Foreign Direct Investment and Industry Linkages:

Evidence from Cambodia

By

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List of Abbreviations

ADB	Asian Development Bank
AREES	Association of Regional Econometrics and Environment Studies
ASEAN	Association of South East Asian Nation
BFDI	Backward Foreign Direct Investment
BL	Backward Linkages
CDC	Cambodia Development Council
CLVM	Cambodia, Laos, Vietnam, Myanmar
EIC	Economic Institute of Cambodia
EU	European Union
FDI	Foreign Direct Investment
FE	Fixed Effect Model
FFDI	Forward Foreign Direct Investment
FL	Forward Linkages
GDP	Growth Domestic Product
GMAC	Garment Manufacturing Association of Cambodia
GMM	General Method of Moments
GSP	General System of Preference
GTAP	Global Trade Analysis Project
H	Human Capital
HFDI	Horizontal Foreign Direct Investment
IDEs	Institute for Developing Economies
IT	Information and Technology
I-O	Input-Output Table
JICA	Japan International Cooperation Agency
Kg	Kilogram
MFIs	Micro Finance Institutions
MFN	Most Favored Nation
NBC	National Bank of Cambodia
NGO	Non-Government Organization
NIEs	Newly Industrialized Economies
NIS	National Institute of Statistics
OECD	Organization for Economic Cooperation and Development
OLI	Ownership, Location and Internalization

OLS	Ordinary Least Square
QIP	Qualified Investment Project
R&D	Research and Development
RE	Random Effect Model
RGC	Royal Government of Cambodia
SEZs	Special Economic Zones
SMEs	Small and Medium Size Enterprises
SOEs	State -Owned Enterprises
SPZs	Special Promotion Zones
TFP	Total Factor Productivity
TFPGap	Total Factor Productivity Gap
TR	Training
USA	United States of America
USD	United States Dollars
WTO	World Trade Organization

Chapter 1: Introduction

1.1 Background of the Study

Foreign Direct Investment (FDI) has become an important tool in the development of many developing countries. They turn to open their countries for foreign direct investment because they believe that arrival of FDI will promote growth in their countries through job creation and technology transfer. The experience of some developing countries that enjoy the fruits of FDI, such as Newly Industrialized Economies (NIEs), have induced many host countries to continue offering attractive policy for foreign direct investment.

Technology is an important element for long-term growth of many countries because technology can push countries out of the diminishing return trap (Barro and Sala-i-Martin, 1995). Moreover, literatures on foreign direct investment always stress that the multinational firms own some specific technology as their competitive advantages and these assets enable them to compete when they invest in the host countries (Rodriguez-Clare, 1996; Markusen and Venables, 1999). Therefore, the arrival of the foreign firms would lead to the possibilities that some of the technology brought by multinational firms could be transferred or spillover to the host countries.

Arrival of multinational firms enables cross-border technology. However, this does not guarantee that the host countries can completely benefit from such cross-border technology. The reasons are, first, the multinational firms could try to prevent the leakage of their technology to their competitors. Second, the host countries, especially the domestic firms, may lack some abilities to benefit from the technology brought by those multinational firms fully.

Consequently, the most important role of host government is to direct the technology brought by FDI in a way that it is beneficial to the domestic firms. If domestic firms are able to learn and absorb that technology, there are possibilities that industrialization could start in the host country, and the long-term growth is expected. One of the important policies, carried out by many host countries, is to build linkages between FDI and domestic firms because as long as the FDI generates some demand for intermediate goods produced by domestic suppliers, there is hope that technology transfer or spillover to domestic suppliers occurs. An alternative policy is to promote the domestic firms' abilities so that they can benefit from the new technology or learn to absorb the new technology.

As mentioned above, if the foreign firms generate demand for intermediate goods, they will creat linkages with domestic suppliers. These linkages could bring two benefits to host countries. First, the linkages between foreign firms and the domestic suppliers can generate technology spillover to domestic suppliers. Second, the linkages will encourage many entries and employment in the supplying industries. However, not all the domestic suppliers can benefit from the technology spillover. Domestic suppliers will benefit from the technology spillover differently, depending on their characteristic and absorptive capacity (Gorg and Greenaway, 2004; Smeets, 2008).

One of the objectives of this thesis is to address this issue, by focusing on how to enable domestic firms (both domestic supplier and domestic firms in final goods industries) to benefit from the productivity spillover from FDI. Along with this objective, the thesis will try to identify the role of absorptive capacity of domestic firms, their technology gap comparing to their foreign competitors in affecting the productivity spillover.

In fact, many host country governments have provided lots of incentive schemes to FDI. One of the remarkable policies, carried out by many developing countries, is tariff exemption or tariff reduction on imported intermediate goods to foreign direct investment. This policy is used to attract FDI to invest in the host countries. However, little is understood that this policy can affect the industry linkages in the host country. Therefore, it is crucial to understand how such tariff policy affects the industry linkages in the host countries.

The second objective of this thesis is to construct a theoretical model to explain the impact of tariff on intermediate goods on industry linkages in the host countries. To pursue this objective, the thesis will address under what conditions tariff reduction be favorable to industry linkages.

1.2 Literatures of Related Studies

Linkages between FDI and the host country have been the focus of many studies because it is believed that such linkages could benefit host countries. Rodriguez-Clare (1996) and Markusen and Venable (1999) explained that this linkage generates demand for intermediate goods produced by the domestic suppliers, which resulted in the entrance into the supplying industries and may lead to the growth of supplying industries. Furthermore, the linkages also generate employment in those supplying industries. In addition, Javorcik (2004) pointed out that there is also evidence of technology spillover from the foreign firm in the downstream industries to the domestic suppliers in the upstream industries. He explained that foreign firms could encourage domestic suppliers to improve their

productivity or the foreign firms may transfer technology to improve the productivity of domestic suppliers.

Studies on productivity spillover from FDI to domestic firms in the host country are abundant. Most of the empirical studies focused on horizontal spillovers, which occurred when foreign and domestic firms are in the same industries because of competition, imitation and movement of labor from foreign to domestic firms (Blomstrom and Kokko, 1998). However, the results from empirical studies have been mixed with positive and negative spillover (Gorg and Greenaway, 2004; Smeets, 2008). Likewise, empirical evidence of the vertical spillover is also mixed with positive and no spillover (Smeets, 2008).

There is much possible explanation on these mixed findings. However, two prominent factors are the technology gap and the absorptive capacity. Theoretical explanation on the role of the technology gap argues that the technology gap affects the productivity spillover from foreign to domestic firms because the larger gap gives the potential that domestic firms can catch up quickly to foreign firms. That is, the larger the gap, the more opportunities for domestic firms to learn from the foreign firms (Findlay, 1978). On the other hand, there is also theoretical explanation that large gap encourages foreign firms to bring only old technology because with the larger technology gap, foreign firms will be able to earn the profit by using only modest technology in competition with domestic firms. However, if the technology gap is smaller, the foreign firms need to bring the high technology to compete with domestic firms (Wang and Blomstrom, 1992; Glass and Saggi, 1998).

Regarding the role of absorptive capacity, theory has suggested that in order to learn and make use of new knowledge brought by foreign firms, domestic firms need a certain level of absorptive capacity. Cohen and Levinthal (1989, 1990) explained that organization needs prior related knowledge to learn or to imitate the new knowledge. They inferred that basic knowledge is needed before the advanced knowledge can be easily learned or copied. For example, workers may need to know how to type before they are able to use Microsoft Word efficiently. Cohen and Levinthal (1989, 1990) also argued that there are costs associated with imitation and those costs would be lower if an organization has a certain level of absorptive capacity. Despite the theoretical explanation on the role of technology gap and absorptive capacity on productivity spillover, the empirical evidence is mixed (Smeets, 2008).

Because of the benefits of FDI as mentioned above, host countries have used many incentives to attract FDI, but little is known about how such incentive policy could affect the industry linkages in the host country. One of the policies that has been widely used not only in developing countries but also in advanced industrialized countries is the tariff reduction on imported intermediate goods. Lin and Saggi (2007) have constructed a theoretical model to show that competition between domestic and foreign firms in the downstream industries could displace the existing industry linkages in the host countries. This negative impact on industry linkages has been proposed in Rodriguez-Clare (1996) and Markusen and Venables (1999). The model of Lin and Saggi (2007) is very useful but the role of tariff on imported intermediate goods is not mentioned in the model.

1.3 Objectives of This Study

There are two limitations of previous studies on productivity spillover that are subject to discussion and that this thesis attempts to extend. First, the empirical evidence on the role of the technology gap on productivity spillover tends to focus only on the technology gap between domestic and foreign firms within the same industry (horizontal spillover). There is little attention on the technology gap between foreign and domestic firms in vertical linkages. This thesis will attempt to verify whether the technology gap affects the vertical productivity spillover. Particularly, the study will attempt to verify whether the domestic suppliers in upstream industry can benefit from vertical productivity spillover if they have the technology below their foreign competitors and similarly, whether domestic firms in downstream industry can benefit from vertical productivity spillover when they have the technology below their foreign competitors. The main reason for such empirical analysis is that it can point out the role of FDI in both upstream and downstream industries while taking account of the competition between domestic and foreign firms as well.

The second limitation is related to the use of proxies to measure absorptive capacity. Previous studies tend to use R&D as proxies for absorptive capacity but such R&D is not appropriate, especially in least developing countries such as Cambodia. Some reasons that R&D is not a good proxy for absorptive capacity are as follows. Firstly, in the least-developed countries such as Cambodia, most FDI is invested in labor-intensive industries and usually comes with less complicated technology. Therefore, R&D is less needed in industry where labor is used intensively, and simple technology is easily imitated. Secondly, in least-developed countries, majorities of domestic firms are small firms, and they cannot

afford R&D expenditure. Finally, R&D is not a good proxy for absorptive capacity because even though domestic firms may have R&D, they may still need trained workers to use R&D. In this study, two proxies for absorptive capacity are used: worker's education level and training offered by firms.

Besides the two limitations on technology gap and absorptive capacity in the previous studies, there is also limitation of the role of tariff on imported intermediate goods. As mentioned above, Lin and Saggi (2007) ignore the role of tariff on imported intermediate goods. Therefore, this thesis will also attempt to extend the model of Lin and Saggi (2007) by incorporating the role of tariff on intermediate goods. Incorporating this tariff incentives helps explain how such tariff incentives could have the impact on domestic industry linkages in many developing countries.

In summary, this study contributes to the literature by filling some gaps found in the previous studies on the relationship between industry linkages and FDI. In the first direction, it investigates the role of the technology gap on productivity spillover by extending the role of the technology gap to the case of vertical spillover. Also, it investigates the role of absorptive capacity on productivity spillover by introducing new proxies of absorptive capacities: the workers' education and training offered to workers.

In the second direction, it tries to contribute to the literature by constructing a theoretical model to explain the impact of tariff on imported intermediate goods in the host country when there is technology gap between domestic and foreign firms in downstream industries. This model has significant implications on tariff reduction policy used by many developing countries to attract FDI.

To achieve the above objectives, I use both the quantitative and qualitative methods. In achieving the first objective to verify the role of technology gap and absorptive capacity on productivity spillover, a quantitative regression method with panel data will be used to study the effect of technology gap and absorptive capacity on productivity spillover from FDI. To achieve the second objective of understanding the impact of tariff on imported intermediate goods, a theoretical model will be constructed to explain how the tariff on imported intermediate goods affects the backward industry linkages in the host country if there is technology gap between domestic and foreign firms in downstream industries.

The whole dissertation is divided into five chapters. The next chapter overviews Cambodian Economy, FDI and domestic investment, industry linkages, and related policies on FDI and domestic firms. Chapter 3 attempts to verify if there is any productivity spillover occurred in Cambodia by taking account of the technology gap and absorptive capacity. Chapter 4 constructs a theoretical model to explain how the tariff on imported intermediate goods has the impact on industry linkages in the host country when there is a technology gap between domestic and foreign firms in the downstream industries. Chapter 5 gives conclusion, limitation and future direction of the study.

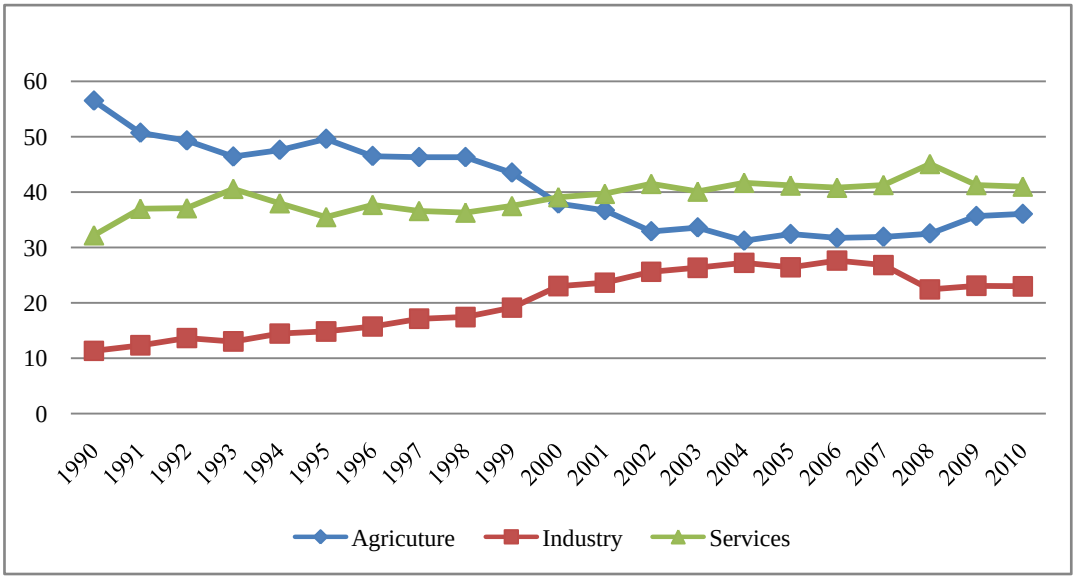
Chapter 2: Overview of Investment and Cambodian Economy

2.1 Overview of the Structure of Cambodian Economy

The GDP growth over several years shows a remarkable change in the structure of industries. At the beginning of the 1990s the economy heavily depended on agriculture as the main sector to sustain the economy. Almost more than 50 percent of GDP in current value came from agriculture, more than 30 percent came from service sector, and only around 11 percent came from industrial sector.

Later, the economy marked a constant increase in the industrial sector and a decline in the agricultural sector, while the share of service sector almost remains stable around 40%. Although the industrial sector was growing and showing the sign of industrialization, the large share of GDP still relied on agriculture up to 2000.

Figure 2-1 GDP Shares of Sectors in Percentages



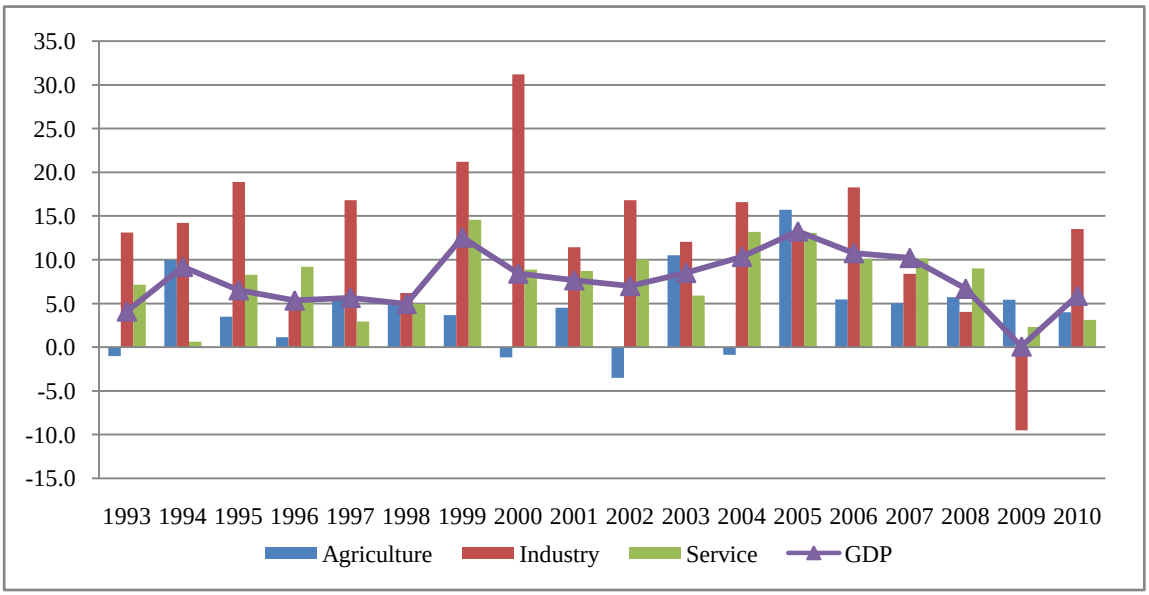
Source: ADB Key Indicator, 2011

In the first decade of the twenty-first century (2000-2010), the path has changed remarkably. The share of industrial sector seems to be constant from 2008 to 2010, but the share of agriculture shows slight recovery trends after 2008. The service sector has the

largest share of the country from 2000 onward. In 2010, the service sector occupied 41% of the GDP share.

The growth rate of current GDP is shown in Figure 2-2. The growth of the industrial sector tends to exceed agriculture and service sector until 2006 and reaches its highest point in 2000 at 31%. From 2007 to 2009, the growth of industrial sector declines and it is below that of the service sector. Growth in the industrial sector becomes negative in 2009. However, it has recovered again in 2010 and exceeds that of the agriculture and service sectors. The service sector maintains positive growth at the end of the first decade in the twenty-first century. The agriculture sector tends to have lower growth comparing to other sectors and show both negative and positive growth over the periods.

