-	-	-	-	-	-	-	-	1.27	6/202	7/249	1.39	3/249	3/249
Crude vegetable materials	292	1.29	6/112	13/249	0.69	18/158	28/249	0.26	31/209	37/249	0.15	38/202	47/249	-0.30	82/249	82/249
Crude petroleum oils and oil-minerals	333	-	-	-	0.68	20/158	32/249	0.68	19/209	23/249	0.61	15/202	18/249	0.47	26/249	26/249
Equipment for distributing electricity	773	-	-	-	-2.05	117/158	184/249	-1.25	122/209	145/249	0.12	40/202	49/249	0.43	28/249	28/249
NEI Index		**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**
Crustaceans, molluscs etc.	036	1.00	9/102	22/249	1.00	10/150	17/249	1.00	7/209	8/249	0.96	20/198	25/249	0.89	25/249	25/249
Rice	042	1.00	13/102	32/249	1.00	8/150	13/249	0.99	9/209	11/249	0.96	21/198	26/249	0.96	16/249	16/249
Coffee and coffee substitutes	071	1.00	2/102	5/249	0.99	20/150	33/249	0.99	10/209	12/249	0.99	10/198	13/249	0.99	9/249	9/249
Oil-seeds & oleaginous fruits extracts	222	1.00	6/102	15/249	1.00	15/150	25/249	0.97	17/209	20/249	0.96	18/198	23/249	0.86	28/249	28/249
Unprocessed natural rubber and gums	231	-	-	-	-	-	-	-	-	-	0.79	29/198	36/249	0.72	35/249	35/249
Crude vegetable materials	292	0.96	23/102	56/249	0.91	40/150	66/249	0.48	48/209	57/249	0.45	46/198	58/249	-0.03	72/249	72/249
Crude petroleum oils and oil-minerals	333	-	-	-	1.00	6/150	10/249	1.00	3/209	4/249	1.00	4/198	5/249	1.00	1/249	1/249
Equipment for distributing electricity	773	-	-	-	-0.97	117/150	194/249	-0.95	139/209	166/249	0.44	47/198	59/249	0.29	53/249	53/249

Source: Author's calculations (data are from UN Comtrade online database)

Note: The adjusted rankings (adj. rank) are the rankings that would prevail when the total number of ranked items were assumed to be 249 for both RCA and NEI indices.

Table 3-33: RCA and NEI ranking trends of apparel and footwear products (Vietnam)

Industry/Commodity	**SITC**	**1985**			**1990**			**1995**			**2000**			**2005**		
RCA Index		**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**	**RCA**	**Raw rank**	**Adj. rank**
Apparel and clothing	***84***	***0.43***			***0.29***			***0.71***			***0.59***			***0.72***		
Men's, boys' clothing, not knit	841	-	-	-	-	-	-	-	-	-	0.93	9/202	11/249	0.92	9/249	9/249
Women's, girls' clothing, not knit	842	-			0.22	32/158	50/249	0.96	12/209	14/249	0.61	14/202	17/249	0.77	15/249	15/249
Men's, boys' clothing, knitted	843	-0.78	64/112	142/249	0.28	29/158	46/249	0.71	17/209	20/249	0.18	35/202	43/249	0.96	8/249	8/249
Women's, girls' clothing, knitted	844	0.54	21/112	47/249	0.47	25/158	39/249	0.86	13/209	15/249	0.13	39/202	48/249	0.88	11/249	11/249
Articles of textile apparel	845	-0.95	67/112	149/249	-0.41	56/158	88/249	0.50	25/209	30/249	0.44	21/202	26/249	0.52	24/249	24/249
Textile clothing accessories	846	-0.60	58/112	129/249	-0.16	49/158	77/249	0.53	23/209	27/249	0.42	23/202	28/249	0.16	37/249	37/249
Non-textile clothing, headgear	848	-0.43	55/112	122/249	-1.20	85/158	134/249	0.35	29/209	35/249	0.05	43/202	53/249	0.27	33/249	33/249
Footwear	851	-0.26	50/112	111/249	-0.76	69/158	109/249	1.06	7/209	8/249	1.14	7/202	9/249	1.18	6/249	6/249
NEI Index		**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**	**NEI**	**Raw rank**	**Adj. rank**
Apparel and clothing	***84***	***0.92***			***0.88***			***0.91***			***0.60***			***0.87***		
Men's, boys' clothing, not knit	841	-	-	-	-	-	-	-	-	-	1.00	6/198	8/249	1.00	7/249	7/249
Women's, girls' clothing, not knit	842	-			0.92	37/150	61/249	0.98	13/209	15/249	0.99	9/198	11/249	1.00	5/249	5/249
Men's, boys' clothing, knitted	843	0.44	42/102	103/249	0.95	35/150	58/249	0.92	24/209	29/249	0.99	7/198	9/249	1.00	8/249	8/249
Women's, girls' clothing, knitted	844	1.00	10/102	24/249	0.99	24/150	40/249	0.98	15/209	18/249	1.00	5/198	6/249	1.00	6/249	6/249
Articles of textile apparel	845	-0.32	56/102	137/249	0.53	50/150	83/249	0.96	20/209	24/249	0.98	12/198	15/249	0.98	10/249	10/249
Textile clothing accessories	846	0.76	34/102	83/249	0.17	57/150	95/249	0.95	21/209	25/249	-0.69	105/198	132/249	-0.52	116/249	116/249
Non-textile clothing, headgear	848	0.41	43/102	105/249	-0.03	61/150	101/249	0.63	40/209	48/249	0.36	51/198	64/249	0.26	54/249	54/249
Footwear	851	0.25	49/102	120/249	0.12	59/150	98/249	0.99	12/209	14/249	0.66	36/198	45/249	0.83	31/249	31/249

Source: Author's calculations (data are from UN Comtrade online database)

Note: The adjusted rankings (adj. rank) are the rankings that would prevail when the total number of ranked items were assumed to be 249 for both RCA and NEI indices.

consideration and accounted for 13-28%. Some major destinations include Australia, Singapore, China, Malaysia, Japan and the US. In 2005, with a share of 22.8% crude oil was the top export commodity.

c. Electric equipment

Compared to Cambodia and Laos, Vietnam has achieved a higher level of development and industrialization. Although exports are concentrated in some agricultural products, crude oil, garments and footwear items, Vietnam's manufacturing industries have gradually moved to more capital-intensive section as expressed in an upward trend in export share of data processing equipment and parts, motorbikes, and certain manufactured articles etc. For example, 'equipment for distributing electricity (SITC 773)' has slowly gained CA, as its RCA and NEI index has turned positive and its ranking has improved from 184/249 to 28/249 (194/249 to 53/249 for NEI index) (Table 3-32). The export value and share has augmented from US$50,000 to US$520 million meaning from less than 0.1% to 1.6%, respectively. It has been exported to 18 countries including Japan, Australia, China, Hong Kong, the US, ASEAN members and some European countries. To date, such products still occupy a tiny portion of the country's exports, but they possess great potential for export and are the goals of the next stage of industrialization.

d. Garment and footwear industry

Over the last two decades the export value of garment and footwear industry (SITC 84, 85) has increased drastically from US$22.3 million in 1985 to US$7.8 billion in 2005 and the share from approximately 6.4% to 24%. These two subindustries are among the most dynamic industries which have progressively gained competitiveness.

The apparel and clothing industry consists of seven product groups (see Section 3.1.4. c for details and changes in descriptions). To date, they are exported to more than

40 countries/economies in the world such as the US, most of the EU and ASEAN members, Australia, Canada, and Russia. During 1985-2005 the export value (percentage share) has increased from US$21 million (5.7%) to US$4.7 billion (14.4%). The industry's competitiveness (SITC 84) has enhanced steadily with RCA index rising from 0.43 in 1985 to 0.73 in 2005 (NEI index decreased slightly from 0.92 to 0.87). At the 3-digit level, despite an upward CA trend, until 1990 most of the garment products recorded a negative Balassa's index and ranked rather low, for example 47/249-149/249 in 1985. Since 1995 they have turned to positive RCA index and maintained strong competitiveness (NEI index is positive over the period). Their rankings have improved to 9/249-37/249 in 2005 with some products achieving incredible development, for example 'knitted men's and boys' clothing' from 142/249 in 1985 to 8/249 in 2005 (Table 3-33).

Table 3-34: Basic statistics of manufacturing industries in Vietnam (2000-2005)

Manufacturing industries	**2000**	**2002**	**2003**	**2004**	**2005**
Number enterprises	10,399	14,794	16,916	20,531	24,018
Textiles (% share)	*3.92*	*4.23*	*4.19*	*4.11*	*4.36*
Wearing apparel & dyeing of fur (% share)	*5.57*	*6.73*	*7.16*	*7.63*	*7.27*
Wood and bamboo processing (% share)	*7.14*	*7.29*	*7.01*	*7.20*	*7.12*
Employment (thousand persons)	1597	2203	2557	2893	3099
Textiles (% share)	*7.68*	*6.91*	*6.47*	*5.81*	*6.08*
Wearing apparel & dyeing of fur (% share)	*14.52*	*16.18*	*17.06*	*17.22*	*16.50*
Textile & garment subindustry (% share)	***22.20***	***23.09***	***23.53***	***23.04***	***22.57***
Wood and bamboo processing (% share)	*3.96*	*3.76*	*3.51*	*3.75*	*3.68*
Output in billion VND (1994 prices)	158,098	213,697	252,886	296,294	353,215
Textiles (% share)	*6.35*	*5.77*	*5.62*	*5.61*	*5.40*
Wearing apparel (% share)	*3.82*	*3.83*	*4.14*	*4.32*	*4.33*
Wood manufactures & products (% share)	*2.28*	*2.10*	*2.17*	*2.22*	*2.30*

Source: Statistical Yearbook of Vietnam, 2006. General Statistical Office (GSO)
Notes: 1. Statistics are as of 31 December of the year. 2. Average exchange rate of 2007 is 16178.90 VND per US$ (Key Indicators, 2008)

Over the period under study the development of the footwear industry is equally dynamic, with the RCA index improving from -0.26 to 1.18 (0.25 to 0.83 for NEI) and the ranking from 111/249 to 6/249 (120/249 to 31/249 for NEI). At the 3-digit level footwear products are the second largest export item after crude oil. The value (percentage share) has augmented enormously from just US$2.4 million (0.7%) to

US$3.1 billion (9.5%). To date, like apparel and clothing, footwear is exported to about 40 countries, including the US, Japan and major economies in the world.

The other equally important role of the garment and footwear industry is job creation and income generation. Specifically, they are the largest non-agricultural employer. As can be observed in Table 3-34, roughly these subindustries account for 10-12% of the manufacturing industries in terms of number and output, but they employ about 22-23% of the labor forces in manufacturing.

In summary, this Chapter has illustrated the structure of the exports and the dynamic aspects of revealed comparative advantages of CLV over the last two decades. Undoubtedly, the industrialization in the three countries has been influenced by the changes in RCA and development in other parts of the world and region. On top of this, despite differences in absolute scale and share/significance in national economy, the garment industry in all three countries has shown an impressive development trend in terms of export earnings and competitiveness. This industry surely deserves further analysis with respect to its performance from different perspectives. Chapter 5 studies the garment industry in Cambodia, Laos and Vietnam in detail with an emphasis on firm efficiency and its determinants, and productivity growth and its sources.

CHAPTER FOUR
GLOBAL AND REGIONAL GARMENT INDUSTRY, LITERATURE AND MODELS OF EFFICIENCY AND PRODUCTIVITY MEASUREMENT

4.1 GLOBAL AND REGIONAL GARMENT INDUSTRY

4.1.1 Multi-Fiber Agreement and the GATT/WTO

Year 2004 has witnessed an unprecedented event in the history of the contemporary world of trade, the termination of the regime of controlled trade – the Multi-Fiber Agreement (MFA). International trade in textiles and clothing was controlled for more than 40 years. This process actually started in the late 1950s. For example, when exports of cotton textiles from Japan to the United States put the US textile industry under serious challenges, Japan was encouraged to exercise the so-called voluntary export restrictions in 1957 (Yamazawa (1988) cited in Yamagata (2007)). This also happened to some other exporters, such as Hong Kong, China, India and Pakistan.

The restrictions of textiles and clothing imports to the US, Canada and certain European countries were put in effect in a Short Term Arrangement (STA) in 1961. Then a Long Term Agreement (LTA) was signed to replace the STA in the following year. This LTA regulated international trade in cotton textiles until 1974 (Yamagata, 2007).

In view of avoiding disruptions in their domestic markets, which might be caused by excessive imports from the developing world, developed countries established the MFA to pursue a so-called temporary protection. In 1974 under the framework of the General Agreement of Tariffs and Trade (GATT) the MFA was established to replace the LTA and came into effect of controlling the quantity of trade in T&G sectors. In addition to cotton textiles, the MFA was expanded to cover

synthetic fibers and woolen products. It is largely composed of a framework of bilateral agreements between the two trade partners or unilateral actions of the importing countries. MFA was used by the EU, Australia, Canada, Finland, Norway and the US to allocate export quotas to low cost developing countries or LDCs.

The Uruguay Round of the GATT in 1994 concluded with some of extraordinary decisions which would have permanent impacts on the modern trade regime: (i) an expansion of the scope of the international trade to encompass a general agreement on trade in services, trade-related intellectual property rights and trade-related investment measures; (ii) the establishment of the World Trade Organization (WTO); and (iii) resolving problems in two sectors beyond its control, agriculture and T&G sectors.

On top of this, the most relevant conclusion of the Uruguay Round for the T&G industry was the decision to terminate the MFA in a period of ten years starting in 1995. The MFA was integrated into the WTO regulation and replaced by the Agreement on Textiles and Clothing (ATC). Under WTO control, the ATC is a transitional arrangement to phase out the MFA and fully integrate T&G products into the multilateral trading system under GATT 1994 rules. The list of ATC is greater than that of MFA and covers yarns, textiles, fabrics, made-up textile products and clothing articles. Under the ATC, the MFA would be phased out and trade in T&G products would be gradually liberalized via regulation of annual growth rate until all quotas being removed by 2005. Textiles and clothing have been integrated into the GATT in four phases: (i) Stage I (January 1995): MFA growth rates increased by 16 percent (growth rate of residual quotas), i.e. all member countries integrated 16% of products listed in Annex in Agreement into GATT/WTO (product integration); (ii) Stage II (January 1998): MFA growth rate further increased by 25% and production integration by 17%; Stage III (January 2002): growth rate rose by 27% and product integration by 18%; and Stage IV (January 2005): growth rate increased by 49% and all MFA quotas

were removed (See WTO/GATT 1994 Agreement; Whalley (1997); and Bargawi (2005) for more details on MFA phase-out process).

Two features of the ATC deserve further explanation. First, importing countries are free to choose products to integrate (from ATC) into the GATT under a condition that these items should come from various elements of the aforesaid ATC list. Second, under Article XIX of the GATT 1994 (Emergency Action on Imports of Particular Products) importing countries are able to establish the so-called 'Safeguard' on certain products in the post-MFA period, if imports of such products would harm domestic industries. However, the import volume should not be reduced to below the level of the previous year and the Safeguard shall be terminated no later than eight years after the date of first application or five years after the Agreement on establishing WTO came into effect with the later date being applied (GATT Agreement 1994). Also, under Article VIII the Textile Monitoring Body (TMB) was established to supervise the implementation of provisions. Upon the MFA phase-out, the EU has agreed with China to impose an annual growth rate of 10% on China's T&G products from June 2005. The US followed in November 2005, but unilaterally imposed a rate of 7.5% per annum on Chinese products. The two Safeguards shall expire on 31 December 2008 (see James (2008) for a brief review on US Safeguards and price dynamic).

The European Union, the US, Canada, and Norway carried MFA quota restrictions on to ATC. It has been found in various studies that the integration generally included non-sensitive products for importing countries, while a large amount of items in which developing countries have comparative advantage were left until the last stage (back-loading).

4.1.2 Global Trade in Apparel and Clothing

The quota system has caused distortion in T&G trade and resource allocation and led to welfare loss. First, countries with competitiveness in textiles and clothing

sectors were not able to expand the production to the level it would have been without MFA, while some other countries with relatively low competitiveness have enjoyed a market with protection. Second, foreign direct investment (FDI) in T&G sectors has been directed to countries with a large quota to fill or quota-unrestricted countries. This has contributed to a shift in T&G production. Third, consumers in quota-protected developed countries paid higher prices on textiles and clothing than they would have been without quotas (see also Bargawi, 2005). On the other hand, to certain extent the quota system has aided LDCs, such as Cambodia, Laos and Vietnam, reduce mass poverty and resolve some social problems, and pursue industrialization and economic development. Without quotas allocated to these countries they would face more burdens and problems in socio-economic development process.

In spite of quota restrictions, world trade in clothing has shown positive developments in the MFA-period. World exports of garments have increased by more than double from about US$160 billion in 1995 to more than US$345 billion in 2007. Similarly, during 1995-2005 world imports have augmented from US$170 billion to US$289 billion (Table 4-1). The table also reveals that China, Hong Kong, and most of garment exporting developing countries (except Thailand) have recorded a remarkable increase in exports and a moderate increase in imports. In particular, during 1995-2007 China's exports have soared by more than four times from US$ 24 billion to US$115 billion and to a lesser degree Hong Kong's exports from US$21 billion to US$29 billion. Cambodia's exports increase by more than four times from US$61 million to nearly US$3 billion. Vietnam's garment industry has achieved an extraordinary performance and exports have jumped from US$854 million to more than US$7 billion. To a lesser extent, Laos has also doubled her garment exports to US$175 million within the last decade.

The upward trend in garment imports of developed countries over the same period trends reflect this development. For example, imports to 15 EU countries have

risen from US$62 billion to US$145 billion, imports to the US from US$41 billion to US$85 billion, and the figure for Japan from US$19 billion to US$24 billion. The garment industry in these countries, however, is on the declining except for EU15, in which such an increase would most probably be attributable to Italy's strength and exports of some new members.

Table 4-1: Garment trade of selected Asian and major economies

	Exports (US$ million)				Imports (US$ million)			
Exports	**1995**	**2000**	**2005**	**2007**	**1995**	**2000**	**2005**	**2007**
China	24,049	36,071	74,163	115,238	969	1,192	1,629	1,976
Hong Kong	21,297	24,214	27,292	28,765	12,654	16,008	18,437	19,149
India	4,110	6,178	9,212	9,655	6	26	72	127
Bangladesh	1,969	4,162	8,155	10,060	102	174	68	434
Indonesia	3,376	4,734	5,106	5,870	28	39	71	136
Vietnam	854	1,821	4,681	7,186	41	450	332	426
Thailand	5,008	3,759	4,085	4,073	84	131	214	331
Pakistan	1,611	2,144	3,604	3,806	2	5	27	61
Sri Lanka	1,474	2,287	2,874	3,283	43	74	107	N.A
Cambodia	61	970	2,231	2,893	6	29	80	N.A
Malaysia	2,266	2,257	2,478	3,159	154	148	283	410
Philippines	1,065	2,536	2,287	2,283	66	75	98	100
Singapore	1,464	1,825	1,696	1,779	1,644	1,881	2,132	2,428
Laos	86	125	175	N.A.	4	5	11	N.A
EU15	45,090	46,434	69,521	89,269	61,655	70,818	110,852	144,571
USA	6,651	8,629	4,998	4,297	41,367	67,115	80,071	84,853
Korea	4,957	5,027	2,581	1,914	1,073	1,307	2,913	4,318
Canada	1,016	2,077	1,861	1,585	2,688	3,690	5,976	7,604
Japan	530	534	495	523	18,758	19,709	22,541	23,999
Australia	224	196	206	199	1,262	1,858	3,120	3,703
CLV	*1,001*	*2,916*	*7,521*	*N.A.*	*51*	*484*	*423*	*N.A.*
Total	127,160	155,980	227,702	295,838	142,605	184,733	249,031	294,626
World	*160,460*	*202,243*	*281,985*	*345,301*	*169,630*	*210,581*	*289,068*	*N.A.*

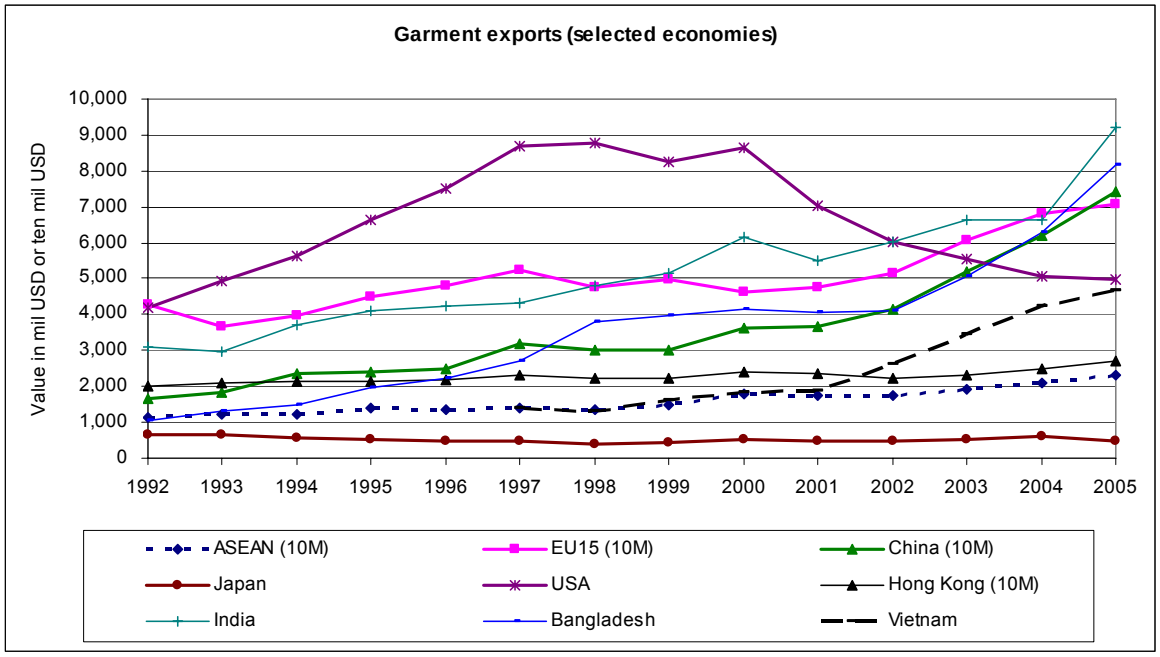
Source: Author' compiled (data are from UN Comtrade online database: http://comtrade.un.org/ and International Trade Statistics, 2008, WTO, http://www.wto.org/).

Notes: 1. EU15 include: Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom; and three members joining in 1995: Austria, Finland, and Sweden. 2. For 1995 EU15 do not include Belgium and Luxembourg. 3. Owing to lack of data, for Sri Lanka data of 1994 and 1999 are used for 1995 and 2000, respectively. 4. Exports of Hong Kong and Singapore include domestic exports and re-exports. 5. Value of CLV is the sum of value of Cambodia, Laos, and Vietnam. 6. Some differences are due to the use of data from two different sources and the use of cif- and fob-data. 7. N.A. denotes 'not available'.

Figure 4-1 and Figure 4-2 illustrate the trends in trade in garments of some selected economies for 1992-2005. In export markets, EU15 and garment exporting developing countries (China, India, Bangladesh, and Vietnam) have achieved positive developments and strong growth in the last 15 years. However, ASEAN and Hong Kong have registered only moderate growth. In contrast, clothing exports of Japan and

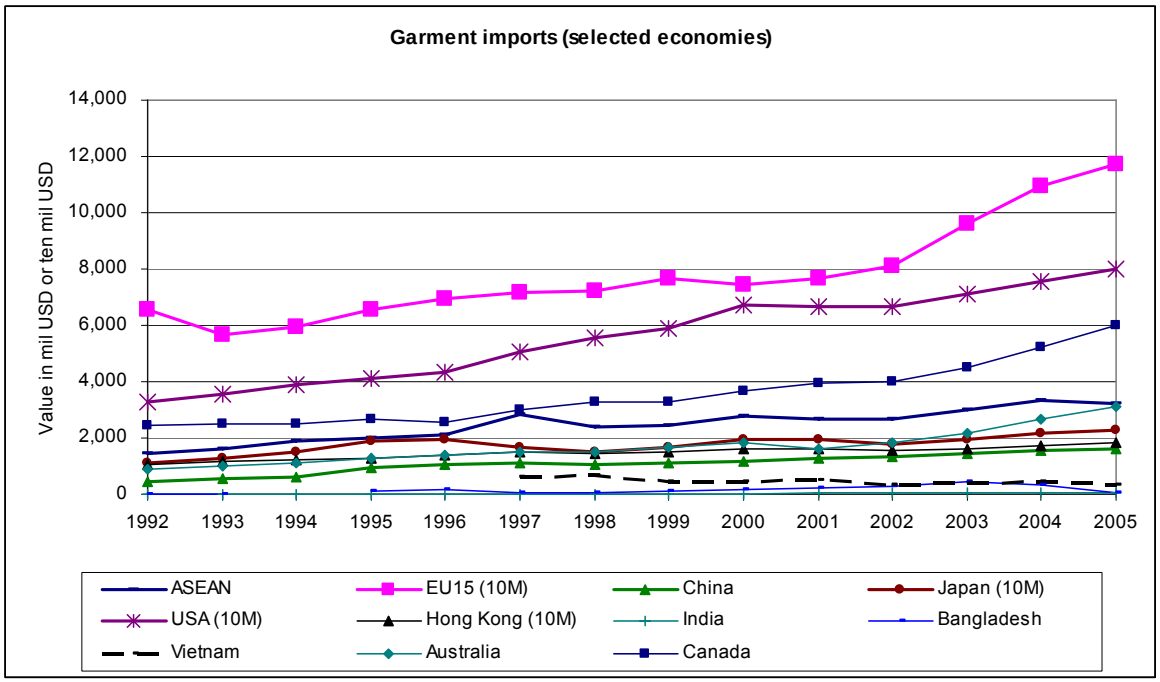
the US are on a declining trend. US garment exports rose until 2000, but have since then declined.

Figure 4-1: Garment exports of selected economies, 1992-2005



Source: Author's calculations (data are from UN Comtrade online database: http://comtrade.un.org).
Notes: 1. (10M) denotes that the value for the respective economy or region is in US$10 million. 2. Due to lack of data, 1999-value of Bangladesh is the simple average of 1998 and 2000.

Figure 4-2: Garment imports of selected economies, 1992-2005



Source: Author's calculations (data are from UN Comtrade online database: http://comtrade.un.org).
Notes: 1. (10M) denotes that the value for the respective economy or region is in US$10 million. 2. Due to lack of data, 1999-value of Bangladesh is the simple average of 1998 and 2000.

On the consumption side, garment imports have recorded positive development trends over the same period. However, it is apparent, that the degree of import augmentation in garment supplying economies (China, Hong Kong, India, Bangladesh, and Vietnam) is much lower than that of developed economies. Once again, EU15 show a unique feature of the member composition in that a large increase in their imports is most probably attributable to the group of more developed members like Germany, France, UK, Italy, and Spain.

Table 4-2 shows the major players in world trade in garments for 2007 in terms of value of trade, market share, growth, and average annual growth of 2000-2007. China is a clear leader with one thirds of the world supply, followed by EU 30%, Hong Kong 8% and so on. Representing Indochina, Vietnam ranks the 7th (6th if EU as a region were not considered) in the world and supplies about 2% of garment products to the world markets. It can be observed that as many as 76% of exports of EU are intra-EU trade and much of exports of Hong Kong is re-exports. Similarly, half of EU imports are among the members within the Union. The list of top-ten importers is led by EU with 46%, US 27%, Japan 7%, Hong Kong 5%, Russia 4% and so on.

The table also reveals some interesting features, namely the concentration of world supply and consumption of clothing and possible winners and losers of the MFA phase-out. Specifically, the first 15 suppliers alone cover more than 86% of the world supply of clothing and the top 15 economies consume 90% of clothing in the world. Moreover, Mexico, the US, and Hong Kong (excluding re-exports) are losing their market share in garment exports. The apparel and clothing industry in these economies seems to be on the declining trend, as the 2007-growth rate and the average rate of 2000-2007 are negative. Recently, Thailand's clothing industry has also recorded negative growth. It appears to follow the trend in the three economies mentioned above.

Table 4-2: Leading exporters and importers of garments (billion dollars and % share)

Exporters	Value 2007	Share 2007	Growth (%) 2007	Growth (%) 00-07	Importers	Value 2007	Share 2007	Growth (%) 2007	Growth (%) 00-07
China [a]	115.2	33.37	20.81	18.05	EU27	162.8	45.51	12.73	10.07
EU27	103.4	29.94	13.05	9.08	extra-EU27	84.2	23.54	13.24	11.16
extra-EU27	24.8	7.17	18.50	9.70	USA	84.9	23.72	2.27	3.41
Hong Kong	28.8	8.33	1.32	2.49	Japan	24.0	6.71	0.54	2.85
domestic	*5.0*	*1.44*	*-25.87*	*-9.38*	Hong Kong	19.1	5.35	1.57	2.59
re-exports	*23.8*	*6.89*	*9.76*	*7.56*	Russia [b, c]	14.5	4.05	79.00	27.23
Turkey [b]	14.0	4.05	16.17	11.50	Canada	7.6	2.13	11.54	10.88
Bangladesh [b]	10.1	2.91	4.43	10.30	Switzerland	5.2	1.45	11.39	7.33
India	9.7	2.80	2.01	7.13	UAE [b]	5.0	1.40	63.98	29.25
Vietnam [b]	7.2	2.08	28.81	21.66	Korea	4.3	1.21	15.35	18.62
Indonesia	5.9	1.70	1.91	3.12	Australia [c]	3.7	1.04	12.92	10.36
Mexico [a]	5.1	1.49	-18.56	-7.11	Mexico [a, c]	2.5	0.69	-1.70	-5.22
USA	4.3	1.24	-11.87	-9.48	Singapore	2.4	0.68	-2.74	3.71
Thailand	4.1	1.18	-4.11	1.15	*retained IM*	*0.9*	*0.24*	*16.36*	*6.54*
Pakistan	3.8	1.10	-2.57	8.54	Norway	2.3	0.64	15.59	8.56
Morocco [a]	3.6	1.04	11.06	5.94	China [c]	2.0	0.55	14.63	7.49
Tunisia	3.6	1.03	18.32	6.98	Saudi Arabia	1.9	0.54	17.61	13.22
Sri Lanka [b]	3.3	0.95	7.78	2.24					
Sum	*298.1*	*86.34*			*Sum*	*323.1*	*90.31*		

Source: International Trade Statistics, 2008, WTO (http://www.wto.org/).
Notes: 1. Value is denominated in billion US Dollars and share denotes percentage share in world exports/imports. The letter in brackets denote: [a] include significant shipments through processing zones; [b] includes WTO-Secretariat estimates; and [c] imports are fob-value. 2. EU27 include: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom.

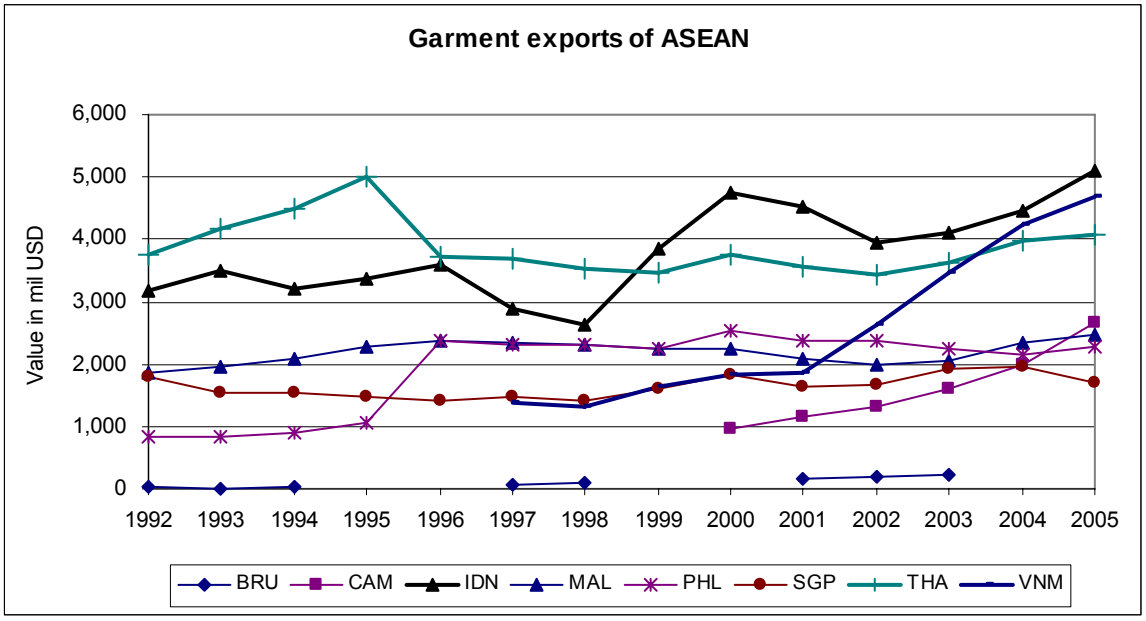
Recent trends in apparel and clothing exports of some of the world's leading exporters to the three major markets, the EU, the US, and Japan, are presented in Table 4A-1 to 4A-3 in the chapter appendix, respectively. Two distinctive features are apparent. First, upon the MFA abolition the demand in the major markets continues to grow and there are some winners and losers. For example, China has so far benefited the most from this event, as it has not only maintained the leading position, but has also been able to increase the market share in all markets. In a short period of 2003-2007, China has doubled the share in the US market to 34%, and increased the share by 10 percentage points to 25% in the EU market and by nearly 3 percentage points to 82% in Japan. To a lesser extent, other winners in global garment trade are India, Bangladesh, Turkey, Vietnam and Cambodia. Hong Kong and Mexico appear to be among the losers as their market share has been decreased. Second, with the exception of China, exporting countries seem to show some specialization in certain markets. For instance,

Turkey, Bangladesh and Laos tend to specialize in the EU market, whereas Mexico, Hong Kong, Vietnam, Indonesia and Cambodia prefer the US market to the EU. These trends might be a result of historical development during the quota era and political and trade relations among the partners.

4.1.3 CLV in Regional and Global Garment Markets

On the whole, the garment industry in Indochina emerged around the late 1980s to mid-1990s. The emergence of this industry has been facilitated by both internal development (economic transition, rebuilding of peace and international relations etc.) and external factors (reallocation of investment, resources and production location to the Southeast Asian region caused by wage increases and/or quota allocations in T&G industry etc.). The industry has since then grown steadily. At the national level it has played a crucial role in economic development of the three countries and at the regional and global level it has contributed a large portion to the world's garment supply.

Figure 4-3: Garment exports of ASEAN member countries, 1992-2005

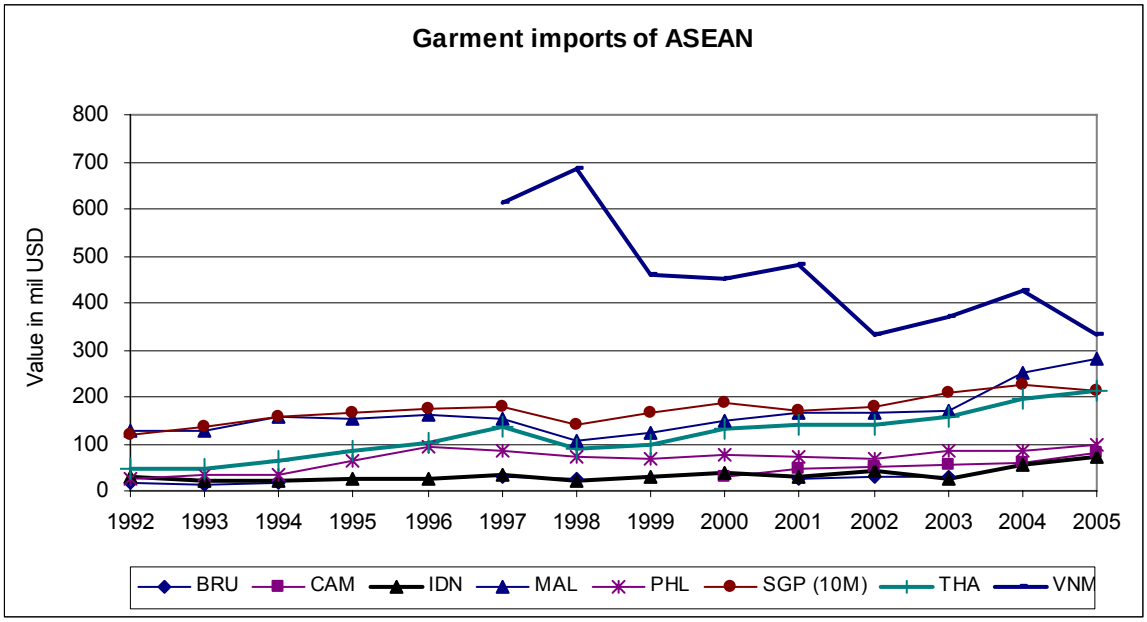


Source: Author's calculations (data are from UN Comtrade online database: http://comtrade.un.org).
Note: Laos and Myanmar are not included due to lack of time series data.

East Asia as a region has long been an important supplier of textiles and clothing of the world for decades, but the supplying countries have changed. It started with Japan after the World War II and then moved to the four tigers (Korea, Hong

Kong, Taiwan, and Singapore), and later China and the ASEAN-4 countries like Malaysia, Indonesia, Thailand, and the Philippines. Recently, Cambodia and Vietnam, as new ASEAN members, have become competitive in this industry and supplied a significant portion of garments to the world, and also, to a lesser degree, Laos has achieved some competitiveness and contribution to the supply. Figure 4-3 and Figure 4-4 present the trend of garment exports and imports of eight ASEAN member countries for the period of 1992-2005. Myanmar and Laos are not included in the figures due to lack of time series data, while data of Brunei are available for only some years. Overall, exports of the ASEAN increased from US$11.5 billion to US$23.2 billion. As can be observed in Figure 4-3, the member countries can be classified into two groups.

Figure 4-4: Garment imports of ASEAN member countries, 1992-2005



Source: Author's calculations (data are from UN Comtrade online database: http://comtrade.un.org).
Notes: 1. Laos and Myanmar are not included due to lack of time series data. 2. For Singapore, (10M) denotes that the value in US$10 million.

The first group consists of countries which have achieved strong growth in clothing exports, namely Indonesia, Cambodia and Vietnam. Despite significant fluctuations during the Asian Financial Crisis (AFC) and in the aftermath, Indonesia's garment exports have recovered well after the AFC and registered steady growth since 2002. The country's exports increased from US$3.1 billion to US$5.1 billion. Similarly,

garment exports of Cambodia and Vietnam have been growing relatively well since the beginning of the decade and reached US$2.7 billion and US$4.7 billion, respectively. The second group, including Malaysia, the Philippines, Singapore and Thailand, has recorded moderate growth except for Singapore with a declining trend and Brunei without a clear trend.

In regard to imports, with the exception of Vietnam all members have maintained a relatively stable trend over the period. The declining trend of clothing imports in Vietnam could be a consequence of significant development in this industry for both domestic and international markets in the last decade. In terms of value, Singaporean imports are roughly ten times the ASEAN average. For example, in 2005, Singapore imported about US$2,132 million apparel and clothing. The figure for Thailand is US$214 million and the average of ASEAN is US$184 million (Figure 4-4).

Table 4-3: Garment exports of CLV in major markets

Apparel and clothing (SITC 84)	**1985**	**1990**	**1995**	**2000**	**2005**
Exports in million US$					
Garment exports of CLV	21	94	1,002	2,916	7,520
Garment exports of ASEAN	N.A.	7,460	14,182	18,027	23,174
Garment exports of China	N.A.	N.A.	24,049	36,071	74,163
World garment exports	40,861	109,737	160,460	202,243	281,985
Share in major markets (%)					
CLV's exports in ASEAN exports	N.A.	1.26	7.07	16.18	32.45
CLV's exports in world's exports	0.05	0.09	0.62	1.44	2.67
CLV's exports in imports of USA	N.A.	0.00	0.07	1.38	6.03
China's exports in world exports	N.A.	N.A	14.99	17.84	26.30
China's exports in imports of USA	N.A.	13.71	14.91	13.30	26.40

Source: Author compiled (data are from UN Comtrade online database and UN International Trade Statistics Yearbook, various issues).
Notes: 1. Export value is in nominal term. 2. CLV stands for Cambodia, Laos, and Vietnam. 3. 'N.A.' denotes that data are not available. 4. Data and share of US imports are US data.

Table 4-3 presents the position of CLV's garment industry relative to the ASEAN and world leader (China) for the last two decades. The upper half of the table shows the export value: exports of Indochina have increased drastically since the early 1990s and reached US$7.5 billion in 2005 as compared to ASEAN US$23.2 billion, China US$74 billion and the world US$282 billion. However, the role of the CLV's garment industry in the global and regional supply chain has been more and more

pronounced, mainly owing to the size of Cambodia's and Vietnam's exports in the EU and US markets. As can be seen in the lower half of the table, over the last 15 years CLV have augmented their share in ASEAN's exports from 1.3% to 32.5%, and in the world supply from just 0.1% to 2.7%. In the three major markets for garments, CLV have managed to increase both their export value and market share and currently supply about 1.9% of the EU imports, 7.1% of the US imports and 1.2% of Japan's imports (Table A4-1 to A4-3 in the Appendix 4A). In the domestic context, the dominant role of the apparel and clothing industry (compared to the textile industry) in the commodity exports of the Indochinese countries is presented in Table 4-4. The share of garments in merchandise exports has been rising steadily and reached 45% in 2005, while the figure of the textile industry is less than 2%. The emergence, major issues related to development and the role of the garment industry in Cambodia's, Lao and Vietnam's economy are presented in more detail in Section 5.1.1, 5.2.1 and 5.3.1, respectively.

Table 4-4: Textile and garment exports in commodity exports of CLV

Share in commodity exports (% share)	**1985**	**1990**	**1995**	**2000**	**2005**
A. Share of textile products (SITC 26+65)					
Cambodia	1.28	0.89	0.40	1.02	1.53
Laos	0.86	0.19	0.37	0.36	0.14
Vietnam	2.04	1.86	2.65	2.14	2.33
CLV Average	*1.39*	*0.98*	*1.14*	*1.18*	*1.33*
B. Share of garment products (SITC 84)					
Cambodia	3.65	1.92	19.64	69.81	83.31
Laos	0.36	9.39	36.36	29.44	35.70
Vietnam	5.70	6.35	16.29	12.57	14.43
CLV Average	*3.23*	*5.89*	*24.10*	*37.28*	*44.48*

Source: Author compiled (data are from UN Comtrade online database).