Figure 2-2 Growth of Current GDP by Sectors of Economy in Percentages



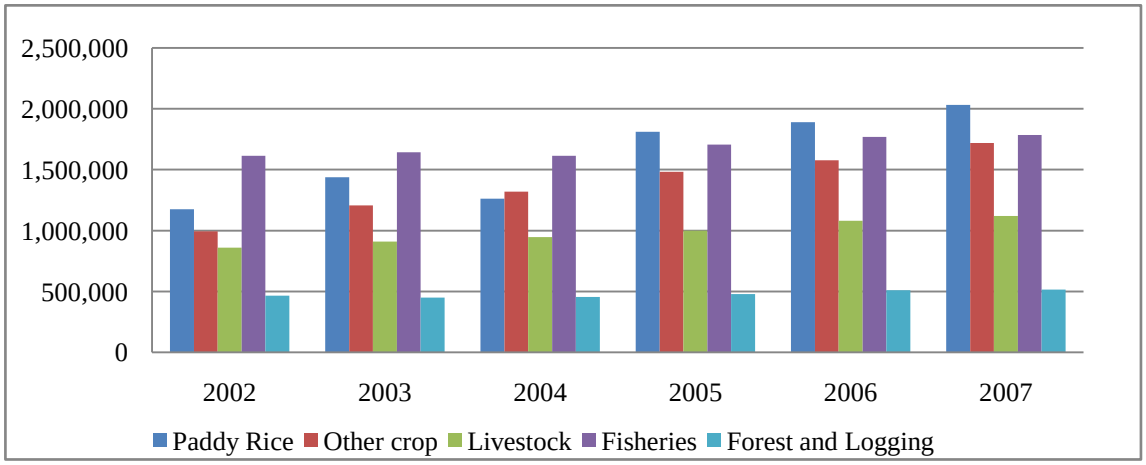
Source: ADB Key Indicator, 2011

It appears that the service sectors, which occupy the large share of GDP after 2000 onward, tend to be the most stable sector to ensure growth of the country. Industrial sector,

even though it has small share comparing to agriculture, shows higher potential growth than agriculture. The country average GDP growth rate is between 5% and 10%.

Production of agriculture in total GDP is shown in Figure 2-3. The leading agricultural sector is rice production, which exceeds other sectors after 2005. The second agricultural sector that accounts for the largest share in GDP is fisheries. It is followed by other crops (corn, cassava, sweet potatoes, vegetable, mung bean, peanuts, soybeans, sugar cane, sesame tobacco, jute, cotton, black pepper), livestock (poultry, buffalo, pig, cattle), and forest and logging.

Figure 2-3 Production of Agricultural Sector Outputs (Billion Riels)



Source: NIS Year Book, 2008 pp. 361

Table 2-1 displays the structure of the industrial sector as percentage share of GDP at constant price. The industry sector contributes about 30% to total GDP. Among the industrial sector, textile, wearing apparel and footwear account for the largest share of GDP comparing to the other industrial sector. This shows that the country is still depending on light manufacturing as one of the main sectors for economic growth. The second top industrial sector is the construction sector and is followed by food, beverage and tobacco sector.

Table 2-1 GDP Shares of Industrial Sectors in Percentages

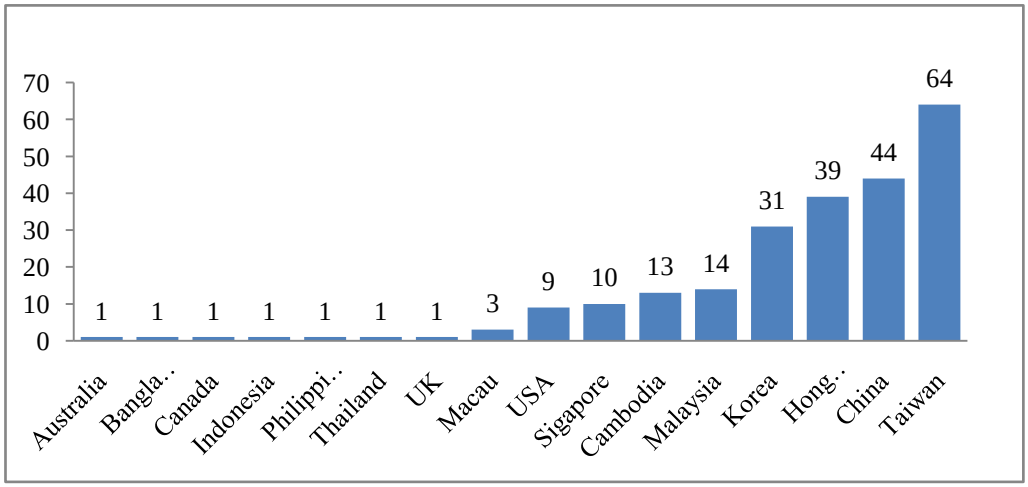
Industrial Sectors	**2003**	**2004**	**2005**	**2006**	**2007**
Industry	**24.7**	**25.5**	**26.9**	**26.8**	**28.6**
Mining	0.3	0.4	0.4	0.4	0.4
Manufacturing	**18.3**	**18.9**	**20.2**	**19.6**	**20.8**
Food, Beverage, and tobacco	2.8	2.7	2.3	2.2	2.1
Textile, Wearing Apparel, and Footwear	**12.5**	**13.4**	**15.2**	**14.6**	**15.9**
Wood, Paper and Publishing	0.6	0.5	0.4	0.4	0.4
Rubber Manufacturing	0.4	0.4	0.3	0.2	0.2
Other Manufacturing	2.1	2.1	2.0	2.1	2.2
Electricity, Gas and Water	0.5	0.5	0.5	0.5	0.5
Construction	5.6	5.8	5.9	6.4	6.9

Source: NIS Year Book, 2008 pp. 361

A detailed look at the textile, apparel, and footwear sectors shows that these sectors are aimed at export to other markets due to the benefit from low tariff of MFN and GSP given to least-developed countries by advanced countries in accordance to WTO charter.

Figure 2-4 shows the total number of garment factories by nationalities based on data from Garment Manufacturing Association of Cambodia (GMAC).

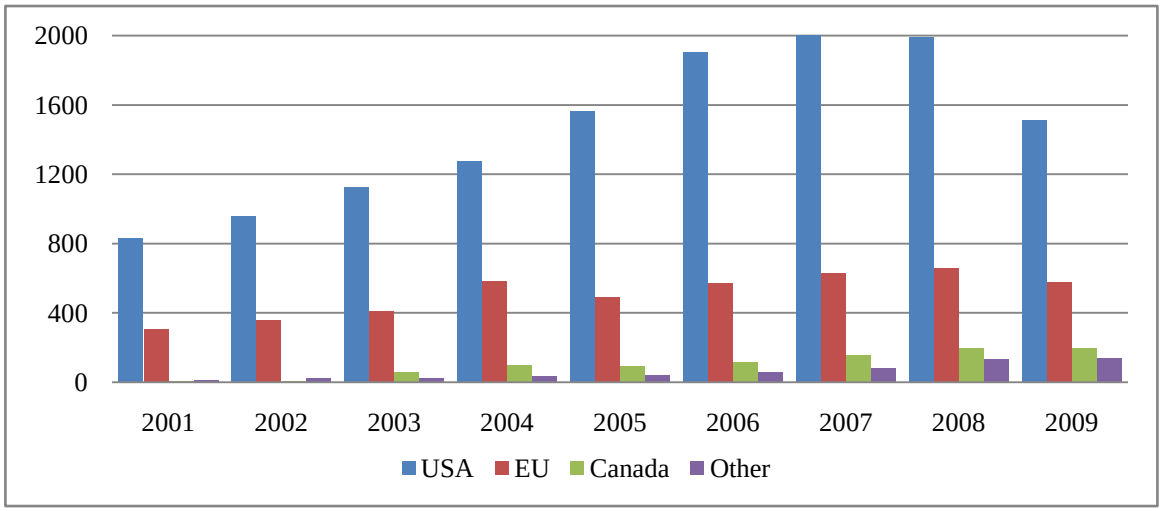
Figure 2-4 Number of Garment Factories by Nationality



Source: GMAC Annual Bulletin, 2010

The main markets for garment product are US, EU, Canada and Japan. Figure 2-5 displays the volume of export by markets. There are some reasons that lead to high export of garment product such as (1) MFN and GSP granted by US and EU since 1996, (2) quota imposed by US in 1999 but is removed at the end of 2004 (GMAC Annual Bulletin, 2010).

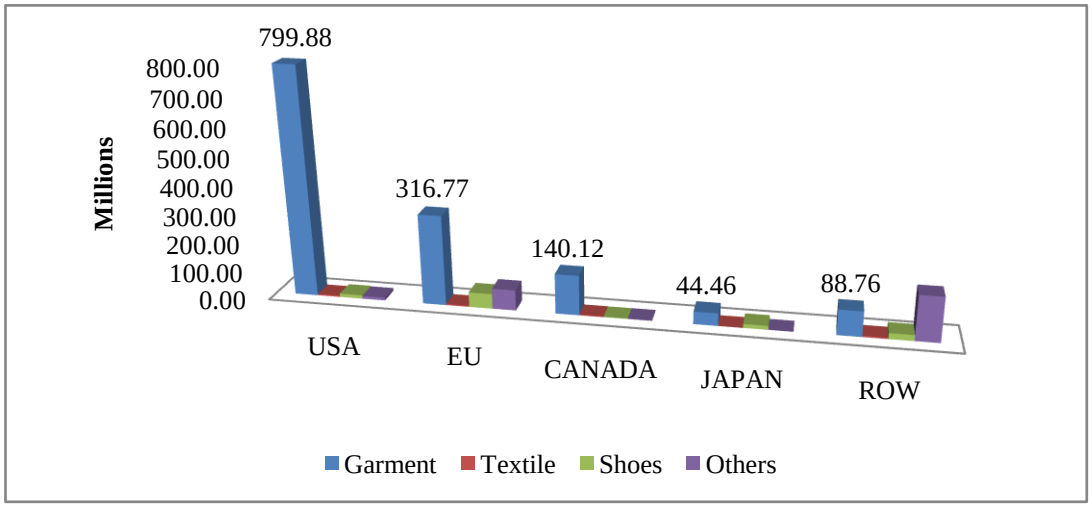
Figure 2-5 Exports of Garment, Textile, and Shoes Product (Mil US$)



Source: GMAC Annul Bulletin 2010

In 2010, the market of export has been extended to Japan too (GMAC Annual Bulletin, 2010), which is shown in Figure 2-6. It shows that USA is the major market for garments, while EU is the top market for shoes and other products.

Figure 2-6 Volume of Exports by Markets (Mil US$)



Source: GMAC Anuula Bulletin 2011

Table 2-2 displays the structure of service sectors in Cambodia in percentage as constant price of the year 2000. It shows that the trade sector remains the top sector in the service sector and it accounts for the largest share of GDP compared to other service sectors. In 2007, the trade sector accounts for 8.4 percent of GDP. The second largest sector is the real estates and business sectors, followed by the transportation and the hotel and restaurant sectors.

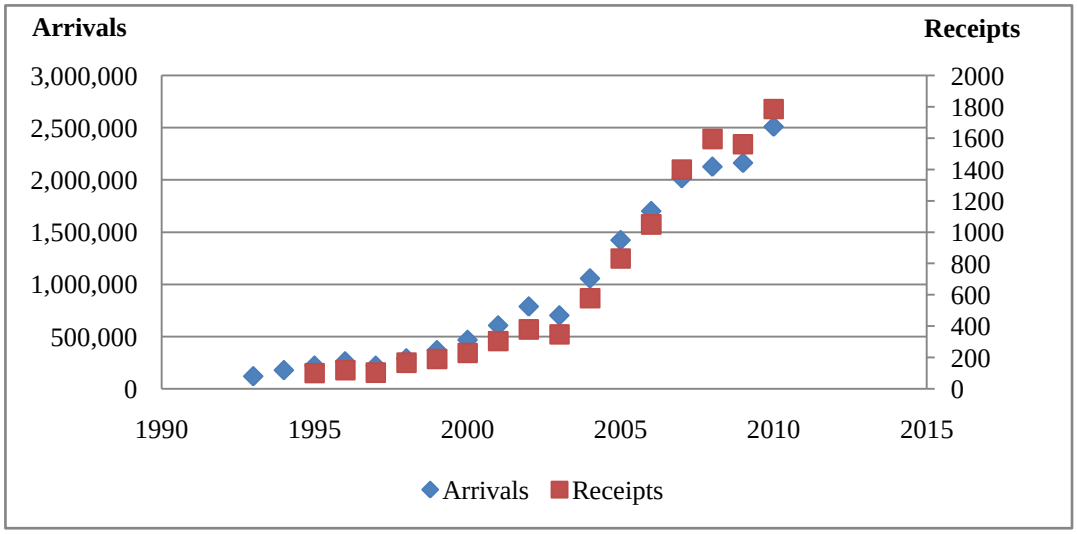
Table 2-2 GDP Shares of Service Sectors in Percentages

	2003	**2004**	**2005**	**2006**	**2007**
Services	**38.6**	**37.6**	**38.6**	**38.5**	**38.3**
Trade	**9.9**	**9.5**	**9.1**	**8.7**	**8.4**
Hotel and Restaurants	4.7	3.6	4.0	4.3	4.4
Transport and Communications	7.1	6.8	6.7	6.8	6.2
Finance	1.0	1.0	1.1	1.1	1.3
Public Administration	2.2	1.9	1.6	1.5	1.4
Real Estates and Business	6.4	7.3	8.0	7.6	7.6
Other Services	7.2	7.6	8.1	8.5	9.0

Source: NIS Year Book, 2008 pp. 361

The tourism sector shows strong potential of growth of Cambodia. As Figure 2-7 shows, the number of arrivals continues to grow despite the period of economic recession around the world. The total number of tourist arrivals increases to almost 3 million with the total revenue around 2000 million US Dollars (Ministry of Tourism Statistics Report, 2011). The statistic reported by the ministry of tourism also reveals that in May 2011, the top arrivals is from Vietnam (234,485 tourists), the second is from Korea (151,056 tourists), which is followed by China (99,531 tourists) and Japan (69,319 tourists).

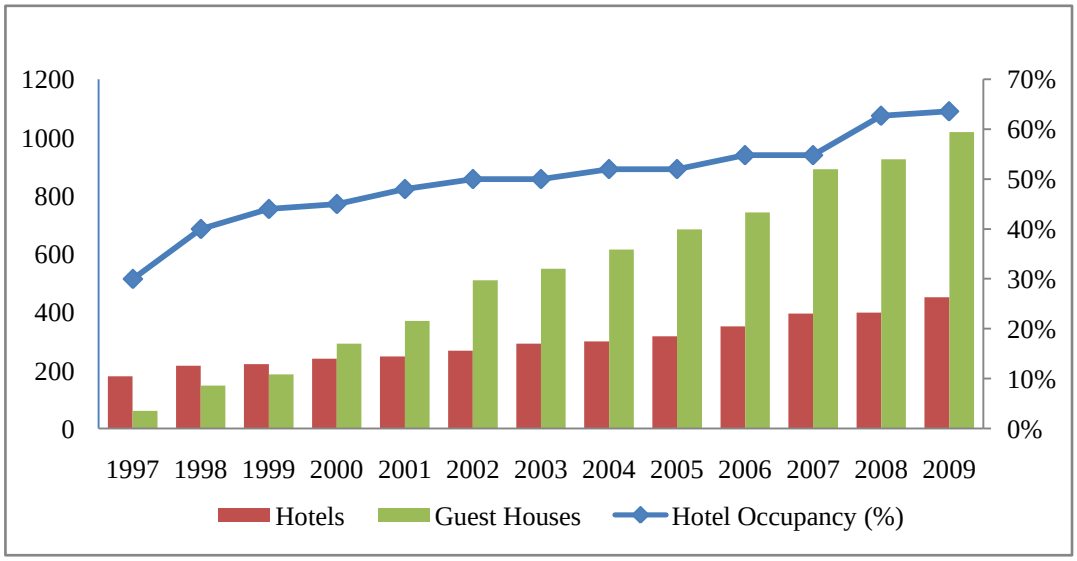
Figure 2-7 Number of Tourist Arrivals and Receipts (Mil US$)



Source: Ministry of Tourism, Tourism Statistics Report 2011

Despite the large increase in the tourist arrivals, the hotel capacity is not yet fully reached. Figure 2-8 displays the hotel occupancy in percentage, number of hotels and guest houses. Expansion of hotels and guesthouses is needed to reap the benefits from tourism sectors. By the year 2010, 70% of hotel occupancy is reached.

Figure 2-8 Hotel Occupancy and Number of Hotels and Guest Houses



Source: Ministry of Tourism, Tourism Statistics Report 2011

In the last decades, there are also rapid increases in the banking and financial sectors. Table 2-3 shows the number of commercial banks and other types of financial institutions in Cambodia. The private commercial banks account for the largest number of private banks in Cambodia. There are also a large number of Micro Finance Institutions (MFI). These MFIs play a very important role in giving loan to people in rural areas where large commercial banks are not available. In 2007, there are 24 banks and 17 MFIs across the country.

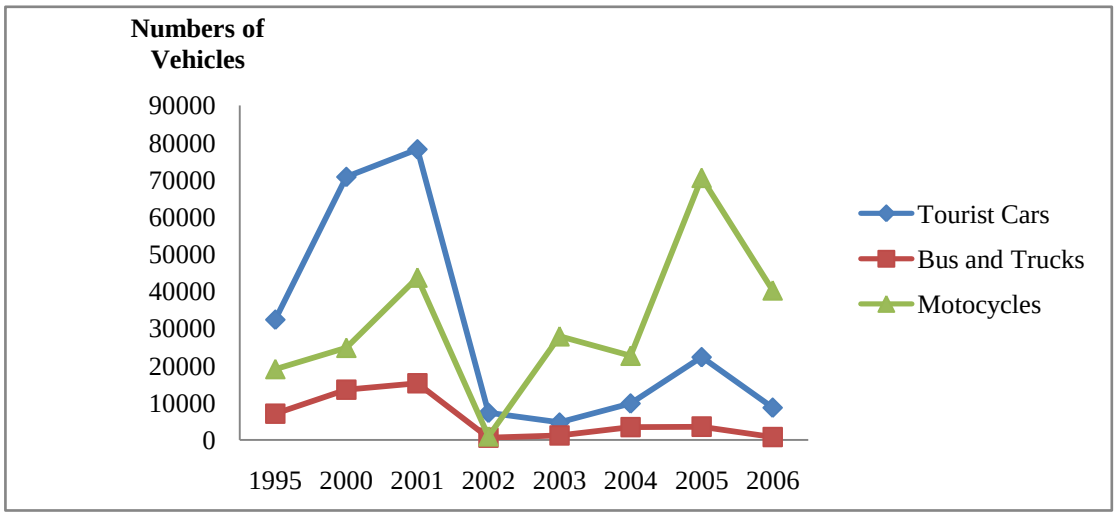
Table 2-3 Number of Banks and Financial Institutions in Cambodia

	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Numbers of Banks	**17**	**19**	**20**	**24**	**29**	**30**	**36**	**35**
Private Local Banks	12	15	16	20	25	26	28	27
Foreign Banks	**3**	**3**	**3**	**3**	**3**	**3**	**7**	**7**
State-Owned Banks	2	1	1	1	1	1	1	1
Licensed MFIs	13	16	16	17	17	18	25	27
Leasing Companies	0	1	1	1	n.a	n.a	n.a	n.a
Insurance Companies	4	4	4	7	n.a	n.a	n.a	n.a

Source: IFC Financial Sector Diagnostic 2008 and NBC Quarterly Bulletin

Another service sector which booms in the recent decades is transportation, telecommunications, information and technology (IT). Figure 2-9 shows the number of vehicles in Cambodia by types of vehicles. Notice the largest number of vehicles is motorcycles followed by tourist car, bus and trucks.

Figure 2-9 Number of Vehicles by Types



Source: NIS Year Book, 2008 pp. 262

Table 2-4 shows the volume of cargo by air and ship vessels.

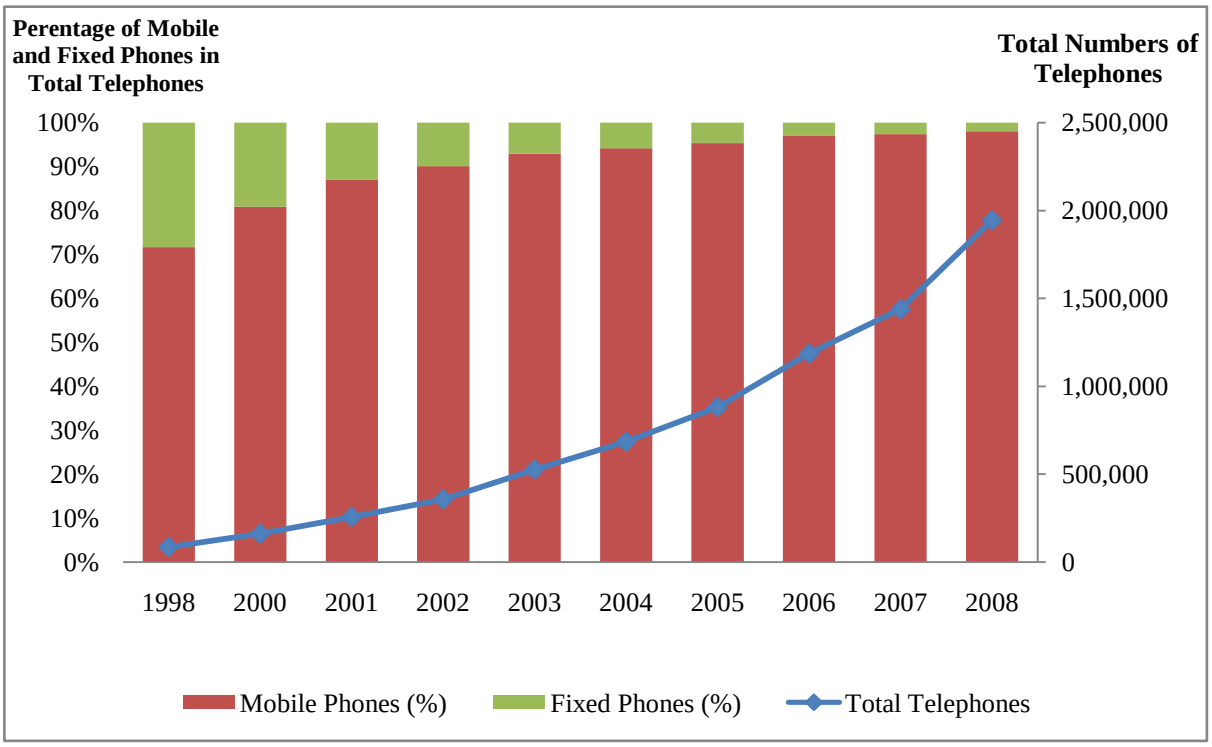
Table 2-4 Volume of Cargo by Air and Ship Vessels

	2004	**2005**	**2006**	**2007**
Number of flights	18,001	18,001	35,648	34,538
Volume of Passengers	1,633,772	1,927,711	2,499,713	2,979,116
Volume of Baggage by Air (Kg)	39,978,271	28,189,926	33,413,267	41,158,466
Volume of Cargo by Air (Kg)	34,709,530	16,914,388	22,685,594	26,032,538
Volume of Mail by Air (Kg)	282,171	529,385	473,980	566,266
Quantity of Commodity Rail (ton)	297,217	268,800	317,470	315,367
Volume of Vessels Phnom Penh (ton)	601,971	724,883	956,270	1,106,701
Volume of Vessels Sihanoukville (ton)	1,805,322	1,838,896	1,549,000	1,818,876

Source: NIS Year Book, 2008

Among the service sectors in Cambodia, the most fascinating and rapid growing sectors are telecommunications, information and technology sectors. Figure 2-10 displays the number of telephones used in Cambodia.

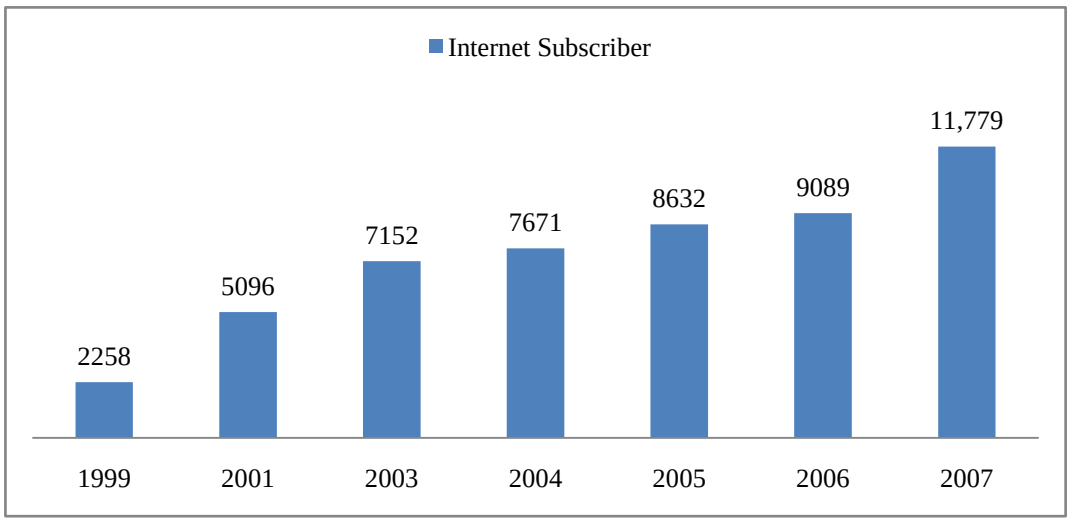
Figure 2-10 Number of Telephones from 1998 to 2008



Source: MPTC 2008, NIS 2006, CDC 2008, CDRI Annual Development Review 2009-2010, Chap 8, pp. 211

Figure 2-11 displays the number of the internet subscribers based on data from the Ministry of Post and Telecommunication. The number of internet users increased steadily.

Figure 2-11 Internet Subscribers



Source: Ministry of Post and Telecommunications

2.2 Industry Linkages in Cambodia

To understand the structure of an economy requires understanding how each sectors of the economy is related one another. The role of industry linkages has long been an interest for economists since Hirschman (1958), who argued that interdependent structure is very important for economic development in a country. He postulated that industry linkages depend on demand and supply of inputs of intermediate goods to other economic activities. A rise or a fall in production of an economic sector would have an impact on the other sector of the economy. The magnitude of the impact depends on whether that sector has strong or weak linkages with the others.

The study of industry linkages among economic sectors requires the use of an input-output table, which is compiled from a comprehensive survey of demand and supply of intermediate goods among all sectors of an economy. The input-output table could show the degree of interdependence that one economic sector depends on the other. Usually, the construction of input-output table is costly and only the government can compile the table.

Having a good input-output table enables us to predict the impact of growth in one economic sector on the other. Recently, input-output table has provided a good tool for simulation of macroeconomic policy for many countries. For example, the impact of the growth of import or export of final demand to all sectors in the economy and the impact of an increase in wage rate, consumption tax or import duties.

In Cambodia, there is no input-output table available. The government and the ministry of planning are working on the construction of the input-output table. However, many researchers have attempted to construct an input-output table using their available

information in order to estimate the impact of the industry linkages. Consequently, the input-output table turns to give the different measure of the degree of interdependence of one sector to the other sector of the Cambodian economy. Moreover, the constructed input-output table turns to vary according to the purpose of a researcher. Some input-output tables turns to have more sub-sectors for agriculture, while others have the smaller number.

For example, Kobayashi et al. (2009) study the industrial structure of Cambodia and the role of agriculture and fishery by building their own input-output table, which consisted of 16 sectors. The agricultural sector is divided into different sub-sectors. On the other hand, a Cambodian researcher, Oum Sothea also constructed an input-output table for 2003 data, and the table has been revised in 2008. Oum uses available data on Thailand and Vietnam from Global Trade Analysis Project (GTAP) as a comparison and in combination with the survey data from Cambodia conducted by Economic Institute of Cambodia, National Institute of Statistics, National Bank of Cambodia and other international institutions.

Table 2-5 attempts to construct the degree of backward and forward linkages based on Oum's input-output table. Backward linkages measure the relative importance of a sector as a user of raw material inputs from the entire production system. At the sector level, it is calculated as follows:

$$BL_j = \frac{\sum_{i=1}^{n} r_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} r_{ij}}$$

where r_{ij} is the element in the Leontief inverse matrix $(I - A)^{-1}$. The higher BL_j means sector j's stronger influence as a user of the intermediate input. Similarly, the forward linkages measure the relative importance of a sector as a supplier of raw materials to the entire production system. It is calculated as follows:

$$FL_i = \frac{\sum_{j=1}^{n} r_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} r_{ij}}$$

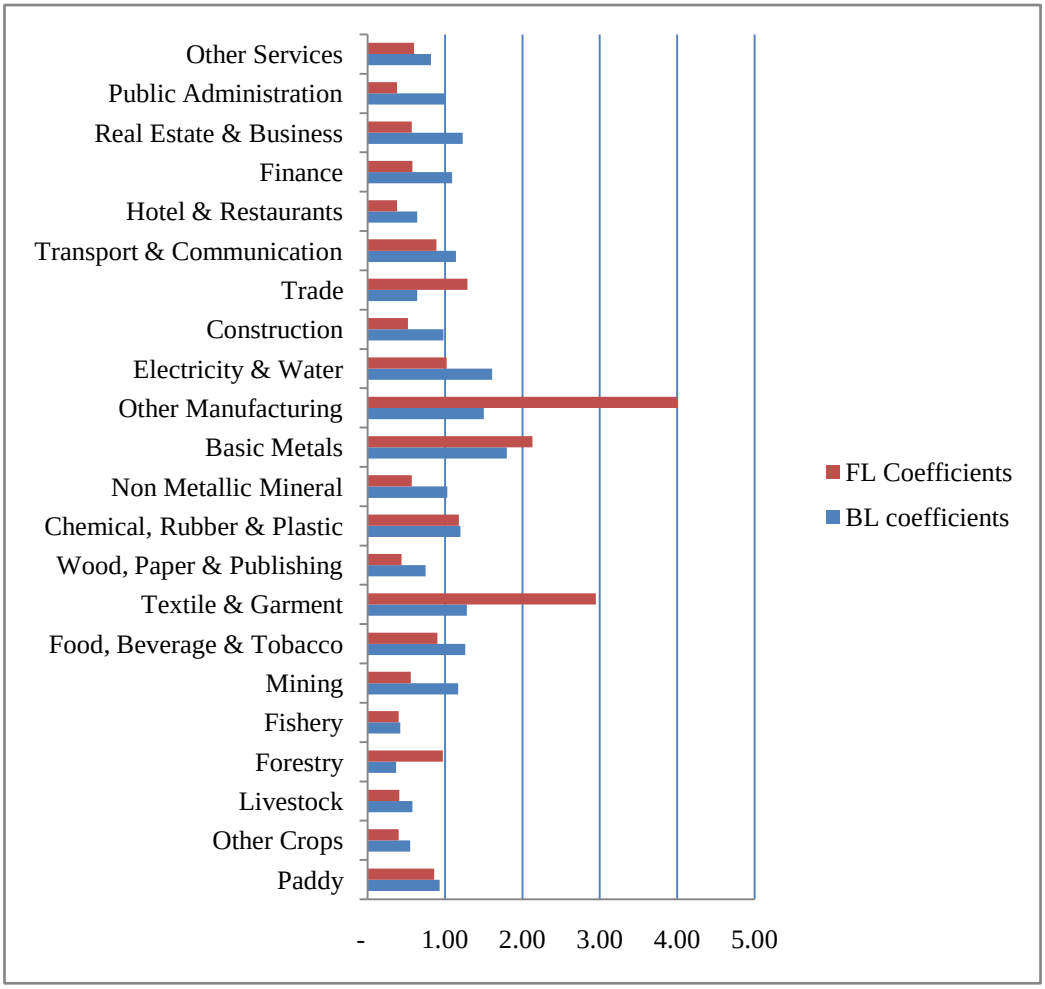
The higher value of FL_i means its greater influence as a supplier of intermediate inputs to the entire production system. Table 2-5 shows the computed results of BL and FL by sector. Figure 2-12 shows the ranking of industry linkages for each sector.

Table 2-5 Cambodia's Backward and Forward Industry Linkages

	Total BL	BL coefficients	Rank	Total FL	FL Coefficients	Rank
Paddy	2.50	0.93	14	2.30	0.86	10
Other Crops	1.47	0.55	20	1.06	0.40	20
Livestock	1.55	0.58	19	1.11	0.41	18
Forestry	1.00	0.37	22	2.59	0.97	7
Fishery	1.13	0.42	21	1.07	0.40	19
Mining	3.14	1.17	8	1.51	0.56	15
Food, Beverage & Tobacco	3.38	1.26	5	2.41	0.90	8
Textile & Garment	3.43	1.28	4	7.92	2.95	2
Wood, Paper & Publishing	2.02	0.75	16	1.19	0.44	17
Chemical, Rubber & Plastic	3.21	1.20	7	3.17	1.18	5
Non Metallic Mineral	2.77	1.03	11	1.52	0.57	14
Basic Metals	4.82	1.80	1	5.72	2.13	3
Other Manufacturing	4.02	1.50	3	10.75	4.00	1
Electricity & Water	4.33	1.61	2	2.73	1.02	6
Construction	2.62	0.98	13	1.40	0.52	16
Trade	1.73	0.64	17	3.47	1.29	4
Transport & Communication	3.06	1.14	9	2.40	0.89	9
Hotel & Restaurants	1.73	0.64	18	1.02	0.38	21
Finance	2.93	1.09	10	1.57	0.58	12
Real Estate & Business	3.30	1.23	6	1.53	0.57	13
Public Administration	2.71	1.01	12	1.02	0.38	22
Other Services	2.20	0.82	15	1.60	0.60	11
Average	2.68	1.00		2.68	1.00	

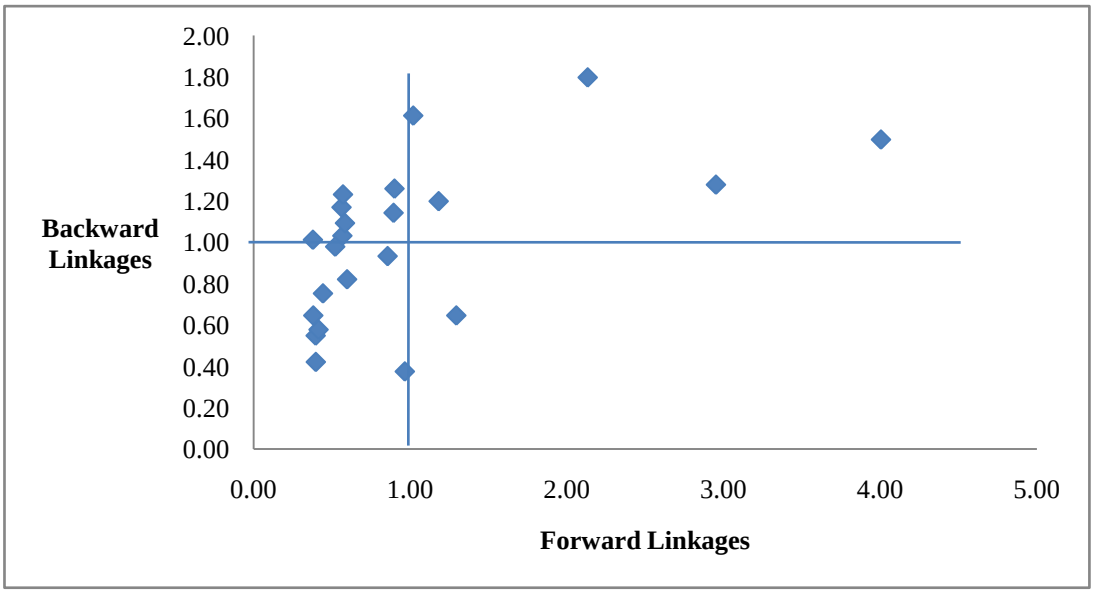
Source: Author’s calculation based on Cambodia 2008 input-output table.