4.2 REVIEW OF LITERATURE ON EFFICIENCY STUDY

Efficiency study is a long-standing issue and dates back to the pioneer work by Pareto and Koopmans, who took a theoretical approach to assessing efficiency without specifying how technical efficiency could be identified (Cooper et al., 2006, p. 66). Unlike the effectiveness, which deals with the ability to state and achieve goals without

referring to resources used, the concept of efficiency involves both the resources utilized and the resulting (obtained) benefits. Technical efficiency is viewed as a firm's ability to produce the maximum possible output given the technology and the level of inputs. The concept can involve comparing the observed input to minimum potential input required to produce the output (input orientation), or comparing the observed output to maximum potential output attainable from the input (output orientation), or some combination of the two. In these two cases, the optimum is defined in terms of production possibilities and the efficiency is *technical*. Another possibility is to define the optimum in terms of producer's behavioral goal and compare observed and optimum cost, revenue, profit etc. In such cases the optimum is expressed in value terms and the efficiency is *economic* (Fried et al., 2008, p. 8).

The empirical measurement of efficiency was practically introduced in a seminal paper by Farrell (1957), who proposed a decomposition of the overall (economic) efficiency of a firm into price (allocative) efficiency and technical efficiency (TE). The former refers to a firm's success in choosing an optimal set of inputs, and is argued to be unstable and only provide a good measure of a firm's efficiency in adjusting to factor prices under a fully static condition. The *technical efficiency* (also called Farrell Efficiency), on the other hand, measures the success in producing as large as possible an output from a given set of inputs or can be interpreted as measuring how much more output could be obtained from the same inputs. He also argued that the former confronts more difficulties, whereas the latter is a relatively uncomplicated measure. It is the technical efficiency that has later been further developed and applied in empirical work extensively.

Following Farrell's work, the analysis of efficiency has mainly developed into two branches: the non-parametric (mathematical programming) and parametric (econometric) approaches. The striking difference between these approaches lies in the treatment of statistical noise and the flexibility in the structure of production

technology. In the stochastic frontier analysis (SFA), the econometric approach attempts to distinguish the effects of noise from those of inefficiencies, and thereby provides the basis for statistical inference. On the other hand, the data envelopment analysis uses the linear programming to avoid confounding the effects of misspecification of the functional form of both technology and efficiency with those of efficiency (Fried et al., 2008, p. 33).

4.2.1 Nonparametric Approach to Efficiency Measurement

Since the introduction of input distance functions by Shephard for production analysis and by Malmquist for consumption analysis in the early 1950s, in the vast literature, the construction of a grand frontier from observed data points and calculation of distance functions often use the non-parametric approach, the data envelopment analysis (DEA). In other words, DEA uses the actual observations to construct a frontier and evaluates the efficiency of a DMU[25] (observation) relative to this frontier, subject to the restriction that all DMUs are on or below the production possibility frontier. Any deviation of a DMU from this frontier is interpreted as inefficiency.

The modern version of DEA was introduced by Charnes, Cooper and Rhodes (1978). The concept of efficiency was adopted from the field of (combustion) engineer and defined as the ratio of the actual amount of heat released in a given device to the maximum amount which could be released from the fuel used. Following Farrell's definition of technical efficiency, the authors introduced an input-oriented model under constant returns to scale condition (CCR-I model[26]) and applied it for assessing the efficiency of DMUs in a public education program. The CCR ratio represents the Farrell efficiency and comprises both pure technical efficiency and scale efficiency.

[25] DMU is the abbreviation for Decision Making Unit, a terminology with loose definition used in DEA to describe the entity responsible for converting inputs into outputs (Cooper et al., 2006a).
[26] CCR stands for the names of the developers Charnes, Cooper, and Rhodes. The letter 'I' denotes the input-orientation, i.e. minimizing inputs while holding the output unchanged.

This concept was extended to separate pure technical efficiency from scale efficiency without explicit specification of functional forms of relationship between inputs and outputs in Banker, Charnes and Cooper (1984). The so-called BCC model[27] allows for variable returns to scale (VRS) and considers the possibility that the average productivity at the most productive scale may not be achievable for other scale sizes. These two models are discussed in more detail in Section 4.4.

Overall, the evolution of nonparametric efficiency measurement approaches (new efficiency theory) can be viewed in three major stages: (1) the development of DEA from the engineering concept of efficiency using a linear programming by Charnes et al. (1978), which applied only data on input and output quantities for estimating technical efficiency; (2) the introduction of the allocative efficiency approach which involves a cost frontier based on observed price data; and (3) the extension of the cost efficiency concept to apply inputs and/or outputs as policy variables, which firm facing market prices optimally choose (Sengupta, 2000).

Owing to advancement in mathematical programming, DEA has made progress and more models have been developed for different practical applications, largely as non-parametric and non-stochastic efficiency measurement technique (Kumbhakar and Lovell, 2003).

4.2.2 Parametric Approach to Efficiency Measurement

In parametric approaches, the traditional estimation of average production functions (for example the ordinary least square) operates under an implicit assumption that firms are fully efficient. This is the case of perfectly competitive market, but in the real world inefficiency exists and is sometimes prevalent. Addressing this issue, in the early 1970s many scholars developed the so-called deterministic production frontier method by accounting deviations from the frontier for inefficiencies. In such a

[27] Similarly, BCC is the abbreviation of the names of the developers Banker, Charnes and Cooper.

deterministic model, inefficiency was considered the only source of error and was linked with specific one-sided error distributions, thereby ignoring the random error component.

Considering both error components, i.e. noise v_i and inefficiency component u_i, Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977) independently developed a stochastic production frontier model with composed error $(v_i - u_i)$. A core element of SFA is to specify a distribution for the error terms, which was a focus of following research work on frontier analysis. Hence, the initially introduced assumption of exponential and half normal distribution in Aigner et al. (1977) has been extended to include more types of distribution, for example truncated normal distribution (Stevenson, 1980) and gamma distribution (Greene, 1990) (for more cases, see Coelli et al., 2005). Also, derived from the statistical characteristics of the underlying distribution of the inefficiency component, the composed error $(v_i - u_i)$ must be negatively skewed and a maximum likelihood estimation must be applied for the model (Kumbhakar and Lovell, 2003).

In practical applications, not only the frontier estimation is of interest, but also possible factors affecting efficiency and causing efficiency discrepancies among firms are of great importance. Hence, a two-stage approach was developed to estimate efficiency in the first stage and evaluate possible determinants of efficiency in the second stage. Later, attempts have been made to integrate these two procedures into one-stage estimation which incorporates explanatory variables directly into the inefficiency component. In such approach, either the mean or the variance of the inefficiency term is modeled to be a function of the determinants included in the inefficiency equation (Battese and Coelli, 1995; Kumbhakar and Lovell, 2003).

It is important to note that, similar to the duality in profit maximization and cost minimization, there exists a cost frontier analysis, in which the production frontier is

replaced by a cost frontier and technical inefficiency by cost inefficiency. A more extensive review of SFA literature can be found in Kumbhakar and Lovell (2003).

Turning to comparison between DEA and SFA, development in both techniques in the last three decades has made them much more robust than previously considered, and the gap is no longer between one method and the other. Rather the issue is the discrepancy between best-practice knowledge and average practice implementation, and the challenge is to narrow this gap (Fried et al., 2008, p. 33). With respect to the consistency between the two techniques, it has been found that the higher the quality of data, the greater is the consistency between the two sets of efficiency estimates.

4.2.3 Application of DEA and SFA

DEA and SFA applications involve efficiency and productivity analysis in many sectors and industries, including agricultural and crop and dairy production (Kumbhakar et al. 1989; Wadud and White, 2000); manufacturing industry; health care and education system (Staat, 2006; Bernet et al., 2008; Kempkes and Pohl, forthcoming); electric supply utilities (Von Hirschhausen et al., 2006); military utilities etc, just to name some. Also its applications range from private enterprises to SOEs (Vu, 2003), government agencies and non-profit organizations (Nunamaker, 1985).

In literature two kinds of combination of SFA and DEA are common applications: DEA-SFA comparison and two-stage DEA-regression analysis (for a brief summary of DEA applications, see Coelli et al., 2005, Chapter 7). In the former, the SFA and DEA are applied on the same dataset and the resulting two sets of efficiency estimates are compared to each other. In the latter, in stage 1 DEA is used to determine efficient and inefficient DMUs; and in stage 2 these results are incorporated in the form of dummy variables in a statistical regression or the efficiency index is regressed upon the exogenous factors to assess the effects of such factors on efficiency (Latruffe et al., 2004; von Hirschhausen et al. 2006; Odeck, 2007, Kravtsova, 2008).

For instance, using SFA technique Brada et al. (1997) study determinants of firm efficiency in 12 sub-industries for Czechoslovakia in 1990 and 15 for Hungary in 1991 (textile and garment industry is also included) and find that the majority of firms in such sectors achieve an efficiency of 0.4-0.7 implying a presence of considerable technical inefficiency, and that efficiency is affected by firm size and profits.

Among the sub-sectors in manufacturing, the textile and garment industry has been studied extensively in relationship to efficiency and its determinants. For example, in a SFA, firm ownership, age and size of firms have largely been found to be influencing firm efficiency in the Indonesian weaving industry (Pitt and Lee, 1981). Also in Indonesia, with 66% of 2,250 garment enterprises achieving a score of 0.5-0.7, the efficiency level is found to be comparable to other studies, and inter-firm variation is considerable. Export orientation, financial integration and female participation in the workforce are among the main determinants (Hill and Kalirajan, 1993). For Chinese SOEs, average technical efficiency of 1990-1994 was estimated at 0.757, which is higher than the level of the building material, chemical and machinery industries (Kong et al., 1999). Also for China, using DEA/Assurance Region methods, Zhu (1996) studies 35 firms of the Nanjin Textiles Corporation in China for 1988-1989 and concludes that (1) some efficient firms are more flexible in adopting the mixture of central planning and market economies; and (2) collective units are more efficient than state-owned units in the period under study. For Australian textile and clothing firms, average technical efficiency has been found between 43-51% and 42-45% for the period 1995-1998, respectively. Also, firm is associated with higher technical efficiency, while capital intensity does not seem to have any impact (Wadud, 2004).

Despite such a large body of studies on efficiency of the textile and garment industry in economics literature, there is limited number of studies on the garment industry for Cambodia. Some of the available research papers address the future of this industry and its ability to cope with the MFA termination, and the role of the industry

in economic development and poverty reduction. In contrast to the predictions in Nordås (2004) it has been revealed that the country, partly in comparison with Bangladesh, is able to overcome the adverse shocks and the garment industry continues to grow with a capacity to enter more developed markets (Yamgata, 2007; Hach, 2007). It has been estimated that Cambodia would be able to absorb a fall of 10-15% in unit value of sales via savings on the costs of export licenses and other measures, while FDI and the share of profit in the value of goods sold and in value-added continue to rise, and real wage and labor's share in value-added are falling. Moreover, labor productivity is agued to have improved and become comparable with China (Bargawi, 2005). The role of this labor-intensive industry in (rural) poverty reduction without strong government intervention is deemed new and impressive, and inevitable for the betterment of human development and livelihoods (Yamagata, 2006; Hach, 2007). Built on the success in the short run, the prospects of Cambodia's garment industry in the longer-term are related to evaluation of production efficiency, enhancement of productivity and production control, quality of labor and human resource development, managerial skills and management information system (USAID, 2005). All these aspects are associated with efficiency directly or indirectly, particularly technical efficiency. Yet, to date, no quantitative analysis on efficiency and its determinants has been made available.

Turning to Laos, the majority of existing literature is available in form of descriptive analysis (Sakurai and Ogawa, 2007) or strategic papers and reports (Thornton, 1999; Boutsyvongsakd et al. 2002; NSC, 2007a-2007d), while quantitative efficiency and productivity study is still yet known, particularly investigations at industry- and plant-level. Drawing from existing research studies, labor productivity in Laos is found to be lower than that of neighboring competitors due to lack of skilled labor, high absence rate and high labor turn over rate (Sakurai and Ogawa, 2006), and appears to be affected by capital intensity and labor quality (Inthakesone, 2007). Also,

the majority of the management of garment factories in Laos shows a rational behavior in business operation (77%), with large companies being more rational than smaller ones due to their superiority in knowledge, technology and financial resources (Wongpit, 2006).

Table 4-5: Summary of average technical efficiency from selected studies

No.	Source	Sector/industries, location, period covered	Method	Average TE	Remarks
1	Vu (2005)	Enterprise Survey, Vietnam, T&G industry, 2000-2003	DEA	4-year average 0.649	See note for annual TE
2	Hill and Kalirajan (1993)	Garment firms in Indonesia, 1986 Census of Small Industry	SFA	66.1% of samples= 0.51-0.70	
3	Brada et al. (1997)	Enterprises in Czechoslovakia and Hungary, 1990 and 19991	SFA	1990: 0.52 1991: 0.41	Czechoslovakia Hungary
4	Kong et al. (1999)	SOEs in textile industry, China, 1990-1994	SFA	0.757	
5	Vu (2003)	SOEs in T&G industry, Vietnam, 1997-1998	SFA	1997: 0.573 1998: 0.574	
6	Wadud (2004)	Clothing firms in Australia, 1995-1998	SFA	95: 0.4188 96: 0.4505	97: 0.4273 98: 0.4389
7	Tran et al. (2008)	Private SMEs, Vietnam, SITC 8, 1996 and 2001	SFA	1996: 0.719 2001: 0.824	

Source: Author compiled from various sources.
Note: Annual technical efficiency estimated in Vu (2005): TE=0.59 for 2000; TE=0.56 for 2001; TE=0.71 for 2002; TE=0.73 for 2003

For Vietnam, research on efficiency and productivity is more widespread. However, the majority covers manufacturing industries, which include the T&G industry in certain cases, while research with specific focus on the garment industry is rather rare. For example, by sing SFA Vu (2003) compares technical efficiency among SOEs in the T&G and in other seven industries for 1995 and 1997. The study reveals that industrial SOEs have achieved a relatively high level and moderate improvement in technical efficiency (average TE for T&G industry was 0.572 for 1995 and 0.574 for 1997)[28], and that the causes of TE differences be attributable to such factors as share of skilled workers, location in Ho Chi Minh (HCM) City and export activity. In a similar vein, a study on non-state SMEs for 1996 and 2001, which covers five sectors at one-digit SITC, yields that micro-level enterprises with fewer than 10 labors and those in

[28] Among 8 sub-industries under study SOEs from chemical and electronics industry achieved the highest TE of 1.000 and those of the leather industry the lowest of 0.530. Average TE of all sub-industries was 0.788.

Metropolitan are found to have superior TE level, while firm age adversely affects TE (Tran et al., 2008).

It is also worth noting that from the available sources the technical efficiency in the Vietnam's garment industry was found to achieve some improvement during 2000-2003 from 0.586 to 0.738 (period average=0.649)[29], particularly in the southern region around HCM (Vu, 2005). Further, the advantage of large scale in textile sub-industry is compensated by lack of managerial and marketing knowledge of young firms, while firm size exerts a positive impact on technical efficiency in the garment sub-sector. State ownership is associated with lower TE level as compared to foreign and private ownership (Vu, 2005). Moreover, in response to the rising wages in Vietnamese industries and to recent changes resulting from the Multi-Fiber Agreement (MFA) phase-out, garment factory owners have moved their production facilities to more rural areas. They have also made efforts to upgrade process and products or consider moving out of the industry in unsuccessful cases (Goto, 2008). Results from selected studies on technical efficiency of the textile and garment industry are summarized in Table 4-5.

4.3 REVIEW OF LITERATURE ON PRODUCTIVITY STUDY

Productivity has drawn attention of people from different parts of society, including policy makers, production managers and researchers in economics and management science. One of the most widely discussed issues, also in public debate, was the productivity slowdown observed in the United States and other industrialized countries during the 1960s – 1970s and the competitive position of the USA (Färe, Grosskopf, Norris, and Zhang, 1994). Productivity study dates back to pioneering works of many influential scholars in the 1950s, such as Malmquist, Shephard, and Solow. Measurement approaches applied in literature can be classified into two branches, namely time continuous and time discrete analysis. Measurement approaches

[29] The corresponding TE improvement for the textile sub-industry during 2000-2003 was 0.601 to 0.749 and the period-average was 0.646.

applied in literature can be classified into two branches, namely time continuous and time discrete analysis.

Following the work of Robert Solow (1957), studies on productivity growth and technical progress have applied the time derivatives of production, cost or profit functions. This useful concept is, however, deemed not quite suitable for measurement of productivity using indices, because this would require a discrete approximation to the time derivative (Caves, Christensen, and Diewert, 1982).

Another approach to productivity evaluation is the use of index numbers for discrete data points. Upon the introduction of distance functions in the early 1950s, index numbers have extensively been developed for measuring productivity level and growth. The consumption quantity (standard of living) index developed by Malmquist can also be interpreted as input quantity index for production analysis. An analogous index for output orientation has been developed upon the introduction of output based distance functions by Shephard in the early 1970s (Lovell, 2003).

In an effort to avoid approximating continuous time concepts, Caves et al. (1982) introduced the currently known as input based Malmquist productivity index (MI) as the ratio of two input distance functions. This theoretical index could overcome the problem of time differences faced by the *(original)* one proposed by Malmquist and, hence, could be used for comparing a firm at two different time periods or two firms at one point or different points in time. Therefore, it can be used for comparison purposes under very general conditions of production structures. Furthermore, they showed that for translog production functions[30] the geometric mean of two Malmquist indexes is equivalent to Törnqvist index.

In this connection, another influential development, which occurred in parallel with the introduction of distance functions, is the afore-mentioned concept of technical

[30] The conditions include (1) time constant second order terms; and (2) and cost minimization and profit maximization for translog production technology (Färe et al., 1994, p. 66).

efficiency introduced by Farrell (1957). Farrell's technical efficiency is the reciprocal of the input distance function introduced by Shephard and Malmquist and the main element of the Malmquist productivity index.

In the early 1990s, attempt was made to combine Farrell's concept of efficiency measurement with the idea of productivity measurement introduced by Caves et al. (1982). In their paper, Färe, Grosskopf, Lindgren and Roos (1992), for the first time, proposed a decomposition of the Malmquist Index (MI) developed by Caves et al. (1982) into two components, one capturing the efficiency change (catch-up) and the other one measuring the technical change or equivalently the change in the frontier technology (frontier-shift), and applied it to study the productivity changes in Swedish pharmacies for 1980-1989. This decomposition, which uses the constant returns to scale (CRS) technology as the reference technology, was extended in Färe et al. (1994) to conceptualize a technology characterized by variable returns to scale (VRS). In other words, the efficiency change term calculated under CRS was further factored into pure technical efficiency change and scale efficiency change. These two components, however, are calculated related to VRS. The MI and its components were computed for 17 OECD countries using data envelopment analysis. It is argued that the technical change specified and computed under CRS technology would capture the maximal average product and be consistent with the concept of technical change defined by Solow (1957), and that the CRS technology would be appropriate for calculating Malmquist productivity as a measure of total factor productivity (Färe et al., 1997).

The afore-mentioned decomposition of MI by Färe et al. (1992, 1994) has received wide applications and stimulated further development in Malmquist index applications. For example, Ray and Desli (1997) discussed the role of reference technology in computing and interpreting productivity, and proposed an alternative decomposition of MI which uses VRS technology as reference technology. In other words, the MI here also equals the product of the technical change, pure efficiency

change and scale efficiency change, but the technical and scale change are shown to be the geometric mean of the ratios of VRS distance functions. In a similar vein, the technical change component from the initial decomposition has been further factored into the output biased technical change; input biased technical change; and magnitude of technical change (Färe, Grosskopf and Lee, 2001). Furthermore, the input based MI has been demonstrated to be equivalent to the quotient of two Fisher indices under CRS and profit maximization (Färe and Grosskopf, 1992).

In more recent literature, approaches to productivity measurement based on distance functions have been classified into two categories: (1) the partially oriented approach is based on ratios of output distance functions or ratios of input distance functions (Malmquist productivity index); and (2) the simultaneously oriented method uses a ratio of output distance functions contained in the output quantity index and a ratio of input distance functions contained in the input quantity index (Malmquist total factor productivity index). The most widely applied Malmquist Index developed by Caves et al. (1982) falls under the first category. The popularity of the Malmquist productivity index (Type 1) can be referred to its precedent development; relationship to the Törnqvist index and Fisher index; decomposition into various sources of productivity changes; and inclusion in available software packages (Lovell, 2003).

The author then evaluated the various decompositions of the two types of MI and proposed a decomposition of the Malmquist total factor productivity index into three components: technical efficiency change, technical change (evaluated in the second period) and scale economies (evaluated in the first period). In this decomposition, under certain conditions, the scale economies term is argued to measure activity effect and could be further split into scale, output mix and input mix effects. Major development in efficiency and productivity measurement relevant for this research is summarized in Table 4-6.

Table 4-6: Major developments in efficiency and productivity analysis in brief

Date	Development
1950s	Sherphard and Malmquist introduced the input distance functions.
1957	Solow developed a classical growth model and introduced the concept of technical progress or Solow residual. Farrell proposed the decomposition of economic efficiency into allocative and technical efficiency, and attempted to measure TE empirically. His work inspired extensive research on efficiency and productivity in the following decades.
1977	Aigner, Lovell and Schmidt, and Meeusen and van den Broecke independently developed the stochastic frontier model with composed error, which is the starting point of the stochastic frontier analysis
1978	Charnes, Cooper and Rhodes formally introduced DEA and developed the input-oriented CCR model (CRS model).
1980	Stevenson proposed a truncated normal distribution for inefficiency component in SFA
1982	Caves, Christensen, and Diewert developed a theoretical index currently known as Malmquist Index as the ratio of two input distance functions.
1984	Banker, Charnes and Cooper extended the CCR model to allow for variable returns to scale technology (BCC model) in DEA
1990	Greene introduced gamma distribution for inefficiency component in SFA
1992	Färe, Grosskopf, Lindgren and Roos proposed the decomposition of the MI introduced by Caves et al. (1982) into efficiency change and technical change components.
1994	Färe, Grosskopf, Norris, and Zhang further decomposed the efficiency change component into pure technical efficiency change and scale efficiency change components.
1995	Battese and Coelli introduced the one-stage estimation of the production frontier and the inefficiency effect model for panel data.

Source: Author compiled from various sources.

In nonparametric approach, the Malmquist Index, which has distance functions as key building blocks, is often calculated via DEA and included as a component in modern DEA software packages, for example DEA-Solver-PRO. In terms of applicability, the Malmquist Index has widely been used for productivity and TFP analysis in several sectors at both micro and macro levels. These include (micro-level) analysis in the farming sector (Umetsu et al., 2003; Odeck, 2007); pharmaceutical and health sector (Färe et al., 1992; Pilyavski and Staat, 2008); manufacturing industries (Färe et al., 1995, 2001; Nguyen, 2005; Nguyen and Giang, 2005); and banking and service industries (Alam, 2001; Chandran and Pandiyan, 2007) just to name some.

Among CLV, productivity analysis for Vietnam is more commonly available in literature, while such a quantitative study is still a rare case for Cambodia and Laos. For instance, studies on total factor productivity (TFP), technical change and technical efficiency in Vietnam's manufacturing industries can be found in Nguyen (2005), and Nguyen and Giang (2005). In this paper, a Malmquist index efficiency model is applied on the firm-level data of 2004-2005 to obtain the index of TFP growth and its

components for individual garment firms in Laos. To our knowledge, this attempt is the first in micro-level analysis of efficiency and productivity for this crucial industry in Lao economy.

Finally, it is worth noting that in most cases a within-industry comparison of empirical findings from this research with those from previous studies would be possible for Vietnam, whereas results for Cambodia and Laos would be compared to developing country cases due to lack of empirical studies.

4.4 THEORETICAL FRAMEWORK AND EMPIRICAL MODELS FOR EFFICIENCY STUDY

In view of the efficiency study, a two-stage DEA-regression and stochastic frontier analysis have been adopted to estimate firm efficiency and its determinants for garment factories in CLV. In the former approach, the efficiency score (technical, pure technical, scale efficiency) is obtained for individual garment enterprises via the data envelopment analysis. Then, the resulting efficiency score is used as dependent variable in a regression analysis to determine possible factors affecting firm's efficiency. In the latter, a stochastic frontier model is employed for the estimation of the production frontier and inefficiency effects. This section presents essential elements of the production theory, including production technology, distance functions and concepts of efficiency measurement, and the methodology of DEA and SFA applied in the empirical analysis.

4.4.1 Production Technology, Distance Functions and Efficiency Concepts

4.4.1.1 Representation of a Production Technology

The most common approach to represent a multi-input multi-output production technology in literature is the use of the technology set, $\boldsymbol{S}$, or equivalently the graph of production technology, GR. This approach shall also be adopted in this study. This

section describes relevant elements of the set theory, which are necessary for the presentation of the DEA models.

It is assumed that firms use a non-negative vector of inputs, denoted by $\boldsymbol{x} = (x_1, ..., x_m) \in R_+^m$, to produce a non-negative vector of outputs, denoted by $\boldsymbol{y} = (x_1, ..., x_s) \in R_+^s$, i.e. the elements of these vectors are non-negative real numbers.

a. Technology set or graph of production technology

Following Coelli et al. (2005) and Kumbhakar and Lovell (2003), the set S or the graph GR of production technology is defined (without time variable) as:

$$\boldsymbol{S} = \{(\boldsymbol{x}, \boldsymbol{y}) : \boldsymbol{x} \text{ can produce } \boldsymbol{y}\} \quad (4.1) \text{ or}$$

$$GR = \{(\boldsymbol{x}, \boldsymbol{y}) : \boldsymbol{x} \text{ can produce } \boldsymbol{y}\} \quad . \quad (4.2)$$

The technology set consists of all feasible input-output vectors, $(\boldsymbol{x}, \boldsymbol{y})$, such that $\boldsymbol{x}$ can produce $\boldsymbol{y}$. In other words, $\boldsymbol{S}$ models the transformation of inputs into outputs. Equivalently, the graph is bounded below by the $\boldsymbol{x}$ axis and bounded above by a curve starting from the origin. $\boldsymbol{S}$ *or* GR is assumed to satisfy the following seven properties:

(i): $(\boldsymbol{x}, \boldsymbol{0}) \in \boldsymbol{S}$ and $(\boldsymbol{0}, \boldsymbol{y}) \in \boldsymbol{S} \Rightarrow \boldsymbol{y} = \boldsymbol{0}$ (meaning any non-negative input can produce at least zero output).

(ii): $\boldsymbol{S}$ *or* GR is a closed set (implying the existence of technically efficient input and output vectors).

(iii): $\boldsymbol{S}$ *or* GR is bounded for each $x \in R_+^m$ (meaning that infinite input cannot produce infinite output).

(iv): $(\boldsymbol{x}, \boldsymbol{y}) \in S \Rightarrow (\lambda \boldsymbol{x}, \boldsymbol{y}) \in S$ for $\lambda \geq 1$ (weak monotonicity or weak disposability necessary for feasible radial expansions of inputs).

(v): $(\boldsymbol{x}, \boldsymbol{y}) \in \boldsymbol{S} \Rightarrow (\boldsymbol{x}, \lambda \boldsymbol{y}) \in \boldsymbol{S}$ for $\lambda \in [0,1]$ (weak monotonicity or weak disposability necessary for feasible radial contractions of outputs).

(vi): $(\boldsymbol{x}, \boldsymbol{y}) \in \boldsymbol{S} \Rightarrow (\boldsymbol{x}', \boldsymbol{y}') \in \boldsymbol{S} \quad \forall (-\boldsymbol{x}', \boldsymbol{y}') \leq (-\boldsymbol{x}, \boldsymbol{y})$ (strong monotonicity or strong/free disposability necessary for any increase in feasible inputs and any decrease in feasible outputs).

(vii): $\boldsymbol{S}$ *or* GR is a convex set.

An alternative way to describe the production technology is to use output and input sets for the representation.

b. Output sets

The output set of production technology, which describes the set of all output vectors, y , that can be produced using the input vector, x , is defined as

$$P(x) = \{y : (x, y) \in S\} = \{y : x \text{ can produce } y\} . \quad (4.3)$$

The output sets are inclusively assumed to possess the common necessary properties, such as being bounded for all inputs, closeness for all inputs, convexity in inputs, strong disposability of inputs and outputs. The output sets are also called production possibility curves or sets (PPC).

c. Input sets

The input set of production technology, which represents the set of all input vectors, x , that can produce a given output vector, y , is defined as

$$L(y) = \{x : (x, y) \in S\} = \{x : x \text{ can produce } y\} . \quad (4.4)$$

The input sets are inclusively assumed to possess the common necessary properties, such as closeness in outputs, convexity in outputs, weak and strong disposability of inputs.

4.4.1.2 Distance Functions

Distance functions introduced by Shephard (1970) are necessary for functional characterization of the structure of production technology, particularly for multiple-input and multiple-output cases without specifying a behavioral objective like profit-maximization. They are related to production frontiers and can describe the technology in a way that enables the measurement of efficiency and productivity in production. There are two types of distance functions: (1) output distance functions describe output sets and consider a maximal proportional expansion of the output vector, given an input

vector; and (ii) input distance functions describe input sets and consider a minimal proportional contraction of the input vector, given an output vector.

a. Output distance function

The output distance function can be defined on the output set, $\boldsymbol{P(x)}$, as:

$$D_O(\boldsymbol{x, y}) = \inf\{\eta : (\boldsymbol{x, y}/\eta) \in \boldsymbol{S}\} = \left(\sup\{\eta : (\boldsymbol{x}, \eta\boldsymbol{y}) \in \boldsymbol{S}\}\right)^{-1} \quad (4.5)$$

It is noted that the symbols *inf* (infimum) and *sup* (supremum) can also be replaced by the less precise symbols *min* (minimum) and *max* (maximum), respectively. An output distance function gives the minimum amount by which outputs can be deflated and still remain feasible with a given set of inputs, i.e. it measures the maximal proportional change in output required to make $(\boldsymbol{x, y})$ feasible for the respective technology. Following Coelli et al. (2005), the following properties can be given:

(i): $D_O(\boldsymbol{x,0}) = 0$ for all non-negative inputs $\boldsymbol{x}$;

(ii): $D_O(\boldsymbol{x, y})$ is non-decreasing in $\boldsymbol{y}$ and non-increasing in $\boldsymbol{x}$;

(iii): $D_O(\boldsymbol{x, y})$ is linearly homogeneous in $\boldsymbol{y}$;

(iv): $D_O(\boldsymbol{x, y})$ is quasi-convex in $\boldsymbol{x}$ and convex in $\boldsymbol{y}$;

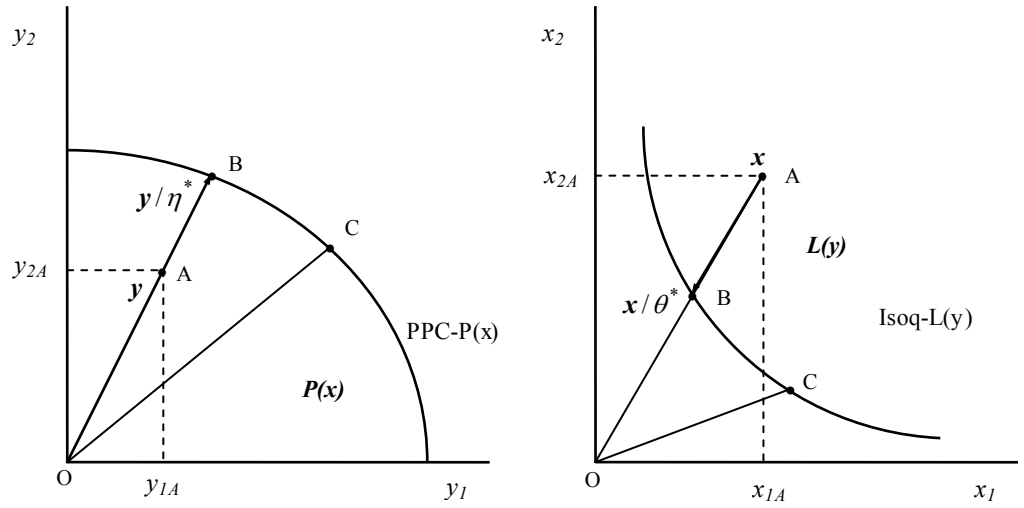
(v): if $\boldsymbol{y}$ belongs to the production possibility set ($\boldsymbol{y} \in \boldsymbol{P(x)}$) of $\boldsymbol{x}$, then $D_O(\boldsymbol{x, y}) \leq 1$; and

(vi): if $\boldsymbol{y}$ belongs to the frontier of the PPC of $\boldsymbol{x}$, then $D_O(\boldsymbol{x, y}) = 1$, i.e. production is technically efficient.

Panel *(a)* of Figure 4-5 illustrates a production possibility frontier (PPC) and the associated output set for a two-output technology. The production possibility set, $\boldsymbol{P(x)}$, is bounded by the PPC, y_1 and y_2 axes. There are three firms shown in the figure, denoted by A, B and C. Firm A is located below the PPC and technically inefficient, whereas firm B and C are technically efficient and located on the frontier. For example, firm A uses inputs (input vector) $\boldsymbol{x}$ to produce outputs (output vector) $\boldsymbol{y}(y_{1A}, y_{2A})$. The value of the associated output distance function is the ratio $\eta = OA/OB$. An improvement in technical efficiency implies that, holding inputs

unchanged, outputs can be increased to point B and still remain feasible. In this case, the radially expanded output vector would be $\boldsymbol{y}/\eta^*$ and the associated distance function would be $D_O(\boldsymbol{x},\boldsymbol{y}) = \eta^* < 1$.

Figure 4-5: The output and input distance functions



(a) Output distance function and PPC *(b)* Input distance function and Isoquant

Source: Adapted from Coelli et al. (2005, p. 48, 50)

b. Input distance function

The input distance function can be defined on the input set, $\boldsymbol{L(y)}$, as:

$$D_I(\boldsymbol{x},\boldsymbol{y}) = \sup\{\theta : (\boldsymbol{x}/\theta, \boldsymbol{y}) \in \boldsymbol{S}\} \qquad (4.6)$$

An input distance function gives them minimum amount by which inputs can be radially contracted and still remain feasible for associated outputs, i.e. it measures the distance from a firm to the boundary of the PPC by adopting an input-conserving approach. Also, following Coelli et al. (2005), the following properties can be given:

(i): $D_I(\boldsymbol{x},\boldsymbol{y})$ is non-decreasing in $\boldsymbol{x}$ and non-increasing in $\boldsymbol{y}$;

(ii): $D_I(\boldsymbol{x},\boldsymbol{y})$ is linearly homogeneous in $\boldsymbol{x}$;

(iii): $D_I(\boldsymbol{x},\boldsymbol{y})$ is concave in $\boldsymbol{x}$ and quasi-concave in $\boldsymbol{y}$;

(iv): if $\boldsymbol{x}$ belongs to the input set of $\boldsymbol{y}$ ($\boldsymbol{x} \in \boldsymbol{L(y)}$) of $\boldsymbol{x}$, then $D_I(\boldsymbol{x},\boldsymbol{y}) \geq 1$; and

(v): if $\boldsymbol{x}$ belongs to the frontier of the input set (the isoquant of $\boldsymbol{y}$), then $D_I(\boldsymbol{x},\boldsymbol{y}) = 1$, i.e. production is technically efficient.

Analogous to the output case, an Isoquant and the associated input set for a two-input technology are depicted in Panel *(b)* of Figure 4-5. The input set, $\boldsymbol{L(y)}$, is the area above the Isoquant. The inefficient firm (denoted A) is located above the Isoquant and the two efficient firms (denoted B and C) are on the curve. For the inefficient firm at point A, which uses inputs (input vector) $\boldsymbol{x}(x_{1A}, x_{2A})$ to produce outputs (output vector) $\boldsymbol{y}$, the associated input distance function has a value of $\theta = OA/OB$. In this case, efficiency enhancement implies that, holding outputs unchanged, inputs can be reduced to point B and still remain feasible. The radially contracted input vector would be $\boldsymbol{x}/\theta^*$ and the associated distance function would be $D_I(\boldsymbol{x}, \boldsymbol{y}) = \theta^* > 1$.

In addition, the following three relationships between the input and output distance functions are relevant for the discussions on efficiency and productivity in this study, and deserve some explanation (for details, see Coelli et al., 2005, p. 50).

1. If the output vector $\boldsymbol{y}$ belongs to the output set $\boldsymbol{P(x)}$ associated with the input vector $\boldsymbol{x}$, then $\boldsymbol{x}$ belongs to the feasible input set $\boldsymbol{L(y)}$ associated with the output vector $\boldsymbol{y}$. That means, if $\boldsymbol{y} \in \boldsymbol{P(x)}$, then $\boldsymbol{x} \in \boldsymbol{L(y)}$.
2. If both inputs and outputs are weakly disposable, it can be stated that $D_I(\boldsymbol{x}, \boldsymbol{y}) \geq 1$ if and only if $D_O(\boldsymbol{x}, \boldsymbol{y}) \leq 1$.
3. If the production technology has global constant returns to scale characteristics, it is possible and sufficient to state that the input and output distance functions are reciprocal to each other for any input-output combinations. That is, $D_I(\boldsymbol{x}, \boldsymbol{y}) = 1/D_O(\boldsymbol{x}, \boldsymbol{y})$, for any $(\boldsymbol{x}, \boldsymbol{y})$.

4.4.1.3 Concepts of Efficiency Measurement

As previously mentioned, technical efficiency in production reflects the ability of a firm to obtain maximal outputs from a given set of inputs (output-orientation), or the ability to minimize inputs given an output vector (input-orientation). The definition of *technical efficiency* (TE) was first proposed by Debreu and Farrell and is often referred to as Debreu-Farrell measure of technical efficiency. Following the majority of

empirical work, this study adopts radial measures of technical efficiency using Isoquants as standards owing to their nice properties, particularly units-invariance.

a. Output-oriented efficiency measure

The output-oriented measure of technical efficiency addresses the first part of the above sentence, i.e. by how much can a firm proportionally increase output quantities without altering input quantities. Following Kumbhakar and Lovell (2003), output-oriented technical efficiency can be defined as:

An output vector $\boldsymbol{y} \in \boldsymbol{P(x)}$ is *technically efficient*, if and only if, $\boldsymbol{y}' \notin \boldsymbol{P(x)}$ for $\boldsymbol{y}' \geq \boldsymbol{y}$ or equivalently $\boldsymbol{y} \in \text{Eff}\, \boldsymbol{P(x)}$, or in functional form $TE_O\boldsymbol{(x,y)} = \max\{\eta : \eta \boldsymbol{y} \in P\boldsymbol{(x)}\}$.

This definition considers a feasible output vector technically efficient if, and only if, no expansion in any output is feasible, given that the input vector is held fixed. $TE_O\boldsymbol{(x,y)}$ is required to satisfy the following properties:

(i): $TE_O\boldsymbol{(x,y)} \leq 1$ (normalization property, i.e. $TE_O\boldsymbol{(x,y)}$ is bounded above by unity);

(ii): $TE_O\boldsymbol{(x,y)} = 1 \Leftrightarrow \boldsymbol{y} \in \text{Isoq}\, \boldsymbol{P(x)}$;

(iii): $TE_O\boldsymbol{(x,y)}$ is non-decreasing in $\boldsymbol{y}$ ($TE_O\boldsymbol{(x,y)}$ does not decline when production of any output increases);

(iv): $TE_O\boldsymbol{(x,y)}$ is homogenous of degree +1 in $\boldsymbol{y}$ (a proportional change in all outputs and the resulting change in $TE_O\boldsymbol{(x,y)}$ go in the same direction); and

(v): $TE_O\boldsymbol{(x,y)}$ is invariant in terms of the measurement units of $\boldsymbol{x}$ and $\boldsymbol{y}$ (measurement units of inputs and outputs do not have any impact on efficiency scores).

A graphical illustration of the output-oriented measure is presented in Panel *(a)* of Figure 4-6 for one input (x_1) -two output (y_1, y_2) production technology under the assumption of CRS (necessary for representing the technology using unit PPC). The curve ZZ' is the unit PPC (frontier), point A represents an inefficient firm located below the frontier, and point B and B' correspond to efficient firms on the frontier. The Farrell's output-oriented technical efficiency measure for firm A can be measured as:

$$TE_O = D_O\boldsymbol{(x,y)} = \eta = OA/OB \qquad (4.7)$$

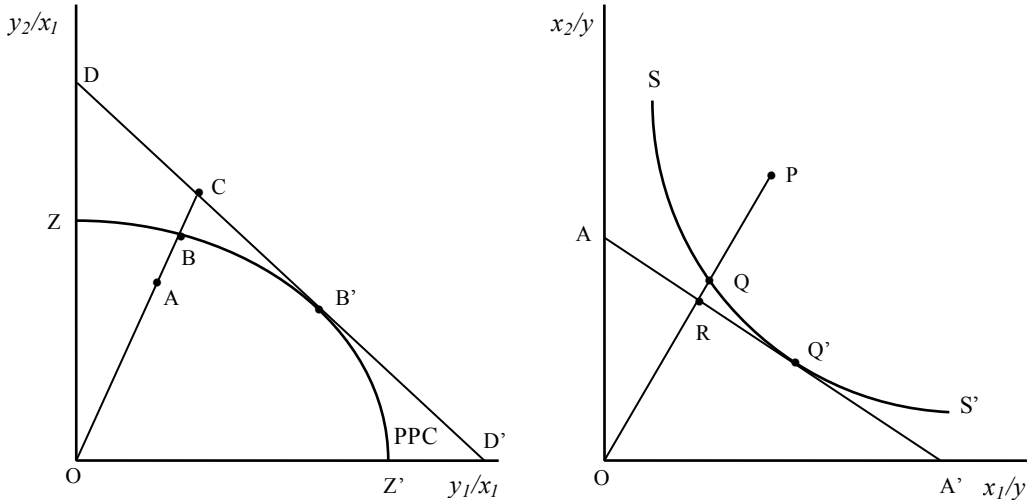
where $D_O(x, y)$ is the output distance function of the observed input-output vector (x, y), and η the associated value of the distance function.