Figure 2-12 Coefficients of Backward and Forward Linkages



Source: Author's calculation based on Cambodia Input-Output table 2008

Figure 2-13 Clusters of Industry Linkages in Cambodia



Source: Author's calculation

As Figures 2-12 and 2-13 show, a large majority of industries in Cambodia have lower forward linkages with the coefficients of forward linkages smaller than 1. While about half of the industries have weaker backward linkage lower than 1, and about half of the industries have stronger backward linkage larger than 1.

Table 2-6 classifies all industries into four categories based on the calculated linkage coefficients. The first category is the strong backward and forward linkages category, which consists of industries that have both backward and forward linkage coefficients larger than 1. The second group consists of industries that have strong backward linkages but weak forward linkages. The third group consists of industries that have weak backward linkages but strong forward linkage. The last group includes industries that have both weak backward and forward linkages.

Table 2-6 Classification of Industries by Degree of Linkages

	Strong Forward Linkages (FL>1)	**Weak Forward Linkages (FL<1)**
Strong Backward Linkages (BL>1)	Basic Metals Other Manufacturing Electricity and Water Textile and Garment Chemical, Rubber and Plastics	Mining Food, Beverage and Tobacco Non Metallic Mineral Transportation and Communication Finance Real Estates and Business Public Administration
Weak Backward Linkages (BL<1)	Trade	Paddy Other Crops Livestock Forestry Fishery Wood, Paper and Publishing Construction Hotel and Restaurant Other Services

Source: Author's calculation

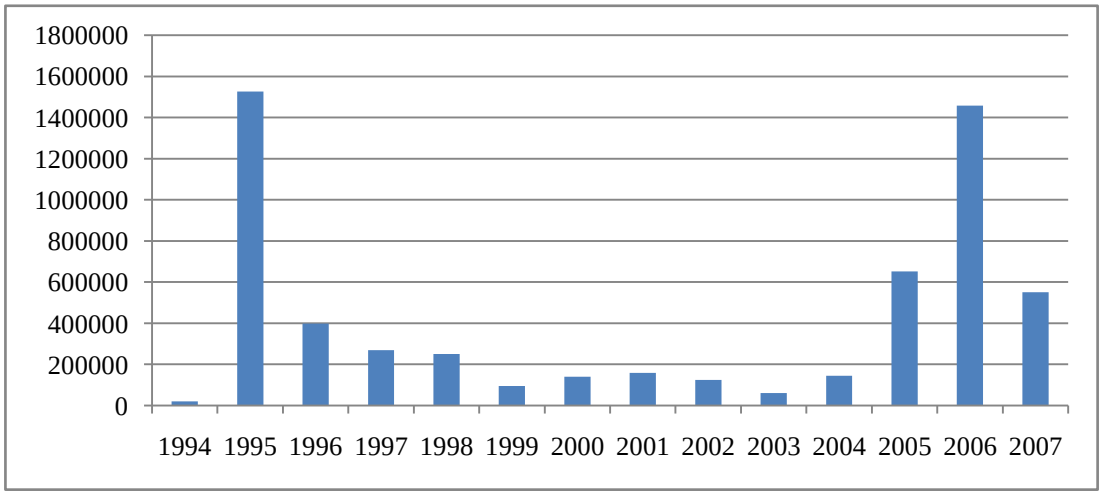
2.3 Foreign Direct Investment in Cambodia

2.3.1 Overview of Foreign Direct Investment in Cambodia

Since the country went into the free-market economy in 1993, privatization has taken place and private ownership is recognized by the constitution. Along with these changes, the country has started to integrate itself with the world through joining the regional and world organization such as the Association of South East Asian Nations (ASEAN) in 1999 and the membership of WTO in 2004. This internationalization has pushed Cambodia to revise her investment policy related to foreign investment and trade.

The 1994 investment law and the amended investment law in 2002 provide various incentives to foreign investment in Cambodia such as the tariff exemption on imported intermediate goods for Qualified Investment Project (QIP), profit tax carried forward, extension of the land contract period and many other incentives schemes.

Figure 2-14 FDI Fixed Assets (Thousand US$)



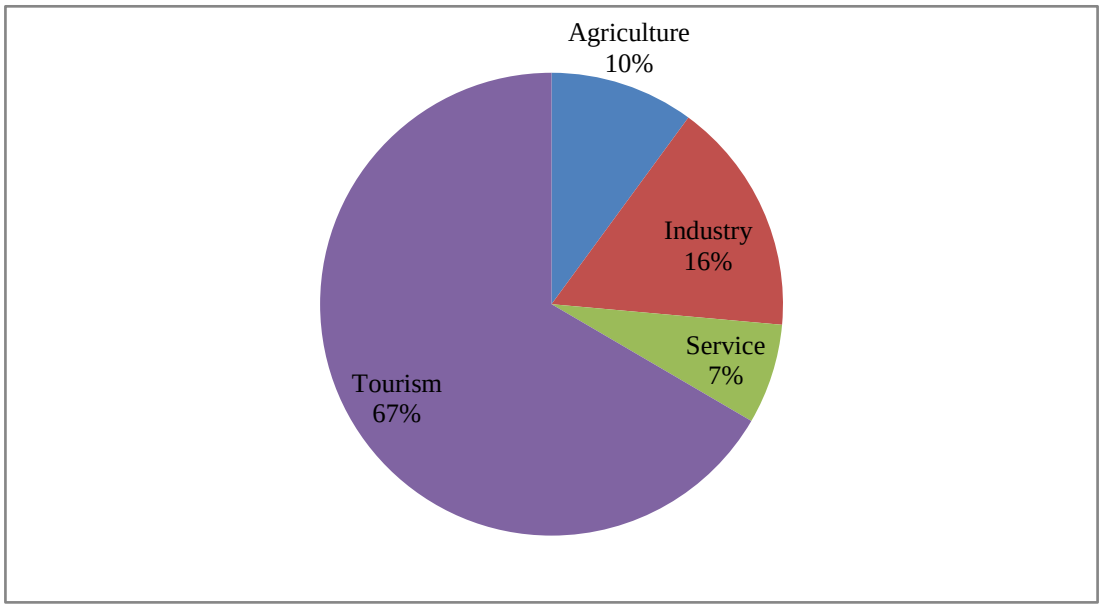
Source: NIS, Year Book 2008

As a result, a large inflow of FDI has come to Cambodia seeking the benefit from these incentives. Figure 2-14 shows the change in FDI from the National Institute of

Statistics (NIS) of the Ministry of Planning. The data show sharp increases in FDI from 2003 to 2006 and a small decline in 2007 due to the effect of the world economic crisis in 2007. However, the trend shows recovery and increasing trend again after 2008.

Sectors that account for the largest share of investment in terms of fixed assets are the tourism sector, industrial sector, followed by infrastructure and service sector, while agriculture receives only 10% of the total fixed assets, as shown in Figure 2-15.

Figure 2-15 Percentage Shares of FDI Fixed Assets by Sectors in 2009

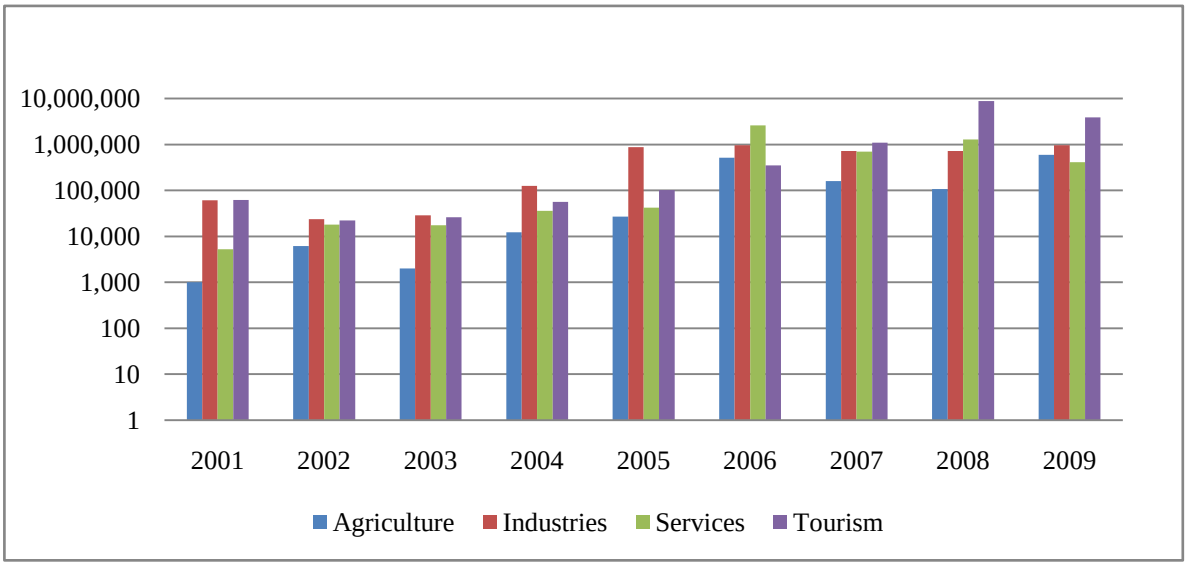


Source: Cambodia Investment Board and Japan ASEAN-Center, 2009

The amount of FDI in fixed assets and the number of FDI projects by industry from 2001 to 2009 are shown in Figures 2-16 and 2-17. In terms of the number of the project of FDI, the industrial sectors exceed other sectors. Throughout these periods except in 2006 and 2009, the combining number of FDI projects in service and tourism sectors exceeds that of agriculture. In terms of fixed assets, the FDI in agriculture remains the lowest for most periods. From 2001 to 2005, FDI in the industrial sector exceeds the other sectors. In 2006, FDI in the industrial sector is less than that in the service sector but larger than the tourism

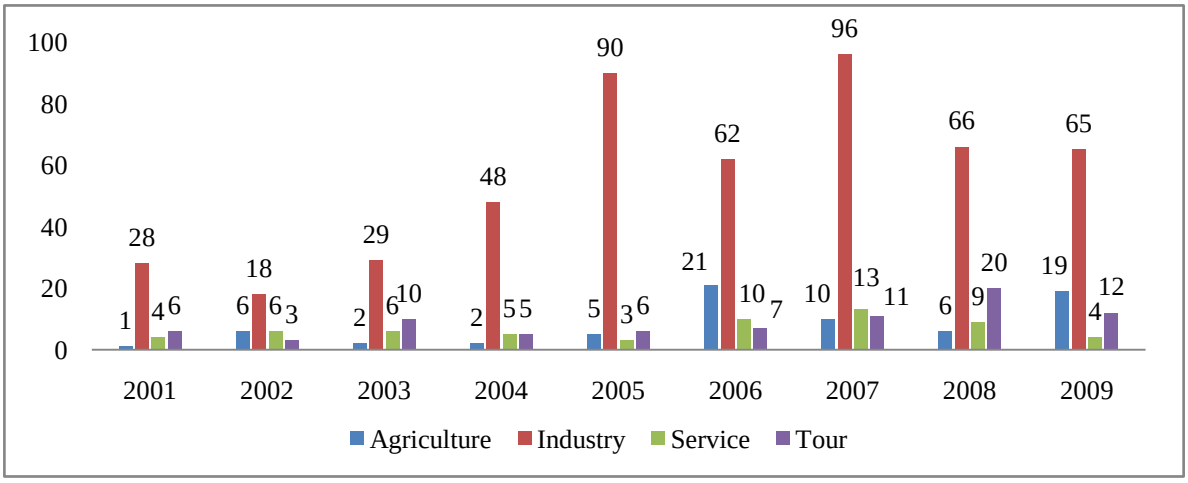
sector. However, in terms of the number of projects, the industrial sector still exceeds that of service and tourism sectors. From 2007 to 2009, FDI in the industrial sector seems stable but FDI in tourism and service sectors show increasing trend.

Figure 2-16 FDI in Fixed Assets by Sectors (Logarithm of Thousand US$)



Source: Cambodia Investment Board and Japan ASEAN-Center, 2009

Figure 2-17 Number of FDI Projects by Sectors



Source: Cambodia Investment Board and Japan ASEAN-Center, 2009

Table 2-7 Number of FDI Projects in Agriculture Sectors

	Agro-Industry	Rubber	Plantation	Animal Farming	Other Agriculture
2005	2	0	1	0	2
2006	19	0	0	0	2
2009	13	4	1	1	0
Total	34	4	2	1	4

Source: Cambodia Investment Board and Japan ASEAN-Center, 2009

Table 2-8 Number of FDI Projects in Industrial Sectors

	Energy	Garment	Cements	Others	Fertilizer	Shoes	Animal Meal
2005	3	53	1	13	0	0	0
2006	3	40	1	18	0	0	0
2009	5	23	0	21	1	7	2
Total	11	116	2	52	1	7	2

Source: Cambodia Investment Board and Japan ASEAN-Center, 2009

Table 2-9 Number of FDI Projects in Service and Tourism Sectors

	Construction	Services	Health Services	Others	Tourism	Hotel	Telecom	Infrastructure	Shopping Mall	Water Supply
2005	2	0	0	1	2	6	0	0	0	0
2006	3	4	1	2	3	4	0	0	0	0
2009	0	0	0	0	11	1	1	1	1	1
Total	5	4	1	3	16	11	1	1	1	1

Source: Cambodia Investment Board and Japan ASEAN-Center, 2009

A closer look at investment in the sub-sector of agricultrue in 2005, 2006 and 2009 (Table 2-7) shows that the leading sector is the agro-industry (13 projects in 2009) and other sectors account for just a small number in the total agricultural sector.

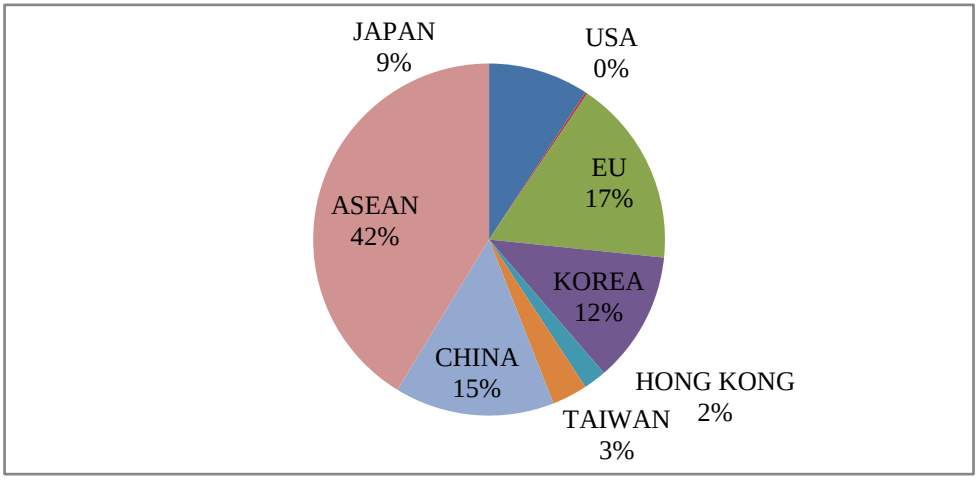
The investment in the sub-sector of industrial sectors is shown in Table 2-8. The garment sector accounts for the largest share of FDI project numbers (23 projects by 2009) and is followed by the other manufacturing sectors. Energy is also a potential sector receiving the large number of FDI.

The investment in the sub-sectors of the service and tourism sectors is shown in Table 2-9. The tourism and hotel account for the largest share of FDI in service sectors and

are followed by services, telecommunication, water supply, infrastructure, shopping mall and other services.

The top investor in Cambodia in 2007 is ASEAN countries and is followed by EU and China. Figure 2-18 shows the pie chart of FDI by country of origin. The combination of China, Hong Kong and Taiwan is around 20% exceeding that of EU and makes it the second largest investor in Cambodia after ASEAN countries.