Moreover, the line DD' represents observed output prices (output price vector) and is called the Iso-revenue line. Given information on output prices, further output-oriented efficiency measures, i.e. allocative efficiency (AE_O) and revenue efficiency (RE_O), can be defined as (see Coelli et al., 2005, pp. 54-57):

$$AE_O = OB / OC \tag{4.8}$$

$$RE_O = OA / OC = (OA / OB) \times (OB / OC) = TE_I \times AE_I \tag{4.9}$$

Figure 4-6: Output and input oriented efficiency measures



(a) Output oriented technical efficiency *(b)* Input oriented technical efficiency

Source: Adapted from Coelli et al. (2005, p. 52, 55)

a. Input-oriented efficiency measure

Analogously, the input-oriented measure of technical efficiency addresses the second part of the foregoing sentence, i.e. by how much can a firm proportionally reduce input quantities without altering output quantities. In fact, this input-oriented concept refers to the original ideas of Farrell. Also, following Kumbhakar and Lovell (2003), input-oriented technical efficiency can be defined as:

An input vector $\boldsymbol{x} \in \boldsymbol{L(y)}$ is *technically efficient*, if and only if, $\boldsymbol{x}' \notin \boldsymbol{L(y)}$ for $\boldsymbol{x}' \leq \boldsymbol{x}$ or equivalently $\boldsymbol{x} \in \text{Eff } \boldsymbol{L(y)}$, or in functional form $TE_I\boldsymbol{(x,y)} = \min\{\theta : \theta\boldsymbol{x} \in \boldsymbol{L(y)}\}$.

This definition considers a feasible input vector technically efficient if, and only if, no contraction in any input is feasible, given that the output vector is held fixed. $TE_I\boldsymbol{(x,y)}$ is required to satisfy the following properties:

(i): $TE_I\boldsymbol{(x,y)} \leq 1$ (normalization property, i.e. $TE_I\boldsymbol{(x,y)}$ is bounded above by unity);

(ii): $TE_I\boldsymbol{(x,y)} = 1 \Leftrightarrow \boldsymbol{x} \in \text{Isoq } \boldsymbol{L(y)}$;

(iii): $TE_I\boldsymbol{(x,y)}$ is non-increasing in $\boldsymbol{x}$ ($TE_I\boldsymbol{(x,y)}$ does not expand when usage of any input increases);

(iv): $TE_I\boldsymbol{(x,y)}$ is homogenous of degree -1 in $\boldsymbol{x}$ (a proportional change in all inputs and the resulting change in $TE_I\boldsymbol{(x,y)}$ go in the opposite directions); and

(v): $TE_I\boldsymbol{(x,y)}$ is invariant in terms of the measurement units of $\boldsymbol{x}$ and $\boldsymbol{y}$ (measurement units of inputs and outputs do not have any impact on efficiency scores).

Panel *(b)* of Figure 4-6 depicts a unit Isoquant for two input (x_1, x_2) -one output (y) production technology under the assumption of CRS (necessary for representing the technology using unit Isoquant). The unit Isoquant (denoted SS') represents fully efficient firms (denoted Q and Q'), while the point P represents an inefficient firm located above the Isoquant. The Farrell's input-oriented technical efficiency measure for firm A is given as:

$$TE_I = 1/D_I\boldsymbol{(x,y)} = \theta = OQ/OP = 1 - QP/OP \qquad (4.10)$$

where $D_I\mathbf{(x,y)}$ denotes the output distance function of the observed input-output vector $\boldsymbol{(x,y)}$, and θ the associated value of the distance function. The ratio OQ/OP represents the proportion of inputs to be reduced in order to achieve technical efficiency in production. The value of TE_I lies between zero and the unity.

Similarly, the line AA' is called the Iso-cost line and its slope represents the ratio of input prices (input price vector). Given information on input prices, further

input-oriented efficiency measures, i.e. allocative efficiency (AE_I) and cost efficiency (CE_I), and can be defined as (see Coelli et al., 2005, pp. 52-54):

$$AE_I = OR / OQ \tag{4.11}$$

$$CE_I = OR / OP = (OQ / OP) \times (OR / OQ) = TE_I \times AE_I \tag{4.12}$$

Finally, it is important to note that the input- and output-oriented measures of technical efficiency after Farrell (1957) are equivalent to the input and output distance functions developed by Shephard (1970). This equality is very important for the calculation of Malmquist indices of TFP growth in DEA applications.

4.4.2 Concept of Data Envelopment Analysis and DEA Models

In DEA efficiency is defined as the ratio of (virtual) output to (virtual) input. DEA involves the use of the distance functions and the linear programming to maximize this ratio. In practice, there are several models and software developed for DEA applications, but for the purpose of this study the output-oriented CCR-O and BCC-O models are employed. In favor of the simplicity, the presentation of the models in this section adopts the approach and the notations applied in Cooper et al. (2007) and Färe et al. (1994).

For each DMU, the *virtual* input and *virtual* output can be formed by unknown input weights (v_i) (i=1,2,...,m) and output weights (u_r) (r=1,2,...,s) as follows:

$$\text{Virtual input} = v_1 x_1 + v_2 x_2 + \ldots + v_m x_m \tag{4.13}$$

$$\text{Virtual output} = u_1 y_1 + u_2 y_2 + \ldots + u_s y_s \tag{4.14}$$

Applying linear programming, the methodology of DEA is to determine the weights by applying in order to maximize the ratio $\frac{virtual\ \ Input}{virtual\ \ Ouput}$.

4.4.2.1 The CCR Model

The CCR model or constant returns to scale model (CRS model), the most widely applied, operates on the assumption of CRS. The input-oriented version of this model (CCR-I model) was first introduced by Charnes et al. (1978). This model seeks to decrease inputs to the minimum possible level, while keeping the outputs at the observed level. On the other hand, the output-oriented model attempts to increase outputs to the maximum potential level, while keeping inputs at the observed level.

a. Fractional programming form (*CCR-FP$_o$*)

Given a set of data with n samples (for example, one-input one-output: (x,y)), the linear programming involves n optimizations for n observations (DMUs). The ordinary fractional programming problem (*CCR-FP$_o$*) can be expressed as follows:

$$(CCR\text{-}FP_o) \qquad \max_{\boldsymbol{v,u}} \quad \theta = \frac{u_1 y_{1o} + u_2 y_{2o} + \ldots + u_s y_{so}}{v_1 x_{1o} + v_2 x_{2o} + \ldots + v_m x_{mo}} = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}} \tag{4.15}$$

$$\text{Subject to} \qquad \frac{u_1 y_{1j} + u_2 y_{2j} + \ldots + u_s y_{sj}}{v_1 x_{1j} + v_2 x_{2j} + \ldots + v_m x_{mj}} = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1; \ (j = 1,2,\ldots,n) \tag{4.16}$$

$$v_1, v_2, \ldots, v_m \ge 0 \tag{4.17}$$

$$u_1, u_2, \ldots, u_s \ge 0 \tag{4.18}$$

where the index o denotes the DMU_j to be evaluated at any trial ($o=1,2,\ldots,n$), $x_{ij}, y_{rj} > 0$ are the known inputs and outputs of the *j-th* DMU, and $u_r, v_i \ge 0$ the variable (input and output) weights to be obtained by the solution of this problem.

The objective of the fractional programming problem is to determine the optimal value for the input weights (v_i) ($i=1,2,\ldots,m$) and the output weights (u_r) ($r=1,2,\ldots,s$) that maximizes the ratio of DMU_o, subject to the condition that similar ratios of virtual output to virtual input be less than or equal to unity for every DMU. Owing to the constraints, the optimal objective value θ^* is at most one (unity).

The efficiency of one DMU (member) is to be rated relative to a reference set consisting of certain DMUs. Given the observations on inputs and outputs for individual DMUs, one can at least obtain *relative efficiency*. The choice of the weights is determined directly from the observed data, subject merely to the constraints in *CCR-FP*$_o$. In other words, the above weightings are objectively determined, so as to attain a scalar measure of efficiency, θ, and no other set of common weights would yield a more favorable rating relative to the reference set. Therefore, if relative efficiency rating of 100% is not achievable under this set of weights, then it will not be achievable from any other set (Charnes et al., 1978, p. 431).

b. Linear programming form (*CCR-LP*$_o$)

In order to make the fractional programming formulation computationally tractable for a large sample size (n) and small numbers of inputs (m) and outputs (s), a procedure has been developed to replace the fractional programming problem with a linear programming problem (Charnes et al., 1978). Hence, the above *CCR-FP*$_o$ can be replaced by the following linear programming problem (*CCR-LP*$_o$).

$$(CCR\text{-}LP_o) \qquad \max_{\boldsymbol{\mu},\boldsymbol{v}} \quad \theta = \mu_1 y_{1o} + \mu_2 y_{2o} + ... + \mu_s y_{so} \tag{4.19}$$

$$\text{Subject to} \qquad \boldsymbol{v}\boldsymbol{x}_o = 1 \tag{4.20}$$

$$\sum_{r=1}^{s} \mu_r y_{rj} \le \sum_{i=1}^{m} v_i x_{ij} \; ; \; (j = 1,2,...,n) \tag{4.21}$$

$$v_1, v_2, ..., v_m \ge 0 \tag{4.22}$$

$$\mu_1, \mu_2, ..., \mu_s \ge 0 \tag{4.23}$$

where $\mu_r \ge 0$ denotes the output weights and other variables are defined as in the above *CCR-FP*$_o$.

Using the matrix of inputs and outputs (***X,Y***) and the row vector ***v*** for input multipliers and ***u*** for output multipliers, the above *CCR-LP*$_o$ can be written in the *(matrix)* multiplier form:

$$(CCR\text{-}LP_o) \quad \max_{\boldsymbol{v},\boldsymbol{u}} \ \boldsymbol{u}\boldsymbol{y}_o \tag{4.24}$$

$$\text{Subject to} \quad \boldsymbol{v}\boldsymbol{x}_o = 1 \tag{4.25}$$

$$-\boldsymbol{v}\boldsymbol{X} + \boldsymbol{u}\boldsymbol{Y} \le \boldsymbol{0} \ ; \ (j = 1,2,...,n) \tag{4.26}$$

$$\boldsymbol{u} \ge \boldsymbol{0}, \boldsymbol{v} \ge \boldsymbol{0} \tag{4.27}$$

where, the index o denotes the DMU_j to be evaluated, $\boldsymbol{v}$ and $\boldsymbol{u}$ are input and output multipliers to be determined by the solution of the *CCR-LP*$_o$. These multipliers are now treated as variables in this linear program problem.

c. Envelopment form (*CCR-I*$_o$)

As the dual problem of the linear program (*CCR-LP*$_o$), the above input-oriented CCR-I model can also be expressed in *(matrix)* envelopment form[31]:

$$(CCR\text{-}I_o) \quad \min_{\theta,\boldsymbol{\lambda}} \ \theta \tag{4.28}$$

$$\text{Subject to} \quad \theta\boldsymbol{x}_o - \boldsymbol{X}\boldsymbol{\lambda} \ge \boldsymbol{0} \tag{4.29}$$

$$\boldsymbol{Y}\boldsymbol{\lambda} \ge \boldsymbol{y}_o \tag{4.30}$$

$$\boldsymbol{\lambda} \ge \boldsymbol{0} \tag{4.31}$$

where θ is a real variable, and $\boldsymbol{\lambda}$ denotes a transpose of a non-negative vector $\boldsymbol{\lambda} = (\lambda_1,...,\lambda_n)^T$ of variables.

(*CCR-I*$_o$) has a feasible solution $\theta = 1, \lambda_o = 1, \lambda_j = 0 (j \ne o)$. Thus, the optimal solution (denoted by θ^*) cannot be greater than unity. Derived from the semi-positive assumption (nonzero) of the data and the constraint (4.30) $\boldsymbol{\lambda}$ must be different from zero because $\boldsymbol{y}_o \ge 0$ and $\boldsymbol{y}_o \ne o$. Applying this result to the constraint (4.29), θ must be greater than zero. Together, all these conditions result in an optimal solution $0 < \theta^* \le 1$.

Further, the input excesses $s^- \in R^m$ and output shortfalls $s^+ \in R^m$, which are identified as *slacks*, can be defined as follows:

$$\boldsymbol{s}^- = \theta\boldsymbol{x}_o - \boldsymbol{X}\boldsymbol{\lambda}, \ \boldsymbol{s}^+ = \boldsymbol{Y}\boldsymbol{\lambda} - \boldsymbol{y}_o, \tag{4.32}$$

where $\boldsymbol{s}^- \ge \boldsymbol{0}, \boldsymbol{s}^+ \ge \boldsymbol{0}$ for any feasible solution $(\theta, \boldsymbol{\lambda})$ of (*CCR-I*$_o$) illustrated above.

[31] Correspondences between the constraints and variables of the Primal (*CCR-LP*$_o$) and the Dual (*CCR-I*$_o$) are available in Cooper et al. (2007), p. 44, Table 3.1.

The model solves the linear programming in two phases: (i) the objective function (4.28) is minimized and the resulting optimal objective value θ^* is the CCR-efficiency (also called Farrell Efficiency, Technical Efficiency); and (ii) in order to find the slacks, the sum of input excesses and output shortfalls is maximized while holding $\theta = \theta^*$. Hence an optimal solution can be expressed by $(\theta^*, \boldsymbol{\lambda}^*, \boldsymbol{s}^{-*}, \boldsymbol{s}^{+*})$, with θ^* being the technical efficiency score of each DMU (see Cooper et al., 2007, pp. 44-46).

d. Output-oriented CCR-O model

The corresponding output-oriented CCR-O model is written in *(matrix)* envelopment form as follows:

$$(CCR\text{-}O_o) \qquad \max_{\eta, \boldsymbol{\mu}} \quad \eta \tag{4.33}$$

$$\text{Subject to} \qquad \boldsymbol{x}_o - \boldsymbol{X}\boldsymbol{\mu} \geq \boldsymbol{0} \tag{4.34}$$

$$\eta \boldsymbol{y}_o - \boldsymbol{Y}\boldsymbol{\mu} \leq \boldsymbol{0} \tag{4.35}$$

$$\boldsymbol{\mu} \geq \boldsymbol{0} \tag{4.36}$$

where, analogously, η is a real variable, and $\boldsymbol{\mu}$ denotes a transpose of a non-negative vector $\boldsymbol{\mu} = (\mu_1, ..., \mu_n)^T$ of variables.

The optimal solution of the CCR-O model relates to that of CCR-I model in the following manner. If we define $\theta = 1/\eta$ and $\boldsymbol{\lambda} = \boldsymbol{\mu}/\eta$, the CCR-O model would turn to a CCR-I model as described in equation (4.28) to (4.31). Therefore, the optimal solution of the output-oriented CCR-O model corresponds to that of the input-oriented CCR-I via $\eta^* = 1/\theta^*$ and $\boldsymbol{\mu}^* = \boldsymbol{\lambda}^*/\theta^*$. Hence, $\theta^* \leq 1$ implies $\eta^* \geq 1$. The lower the value of θ^* (input reduction rate) or the higher the value of η^* (output enlargement rate), the less efficient is the DMU.

The slacks $(\boldsymbol{t}^-, \boldsymbol{t}^+)$ of the CCR-O model are defined as:

$$\boldsymbol{t}^- = \boldsymbol{x_o} - \boldsymbol{X}\boldsymbol{\mu}\ ,\ \boldsymbol{t}^+ = \boldsymbol{Y}\boldsymbol{\mu} - \eta \boldsymbol{y}_o \tag{4.37}$$

They are related to the CCR-I model in the following manner:

$$\boldsymbol{t}^{-*} = \boldsymbol{s}^{-*}/\theta^*\ ,\ \boldsymbol{t}^{+*} = \boldsymbol{s}^{+*}/\theta^* \tag{4.38}$$

A DMU with a technical efficiency score of unity ($\theta^*, \eta^* = 1$) and zero slacks (no input excesses and output shortfalls) is identified as technically efficient (CCR-efficient or Farrell-efficient).

4.4.2.2 The BCC Model

By extending the CCR model, the BCC model developed in Banker et al. (1984) allows for variable returns to scale (VRS) including decreasing, constant and increasing returns to scale (DRS, CRS, IRS). This model applies a convex production possibility set P_B, which is defined as:

$$P_B = \{(\boldsymbol{x},\boldsymbol{y}) \mid \boldsymbol{x} \geq \boldsymbol{X\lambda}, \boldsymbol{y} \geq \boldsymbol{Y\lambda}, \boldsymbol{e\lambda} = 1, \boldsymbol{\lambda} \geq \boldsymbol{0}\} \tag{4.39}$$

where $\boldsymbol{X} = (\boldsymbol{x}_j) \in R^{m \times n}$ and $\boldsymbol{Y} = (\boldsymbol{y}_j) \in R^{s \times n}$ are observed data, $\boldsymbol{\lambda} \in R^n$ and $\boldsymbol{e}$ are a row vector with all elements equal to one.

a. Input-oriented BCC model

The linear program of an input-oriented BCC model is defined in *(matrix)* envelopment form as follows:

(*BCC-I*$_o$)	$\min_{\theta_B, \boldsymbol{\lambda}} \quad \theta_B$	(4.40)
Subject to	$\boldsymbol{\theta_B x_o} - \boldsymbol{X\lambda} \geq \boldsymbol{0}$	(4.41)
	$\boldsymbol{Y\lambda} \geq \boldsymbol{y}_o$	(4.42)
	$\boldsymbol{e\lambda} = 1$	(4.43)
	$\boldsymbol{\lambda} \geq \boldsymbol{0}$	(4.44)

where the measure θ_B is a scalar, $\boldsymbol{\lambda}$ a column vector with non-negative elements, $\boldsymbol{e}$ a row vector of ones, and all other variables are defined as in the CCR model. The constraint (4.43) implies a convexity condition for possible combinations of DMUs.

Similar to the CCR model, the BCC model minimizes the objective function (4.40) to obtain an optimal solution θ_B^* in Phase I and maximizes the sum of input excesses and output shortfalls while keeping $\theta_B = \theta_B^*$ in Phase II. Here, an optimal solution, denoted by $(\boldsymbol{\theta_B^*}, \boldsymbol{\lambda^*}, \boldsymbol{s^{-*}}, \boldsymbol{s^{+*}})$, gives a pure technical efficiency (PTE) score for a

DMU, and any DMU with PTE score of unity and zero slacks is considered purely technically efficient (BCC-efficient).

b. Output-oriented BCC model

The output-oriented BCC-O model evaluates the efficiency of DMU_o ($o=1,2,...,n$) by solving the following linear program in *(matrix)* envelopment form:

$$(BCC\text{-}O_o) \quad \max_{\eta_B,\boldsymbol{\lambda}} \ \eta_B \tag{4.45}$$

Subject to

$$\boldsymbol{X\lambda} \le \boldsymbol{x_o} \tag{4.46}$$

$$\eta_B \boldsymbol{y_o} - \boldsymbol{Y\lambda} \le \boldsymbol{0} \tag{4.47}$$

$$\boldsymbol{e\lambda} = 1 \tag{4.48}$$

$$\boldsymbol{\lambda} \ge \boldsymbol{0} \tag{4.49}$$

where, similarly, the measure η_B is a scalar, $\boldsymbol{\lambda}$ a column vector with non-negative elements, $\boldsymbol{e}=(1,...1)$ a row vector of ones, and all other variables are defined as in the CCR model.

c. BCC linear and fractional program

The corresponding dual multiplier form ($BCC\text{-}LP_o$) of the output-oriented BCC model ($BCC\text{-}O_o$) is described as follows:

$$(BCC\text{-}LP_o) \quad \min_{\boldsymbol{v},\boldsymbol{u},v_0} \ z = \boldsymbol{vx}_o - v_0 \tag{4.50}$$

Subject to

$$\boldsymbol{uy}_o = 1 \tag{4.51}$$

$$\boldsymbol{vX} - \boldsymbol{uY} - v_0\boldsymbol{e} \ge \boldsymbol{0} \tag{4.52}$$

$$\boldsymbol{v} \ge \boldsymbol{0}, \boldsymbol{u} \ge \boldsymbol{0}, v_0 \text{ free in sign} \tag{4.53}$$

Also, the equivalent BCC fractional program ($BCC\text{-}FP_o$) can be obtained from the dual program as:

$$(BCC\text{-}FP_o) \quad \min \ \frac{\boldsymbol{vx}_o - v_0}{\boldsymbol{uy}_o} \tag{4.54}$$

Subject to

$$\frac{\boldsymbol{vx}_j - v_0}{\boldsymbol{uy}_j} \ge 1, \ (j = 1,2,...,n) \tag{4.55}$$

$$\boldsymbol{v} \ge \boldsymbol{0}, \boldsymbol{u} \ge \boldsymbol{0}, v_0 \text{ free in sign} \tag{4.56}$$

It is apparent that the difference between the CCR and BCC models is the free variable v_0 in ($BCC\text{-}FP_o$), which is the dual variable $\boldsymbol{e\lambda}=1$ in the constraint (4.48) of

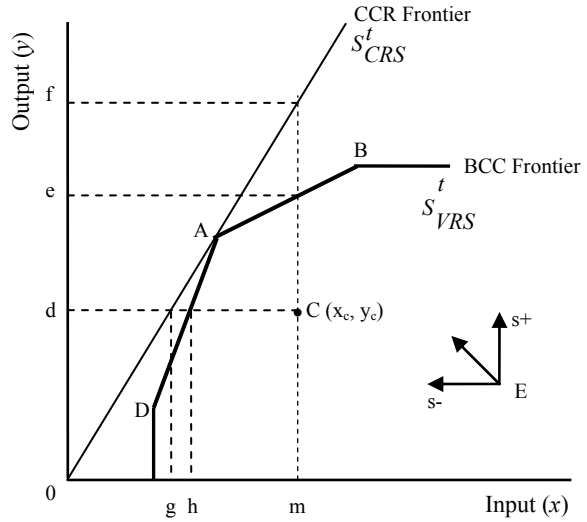
(*BCC-O*$_o$). This variable is absent in the CCR model. All other variables are defined as in the CCR model and input-oriented BCC-I model discussed above.

Similar to CCR-efficiency, any DMUs with pure technical efficiency score of unity $\eta_B^* = 1$ and zero slacks are considered purely technically efficient (BCC-efficient).

4.4.2.3 Decomposition of Technical Efficiency

Generally, the efficiency performance of a DMU might be influenced by its inefficient operation or by certain disadvantageous conditions, such as its operation scale. The CCR model estimates the TE index under the CRS production possibility set, which implies that the radial expansion and reduction of all observed DMUs and their nonnegative combinations are possible. Hence, the TE index or CCR score is denoted *global technical efficiency*. On the other hand, in the BCC model the production possibility set is assumed to be formed by convex combinations of the observed DMUs. Thus, the PTE index estimated by a BCC model is called *local pure technical efficiency*.

Figure 4-7: Frontiers of the CCR and BCC models



Source: Adapted from Färe et al. (1994, p. 74) and Cooper et al. (2007, p. 90)

If a DMU is fully efficient in both TE and PTE indices ($TE = 1$ and $PTE = 1$), it is said to operate at the *most productive scale size*. If a DMU achieves full PTE but has

a lower TE ($PTE = 1 \text{ but } TE < 1$) it is said to operate locally efficiently but not globally efficiently due to its scale size. The TE score obtained from the CCR model does not exceed the PTE score from the BCC model. The relationship between the two models is illustrated by using a single-input single-output case (Figure 4-7). The DMUs are denoted by *A, B, C, D* and *E*. The frontier of the CCR model is presented by a thin line with vertex at 0 and that of the BCC model by a thick line.

Observing an inefficient DMU, for example $C(x_C, y_C)$, it is apparent that the TE score ($TE_I = og/om$ and $TE_O = od/of$) [32] is less than the PTE score ($PTE_I = oh/om$ and $PTE_O = od/oe$). *A*, *B* and *D* are located on the BCC-frontier and thus purely technically efficient, but *B* and *D* are not technically efficient. On the other hand, *A* is located at the tangent point of the two frontiers and is both purely technically efficient and technically efficient (technical efficiency implies pure technical efficiency). If more cases of returns to scale, such as the increasing and decreasing returns to scale (IRS, DRS) and the generalized returns to scale (GRS), are considered, the relationship $\theta^*_{CCR} \le \theta^*_{IRS}, \theta^*_{DRS}, \theta^*_{GRS} \le \theta^*_{BCC}$ would prevail. Further, the input and output orientation is represented by the arrows at *E*. A horizontal movement is the input orientation (input reduction/minimization), whereas a movement in the vertical direction implies the output orientation (output expansion/maximization).

Derived from the relationship between the two models, technical efficiency can be decomposed into pure technical efficiency (PTE) and scale efficiency (SE). The scale efficiency is defined as follows:

$$SE = \frac{\theta^*_{CCR}}{\theta^*_{BCC}} = \frac{TE}{PTE}, \text{ i.e. } SE_I = og/oh \text{ or } SE_O = oe/of \qquad (4.57)$$

[32] The evaluation of TE_O and TE_I yields the same results. Hence, the CCR-I and CCR-O models give identical technical efficiency score for each DMU under question.

where θ^*_{CCR} or *TE* denotes the *(global) technical efficiency* from the CCR model, and θ^*_{BCC} or *PTE* denotes the *(local) pure technical efficiency* from the BCC model. For more details on the derivation of the models in this section see Cooper et al. (2006, pp. 21-150). In this study DEA models are applied with one output (revenue) and three inputs for Cambodia and Vietnam, and two inputs for the case of Laos. The scores of technical efficiency and pure technical efficiency are obtained from the package DEA-Solver-PRO6.

4.4.3 DEA-Regression Analysis

The second stage of the DEA-regression analysis is to assess possible determinants of the efficiency of the garment enterprises. Similar to the case of stochastic frontier estimation, the efficiency index is assumed to be a function of certain explanatory variables in additive form (Coelli et al., 2005). To this end, the resulting efficiency scores from the DEA models are employed as explained (dependent) variable in a regression model as follow:

$$EFF_i = \alpha_0 + \sum_{j=1}^{q} \alpha_j z_{ij} + \varepsilon_i, \tag{4.58}$$

where the dependent variable *EFF* is the individual efficiency score obtained from DEA (TE, PTE and SE score), α_0 is the constant, $z_{ij}\,(j = 1,2,...,q)$ is a vector of explanatory variables, which are expected to influence on efficiency of the firm and α_j is a vector of unknown coefficients to be estimated. ε is the error term and the index *i* denotes the *i-th* firm. Derived from equation (4.58), the empirical model for determinants of firm efficiency is specified for the individual countries below.

Cambodia:

$$\begin{aligned} EFF_i = {} & \alpha_0 + \alpha_1 AGE_i + \alpha_2 LnCAPIN_i + \alpha_3 FL\_SHARE_i \\ & + \alpha_4 LnPWWAGE_i + \alpha_5 PVAR_i + \alpha_6 DPNH_i \\ & + \alpha_7 DACHN_i + \alpha_8 DKOR_i + \alpha_9 DOTHERS_i + \varepsilon_i \end{aligned} \tag{4.59}$$

Where the variables are specified as follows:

(i) continuous variables:

- *EFF* is the efficiency score (TE, PTE, SE) applied as dependent variable;
- *AGE* is the firm age;
- *LnCAPIN* is the capital intensity in natural logarithm;
- *FL_SHARE* represents the share of foreign workers;
- *LnPWWAGE* is the natural logarithm of annual wage per worker;
- *PVAR* is product variety;

(ii) dummy variables:

- *DPNH* denotes the location of a firm (1 for Phnom Penh, 0 otherwise);
- *DCAM* is the dummy for Cambodian firms *(reference group)*;
- *DACHN* is the dummy for firm with Chinese-owned (origin) firms;
- *DKOR* denotes firms owned by Korean investors;
- *DOTHERS* denotes all other nationalities excluding Chinese, Cambodian, and Korean ownership;

Laos:

$$EFF_i = \begin{matrix} \alpha_0 + \alpha_1 AGE_i + \alpha_2 LnCAPIN_i + \alpha_3 STAFF\_SHARE_i \\ + \alpha_4 DFDI_i + \alpha_5 DJV_i + \varepsilon_i \end{matrix} \quad (4.60)$$

Where the variables are specified as follows:

(i) continuous variables:

- *EFF* is the efficiency score (TE, PTE, SE) applied as dependent variable;
- *AGE* is the firm age;
- *LnCAPIN* is the capital intensity in natural logarithm;
- *STAFF_SHARE* represents the share of managers and head of production lines;

(ii) dummy variables:

- *DLAO* represents the dummy for Lao firms *(reference group)*;
- *DFDI* is the dummy for wholly foreign-owned firms;
- *DJV* denotes Joint Venture-type firms owned by Lao and foreign investors;

Vietnam:

$$EFF_i = \begin{matrix} \alpha_0 + \alpha_1 AGE_i + \alpha_2 LnCAPIN_i + \alpha_3 LnPWWAGE_i + \alpha_4 DFDI_i \\ + \alpha_5 DPPRIV_i + \alpha_6 DPLTD_i + \alpha_7 DPJSC_i + \alpha_8 DLSE_i + \varepsilon_i \end{matrix} \quad (4.61)$$

Where the variables are indicated as follows:

(i) continuous variables:

- *EFF* is the efficiency score (TE, PTE, SE) applied as dependent variable;
- *AGE* presents the firm age;
- *LnCAPIN* is the capital intensity in natural logarithm;
- *LnPWWAGE* denotes the natural logarithm of annual wage per worker;

(ii) dummy variables:

- *DSOE* denotes the state-owned enterprises *(reference group)*;
- *DFDI* is the dummy for wholly foreign-owned enterprises (FDI firms);
- *DPPRIV* denotes the purely private-owned enterprises;
- *DPLTD* symbolizes the private limited companies;
- *DPJSC* is the dummy for private joint stock companies;
- *DLSE* stands for the large size enterprises (LSEs); and
- *DSME* is the dummy for small and medium enterprises (SMEs, *this is reference group for ownership type with respect to size*).

The definition of the variables and proxies are described in the analysis for the respective countries in Chapter 5. Equations (4.59) to (4.61) could be estimated by various regression models, such as the ordinary least square (OLS) regression or the Tobit model.

4.4.4 Concept and Model of Stochastic Frontier Analysis

An alternative methodology (to DEA) for frontier estimation is the application of econometric techniques – the stochastic frontier analysis (SFA). Like DEA, stochastic frontier analysis is developed based on the theoretical material discussed in Section 4.4.1. However, the striking difference from DEA is that SFA assumes a functional form of the relationship between inputs and outputs (in most cases one output), and is said to be more computationally demanding. But it has some advantages over the non-parametric approach, for example, it provides statistical inferences on economic data based on hypothesis testing and can accommodate both cross-sectional and panel data in the estimation.

In this methodology, production frontiers provide the standards for assessing firm's performance using the output-oriented measure of technical efficiency. Commonly in SFA, three types of frontiers, i.e. production, cost and profit frontiers, are estimated. Since the study only addresses efficiency in production, as the background for the empirical analysis, this section briefly presents the theoretical concept and the empirical model for production frontier analysis.

a. The stochastic frontier model

The basic concept of the stochastic (production) frontier model, independently introduced by Aigner et al. (1977) and Meeusen and van den Broeck (1977), was to specify a two-component error term that captures both random errors and technical inefficiencies. The model can mathematically be expressed as follows:

$$Y_i = f(\boldsymbol{X}_i,\boldsymbol{\beta})e^{v_i-u_i} = f(\boldsymbol{X}_i,\boldsymbol{\beta})e^{v_i} \times TE_i \qquad (4.62)$$

where i indexes firms, Y_i denotes output of firm i, $\boldsymbol{X}_i$ represents a vector of (non-stochastic) inputs of firm i, and $\boldsymbol{\beta}$ is a vector of unknown parameters to be estimated.

The production frontier $f(\boldsymbol{X}_i,\boldsymbol{\beta})$ without the error term in equation (4.62) is called a deterministic production frontier. The entire deviation from the observed output is attributed to technical inefficiency. In such a case, it ignores the variations in output that are caused by factors outside the control of the producer, i.e. random shocks. The stochastic frontier, on the other hand, can incorporate both random shocks (noise) and inefficiency in the analysis and thereby carrying a two-component error term in the equation.

The difference between the conventional OLS and the stochastic frontier approach is the composed error term $v_i - u_i$. The symmetric disturbance v_i is assumed to be independently (of u_i) and identically normally distributed $v_i \sim iidN(0,\sigma_v^2)$, and reflects random variation in output due to factors outside control of the firm. The non-

negative error term u_i , which captures inefficiency effects, is assumed to be independent (of v_i) and follow a one-sided distribution $u_i \sim iidN^+(0,\sigma_u^2)$.

The observed output is bounded by the stochastic quantity

$$\tilde{Y}_i = f(\boldsymbol{X_i}, \boldsymbol{\beta})e^{v_i} \quad (4.63) \text{ or}$$

$$Y_i = f(\boldsymbol{X}_i, \boldsymbol{\beta})e^{v_i - u_i} = \tilde{Y}_i \times TE_i \quad (4.64)$$

where i and v_i are defined as above to account for random variations of production beyond the control of the individual firms.

Given this property, the technical efficiency of the *i-th* firm is defined by the following ratio:

$$TE_i = \frac{Y_i}{\tilde{Y}_i} = \frac{f(\boldsymbol{X_i}, \boldsymbol{\beta})e^{v_i - u_i}}{f(\boldsymbol{X_i}, \boldsymbol{\beta})e^{v_i}} = \exp(-u_i) \quad (4.65)$$

As discussed in Section 4.4.1, it TE_i is required to be less than or equal to unity, we have $u_i \geq 0$. In addition, this study assumes homoskedastic case for the two error components, i.e. $Var[u_i] = \sigma_u^2$ and $Var[v_i] = \sigma_v^2$.

If the inefficiency term u_i is equal to zero, given the set of inputs, the firm is said to operate on the frontier and is fully efficient at its maximum output. If $\sigma_v^2 = 0$, the model becomes a deterministic frontier model as described above. In addition, homogeneity implies that the mean and variance of the underlying distributions of the error terms are constant.

In practice, there exist many stochastic frontier models associated with the assumptions of the distribution of u_i, such as exponential, half normal, truncated normal and gamma distribution (for comprehensive treatment of individual models, see Kumbharkar and Lovell, 2003). However, by adopting the methodology developed by Battese and Coelli (1995), the inefficiency measure u_i is assumed to be obtained by the truncation of the normal distribution $N(\mu_i, \sigma_u^2)$. Hence, our frontier model has a

combination of normal-truncated normal distributions for $v_i - u_i$. Moreover, for the heterogeneity in mean, the distribution parameter $E[u] = \mu_i$ is assumed to be a function of determinants that explain the technical inefficiency level as follows:

$$\mu_i = \delta_0 + \sum_{j=1}^{k} \delta_j z_{ij} + \omega_i \qquad (4.66)$$

where μ_i represents inefficiency, z_{ij} is a vector of explanatory variables which are hypothesized to have some impacts on the technical inefficiency level of the firm, δ_j is a vector of unknown coefficients to be estimated, and ω_i is defined by the truncation of the normal distribution, such that the point of truncation is $-(\delta_0 + z_i\delta)$.

In contrast to the DEA-regression analysis, which estimates firm efficiency and assesses the impacts of the determinants in two separate steps, this model formulation enables the two procedures to be carried out in one stage (by maximum likelihood estimation method). This is said to provide more efficient estimates and is consistent with the assumption of independent and identical distribution of inefficiency effects (Coelli, 1995; Vu, 2003).

In addition, various parameters have been developed to evaluate the relative dominance of the two sources of random error. For truncated normal random variable u_i, Aigner et al. (1977) proposed two parameters $\lambda = \sigma_u / \sigma_v$ and $\sigma^2 = \sigma_u^2 + \sigma_v^2$ of the log-likelihood function. $\lambda \to 0$ implies $\sigma_u^2 \to 0$ and/or $\sigma_v^2 \to \infty$ and deviations from the frontier are mainly attributable to noise, and $\lambda = 0$ implies an absence of inefficiency effects on deviations from the frontier. Hence, the greater the value of λ, the more dominant are the inefficiency effects.

b. The econometric model

In terms of functional form, following the vast majority of literature, the paper adopts the translog specification of the production frontier $f(\boldsymbol{X_i}, \boldsymbol{\beta}) = \exp(\boldsymbol{X_i}, \boldsymbol{\beta})$ [33]. Equation (4.62) can be written:

$$Y_i = \exp(\boldsymbol{X_i}, \boldsymbol{\beta}) e^{v_i - u_i}, \tag{4.67}$$

This specification is widely accepted and applied in empirical efficiency studies. Hence, taking natural logs of both sides of equation (4.67), the model can be expressed as follows:

$$\begin{aligned} \ln Y_i = \; & \beta_0 + \beta_1 \ln K_i + \beta_2 \ln L_i + \beta_3 \ln M_i \\ & + \beta_4 \ln K_i \ln L_i + \beta_5 \ln K_i \ln M_i + \beta_6 \ln L_i \ln M_i \\ & + \beta_7 (\ln K_i)^2 + \beta_8 (\ln L_i)^2 + \beta_9 (\ln M_i)^2 + v_i - u_i \end{aligned} \tag{4.68}$$

where i indexes firms, Y_i denotes output, and K_i, L_i and M_i represent the three factors of production: capital, labor and material input, respectively. The production frontier reduces to a Cobb-Douglas model, if the coefficients of the interaction and squared terms equal zero ($\beta_4 = \beta_5 = ... = \beta_9 = 0$). A generalized likelihood ratio test (LR) is applied to test for the appropriateness of the model specification.

The SFA is applied for Vietnam's garment industry in Chapter 5 (Section 5.3.3.3). Given the available determinants of efficiency as in equation (4.61), the inefficiency effect model of equation (4.66) can be specified in an analogous way.

$$\begin{aligned} \mu_i = \; & \delta_0 + \delta_1 AGE_i + \delta_2 LnCAPIN_i + \delta_3 LnPWWAGE_i \\ & + \delta_4 DPPRIV_i + \delta_5 DPLTD_i + \delta_6 DPJSC_i + \delta_7 DLSE_i + \omega_i \end{aligned} \tag{4.69}$$

where i denotes the *i-th* firm, μ_i represents inefficiency, δ_0 is the constant, the coefficients $\delta_j (j = 1,2,...,7)$ are to be estimated. It is also noted that in order to avoid violation of the underlying assumption of SFA – the profit maximization, state-owned enterprises are excluded from this stochastic frontier analysis. Instead, foreign firms (*DFDI*) are the reference group for type of ownership and hence excluded from the

[33] Since the stochastic frontier analysis in the study applies cross-section data, terms associated with the time trend are omitted from the translog specification.

equation, while SMEs (*DSME*) remains the base group for the type of enterprise with respect to size. The data and definition of the variables and proxies for the stochastic frontier model are described in Section 5.3.2 of Chapter 5.

c. Kernel density estimation

In parametric models, strong assumptions about the distribution of variables have long been a critical issue. Efforts have been made to avoid such assumptions by using the linear regression models with normally distributed error terms or to generalize the functional form using translog models, polynomials etc. Non-parametric estimation techniques have proved to be useful in evaluating such generalization, i.e. to describe the distribution of variables under investigation. Despite their rather imprecise inferences and limited structures, non-parametric estimations provide very robust information without fixed assumption on functional form (Greene, 2003).

In this regard, the distribution of the technical inefficiency scores (error term u_i) obtained from the stochastic frontier model can be verified by applying the kernel density estimator. It is a non-parametric method and does not assume the underlying distribution. In fact, he histogram is a crude kernel density function. Following Greene (2002, 2003) the kernel density function for a single variable can be calculated as

$$f(z_j) = \frac{1}{n}\sum_{i=1}^{n}\frac{1}{h}\frac{\boldsymbol{K}\left[(z_j - x_i)/h\right]}{h}, \quad j = 1,2,...,M \qquad (4.70)$$ or

$$\hat{f}(x) = \frac{1}{n}\sum_{i=1}^{n}\frac{1}{h}\boldsymbol{K}\left[\frac{x_i - x}{h}\right], \quad \boldsymbol{K}[z] = \boldsymbol{I}[-1/2 < z < 1/2] \qquad (4.71)$$

where n denotes the sample size, h the bandwidth of the density estimator, and x_i the *i-th* sample.

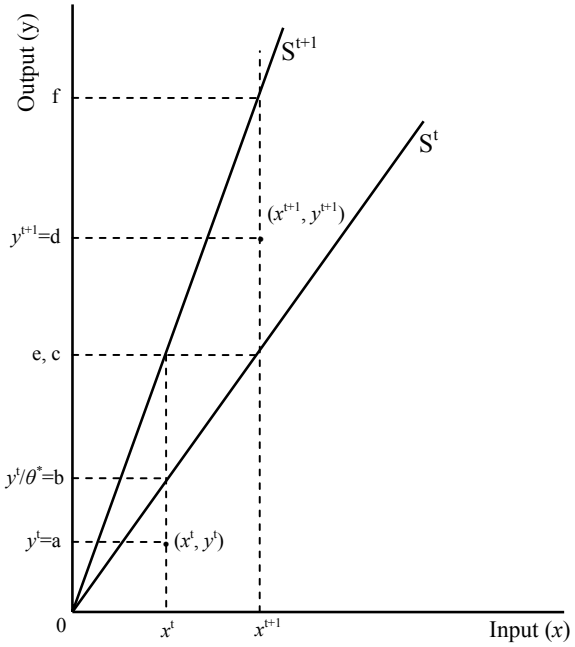
The main component of the estimation, i.e. the kernel density function, $\boldsymbol{K}[z]$, is calculated for a specified set of value $z_j, j = 1,2,...,M$. The sum over the full sample of n observations is required for each value. The larger the value of h, the more stable and flatter the kernel density function and the lower the resolution. To date, several

alternatives are available for $K[z]$ in modern econometric software packages (for more details see Greene, 2002, p. E2-26; Greene, 2003, pp. 453-456).

4.5 THE PRODUCTIVITY MODEL (MALMQUIST INDEX)

For productivity growth estimation, an output-oriented Malmquist productivity index is used to evaluate total factor productivity (TFP) growth of DMUs (garment firms). In other words, this index measures the TFP changes of individual DMUs between two different time periods and represents the sources of such changes. For the purpose of this study, we adopt the composition developed by Färe et al. (1992, 1994, 2001). The development of the Malmquist Index in this section is also based on the theoretical background discussed in Section 4.4.1.

Figure 4-8: Malmquist Index and distance functions



Source: Adapted from Färe et al. (1994, p. 70)

As in Färe et al. (1994) and similar to equation (4.1), for time period *t=1, 2,...* the production technology, which models the transformation of inputs into outputs, can be expressed as:

$$S^t = \{(x^t, y^t) : x^t \text{ can produce } y^t\} \tag{4.72}$$

The output distance function can, respectively, be defined at time *t* and *t+1*as:

$$D_o^t(x^t, y^t) = \inf\left\{\theta : (x^t, y^t / \theta) \in S^t\right\} = \left(\sup\left\{\theta : (x^t, \theta y^t) \in S^t\right\}\right)^{-1} \quad (4.73)$$

$$D_o^{t+1}(x^{t+1}, y^{t+1}) = \inf\left\{\theta : (x^{t+1}, y^{t+1} / \theta) \in S^{t+1}\right\} \quad (4.74)$$

By definition the distance function is homogenous of degree +1 in output:

$$D_o^t(x^t, \theta y^t) = \theta D_o^t(x^t, y^t), \theta > 0 \text{, fixed inputs } x^t \quad (4.75)$$

It measures how far an observation is from the grand frontier of technology and equals the reciprocal of Farrell's efficiency (also refer to section 4.4.1 for more explanation). Observing Figure 4-8, the value of the associated output distance function at (x^t, y^t) is $D_O^t(x^t, y^t) = 0a/0b$.

At this point, it is worth noting that for simplicity of the presentation the necessary characteristics, such as weakly disposable outputs and distance function of less than unity on the technology S^t are assumed inclusively. Readers could refer to Färe et al. (2001) for details of the assumptions and derivation.

Next, the Malmquist productivity index (*MI*) defined in Caves et al. (1982) can be written for period *t* and *t+1* as follow:

$$MI_{CCD}^t = \frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \text{ (reference technology of period } t\text{)} \quad (4.76)$$

$$MI_{CCD}^{t+1} = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^t, y^t)} \text{ (reference technology of period } t+1\text{)} \quad (4.77)$$

where the subscript CCD stands for Caves, Christensen, and Diewert.

The output based Malmquist productivity index, defined as the geometric mean of two CCD-type Malmquist indices of two periods, is |

$$MI_o^t(x^{t+1}, y^{t+1}, x^t, y^t) = \left[MI_{CCD}^t \times MI_{CCD}^{t+1}\right]^{1/2} \quad (4.78)$$

$$MI_o^t(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\left(\frac{D_o^t(x^{t+1}, y^{t+1} \mid CRS)}{D_o^t(x^t, y^t \mid CRS)}\right)\left(\frac{D_o^{t+1}(x^{t+1}, y^{t+1} \mid CRS)}{D_o^{t+1}(x^t, y^t \mid CRS)}\right)\right]^{1/2} \quad (4.79)$$

Following Färe et al. (1992), by allowing for inefficiencies, the index can be decomposed into efficiency change (*EFFCH*) and technical change (*TECH*), i.e. *MI=EFFCH*TECH*

$$MI_o^t(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \times \left[\left(\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})} \right) \left(\frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)} \right) \right]^{1/2} \tag{4.80}$$

where $$EFFCH = \frac{D_o^{t+1}(x^{t+1}, y^{t+1} \mid CRS)}{D_o^t(x^t, y^t \mid CRS)} \tag{4.81}$$

$$TECH = \left[\left(\frac{D_o^t(x^{t+1}, y^{t+1} \mid CRS)}{D_o^{t+1}(x^{t+1}, y^{t+1} \mid CRS)} \right) \left(\frac{D_o^t(x^t, y^t \mid CRS)}{D_o^{t+1}(x^t, y^t \mid CRS)} \right) \right]^{1/2} \tag{4.82}$$

The above MI was developed under CRS, but it is said to hold for variable returns to scale as well. *EFFCH* captures the change in efficiency and measures how much closer an observation moves to the frontier (catch-up effect), while *TECH* captures the change in frontier technology and measures how much the frontier shifts at each observation's input mix (frontier-shift effect).

In the extended decomposition proposed by Färe et al. (1994), the efficiency change term (*EFFCH*) can be expressed as the product of (i) the pure efficiency change component in VRS technology (*PEFFCH*) and (ii) the scale efficiency component (*SCALECH*) to capture the deviation between the CRS and VRS frontiers. That means *EFFCH= PEFFCH*SCALECH* and *MI=TECH *PEFFCH*SCALECH*:

$$PEFFCH = \frac{D_o^{t+1}(x^{t+1}, y^{t+1} \mid VRS)}{D_o^t(x^t, y^t \mid VRS)} \tag{4.83}$$

$$SCALECH = \frac{D_o^t(x^t, y^t \mid VRS) / D_o^t(x^t, y^t \mid CRS)}{D_o^{t+1}(x^{t+1}, y^{t+1} \mid VRS) / D_o^{t+1}(x^{t+1}, y^{t+1} \mid CRS)} \tag{4.84}$$

Observing Figure 4-8, the Malmquist Index can be expressed as:

$$MI_o^t(x^{t+1}, y^{t+1}, x^t, y^t) = \left(\frac{0d/0f}{0a/0b} \right) \left[\left(\frac{0d/0e}{0d/0f} \right) \left(\frac{0a/0b}{0a/0c} \right) \right]^{1/2}$$

$$= \left(\frac{0d}{0f} \right) \left(\frac{0b}{0a} \right) \left[\left(\frac{0f}{0e} \right) \left(\frac{0c}{0b} \right) \right]^{1/2} \tag{4.85}$$

The Malmquist Index, as expressed in equation (4.79) or (4.80), of greater than unity implies positive productivity growth. Similarly, efficiency improvement and technical advancement occur, if EFFCH and TECH are greater than unity. Otherwise, deterioration in productivity, efficiency and frontier technology is evident, if the three Malmquist indices are less than one. The interpretation for PEFFCH and SCALECH follow the same patterns.

The Malmquist indices as presented above are called radial measures and are said to suffer from neglect of the slacks. In an effort to overcome this problem, several measures and models have been developed over the last decade, for example the slacks-based measure (SBM) and super-slacks-based measure (SuperSBM). For this advantage, the productivity analysis in this study uses non-radial output-oriented models for estimating the Malmquist TFP Index. Detailed presentation of such models is available in Cooper et al., (2007, Chapter 11).

Appendix 4A: Recent trends in garment exports to three major markets

Table 4A-1: EU's imports from leading exporters and CLV (US$ million and %share)

$M/% share	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
World	***101,415***	***115,700***	***123,564***	***135,057***	***153,704***	***100***	***100***	***100***	***100***	***100***
China	14,806	18,521	26,547	30,105	37,857	14.6	16.0	21.5	22.3	24.6
Turkey	9,272	10,609	11,181	11,505	13,735	9.14	9.17	9.05	8.52	8.94
Bangladesh	3,876	5,126	4,895	6,455	6,843	3.82	4.43	3.96	4.78	4.45
India	3,449	3,947	5,073	5,863	6,505	3.40	3.41	4.11	4.34	4.23
Hong Kong	3,064	3,137	2,859	3,823	3,044	3.02	2.71	2.31	2.83	1.98
Indonesia	1,859	2,015	1,861	2,188	2,085	1.83	1.74	1.51	1.62	1.36
Vietnam	701	961	1,033	1,560	1,920	0.69	0.83	0.84	1.16	1.25
Sri Lanka	970	1,222	1,238	1,457	1,766	0.96	1.06	1.00	1.08	1.15
Pakistan	1,259	1,517	1,391	1,565	1,748	1.24	1.31	1.13	1.16	1.14
Thailand	1,363	1,560	1,434	1,618	1,665	1.34	1.35	1.16	1.20	1.08
Cambodia	540	734	672	796	844	0.53	0.63	0.54	0.59	0.55
Laos	138	159	163	174	170	0.14	0.14	0.13	0.13	0.11
Mexico	61	78	74	101	112	0.06	0.07	0.06	0.07	0.07
CLV	*1,380*	*1,853*	*1,868*	*2,530*	*2,934*	*1.36*	*1.60*	*1.51*	*1.87*	*1.91*

Source: Author's calculations (data are from UN Comtrade online database: http://comtrade.un.org/).
Note: EU includes: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom.

Table 4A-2: US Imports from leading exporters and CLV (US$ million and %share)

$M/% share	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
World	***71,277***	***75,731***	***80,071***	***82,972***	***84,853***	***100***	***100***	***100***	***100***	***100***
China	12,015	14,394	21,138	24,403	28,530	16.86	19.01	26.40	29.41	33.62
Mexico	7,257	7,005	6,374	5,574	4,743	10.18	9.25	7.96	6.72	5.59
Hong Kong	3,967	4,128	3,738	4,003	4,619	5.56	5.45	4.67	4.82	5.44
Vietnam	2,552	2,748	3,376	3,560	4,306	3.58	3.63	4.22	4.29	5.07
Indonesia	2,370	2,644	3,163	3,430	3,505	3.33	3.49	3.95	4.13	4.13
India	2,309	2,540	2,911	3,121	3,286	3.24	3.35	3.64	3.76	3.87
Thailand	2,278	2,344	2,537	2,968	2,559	3.20	3.09	3.17	3.58	3.02
Bangladesh	1,973	2,119	2,351	2,395	2,311	2.77	2.80	2.94	2.89	2.72
Sri Lanka	1,567	1,689	1,818	2,271	2,162	2.20	2.23	2.27	2.74	2.55
Turkey	1,368	1,520	1,796	1,836	1,711	1.92	2.01	2.24	2.21	2.02
Cambodia	1,311	1,322	1,447	1,628	1,696	1.84	1.75	1.81	1.96	2.00
Pakistan	1,200	1,260	1,026	805	624	1.68	1.66	1.28	0.97	0.74
Laos	4	2	3	9	11	0.01	0.003	0.004	0.01	0.01
CLV	*3,868*	*4,072*	*4,826*	*5,197*	*6,013*	*5.43*	*5.378*	*6.027*	*6.26*	*7.09*

Source: Author's calculations (data are from UN Comtrade online database: http://comtrade.un.org/).

Table 4A-3: Japan's from leading exporters and CLV (US$ million and %share)

$M/% share	**2003**	**2004**	**2005**	**2006**	**2007**	**2003**	**2004**	**2005**	**2006**	**2007**
World	***19,485***	***21,687***	***22,541***	***23,870***	***23,999***	***100***	***100***	***100***	***100***	***100***
China	15,579	17,544	18,243	19,562	19,795	79.96	80.89	80.94	81.95	82.48
Hong Kong	498	566	610	643	717	2.56	2.61	2.71	2.70	2.99
Vietnam	255	274	280	294	271	1.31	1.26	1.24	1.23	1.13
Indonesia	137	127	141	174	157	0.71	0.59	0.63	0.73	0.65
India	95	110	125	147	134	0.49	0.51	0.56	0.61	0.56
Thailand	56	64	58	66	53	0.29	0.30	0.26	0.28	0.22
Bangladesh	29	37	45	55	46	0.15	0.17	0.20	0.23	0.19
Sri Lanka	22	24	23	24	30	0.11	0.11	0.10	0.10	0.12
Mexico	19	17	24	27	25	0.10	0.08	0.10	0.11	0.11
Turkey	19	22	20	24	22	0.10	0.10	0.09	0.10	0.09
Cambodia	8	10	8	14	15	0.04	0.04	0.04	0.06	0.06
Pakistan	8	8	8	8	9	0.04	0.04	0.04	0.03	0.04
Laos	1	2	1	2	2	0.005	0.01	0.01	0.01	0.01
CLV	*264*	*285*	*290*	*310*	*287*	*1.36*	*1.31*	*1.29*	*1.30*	*1.20*

Source: Author's calculations (data are from UN Comtrade online database).

CHAPTER FIVE
EFFICIENCY AND PRODUCTIVITY OF THE GARMENT INDUSTRY IN CLV

The empirical analysis in this chapter addresses two important issues for long term development of the garment industry in CLV, namely firm efficiency and its determinants, and total factor productivity growth and the sources. The efficiency analysis applies non-parametric and parametric approaches and a combination of them – the two-stage DEA-regression analysis. Technical efficiency[34] (TE score[35]), pure technical efficiency (PTE score) and scale efficiency (SE score) are obtained from the software DEA-Solver-PRO Version 6 and the econometric results are obtained by using the packages Eviews6 and STAT9.2.

In addition, for the case of Vietnam a stochastic frontier analysis has also been conducted to examine the problems without SOEs and to ascertain the findings. The estimation of the frontier production functions and the corresponding inefficiency effects are conducted by using the package LIMDEP8. Moreover, the productivity analysis applies the DEA-based Malmquist Index for the Lao garment industry. Similarly, the Malmquist productivity index and its components are obtained from the software DEA-Solver-PRO Version 6.

In terms of geographical coverage, the study takes up the most important areas of garment production in Indochina: Phnom Penh in Cambodia, Vientiane Capital in Laos and Ho Chi Minh City in Vietnam.

5.1 FIRM EFFICIENCY IN CAMBODIA'S GARMENT INDUSTRY

5.1.1 Recent Development in Cambodia's Garment Industry

[34] In this paper the term 'efficiency' is understood as 'technical efficiency', while a full description is used for other cases, i.e. pure technical efficiency and scale efficiency.
[35] In literature of efficiency analysis, the TE score is also called the CRS technical efficiency and the PTE score the VRS technical efficiency.

a. Emergence and role of the garment industry

In the last decade, Cambodia experienced rapid emergence of the textile and garment industry. It has formed the backbone of the Cambodia's economy both in terms of output and employment. Garment exports have flourished over the last decade and reached US$2.7 billion in 2005, making up about 83% of the country's merchandise exports. In particular, large establishments and employment in textile, wearing apparel and leather characterized the development patterns in manufacturing industries (Table 5-1). It is the labor-intensive garment industry which is flexible in response to global market condition changes and is often an issue in international trade debates. This industry is seen as a footloose industry as it moves from countries whose wage rates have reached a certain level considered to be less competitive to more (labor) cost advantageous economies.

Table 5-1: Establishment and labor in major manufacturing industries (Cambodia)

Large Establishment	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Food, beverage, tobacco	32	32	31	31	31	34	39	43
Textile, apparel, leather	179	226	256	240	255	283	320	374
Wood products, furniture	22	13	12	7	7	7	7	7
Chemicals, petroleum, coal etc.	11	15	16	16	16	18	20	20
Non-metalic mineral products	15	10	10	11	11	11	11	11
Fabricated metal products	5	10	10	11	12	12	12	17
Total	267	310	340	320	336	371	415	483
Labor (1000 persons)	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
Textile, apparel, leather	85	113	137	190	228	248	291	315
Others	14	14	14	15	12	13	13	16
Total	99	127	151	205	241	260	303	331

Source: *Statistical Yearbook 2006*, National Institute of Statistics, Ministry of Planning of Cambodia

The modern history of Cambodia's garment industry dates back to around 1994 when foreign investors from Hong Kong, Taiwan, Malaysia and Singapore started their business in the country after peace and normalized political and economic relations with the global community have been restored. The quantitative constraint (quota) of China's exports and the absence of quota restrictions on Cambodia's garment products during that period were the principal factors for the establishment of this industry in the country (Bargawi, 2005, p. 5). The emergence of Cambodia's garment industry is often

discussed in close relation with the MFA, as it influences the development of this industry a great deal in many aspects.

Table 5-2: Emergence of Cambodia's garment industry

Year	Factories (number)	Total employment (thousand)	% share of labors in manufacturing	Garment exports (US$ million)	% share in merchandise exports
1995	20	18.7	17.24	26.2	3.07
1996	24	24.0	14.22	106.4	16.53
1997	67	51.6	35.74	223.9	25.99
1998	129	79.2	49.82	355.3	44.30
1999	152	96.6	37.32	653.0	57.77
2000	190	122.6	33.38	965.0	69.07
2001	186	188.1	34.52	1,119.8	71.27
2002	188	210.4	37.82	1,338.4	75.97
2003	197	234.0	36.89	1,581.5	76.08
2004	206	245.6	34.49	1,987.0	77.04
2005	247	279.1	38.41	-	-
2006	263	289.2	38.85	-	-

Source: (1) US Embassy in Cambodia, 'Economic Significance of the Garment Sector in Cambodia' reported in USAID (2005). (2) Ministry of Commerce of Cambodia. (3) Key Indicators 2007, Asian Development Bank, Manila.

The garment industry has grown steadily since the mid-1990s. The emergence and the crucial role of the industry are highlighted in the employment and apparel exports (Table 5-2). During 1995-2006 the number of garment factories increased from 20 to 263. Over the same period, the number of workers rose from 19 thousand to 289 thousand sharing on average about 34% of labors employed in manufacturing industries. Similarly, the exports of clothing recorded a steady increase from US$26 million in 1995 to about US$2 billion in 2004, making up about 77% of the country's commodity exports. Hence, the garment industry is the leader in generating employment and income for the poor, and earning foreign currencies for the country.

b. Development trend in post MFA-era[36]

According to the Garment Manufacturers' Association in Cambodia (GMAC)[37], upon the MFA phase-out Cambodia's garment exports still continue to grow, but the growth rate has slowed down in 2008. For 2005-2007 the industry records an annual

[36] Much of information about recent development trends and issues in Cambodia's garment industry presented in this chapter is drawn from a field survey conducted by the author in August, 2008.
[37] Interview with the External Affairs Manager of GMAC

growth rate of 15-20%, but in the first quarter of 2008 exports to the US increase by only 1.25% as compared to the year before, while the growth rate of exports to EU reaches about 30%. A main reason for such a drop is likely the slow-down in the US economy. Clothing exports to the US share about 70% of the total garment exports, while much of the remaining is for EU markets. Therefore, a drop in the growth rate of US exports implies a decreasing trend and warning signal for the industry.

Table 5-3: Ownership structure of Cambodia's garment industry

Year	Total	Cambodian	Chinese	Korean	Others	Foreign
2004	203	14 (6.90)	161 (79.31)	17 (8.37)	11 (5.42)	189 (93.10)
2005	247	21 (8.50)	182 (73.68)	22 (8.91)	22 (8.91)	226 (91.50)
2006	263	23 (8.75)	194 (73.76)	25 (9.51)	21 (7.98)	240 (91.25)

Source: Author's calculations. Data are from the Ministry of Commerce of Cambodia.
Notes: 1. Percentage share is in parentheses. 2. Chinese ownership includes Chinese, Hong Kong, Macau, Malaysian, Singaporean, and Taiwanese. Those enterprises are owned and operated by investors with Chinese origin, although the registered nationalities may be different. 3. Others include Canadian, Indonesia, Filipino, Portuguese, Thai, British, and American.

The membership with GMAC has increased remarkably in the post-MFA era. In 2004 there were about 206 firms registered with GMAC, and this number increases to about 300 in 2008 with 8 newly established factories (Taiwan, Hong Kong, China) and nearly all of them are operating. A unique characteristic of Cambodia's garment industry is the dominance of foreign ownership in production facilities and labor employment. Specifically, foreign-owned garment factories make up more than 90% in which investors with Chinese origin leading the list and followed by Korean owners (Table 5-3). Similarly, about 95% of the industry's workforce is employed in FDI firms.

In terms of competitiveness, for example as compared to neighboring Vietnam, Cambodia's productivity is lower and total wage is slightly higher, although the basic wage is somewhat lower. For Cambodia's exports, 80 percent of the items are free of tax and about 128 items are still in the negative list, meaning that such commodities are subject to import duties in the destination markets (for comparison, Vietnam has over 200 items in the negative list). Regarding the labor standard compliance, it is supposed

to give a good image of Cambodia's garment industry, but this one-way communication and ILO reports tend to be more negative toward garment factories.

c. Export and import of garment products

The Cambodia's apparel industry exports its entire production to world's major markets (USA, EU) and the country imports clothing products for domestic consumption. Table 5-4 illustrates the trade in textile and garment products for 2005. Export turnover classified by destination is as follows: 67% to USA, 24% EU, 4% Canada and 5% other trade partners. The main suppliers of garment products for domestic consumption are Asian economies, such as Hong Kong (59%); China (28%); ASEAN countries (7%) and Korea (4%).

With regard to material input, Cambodia's garment producers mainly rely on imported materials designated by customers or their associated agents. Given the lack of the backward-linkage industry, i.e. the textile and supporting industries, 97% of fabrics and accessories for production are imported from above-mentioned suppliers. This fact is also reflected in our calculations for 2005 that the garment industry (SITC 84) recorded a trade surplus of US$2.62 billion, while the textile industry (SITC 26 and 65) had trade deficit of US$915 million. Overall, in 2005 the textile and garment industry made a trade surplus of about US$1.71 billion.

d) Development issues and impediments

Apart from the positive development trends, the expansion of Cambodia's garment industry is hampered by several factors. Among a long list of problems, our recent field survey has revealed four major problems, namely intensified competition, rising production and living costs, local labor shortage and labor unions. First, upon the MFA phase-out competition in this business has been fiercer than ever. With the Safeguards on China being terminated by this year and Vietnam joining the WTO, the

Table 5-4: Cambodia's trade flows in garment and textile products in 2005 (US$ thousand)

CAMBODIA	Garment industry (SITC 84)						Textile industry (SITC 65 + SITC 26)						T&G
Trade Partners	**Exports**		**Imports**		**Net Exports**		**Exports**		**Imports**		**Net Exports**		**Net**
	Value	% share	Value	% share	Value	% share	Value	% share	Value	% share	Value	% share	**Exports**
EU 15	**660,099**	**24.42**	**347**	**0.43**	**659,752**	**25.16**	**2,220**	**4.47**	**5,627**	**0.58**	**-3,407**	**-0.37**	**656,345**
ASEAN 10	**47,262**	**1.75**	**5,543**	**6.86**	**41,720**	**1.59**	**14,872**	**29.91**	**163,128**	**16.90**	**-148,256**	**-16.19**	**-106,536**
Indonesia	210	0.01	98	0.12	112	0.00	84	0.17	14,748	1.53	-14,664	-1.60	-14,552
Malaysia	459	0.02	1,156	1.43	-698	-0.03	684	1.38	47,833	4.96	-47,149	-5.15	-47,847
Philippines	77	0.00	2	0.00	75	0.00	1,242	2.50	4,295	0.44	-3,052	-0.33	-2,977
Singapore	45,228	1.67	1,110	1.37	44,119	1.68	1,840	3.70	18,939	1.96	-17,099	-1.87	27,020
Thailand	420	0.02	2,296	2.84	-1,876	-0.07	8,200	16.49	55,612	5.76	-47,412	-5.18	-49,288
Vietnam	868	0.03	881	1.09	-13	-0.00	2,821	5.67	21,700	2.25	-18,879	-2.06	-18,892
China	2,080	0.08	22,950	28.40	-20,869	-0.80	8,126	16.34	344,433	35.69	-336,307	-36.74	-357,176
Hong Kong	1,571	0.06	48,029	59.44	-46,458	-1.77	3,451	6.94	330,227	34.21	-326,776	-35.69	-373,234
India	42	0.00	127	0.16	-86	-0.00	49	0.10	5,927	0.61	-5,878	-0.64	-5,964
Pakistan	2	0.00	226	0.28	-224	-0.01	122	0.25	10,351	1.07	-10,229	-1.12	-10,453
USA	1,818,326	67.27	448	0.55	1,817,878	69.32	14,644	29.45	4,661	0.48	9,983	1.09	1,827,861
Japan	8,396	0.31	6	0.01	8,390	0.32	31	0.06	4,355	0.45	-4,324	-0.47	4,066
Korea	2,123	0.08	3,009	3.72	-886	-0.03	175	0.35	94,622	9.80	-94,447	-10.32	-95,333
Australia	4,453	0.16	26	0.03	4,427	0.17	832	1.67	821	0.09	11	0.00	4,438
Canada	106,316	3.93	36	0.04	106,280	4.05	752	1.51	758	0.08	-6	-0.00	106,274
Mexico	6,235	0.23		0.00	6,235	0.24	4,223	8.49	0	0.00	4,223	0.46	10,458
World Total	**2,703,148**	**100.00**	**80,799**	**100.00**	**2,622,349**	**100.00**	**49,725**	**100.00**	**965,192**	**100.00**	**-915,467**	**-100.00**	**1,706,882**

Source: Author's calculations based on the commodity trade data from the UN Comtrade.
Notes: 1. SITC 84: Articles of apparel and clothing accessories. 2. SITC 65: Textile yarn, fabrics, fibres made-up articles. 3. SITC 26: Textile fibres.

competition with the two main competitors requires drastic improvement in competitiveness, productivity and efficiency if the industry is to be further developed.

Second, rising energy prices and inflation have put upward-pressure on production cost for factories and living cost for workers. For example, electricity accounts for about 15% of production cost, while inflation in the first quarter of 2008 stood at 17-18%. The hike in living cost has triggered an increase in minimum wage by US$5 to US$50 per month in February 2008 and an additional living allowance of US$6 per month in April as compensation for impacts of high inflation on workers. Furthermore, a social security scheme has been established by GMAC to which factories are required to contribute 0.8% for each employee. The question under debate is whether the minimum wage or total worker income would be taken into calculation. If it is the latter, garment factory owners would find it hard to accommodate such an increase.

Third, like in Vietnam and Laos, the industry has faced the so-called local labor shortage, particularly in the Phnom Penh area with high concentration of garment factories. By the time of the survey, workers went home for election or for harvesting, but many have not come back. In addition, the rising rice prices have triggered a movement of workers back to their hometown to do farming. However, the problems of workers are that most of them do not own land and it is difficult to make profit and earn stable income from farming unless it is commercialized. Yet, the workers tend to prefer staying with their families despite lower income. Hence, average factories in the Phnom Penh area find it difficult to recruit and retain new workers.

Finally, complex business regulation, bribery and labor unions have been cited as major concerns by business managers. Particularly, the major problems faced by investors, managers and business owners are the number of labor unions, the strikes without objective and uneducated union leaders. On average, there are 3.7 labor unions in a garment factory with the actual number ranging from one to ten unions. To avoid

such harmful strikes, many factories have assigned local middle-level managers to deal with union leaders and resolve the outstanding issues in a more reserved and polite way. This practice has brought more understanding and work harmony among the parties concerned.

In sum, the industry has developed into two poles: (i) the successful group includes large and competitive firms which have been able to gain more and more orders and grow; and (ii) the less successful group of factories which are struggling to survive with decreasing order and high turn-over rate of workers. Hence, productivity and efficiency have been viewed by various stakeholders as a key for the industry to survive and further develop.

5.1.2 Data and Variables for Empirical Analysis (Cambodia)

The study is largely based on statistical data from the Ministry of Commerce and the Ministry of Finance and Economy of Cambodia, and a field survey in August 2008 (interviews with firm management, GMAC, GIPC). The statistical information is of year 2004. Hence, the findings and conclusions are confined to the period prior to the MFA phase-out. Constrained by the availability of the data, the scope of the study is limited to firm-specific determinants for 2004.

5.1.2.1 Data Mining

The initial dataset consists of 203 samples. The following four criteria are applied in selecting enterprises to be included in the analysis:

1. enterprises with complete information on output, capital, labor, materials, ownership and other necessary variables;
2. firms with at least one-year of age;
3. the ratio of the minimum and maximum value of each variable (except for dummies) must be greater than 0.0001 (required by DEA Solver software to avoid loss of numerical accuracy of efficiency score) (Seitech Inc., 2006, p. 21); and

4. enterprises with positive cost of production (materials).

Six samples are removed due to extreme data on capital intensity and efficiency (these samples represent firms which are almost insolvent or closed). Upon data mining, there are 197 samples in the dataset. These samples represent 95.6% of the 206 firms listed as members of the Garment Manufacturers Association in Cambodia (USAID, 2005, Table 2-1, p. 4). The dataset is summarized in Table 5-5.

Table 5-5: Composition of data (Cambodia)

By owner's nationality	**Sample**	**Cambodian**	**Chinese**	**Korean**	**Others**
	197 (100.0)	14 (7.11)	156 (79.19)	17 (8.63)	10 (5.08)
By labor	**Sample**	**1- 500**	**501-1000**	**1001 - 5000**	**5001 ~**
	197 (100.0)	42 (21.32)	91 (46.19)	56 (28.43)	8 (4.06)

Source: Author's calculations. Data are from the Ministry of Commerce of Cambodia.
Notes: 1. Percentage share is in parentheses. 2. Chinese ownership includes Chinese, Hong Kong, Macau, Malaysian, Singaporean, and Taiwanese. Those enterprises are owned and operated by investors with Chinese origin, although the registered nationalities are different. 3. Others include Canadian, Indonesia, Filipino, Portuguese, Thai, British, and American

It can be observed in the upper half of the table that local enterprises share only about 7% of the industry, while firms with Chinese origin (Chinese, Hong Kong, Macau, Malaysian, Singaporean, and Taiwanese) comprise 79% and constitute the majority of the clothing industry in Cambodia. The second largest foreign ownership or nationality is Korean with nearly 9% share. Together investors from UK, Canada, Indonesia, the Philippines, Portugal, Thailand, Vietnam, and the US share about 5%. In a more detailed breakdown of ownership structure Hong Kong and Taiwanese firms are leaders with 25.9% and 23.4% share, respectively.

With respect to size, firms in Cambodia tend to be large. Specifically, nearly half of the garment firms (46%) employ 501 to 1000 workers, followed by even larger enterprises (28%) with the number of workers from 1000 to 5000. In fact, there is only one firm in the samples with fewer than 100 employees. Based on the criteria for small and medium enterprise suggested in the SME development framework (USAID, 2005), all the samples are large enterprises with only one exception.

5.1.2.2 Variable Definition

As in many enterprise-level analyses, the application of estimation models and the choice of proxy variables for firm efficiency in this study are mainly constrained by the availability of statistical data. This section describes the definition of the proxy variables used in the empirical analysis.

a. Variables for the DEA models

As mentioned in Section 4.4, the CCR-O and BCC-O models are applied with three inputs and one output. The variables for the two models are defined as follows:

- Output (*EXPORT*): is the value of total export of the enterprise in 2004 denominated in US dollar;
- Input 1 (*K*): is the US dollar value of machines used as a proxy for capital;
- Input 2 (*L*): is the total number of employees (labor) as of the end of 2004;
- Input 3 (*M*): is the value of imports for production in US dollar used as a proxy for materials.

b. Variables for the regression model

In literature, the determinants of firm efficiency applied in empirical analysis are numerous. Such variables describe the characteristics of the individual enterprises (internal factors) or the business environment in which those firms are operating (external factors) and the like. As described in equation (4.59) this study focuses on the firm characteristics. This section presents the definition of the independent variables for this regression model.

b.1) Continuous explanatory variables:

- *AGE* denotes the number of years of operation and is defined as the difference between year 2004 and the establishment year;
- *CAPIN* is the capital intensity (in US dollar) and defined as the ratio of value of machines over the total number of employees (this variable is deemed to give some measure of the technical level of the individual garment enterprises);

- *FL_SHARE* represents the percentage share of foreign workers (expatriates) employed in a firm;
- *PWWAGE* is the average annual wage per worker of each enterprise denominated in US dollar; and
- *PVAR* represents the number of product categories a firm can produce. This is a proxy for product variety.

b.2) Discrete explanatory (dummy) variables:

Although most of garments firms in Cambodia are concentrated in the capital, it might be interesting to study the impact of such concentration (agglomeration) on firm efficiency. The dummy for location is *DPNH* which is defined as 1 if the corresponding firm is located in Phnom Penh and 0 for other locations.

With respect to ownership, our dataset contains merely information about the nationality of the enterprise owners. Hence, in this study ownership means nationality of the owner. There are 15 nationalities in total, but for the purpose of the analysis they have been summarized to only four categories as follows:

- *DCAM* is the dummy for Cambodian-owned enterprises and equals 1 if true and 0 otherwise;
- *DACHN* is firms with Chinese origin (All Chinese-owned) and equals 1 if true and 0 otherwise. This category includes Chinese, Hong Kong, Macau, Singaporean, and Taiwanese;
- *DKOR* denotes the dummy for Korean ownership and is 1 if true; and
- *DOTHERS* is the dummy for all other nationalities including Canadian, Indonesian, Malaysian, Filipino, Portuguese, Thai, British, and American. It is equal 1 if true and 0 otherwise.

The summary statistics of the dataset are presented in Table 5-6. It reveals that on average a garment firm in Cambodia exports US$9.6 million, which includes US$3.2 million imported materials for production. The average value of capital is US$151,000, but the variation is relatively large. The labor or firms size shows a similar behavior with an average of 1,250 workers. Among the variables of production,

material imports are the most volatile (coefficient of variation is 2.45), followed by exports and labor (1.30 and 1.08 respectively).

Table 5-6: Summary of main variables (Cambodia)

Cambodia's garment 2004	Obs.	Mean	Std. Dev.	Min	Max	Coeff. of variation
TE	197	0.435	0.253	0.030	1.000	0.58
PTE	197	0.501	0.278	0.031	1.000	0.56
SE	197	0.889	0.160	0.045	1.000	0.18
EXPORT (thousand US$)	197	9,637.2	12,500.0	28.9	69,500.0	1.30
K (thousand US$)	197	150.7	140.8	10.5	1,217.4	0.93
L (US$)	197	1,250.5	1,347.5	93.0	7,763.0	1.08
M (thousand US$)	197	3,178.4	7,785.4	8.9	75,700.0	2.45
AGE (years)	197	6.65	2.44	2	12	0.37
CAPIN (US$/worker)	197	143.77	57.38	2.37	312.22	0.40
PWWAGE (US$/worker)	197	796.86	259.52	97.51	3,130.44	0.33
PVAR (# of product categories)	197	5.62	3.59	1	15	0.64
Share of foreign labor (%)	197	16.68	12.23	0.00	89.51	0.73

Source: Author's calculations (data are from the Ministry of Commerce and the Ministry of Economy and Finance of Cambodia).

The young history of modern Cambodia's garment industry is reflected in the firm age. On average, they are relatively young with 7 years. Although it is vague, the capital intensity and product variety could shed some light on the development of the industry. An average firm in Cambodia would invest about US$144 per worker on production machine and could produce 6 different types of garments. The share of foreign staff and workers is also low. With respect to income, a typical garment worker would earn about US$800 per annum, an income that is deemed insufficient in many countries.

5.1.3 Empirical Results and Discussions (Cambodia)

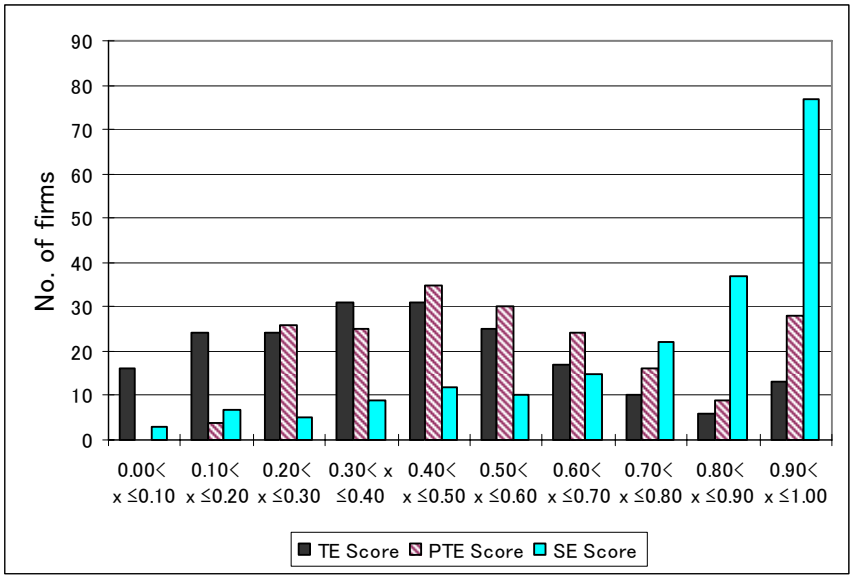
5.1.3.1 Efficiency Performance

a. Distribution of efficiency indices

The results of the DEA estimation are summarized in Table 5-6 (raw 1-3). The average efficiency of Cambodia's garment industry is about 44% (TE=0.435) and the pure technical efficiency is about 50% (PTE=0.501). The PTE index is generally greater than the TE index as stated in the theory. The average technical efficiency level

is higher than the Lao average (0.329) but lower than the average of garment factories in Ho Chi Minh City (0.621) (Matsunaga and Vixathep, 2008). Since DEA measures efficiency of DMUs relative to the grand frontier constituted by the best performers in a sample, this result would imply that, in terms of efficiency garment firms in Phnom Penh are more widespread than those in Ho Chi Minh City but less than those in Vientiane. Also, the distribution of the three efficiency indices is less volatile, as the coefficient of variation varies only between 0.18 and 0.58 (Column 6 in Table 5-6). This finding could result from the concentration, competition, technical spillover and homogeneity of firms in Phnom Penh.

Figure 5-1: Distribution of efficiency indices (Cambodia)



Source: Authors' calculations.

The distribution of the three efficiency indices is presented in Figure 5-1. It is apparent that the distribution of TE scores is closer to a normal distribution than that of the PTE and SE scores, with the majority recording an efficiency level of 0.3-0.5 (44% of garment firms in Phnom Penh). The distribution of these indices is an important factor which will have some impacts on the result of the following regression analysis by OLS regression and Tobit model. It is worth noting that most of the firms have achieved high scale efficiency (69% of the sample record SE of 0.7-1.0)

b. Comparison of efficiency among nationalities/ownership[38]

Table 5-7 summarizes the three efficiency indices classified by nationality: Cambodian, Chinese origin, Korean, other nationalities, and foreign ownership as a whole. The significance of the difference among the groups is based on the analysis of variance (single-factor ANOVA). Overall, Chinese and other nationalities have achieved the highest technical efficiency with an average rate of 45.1% and 54.6%, respectively. Local garment factories turn out to be the least efficient (27.9%), while average Korean enterprises are between the local and other nationalities (35.0%). However, the difference is not statistically significant in the case of Korean enterprises. Also, with average efficiency of 44.7% foreign firms as a whole outperform their Cambodian counterparts. Detailed results of the ANOVA are presented in Table 5A-2 in Appendix 5A.

Table 5-7: Efficiency indices classified by ownership/nationality (Cambodia)

Ownership/ Nationality	**Number (% share)**	**Mean and standard deviation**					
		TE index		**PTE index**		**SE index**	
		Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Cambodian	14 (7.11)	0.279*	0.159	0.344*	0.208	0.843	0.142
Chinese origin	156 (79.19)	0.451*	0.245	0.516*	0.270	0.893	0.158
Korean	17 (8.63)	0.350	0.330	0.421	0.360	0.897	0.225
Other nationalities	10 (5.08)	0.546*	0.236	0.619*	0.262	0.881	0.089
Foreign total	*183 (92.89)*	*0.447**	*0.255*	*0.513**	*0.280*	*0.893*	*0.161*
Total	**197 (100.0)**	**0.435**	**0.253**	**0.501***	**0.278**	**0.889**	**0.160**

Source: Author's calculations.
Notes: 1. Chinese (origin) ownership includes Chinese, Hong Kong, Macau, Singaporean, and Taiwanese. 2. Other nationalities include Canadian, Indonesia, Malaysian, Filipino, Portuguese, Thai, British, and American. 3. The asterisk * implies that the average efficiency of the respective nationality/ownership is at least statistically different from another nationality/ownership at the 5% level or higher (Analysis of Variance or ANOVA).

Pair-wise Comparisons between two types of ownership reveal that an average firm of Chinese ownership and other nationalities is roughly 17% and 27% more technically efficient than Cambodian firm, respectively. Foreign firms are about 17% more efficient than local firms. The pattern of PTE index assimilates the trend of TE score as discussed above. It is important to note that these results should be interpreted

[38] For the case of Cambodia, the distinction between 'the types of ownership' implies 'the nationalities (of owner)'. Hence, these two terms are used interchangeably.

with caution, because the ANOVA is relatively sensitive to the distribution of the efficiency indices due to unequal sample sizes. Hence, these findings should be viewed in close relation with those of the following regression analysis.

5.1.3.2 Determinants of Firm Efficiency

This section presents the estimates from the regression analysis on possible determinants of technical efficiency. Equation (4.59) has been estimated by the ordinary least square regression and Tobit model. For the interpretability and simplicity the following discussion is based on the OLS results and the Tobit models are attached for comparison and completeness. The results from the two empirical methods are very similar in terms of sign and significance of the determinants (Table 5-8). Column (1) to (3) present the estimates for TE, PTE and SE from the OLS, and corresponding results from the Tobit model are in column (4) to (6), respectively. The choice of determinants or explanatory variables for efficiency is also deemed acceptable for cross-section regressions (R^2 equals 0.22 and 0.16 for TE and PTE index, respectively).

All regressions have been tested for heteroskedasticity and corrected by using the White robust standard error and Huber/White procedure. Generally, it can be observed that the principal estimates are significant for technical and pure technical efficiency, whilst the coefficients for the scale efficiency score are not significant. The absence of the impacts of the selected determinants on scale efficiency is attributable to the fact that the SE score does not seem to follow a normal distribution which is one of the necessary assumption for the regression analysis.

a. Effect of technological level (Capital intensity)

The estimate for capital intensity or technological level is very significant for TE and PTE indices with a negative sign. This means that, ceteris paribus, an increase in capital intensity by one percentage point would be associated with deterioration in efficiency by roughly one tenth percentage point. Although the magnitude is relatively

small, the result points to the fact that the current technological level in Cambodia's garment industry might not be appropriate for the production and labor. A similar result found in Vu (2005) suggests that investment was not comprehensive or the human resource was not adequate.