Figure 2-18 FDI by Country of Origin in Percentage

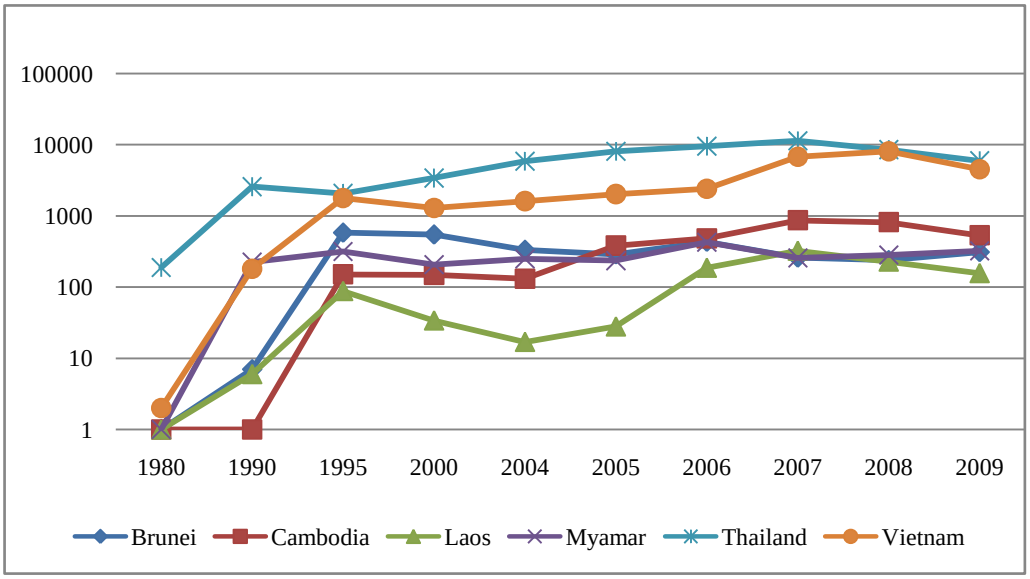


Source: Cambodia Investment Board and Japan ASEAN-Center. 2007

2.3.2 Comparing FDI in Cambodia and ASEAN

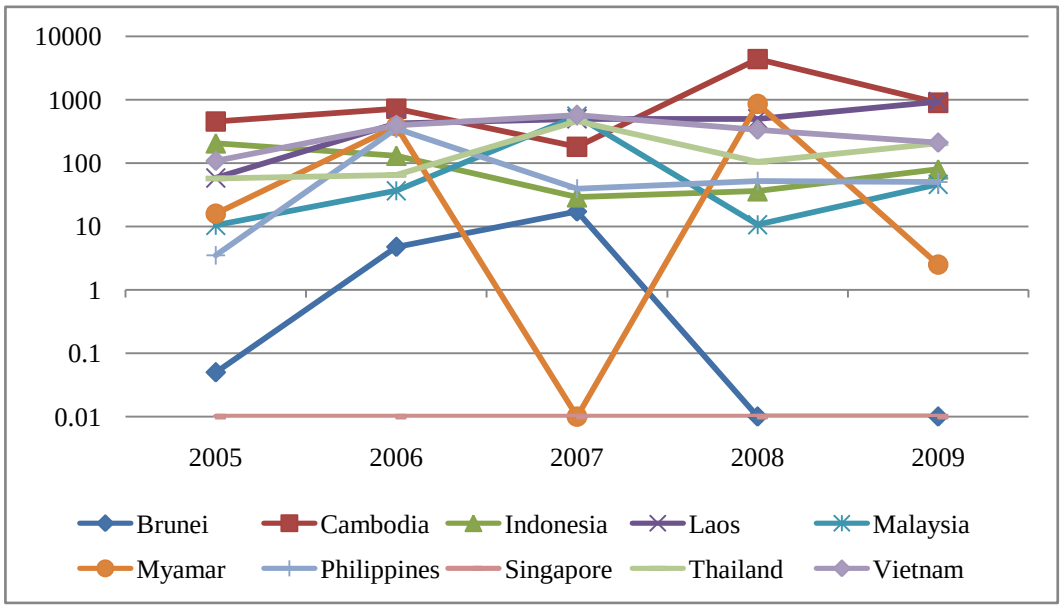
The statistics of FDI in comparison with other neighboring countries is shown in Figure 2-19 for Brunei, Cambodia, Laos, Myanma, Thailand and Vietnam. It is shown that Thailand receives the largest amount of FDI while Vietnam is the second largest receiver. Cambodia became the third largest destination of FDI from 2005 afterward.

Figure 2-19 Foreign Direct Investment into ASEAN (Logarithm of Mil US$)



Source: ASEAN-JAPAN Statistics 2010

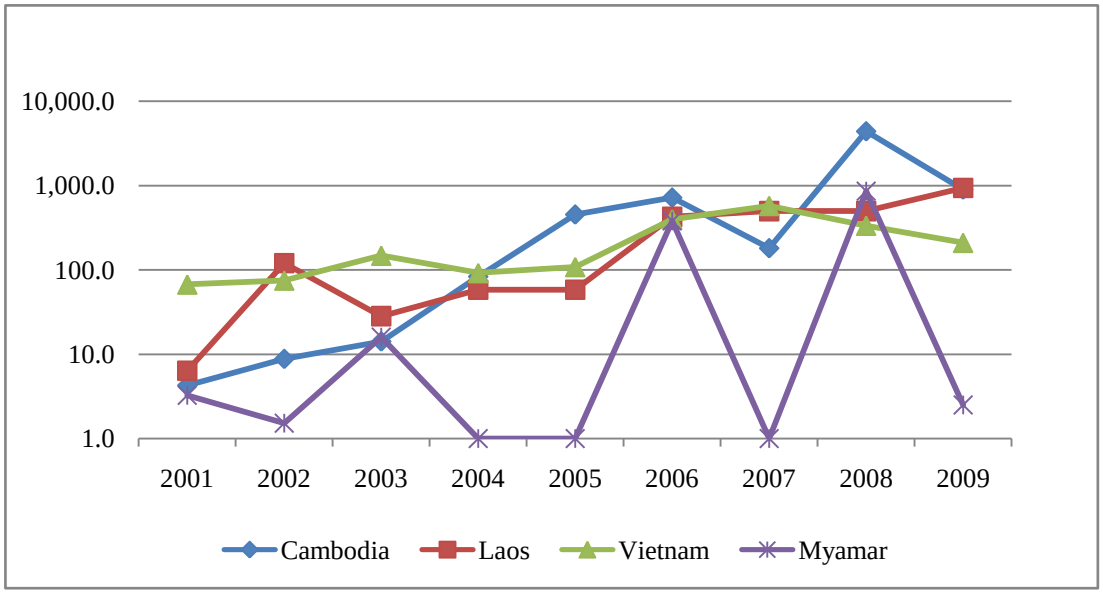
Figure 2-20 Chinese FDI to ASEAN (Logarithm of Mil US$)



Source: ASEAN-JAPAN Statistics 2010

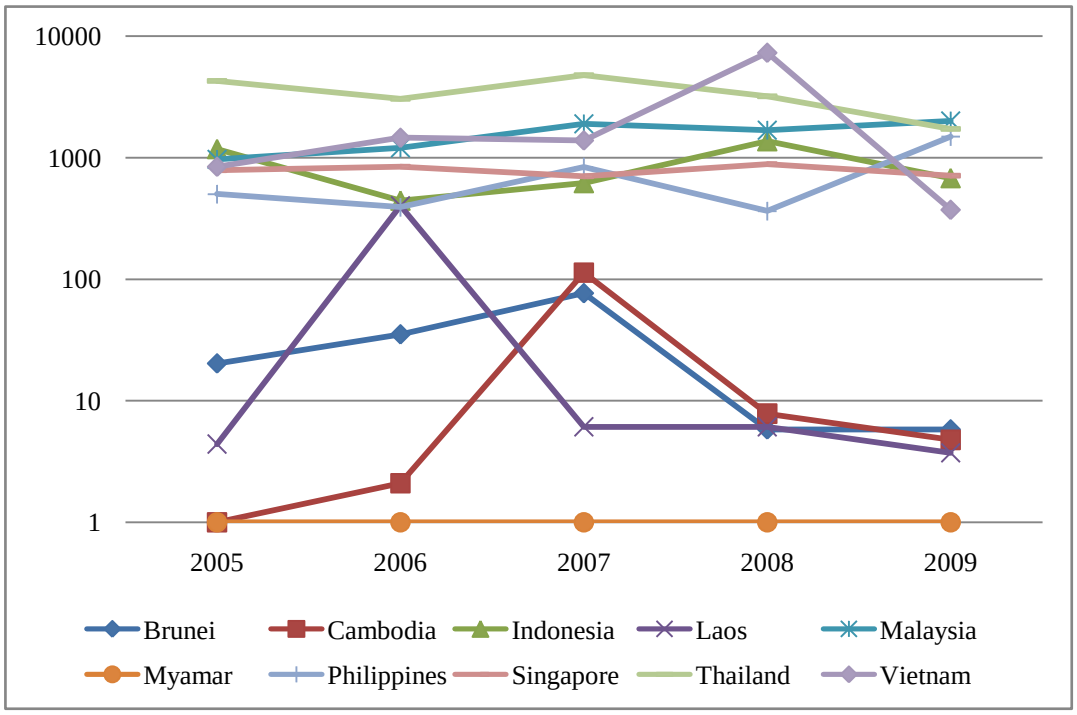
Comparing Chinese FDI in ASEAN countries shows that only Cambodia and Laos receive the largest amount of Chinese FDI in recent years, as shown in Figure 2-20 and 2-21. The data shows that Cambodia is the top reciever of Chinese investment in comparison to other ASEAN members.

Figure 2-21 Chinese FDI to CLVM (Logarithm Mil of US$)



Source: ASEAN-JAPAN Statistics 2010

Figure 2-22 Japanese FDI in ASEAN (Logarithm of Mil US$)

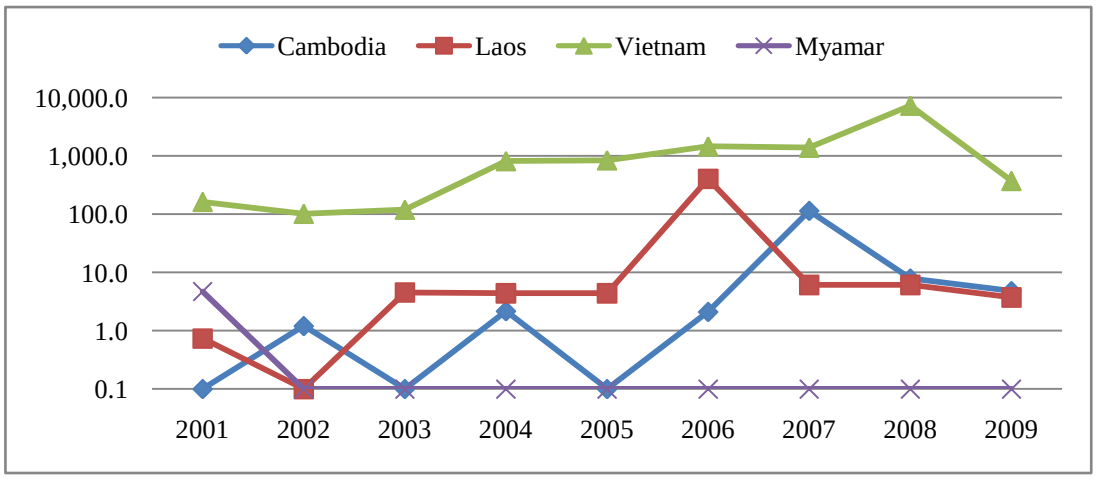


Source: ASEAN-JAPAN Statistics 2010

Figures 2-22 and 2-23 display Japanese FDI in ASEAN. It seems to show that Japanese FDI rises sharply in highly-developed members of ASEAN such as Malaysia,

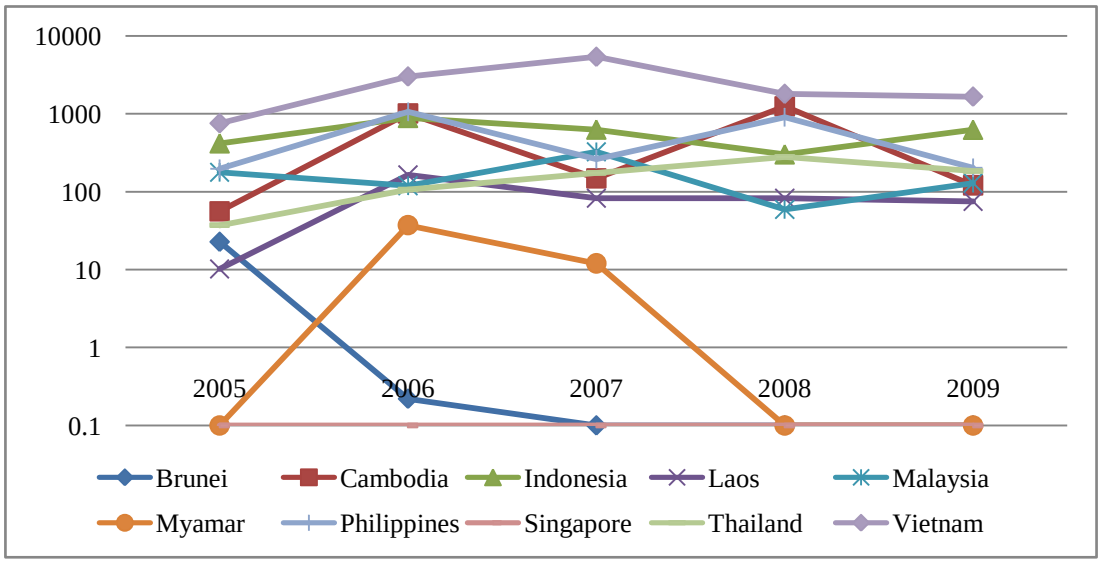
Thailand, Singapore, Philippines, Indoneisa and Vietname. After 2005, the Japanese FDI has shifted toward Laos, and finally, it moves to Cambodia. Japanese FDI in Cambodia overtook Laos from 2007 to the present.

Figure 2-23 Japanese FDI in CLVM (Logarithm of Mil US$)



Source: ASEAN-JAPAN Statistics 2010

Figure 2-24 Korean FDI into ASEAN (Logarithm of Mil US$)

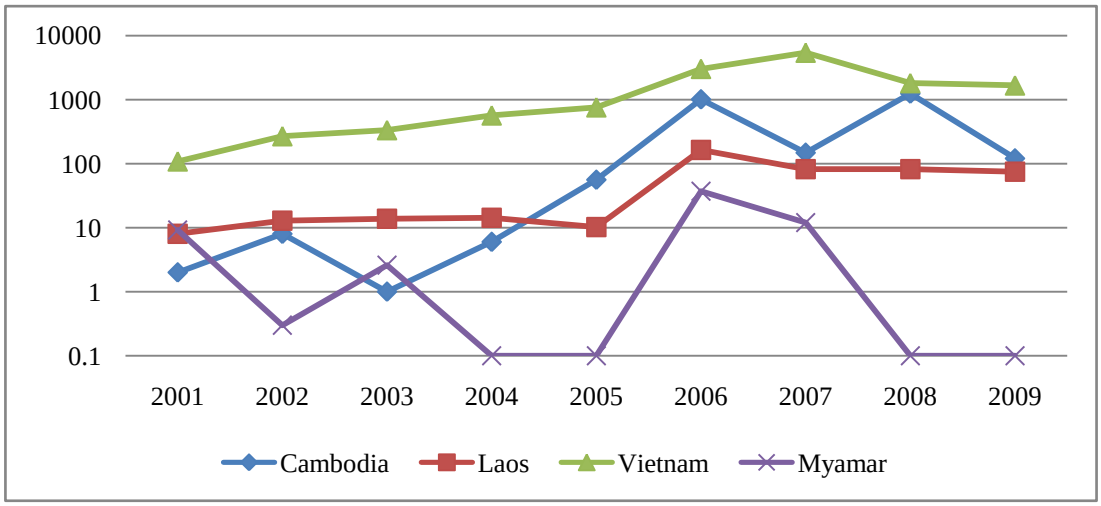


Source: ASEAN-JAPAN Statistics 2010

Figures 2-24 and 2-25 show that Korean investment tends to go to Laos and Cambodia from the beginning of 2000 up to present. The large amount has increased in

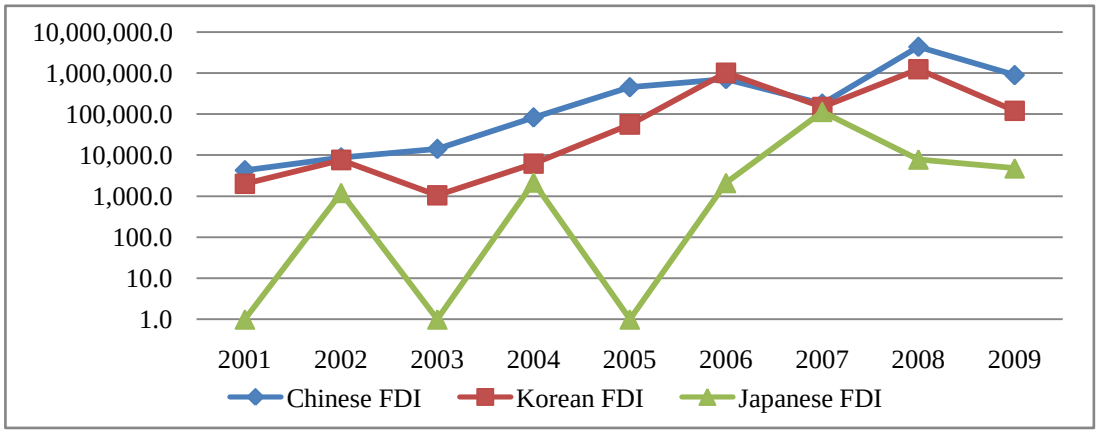
Cambodia and surpassed that of Laos in recent years. Figure 2-26 summarizes Chinese, Korean and Japanese FDI in Cambidia.

Figure 2-25 Korean FDI in CLVM (Logarithm of Mil US$)



Source: ASEAN-JAPAN Statistics 2010

Figure 2-26 Chinese, Korean and Japanese FDI in Cambodia



Source: ASEAN-JAPAN Statistics 2010

2.3.3 Determinants of FDI to Cambodia

There are questions why FDI comes to Cambodia and not the other neighboring countries. The theory of determinants of FDI has attracted many researchers. The most well-

known one is the theory of Dunning (1977) known as OLI, which stands for ownership (O), location (L) and internalization (I).

The ownership advantage refers to the specific assets which give firms the potential to earn greater profits in the future. It may include the size of firms, the level and quality of management, access to factor inputs, access to product market and technological capabilities, advantage of economies of joint supply, and possession of the other knowledge information. Location advantage refers to assets which make the production attractive in contrast to exporting. It may include input prices, transportation costs, communication costs and government incentives, stable political and legal system, commercial infrastructure, language and culture. Internalization advantage refers to ways by which a firm maximizes the gain from their ownership to avoid or overcome the market imperfections.

For the case of Cambodia, Cuyvers, Plasmans, Soeng, and Buckle (2008a) use unbalanced panel data during 1995-2005 for both approval and realized FDI to find the following country characteristics. First, country home market effect measured by GDP, bilateral trade, and exchange rate have positive impacts on inward FDI to Cambodia, while geographic distance has a negative impact on the level of FDI inflows to Cambodia.