Table 5-8: Results from OLS and Tobit estimations (Cambodia)

	OLS Regression			**Tobit Model**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	Dependent variable:			**Dependent variable:**		
Variable	**TE**	**PTE**	**SE**	**TE**	**PTE**	**SE**
CONS	-0.113	0.018	0.697***	-0.046	0.123	0.765***
	(0.344)	(0.367)	(0.207)	(0.362)	(0.400)	(0.202)
AGE	0.005	0.006	0.001	0.005	0.004	-0.0001
	(0.009)	(0.010)	(0.006)	(0.009)	(0.011)	(0.006)
LnCAPIN	-0.102***	-0.098***	-0.005	-0.121***	-0.123***	-0.022
	(0.032)	(0.034)	(0.016)	(0.040)	(0.045)	(0.022)
FL_SHARE	0.003**	0.004**	-0.001	0.003**	0.005**	-0.001
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
LnPWWAGE	0.125**	0.107**	0.026	0.130**	0.113**	0.030
	(0.053)	(0.058)	(0.033)	(0.056)	(0.062)	(0.033)
PVAR	0.012	0.009	0.006	0.011	0.009	0.006
	(0.006)	(0.006)	(0.003)	(0.006)	(0.007)	(0.003)
DPNH	-0.117**	-0.087*	-0.046**	-0.121**	-0.099*	-0.050**
	(0.051)	(0.054)	(0.022)	(0.052)	(0.060)	(0.023)
DACHN	0.180***	0.165***	0.071	0.182***	0.171***	0.074*
	(0.046)	(0.005)	(0.041)	(0.046)	(0.055)	(0.041)
DKOR	0.123	0.123	0.071	0.129	0.129	0.078
	(0.081)	(0.095)	(0.070)	(0.081)	(0.096)	(0.069)
DOTHERS	0.282***	0.277***	0.056	0.282***	0.291***	0.057
	(0.096)	(0.102)	(0.050)	(0.095)	(0.108)	(0.050)
Obs.	197	197	197	197	197	197
R-squared	0.216	0.163	0.046			
Log likelihood				-4.514	-45.316	68.705
Pseudo R-sq.				0.843	0.278	-0.087

Source: Author's calculations.

Notes: 1. Heteroskedasticity was tested and corrected using White robust standard method in OLS regressions and Huber/White method for the Tobit model. 2. Standard errors are in parentheses. 3. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively. 4. All variables have been tested for collinearity using the correlation coefficients. The result indicates no collinearity.

Since the industry is relatively young and dominated by CMT-business, it would be difficult for average garment firms earning only a labor cost margin to afford state-of-the-art technologies. Hence, they would tend to purchase used and out-of-date equipment for production or the labor quality might be inadequate for investment in new technologies. An upgrading in the level of technology and capital goods investment alone would not yield expected positive impact, unless young garment

workers are also provided with skill training to capitalize on the more advanced technologies. Our field survey also reveals a need for skill training raised by garment firm operators (managers, production managers, owners) in Phnom Penh area.

b. Effect of worker remuneration

The coefficients for workers' reward on technical efficiency are positively significant at the 5% level, implying that a one-percentage point increase in wages would yield an improvement in efficiency by roughly 0.12%. This result could be explained by the fact that the wage rates in Cambodia are still low, far below the efficiency wage (fundamental efficiency wage). Hence, a rise in wages would give workers more incentive to work harder and improve their productivity and efficiency.

To date, the recruitment and remuneration in this industry, especially in the capital city Phnom Penh, are exacerbated by the hike in prices and living costs. The recent increase in minimum wage and compensation for inflation ($11 per month in total) would be an incentive for workers to maintain their work efforts and thereby contribute to enhancing productivity and efficiency. Moreover, the movement of workers back to farming as a result of an increase in rice price would point to a decrease in real wages in the garment industry. On the other hand, an increase in wages is a burden for factory owners as it adds to production costs and deteriorates the comparative advantage of the industry.

c. Effect of ownership/nationality

The probably most interesting feature of the investigation is the analysis of the efficiency difference among nationalities and the factors behind such performance. The coefficient estimates are statistically very significant for Chinese and other nationalities, while that of Korean nationality is insignificant. The findings imply that, if the ownership or nationality is controlled for, compared to Cambodian garment firms, an average Chinese firm is roughly 18% more efficient and an enterprise owned by other

nationalities is about 28% superior in technical efficiency. Korean firms seem to achieve comparable efficiency level as local counterparts. Furthermore, pure technical efficiency shows similar behavior with an efficiency difference of approximately 17% for Chinese and 28% for other nationalities. Overall, these results lend support to the trends revealed in the above-mentioned ANOVA (Section 5.1.3.2.b).

These findings are most attributable to the fact that foreign garment firms are superior to local factories in many aspects of business, such as production technologies, knowledge and skills, marketing, customer relations, and the like. Also, many foreign factories in Cambodia are affiliates or members of multi-national garment corporations with headquarters and agents located in more developed countries and/or closer to the major markets (China, Taiwan, Hong Kong, USA, UK, EU, etc.). They possess better market information and access, superior marketing knowledge, and wider range of supplier choices etc. Hence, they are in a more advantageous position in the production chain and can consequently achieve superior performance. The following example would illustrate this situation more clearly.

The recent field survey includes interviews and visits to 12 factories of different nationalities, including the (likely) most efficient firm in the country. This factory mainly produces men's shirts for UK market. It is part of a big corporation which owns many production plants in many countries, such as Bangladesh, Mauritius, Morocco, China and Sri Lanka, and has a share of 43% in men's shirt in the UK market. The management team consists of garment experts with 27 to 40 years of experience in this business. Therefore, they are superior to competitors in many aspects, such as worker training, production equipment and layout, logistics and so on. The factory has achieved extraordinary high productivity of 5,200 dozens of shirts per week, increased from 3,400 in 2006 (time-wise measure of productivity, like number of men's shirts produced in one minute or number of the items produced in one minute in each section).

d. Additional determinants of efficiency

Apart from the main determinants discussed above, the regression analysis also includes some other variables: product variety, percentage share of expatriates and a dummy for location in Phnom Penh. First, the types of products a factory can produce, a proxy for product variety, does not seem to exert any impact on firm efficiency. Second, although the presence of foreign workers has some positive significant impact on efficiency, the magnitude is negligible.

Finally, the location in the capital city appears to harm firm efficiency (see Hem (2006) for a similar effect on labor productivity). Possible reasons for this rather unexpected finding might be the spillover effect, high turn-over rate and proximity to the port. Newly recruited workers usually receive two- to four-week training prior to placement in the production. Having gained certain experience, they could move to other factories in the concentrated production area more easily in favor of higher wages or better work conditions. The movement of labors and high turn-over rate would contribute to knowledge spillovers among workers. Hence, some firms would gain from this effect, but some others would lose good workers, and this might have some impact on the production. Moreover, the majority of garment factories are concentrated in Phnom Penh, which is about 230 kilometers from the deep-sea port in Sihanoukville. The distance from port could add to cost of logistics, transportation and overall production, while garment firms located near to the port area could reduce such costs. Therefore, with high energy and transportation cost, this effect might be apparent in the technical efficiency of firms.

Appendix 5A: Additional Results for Cambodia

Table 5A-1: Frequency distribution of efficiency indices (Cambodia)

		TE score		PTE score		SE score	
No.	**Efficiency score interval**	**No. of firm**	**% share**	**No. of firm**	**% share**	**No. of firm**	**% share**
1	0.00< x ≤0.10	16	8.12	0	0.00	3	1.52
2	0.10< x ≤0.20	24	12.18	4	2.03	7	3.55
3	0.20< x ≤0.30	24	12.18	26	13.20	5	2.54
4	0.30< x ≤0.40	31	15.74	25	12.69	9	4.57
5	0.40< x ≤0.50	31	15.74	35	17.77	12	6.09
6	0.50< x ≤0.60	25	12.69	30	15.23	10	5.08
7	0.60< x ≤0.70	17	8.63	24	12.18	15	7.61
8	0.70< x ≤0.80	10	5.08	16	8.12	22	11.17
9	0.80< x ≤0.90	6	3.05	9	4.57	37	18.78
10	0.90< x ≤1.00	13	6.60	28	14.21	77	39.09
	Total	197	100.00	197	100.00	197	100.00

Source: Author's calculations

Note: TE, PTE and SE represent technical efficiency, pure technical efficiency and scale efficiency, respectively.

Table 5A-2: Detailed results from ANOVA (Cambodia)

ANOVA for TE	***DCAM***	***DACHN***	***DKOR***	***DOTHERS***	***DFOREIGN***
DCAM		**	-	***	**
DACHN			-	-	
DKOR				-	
DOTHERS					
DFOREIGN					
ANOVA for PTE	***DCAM***	***DACHN***	***DKOR***	***DOTHERS***	***DFOREIGN***
DCAM		**	-	***	**
DACHN			-	-	
DKOR				-	
DOTHERS					
DFOREIGN					
ANOVA for SE	***DCAM***	***DACHN***	***DKOR***	***DOTHERS***	***DFOREIGN***
DCAM		-	-	-	-
DACHN			-	-	
DKOR				-	
DOTHERS					
DFOREIGN					

Source: Author's calculations

Notes: 1. *, **, *** represents significance at the 1%, 5%, and 10% level, respectively. 2. The minus symbol '-' denotes insignificance. 3. *DCAM* represents Cambodian, *DACHN* Chinese origin, *DKOR* Korean, DOTHERS all other nationalities/ownership, and *DFOREIGN* all foreign ownerships combined.

5.2 FIRM EFFICIENCY AND PRODUCTIVITY IN LAO GARMENT INDUSTRY

5.2.1 Recent Development in Lao Garment Industry

a. Emergence and role of the garment industry

The modern history of the Lao garment industry is relatively short. In fact, it started in the early 1990s, immediately upon the implementation of the transition policy (the so-called New Economic Mechanism). In 1990 there were merely two factories operating and exporting garment products of about US$6 million, which comprised roughly 9%[39] of the merchandise exports.

Table 5-9: Basic statistics of Lao garment industry 1995-2006

Year	Export firms (subcont.) (1)	Workers (persons) (2)	Quantity (1000 pieces) (3)	Nominal exports (1000 US$) (4)	Exports at 2000-prices (1000 US$) (5)	Real growth (%) (6)	% share in goods exports (7)
1995	N/A	N/A	20,500	87,000	92,402	-	27.97
1996	N/A	N/A	16,500	62,000	63,442	-31.34	19.20
1997	N/A	N/A	20,285	73,056	67,218	5.95	20.35
1998	58 (10)	17,200	27,064	76,146	68,070	1.27	20.58
1999	55 (18)	18,000	25,934	100,026	106,305	56.17	32.16
2000	53 (26)	19,000	25,560	108,087	108,087	1.68	32.75
2001	52 (26)	20,000	26,955	103,486	106,984	-1.02	31.26
2002	53 (27)	21,462	23,114	103,380	113,594	6.18	34.69
2003	55 (31)	23,846	32,247	115,134	113,363	-0.20	32.07
2004	57 (43)	26,000	31,909	131,720	119,746	5.63	36.49
2005	58 (55)	27,500	33,470	144,868	86,518	-27.75	33.30
2006	59[a] (57[a])	N/A	35,581	151,182	56,616	-34.56	N/A

Source: Association of the Lao Garment Industry (ALGI), 2007.
Notes: 1. figure in parentheses in column (1) represents number of branches and subcontractors. 2. In column (5) nominal export value is deflated by Export Value Index (2000=100). 3. Superscript 'a' denotes that the data are for January-March, 2006. 3. Data of merchandise (goods) exports are taken from World Development Indicators, 2007, World Bank.

In the following decade, however, the country has experienced remarkable emergence of this industry until the end of the quota period. Specifically, the number of export firms increased to 58 in 1998 and has fluctuated between 52 and 58 during 1999-2005. Over the same period, the number of subcontractors and labor employed increases steadily to 55 factories and 27,500 persons, respectively (Table 5-9, column 1-3). This would imply that export garment firms in Laos tend to expand their

[39] Source: Author's calculations based on the commodity trade data from UN Comtrade.

production plants and outsource their production to meet the growing demand, while new entry is less apparent.

With respect to industry's output, both export quantity and value in nominal terms have rise steadily for 15 years to 33.5 million pieces and US$145 million in 2005, respectively. However, the real export value showed an increasing trend in the quota period and peaked at US$120 million in 2004, but upon the termination of the MFA it declined to US$87 million in 2005. The rate of real growth, which was mainly positive in the MFA-period, has turned negative in the post-MFA period (-35% in 2006).

The crucial role of this industry in the national economy is highlighted in the apparel exports and employment. The garment industry is among the top three export industries earning foreign exchanges for the country (the other two are hydropower and mining industries). Its share in merchandise exports increases from about 20% in the mid-1990s to 33% in 2005 (Table 5-9, column 7). Garment exports ranked first in the export list during 1998-2002 and have just been surpassed by gold and copper exports recently (NSC, 2007a). On the other hand, the garment industry is the largest non-agricultural sector which provides employment opportunities for the poor, especially rural females. It employs more than a quarter of about 100,000 labors in the industry sector and this trend has been increasing for recent years (Table 5-10).

Table 5-10: Structure of enterprises in Laos

No.	Description	2002	2003	2004	2005
1	Number of enterprises	24,742	25,607	26,200	23,420
	Large size	112	119	207	144
	Medium size	604	614	722	775
	Small size	24,026	24,874	25,271	22,501
2	Production value (billion Kip)	1,423	2,314	2,911	N/A
3	Total labor in industry	91,034	98,557	103,021	101,945
4	*% share of labor in garment ind.*	*23.58*	*24.20*	*25.24*	*26.98*

Source: Ministry of Industry and Commerce, Vientiane, Lao PDR (formerly: Ministry of Industry and Handicraft) and ALGI, 2007

Note: Enterprises with 100 employees and above are classified as large, between 10 and 99 medium, and less than 10 small.

Table 5-11: Lao trade flows in garment and textile products in 2005 (US$ thousand)

LAOS	Garment industry (SITC 84)						Textile industry (SITC 65 + SITC 26)						T&G
Trade Partners	**Exports**		**Imports**		**Net Exports**		**Exports**		**Imports**		**Net Exports**		**Net**
	Value	% share	Value	% share	Value	% share	Value	% share	Value	% share	Value	% share	**Exports**
EU 15	**159,698**	**91.26**	**137**	**1.26**	**159,561**	**97.24**	**28**	**5.00**	**740**	**0.78**	**-712**	**-0.77**	**158,848**
ASEAN 10	**1,251**	**0.72**	**8,195**	**75.11**	**-6,943**	**-4.23**	**1,911**	**88.28**	**83,586**	**87.90**	**-81,675**	**-87.90**	**-88,618**
Indonesia	1	0.00	52	0.48	-50	-0.03	0	0.00	391	0.41	-391	-0.42	-442
Malaysia	7	0.00	32	0.29	-25	-0.02	0	0.00	1,335	1.40	-1,335	-1.44	-1,360
Singapore	179	0.10	7	0.07	171	0.10	0	0.00	28	0.03	-28	-0.03	143
Thailand	1,047	0.60	5,376	49.27	-4,329	-2.64	683	31.55	67,653	71.15	-66,970	-72.07	-71,299
Vietnam	18	0.01	2,728	25.00	-2,710	-1.65	1,228	56.72	14,179	14.91	-12,951	-13.94	-15,661
China	202	0.12	2,080	19.06	-1,878	-1.14	45	2.09	4,571	4.81	-4,526	-4.87	-6,404
Hong Kong		0.00	376	3.44	-376	-0.23	29	1.35	3,995	4.20	-3,965	-4.27	-4,341
Pakistan	184	0.11	89	0.81	95	0.06	0	0.00	745	0.78	-745	-0.80	-650
USA	2,983	1.70		0.00	2,983	1.82	26	1.22	167	0.18	-141	-0.15	2,843
Japan	1,337	0.76	17	0.16	1,319	0.80	81	3.72	883	0.93	-803	-0.86	516
Canada	5,708	3.26		0.00	5,708	3.48	5	0.23	0	0.00	5	0.01	5,713
Australia	272	0.16	16	0.15	256	0.16	8	0.39	226	0.24	-218	-0.23	38
World Total	**174,999**	**100.00**	**10,910**	**100.00**	**164,088**	**100.00**	**2,164**	**100.00**	**95,087**	**100.00**	**-92,923**	**-100.00**	**71,166**

Source: Author's calculations based on the commodity trade data from UN Comtrade (export data are CIF-import data of 38 trade partners).
Notes: 1. SITC 84: Articles of apparel and clothing accessories. 2. SITC 65: Textile yarn, fabrics, fibres, made-up articles. 3. SITC 26: Textile fibres. 4. The difference between the export value reported in this table and that of Table 5-9, column 4, is due to the fact that the export data of Laos here are represented by CIF-import data reported by Laos' trade partners, and, hence, the difference is attributable to the insurance and freight components of the CIF-data.

b. Exports and imports in textile and apparel products

The Lao garment industry is highly export oriented. It exports the production to world's major markets (EU, Canada, USA) and the country imports clothing products for domestic consumption. Table 5-11 presents the trade in textile and garment products for 2005. Export turnover classified by destination is as follows: 91% to EU, 3% Canada and 2% USA. The main suppliers of garment products for domestic consumption are member countries of the ASEAN, such as Thailand (49%) and Vietnam (25%) as well as China (19%); and Hong Kong (3%).

With regard to material input, Lao garment producers need to import materials for production. Owing to the absence of the backward-linkage (textile) industry and the dominance of CMT-type business, practically all of fabrics and accessories for production are imported in accordance with the requirements of customers. Similar to the case of garment imports, ASEAN countries supply about 88% of textile yarns, fabrics and fibers, of which Thailand (71%) and Vietnam (15%) are the leaders. The garment industry (SITC 84) records a trade surplus of US$164.1 million, while the textile industry (SITC 26 and 65) has a trade deficit of US$92.9 million. Overall, in 2005 the textile and garment industry make a trade surplus of about US$71.2 million.

The pattern of Lao garment exports to the major market is characterized by the Generalized System of Preferences (GSP) applied by the EU[40]. Under this scheme Lao exporters need to fulfill certain requirements of the rule of origin (ROO) in order to receive export quotas from the EU. There are two types of ROOs: (1) Derogations: Laos needs to request a derogation to use raw materials from other countries with ceiling on exports to EU, which is valid for 2 years and must be renewed after expire; and (2) ASEAN Cumulative Rules of Origin: As a member of ASEAN Laos can use raw materials from ASEAN members for knitted and woven products exported to EU,

[40] Much of information about GSP and recent development trends in Lao garment industry presented in this chapter is drawn from 2 field surveys conducted by the author in February and December, 2006. Further explanations on GSP are also available in NSC (2007a), p. 27.

but the domestic value-added (VA) must be higher than the highest value of imported materials.

c. Development trend in post-MFA era

In a short period about 15 years, the Lao garment industry has been growing remarkably and emerged into one of the country's leading export industries. Similar to Cambodia, the industry is characterized by foreign dominance in form of FDI and Joint Venture (JV) ownership, which accounts for nearly 70% of garment factories in 2005, whereas Lao firms share only one thirds (Table 5-12). The table also accentuates the role of foreign direct investment (FDI) as nearly four fifths of the labors and production equipment are employed by FDI and JV firms. In terms of business structure, roughly 40% are operating on the FOB basis and most of them are FDI and JV enterprises (NSC, 2007a).

Table 5-12: Ownership structure of garment firms 2005 (Laos)

	Number (% share)	**Labor (persons)**	**Machine (units)**	**Production capacity (1000 pcs/year)**
Lao	19 (32.76)	5,274	3,086	13,165
FDI	28 (48.28)	12,685	7,442	26,541
JV	11 (18.97)	5,165	3,020	5,356
Total	58 (100.0)	23,124	13,548	45,061

Source: Membership directory 2005, ALGI

It is worth noting that one unique feature of the Lao garment industry is the provision of accommodation and transportation. Although the wage rates are lower than in many other LDCs, the large part of garment factories in Laos provide dormitory, transportation to and from factories, and meal free of charge. With a minimum wage of US$26/month, wage rates in Laos are among the lowest compared to some main garment exporters (NSC, 2007a, p. 39, Table 5).

To date, the MFA phase-out does not seem to do harm to the industry as relevant indicators have pointed to positive development. However, our field surveys have revealed that many factory owners and managers are quite pessimistic about the

industry's performance in the post-MFA era and upon the termination of the Safeguards, as export revenue has declined after 2004 and the competition has intensified. Also, the normal trade relation (NTR) with the U.S. accorded in December 2004 using MFN treatment has not yielded expected positive effects to Lao garment exports (NSC, 2007a).

In response to these situations, ALGI (Association of Lao Garment Industry) is adopting an approach to avoid direct competition with China and to learn from China on how to export to US. The association is advising its members to (i) select a main market, preferably the EU market; and (ii) focus on EU, New Zealand, Norway, Japan and Canada markets. To date, Lao garment exports cover merely 0.3% of EU's import from LDCs, but the country has a ceiling of 2% and hence there is still much room to improve (based on an interview with the president of ALGI, Mr. Onsey Boutsivongsakd, during author's field survey).

d. Recent issues and impediments

Following the termination of MFA, the Lao garment industry has entered a critical phase with fiercer competition and its development is hindered by many factors, such as local labor shortage and low productivity just to name some. First, the industry has developed around the capital city, Vientiane. Similar to the situation in Ho Chi Minh City (Vietnam) and Phnom Penh (Cambodia), the resulting high concentration has partly given rise to the so-called local labor shortage. Garment workers usually go back to their home town during the farming season to help family. Many of them do not come back or change their jobs or factories, which in turn leads to high labor turn-over rates of 30-40% per annum. Moreover, development in other industries has driven up the wage rates and drawn labor from the industry. Company owners and manager find it more and more difficult to recruit and retain new workers.

Second, being a landlocked country, garment exporters in Laos have to rely on sea transport in neighboring countries. Currently, Lao exporters are using three sea ports for delivery of garment products to customers, namely Bangkok port in Thailand, Danang port and Cua Lo port both in Vietnam. Complicated customs procedures and the associated high cost of transportation lead to higher costs of doing business, lower mark-up margins, longer lead time (up to 70 days), and thereby affect the industry's competitiveness negatively. Also, being located far from the main markets, Lao garment exporters have to rely on the service and assistance of ALGI for market information and market access. Foreign exporters, on the other hand, are in a better position, because they can obtain updated information from parent companies and headquarters.

Third, Lao comparative advantage in low labor cost in partly compensated by low productivity level (measured as output/worker/year). Despite an improvement in labor productivity among garment factories in recent years, the productivity level in Laos is still very low (1,348 pieces/worker/year). In fact, it is the lowest compared to South Asian competitors and China (7,500 pieces/worker/year). Shortage of skilled labor, low education level of workers, high labor turn over rate, and low capital productivity have been figured out as main factors affecting labor productivity (NSC, 2007a).

In sum, the overall competitiveness of the Lao garment industry is impeded by several factors, such as inefficiency in ports and transportation, weak physical infrastructure, low labor skills, lack of backward linkage or supporting industries, lack of access to market information and finance, low labor productivity and the like. Therefore, one of the key issues in longer-term is how to enhance efficiency and productivity in order to cope with more intensified competition, improve competitiveness and further develop this industry.

5.2.2 Data and Variables for Empirical Analysis (Laos)

Statistical data for the empirical analysis are obtained from the Ministry of Industry and Commerce (Department of Industry and Commerce) and the Ministry of Finance, which include information of year 2004-2005 and cover the transition period from quota to post-quota era. This fact is very crucial for the analysis and needs to be taken into account when interpreting the results. For the purpose of this study, the author also conducted 2 field surveys in Vientiane in February and December 2006, which include interviews with the management of garment firms and ALGI.

5.2.2.1 Data Mining

The initial dataset consists of 38 samples. The following criteria are applied in selecting enterprises to be included in the analysis:

1. enterprises with complete information on output/exports, capital, labor, ownership and other necessary variables;
2. firms with at least one-year of age; and
3. the ratio of the minimum and maximum value of each variable (except for dummies) must be greater than 0.0001 (required by DEA Solver software to avoid loss of numerical accuracy) (Seitech Inc., 2006, p. 21).

Table 5-13: Composition of data on Lao garment industry

By ownership	Sample	Lao	FDI	Joint Venture
2004	33 (100.0)	9 (27.27)	17 (51.52)	7 (21.21)
2005	33 (100.0)	9 (27.27)	17 (51.52)	7 (21.21)
By labor	**Sample**	**1- 99**	**100 - 499**	**500 ~**
2004	33 (100.0)	1 (3.03)	24 (72.73)	8 (24.24)
2005	33 (100.0)	1 (3.03)	23 (68.70)	9 (27.27)

Source: Author's calculations. Data are from the Ministry of Industry and Commerce of Laos (former Ministry of Commerce).
Notes: 1. Percentage share is in parentheses. 2. Lao denotes Lao ownership. 3. FDI represents wholly foreign owned garment firms. 4. Joint Venture represents joined ownership between Lao and foreign investors.

Upon data mining and removing extreme value of capital, efficiency and productivity change, there are 33 samples in the dataset covering 57-58% of the garment listed as members of the ALGI for the years under study. Table 5-13 summarizes the dataset.

Similar to the case of Cambodia, Lao garment industry is dominated by foreign-owned enterprises (52%) and Joint Venture firms (21%), while local enterprises share only about 27%. In another classification, the same dataset is classified by owner's nationality and it is revealed that one thirds is owned by Lao citizens, while Thai investors constitute the largest group of foreign owners (30%) and other nationalities[41] shares about 37%. In terms of labor, only one firm (3%) is of medium size[42] and the remaining is classified as large size enterprises, of which the majority (72.8%) employs 100 to 499 workers. Firms with 500 workers or more comprise 8%.

5.2.2.2 Variable Definition

As in many enterprise-level analyses, the choice of proxy variables for the estimation of firm efficiency and productivity growth in this paper are mainly constrained by the availability of statistical data. This section describes the definition of the proxy variables used in the empirical analysis.

a. Variables for Efficiency and Productivity (DEA) models

The CCR-O model, BCC-O model, and the output-oriented non-radial Malmquist Index are estimated with two inputs and one output. The estimation of the Malmquist Index uses panel data, and hence, the monetary variables (exports, capital) are expressed in real terms. The variables for the three models are defined as follows:

- Output (*EXPORT*): represents real exports of the enterprises in 2004 and 2005 denominated in US dollar. The export value index is used as deflator (2000=100);
- Input 1 (*K*): is the US dollar value of the total fixed assets used as a proxy for capital. Since most of the firms' fixed assets are imported capital goods (machinery, trucks and vehicles, construction materials etc.), we use the import value index as deflator (2000=100). Also, the consumer price index with the same base year is used for comparison purposes; and

[41] Other nationalities include Chinese, French, Japanese, Korean, Dutch, Pakistani, and Taiwanese.
[42] In Laos, enterprises with 100 employees and above are classified as large, between 10 and 99 medium, and less than 10 small.

- Input 2 (L): is the total number of workers (labor) as of the end of 2004 and 2005.

b. Variables for the regression model

In literature, there are different kinds of determinants of firm efficiency applied in empirical analysis. Such variables describe the characteristics of the individual enterprises (internal factors) or the business climate in which those firms are operating (external factors) and the like. As described in equation (4.60) this study focuses on the firm characteristics. This section presents the definition of the independent variables for this regression model. The dependent variable is the efficiency index (TE, PTE, and SE) obtained from the DEA models.

b.1) Continuous explanatory variables:

- *AGE* denotes the number of years of operation and is defined as the difference between year 2004 or 2005 and the establishment year;
- *CAPIN* is the capital intensity (in US dollar) and defined as the ratio of fixed assets over the total number of employees (this variable is deemed to give some measure of the technical level of the individual garment enterprises); and
- *STAFF_SHARE* represents the percentage share of staff to workers (staff includes managers, head of production lines, technicians and secretaries). This variable is considered as a measure of quality of labor;

b.2) Discrete explanatory (dummy) variables:

There are only three dummy variables, which represent the types of ownership of garment firms: Lao, foreign-ownership and Joint Venture.

- *DLAO* is the dummy for Lao-owned enterprises and equals 1 if true and 0 otherwise. The local firms are reference group for the regressions;
- *DFDI* is the dummy for wholly foreign-owned enterprises and equals unity if true; and
- *DJV* denotes the dummy for Joint Venture firms as recorded in the list of membership of ALGI. It is also defined similar to the other dummies.

The summary statistics of the dataset are presented in Table 5-14. It reveals that on average exports of a garment firm in Laos decreased from US$5.6 million in 2004 to US$3.5 million in 2005. However, garment firm owners in Laos appear to be optimistic about business prospects and invested more on capital goods and employ more labor. As a result, the average capital stock per factory expanded slightly from US$1.1 million to US$1.3 million and average workers per factory increased from 401 to 440 over the same period.

Table 5-14: Summary of main variables (Laos)

Lao garment 2004						**Coeff. of**
	Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**	**variation**
TE	33	0.329	0.296	0.049	1.000	0.90
PTE	33	0.452	0.318	0.055	1.000	0.70
SE	33	0.732	0.235	0.110	1.000	0.32
EXPORT (thousand US$)	33	5,605	4,694	511	20,903	0.84
K (thousand US$)	33	1,085	1,376	63	5,899	1.27
L (persons)	33	401	296	86	1,261	0.74
AGE (years)	33	10	3	2	14	0.30
CAPIN (US$/worker)	33	3,323	4,368	91	19,331	1.31
Share of staff (%)	33	6.88	7.39	0.31	42.19	1.07
Lao garment 2005	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**	**COV**
TE	33	0.290	0.267	0.050	1.000	0.92
PTE	33	0.411	0.313	0.065	1.000	0.76
SE	33	0.748	0.252	0.130	1.000	0.34
EXPORT (thousand US$)	33	3,546	2,974	139	14,614	0.84
K (thousand US$)	33	1,260	1,451	27	6,433	1.15
L (persons)	33	440	341	68	1,520	0.78
AGE (years)	33	11	3	3	15	0.27
CAPIN (US$/worker)	33	3,341	3,700	228	16,916	1.11
Share of staff (%)	33	5.15	3.38	0.31	15.17	0.66

Source: Author's calculations.
Notes: 1. Staff includes managers and line managers. 2. Efficiency indices are export-oriented type.
2. 'COV' stands for coefficient of variation.

The average capital intensity and share of staff to workers remain relatively stable over the period. Of all variables under consideration, those associated with capital, i.e. capital stock and capital intensity, are the most volatile, as the coefficient of variation is greater than unity (last column). Average age is of garment firms in Laos is about 10 years old.

5.2.3 Empirical Results and Discussions (Laos)

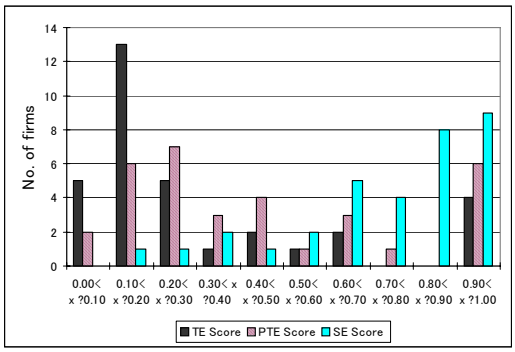
5.2.3.1 Efficiency Performance

a. Distribution and trend of efficiency indices

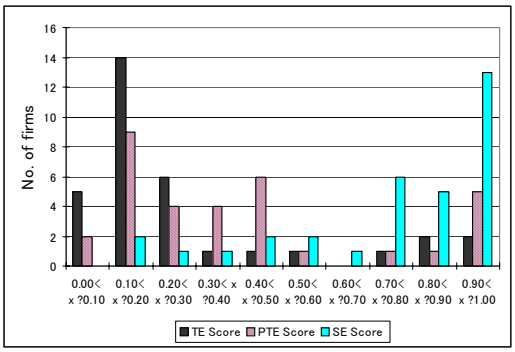
The measure of technical efficiency is closely related to the basic component of the Malmquist Index. Hence, in this first part the histogram of the three efficiency indices from DEA models are presented in Figure 5-2. The frequency distribution is reported in Table 5B-1 in Appendix 5B.

Figure 5-2: Distribution of efficiency indices (Laos)

(a) Distribution 2004



(b) Distribution 2005



Source: Author's calculations

The average efficiency level of the Lao garment industry is about 30% for the period under study. The PTE scores are greater than the TE scores as stated in the theory (Table 5-14). However, two points deserve discussion here. First, average technical efficiency decreased from 32.9% in 2004 to 29.0% in 2005. Although the decrease is rather marginal, this result implies that the gap between the best performers and the remaining garment firms has become wider. This might be caused by the MFA phase-out, which has induced more competition in this industry at global and national levels. For Laos, many firms have faced a drastic decrease in orders or even loss of orders and these might include some of the best performers of 2004 as well, and this would lead to a wider gap among garment firms. Second, the average TE score is quite low compared to other developing countries, such as 62% in Vietnam (Matsunaga and Vixathep, 2008) and 50% in Cambodia. Hence, this finding would mean that garment

firms in Laos are more widespread in terms of efficiency performance than in those countries. Similar to Cambodia's case, garments firms in Laos have achieved better scale efficiency performance as compared to TE and PTE (2004: 63.9% record a SE score of 0.7-1.0; 2005: 72.7% record a SE score of 0.7-1.0).

A comparison of individual firms during 2004-2005 reveals that 18 firms experienced efficiency deterioration, of which three were best performers and 16 recorded a TE score of 0.18 and above in 2004. On the other hand, out of 14 factories, which achieved augmentation, ten recorded a TE score of less than 0.17. Only one firm was able to retain the most efficient status. These trends imply that most of relatively efficient garment factories have experienced deterioration in efficiency over the study period which could lead to a fall in average TE score and wider gap in efficiency performance.

With respect to volatility, the coefficient of variation is less than unity in all cases (0.32-0.90, Column 6 in Table 5-14) mainly due to concentration, competition, technical spillovers and homogeneity of firms in Vientiane. However, the distribution of efficiency indices is more disperse than the case of Cambodia and Vietnam[43], implying that inter-firm variations are more considerable here. The distribution of the three efficiency indices presented in Figure 5-2 also confirms this behavior. Indeed, 50-60% of garment firms in Laos achieve an efficiency level of 20-30% (Table 5B-1 in the Appendix 5B).

b. Comparison of efficiency among types of ownership

Table 5-15 summarizes the three efficiency indices classified by ownership: Lao, foreign owned (FDI) and Joint Venture (JV). The significance of the difference among the groups is based on the analysis of variance (single-factor ANOVA). Overall, it appears that 100% Lao ownership is associated with higher efficiency (above the

[43] The coefficient of variation of technical efficiency is 0.28 for Vietnam, 0.58 for Cambodia, and 0.90-0.92 for Laos.

industry's average) for the whole period under study. On the other hand, foreign firms seem to perform more efficiently than Joint Venture firms in 2004, but the trend is reversed for 2005.

These results are rather surprised, because FDI and JV firms are considered to have superior technologies, managerial skills, marketing, and access to markets and finance and hence higher efficiency. However, the differences among the types of ownership are not statistically significant as obtained by ANOVA, implying that the efficiency level of garment firms in Laos is comparable regardless of ownership.

Table 5-15: Efficiency indices classified by ownership (Laos)

2004		Mean and standard deviation					
	Number	**TE index**		**PTE index**		**SE index**	
Ownership	**(% share)**	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Lao	9 (27.27)	0.396	0.305	0.554	0.333	0.779	0.286
FDI	17 (51.52)	0.321	0.337	0.434	0.344	0.714	0.247
JV	7 (21.21)	0.262	0.170	0.364	0.224	0.716	0.137
Total	**33 (100.0)**	**0.329**	**0.296**	**0.452**	**0.318**	**0.732**	**0.235**
2005		**Mean**	**Std. dev**	**Mean**	**Std. dev**	**Mean**	**Std. dev**
Lao	9 (27.27)	0.334	0.265	0.474	0.325	0.792	0.277
FDI	17 (51.52)	0.227	0.236	0.356	0.287	0.696	0.277
JV	7 (21.21)	0.385	0.334	0.460	0.379	0.819	0.121
Total	**33 (100.0)**	**0.290**	**0.267**	**0.411**	**0.313**	**0.748**	**0.252**

Source: Author's calculations.
Notes: 1. Lao denotes Lao ownership. 2. FDI represents wholly foreign owned firms. 3. Joint Venture (JV) represents joined ownership between Lao and foreign investors. 4. The asterisk * implies that the average efficiency of the respective ownership form is at least statistically different from another ownership form at the 10% level or higher (Analysis of Variance or ANOVA). 5. ANOVA reveals no statistically significant differences among ownerships.

It is worth noting that these results should be interpreted with caution, because the ANOVA is relatively sensitive to the distribution of the efficiency indices due to unequal sample sizes. Hence, these findings should be viewed in close relation with the outcomes of the productivity and regression analysis.

5.2.3.2 Determinants of Firm Efficiency

This section presents the estimates from the regression analysis on possible determinants of technical efficiency. Equation (4.60) is estimated by the ordinary least square regression and Tobit model. For the interpretability and simplicity the following discussion is based on the OLS results and the Tobit models are attached for

comparison and completeness. The results from the two empirical methods are very similar in terms of sign and significance of the determinants (Table 5-16 and Table 5B-2). The choice of explanatory variables for efficiency in this analysis is deemed acceptable for cross-section regressions (R^2 ranges between 0.15 and 0.28, except for TE in 2005 only 0.09). All regressions have been tested for heteroskedasticity and corrected by using the White robust standard error for OLS and Huber/White procedure for Tobit model. Most surprisingly, the coefficient estimates are statistically significant for only one variable: *STAFF_SHARE*. The regression results can be summarized as follows:

Table 5-16: Estimation results from OLS regressions (Laos)

	OLS Regression (2004)			**OLS Regression (2005)**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	Dependent variable:			**Dependent variable:**		
Variable	**TE**	**PTE**	**SE**	**TE**	**PTE**	**SE**
CONS	0.311	0.975*	0.426	0.434	1.316**	0.206
	(0.413)	(0.537)	(0.449)	(0.410)	(0.505)	(0.536)
AGE	0.010	-0.009	0.013	-0.001	-0.021	0.009
	(0.015)	(0.022)	(0.018)	(0.019)	(0.024)	(0.019)
LnCAPIN	-0.028	-0.061	0.014	-0.021	-0.08*	0.051
	(0.052)	(0.051)	(0.036)	(0.046)	(0.049)	(0.044)
STAFF_SHARE	0.019***	0.013**	0.011**	0.010	0.004	0.020
	(0.005)	(0.005)	(0.005)	(0.015)	(0.018)	(0.012)
DFDI	0.025	-0.068	-0.001	-0.093	-0.108	-0.098
	(0.118)	(0.142)	(0.122)	(0.119)	(0.122)	(0.113)
DJV	-0.047	-0.137	-0.014	0.069	-0.006	0.034
	(0.099)	(0.133)	(0.118)	(0.145)	(0.171)	(0.106)
Observations	33	33	33	33	33	33
R-squared	0.278	0.192	0.153	0.091	0.147	0.151

Source: Author's calculations

Notes: 1. Heteroskedasticity was tested and corrected using White robust standard method in OLS regressions and Huber/White method for the Tobit model. 2. Standard errors are in parentheses. 3. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively. 4. All variables have been tested for collinearity using the correlation coefficients. The result indicates no collinearity.

First, similar to the ANOVA, the efficiency difference among various ownerships is negligible, although the sign and magnitude differ in some cases. This result lends support to the above argument that efficiency among garment firms in Laos be comparable regardless of ownership. The following factors might be considered as causes: (i) the weakness in the system, such as inappropriate infrastructure, bottlenecks in transportation due to absence of sea access and port, backwardness in information

and communication technology (ICT) etc., might prevent enterprises from realizing their potential (see NSC (2007a) for further causes); (ii) garment enterprises in Laos might employ local staff at the middle management level, which could result in low level and homogeneity in efficiency owing to their comparable background, knowledge and skills (more in-depth research is needed to ascertain this claim); and (iii) the reason for such results might lie in the erroneous collection and record of data.

Second, the insignificance of coefficient estimates of age implies that the years of operation would not help improve technical efficiency. This finding points to two important issues. First, ceteris paribus, average young firms would be able to catch up with other competitors in terms of managerial, technical and marketing skills to improve firm efficiency in relatively short time. This could be explained by the intra-industry specialization of the Lao garment industry in relatively simple product lines, which would enable such a catch-up in a short period of time (Vixathep and Matsunaga, 2007), and the dominance of CMT-business. Second, the years of operation among garment firms in Laos are comparable, which would lead to comparable technical and skill levels. In fact, one can observe that the average age of garment firms is about 10 years old (Table 5-14) and the number of firms in the garment industry has been relatively stable (Table 5-9), meaning that they would be comparable in many aspects of production, marketing and exports.

Third, the coefficient for capital intensity is negative and insignificant. This finding would imply that the current technology level is not appropriate for the skill level of workers. Vu (2005) found a similar result and suggested that investment was not comprehensive or the human resource was not adequate. An upgrading in the level of technology and capital goods investment alone would not yield expected positive impact, unless young garment workers are also provided with skill training to capitalize on the more advanced technologies. Our field surveys also reveal a need for skill training raised by garment firm operators (managers, production managers, owners) in

Vientiane. Also, the problem of low skill base of labor and the need for improving education system has been pointed out as causes of low productivity in NSC (2007a). A mismatch between technology and labor skill level could lead to insignificance of capital investment.

Finally, the estimate of staff share on efficiency is the only significant coefficient and implies that, if this factor is controlled for, one percentage point increase would be associated with efficiency augmentation by 0.02%[44]. The effect appears to be merely marginal, but if a more appropriate and accurate proxy of labor quality is available, the magnitude would increase substantially. This result points to the importance of the education and skill training of labor force (labor quality) in enhancing efficiency and productivity. This would also lend support to the aforesaid argument that capital goods investment should match with human resource development if technical efficiency is to be improved. Also, this variable is rather vague to advocate a firm conclusion. Hence, further analysis that uses more accurate proxies for labor quality or human capital would undoubtedly yield improved results and could ascertain the argument put forward here.

As mentioned in Section 5.2.3.1, the analysis has also been conducted under a classification by owner's nationality. The composition of the data, results of the ANOVA and regression analysis are presented in Appendix 5C for reference (Table 5C-1 to 5C-4). Overall, the empirical analysis under this classification has revealed comparable results and findings to those presented in this section. Similarly, the use of consumer price index as deflator for value of capital yields comparable results to those presented in this case.

[44] For explanation, an increase in STAFF_SHARE by 1% (ΔSTAFF_SHARE=1%) would be associated with an improvement in technical efficiency of ΔTE=[0.019/100]*ΔSTAFF_SHARE= 0.00019 Unit. However, in this special case the unit of TE itself is the percentage point, i.e. %ΔTE=0.00019*100%=0.019%.

5.2.3.3 Total Factor Productivity Growth

a. Components of total factor productivity

The non-radial output-oriented Malmquist Index has been calculated together with the technical change, efficiency change, pure technical change and scale efficiency change for all samples by means of equation (4.80) – (4.84). It is noted that the conventional radial output-oriented Malmquist Index has also been calculated for comparison. Results from the two models are nearly identical thereby implying an absence of slacks-problems. The discussions in this section are based on the non-radial output-oriented Malmquist TFP Index and its components.

Table 5-17: Components of TFP (average annual change) (Laos)

	MI	**TECH**	**EFFCH**	**PEFFCH**	**SCALECH**
Average	0.594	0.607	0.984	0.955	1.024
Std. Dev.	0.278	0.049	0.465	0.393	0.187
Max	1.220	0.682	1.918	1.891	1.304
Min	0.200	0.492	0.307	0.294	0.307
Coef. of var.	0.468	0.081	0.473	0.412	0.182
Average by ownership	**MI**	**TECH**	**EFFCH**	**PEFFCH**	**SCALECH**
Lao	0.551	0.629	0.888	0.852	1.031
FDI	0.536	0.607	0.874	0.891	0.980
Joint Venture	0.791	0.579	1.377	1.242	1.123

Source: Author's calculations.
Notes: 1. MI represents the Malmquist Index. 2. EFFCH denotes CRS efficiency change or catch-up. 3. TECH represents CRS technical change or frontier shift. 4. PEFFCH denotes variable returns to scale efficiency change. 5. SCALECH is scale efficiency change.

Table 5-17 reports the decomposition of TFP and Table 5-18 shows the TFP performance by ownership. The decomposition of TFP for individual firms is presented in Table 5B-3 in Appendix 5B. The figures in Table 5-17 are average change of 2004-2005. It is noted that a value of the MI or any of its components of greater than unity implies progress or improvement, whereas a value of less than unity denotes regress or deterioration in the corresponding components during 2004-2005. More precisely, the average annual change (increase or decrease) in the individual components can be calculated by subtracting one from the corresponding figures presented in the table.

Also, as in any DEA procedure, the performance of individual DMUs is evaluated relative to the grand frontier constructed by the best performers in the sample.

Overall, total factor productivity (i.e. MI) of Lao garment industry regressed by -40.6% in 2005 as compared to 2004. This decrease is mainly caused by deterioration in technical progress (TECH), which records a decrease of -39.27% as compared to a fall in efficiency change (EFFCH) by -1.56%. The small regress in EFFCH is attributable to improvement in scale efficiency (SCALECH) of 2.41%, because there was pure efficiency worsening (PEFFCH) by -4.51% based on the VRS technology. One can also note that inter-firm variations in MI and its components is of less significance, particularly the volatility TECH with a coefficient of variation of 0.081.

Next, part IV of Table 5-18 gives a more detailed picture of TFP growth, namely only 3 firms (9%) achieved TFP enhancement and 15 firms (45%) efficiency augmentation. On the other hand, all the firms recorded negative technical change, whereas 12 firms (36%) and 24 firms (73%) of the studied firms, respectively, achieved positive PEEFCH and SCALEFF in VRS technology, which was a source of the more positive trend in EFFCH under CRS.

Table 5-18: TFP performance by ownership (Laos)

	Ownership	Category	MI	TECH	EFFCH	PEFFCH	SCALECH
I	Lao	X > 1	0	0	3	2	7
	(9 firms)	X = 1	0	0	0	1	0
		X < 1	9	9	6	6	2
II	FDI	X > 1	1	0	7	5	10
	(17 firms)	X = 1	0	0	0	1	0
		X < 1	16	17	10	11	7
III	Joint	X > 1	2	0	5	5	7
	Venture	X = 1	0	0	0	0	0
	(7 firms)	X < 1	5	7	2	2	0
IV	Total	X > 1	3	0	15	12	24
	(33 firms)	X = 1	0	0	0	2	0
		X < 1	30	33	18	19	9
	Sample		33	33	33	33	33

Source: Author's calculations.

Notes. 1. Figures appearing in the table represent the number of garment firms in corresponding category. 2. MI represents the Malmquist Index. 3. EFFCH denotes CRS efficiency change or catch-up. 4. TECH represents CRS technical change or frontier shift. 5. PEFFCH denotes variable returns to scale efficiency change. 6. SCALECH is scale efficiency change.

The results in this analysis are consistent with the findings in previous studies for developing and transition economies that efficiency improvement occurs but technical progress is usually a rare case (see Chandran and Pandiyan (2007) for Malaysia; Nguyen and Giang (2005) for Vietnam; and Pilyavski and Staat (2008) for Ukraine). For more developed economies, growth in TFP often comes from technical progress (see Färe et al. (2001) for apparel and textile industry in Taiwan).

b. TFP performance by ownership

The bottom part of Table 5-17 shows the average performance in the Malmquist Index and its components by three ownership groups: Lao, FDI and JV firms. Results from ANOVA reveal that the differences in these components are largely significant for Joint Venture firms, whereas the figures for Lao and FDI firms are statistically not different. It is apparent that firms of all three ownerships record a deterioration in TFP (from -20.90% to -46.43%) and technical efficiency (-37.11% to -42.07%). With regard to EFFCH, however, Joint Venture firms achieve an improvement of 37.66% and this progress comes from pure efficiency augmentation (24.21%) and scale efficiency change (12.33%) under VRS technology. It is also noted that the degree of the regress in EFFCH is less than that of TFP and TECH (-11.22% for Lao and -12.60% for FDI firms). Again, the source of change comes from SCALECH in VRS technology (3.11% for Lao and -2.05% for FDI firms).

Part I, II and III in Table 5-18 confirm this trend. Specifically, three out of nine Lao firms (3/9), 7/17 FDI firms, and 5/7 Joint Venture firms achieve positive EFFCH. The figures in the table also confirm that the source of such change comes from PEFFCH and SCALECH under the VRS technology.

Similar to the case of efficiency analysis, the productivity analysis under the classification by owner's nationality has also revealed comparable results and findings. The detailed results are reported in Table 5B-3, 5C-5 and 5C-6 for reference.

In interpreting the results, two points should be noted here for consideration. First, the analysis is based on data of two adjacent years, which covers the termination of the quota system. Hence, long-term impacts of the MFA phase-out might not be evident as the statistics would contain exports and imports that have been agreed upon prior to the event. Second, the regress in TFP might be caused by a decrease in orders placed to garment factories in Laos and a fall in observed unit price[45] resulting from the phase-out (fiercer competition with China and Vietnam). In such a case, the rate of idled (unused) capital would increase, and hence, TFP is found to be deteriorated. However, efficiency and productivity might be underestimated and the garment firms would even have excess capacity. Therefore, further research applying longer time series data should be conducted in future to fully analyze and correctly understand the situation at hand.

[45] The field surveys reveal that unit price and the resulting markup margins of garment suppliers have decreased.

Appendix 5B: Additional Results for Laos

Table 5B-1: Frequency distribution of efficiency indices (Laos)

Lao garment 2004		TE score		PTE score		SE score	
No.	**Efficiency score interval**	**No. of firm**	**% share**	**No. of firm**	**% share**	**No. of firm**	**% share**
1	0.00< x ≤0.10	5	15.15	2	6.06	0	0.00
2	0.10< x ≤0.20	13	39.39	6	18.18	1	3.03
3	0.20< x ≤0.30	5	15.15	7	21.21	1	3.03
4	0.30< x ≤0.40	1	3.03	3	9.09	2	6.06
5	0.40< x ≤0.50	2	6.06	4	12.12	1	3.03
6	0.50< x ≤0.60	1	3.03	1	3.03	2	6.06
7	0.60< x ≤0.70	2	6.06	3	9.09	5	15.15
8	0.70< x ≤0.80	0	0.00	1	3.03	4	12.12
9	0.80< x ≤0.90	0	0.00	0	0.00	8	24.24
10	0.90< x ≤1.00	4	12.12	6	18.18	9	27.27
	Total	**33**	**100**	**33**	**100**	**33**	**100**
Lao garment 2005		**No.**	**% share**	**No.**	**% share**	**No.**	**% share**
1	0.00< x ≤0.10	5	15.15	2	6.06	0	0.00
2	0.10< x ≤0.20	14	42.42	9	27.27	2	6.06
3	0.20< x ≤0.30	6	18.18	4	12.12	1	3.03
4	0.30< x ≤0.40	1	3.03	4	12.12	1	3.03
5	0.40< x ≤0.50	1	3.03	6	18.18	2	6.06
6	0.50< x ≤0.60	1	3.03	1	3.03	2	6.06
7	0.60< x ≤0.70	0	0.00	0	0.00	1	3.03
8	0.70< x ≤0.80	1	3.03	1	3.03	6	18.18
9	0.80< x ≤0.90	2	6.06	1	3.03	5	15.15
10	0.90< x ≤1.00	2	6.06	5	15.15	13	39.39
	Total	**33**	**100**	**33**	**100**	**33**	**100**

Source: Author's calculations

Note: TE, PTE and SE represent technical efficiency, pure technical efficiency and scale efficiency, respectively.

Table 5B-2: Estimation results from Tobit models (Laos)

	Tobit Model (2004)			Tobit Model (2005)		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:			Dependent variable:		
Variable	**TE**	**PTE**	**SE**	**TE**	**PTE**	**SE**
CONS	0.274	0.95*	0.341	0.450	1.508**	0.229
	(0.422)	(0.545)	(0.429)	(0.385)	(0.607)	(0.493)
AGE	0.012	-0.006	0.016	-0.001	-0.029	0.009
	(0.014)	(0.021)	(0.017)	(0.017)	(0.028)	(0.017)
LnCAPIN	-0.033	-0.068	0.011	-0.023	-0.092*	0.048
	(0.053)	(0.055)	(0.037)	(0.043)	(0.054)	(0.041)
STAFF_SHARE	0.029***	0.022**	0.027**	0.010	0.002	0.019*
	(0.011)	(0.010)	(0.011)	(0.013)	(0.018)	(0.011)
DFDI	0.037	-0.048	0.012	-0.088	-0.131	-0.091
	(0.119)	(0.144)	(0.112)	(0.110)	(0.124)	(0.105)
DJV	-0.063	-0.150	-0.043	0.069	0.004	0.035
	(0.098)	(0.127)	(0.110)	(0.132)	(0.186)	(0.096)
Observations	33	33	33	33	33	33
Log likelihood	-8.068	-11.300	-0.987	-3.679	-12.701	-0.296
Pseudo R-sq.	0.445	0.109	0.836	0.278	0.184	0.887

Source: Author's calculations

Notes: 1. Heteroskedasticity was tested and corrected using White robust standard method in OLS regressions and Huber/White method for the Tobit model. 2. Standard errors are in parentheses. 3. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively. 4. See Note 4 in Table 5-16 for test for collinearity.

Table 5B-3: Malmquist Index and its components for individual DMUs (Laos)

ID	Ownership	Owner's nationality	MI	EFFCH	TECH	PEFFCH	SCALECH
1	FDI	Thai	0.807	1.383	0.584	1.347	1.026
2	JV	Lao	1.180	1.875	0.629	1.630	1.150
3	FDI	Others	0.696	1.114	0.624	0.991	1.124
4	FDI	Others	0.204	0.416	0.492	0.483	0.860
5	FDI	Others	0.733	1.159	0.633	0.997	1.162
6	JV	Thai	0.448	0.677	0.662	0.642	1.055
7	FDI	Thai	0.417	0.656	0.636	0.817	0.803
8	FDI	Others	0.256	0.430	0.596	0.564	0.762
9	LAO	Lao	0.553	0.871	0.635	0.810	1.076
10	FDI	Others	0.297	0.535	0.554	0.624	0.858
12	FDI	Thai	0.505	0.777	0.650	0.871	0.892
13	JV	Lao	0.802	1.475	0.543	1.132	1.304
14	FDI	Others	0.800	1.260	0.635	1.152	1.094
16	FDI	Thai	0.866	1.432	0.605	1.226	1.168
17	LAO	Thai	0.340	0.529	0.643	0.587	0.901
18	JV	Thai	0.683	1.389	0.492	1.350	1.029
19	LAO	Lao	0.471	0.704	0.669	0.691	1.019
20	LAO	Lao	0.693	1.100	0.630	1.086	1.013
21	FDI	Others	0.750	1.183	0.634	1.272	0.930
22	JV	Lao	0.422	0.703	0.599	0.573	1.227
23	LAO	Lao	0.459	0.723	0.635	0.655	1.103
25	JV	Others	0.816	1.604	0.509	1.478	1.086
26	FDI	Others	1.220	1.918	0.636	1.773	1.082
27	LAO	Lao	0.727	1.299	0.560	1.186	1.095
28	FDI	Thai	0.200	0.335	0.598	0.294	1.138
29	LAO	Lao	0.419	0.622	0.674	0.772	0.805
30	FDI	Others	0.403	0.630	0.639	0.611	1.031
31	LAO	Lao	0.706	1.187	0.595	1.000	1.187
32	FDI	Others	0.466	0.841	0.554	0.753	1.118
33	FDI	Others	0.278	0.483	0.576	0.373	1.296
35	JV	Thai	1.186	1.912	0.620	1.891	1.011
36	LAO	Lao	0.592	0.955	0.620	0.884	1.080
38	FDI	Thai	0.209	0.307	0.682	1.000	0.307
	Average		*0.594*	*0.984*	*0.607*	*0.955*	*1.024*
	Standard deviation.		*0.278*	*0.465*	*0.049*	*0.393*	*0.187*
	Maximum		*1.220*	*1.918*	*0.682*	*1.891*	*1.304*
	Minimum		*0.200*	*0.307*	*0.492*	*0.294*	*0.307*

Source: Author's calculations.

Notes: 1. MI represents the Malmquist Index. 2. EFFCH denotes CRS efficiency change or catch-up. 3. TECH represents CRS technical change or frontier shift. 4. PEFFCH denotes variable returns to scale efficiency change. 5. SCALECH is scale efficiency change.

Appendix 5C: Empirical Results Based on Owner's Nationality

Table 5C-1: Composition of Lao garment industry by owner's nationality

By Owners' nationality	Sample	Lao	Thai	Others	Foreign
2004	33 (100.0)	11 (33.33)	10 (30.30)	12 (36.36)	22 (66.67)
2005	33 (100.0)	11 (33.33)	10 (30.30)	12 (36.36)	22 (66.67)

Source: Author's calculations. Data are from the Ministry of Industry and Commerce of Laos (former Ministry of Commerce).
Notes: 1. Percentage share is in parentheses. 2. Other nationalities include Chinese, French, Japanese, Korean, Dutch, Pakistani, and Taiwanese. 3. Foreign includes all non-Lao nationalities.

Table 5C-2: Efficiency indices classified by owner's nationality (Laos)

2004		**Mean and standard deviation**					
Owner's	**Number**	**TE index**		**PTE index**		**SE index**	
nationality	**(% share)**	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Lao	11 (33.33)	0.348	0.295	0.495	0.327	0.733	0.255
Thai	10 (30.30)	0.308	0.276	0.442	0.338	0.724	0.258
Others	12 (36.36)	0.330	0.336	0.421	0.317	0.739	0.217
Foreign	*22 (66.67)*	*0.320*	*0.303*	*0.431*	*0.319*	*0.732*	*0.231*
Total	**33 (100.0)**	**0.329**	**0.296**	**0.452**	**0.318**	**0.732**	**0.235**
2005		**Mean**	**Std. dev**	**Mean**	**Std. dev**	**Mean**	**Std. dev**
Lao	11 (33.33)	0.315	0.242	0.444	0.302	0.788	0.252
Thai	10 (30.30)	0.245	0.232	0.408	0.332	0.695	0.308
Others	12 (36.36)	0.303	0.327	0.382	0.330	0.756	0.212
Foreign	*22 (66.67)*	*0.277*	*0.283*	*0.394*	*0.324*	*0.728*	*0.255*
Total	**33 (100.0)**	**0.290**	**0.267**	**0.411**	**0.313**	**0.748**	**0.252**

Source: Author's calculations.
Notes: 1. Other nationalities include Chinese, French, Japanese, Korean, Dutch, Pakistani, and Taiwanese. 2. Foreign includes all non-Lao nationalities. 3. The asterisk * implies that the average efficiency of the respective ownership form is at least statistically different from another ownership form at the 10% level or higher (Analysis of Variance or ANOVA). 4. ANOVA reveals no statistically significant differences among nationalities/ownership.

Table 5C-3: OLS estimation regressions by owner's nationality (Laos)

	OLS Regression (2004)			OLS Regression (2005)		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:			Dependent variable:		
Variable	**TE**	**PTE**	**SE**	**TE**	**PTE**	**SE**
CONS	0.305	0.915	0.397	0.389	1.283	0.119
	(0.399)	(0.530)	(0.389)	(0.408)	(0.538)	(0.529)
AGE	0.010	-0.006	0.013	-0.0002	-0.019	0.008
	(0.013)	(0.021)	(0.016)	(0.021)	(0.026)	(0.019)
LnCAPIN	-0.031	-0.064	0.013	-0.018	-0.088	0.064
	(0.051)	(0.052)	(0.033)	(0.047)	(0.052)	(0.046)
STAFF_SHARE	0.019***	0.013**	0.012**	0.012	0.004	0.024**
	(0.005)	(0.005)	(0.005)	(0.013)	(0.016)	(0.012)
DTHAI	0.001	-0.022	0.012	-0.081	-0.00002	-0.171
	(0.098)	(0.137)	(0.105)	(0.104)	(0.138)	(0.117)
DOTHERS	0.058	-0.021	0.051	-0.007	-0.027	-0.072
	(0.121)	(0.136)	(0.103)	(0.123)	(0.126)	(0.097)
Observations	33	33	33	33	33	33
R-squared	0.277	0.172	0.162	0.045	0.120	0.164

Source: Author's calculations

Notes: 1. Heteroskedasticity was tested and corrected using White robust standard method in OLS regressions and Huber/White method for the Tobit model. 2. Standard errors are in parentheses. 3. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Table 5C-4: Estimation results from Tobit models by owner's nationality (Laos)

	Tobit Model (2004)			Tobit Model (2005)		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:			Dependent variable:		
Variable	**TE**	**PTE**	**SE**	**TE**	**PTE**	**SE**
CONS	0.285	0.956*	0.336	0.410	1.509**	0.146
	(0.418)	(0.559)	(0.389)	(0.386)	(0.649)	(0.488)
AGE	0.012	-0.006	0.016	-0.0003	-0.028	0.008
	(0.012)	(0.020)	(0.016)	(0.019)	(0.031)	(0.017)
LnCAPIN	-0.036	-0.075	0.008	-0.020	-0.102	0.061
	(0.054)	(0.058)	(0.035)	(0.044)	(0.058)	(0.043)
STAFF_SHARE	0.029***	0.022**	0.028**	0.012	0.003	0.024
	(0.010)	(0.010)	(0.012)	(0.012)	(0.017)	(0.011)
DTHAI	-0.016	-0.018	-0.019	-0.078	0.012	-0.168
	(0.090)	(0.136)	(0.104)	(0.095)	(0.145)	(0.106)
DOTHERS	0.066	-0.004	0.054	0.002	-0.020	-0.061
	(0.126)	(0.141)	(0.102)	(0.119)	(0.131)	(0.093)
Observations	33	33	33	33	33	33
Log likelihood	-8.125	-13.500	-0.829	-4.368	-15.021	0.024
Pseudo R-sq.	0.441	0.228	0.863	0.143	0.133	1.009

Source: Author's calculations

Notes: 1. Heteroskedasticity was tested and corrected using White robust standard method in OLS regressions and Huber/White method for the Tobit model. 2. Standard errors are in parentheses. 3. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Table 5C-5: Components of TFP (owner's nationality) (Laos)

	MI	EFFCH	TECH	PEFFCH	SCALECH
Average	0.594	0.984	0.607	0.955	1.024
Std. Dev.	0.278	0.465	0.049	0.393	0.187
Max	1.220	1.918	0.682	1.891	1.304
Min	0.200	0.307	0.492	0.294	0.307
Coeff. of var.	0.468	0.473	0.081	0.412	0.182
Average by owner's nationality					
	MI	**EFFCH**	**TECH**	**PEFFCH**	**SCALECH**
Lao	0.638	1.047	0.617	0.947	1.096
Thai	0.566	0.940	0.617	1.002	0.933
Others	0.577	0.964	0.590	0.923	1.034

Source: Author's calculations.

Notes: 1. MI represents the Malmquist Index. 2. EFFCH denotes CRS efficiency change or catch-up. 3. TECH represents CRS technical change or frontier shift. 4. PEFFCH denotes variable returns to scale efficiency change. 5. SCALECH is scale efficiency change.

Table 5C-6: TFP performance by owner's nationality (Laos)

	Nationality	Criteria	MI	EFFCH	TECH	PEFFCH	SCALECH
I	Lao	X > 1	1	5	0	4	10
	(11 firms)	X = 1	0	0	0	1	0
		X < 1	10	6	11	6	1
II	Thai	X > 1	1	4	0	4	6
	(10 firms)	X = 1	0	0	0	1	0
		X < 1	9	6	10	5	4
III	Others	X > 1	1	6	0	4	8
	(12 firms)	X = 1	0	0	0	0	0
		X < 1	11	6	12	8	4
IV	Total	X > 1	3	15	0	12	24
	(33 firms)	X = 1	0	0	0	2	0
		X < 1	30	18	33	19	9
	Sample		**33**	**33**	**33**	**33**	**33**

Source: Author's calculations.

Notes. 1. Figures appearing in the table represent the number of garment firms in corresponding category. 2. MI represents the Malmquist Index. 3. EFFCH denotes CRS efficiency change or catch-up. 4. TECH represents CRS technical change or frontier shift. 5. PEFFCH denotes variable returns to scale efficiency change. 6. SCALECH is scale efficiency change.

5.3 FIRM EFFICIENCY IN VIETNAM'S GARMENT INDUSTRY

5.3.1 Recent Development in Vietnam's Garment Industry

a. Overview of the Vietnam's garment industry

Together with the national economy, the Vietnam's garment industry has been growing steadily in the last decade. In 2005, the export revenue of garment reaches US$4.68 billion and shares about 14.5% of the country's total exports. While on average the industry shares about 15% in the country's total exports (13-17%), its value in money terms has increased by more than five times as compared to 1995 (from about US$845 million[46]). In the global market, Vietnam is the 6th garment exporter in 2005. Nationwide the Vietnam Textile and Apparel Association (VITAS) has about 2,000 members, of which 1,500 are private and Joint-Stock enterprises, 450 FDI and 50 mix-type enterprises[47]. The government is in the process of transferring SOEs to Joint Stock companies or private enterprises, and by 2010 all SOEs should be privatized.

In terms of production capacity, according to VITAS, with about 3 million spindles the industry can produce (per year) 15,000 tons natural cotton; 300,000 tons yarns; 680 million squared meter woven fabrics; 30 tons towels; and 2 billion pieces clothing of all types.

b. Role of the garment industry

As mentioned previously, the role of the garment industry in the economy can be viewed from the two aspects: earning foreign currency and generating employment. In terms of export value, the garment industry is the second largest behind crude oil in 2005: exports of crude oil and petroleum products (SITC 33) reached US$7.69 billion as compared to US$4.68 billion for garment products (SITC 84). With respect to employment, of roughly 3.1 million labors in manufacturing industries, 16.5% are

[46] Source: Author's calculations based on the commodity trade data from the UN Comtrade.
[47] Much of the information about recent trends, issues, and development in the garment industry presented in this section is drawn from a field survey conducted by the author in March, 2008.

employed in the garment industry, a much higher rate than that of the petroleum industry.

c. Concentration of T&G industry in HCM area

Turning to HCM City, there are 7,762 garment establishments in 2005. The garment industry is very much concentrated in this area with nearly 50% of garment workers and production. Private garment enterprises are the leading employers, followed by the FDI and individual enterprises (Table 5-19, column 4).

d. Export and import of garment products

The trade in Vietnam's garment and textile products in 2005 is presented in Table 5-20. The turnover classified by destination is as follows: 56% to USA, 17% EU, 12% Japan and 11% other trade partners. The main suppliers of garment products to Vietnam are Korea, Japan, Hong Kong and China, whose exports cover about 73% of the country's imports of garment products.

Table 5-19: Cross-industrial statistics of the garment industry in HCM (Vietnam)

Ho Chi Minh City	**Number of enterprise**		**Number of employee (persons)**		**Industrial Production (mil VND, 1994 prices)**	
	2000	**2005**	**2000**	**2005**	**2000**	**2005**
SOEs	15	7	32,050	26,208	883,220	1,934,638
% share	0.4	0.1	23.9	10.6	26.9	24.0
Collectives	7	5	493	588	3,208	10,132
% share	0.2	0.1	0.4	0.2	0.1	0.1
Private	206	781	50,390	95,082	873,563	2,572,955
% share	5.4	10.1	37.6	38.5	26.6	32.0
Individuals	3,519	6,840	25,681	46,285	633,449	1,188,929
% share	92.4	88.1	19.2	18.7	19.3	14.8
Dom. private	*3,732*	*7,626*	*76,564*	*141,955*	*1,510,220*	*3,772,016*
% share	*98.0*	*98.2*	*57.1*	*57.5*	*46.0*	*46.9*
FDIs	61	129	25,360	78,708	890,825	2,340,685
% share	1.6	1.7	18.9	31.9	27.1	29.1
Total	**3,808**	**7,762**	**133,974**	**246,871**	**3,284,265**	**8,047,339**
% share	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: *Statistical Yearbook in Ho Chi Minh City 2006*, Statistical Office of Ho Chi Minh City.
Note: Domestic private is the sum of collectives, private and individuals.

With regard to input, Vietnam imports roughly 90% of cotton; 70% of raw material for production of garments; and 100% equipment. This fact is also reflected in

our calculations for 2005 that the garment industry (SITC 84) recorded a trade surplus of US$4.35 billion, while the textile industry (SITC 26 and 65) had trade deficit of US$3.10 billion. Overall, in 2005 the textile and garment industry made a trade surplus of nearly US$1.25 billion.

With respect to the type of business, both the CMT (cut-make-trim) and the FOB (free on board) types can be found in Vietnam. In the CMT-type business, the customers provide nearly all necessary things for production, including raw materials, designs, quality control etc., and the garment factories in Vietnam would earn the labor cost margin. The FOB-type business in Vietnam, on the other hand, can be classified into three types: (1) FOB-type I: customers provide a model and ask a garment company to produce exactly the same product; (2) FOB-type II: customers provide a model and ask a garment factory to change some features before the mass production; and (3) FOB-type III: customers accept a model designed by a Vietnam's garment company. In the current situation, our recent field survey has revealed that the first type of FOB business dominates, i.e. Vietnam's garment factories need to buy all raw materials for production and the customers just provide the model. In some cases, customers even provide the outer materials and the contracted garment enterprise purchase the lining materials for production, or the customers designate certain suppliers for the contracted firms to purchase materials. A more detailed illustration of the FOB arrangement can be found in Goto (2007, p. 525).

e. Recent issues and impediments

Apart from the positive aspects mentioned above, the industry is not developing without obstacles. Among a long list of problems, our field survey has revealed three major problems, namely local labor shortage, lack of skill training, and difficulties in accessing financial resources. The causes are many, such as the increasing wages due

Table 5-20: Vietnam's trade flows in garment and textile products in 2005 (US$ thousand)

VIETNAM	Garment industry (SITC 84)						Textile industry (SITC 65 + SITC 26)						T&G
Trade Partners	Exports		Imports		Net Exports		Exports		Imports		Net Exports		Net
	Value	% share	Value	% share	Value	% share	Value	% share	Value	% share	Value	% share	Exports
EU 15	**811,152**	**17.33**	**14,738**	**4.44**	**796,413**	**18.31**	**103,718**	**13.74**	**114,046**	**2.96**	**-10,329**	**-0.33**	**786,085**
ASEAN 10	**37,994**	**0.81**	**14,308**	**4.31**	**23,685**	**0.54**	**124,054**	**16.44**	**280,940**	**7.29**	**-156,886**	**-5.06**	**-133,201**
Cambodia	881	0.02	868	0.26	13	0.00	21,700	2.88	2,821	0.07	18,879	0.61	18,892
Indonesia	426	0.01	1,128	0.34	-702	-0.02	8,474	1.12	63,431	1.65	-54,958	-1.77	-55,660
Laos	2,728	0.06	18	0.01	2,710	0.06	14,179	1.88	1,228	0.03	12,951	0.42	15,661
Malaysia	26,433	0.56	3,920	1.18	22,513	0.52	21,652	2.87	62,004	1.61	-40,351	-1.30	-17,839
Philippines	1,276	0.03	954	0.29	322	0.01	19,127	2.53	6,987	0.18	12,140	0.39	12,462
Singapore	4,818	0.10	3,590	1.08	1,228	0.03	10,906	1.45	67,108	1.74	-56,202	-1.81	-54,974
Thailand	1,408	0.03	3,830	1.15	-2,422	-0.06	28,016	3.71	77,361	2.01	-49,345	-1.59	-51,767
China	8,370	0.18	37,224	11.22	-28,854	-0.66	41,507	5.50	834,546	21.65	-793,039	-25.58	-821,893
Hong Kong	13,379	0.29	55,483	16.72	-42,104	-0.97	22,562	2.99	331,741	8.61	-309,179	-9.97	-351,283
India	617	0.01	134	0.04	484	0.01	3,402	0.45	23,144	0.60	-19,742	-0.64	-19,258
Pakistan	107	0.00	30	0.01	76	0.00	2,903	0.38	19,189	0.50	-16,286	-0.53	-16,210
Bangladesh	153	0.00	80	0.02	73	0.00	11,498	1.52	7,370	0.19	4,129	0.13	4,202
USA	2,629,918	56.19	2,424	0.73	2,627,494	60.42	60,301	7.99	75,228	1.95	-14,927	-0.48	2,612,567
Japan	596,084	12.74	74,088	22.32	521,996	12.00	108,308	14.35	314,887	8.17	-206,579	-6.66	315,417
Korea	44,733	0.96	76,236	22.97	-31,503	-0.72	93,483	12.39	781,134	20.27	-687,651	-22.18	-719,154
Australia	24,186	0.52	413	0.12	23,773	0.55	9,914	1.31	6,365	0.17	3,548	0.11	27,321
Canada	83,580	1.79	82	0.02	83,498	1.92	5,554	0.74	2,334	0.06	3,220	0.10	86,718
Russia	48,253	1.03	97	0.03	48,156	1.11	1,929	0.26	102	0.00	1,827	0.06	49,983
World Total	**4,680,634**	**100.0**	**331,884**	**100.00**	**4,348,750**	**100.00**	**754,702**	**100.00**	**3,854,472**	**100.00**	**-3,099,770**	**-100.00**	**1,248,979**

Source: Author's calculations based on the commodity trade data from the UN Comtrade.
Notes: 1. SITC 84: Articles of apparel and clothing accessories. 2. SITC 65: Textile yarn, fabrics, fibres made-up articles. 3. SITC 26: Textile fibres.

to inflation, the establishment of industrial zones (IZs) in the provinces, positive development in others sectors. Many enterprises, particularly those in HCM, have responded to such problems by providing better care and social benefits, and providing tailor-made in-house training for their workers, etc.

To overcome the labor shortage, the most serious problem facing garment firms in HCM, several firms devote their time and financial resources to recruit new labors at their home towns and villages in rural and remote areas, and once the labors have been recruited, they apply many kinds of measures and human resource policies to contain those workers. Another common strategy is to move the production plants close to the source of labor, i.e. to newly established IZs in remoter provinces, since workers prefer to stay with their families if employment is available in their neighborhood (for more detail, see also Goto, 2008)

5.3.2 Data and Variables for Empirical Analysis (Vietnam)

The empirical study makes use of statistical data from the 2007 Enterprise Survey in Ho Chi Minh City conducted by the General Statistical Office of Vietnam (GSO). Hence, the statistical information is of year 2006. Furthermore, to help understand the real situations and interpret the result, the author conducted a field survey in Hanoi and Ho Chi Minh City in March 2008. The survey covers interviews and firm visits to 25 garment factories, and an interview with the management of VITAS in both locations.

5.3.2.1 Data Mining

From the original dataset, only garment enterprises, i.e. firms that have at least apparel and clothing (garment) section, have been selected. Further, the following six criteria are applied in selecting enterprises to be included in the analysis:

1. enterprises with complete information on revenue, capital, labor, and ownership;

2. firms with at least one-year of age;
3. enterprises with more than 20 employees (to avoid inaccuracy in book keeping of micro-firms);
4. firms with the number of employees up to 5,000 (to avoid adverse effect of very large firms on the estimation results);
5. the ratio of the minimum and maximum value of each variable (except for dummies) must be greater than 0.0001 (required by DEA to avoid loss of numerical inaccuracy of efficiency score) (Seitech Inc., 2006, p. 21); and
6. enterprises with positive cost of production

Upon data mining, for DEA-regression analysis there are 476 samples in the dataset (POOLED Set). This POOLED set is divided into two subsets: (1) the SME-set contains 337 small and medium size enterprises (SMEs[48]) with the number of workers up to 300; and (2) the LSE-set contains 139 large size enterprises (LSEs) with more than 300 labors. The reduced dataset for SFA[49] contain 460 firms with 327 SMEs and 133 LSEs. The three datasets are summarized in Table 5-21.

Table 5-21: Composition of data for DEA and SFA (Vietnam)

	Sample	**SOE**	**FDI**	**Purely private**	**Private Ltd. Co.**	**Private JSC**
Number of enterprise and % share for DEA-regression						
POOLED	476 (100.0)	10 (2.10)	89 (18.70)	45 (9.45)	319 (67.02)	13 (2.73)
SME	337 (100.0)	4 (1.19)	32 (9.50)	36 (10.68)	257 (76.26)	8 (2.37)
LSE	139 (100.0)	6 (4.32)	57 (41.01)	9 (6.47)	62 (44.60)	5 (3.60)
Number of enterprise and % share for SFA						
POOLED	460 (100.0)	-	89 (19.35)	45 (9.78)	313 (68.04)	13 (2.83)
SME	327 (100.0)	-	32 (9.79)	36 (11.01)	251 (76.76)	8 (2.45)
LSE	133 (100.0)	-	57 (42.86)	9 (6.77)	62 (46.62)	5 (3.76)

Source: Author's calculations. Data are extracted from Enterprise Survey, 2007, GSO.
Notes: 1. Percentage share is in parentheses. 2. SOEs include state-owned enterprises at central and local level, state-owned limited companies, joint-stock and limited companies with government share > 50% and collective enterprises (cooperatives). 3. FDI-type enterprises include only wholly foreign-owned enterprises. 4. Purely private enterprises include wholly private and partnership enterprises. 5. Private limited companies include 100% private limited enterprises and limited enterprises with government share ≤ 50%. 6. Private joint-stock companies include only JSC without government share.

It can be observed that, with about 70% share, SMEs constitute the majority of the samples. In terms of ownership, among the five types of ownership considered in

[48] The criteria for SME are: (i) labor ≤ 300 and/or (ii) registered capital ≤ 10 billion VND. Owing to data limitation the labor is used as criterion. The dummy *DLSE* and *DSME* are also defined according to this definition. See section 5.2.2 for more details.
[49] In addition to SOEs, six more samples of SMEs were removed from the initial data sets due to extreme value of inefficiency (inefficiency >1.0).

this study, private limited enterprises comprise 67%, followed by foreign owned enterprises with nearly one fifths and the private and partnership type of ownership (purely private) with about 10%. The trend in the two subsets shows great similarity to the overall trend. Also, the exclusion of SOEs for SFA does not affect the data composition as presented in the bottom half of the table. Any statistical inferences in this study are thought to be influenced by this somewhat biased composition.

5.3.2.2 Variable Definition

As it is the common case of many enterprise-level analyses, the choice of proxy variables for firm efficiency in this research study is mainly constrained by the availability of statistical data. This section describes the definition of the proxy variables used in the empirical analysis.

a. Variables for the DEA models

As discussed previously, the CCR-O and BCC-O models are applied with three inputs and one output. The variables for the two models are defined as follows:

- Output (*REV*): is the total revenue of the enterprise in 2006 denominated in million Vietnamese Dong (VND);
- Input 1 (*K*): is the total capital of the enterprise as of the end of 2006 in million VND;
- Input 2 (*L*): is the total number of employees (labor) as of the end of 2006;
- Input 3 (*PCOST10*): is the production cost including the costs of materials, energy, administration etc. in million VND. This variable is initially not available in the dataset and has been computed based on available information:

$$PCOST10 = REV - PROFIT - WAGE - d * K\,, \tag{5.1}$$

where *PROFIT* is the firm profit before tax in million VND, *WAGE* denotes the total wage of employees in million VND, d is the rate of the depreciation of capital.

In the calculation of *PCOST10* various depreciation rates, such as 0%, 5% and 10%, have been simulated. However, upon several tests the 10% depreciation rate (*d=0.10*) has been assumed for all types of enterprises, except SOEs. It is the practice that the investment budget of SOEs does not come from the business revenue, but is allocated by the government. Hence, the depreciation can be excluded from the calculation and a 0%-rate has been assumed for SOEs in this study.

b. Variables for the DEA-regression model

In literature, the determinants of firm efficiency applied in empirical analysis are numerous. Such variables describe the characteristics of the individual enterprises (internal factors) or the business environment in which those firms are operating (external factors) and the like. As described in equation (4.61) this study focuses on the firm characteristics. This section presents the definition of the independent variables for this regression model.

b.1) Continuous explanatory variables:

- *AGE* is the number of years of operation and is defined as the difference between year 2006 and the establishment year;
- *CAPIN* is the capital intensity (in million VND) and defined as the ratio of total capital (asset) over the total number of employees (this variable is deemed to give some measure of the technical level of the individual garment enterprises); and
- *PWWAGE* is the annual wage per worker of each enterprise denominated in million VND.

b.2) Discrete explanatory (dummy) variables:

With respect to ownership, initially there are 14 types in the dataset. However, for the purpose of the study they have been summarized to the five categories as follows:

- *DSOE* is the dummy for state-owned enterprises and equals 1 if true and 0 otherwise. SOEs include six types of state ownership: (i) SOEs of the

central government; (ii) SOEs of the local government; (iii) state-owned limited enterprises of the central government; (iv) state-owned limited enterprises of the local government; (v) Joint Stock and limited companies with government share greater than 50%; and (vi) state-owned cooperatives or collectives. The main reason for this classification is that these enterprises are deemed to operate in a comparable environment with respect to government support;

- *DFDI* is the dummy for wholly foreign-owned enterprises. There are three types of ownership related to FDI: (i) wholly foreign owned enterprises or FDI enterprises; (ii) Joint Venture between government and foreign enterprises; and (iii) Joint Venture between non-government and foreign enterprises. The last two types could be classified into FDI ownership if the foreign share exceeds 50%, or accordingly to SOEs and private enterprises. However, the dataset lacks information on the share of individual parties. Attempts have been made to incorporate these two scenarios, but the results of the regression analysis are significantly deteriorated compared to the exclusion of such enterprises. Hence, only 100% FDI enterprises are included in the study;
- *DPPRIV* is the dummy for purely private enterprises. This category includes two types of ownership, namely (i) private companies and (ii) partnership companies;
- *DPLTD* is the dummy for private limited companies. This category includes private limited enterprises and limited enterprises with government share of less than 50%; and
- *DPJSC* is the dummy for private joint stock companies (JSCs). Private JSCs include (i) JSCs without government share holding and (ii) JSCs with government share of less than 50%. The second part of the definition is somewhat imprecise. However, after the data mining there is no JSCs with government share in the dataset, and hence, only private JSCs are considered.

Another enterprise classification is to distinguish between small and medium size enterprises (SMEs) and large size enterprises (LSEs). The definition of SME involves both labor and capital (Decree 90/2001/CP-NDD, approved on 23 November

2001). Hence, an enterprise is classified as SME if (1) it has 300 labors or fewer; and/or (2) its registered capital is less than or equal to 10 billion VND. In Vietnam a distinction between small size and medium size is not common. Owing to data limitation the labor criterion is applied.

- *DLSE* is the dummy for large size or large-scale enterprises, i.e. those with more than 300 labors; and
- *DSME* is the dummy for small size enterprises, i.e. those with up to 300 labors.

c. Variables for the stochastic frontier model

In SFA, both the production frontier model and the technical inefficiency model are to be estimated. Hence, all variables defined as in previous sections for DEA-regression are necessary and will be applied for the estimations. It is noted that three variables of inputs (*K, L, and M*) and output *(REV*) for the production frontier estimation are used in natural logarithm for equation (4.68).

The summary statistics of the initial POOLED set are presented in Table 5-22. Table 5D-1 in Appendix 5D contains the statistics of all the three datasets (including SOEs).

Table 5-22: Summary of main variables (POOLED set including SOEs) (Vietnam)

POOLED (SME and LSE)						**Coeff. of**
	Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**	**variation**
TE	476	0.62	0.18	0.16	1.00	0.28
PTE	476	0.70	0.19	0.16	1.00	0.28
SE	476	0.90	0.11	0.22	1.00	0.12
REV (mil VND)	476	14,953	26,803	144	210,606	1.79
K (mil VND)	476	14,636	27,784	29	232,659	1.90
L (persons)	476	300	448	21	3,687	1.50
PCOST10 (mil VND)	476	9,035	19,242	2	170,873	2.13
AGE (years)	476	5.50	4.10	1.00	30.00	0.74
CAPIN (mil VND/labor)	476	59.76	78.63	0.55	643.92	1.32
PWWAGE(mil VND/labor)	476	14.25	7.78	0.67	82.16	0.55

Source: Author's calculations

It is a coincidence that the average revenue and capital is about 15 billion VND for all firms, but the difference between the SME and LSE groups is very large. The production cost shows a similar trend. On the other hand, SMEs tend to be more capital

intensive than LSEs with an average for all enterprises being nearly 60 million VND per employee. However, this fact could also be referred to the difference in efficiency of the two sets of firms. Also, SMEs are on average 3 years younger than LSEs.