2.3.4 FDI and Job Creation in Cambodia

In developing countries like Cambodia, unemployment is a very vital and challenging problem and a root of poverty. Therefore, the government has provided incentives in different forms to draw FDI into the country and to create jobs.

A few sectors that FDI project creates most employment are 481,516 jobs of garment, 26,814 jobs of tourism, 22,431 jobs of shoes, 19,347 jobs of wood processing and 19,216

jobs of chemical. Garment industry creates both direct and indirect jobs. Most of the indirect jobs are concentrated in the service sectors such as transportation, trade, restaurant and other small services (EIC, 2006).

It is noted that most of the employment created through approved investment projects are unskilled work. Approved investment projects from 1994 to 2005 created 45,749 employment in agriculture, of which 28,213 are unskilled work, 620,949 employment in the industrial sector, of which 46,588 are unskilled work, 18,888 employment in the service sector, of which 9,594 are unskilled work, and 26,814 employment in the tourism sector, of which 10,528 is unskilled work (Hing, 2006, pp. 233-234).

2.3.5 Foreign Direct Investment and Cross-border Technology in Cambodia

FDI is considered as a means by which the technology flows across the border. However, is there any evidence that technology brought by FDI has been absorbed by the domestic firms in Cambodia? If such technology flow through FDI has reached the domestic firms, by what mechanism is it?

Empirical findings by Cuyvers, Soeng, Plasmans, and Buckle (2008b) have shown that there exist productivity spillover to the domestic firms in Cambodia in the manufacturing sector based on the establishment data of the NIS.

However, the study cannot answer the question, how much the improved productivity of the domestic firms is a result of technology spillover brought by FDI in vertical or horizontal spillovers. Furthermore, the study does not mention the heterogeneity

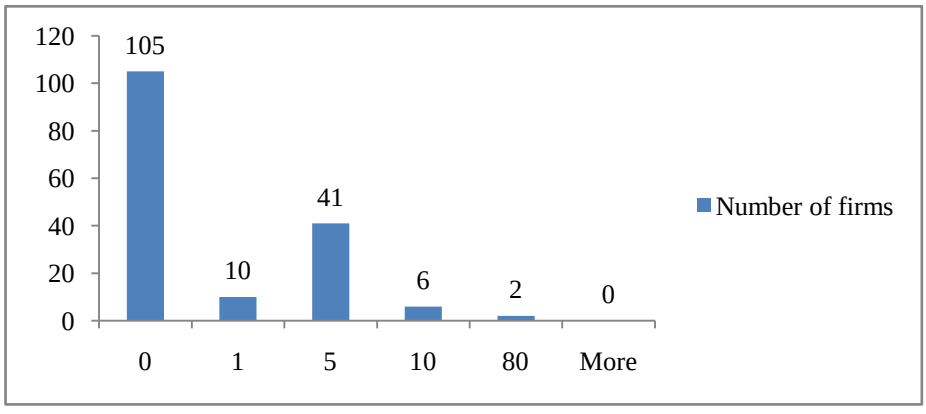
of domestic firm's absorptive capacity. Domestic firms do have the different ability in absorbing the technology brought by FDI.

2.3.6 FDI and Industry Linkages in Cambodia

There is no detailed study on the role of FDI in industry linkages in Cambodia yet. However, the large increase in FDI gives potential for FDI to create industry linkages in Cambodia. The World Bank Report 2003 on the value chain analysis has estimated that if industry linkages could be generated in the garment sector, which receives the largest number of foreign firms, it will reduce 18% of production costs. ADB in 2004 mentioned that fabric and other accessories have the building industry linkages with the garment sector.

Figure 2-27 shows the problem of the delayed delivery of intermediate goods for production in the garment sector, which is based on the data survey by Yamagata (2006) under the research by the Japanese Institute for Developing Economies (IDEs).

Figure 2-27 Delay in Materials Delivery of Garment Firms in Cambodia

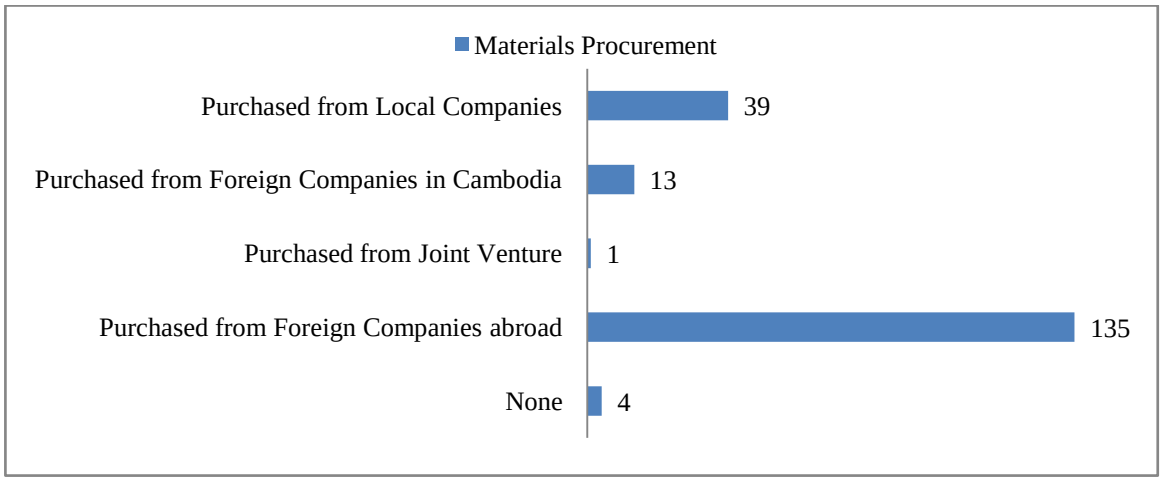


Source: Calculated from the survey of Yamagata (2006)

Building local linkages between FDI in the garment sector and domestic suppliers of intermediate goods could help reduce time delay in processing the garment product, and it also helps build the competitive advantage for firms in garment sectors.

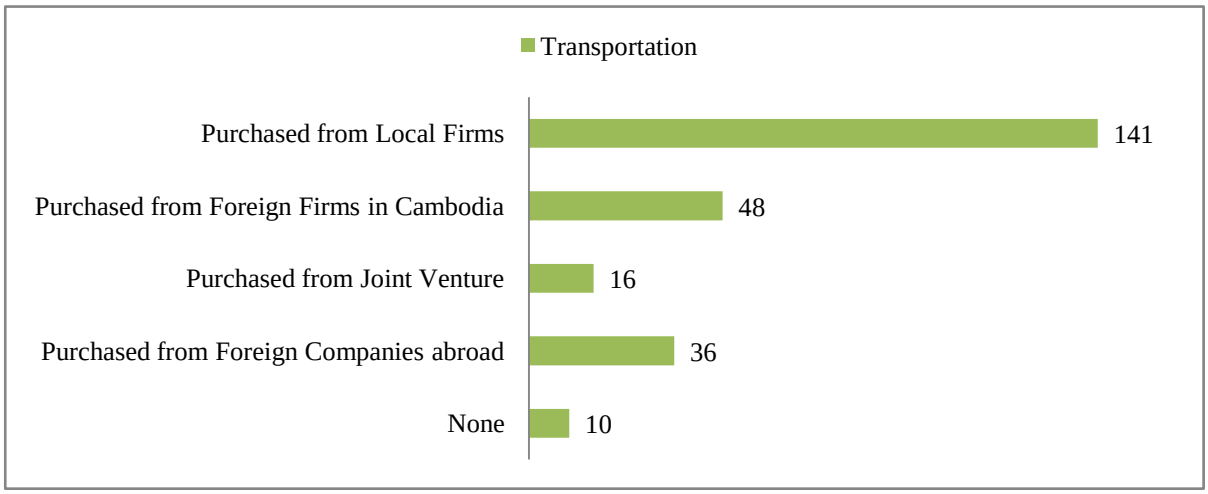
Based on data survey by Yamagata (2006), most of the intermediate goods are bought from foreign firms locating abroad. Figure 2-28 shows that only 39 garment factories purchased the material from domestic suppliers in Cambodia.

Figure 2-28 Modes of Material Procurement



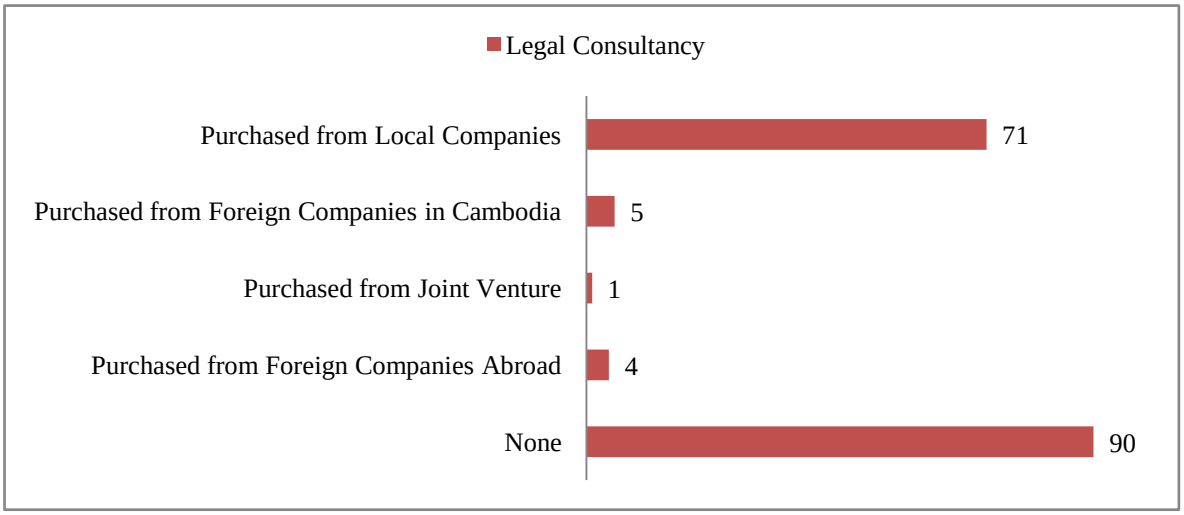
Source: Calculated from the survey of Yamagata (2006)

Figure 2-29 Linkages of Garment Companies and Transportation Services



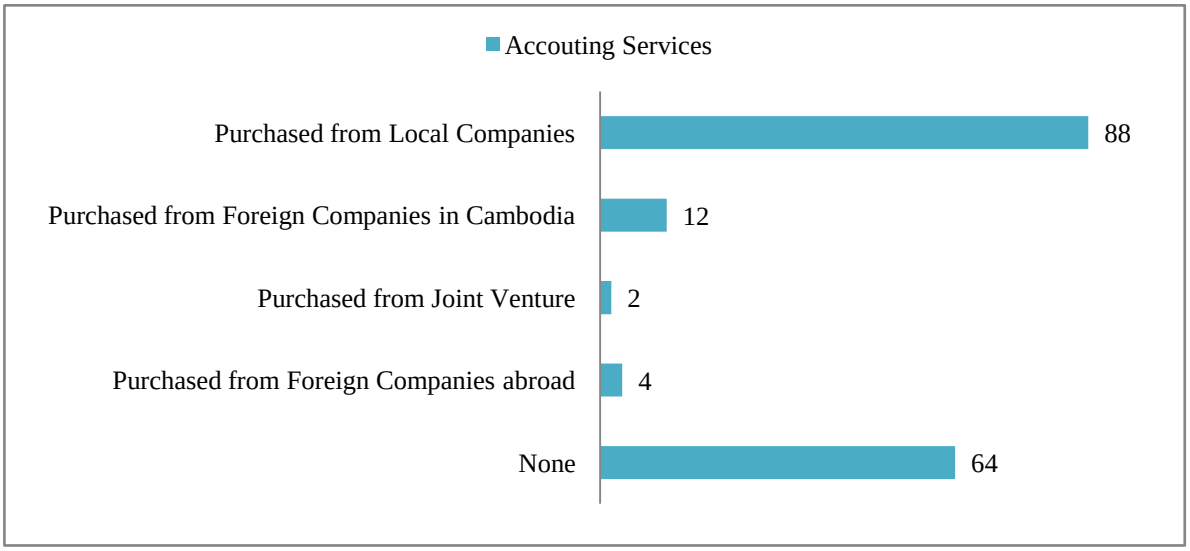
Source: Calculated from the survey of Yamagata (2006)

Figure 2-30 Linkages of Garment Companies and Legal Consultancy Services



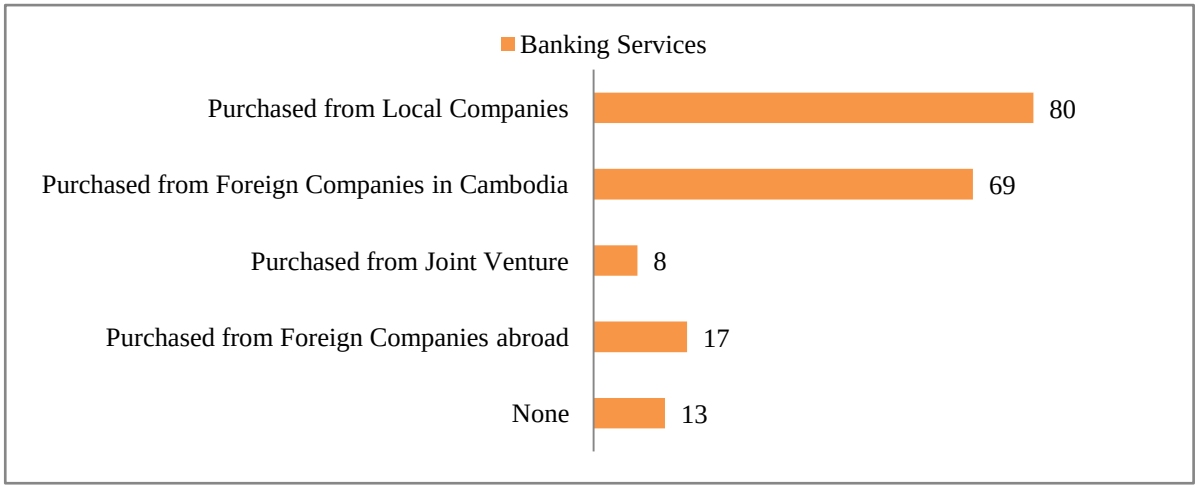
Source: Calculated from the survey of Yamagata (2006)

Figure 2-31 Linkages of Garment Companies and Accounting Services



Source: Calculated from the survey of Yamagata (2006)

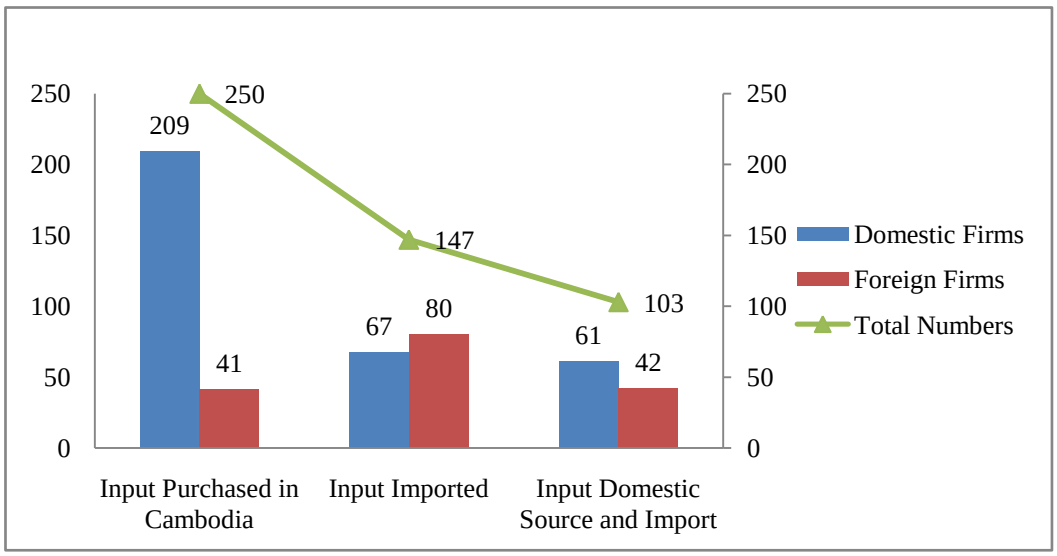
Figure 2-32 Linkages of Garment Companies and Banking Services



Source: Calculated from the survey of Yamagata (2006)

Even though industry linkages in the garment sector in terms of intermediate goods are weak, data from the survey show strong industry linkages between FDI in the garment sector and service industry in Cambodia. Figures 2-29 – 2-32 show the linkages between FDI in garment sector and firms in consultancy, accounting and banking service. It has been shown that in these service sectors, FDI in the garment sector plays an important role for their growth.

Figure 2-33 Number of Firms and Input-Sourcing Pattern in Cambodia



Note: Inputs are material used in the production process but they are not the equipments. The inputs are physical material but not services that firms used in the production.
Source: Calculated from the World Bank Survey (2006)

Besides the garment sectors, there is no study on linkages between FDI and domestic firms in other sectors of Cambodia. Figure 2-33 is based on data from the survey of the World Bank for Cambodian firms in 2006. Totally, there are 502 survey firms in different sectors, including manufacturing, trade and others. The survey was conducted to study the effect of business environment on firms' activity in Cambodia. The survey also asked firms questions related to the use of input and materials for the production. It explained that inputs are materials used in the production process but that they are not equipments. Although the survey responses cannot show the linkages of each firm to service sectors, it could give a

rough picture for the linkages of firms in each sector and the use of inputs materials. Among the 500 firms that responded to this question, 250 firms sourced the input-materials from Cambodia, and 250 imported the input-material directly and indirectly. As shown in Table 2-10, 41 of the firms that purchased input-material in Cambodia are those with foreign share larger than 50%. The domestic firms tend to source more inputs inside Cambodia than from the foreign firms.