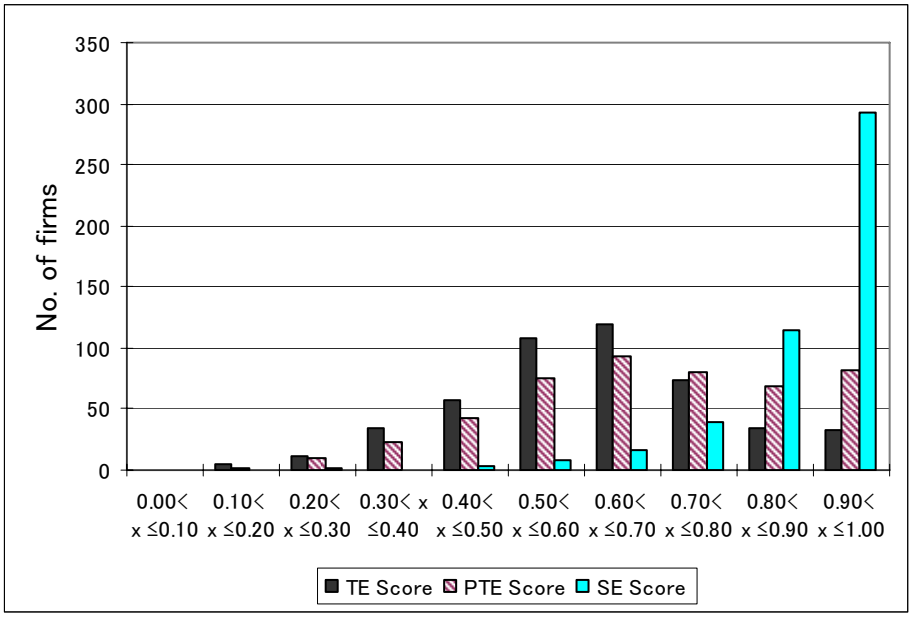
Of the variables applied in this analysis, the production cost, the capital, the revenue and the capital intensity are the most volatile measures as witnessed by a coefficient of variation of greater than unity. The efficiency scores, on the other hand, have a relatively small coefficient of variation, which suggests that these variables are less volatile.

5.3.3 Empirical Results and Discussions (Vietnam)

5.3.3.1 Efficiency Performance from DEA Models

The results of the DEA estimation are summarized in Table 5-22 (row 1-3), Table 5-23, Figure 5-3, Figure 5-4 and Table 5D-2 of Appendix 5D.

Figure 5-3: Distribution of efficiency indices (POOLED set) (Vietnam)



Source: Author's calculations

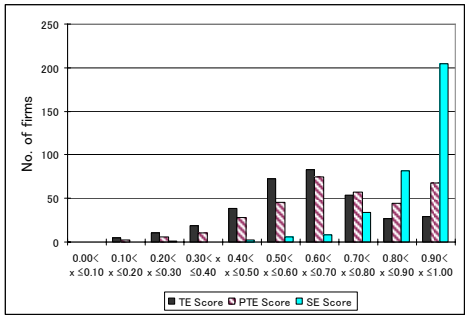
a. Distribution of efficiency indices

On average, garment firms in HCM are 62% efficient (TE=0.621), and the difference between the two groups (SMEs and LSEs in pooled estimation) is about 7

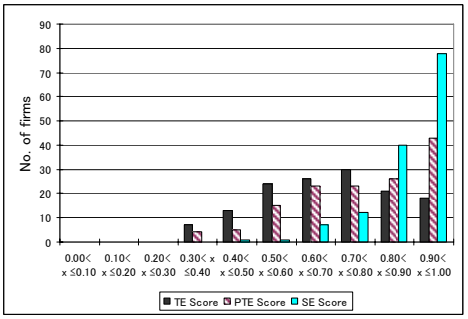
percent. Figure 5-3 presents the histogram of the three efficiency indices of garment firms in HCM (POOLED set) and Figure 5-4 shows the histogram for SME-set and LSE-set. The frequency distribution is presented in Table 5D-2 of Appendix 5D for comparison. It is apparent that the distribution of TE scores is closer to the normal distribution than that of PTE and SE scores in all three sets. Nearly half of garment SMEs in HCM (46%) achieve an efficiency level of 0.5-0.7 and 74% are in the range of 0.4-0.8, which is also reflected in the pooled case (48% and 75%, respectively). LSEs record somewhat higher technical efficiency 0.6-0.8 (about 86% of LSEs record an efficiency level of 0.5-1.0). This fact is also reflected by the average efficiency level of each group (Table 5D-1). This result implies that with regard to technical efficiency SMEs are more widespread than LSEs as illustrated in the result for the respective sets, and that the overall dispersion in the POOLED is mainly driven by SMEs owing to their dominance in numbers. In Vietnam too, garments firms have achieved better scale efficiency performance than TE and PTE (POOLED: 94% record a SE score of 0.7-1.0; SME: 95% record a SE score of 0.7-1.0; LSE: 94% record a SE score of 0.7-1.0).

Figure 5-4: Distribution of efficiency indices for SMEs and LSEs (Vietnam)

(a) Distribution for SMEs



(a) Distribution for LSEs



Source: Author's calculations

The PTE and SE scores are in all cases greater than TE scores as suggested in the theory. With respect to pure technical efficiency, most of the firms tend to have achieved a level of greater than 60%, particularly the larger enterprises. Further, it

appears that more than half of the firms under study have adopted an appropriate scale in production.

These results are comparable to the findings in many previous studies on Vietnam's garment industry. For example, Vu (2005) found that during 2000-2003 technical efficiency of garment firms in Vietnam fluctuated between 0.56 and 0.74 with an upward trend. Our results are between this range and comparable to the average in terms of dispersion in firm efficiency.

One result in this analysis, which at first appears to be contradictory to many previous studies (Hill and Kalirajan, 1993), is that the coefficient of variation of the efficiency scores is relatively small in all three datasets implying that inter-firm variations are less of significance (Table 5-22 and Table 5D-1). In fact, this finding is not inconsistent to other studies, because our samples are concentrated in HCM and firms tend to be more homogenous as a result of technical spillover, competition and similarities in many other aspects of the firms. The difference might also be attributable to the approaches used in the analysis.

b. Comparison among types of ownership

Table 5-23 summarizes the three efficiency indices classified by type of ownership for POOLED dataset, SMEs and LSEs. The significance of the difference among the groups is based on the analysis of variance (single-factor ANOVA). Detailed results from ANOVA are also presented in Appendix 5D (Table 5D3 – 5D5).

Overall, the analysis reveals that wholly foreign-owned firms have achieved the highest relative technical and purely technical efficiency, followed by private Joint Stock companies (JSC), and private and partnership enterprises (purely private). SOEs perform less efficiently than firms under study. Compared to SOEs, the difference of an average FDI firm is about 10.7%, purely private firm 8.2%, private limited company 5.6%, and private JSC 9.0%. Such differences are significant for FDI and private

limited firms. Comparison among SMEs has revealed a similar pattern in both magnitude and significance level. This might be explained that under the current privatization process, many SOEs including efficient ones have been transferred to private ownership. It is also reasonable that more efficient SOEs would have initiated the privatization in the early stage and by this time already been converted to other types of ownership.

Table 5-23: Efficiency indices classified by ownership (Vietnam)

POOLED		**Mean and standard deviation**					
Ownership/	**Number**	**TE index**		**PTE index**		**SE index**	
Nationality	**(% share)**	**Mean**	**Std. dev**	**Mean**	**Std. dev**	**Mean**	**Std. dev**
SOE	10 (2.10)	0.553*	0.140	0.681	0.211	0.833*	0.109
FDI	89 (18.70)	0.660*	0.180	0.753*	0.194	0.884*	0.111
Purely private	45 (9.45)	0.636	0.161	0.738*	0.173	0.874*	0.140
Private LTD	319 (67.02)	0.610*	0.175	0.673*	0.190	0.912*	0.106
Private JSC	13 (2.73)	0.644	0.191	0.722	0.234	0.903*	0.073
Total	**476 (100.0)**	**0.621**	**0.175**	**0.695**	**0.193**	**0.901**	**0.111**
SME		**Mean**	**Std. dev**	**Mean**	**Std. dev**	**Mean**	**Std. dev**
SOE	4 (1.19)	0.547	0.166	0.648	0.233	0.859	0.073
FDI	32 (9.50)	0.718*	0.203	0.780*	0.195	0.916	0.075
Purely private	36 (10.68)	0.647	0.157	0.752*	0.164	0.873	0.142
Private LTD	257 (76.26)	0.621*	0.182	0.693*	0.192	0.900	0.108
Private JSC	8 (2.37)	0.632	0.222	0.691	0.231	0.907	0.085
Total	**337 (100.0)**	**0.633**	**0.184**	**0.707**	**0.192**	**0.898**	**0.109**
LSE		**Mean**	**Std. dev**	**Mean**	**Std. dev**	**Mean**	**Std. dev**
SOE	6 (4.32)	0.780	0.068	0.856	0.099	0.916	0.081
FDI	57 (41.01)	0.694	0.180	0.789	0.187	0.883	0.103
Purely private	9 (6.47)	0.751	0.166	0.844	0.129	0.898	0.166
Private LTD	62 (44.60)	0.676	0.168	0.754	0.174	0.899	0.095
Private JSC	5 (3.60)	0.775	0.195	0.847	0.219	0.916	0.041
Total	**139 (100.0)**	**0.696**	**0.172**	**0.782**	**0.177**	**0.894**	**0.102**

Source: Author's calculations.

Notes: 1. SOEs include state-owned enterprises at central and local level, state-owned limited companies, joint-stock and limited companies with government share > 50% and collective enterprises (cooperatives). 2. FDI-type enterprises include only wholly foreign-owned enterprises. 3. Purely private enterprises include wholly private and partnership enterprises. 4. Private limited companies include 100% private limited enterprises and limited enterprises with government share ≤ 50%. 5. Private joint-stock companies include only JSC without government share. 6. The asterisk * implies that the average efficiency of the respective ownership form is at least statistically different from another ownership form at the 10% level or higher (Analysis of Variance or ANOVA).

If one compares among LSEs, the trend is rather reversed. In this group, state-owned enterprises perform most efficiently followed by private JSCs, and FDI firms are among the followers. These findings are likely attributable to the fact that most of SOEs would be of large sale and they would have privilege and advantage over

competitors in accessing to finance for investment in new technologies. The differences among the groups, however, are not statistically significant.

It is necessary to note that, these results should be interpreted with caution, because the ANOVA is relatively sensitive to the distribution of the efficiency indices due to unequal sample sizes. Hence, these findings should be viewed in close relation with those of the following DEA-regression analysis and SFA.

5.3.3.2 Determinants of Firm Efficiency

In the previous section, the results from DEA have highlighted some trends in efficiency performance with a focus on ownership. This section presents the estimates from the regression analysis with regard to possible determinants of technical efficiency. In literature, various regression techniques have been applied, such as the maximum likelihood estimation, the Tobit model etc. In this study, the Tobit model and the ordinary least squared estimation (OLS) have been employed to estimate equation (4.61), and the results are very similar in terms of sign and significance level of the estimates. In favor of interpretability we have opted for OLS. Corresponding estimation results from the Tobit model are presented in Appendix 5D for comparison purpose (Table 5D-6).

The OLS estimates are presented in Table 5-24. Column (1)-(3) present the regression results on determinants for technical efficiency for all firms, SMEs and LSEs, respectively. Column (4)-(6) show the corresponding estimates for PTE index, and the last three columns, (6)-(9), record the OLS coefficients for SE. All regressions have been tested for heteroskedasticity and corrected by using the White robust standard error procedure. It is apparent that the TE coefficient estimates are generally very significant at the 1% level for the POOLED set and quite significant for SME set. The results for LSE set are rather insignificant except for the case of workers' income with 1% significance. The choice of determinants or explanatory variables for

efficiency is also deemed acceptable for cross-section regressions (R^2 ranges between 0.31 and 0.44 for PTE and TE indices).

a. Age effect

The coefficients for age on technical and purely technical efficiency are insignificant, meaning that the years of operation would not help improve technical efficiency. This finding implies that, ceteris paribus, average firms and young SMEs would be able to catch up with other competitors in terms of managerial, technical and marketing skills to improve firm efficiency in relatively short time, and larger firms appear to be in the position to compensate for this by using other advantage such as large scale operation. In fact, many SME owners have long working experience in this industry and established a good relationship with customers prior to setting up their own companies. After the start-up the production could go smoothly and they can receive sufficient amount of orders. Hence, our study would point to the fact that, not the firm age, but rather the work experience of owners or managers would contribute to improving firm efficiency. The age effect found in Tran et al. (2008) is negative and it is argued that the technology is relatively old.

On the other hand, despite a small magnitude, the age coefficient for scale efficiency is statistically significant for pooled samples and SMEs. This result is not a surprise, since young SMEs constitute the majority of the pooled samples. Specifically, 74% of SMEs are 1-5 years old, while 53% of LSEs have been operating for 6-30 years. The findings would suggest that as SMEs are relatively young (generally 3 years younger than LSEs, Table 5D-1), given favorable business conditions, the longer they operate , the lager they would be able to grow, and thereby employing more labors and moving to more productive scale of production.

b. Effect of technological level (Capital intensity)

The estimate for capital intensity is statistically significant at the 1% level for SMEs and pooled samples, but the magnitude is very small. This means that, if this explanatory variable is controlled for, an increase by one percentage point would be associated with an improvement in efficiency by about 0.03%[50]. Since the capital intensity can be interpreted as a measure of technical level, the result points to the fact that the current technological level in Vietnam's garment industry is relatively low. Similar to the above case, for average garment SMEs an increase in the level of technology and in capital goods investment would yield a positive impact on efficiency, since the majority of SMEs are young and initial investment would not be sufficient in most cases. An opposite result found in Vu (2005) suggests that investment was not comprehensive or the human resource was not adequate.

On the other hand, the absence of such impacts on technical efficiency for LSEs would imply that large firms appear to have acquired appropriate technology for their workers. Investment in physical capital would need to be accompanied with proper skill and human resource development to capitalize on more advanced technologies.

c. Effect of worker remuneration

Worker's income is the only variable with a very significant positive coefficient estimate for nearly all cases. This result implies that, on average a one-percentage increase in wage per worker would enhance technical efficiency by roughly 0.2% (%ΔTE=[0.185/100]*100%=0.185%). The finding is attributable to the fact that the wage rates in Vietnam (minimum wage is 600,000 VND or about US$36 per month) are still low, far below the efficiency wage, i.e. the fundamental efficiency wage. Therefore, an improvement in wages would give workers incentive to work harder and

[50] For example, in the case of SMEs, an increase in CAPIN by 1% (ΔCAPIN=1%) would be associated with an improvement in technical efficiency of ΔTE=[0.028/100]*ΔCAPIN=0.00028 Unit. However, in this special case the unit of TE itself is the percentage point, i.e. %ΔTE=0.00028*100%=0.028%.

Table 5-24: Results from OLS regressions (Vietnam)

	Dependent Variable: TE			Dependent Variable: PTE			Dependent Variable: SE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	**POOLED**	**SME**	**LSE**	**POOLED**	**SME**	**LSE**	**POOLED**	**SME**	**LSE**
CONS	-0.068	0.018	-0.006	0.100	0.215**	0.192	0.724***	0.664***	0.698***
	(0.052)	(0.055)	(0.140)	(0.072)	(0.083)	(0.130)	(0.053)	(0.067)	(0.082)
AGE	0.0001	0.0002	-0.0003	-0.002	-0.002	-0.0004	0.003***	0.004**	0.0006
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)
LnCAPIN	0.036***	0.028***	0.026	0.037***	0.022**	0.0002	0.002	0.012**	0.030**
	(0.009)	(0.010)	(0.020)	(0.009)	(0.010)	(0.018)	(0.004)	(0.005)	(0.012)
LnPWWAGE	0.185***	0.185***	0.240***	0.167***	0.171***	0.235***	0.040***	0.040***	0.031
	(0.015)	(0.017)	(0.038)	(0.017)	(0.018)	(0.040)	(0.012)	(0.013)	(0.028)
DFDI	0.090***	0.057	-0.035	0.034	0.001	-0.031	0.073*	0.067	-0.009
	(0.031)	(0.046)	(0.026)	(0.054)	(0.075)	(0.037)	(0.042)	(0.059)	(0.031)
DPPRIV	0.129***	0.084**	0.035	0.103**	0.055	0.020	0.045	0.058	0.024
	(0.035)	(0.040)	(0.063)	(0.057)	(0.074)	(0.069)	(0.045)	(0.061)	(0.059)
DPLTD	0.100***	0.057*	-0.026	0.034	-0.002	-0.049	0.084**	0.080	0.019
	(0.027)	(0.033)	(0.028)	(0.051)	(0.069)	(0.036)	(0.041)	(0.058)	(0.032)
DPJSC	0.092**	0.035	0.029	0.042	-0.028	0.012	0.071	0.072	0.016
	(0.041)	(0.063)	(0.051)	(0.064)	(0.088)	(0.071)	(0.043)	(0.061)	(0.035)
DLSE	-0.007	-	-	0.054***	-	-	-0.072***	-	-
	(0.014)	-	-	(0.017)	-	-	(0.010)		
Obs.	476	337	139	476	337	139	476	337	139
R-squared	0.438	0.426	0.419	0.336	0.317	0.312	0.135	0.106	0.129

Source: Author's calculations.

Notes: 1. Heteroskedasticity was tested and corrected using White robust standard method in all models. 2. Robust standard errors are in parentheses. 3. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. 4. All variables have been tested for collinearity using the correlation coefficients. The result indicates no collinearity.

improve their productivity and efficiency. This effect is more pronounced in the case of large enterprises. Indeed, workers in large garment enterprises often receive their wages indexed in US dollar, and with the recent depreciation of the US currency their wages have increased

However, the recent economic boom and relatively high inflation could lead to a decrease in real wages. The impact is particularly serious for garment workers in smaller factories due to their lower average wages as compared to the workers in LSEs. The establishment of industrial zones in rural provinces also pulls workers back to their home towns with their families, even though they might receive lower wages. All these development events put pressure on garment factory owners to improve productivity and efficiency to cope with the hard situation. But, an increase in wages is a burden for factory owners as it adds to production costs and deteriorates the comparative advantage of the industry.

d. Effect of ownership

One of the interesting features of the analysis is to investigate the efficiency difference among the various types of ownership and the reasons of such performance. The coefficients estimates are statistically significant for all four types of ownership included in the regression model in the POOLED dataset. For SMEs they are significant for purely private and private limited enterprises, although less strongly. The results for LSEs are not significant in any cases.

The findings imply that, if the ownership is controlled for, compared to state-owned enterprises an average FDI firm is roughly 9%[51] more efficient, a private and partnership enterprise (purely private) 13%, a private limited company 10%, and a private JSC 9%. In the case of SMEs, purely private and private limited ownership is associated with an improved technical efficiency level of 8% and 6%, respectively. For

[51] For pooled data, TE(FDI)-TE(SOE)=ΔTE=0.090 Unit, and similarly, %ΔTE =0.090*100%=9.0%.

large-scale firms the types of ownership do not seem to have any impact on efficiency level. Comparable findings could also be found in Truong et al. (2006) and Vu (2005).

These findings, which are also revealed in the analysis of efficiency performance in Section 5.3.3.1, would suggest that as the firm size is relatively small foreign and private owners could use their available resources to manage the production and run the business in such a way to achieve higher efficiency, while SOE managers are less concerned with profit maximization. As the firm size increases, as it is the case of LSEs, the level of technology and state-ownership would be of advantage. SOEs generally receive their annual budget for investment and business operation allocated by the government. They also often obtain privilege status in many aspects of doing business and concessional financing, particularly if the industry is included among development priorities of the government. All these factors would contribute in one way or another to improving technical efficiency, and thereby compensate for other disadvantages which smaller SOEs would find difficult to deal with.

This finding lends support to the argument set forth in Nadvi and Thoburn (2004b) that many T&G SMEs, particularly textile firms, have been able to upgrade their production through government credits and supply their products for garment exports. However, as argued in Section 5.3.3.1.b, some of these successful SOEs might have been transferred to private enterprises and, hence, the results here are consistent with those mentioned. The argument is also supported by the findings in Truong et al. (2006) that efficiency and profitability has increased upon privatization.

e. Efficiency analysis under new assumption of state ownership

In order to ascertain the argument – presented in Section 5.3.3.1.b and 5.3.3.2.d – that more efficient SOEs have been transferred to private ownership, a new dummy variable (*XSOE*) has been created under a new assumption for further analysis. This binary variable includes state-owned enterprises at central and local level, state-owned

limited companies, Joint Stock and limited companies with government share of greater than 50% and collective enterprises and private Joint Stock companies, i.e. *XSOE* equals the sum of *DSOE* and *DPJSC* (the last group is assumed to be converted from SOEs recently and hence called Ex-SOEs).

The composition of data under this new assumption is presented in Table 5E-1 in Appendix 5E. It is logical that the share of SOEs increases in all cases and the private Joint Stock companies disappear from the datasets. For example, in the POOLED set the number of Ex-SOEs increases to 23, comprising 4.8% of the 476 samples (column 2). Similarly, the number of this group in SME-set and LSE-set increase to 12 and 11, respectively.

The results from the DEA and ANOVA are presented in Table 5E-2 to 5E-5. Table 5E-6 summarizes the results of the corresponding OLS regressions. A comparison between the new and the previous DEA results reveals that there is no significant change in the ranking of the various types of ownership in terms of efficiency indices. Specifically, although there is a small improvement in the magnitude of efficiency indices for newly defined SOEs (*XSOE*), they still rank the lowest in SME-set and POOLED set. On the other hand, despite a small decrease in magnitude, among large-scale enterprises SOEs still achieve the highest efficiency indices and rank first in this classification.

The results from the OLS regression show that purely private and private limited firms are associated with higher technical efficiency as compared to state ownership, although the significance level and the magnitude decrease in all cases. It is also worth noting that under this new assumption the efficiency difference of foreign enterprises (*DFDI*) is no longer significant (Column (1) and (2) in Table 5E-6). It can be observed that despite some minor differences in the significance levels, the results from ANOVA are largely consistent with those from econometric analysis.

In sum, the above results lend support to the argument that for well performing SOEs there is a tendency to capitalize on government investment/credits for upgrading production technologies and improving efficiency and to transfer to private ownership. Such a trend is more apparent among the small and medium size enterprises.

5.3.3.3 Empirical Results from Stochastic Frontier Analysis

Table 5-25: Hypothesis tests for functional form and inefficiency effects

	POOLED	**SME**	**LSE**
1. Generalized likelihood ratio test for functional form			
Null hypothesis	Production function is Cobb-Douglas		
	$\beta_4 = \beta_5 = ... = \beta_9 = 0$ (*df*=6)		
$\chi^2_{0.99}$-critical value	16.81	16.81	16.81
χ^2 - statistic	Frontier estimation halted		35.61
Decision	Translog PF	Translog PF	Reject H_0
2. Generalized likelihood ratio test for presence of inefficiency effects			
Null hypothesis	There are no inefficiency effects		
	$\delta_o = \delta_1 = ... = \delta_j = 0$ (*df*=8; 7)		
	(*j=7 for POOLED set; 6 for SME and LSE sets*)		
$\chi^2_{0.99}$-critical value	21.67	20.09	20.09
χ^2 - statistic (LR)	348.43	252.81	104.64
Decision	Reject H_0	Reject H_0	Reject H_0
3. Generalized likelihood ratio test for firm-specific effects			
Null hypothesis	Determinants have no impact on technical efficiency		
	$\delta_1 = \delta_2 = ... = \delta_j = 0$ (*df*=7; 6)		
	(*j=7 for POOLED set; 6 for SME and LSE sets*)		
$\chi^2_{0.99}$-critical value	20.09	18.48	18.48
χ^2 - statistic (LR)	335.56	245.57	100.65
Decision	Reject H_0	Reject H_0	Reject H_0

Notes: 1. *df* denotes the degree of freedom (the number of restrictions). 2. The likelihood ratio is calculated as *LR=2(Lu-Lr)*, where *Lu* and *Lr* denotes the log-likelihood value of the unrestricted and restricted models, respectively. The LR statistic approximately follows a Chi-squared distribution with the degree of freedom equal to the variables assumed to be zero in the null hypothesis. 3. Starting values for maximum likelihood estimators in cross-section models are calculated by solving two moment equations computed from OLS residuals. Technically, if the OLS residuals are found positively skewed, LIMDEP would halt the estimation at this point and give an error message. The cause might be a specification problem or inconsistency of the data with the model (for more details, see Sena (1999)). For POOLED and SME sets, the Cobb-Douglas specification seems to be inappropriate.

Three generalized likelihood ratio tests have been carried out to examine (i) model specification, (ii) absence of inefficiency effects, and (iii) firm-specific effects (Table 5-25). The first test is to ascertain the appropriate functional form of the production frontier. The null hypothesis is that the coefficients of the mixed and

squared terms in equation (4.68) are zero ($\beta_4 = \beta_5 = ... = \beta_9 = 0$). The results presented in the upper part of the table clearly show that the translog production technology is appropriate for the garment industry in HCM. It is noted that for POOLED and SME sets, the estimation of the Cobb-Douglas production frontier was halted, most probably because this specification is inappropriate for the model (see also note 3 in Table 5-25).

The second hypothesis test is to ensure whether technical inefficiency is present in the production of garment factories. The null hypothesis favors the absence of inefficiency effects ($\delta_o = \delta_1 = ... = \delta_j = 0$ in equation (4.69)) and implies that there is no deviation from the frontier attributable to inefficiency. In such a case, the model without inefficiency effects is just equivalent to the average response of the frontier and can be estimated by OLS. The null hypothesis can be rejected in all three cases, since the LR statistics presented in the middle part of the table clearly confirm the presence of inefficiency effects and implies that the estimation using the inefficiency model is an improvement over the conventional OLS.

The last test is to ensure whether the determinants in equation (4.69) have any impacts on technical inefficiency with a null hypothesis favoring the absence of such effects except for the constant ($\delta_1 = \delta_2 = ... = \delta_j = 0$). Similarly, the results shown in the lower part of the table strongly indicate that the joint effects of the explanatory variables are significant, although the individual effects of certain determinants are statistically not significant.

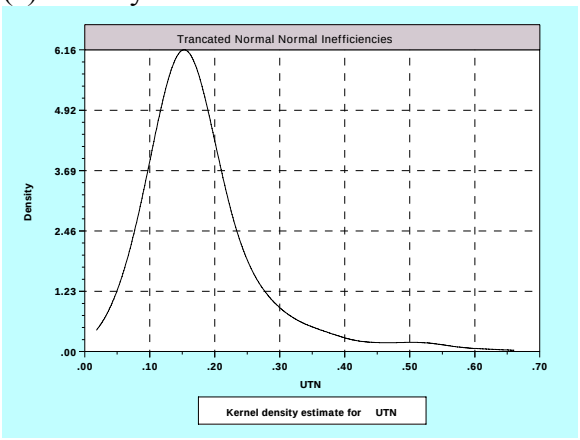
The estimates of the stochastic production frontiers and technical inefficiency effects for POOLED, SME and LSE sets are summarized in Table 5-26 (column 1-6). In addition, the results from the corresponding DEA-Tobit regressions using the same (reduced) datasets are presented for reference (column 7-12).

Overall, it is revealed that the estimates in production and inefficiency equations are more statistically significant for POOLED and SME sets than those of

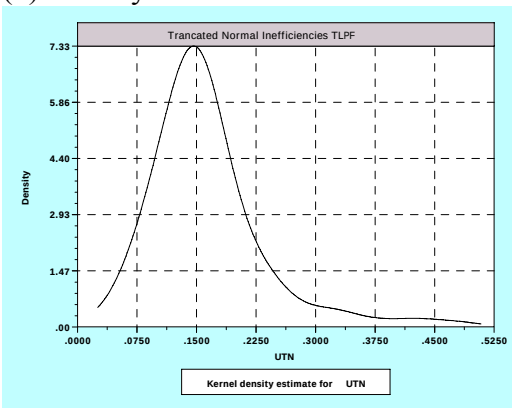
LSE set. In particular, the coefficients of input factors are significant at the 1% level (except for only one case). Also, the value of the parameter lambda (λ) is significant and exceeds the unity in all cases, which implies that the inefficiency effects are dominant in output variation and that the traditional production function without technical inefficiency is less adequate for representing the data of garment firms.

Figure 5-5: Density estimates of technical inefficiency from SFA (Vietnam)

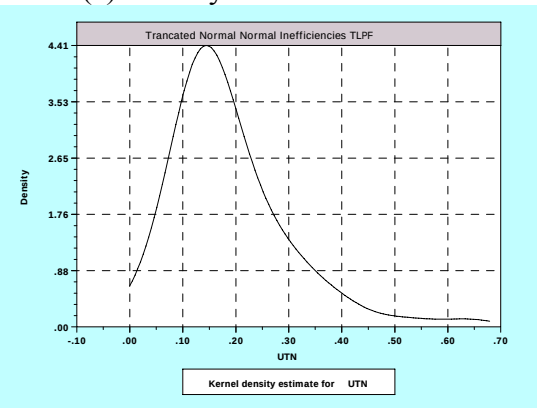
(a) Density estimates for POOLED



(b) Density estimates for SMEs



(c) Density estimates for LSEs



Source: Author's calculations

It is worth noting that the maximum likelihood estimators of the coefficients δ_j in equation (4.69) are obtained by the truncation of the normal distribution. The shape of the truncated normal distribution can be examined and confirmed with help of the kernel density estimates. The kernel density estimates shown in Figure 5-5 are obtained by means of equation (4.70) under the default setting. In other terms, without any specific options, the standard routine uses the following *logit kernel function* and

bandwidth for the computation of the kernel density estimates (for more details, see Greene, 2002, p. E2-26):

$$K[z] = \Lambda(z)[1 - \Lambda(z)] \quad (5.2)$$

$$h = 0.9 \times Q / n^{0.2}, \text{ where } Q = \min(std.dev., range/1.5) \quad (5.3)$$

It can be confirmed that the underlying distribution of the inefficiency scores for all three sets (POOLED, SME, and LSE sets) posses a shape of a truncated normal distribution.

The main findings from the inefficiency model are summarized and discussed in comparison with the findings from the DEA-regression analysis. Previous explanations and reasons for the respective determinants and findings are also valid here.

First, on average estimated technical efficiency from SFA is greater than that from DEA, most probably owing to the difference in methodology (see also Table 5-23, column (1) – (3)). However, this result seems to be consistent with the findings from previous studies using the same estimation method, for instance for manufacturing industries in Vietnam (Vu, 2003; Tran et al., 2008) and for textile and garment firms in Australia (Wadud, 2004, 2007).

Second, the technical inefficiency model and the DEA-Tobit model yield comparable estimates for age, capital intensity and wage per worker in terms of sign and significance level. The absence of impact of firm age could be justified by the fact that newly established garment firms would be able to catch up with competitors in relatively short time, partly owing to low requirement of capital investment, availability of overseas orders resulting from a boom in this sector, presence of sewing skills among Vietnamese workers and the like. Furthermore, the significant effect of technological level and workers' remuneration on technical efficiency could be explained by the fact that (i) the initial capital investment would be relatively low and

there would be room for improvement; (ii) firms are rather young and could improve efficiency over the years of operation; and (iii) wage rates in Vietnam are quite low (below efficiency wage) and an increase in remuneration would mean an incentive for garment workers. More detailed discussions are given in Section 5.3.3.2.a to 5.3.3.2.c.

Third, the major difference between the previous DEA-regression analysis (Section 5.3.3.2) and the SFA is that SOEs have been excluded from this analysis in favor of the profit maximization assumption and that FDI firms constitute the reference group. The estimation results from the two models presented in Table 5-26 also show consistency in both direction and significance level of impact on firm efficiency. On average, the efficiency performance of foreign-owned companies and domestic garment firms of different types appears to be comparable, since the estimated coefficients are statistically insignificant and negligible. The only exception is the superior efficiency performance of private and partnership (purely private) firms as compared to FDI counterparts. Although such a discrepancy might be referred to statistical characteristics of the models, possible causes could include differences in firm age, established markets and the type of liability. In this case, domestic firms would have been longer in market and established a permanent relationship with customers and secured regular orders. Also, unlimited liability of private ownership and partnership would stimulate owners, who often manage the firm by themselves, to make more efforts in doing business and hence achieve higher technical efficiency.

Table 5-26: Estimated production frontiers and inefficiency functions (SFA), and determinants of technical efficiency (DEA-Tobit)

	Stochastic Frontier Analysis						DEA-Regression (Tobit)					
	POOLED		SME		LSE		POOLED		SME		LSE	
	Coeff	Std-err	Coeff	Std-err	Coeff	Std-err	Coeff	Std-err	Coeff	Std-err	Coeff	Std-err
1. Stochastic production frontiers												
Constant	3.105***	0.286	2.981***	0.546	5.567***	1.730						
LnK	-0.427***	0.081	-0.613***	0.137	-0.057	0.337						
LnL	1.400***	0.097	1.780***	0.205	0.454	0.680						
LnM	0.227***	0.045	0.274***	0.070	-0.037	0.227						
*LnK*LnK*	0.060***	0.006	0.071***	0.009	0.059**	0.030						
*LnL*LnL*	0.111***	0.013	0.121***	0.025	0.103	0.090						
*LnM*LnM*	0.075***	0.004	0.066***	0.004	0.097***	0.021						
*LnK*LnL*	-0.096***	0.017	-0.137***	0.025	-0.059	0.085						
*LnK*LnM*	-0.022***	0.008	-0.004	0.010	-0.078*	0.045						
*LnL*LnM*	-0.142***	0.011	-0.154***	0.017	-0.078*	0.047						
2. Technical inefficiency effects							*Determinants of technical efficiency (DEA-Tobit)*					
Constant	2.582***	0.335	2.993***	0.428	2.080	2.158	-0.033	0.050	0.052	0.074	-0.081	0.138
AGE	-0.001	0.005	0.000	0.006	-0.004	0.007	0.000	0.001	0.000	0.002	0.000	0.003
LnCAPIN	-0.304***	0.061	-0.425***	0.095	-0.123	0.088	0.038***	0.009	0.028***	0.011	0.028	0.022
LnPWWAGE	-0.464***	0.113	-0.476***	0.147	-0.459	0.524	0.204***	0.016	0.198***	0.021	0.254***	0.041
DPPRIV	-0.134***	0.050	-0.145**	0.064	-0.001	0.120	0.045	0.031	0.024	0.043	0.085	0.077
DPLTD	-0.082*	0.045	-0.053	0.049	-0.052	0.081	0.013	0.019	-0.002	0.036	0.010	0.026
DPJSC	-0.003	0.115	0.046	0.133	-0.009	0.267	0.002	0.036	-0.029	0.060	0.058	0.051
DLSE	0.001	0.040	-	-	-	-	-0.010	0.016	-	-	-	-
Observations	460		327		133		460		327		133	
Lambda (λ)	1.155***	0.142	1.189***	0.155	1.744	1.905						
Sigma (σ)	0.181***	0.006	0.188***	0.009	0.150***	0.010						
Log-likelihood	196.478		137.082		72.070		249.129		142.844		51.036	
Mean TE	0.821		0.838		0.813		0.627		0.642		0.693	

Notes: 1. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. 2. $\lambda = \sigma_u / \sigma_v$ and $\sigma = \left(\sigma_u^2 + \sigma_v^2\right)^{1/2}$, where σ_u^2 and σ_v^2 represents the variance of the inefficiency and noise component, respectively. 3. See Note 4 in Table 5-24 for test for collinearity.

Appendix 5D: Additional Results for Vietnam

Table 5D-1: Summary of main variables (all three datasets) (Vietnam)

POOLED (SME and LSE)						**Coeff. of**
	Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**	**Variation**
TE	476	0.62	0.18	0.16	1.00	0.28
PTE	476	0.70	0.19	0.16	1.00	0.28
SE	476	0.90	0.11	0.22	1.00	0.12
REV (mil VND)	476	14,953	26,803	144	210,606	1.79
K (mil VND)	476	14,636	27,784	29	232,659	1.90
L (persons)	476	300	448	21	3,687	1.50
PCOST10 (mil VND)	476	9,035	19,242	2	170,873	2.13
AGE (years)	476	5.50	4.10	1.00	30.00	0.74
CAPIN (mil VND/labor)	476	59.76	78.63	0.55	643.92	1.32
PWWAGE(mil VND/labor)	476	14.25	7.78	0.67	82.16	0.55
Small and Medium Enterprise (SME)						**Coeff. of**
	Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**	**variation**
TE	337	0.63	0.18	0.16	1.00	0.29
PTE	337	0.71	0.19	0.19	1.00	0.27
SE	337	0.90	0.11	0.22	1.00	0.12
REV (mil VND)	337	5,750	6,442	144	55,210	1.12
K (mil VND)	337	5,869	8,906	29	72,739	1.52
L (persons)	337	104	72	21	300	0.70
PCOST10 (mil VND)	337	3,766	5,197	2	42,230	1.38
AGE (years)	337	4.77	3.68	1.00	29.00	0.77
CAPIN (mil VND/labor)	337	65.51	88.02	0.55	643.92	1.34
PWWAGE(mil VND/labor)	337	13.75	8.46	0.67	82.16	0.62
Large-Sized Enterprise (LSE)						**Coeff. of**
	Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**	**variation**
TE	139	0.70	0.17	0.31	1.00	0.25
PTE	139	0.78	0.18	0.37	1.00	0.23
SE	139	0.89	0.10	0.48	1.00	0.11
REV (mil VND)	139	37,266	40,784	2,018	210,606	1.09
K (mil VND)	139	35,894	42,673	236	232,659	1.19
L (persons)	139	775	598	305	3,687	0.77
PCOST10 (mil VND)	139	21,493	30,873	238	170,873	1.44
AGE (years)	139	7.29	4.51	1.00	30.00	0.62
CAPIN (mil VND/labor)	139	45.84	46.29	0.64	300.11	1.01
PWWAGE(mil VND/labor)	139	15.44	5.64	3.68	34.88	0.37

Source: Author's calculations

Table 5D-2: Frequency distribution of efficiency indices (Vietnam)

POOLED		TE score		PTE score		SE score	
No.	**Efficiency score**	**No. of firm**	**% share**	**No. of firm**	**% share**	**No. of firm**	**% share**
1	0.00< x ≤0.10	0	0.00	0	0.00	0	0.00
2	0.10< x ≤0.20	5	1.05	2	0.42	0	0.00
3	0.20< x ≤0.30	12	2.52	9	1.89	1	0.21
4	0.30< x ≤0.40	35	7.35	23	4.83	0	0.00
5	0.40< x ≤0.50	57	11.97	42	8.82	3	0.63
6	0.50< x ≤0.60	108	22.69	76	15.97	8	1.68
7	0.60< x ≤0.70	119	25.00	94	19.75	16	3.36
8	0.70< x ≤0.80	73	15.34	80	16.81	40	8.40
9	0.80< x ≤0.90	35	7.35	69	14.50	115	24.16
10	0.90< x ≤1.00	32	6.72	81	17.02	293	61.55
	Total	476	100.00	476	100.00	476	100.00
SME		**TE score**		**PTE score**		**SE score**	
1	0.00< x ≤0.10	0	0.00	0	0.00	0	0.00
2	0.10< x ≤0.20	5	1.48	2	0.59	0	0.00
3	0.20< x ≤0.30	10	2.97	6	1.78	1	0.30
4	0.30< x ≤0.40	19	5.64	11	3.26	0	0.00
5	0.40< x ≤0.50	38	11.28	28	8.31	2	0.59
6	0.50< x ≤0.60	72	21.36	46	13.65	6	1.78
7	0.60< x ≤0.70	83	24.63	75	22.26	8	2.37
8	0.70< x ≤0.80	54	16.02	57	16.91	34	10.09
9	0.80< x ≤0.90	27	8.01	44	13.06	82	24.33
10	0.90< x ≤1.00	29	8.61	68	20.18	204	60.53
	Total	337	100.00	337	100.00	337	100.00
LSE		**TE score**		**PTE score**		**SE score**	
1	0.00< x ≤0.10	0	0.00	0	0.00	0	0.00
2	0.10< x ≤0.20	0	0.00	0	0.00	0	0.00
3	0.20< x ≤0.30	0	0.00	0	0.00	0	0.00
4	0.30< x ≤0.40	7	5.04	4	2.88	0	0.00
5	0.40< x ≤0.50	13	9.35	5	3.60	1	0.72
6	0.50< x ≤0.60	24	17.27	15	10.79	1	0.72
7	0.60< x ≤0.70	26	18.71	23	16.55	7	5.04
8	0.70< x ≤0.80	30	21.58	23	16.55	12	8.63
9	0.80< x ≤0.90	21	15.11	26	18.71	40	28.78
10	0.90< x ≤1.00	18	12.95	43	30.94	78	56.12
	Total	139	100.00	139	100.00	139	100.00

Source: Author's calculations

Note: TE, PTE and SE denote technical efficiency, pure technical efficiency and scale efficiency, respectively.

Table 5D-3: Detailed results of ANOVA for POOLED data (Vietnam)

ANOVA for TE	***DSOE***	***DFDI***	***DPPRIV***	***DPLTD***	***DPJSC***
DSOE		*	-	-	-
DFDI			-	**	-
DPPRIV				-	-
DPLTD					-
DPJSC					
ANOVA for PTE	***DSOE***	***DFDI***	***DPPRIV***	***DPLTD***	***DPJSC***
DSOE		-	-	-	-
DFDI			-	***	-
DPPRIV				**	-
DPLTD					-
DPJSC					
ANOVA for SE	***DSOE***	***DFDI***	***DPPRIV***	***DPLTD***	***DPJSC***
DSOE		-	-	**	*
DFDI			-	**	-
DPPRIV				**	-
DPLTD					-
DPJSC					

Source: Author's calculations.

Notes: 1. *, **, *** denotes significance at the 10%, 5%, and 1% level, respectively. 2. '-' denotes insignificance. 3. SOEs include state-owned enterprises at central and local level, state-owned limited companies, joint-stock and limited companies with government share > 50% and collective enterprises (cooperatives). 4. FDI-type enterprises include only wholly foreign-owned enterprises. 5. Purely private enterprises include wholly private and partnership enterprises. 6. Private limited companies include 100% private limited enterprises and limited enterprises with government share ≤ 50%. 7. Private joint-stock companies include only JSC without government share.

Table 5D-4: Detailed results of ANOVA for SMEs (Vietnam)

ANOVA for TE	***DSOE***	***DFDI***	***DPPRIV***	***DPLTD***	***DPJSC***
DSOE		-	-	-	-
DFDI			-	***	-
DPPRIV				-	-
DPLTD					-
DPJSC					
ANOVA for PTE	***DSOE***	***DFDI***	***DPPRIV***	***DPLTD***	***DPJSC***
DSOE		-	-	-	-
DFDI			-	**	-
DPPRIV				*	-
DPLTD					-
DPJSC					
ANOVA for SE	***DSOE***	***DFDI***	***DPPRIV***	***DPLTD***	***DPJSC***
DSOE		-	-	-	-
DFDI			-	-	-
DPPRIV				-	-
DPLTD					-
DPJSC					

Source: Author's calculations.

Notes: See notes in Table 5D-3.

Table 5D-5: Detailed results of ANOVA for LSEs (Vietnam)

ANOVA for TE	***DSOE***	***DFDI***	***DPPRIV***	***DPLTD***	***DPJSC***
DSOE		-	-	-	-
DFDI			-	-	-
DPPRIV				-	-
DPLTD					-
DPJSC					
ANOVA for PTE	***DSOE***	***DFDI***	***DPPRIV***	***DPLTD***	***DPJSC***
DSOE		-	-	-	-
DFDI			-	-	-
DPPRIV				-	-
DPLTD					-
DPJSC					
ANOVA for SE	***DSOE***	***DFDI***	***DPPRIV***	***DPLTD***	***DPJSC***
DSOE		-	-	-	-
DFDI			-	-	-
DPPRIV				-	-
DPLTD					-
DPJSC					

Source: Author's calculations.
Notes: See notes in Table 5D-3.

Table 5D-6: Estimation results from the Tobit model (Vietnam)

	Dependent Variable: TE			Dependent Variable: PTE			Dependent Variable: SE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	**POOLED**	**SME**	**LSE**	**POOLED**	**SME**	**LSE**	**POOLED**	**SME**	**LSE**
CONS	-0.084	-0.001	-0.054	0.062	0.179**	0.116	0.711***	0.649***	0.663***
	(0.053)	(0.056)	(0.145)	(0.079)	(0.086)	(0.157)	(0.055)	(0.069)	(0.090)
AGE	0.00003	0.00007	-0.0006	-0.003*	-0.003	-0.002	0.003**	0.004**	0.0003
	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.001)	(0.002)	(0.002)
LnCAPIN	0.035***	0.027**	0.028	0.038***	0.021**	0.002	0.0002	0.011*	0.031**
	(0.009)	(0.011)	(0.022)	(0.010)	(0.011)	(0.025)	(0.005)	(0.006)	(0.013)
LnPWWAGE	0.193***	0.195***	0.255***	0.188***	0.195***	0.272***	0.047***	0.048***	0.042
	(0.016)	(0.018)	(0.041)	(0.019)	(0.021)	(0.047)	(0.014)	(0.014)	(0.030)
DFDI	0.092***	0.063	-0.028	0.038	0.005	-0.027	0.077*	0.075	-0.004
	(0.031)	(0.047)	(0.027)	(0.059)	(0.076)	(0.053)	(0.042)	(0.061)	(0.031)
DPPRIV	0.133***	0.086**	0.056	0.107*	0.053	0.038	0.048	0.060	0.041
	(0.036)	(0.040)	(0.070)	(0.063)	(0.074)	(0.094)	(0.045)	(0.063)	(0.061)
DPLTD	0.101***	0.057*	-0.018	0.031	-0.006	-0.047	0.086**	0.081	0.027
	(0.026)	(0.032)	(0.028)	(0.055)	(0.067)	(0.052)	(0.041)	(0.059)	(0.032)
DPJSC	0.092**	0.033	0.031	0.038	-0.029	0.050	0.071	0.071	0.018
	(0.040)	(0.062)	(0.047)	(0.068)	(0.089)	(0.101)	(0.044)	(0.062)	(0.035)
DLSE	-0.010	-	-	0.055***	-	-	-0.076***	-	-
	(0.015)	-	-	(0.020)	-	-	(0.010)	-	-
Obs.	476	337	139	476	337	139	476	337	139
Log likelihood	241.4230	143.406	57.184	75.391	47.540	3.689	363.023	246.486	101.656
Pseudo R-squared	-1.264	-1.833	-1.711	5.153	4.205	1.196	-0.110	-0.092	-0.108

Source: Author's calculations

Notes: 1. Heteroskedasticity was corrected using Huber/White method. 2. Standard errors are in parentheses. 3. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. 4. See Note 4 in Table 5-24 for test for collinearity.

Appendix 5E: Results under New Assumption of State Ownership

Table 5E-1: Composition of data under new ownership assumption (Vietnam)

	Sample	XSOE	FDI	Purely private	Private Ltd. Co.
Number of enterprise and % share in total					
SME	337 (70.80)	12 (2.52)	32 (6.72)	36 (7.56)	257 (53.99)
LSE	139 (29.20)	11 (2.31)	57 (11.97)	9 (1.89)	62 (13.03)
POOLED	476 (100.0)	23 (4.83)	89 (18.70)	45 (9.45)	319 (67.02)
Number of enterprise and % share within individual group					
SME	337 (100.0)	12 (3.56)	32 (9.50)	36 (10.68)	257 (76.26)
LSE	139 (100.0)	11 (7.91)	57 (41.01)	9 (6.47)	62 (44.60)
POOLED	476 (100.0)	23 (4.83)	89 (18.70)	45 (9.45)	319 (67.02)

Source: Author's calculations.

Notes: 1. Percentage share is in parentheses. 2. XSOEs include state-owned enterprises at central and local level, state-owned limited companies, joint-stock and limited companies with government share > 50% and collective enterprises (cooperatives) and private joint-stock companies (the last group is assumed to be converted from SOEs. Thus, the name XSOEs, i.e. *XSOE=DSOE+DJSC*). 3. FDI-type enterprises include only wholly foreign-owned enterprises. 4. Purely private enterprises include wholly private and partnership enterprises. 5. Private limited companies include 100% private limited enterprises and limited enterprises with government share ≤ 50%.

Table 5E-2: Efficiency indices under new ownership assumption (Vietnam)

POOLED		**Mean and standard deviation**					
Ownership	**Number/**	**TE index**		**PTE index**		**SE index**	
	(% share)	**Mean**	**Std. dev**	**Mean**	**Std. dev**	**Mean**	**Std. dev**
XSOE	23 (4.83)	0.605	0.173	0.704	0.220	0.873*	0.095
FDI	89 (18.70)	0.660**	0.180	0.753***	0.194	0.884**	0.111
Purely private	45 (9.45)	0.661	0.161	0.738**	0.173	0.874	0.140
Private LTD	319 (67.02)	0.662**	0.175	0.673***	0.190	0.912**	0.106
Total	**476 (100.0)**	**0.621***	**0.175**	**0.695*****	**0.193**	**0.901****	**0.111**
SME		**Mean**	**Std. dev**	**Mean**	**Std. dev**	**Mean**	**Std. dev**
XSOE	12 (3.56)	0.604	0.202	0.677	0.222	0.891	0.081
FDI	32 (9.50)	0.718***	0.203	0.780**	0.195	0.916	0.075
Purely private	36 (10.68)	0.647	0.157	0.752*	0.164	0.873	0.142
Private LTD	257 (76.26)	0.621***	0.182	0.693**	0.192	0.900	0.108
Total	**337 (100.0)**	**0.633****	**0.184**	**0.707****	**0.192**	**0.898**	**0.109**
LSE		**Mean**	**Std. dev**	**Mean**	**Std. dev**	**Mean**	**Std. dev**
XSOE	11 (7.91)	0.778*	0.132	0.852*	0.155	0.916	0.081
FDI	57 (41.01)	0.694	0.180	0.789	0.187	0.883	0.103
Purely private	9 (6.47)	0.751	0.166	0.844	0.129	0.898	0.166
Private LTD	62 (44.60)	0.676*	0.168	0.754*	0.174	0.899	0.095
Total	**139 (100.0)**	**0.696**	**0.172**	**0.782**	**0.177**	**0.894**	**0.102**

Source: Author's calculations.

Notes: 1. The asterisk * implies that the average efficiency of the respective ownership form is at least statistically different from another ownership form at the 10% level or higher (Analysis of Variance or ANOVA). 2. See notes in Table 5E-1 for definition of types of ownership.

Table 5E-3: ANOVA under new assumption for POOLED data (Vietnam)

ANOVA for TE	***DXSOE***	***DFDI***	***DPPRIV***	***DPLTD***
DXSOE		-	-	-
DFDI			-	**
DPPRIV				-
DPLTD				
ANOVA for PTE	***DXSOE***	***DFDI***	***DPPRIV***	***DPLTD***
DXSOE		-	-	-
DFDI			-	***
DPPRIV				**
DPLTD				
ANOVA for SE	***DXSOE***	***DFDI***	***DPPRIV***	***DPLTD***
DXSOE		-	-	*
DFDI			-	**
DPPRIV				**
DPLTD				

Notes: 1. *, **, *** denotes significance at the 10%, 5%, and 1% level, respectively. 2. '-' denotes insignificance. 3. XSOEs include state-owned enterprises at central and local level, state-owned limited companies, joint-stock and limited companies with government share > 50% and collective enterprises (cooperatives) and private joint-stock companies (the last group is assumed to be converted from SOEs. Thus, the name XSOEs). 4. FDI-type enterprises include only wholly foreign-owned enterprises. 5. Purely private enterprises include wholly private and partnership enterprises. 6. Private limited companies include 100% private limited enterprises and limited enterprises with government share ≤ 50%.

Table 5E-4: ANOVA under new assumption for SMEs (Vietnam)

ANOVA for TE	***DXSOE***	***DFDI***	***DPPRIV***	***DPLTD***
DXSOE		-	-	-
DFDI			-	***
DPPRIV				-
DPLTD				
ANOVA for PTE	***DXSOE***	***DFDI***	***DPPRIV***	***DPLTD***
DXSOE		-	-	-
DFDI			-	**
DPPRIV				*
DPLTD				
ANOVA for SE	***DXSOE***	***DFDI***	***DPPRIV***	***DPLTD***
DXSOE		-	-	-
DFDI			-	-
DPPRIV				-
DPLTD				

Source: Author's calculations.
Notes: See notes in Table 5E-3

Table 5E-5: ANOVA under new assumption for LSEs (Vietnam)

ANOVA for TE	***DXSOE***	***DFDI***	***DPPRIV***	***DPLTD***
DXSOE		-	-	*
DFDI			-	-
DPPRIV				-
DPLTD				
ANOVA for PTE	***DXSOE***	***DFDI***	***DPPRIV***	***DPLTD***
DXSOE		-	-	*
DFDI			-	-
DPPRIV				-
DPLTD				
ANOVA for SE	***DXSOE***	***DFDI***	***DPPRIV***	***DPLTD***
DXSOE		-	-	-
DFDI			-	-
DPPRIV				-
DPLTD				

Source: Author's calculations.
Note: See notes in Table 5E-3

Table 5E-6: OLS estimation results under new ownership assumption (Vietnam)

	Dependent Variable: TE			Dependent Variable: PTE			Dependent Variable: SE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	**POOLED**	**SME**	**LSE**	**POOLED**	**SME**	**LSE**	**POOLED**	**SME**	**LSE**
CONS	-0.013	0.043	0.008	0.125**	0.195***	0.198	0.766***	0.714***	0.706***
	(0.051)	(0.059)	(0.138)	(0.060)	(0.065)	(0.131)	(0.041)	(0.042)	(0.077)
AGE	-0.0003	-0.00003	-0.0003	-0.003	-0.002	-0.0004	0.003**	0.003**	0.001
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)
LnCAPIN	0.036***	0.028***	0.026	0.037***	0.022**	0.00006	0.002	0.013**	0.029**
	(0.009)	(0.010)	(0.020)	(0.009)	(0.010)	(0.018)	(0.004)	(0.005)	(0.012)
LnPWWAGE	0.186***	0.185***	0.240***	0.168***	0.170***	0.235***	0.040***	0.040***	0.031
	(0.015)	(0.017)	(0.038)	(0.017)	(0.018)	(0.040)	(0.012)	(0.013)	(0.027)
DFDI	0.035	0.032	-0.048	0.009	0.021	-0.037	0.031	0.017	-0.017
	(0.029)	(0.048)	(0.033)	(0.037)	(0.051)	(0.042)	(0.023)	(0.028)	(0.022)
DPPRIV	0.074**	0.059	0.022	0.078*	0.075	0.014	0.003	0.007	0.017
	(0.034)	(0.044)	(0.069)	(0.042)	(0.049)	(0.073)	(0.029)	(0.032)	(0.055)
DPLTD	0.045*	0.032	-0.039	0.009	0.018	-0.054	0.042*	0.029	0.012
	(0.025)	(0.037)	(0.033)	(0.033)	(0.040)	(0.041)	(0.022)	(0.025)	(0.022)
DLSE	-0.007	-	-	0.054***	-	-	-0.073***	-	-
	(0.014)	-	-	(0.017)	-	-	(0.010)	-	-
Obs.	476	337	139	476	337	139	476	337	139
R-squared	0.435	0.426	0.418	0.336	0.317	0.312	0.130	0.103	0.128
Adj. R^2	0.426	0.415	0.392	0.326	0.304	0.281	0.117	0.086	0.089

Source: Author's calculations

Notes: 1. Heteroskedasticity was tested and corrected using White robust standard method in all models. 2. Robust standard errors are in parentheses. 3. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. 4. XSOE (*XSOE=DSOE+DJSC*) and SME are reference. 5. See Note 4 in Table 5-24 for test for collinearity.

CHAPTER SIX
SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

6.1 SUMMARY OF COMPARATIVE ADVANTAGE AND INDUSTRIALIZATION IN CLV

In order to study whether CLV follow the neoclassical path of comparative advantage, the paper investigates the structure of external trade, the comparative advantages (CA) and the effects of the changes in CA on the industrialization process for the period of 1985-2005. The empirical analysis employs the export performance index (Balassa's index or RCA index) and the net export index (NEI index or UNIDO-type index) to measure revealed comparative advantages (RCA) and provide inferences on the changes in RCA and trade patterns. To this end, the analysis applies commodity trade data reported by the country or its trade partners in the Comtrade database. The indices of RCA are calculated for all available products at the three-digit level of the SITC depending upon the availability of trade data.

In addition to observing and comparing the value of the two indices of revealed comparative advantage, the study applies the ranking, the share of each product (group) in the country's commodity exports, and three additional indicators to examine the structure and diversification of exports and ascertain the results. These are: (1) the share of high RCA/NEI products to total exported products; (2) the standard deviation of the indices of RCA; and (3) the Spearman Rank Correlation coefficient of the indices of RCA.

6.1.1 Summary of Analysis on Cambodia's RCA and Industrialization

Under the constraint of data availability, trade data reported by 47 trade partners are applied for 1985; 1990; 1995; and 2005, and Cambodia's data are used for 2000-2004. RCA and NEI indices are calculated based on these data. In terms of trade structure, our results lend support to the findings in the Economic Policy Support Study

(JICA, 2007) that Cambodia's exports mainly concentrate in certain agricultural commodities (rubber, oil-seeds and fruit extracts), crude animal and vegetable materials, and labor-intensive industrial products (garment, footwear). The country imports raw materials for production, such as fuel, yarns and textiles, steel and industrial machines and road vehicles. On trade partners, Cambodia's export destinations have changed over the last two decades from the countries of the former Eastern bloc to the US and EU. Similarly, main suppliers have shifted to Asian economies and ASEAN member countries.

In particular, trends of RCA at the commodity-level reveal that garment and footwear products have steadily gained competitiveness and export share over the study period, with knitted garments for men and women becoming leaders of the top-ten export items since 2000. Moreover, a shift in Cambodia's exports from crude materials (rubber, oil-seeds) to light and labor-intensive industrial products in the mid-1990s has been observed, partly owing to economic and trade development efforts of the government. At the three-digit level some commodities of agro-processing and manufacturing industries have shown a potential for development for export, for example fresh or dried fruits and nuts (SITC 057), tobacco products (SITC 121, 122), and made-up articles of textiles (SITC 658) have improved competitiveness with an upward trend of the RCA index.

With respect to diversification, the three measures indicate a rather rigid structure of exports over the last 20 years. Specifically, the ratio of high RCA products to total exported products has decreased for both the export performance index and net export index. The standard deviation of the RCA index has increased significantly, whereas that of NEI index has declined marginally. The SRC coefficients have identified some differences among the exports of the 1980s and those of the 1990s. Therefore, the results imply that considerable changes in the structure of exports occurred prior to the shift (1985-1995), but little has happened in the second decade of

the period covered under the study. This result would suggest that the participation in AFTA and accession to WTO have so far not brought the expected positive effects to the country's competitiveness. In addition, intra-industry specialization tends to occur in the simple product groups, such as simply worked wood; wood in rough or squared; and men's and women's cloth, while the more sophisticated items like 'textile and clothing accessories' (SITC 846) have lost competitiveness.

6.1.2 Summary of Analysis on Lao RCA and Industrialization

The study on RCA and industrialization of Laos faces the most serious problem of data availability. Since there are no data reported by the country in domestic and international sources, the analysis has relied on commodity trade data reported by 38 trade partners. The two indices are calculated for 1985, 1990, 1995, 2000 and 2005.

With respect to trade structure, our results support the findings of Hara and Shuto (2005) that the exports of Laos largely compose of some cash crops and unprocessed agricultural products (raw hides and skins, coffee, spices, un-milled cereals and maize); resource-based commodities (wood and wood products, copper, coal); and products of labor-intensive industry (apparel and clothing industry). Similar to Cambodia, Laos imports most of materials for production, such as petroleum oils, yarns and textiles, industrial machines and vehicles. In regard to trade partners, East Asian economies (with Thailand and Vietnam leading) and the EU have been main markets for Lao products. Similarly, Lao imports largely come from Thailand, Vietnam, China, and the EU.

At the product-level, coffee, wood and wood products are the leading export commodities of Laos, both in terms of value and competitiveness. Other agricultural products seemed to lose competitiveness over time or their demand was temporary. During this period, revealed comparative advantages of Laos have moved from agricultural commodities to light and labor-intensive industry. The clothing industry

has proved to be one of the most dynamic industries. Garment products have gained comparative advantage and have dominated Lao exports for a decade. The mining industry (gold and copper) has gained competitiveness and contributed to a recently positive trade balance. The FDI-driven hydropower industry would also illustrate a similar development trend, but it has been excluded from this analysis solely because of data unavailability in SITC Revision 2. Apart from these, we can observe that a number of agricultural products (maize and cereal, vegetables, preserved fruits) and manufactures (furniture, footwear) have gained comparative advantages over the years. They could be regarded as products with potential for exports.

In terms of diversification, all indicators point to a rather rigid structure of exports. The ratio of high RCA products to total exported products has remained largely unchanged for Balassa's index and shown a decreasing trend for UNIDO-type index. The standard deviation of the two indices has increased or remained constant, and the SRC coefficients have indicated some differences in export structures only for longer time lags. By all these measures, the structure of Lao exports has been rigid and little diversification has occurred, implying that the accession to ASEAN and joining AFTA has so far not brought the expected positive effects to the country's competitiveness. Additionally, intra-industry diversification has been found to occur in the wood processing and garment industry. In other words, specialization tends to occur in the simple product lines, such as simply worked wood; wood in rough or squared; and men's and women's cloth, while the more sophisticated items like wood manufactures and non-textile clothing have not gained competitiveness.

6.1.3 Summary of Analysis on Vietnam's RCA and Industrialization

Among the three countries under examination, Vietnam has made trade data available in the Comtrade database for the longest period 1997-2005. For the previous

sub-period 1985-1995, trade data reported by 51 trade partners are applied. The RCA and NEI indices are calculated based on these data.

In terms of trade value and structure, Vietnam's exports have increased noticeably over the study period, yet largely concentrated in certain agricultural and fishery products, crude materials, crude oil, and labor-intensive industrial products like garment and footwear items. Moreover, a shift in exports from crude materials (excluding crude oil) to light and labor-intensive industrial products in the mid-1990s has been observed, partly reflecting the country's endowments and economic transition and trade liberalization efforts of the government. Vietnam largely imports products of oils, chemical and pharmaceutical materials, iron and steel, industrial machinery, and vehicles. Similar to Cambodia and Laos, the country has shifted export destinations from Eastern Europe to the US, the EU and China. Main suppliers of Vietnam are also countries in East Asia and ASEAN.

At the commodity-level, marine products, rice, and coffee have maintained competitiveness and an upward trend in export value over the study period, although their share has fluctuated and declined. Crude oil, on the other hand, has retained both competitiveness and export share over the last decade. It has become the leading export item in terms of value. Similarly, garment and footwear products have steadily gained competitiveness and export significance over the study period. Knitted and not-knitted garments for men and women have been representatives for the garment industry among the top-ten export items, and footwear has become the second export commodity after crude oil. Moreover, many other products have gained competitiveness and shown great potential for export, for example rubber, furniture and parts, travel goods and handbags, and more capital-intensive products like textiles, electric equipment, and motor cycles etc.

With respect to diversification, the three measures indicate a positive development over the period under study. Specifically, the ratio of high RCA products

to total exported products has decreased for both indices until the mid-1990s and since then remained roughly constant. Unlike Cambodia and Laos, the standard deviation of the two indices of RCA has declined steadily. The SRC coefficients show a similar behavior to the first indicator and identify some differences among the exports of the period before and after 1995. Consequently, by all measures, Vietnam's exports have diversified toward manufactured products in the late 1990s. Together with crude oils, manufacturing industries have dominated the country's exports in terms of earnings.

The results would imply that the Doi Moi policy and trade integration have brought about some expected positive development to the country's competitiveness and industrialization. In other words, apart from resource-based exports and somewhat simple manufactured commodities, a sign of intra-industry specialization in more sophisticated product ranges, such as 'non-textile clothing and headgear' (SITC 848), travel goods and bags (SITC 831), and some electric equipment (SITC 773) and motor cycles (SITC 785), has been observed.

6.2 Summary of Efficiency and Productivity in CLV's Garment Industry

The results of the above analyses have, inter alia, highlighted a dynamic evolution of the garment industry with respect to its export performance, competitiveness, and its role in industrial and economic development of the Indochinese countries. Clearly, there appears to be a need for further study on this particular industry in more detail, because over the last two decades it has achieved a dynamic development and significant contributions to the national output, employment creation and income generation for the poor, and thereby to poverty reduction goals and targets of the government of CLV.

Cambodia, Laos and Vietnam have benefited from recent development in the global garment industry and capitalized on resource endowment (abundant and cheap labor) in establishing their garment industry. Following a production shift from NIEs

and China to the region in the 1980s and 1990s, the garment industry in CLV has emerged and flourished over the decade. The industry is the major non-agricultural sector which provides job opportunities to young people and employs 16 to 34 percent of the labor forces in manufacturing, of which the large part is less educated girls from rural and remote regions. The remittances from these workers to their families in rural areas can sustain the daily lives of an underprivileged portion of the population. For the national economy, the industry has contributed to foreign currency earnings, export growth and overall economic growth. Recently, it has made up 15 to more than 80 percent of the commodity exports in CLV.

The garment industry in CLV has survived the MFA abolition in 2004 and continues to grow in the post-MFA era, partly owing to the Safeguards imposed by the EU and US on China's textile and clothing products. However, the future of this industry upon the termination of the Safeguards has recently been an issue of debates and discussions among policy makers and researchers. A shrinkage or collapse of this industry would cause huge social and economic problems to the government of CLV. In particular, the long-term question is whether the industry can retain its competitiveness in a fiercer competition after the Safeguard termination by the end of 2008. On top of this, efficiency and productivity have been considered a key to retain competitiveness and continue development.

Derived from this background, the research study evaluates the efficiency level (technical, pure technical and scale efficiency) and its determinants, and examines total factor productivity growth and its sources for garment firms in CLV. It makes use of nonparametric and parametric approaches, i.e. DEA, DEA-regression analysis and SFA. To the former approach, the analysis applies the output-oriented CCR-O and BCC-O models to estimate firm efficiency and a two-stage DEA-regression to evaluate the determinants of firm efficiency. Both primary and secondary data are employed: (i) secondary data from enterprise survey and government agencies/ministries are used for

empirical analysis; and (ii) primary data and findings from four field surveys in Phnom Penh, Vientiane, Hanoi and HCM are essential for understanding the real situations, current development issues, and future prospects of the garment industry in CLV, and hence, necessary for appropriate interpretations of the empirical results.

6.2.1 Summary of Analysis on Cambodia's Garment Industry

The Cambodia's garment industry has been widely recognized for its crucial role in export earnings and income generation for the poor. Currently, more than ever, the industry needs to improve competitiveness and efficiency to deal with local labor shortage problem and fiercer competition after 2008. Recognizing these urgent issues, the study analyzes the technical efficiency level of garment enterprises in major garment production areas. Firm data of 2004 obtained from the Ministry of Commerce and the Ministry of Finance and Economy of Cambodia are applied for the estimation.

The analysis reveals that inter-firm variations in terms of efficiency performance are relatively low and that the factors affecting efficiency can be evaluated. The distribution of the technical efficiency (TE) and pure technical efficiency (PTE) score is closer to a normal distribution than that of scale efficiency (SE), which exerts some impacts on the results of the econometric estimation.

In terms of performance, garment firms in Cambodia are more widespread than firms in Vietnam but less than those in Laos. Moreover, local firms are facing difficulty to catch up with foreign competitors in the country, whereas firms with Chinese and other ownership appear to be the most efficient owing to their superiority in many aspects of business, such as production technologies, knowledge and skills, marketing, customer relations, and the like.

The current technological level in Cambodia's garment industry appears not to be appropriate for the production and labor skills or there is a mismatch between physical investment and human resource development. Hence, there would be a need to

enhance skill training for labor and local middle management staff to accommodate investment in production equipment and up-to-date technologies. The dominance of the rather simple CMT-type business is also reflected in the fact that young firms would be able to catch up with other competitors, who have been in the business for longer time, and gained more experience in relatively short time. This result is also consistent with an outcome of the RCA analysis that Cambodia tends to specialize on simple product lines of the clothing industry. In addition, the wage rates in Cambodia are found to be below the fundamental efficiency wage.

Furthermore, the presence of foreign and expatriate workers and product variety does not seem to have any effect on firm efficiency. Similarly, the location in Phnom Penh does not appear to contribute to efficiency enhancement, most likely due to the distance from the deep seaport in Sihanoukville and the associated cost of logistics, transportation and overall production.

6.2.2 Summary of Analysis on Lao Garment Industry

Despite being small in absolute size, the crucial role of the Lao garment industry in national output, employment and income generation, poverty reduction and overall economic development has been evident since the last decade. Like Cambodia, the industry needs to improve efficiency and productivity aiming at retaining competitiveness and coping with local labor shortage and fiercer competition from much larger rivals in the post-MFA era and after the termination of the Safeguards.

In recognizing these issues, the research study is set out to evaluate firm efficiency and its determinants, and the change in total factor productivity and the sources of such changes for garment firms in Vientiane Capital. Similar to the case of Cambodia, the DEA is applied to firm-level data to calculate firm efficiency and a two-stage DEA-regression is employed to evaluate the determinants of efficiency. In addition, the DEA-based Malmquist TFP Index and its components (*EFFCH; TECH;*

PEFFCH; SCALECH) are calculated using non-radial output-oriented models. Data of 2004-2005 are obtained from the Ministry of Industry and Commerce, Ministry of Finance and the Association of the Lao Garment Industry, and cover the transition period to post-MFA era. This fact is very crucial and needs to be taken into account when interpreting the results.

The study reveals that overall the Lao garment industry is struggling to catch up with neighboring competitors in the post-MFA era. The efficiency dispersion of garment firms in Laos is greater than that of firms in Cambodia and Vietnam, and this efficiency gap in both TE and PTE has widened. Only scale efficiency seems to have improved marginally. The efficiency level is comparable among the ownerships.

The distribution of the three efficiency indices (TE; PTE; SE) is far from a normal distribution. This indeed has a great influence on the results of the econometric estimation, in that all the evaluated determinants (except for staff share) do not seem to have any contribution to efficiency enhancement.

On the other hand, the current technology level appears not to be appropriate for the skill level of workers or the equipment is out of date. This result supports the finding from the case of Cambodia (see above) and the argument of Vu (2005). Furthermore, the role of human capital is evident in this study. Looking positively, these two results imply that investment in physical capital should take into the account labor skill level in order to optimally utilize new technologies and that the knowledge and skill level of local staff at the middle management level should be improved if firm efficiency and productivity enhancement is to be realized. Similarly, the dominance of the simple CMT-type operation and the intra-industry specialization in low value-added garment products are also reflected in the fact that new entry firms would be able to catch up with other competitors, who have been in the business for longer time and equipped with more experience, in relatively short time.

Moreover, efficiency improvement and productivity augmentation are evident only at firm level, while TFP of Lao garment industry has declined over the period 2004-2005. The main source of such worsening in productivity is found to be the deterioration in technical change or technical regress, whereas some improvement in scale efficiency has occurred. These results are consistent with the findings in previous studies for developing and transition economies that efficiency improvement occurs but technical progress is often a rare case. In regard to ownership, only Joint Venture firms have achieved an efficiency improvement (positive EFFCH) and this progress comes from pure efficiency augmentation and scale efficiency change. The findings point to an urgent need to enhance firm efficiency and productivity; in particular, there is much room for technical progress.

Finally, many bottlenecks and impediments in business should be gradually removed so that garment firms in Laos, especially foreign-owned and JV firms with greater potentials could realize their capacity and improve their business operations.

6.2.3 Summary of Analysis on Vietnam's Garment Industry

Derived from the role of the Vietnam's garment industry in export earnings and income generation and the need for improving efficiency to deal with increased competition in the post-Safeguard era and local labor shortage, the paper examines the technical efficiency level of garment enterprises in Ho Chi Minh City. The garment industry is very much concentrated in this area with nearly 50% of garment workers and production.

This study applies both non-parametric and parametric methods for the quantitative investigation. In the first part, as in Cambodia's and Lao case, DEA and DEA-regression are used. In the second part, a stochastic frontier analysis (SFA) is utilized on the same dataset (excluding SOEs) to assure the consistency and robustness of the results. Another major difference is the availability of data from Enterprise

Survey, 2007 (data of 2006). Moreover, data of garment firms can be classified by size into small and medium enterprises (SME set) or large-scale enterprises (LSE set) and the POOLED set, and by ownership into different types: collective and state-owned enterprises; private limited companies; Joint Stock companies; private and partnership firms; and FDI firms and so on. Foreign ownership is not the majority in Vietnam.

Overall, the analysis results from the two approaches show robustness and consistency. The analysis shows that inter-firm variations in terms of efficiency performance are relatively low and that the factors affecting efficiency can be evaluated. The distribution of TE score is closer to the normal distribution than that of PTE and SE scores in all three sets. With regard to efficiency performance, SMEs are more widespread than LSEs and the overall dispersion in the POOLED is mainly driven by SMEs owing to their dominance in numbers. Comparing among CLV countries, the efficiency dispersion of garment firms in HCM is by far the smallest, followed by firms in Phnom Penh and those in Vientiane Capital.

Non-state garment firms of domestic and foreign ownership are superior in technical efficiency as compared to state-owned enterprises, whereas such a trend is not prevalent among various types of private ownership and foreign ownership. In contrast, state-ownership is of advantage for large-scale garment firms. Moreover, there is evidence that more efficient SOEs, mostly capitalizing on large scale public investment, tend to undergo and complete the privatization process ahead of their less efficient counterparts.

In contrast to Cambodia's and Lao case, for average garment SMEs an improvement in technology and in capital goods investment would yield a positive impact on efficiency. This is most likely due to the fact that the majority of SMEs are young and initial investment would not be sufficient in most cases, leading to a relatively low level of technology in the initial state. Hence, any technical improvement would yield a positive impact. On the other hand, large-scale enterprises with much

higher financial capacity would be able to afford state-of-the-art technologies. Hence, they appear to face the problem of mismatching rather than backward technology as faced by non-state firms of smaller size. Moreover, many of the LSEs are SOEs which can receive fund injections from the government for physical investment in up-to-date production technologies. However, in implementing government policies on employment they would have to employ a large amount of workers regardless of skills. This could exacerbate the above-mentioned effect of mismatching. Overall, investment in physical capital should go parallel with human resource development if the efficiency level is to be improved.

With regard to type of business operation, the effect of firm age is compatible to the case of Cambodia and Laos. In Vietnam too, there is evidence of the dominance of CMT-type operations and FOB-type-I business, and the intra-industry specialization in relatively low value-added garment products. Hence, young and newly established garments firms would be able to catch up with other veteran competitors in relatively short period of time. With regard to remuneration, like Cambodia the wage rates in Vietnam are found to be below the fundamental efficiency wage.

6.3 CONCLUSIONS

In view of exploring the path of comparative advantages in Indochina, two indices of revealed comparative advantage (RCA index and NEI index) are calculated for analyzing the structure of external trade, trends of revealed comparative advantages and export diversification for all exported commodities at the 3-digit SITC level for the period of 1985-2005. Subsequently, in order to address the competitiveness of the garment industry in the post-MFA era, using both nonparametric and parametric approaches we estimate firm efficiency and productivity growth, and evaluate certain factors that affect such performance for garment firms in the production centers of

CLV. To our knowledge, these issues have been addressed at this comprehension for the first time, particularly for Cambodia and Laos.

It is found that Cambodia, Laos and Vietnam have largely been following the neoclassical path of comparative advantages, moving from agriculture to light and labor-intensive industry. Exports are still concentrated in some agricultural and fishery products, crude materials and resources and light-industrial products. In addition, some potential commodities with positive indices of RCA or an upward trend in RCA also exist, but they still occupy a small share in exports. These sectors/industries could be developed for export markets provided that appropriate promotion and sound policies are put in place. Moreover, a shift in exports to light and labor-intensive industrial products in the mid-1990s has been observed, partly reflecting the country's endowments and economic transition and trade liberalization efforts of the governments of CLV.

Overall, export diversification has been low. To some extent, structural changes in exports were evident prior to the shift (1985-1995), but little has been found in Cambodia and Laos since the mid-1990s. Also, intra-industry specialization in the wood processing and garment industry tends to occur in the simple and low value-added product groups. These findings would suggest that the participation in AFTA and accession to WTO have so far not brought the expected positive effects to competitiveness of these two countries.

Vietnam, on the other hand, has been able to diversify her exports toward manufactured products in the late 1990s implying that reforms have induced positive developments in competitiveness and industrialization. Given endowment in natural resources and labor and her capacity, Vietnam is moving ahead of Cambodia and Laos in the industrialization process and is penetrating more capital-intensive industries such as electric equipment and parts for automobiles. The industrial sector has a much more solid foundation and consists of a wide range from mining, agro-industry, light and

labor-intensive industries, some heavy industries, and some more capital-intensive industries.

Unlike some predecessors such as Korea (Lee, 1995), the industrialization process in CLV occurs rather gradually without strong push to capital-intensive industry, as they are still regarded as labor-abundant economies. The exception is some special large FDI investment projects, which the host country does not have the capacity for undertaking, like hydropower and large mining projects. The industrialization, as indicated by revealed comparative advantage dynamics, is still in the early stage with some focus on light and labor-intensive industry. This might be a consequence of the development occurring in other developing economies in the region, which have succeeded to move to newly industrialized economies. Industries in these economies have moved to a more capital- and technology-intensive level, and labor-intensive industries have shifted out to other economies with lower wage rates like Indochina. The countries could use these industries as a base for industrialization. Yet, much still remains to be done to develop a solid base for the industry.

Regarding the garment industry, some common characteristics are apparent in Indochina. In particular, a comparable development stage is evident for Cambodia and Laos, although the difference in the industry's scale is large. On the other hand, the industry in Vietnam is rather more developed and has a better backward linkage and a significant domestic market.

Despite a continuing expansion, the Cambodia's and Lao garment industry is facing some difficulties to catch up with neighboring competitors in the post-MFA era in terms of efficiency. Within the domestic supply chain, local firms are struggling to catch up with foreign competitors. They also have many other common features. First, the dominance of foreign firms is pronounced in all aspects, including number of firms, employed labor, output and efficiency performance. Second, the current technological level appears to be out-of-date or there is a mismatch between technology and labor

skills. Third, the role of human capital is evident, in that upgrading production technology should take into account labor skills in order to optimally utilize production equipment and new technologies and that the knowledge and skill level of local staff at the middle management level should be improved if firm efficiency and productivity enhancement is to be realized.

A specific characteristic for Cambodia is that the presence of foreign workers and agglomeration in Phnom Penh does not appear to contribute to efficiency enhancement. For Laos, efficiency improvement and productivity augmentation are evident at firm level, while the opposite is observed at the industry level. There is an urgent need to enhance firm efficiency and productivity, in particular there is much room for technical progress.

Turning to Vietnam, the industry has some specific characteristics in that firm ownership is classified in terms of legal status of enterprises or shareholding. There is no evidence of foreign dominance. For smaller size enterprises non-state and foreign ownership gives rise to firm efficiency enhancement, whereas state-ownership is of advantage for large-scale garment firms. In addition, more efficient SOEs have benefited from large-scale public investment, undergone and completed the privatization process ahead of their less efficient counterparts. Having advantage in state-of-the-art technologies, these larger firms should focus on higher value added garment products

In all, the short-term dispersion of firm efficiency in Cambodia lies between that of Vietnam and Laos. Recently, this efficiency gap in Laos has widened. The current garment supply in CLV largely concentrates on simple products and the CMT-type operation. Investment in physical capital should go parallel with human resource development if the efficiency level is to be improved. Foreign and private ownership would significantly contribute to efficiency augmentation.

6.4 POLICY IMPLICATIONS

In view of fostering economic development in Indochina, the ongoing transition should be deepened and accelerated. The industrialization, among other things, has been proved to be a crucial component to accommodate development and progress in the agricultural sector and to sustain economic growth. In this connection, the present research study has attempted to contribute to hasten and sustain the industrialization process by addressing comparative advantages and two major issues for long-term development – efficiency and productivity – in the garment industries in CLV. Hence, in order to make use of the findings from the research, certain policy implications can be drawn and summarized as follows.

Derived from the analysis of comparative advantages, CLV would need to build a solid base for industrialization, such as improving (hard) physical and (soft) institutional infrastructure, enhancing human resource development and the like, to be able to develop and promote sectors and industries which have potential for export and to accommodate successes, and rapid development in real sectors.

In order to expand the country's production capacity, increase foreign currency earnings for economic development, and have better risk management in the international markets, export diversification should be fostered and/or accelerated to cover agricultural products and crude materials with CA in the mean time, and to gradually move to light and more capital-intensive industrial products in the longer term. To this end, appropriate and sound industrial and trade policies should be put in place to realize the potential of such sectors and industries, and thereby diversifying the rather concentrated exports and moving to higher value-added products.

Based on the findings from the analysis of efficiency and productivity of the garment industry, two major policy implications can be drawn and presented. First, the formulation of industrial, trade and education policy should go hand-in-hand, in order to obtain monetary and technical benefits from trade development and industrialization.

Specifically, investment in human resources and labor skill development should be promoted and coordinated with the industry in order to capitalize on investment in physical capital and state-of-the-art technologies. Second, appropriate foreign direct investment should be formulated to attract quality foreign direct investment and more efficient foreign enterprises so as to promote development and efficiency enhancement in the garment industry as a whole. In addition, some specific policy implications for each country are presented below:

Cambodia: For export diversification in the short term, the plantation and processing of some agricultural products with an upward RCA trend, such as fruits and nuts, tobacco and the like, should be developed and promoted. Also, the footwear industry deserves further support and development. Sound policies on FDI are essential to attract quality investment from abroad and mobilize funds into these sectors and industries.

With regard to the garment industry, skill and productivity enhancement measures, such as the initiative of the Garment Industry Productivity Center, should be facilitated and promoted to help the industry improve labor quality. Moreover, there is a need for government to support domestic entrepreneurs and managers at the middle management level, technically and financially, to further develop their skills.

Laos: Given a relatively small domestic market, export diversification is even more crucial. In addition to the implications illustrated above for CLV, Laos needs to urgently diversify her exports by means of developing and promoting sectors identified as potential in this study (maize and cereal, vegetables, preserved fruits etc.) and processing and light industries with potential (furniture, footwear, office stationery supplies). Moreover, on-going large FDI projects in hydropower and mining sectors are essential to government as a major source of income, and need further developing.

With respect to the garment industry, human resource development efforts should be made at grass root level for the poor to gain necessary basic skills to be able

to contribute to and benefit from the ongoing industrialization and for the country to move faster in this process. The quality of foreign direct investment is another issue which needs addressing. In other words, policies on FDI and screening of FDI projects should be enhanced in order to attract more efficient foreign firms to this industry and thereby improve efficiency and productivity of the garment industry as a whole.

Vietnam: It seems to be necessary for Vietnam to further develop the industrial foundation based on the country's comparative advantages, to move to more capital-intensive products (for example electric equipment and parts for automobiles) and climb up the quality ladder to higher value-added, and thereby further diversifying exports. The SOE reform should be accelerated to free up more government budget for other development purposes. In addition, privatization of SOEs can be viewed as a tool to enhance the technical efficiency level in industries like the garment industry. Hence, the ongoing privatization process should be further facilitated and appropriate entrepreneurs are to be found and supported.

For the garment industry, government policies addressing technical and financial assistance are crucial in helping upgrade the current technological and skill level of garment SMEs. For larger firms skill enhancement and human resource development (tailored skill training) are necessary to fully utilize the acquired up-to-date technologies and move up the ladder in the production value. Policies on investment and FDI are also essential to attract quality investment from domestic, overseas Vietnamese and foreign investors into those sectors and industries with potential (e.g. garment SMEs) to further strengthen the private sector and capitalize on the country's tremendous resources and great potential.

6.5 SCOPE FOR FURTHER RESEARCH

Facing the constraint of data availability, the study on efficiency and productivity of the garment industry in CLV has largely focused on the impact of firm

characteristics for a single year or two adjacent years, which are the years prior to the MFA abolition and immediate after the MFA phase-out. If the scope of efficiency study is to be expanded to evaluate possible effects of the MFA termination on efficiency and productivity performance, future research could be expanded in the following ways: (i) the analysis on firm efficiency and its determinants could include environmental variables beyond control of the firm's management, such as variables of business climate or government support and promotion policies, or more precise proxies of education and skill level of employees and technological level of firms, or proxies of the (vocational) education or training system and the like; (ii) the analysis of TFP growth should cover a longer time period to assess possible impacts of the MFA phase-out; and (iii) the availability of time series data would also enable an assessment of average efficiency and its determinants using a panel data construction under the stochastic frontier analysis method.

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