Table 2-10 Number of Firms that Purchase Input Materials in Cambodia by Sectors

Sectors	**Foreign Firms**	**Domestic Firms**
Food	0	5
Textile	0	1
Garment	2	0
Plastic and Rubber	0	1
Basic Metal	0	2
Other manufacturing	1	10
Wholesale	2	4
Retail	2	28
Hotel and Restaurant	8	88
Travel and Tour	1	17
Construction	0	1
Transport	7	11
IT	0	3
Other	18	38
Total	**41**	**209**

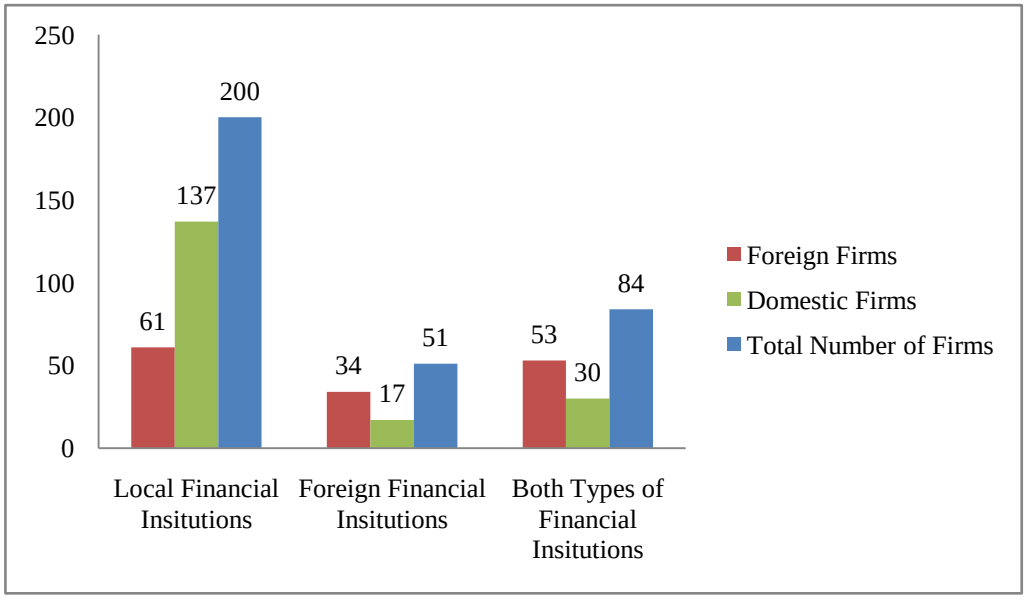
Source: Calculated from the World Bank Survey (2006)

Table 2-10 also shows that the service sectors tend to have the higher potential of linkages with both the domestic and foreign firms. The sector with high priorities for building linkages is the hotel and restaurant sectors. Some of the potential food's supplies such as fish, fruit and vegetables can be locally purchased at low costs compared to imported

foods. The high-potential growth of tourism sectors in Figures 2-7 and 2-8 shows that these sectors are suitable for building linkages.

Figure 2-34 shows the linkages between firms in each sector with financial services based on the data survey by the World Bank in 2006. The survey indicates that 59.7 percent of firms in Cambodia used the financial services provided by the local financial institutions. Only 15.2 percent of the firms reported that they used the financial services provided by the foreign institutions. 22.1 percent of the firms reported that they used the financial service provided by both local and foreign financial institutions.

Figure 2-34 Types of Financial Institutions Used by Firms in Cambodia



Source: Calculated from the World Bank Survey (2006)

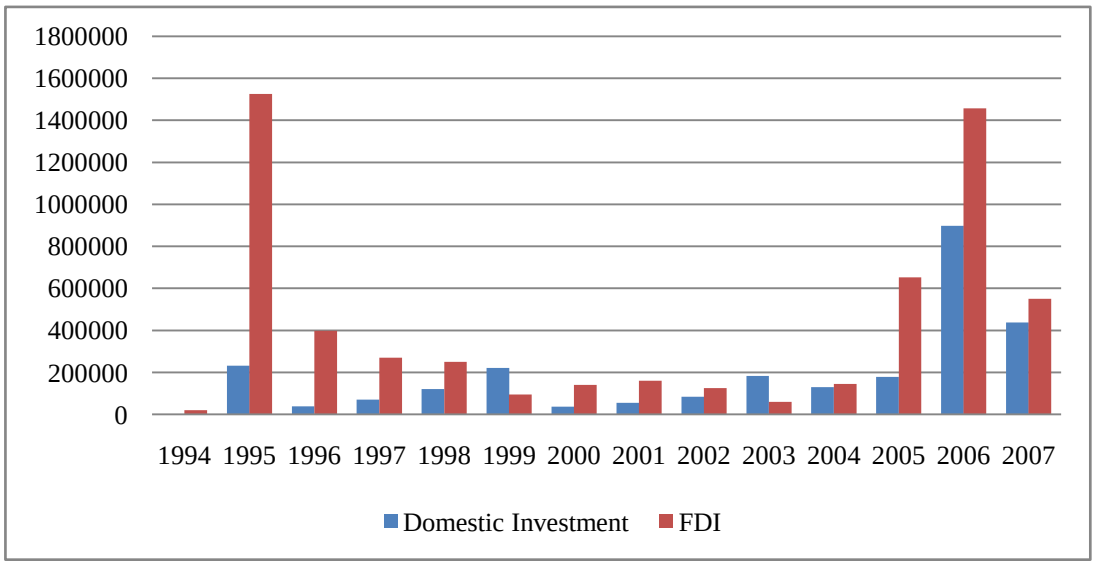
The survey indicates that both foreign and domestic firms tend to use financial services provided by local financial institutions rather than the foreign firms. This shows strong linkages between firms in different sectors and local financial service sectors.

2.4 Domestic Investment and Small and Medium Size Enterprises in Cambodia

2.4.1 Overview of Domestic Investment in Cambodia

Figure 2-35 shows the amount of fixed assets of domestic direct investment from 1994 to 2007 based on data from the National Institute of Statistics (NIS). Usually, the amount of domestic investments is smaller than FDI. The time-series show that except in 1999 and 2003, domestic investment is smaller than FDI.

Figure 2-35 Domestic Investment and FDI in Fixed Assets

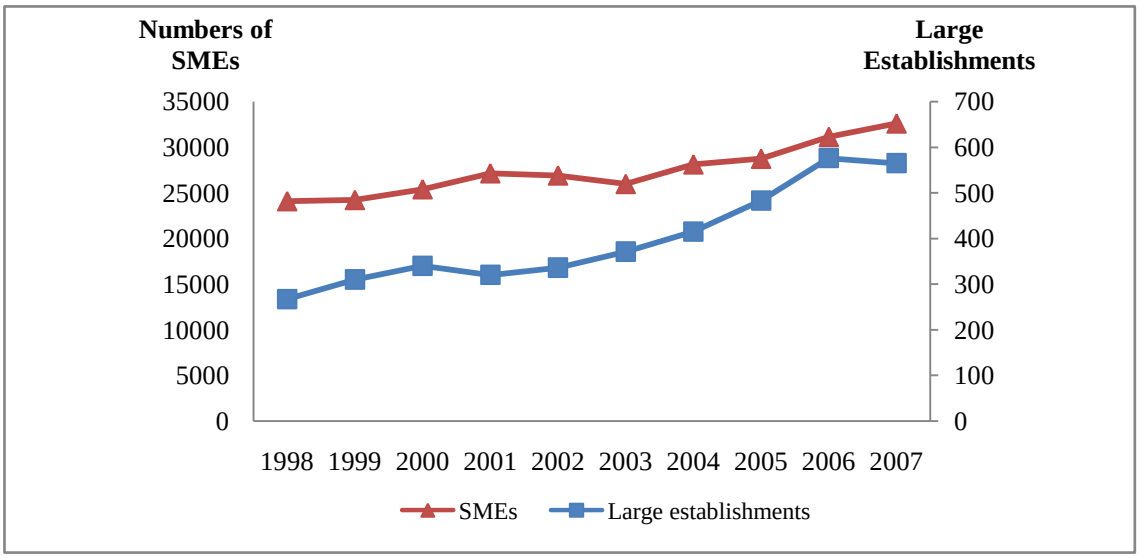


Source: NIS, 2008

2.4.2 Overview of SMEs in Cambodia

If we look at the number of SMEs from 1998 to 2007 based on data from the ministry of industry, mines and energy, it continues to grow despite a small interrupt in 2003. The total number of SMEs reaches 32,619 establishments. Figure 2-36 shows the numbers of establishments in manufacturing from 1998 to 2007 based on data from the ministry of industry, mine and energy.

Figure 2-36 Number of Firms in Cambodia from 1998 to 2007

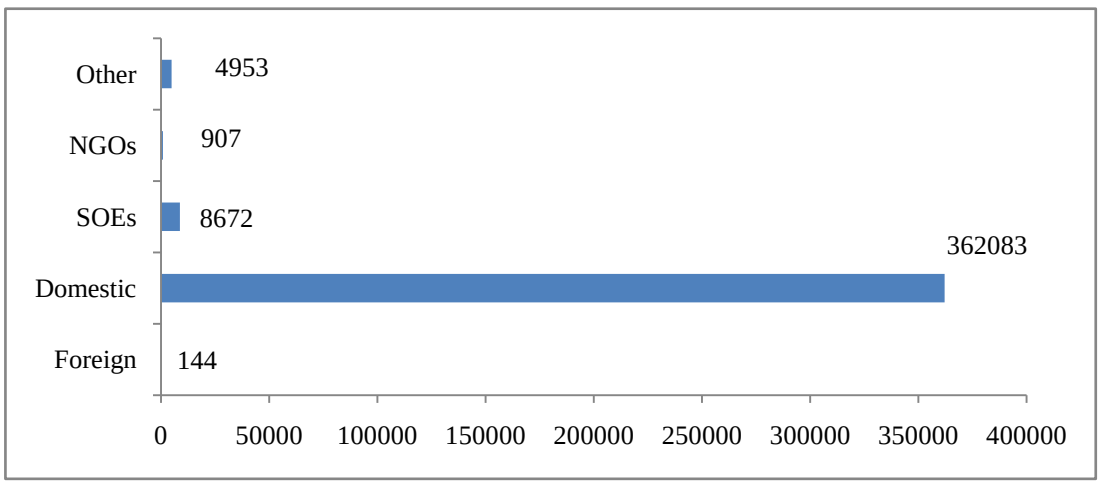


Source: Ministry of Industry, Mine and Energy, 2008

The number of large establishments in manufacturing sector is also growing, although it is smaller compared to the number of SMEs. In 2007, the total number of large establishments in manufacturing sectors is 565.

The National-wide Establishment Listing of Cambodia 2009, which was conducted by the National Institute of Statistics with support from Japan International Cooperation Agency (JICA), has concluded the following result (Figure 2-37) of establishments for both manufacturing and service industry.

Figure 2-37 Number of Establishments in 2009



Source: NIS Establishment Survey, 2009

2.5 FDI, SMEs and Industrial Policy in Cambodia

The Cambodia's government is carrying out a policy to promote small and medium-size enterprises (SMEs) while encouraging the inflow of FDI. The relation between domestic firms and FDI inflow needs a critical study in order to analyze whether better opportunities are available to build linkages between domestic and foreign firms.

The government of Cambodia has laid out the rectangular strategy policy for its development. This strategy has four main policies: (1) enhancment of the agricultural sector, (2) further rehabilitation and construction of physical infrastructure, (3) private sector development and employment, and (4) capacity building and human resource development (Retangular Strategy Phase Two of Royal Government of Cambodia, 2004).

Among these four main policies, the role of investment and SMEs has been emphasized by the third policy, the private sector development and employment, which has the following elements in achieving the policy: (1) strengthening the private sector and attracting investment, (2) creating jobs and ensuring improved working conditions, (3) promoting SMEs, and (4) creating social safety nets for civil servants, employees and workers (Retangular Strategy Phase Two of Royal Government of Cambodia, 2004).

The above core development program of the government points out the two important issues of this study, that is, the promotion of SMEs and attracting FDI. These two issues are related to one another because attracting FDI while trying to build its linkages with SMEs will help achieve these two elements.

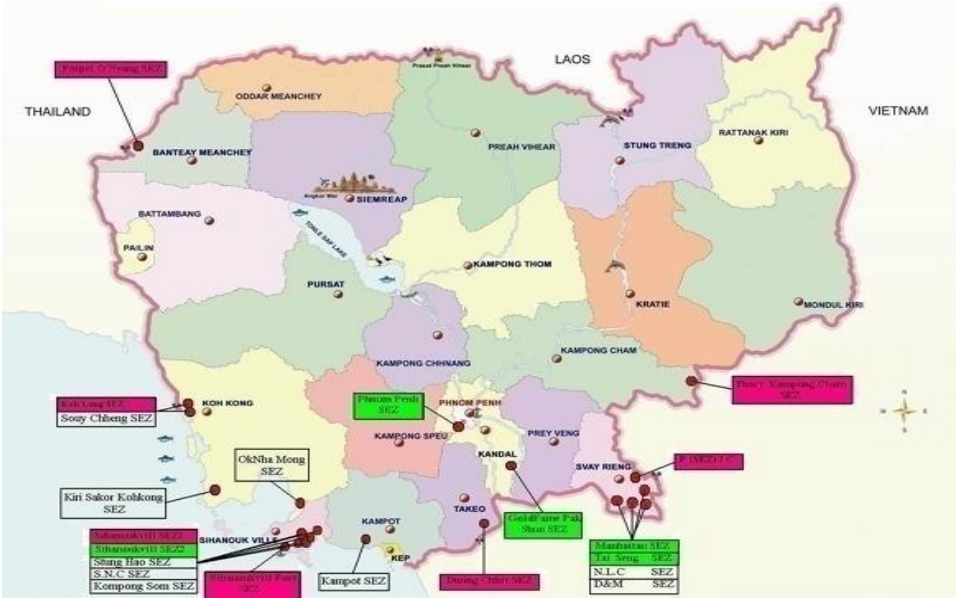
2.5.1 FDI and Incentive Policies

The government has provided various incentives to attract FDI, which has been mentioned in the Law of Investment of 2002 and later amended in 2007. The incentive according to article 12 is aimed at the following sectors: pioneer or high-technology industry, job creating industry, export-oriented industry, tourism industry, agro-industry, tranformation industry, physical infrastructure and energy, provincial and rural development, environment protection, and investment in the special promotion zone (SPZ).

Some of the incentives given are as the follows: corporate income tax rate of 20%, corporate tax emexption with the rule of a trigger period + three years + n, 5 years loss carried forward, full import duty exemption on the machine, intermediate goods, raw material, no export tax, and reinvestment of profit to receive special depreciation rate.

Overall, there are 22 special economic zones. These zones are established to provide ‘one-stop service’ to investors who are willing to reduce time and other procedure in the investment process. The one-stop service is on site-service and enables the investor to apply for the establishment of factory and other service quicker and at lower costs. In Figure 2-38, the red SEZ shows the zone in active operation, and the green zones are in the process, and the white zone is not yet started. See also Table 2-11 for specific zones.

Figure 2-38 Cambodia Special Economic Zones



Source: Cambodia Special Economic Zone Board

Table 2-11 List of Special Economic Zones in Cambodia

Zones' Name	Province
Sihanoukville Special Economic Zone (SSEZ)	Sihanoukville
Sihanoukville SEZ 1	Sihanoukville
Sihanoukville SEZ 2	Sihanoukville
Sihanoukville Port SEZ	Sihanoukville
Neang Kok Koh Kong SEZ	Koh Kong
Suoy Chheng SEZ	Koh Kong
S.N.C SEZ	Sihanoukville
Stung Hav SEZ	Sihanoukville
N.L.C SEZ	Svay Reing
Manhattan (Svay Reing) SEZ	Svay Reing
Poipet O'Neang SEZ	Banteay Meanchey
Doung Chhiv Phnom Den SEZ	Takeo
Phnom Penh SEZ	Kandal
Kampot SEZ	Kampot
Tai Seng Bavet SEZ	Svay Reing
Oknha Mong SEZ	Koh Kong
Goldfame Pak Shun SEZ	Kandal
Thary Kampong Cham SEZ	Kampong Cham
D&M Bavet SEZ	Svay Reing
Kiri Sakor Koh Kong SEZ	Koh Kong
Kampong Saom SEZ	Sihanoukville
Pacific SEZ	Svay Reing

Source: Cambodia Special Economic Zone Board

2.5.2 SMEs Related Policies

The government of Cambodia has adopted a framework for the development of SMEs in alignment with the core rectangular strategy. The framework for the development of SMEs focuses on three main issues: (1) regulatory and legal framework, (2) access to finance and (3) SMEs support activities. (Royal Government of Cambodia, SMEs Development Framework, 2005).

The main interest of the thesis is on the third key issue, SMEs support activities. There is no need for government intervention when the market is efficient. However, with the presence of public goods or the failure of markets, the role of government is needed. According to the SMEs development framework, the supporting activities will include support on improved access to market, upgrading the technology and human resource, and developing linkages especially with large enterprises.

2.6 Conclusions

Over the decades, the structure of Cambodian economy moves along a transition of its structures. Before 1993, the country adopted the planned economy, and agriculture remained a main sector of the economy. After the general election in 1993, the country adopted the free-market economy and the growth of light manufacturing and services has been noticeable. After the year 2000, the service industry surpassed the agricultural sector. While the industry sector showed growing trend, the agriculture sector showed only slow growth and tended to decline over the years. The country is going through the industrialization process.

The service sectors with highly potential growth include tourism, hotel and restaurants, finance, transportation and communication and information and technology. The manufacturing sector with high-potential to grow is garment industry, where the major export markets are US, EU and Canada. Agriculture seems too sluggish, and its main sector produces rice.

Industry linkages in Cambodia based on the input-output table reveal that the country tends to have lower forward linkages and fairly strong backward linkages. The growth of garment sectors does induce the growth in other related sectors through those linkages.

After adopting the market economy and international integration with the regional organization (such as ASEAN) and the world organization (such as WTO), the country experienced a high inflow of foreign direct investment. The top investors in Cambodia are Chinese, Korean and ASEAN investors. The most-favored sector for foreign investment is the light manufacturing sector such as garment and service sectors. Compared to Laos and Myanmar, Cambodia can attract more FDI. However, Cambodia still receives fewer amounts of FDI than Vietnam and Thailand. In fact, the role of FDI in promoting growth and generating employment and transferring technology is significant for Cambodia.

In terms of industry linkages of domestic firms and FDI, there are still few studies even though such linkages play an important role in promoting the growth of domestic firms, especially SMEs. There is evidence showing that the linkages between FDI and domestic suppliers or buyers exist in the garment and finance sectors, but more studies are needed.

Finally, although the incentive is needed to attract more FDI, the evaluation on the positive and negative impact is needed. For instance, tariff reduction on intermediate goods,

which is used not only in Cambodia but in many developing countries, do affect industry linkages. In Cambodia, lots of incentives are given to attract foreign investment in Cambodia, especially in garment and other priority sectors. The Qualified Investment Project encouraged such incentives. In special economic zone, foreign investors are also able to apply for tariff reduction on uses of raw material and other equipment for production in Cambodia. These incentives are very helpful for attracting FDI to Cambodia. However, understanding when such policy is helpful for domestic industry linkages is needed.

As the Royal Government of Cambodia also tries to encourage small and medium-size enterprise, the technology gap of domestic firms compared to foreign firms is important because the technology gap implies not only the opportunity to learn the new technology but also the possibility of crowding-out. Promoting FDI in a way to raise the productivity of domestic firms and enhance the industry linkages between FDI and domestic firms is needed. Enriching the positive impact of FDI and minimizing the negative impact might be the best solution to promote industrialization in Cambodia.

Chapter 3: Industry Linkages and Productivity Spillovers from FDI: Evidence from Cambodia

3.1 Introduction

The host country expects that technology brought by FDI can spill over to domestic firms and promote growth because theories of multinational firms and FDI suggest that foreign firms possess superior knowledge, which is their competitive advantage (Penrose, 1956; Markusen and Venables, 1999). Furthermore, the experience of Newly Industrialized Countries shows that such spillover promotes growth (Markusen and Venables, 1999).

In Cambodia, the amount of FDI recently increased from US$ 2.7 billion in 2007 to US$ 10.9 billion in 2008. The most-favored investment sector is the garment sector with US$ 148 million in fixed assets in 2008 (ASEAN Japan Center, 2008). Moreover, along with the policies to attract FDI, the Royal Government of Cambodia (RGC) is also implementing several policies to support domestic small and medium-scale enterprises (SMEs). As the two policies are implemented simultaneously, examining the linkages between FDI and SMEs is very helpful for policy implication.

Productivity spillover from FDI takes place when foreign firms increase the productivity of domestic firms in a host country, and the multinational firms do not fully internalize the values of these benefits (Javorcik, 2004). Two types of productivity spillover are usually mentioned in literatures: *horizontal spillover* and *vertical spillover* (Gorg and Greenaway, 2004; Smeets, 2008). Horizontal productivity spillover is also called *within-industry spillover* because it takes place when foreign and domestic firms are in the same industry. Through this channel, productivity spillover could occur in three possible ways.

Firstly, in order to compete, domestic firms need to upgrade their technology. Secondly, domestic firms may imitate foreign firms' technology. Finally, workers may quit foreign firms to join domestic firms or set up their own firms (Blomstrom and Kokko, 1998).

Although the horizontal spillover, theoretically, can occur through the above-mentioned channels, the effect remains empirically unclear. For example, Dimelis and Louri (2004) find positive productivity spillover in Greece, while Aitken and Harrison (1999) find no productivity spillover in the case of Venezuela. Gorg and Greenaway (2004) and Smeets (2008) provide a list of empirical studies with mixed evidence on productivity spillovers.

Vertical productivity spillover is called *between-industry spillover* as it takes place between different industries. The linkages between FDI in one industry and firms in other industries could be created by two forms of FDI: *backward FDI* and *forward FDI.* Backward FDI is the FDI in final goods sectors that create demand for intermediate goods produced by domestic firms. This type of FDI has long been theoretically studied since Rodriguez-Clare (1996). In principle, backward FDI enables productivity spillover through three channels. Firstly, the fact that foreign firms need supplies of intermediate goods from domestic firms encourages domestic firms to upgrade their technology in order to be able to supply high quality intermediate goods to foreign firms. Secondly, domestic suppliers may imitate the technology of foreign firms' suppliers, so they can produce intermediate goods of similar quality. Finally, in order for domestic firms to be able to produce intermediate products of desired quality, foreign firms may opt to transfer the technology to their domestic suppliers directly (Javorcik, 2004).[1]

[1] According to Javorcik (2004), even though multinational firm transfers technology to its suppliers, it cannot fully internalize the benefits that its suppliers got, thus there is still spillover.

In contrast, forward FDI is the FDI in the input industry that supplies high quality intermediate goods to domestic producers of final products. By supplying intermediate goods of high quality, foreign firms indirectly help improve productivity of their domestic buyers. The relationship was empirically studied by Javorcik (2004).

Although it is clear in the theory how backward or forward FDI facilitates the productivity spillover, empirical evidence of the effect of these two channels is mixed. Some researchers find positive productivity spillover (Javorcik, 2004; Jabbour and Mucchielli, 2007; Bitzer, Geishecker, and Gorg, 2008; Blalock and Gertler, 2009) while other researchers report only limited or weak vertical productivity spillover (Girma and Gong, 2008; Giuliani, 2008).

What explains these differentials in the findings on productivity spillover? Among all the myriad factors, two important explanations are *technology gap* and *absorptive capacity* of domestic firms.

Existing conceptual debates suggest that the technology gap between domestic firms and foreign firms influences the ability of domestic firms to benefit from the productivity spillover, but it is unclear whether a large gap or a small gap is better. Findlay (1978) argues that the rate of technological progress in the relatively "backward region" is an increasing function of the gap between its own level of technology and that of the "advanced region". The gap indicates the existence of new technological knowledge for domestic firms to learn. However, this disparity must not be too wide for the thesis to hold. In contrast, Wang and Blomstrom (1992) explain that the profit of the domestic firm is negatively related to the technology gap, while that of the multinational firm is positively related to the gap.

Therefore, when the gap is small, foreign firms transfer more advanced technology as they need to compete with domestic firms to guarantee their profits (Glass and Saggi, 1998).

Existing empirical studies also report conflicting findings on the effect of the technology gap on productivity spillover. In the case of Mexican manufacturing firms, Kokko (1994) shows that large gap (ratio of value added per worker of foreign firms to that of domestic firms) is an obstacle for productivity spillover. Using the ratio of total factor productivity (TFP) to the maximum TFP in the UK electronic and engineering sector, Girma and Gorg (2007) show that reduction in the technology gap enhances the ability of domestic firms to benefit from the productivity spillovers. In contrast, Castellani and Zanfei (2003), measuring the technology gap by using the ratio of domestic firms' TFP to their industries's average TFP, find that a large gap positively affects the technology transfer.

On the other hand, how does absorptive capacity affect productivity spillover? Cohen and Levinthal (1989) define the term "absorptive capacity" as "the ability to recognize the value of new information, assimilate it and apply it for commercial end". They explain that an organization needs prior related knowledge to assimilate new knowledge (Cohen and Levithal, 1989 and 1990). So-far, existing studies have employed various indicators of absorptive capacity, including research and development (R&D) and non-R&D, to investigate the effect of absorptive capacity on productivity spillover. R&D represents the absorptive capacity of firms because investment in R&D gives domestic firms prior knowledge that enables them to acquire new knowledge from foreign firms. In addition, they also postulate that there are costs associated with the imitation of new knowledge, but those

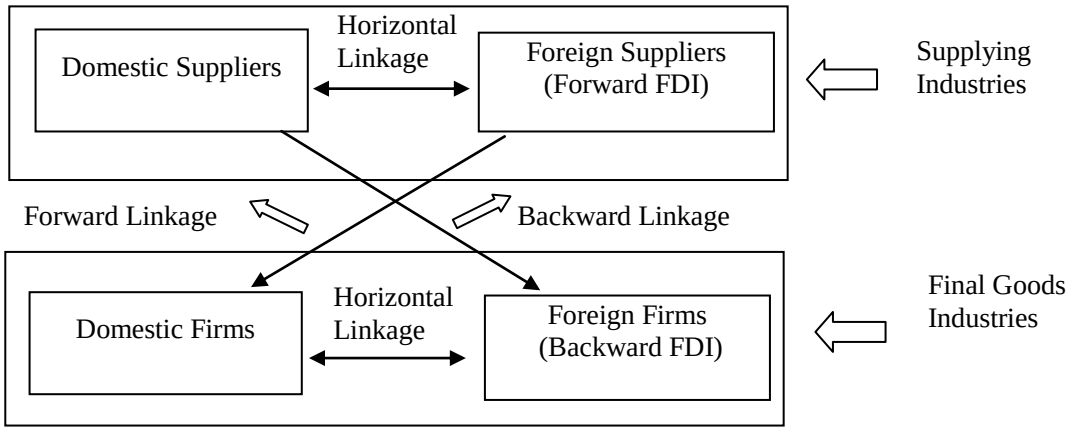
costs are minimized by virtue of existing R&D conducted by the firm to enhance its absorptive capacity in the relevant field.

Findings from existing studies consistently suggest the positive impact of absorptive capacity on productivity spillover. For example, Cohen and Levinthal (1989) study the US firms and find that they have the high ability to acquire new knowledge due to their tremendous investment in R&D activities. Similarly, Kinoshita (2000) and Griffith, Redding and Reenen (2004) have found that R&D enables domestic firms to imitate the technology of foreign firms in the case of Czech Republic and 12 OECD countries. Regarding non-R&D indicators, Barrios and Strobl (2002) and Girma, Gorg and Pisu (2008) show that the export status of domestic firms in Spain and UK, as an indicator of absorptive capacity, affects their ability to benefit from the productivity spillover.

This study is conceived with the aim of filling two substantial gaps in the existing literature (see Figure 3-1 for the analytical framework). Firstly, very few studies have examined the effect of vertical FDI and the technology gap on the productivity spillover on domestic firms. Moreover, notwithstanding the fact that the productivity spillover can occur through vertical and horizontal channels, only a limited number of studies have been conducted to examine the effect of vertical productivity spillover and the technology gap together (see, for example, Marcin, 2008; Girma et al., 2008; Wang, 2010). Most of the existing studies on technology gap and productivity spillover focus principally on the horizontal productivity spillover. This study, therefore, extends the literature by incorporating both vertical and horizontal channels into the investigation. To put it another way, this paper examines how backward and forward FDI affect the productivity of

domestic firms when there is a gap in the technology level between domestic firms and foreign firms.

Figure 3-1 Analytical Framework of FDI and Industry Linkages



Secondly, this study attempts to introduce two new proxies of absorptive capacity to measure the effect of absorptive capacity on productivity spillover. In the case of labor-intensive and service firms, the proxies of workers' education and training seem more suitable than those of R&D for two reasons. Firstly, as it is labor-intensive, FDI often brings less complicated technology to host countries; hence, domestic firms do not necessarily invest heavily in R&D activities to catch up with foreign firms. The high level of workers' education and additional training may do the work. Secondly, although R&D is probably needed, SMEs may not have a big budget to spend on it. For these reasons, R&D is probably less visible in the case of labor-intensive and service industries. Wang (2010) also uses workers' education to examine the effect of absorptive capacity in the vertical channel.

This study chooses Cambodia as a case study for three reasons. Firstly, Cambodia has enjoyed impressive economic growth due to the large in-flow of FDI. Secondly, along with efforts to attract FDI, the Royal Government of Cambodia is also working hard to

promote SMEs. Finally, although there are a few studies examining the productivity spillover in manufacturing firms in Cambodia (see, for example, Cuyvers, Soeng, Plasmans and Bulcke, 2008b) and reporting positive spillover from FDI, they did not investigate the effect of the vertical linkages and technology gap on productivity spillover.

The findings show that domestic firms can benefit from the productivity spillover when the level of their technology is moderately below that of the foreign firms. The absorptive capacity measured by workers' education and training do not have statistically significant effects on the productivity spillover.

The remainder of this chapter is organized into four sections. Section 3.2 describes methodology and data used and is followed by Section 3.3, which discusses the findings. Section 3.4 checks robustness of the results and Section 3.5 concludes the chapter.

3.2 Methodology and Data

3.2.1 Model specification

To estimate the productivity spillover, we follow the conventional method by regressing domestic firms' production level (productivity) on the presence of FDI in the same industries (horizontal FDI), upstream industries (forward FDI) and downstream industries (backward FDI). Gorg and Greenaway (2004) and Smeets (2008) do a thorough literature survey of this conventional method. The effect of productivity spillover is present if the coefficient of FDI is positive. However, this conventional method, as pointed out by Javorcik (2004) and Blalock and Gertler (2009), has problems of unobserved variable and

simultaneity bias. This study deals with these problems by using panel data and random and fixed effect models.

To study how the absorptive capacity and technology gap affect the productivity spillover, this study uses interaction terms of FDI with proxies of the absorptive capacity and technology gap. The interaction method is used due to its simplicity and the convenience of interpretation. Girma (2005) explains that this method permits identification of the threshold level of absorptive capacity (see also Marcin, 2008; Girma et al., 2008; Blalock and Gertler, 2009).

Following Dimelis and Louri (2004), the production function in Cobb-Douglas form is used.

$$Y_{ijt} = L_{ijt}^{\alpha} K_{ijt}^{\beta} M_{ijt}^{\gamma} E_{ijt}^{\theta} e^{\lambda 0+\lambda FDI_{ijt}+\varphi FDI_{ijt}*AC_{ijt}+\mu AC_{ijt}+\rho FDI_{ijt}*TGap_{ijt}+\pi TGap_{ijt}+\varepsilon_{ijt}} \quad (1)$$

where Y_{ijt}, L_{ijt}, K_{ijt}, M_{ijt}, and E_{ijt} are output, labor, capital, materials and energy and electricity of firm *i* in sector *j* at time *t* respectively. *AC* is a proxy of absorptive capacity and *TGap* is the technology gap. ε_{ijt} is the error term. FDI includes horizontal, backward and forward FDI.

By taking the logarithm of both sides of (1), we have:

$$lnY_{ijt} = \lambda_0 + \alpha lnL_{ijt} + \beta lnK_{ijt} + \gamma lnM_{ijt} + \theta lnE_{ijt} + \lambda FDI_{ijt} + \varphi FDI_{ijt} * AC_{ijt} + \mu AC_{ijt} + \rho FDI_{ijt} * TGap_{ijt} + \pi TGap_{ijt} + \varepsilon_{ijt} \quad (2)$$

By subtracting lnL_{ijt} from both sides of the equation, we get:

$$ln\left(\frac{Y_{ijt}}{L_{ijt}}\right) = \lambda_0 + \beta ln\left(\frac{K_{ijt}}{L_{ijt}}\right) + \gamma ln\left(\frac{M_{ijt}}{L_{ijt}}\right) + \theta ln\left(\frac{E_{ijt}}{L_{ijt}}\right) + (\alpha + \beta + \gamma + \theta - 1)lnL_{ijt}$$
$$+ \lambda FDI_{ijt} + \varphi FDI_{ijt} * AC_{ijt} + \mu AC_{ijt} + \rho FDI_{ijt} * TGap_{ijt} + \pi TGap_{ijt}$$
$$+ \varepsilon_{ijt} \quad (3)$$

To control for time and sector specific effects, time and sector specific dummies η_t and a_j are added.

$$ln\left(\frac{Y_{ijt}}{L_{ijt}}\right) = \lambda_0 + \alpha ln\left(\frac{K_{ijt}}{L_{ijt}}\right) + \gamma ln\left(\frac{M_{ijt}}{L_{ijt}}\right) + \theta ln\left(\frac{E_{ijt}}{L_{ijt}}\right) + (\alpha + \beta + \gamma + \theta - 1)lnL_{ijt}$$
$$+ \lambda FDI_{ijt} + \varphi FDI_{ijt} * AC_{ijt} + \mu AC_{ijt} + \rho FDI_{ijt} * TGap_{ijt} + \pi TGap_{ijt} + \eta_t + a_j$$
$$+ \varepsilon_{ijt} \quad (4)$$

Therefore, the estimation equation for labor productivity spillover is:

$$ln\left(\frac{Y_{ijt}}{L_{ijt}}\right) = \lambda_0 + \alpha ln\left(\frac{K_{ijt}}{L_{ijt}}\right) + \gamma ln\left(\frac{M_{ijt}}{L_{ijt}}\right) + \theta ln\left(\frac{E_{ijt}}{L_{ijt}}\right) + \delta lnL_{ijt} + \lambda FDI_{ijt} + \varphi FDI_{ijt}$$
$$* AC_{ijt} + \mu AC_{ijt} + \rho FDI_{ijt} * TGap_{ijt} + \pi TGap_{ijt} + \eta_t + a_j$$
$$+ \varepsilon_{ijt} \quad (5)$$

where $\delta = (\alpha + \beta + \gamma + \theta - 1)$.

3.2.2 Data and main variables

Recently, Cambodia has been receiving a large amount of FDI (US$ 2.7 billion in 2007 and US$ 10.8 billion in 2008). The manufacturing industry received the largest number of FDI projects (66 projects with fixed assets of US$ 715 million in 2008) and is followed by the tourism industry (20 projects with fixed assets of US$ 8.7 billion in 2008), the service industry (nine projects with fixed assets of US$ 1.2 billion in 2008) and the agricultural industry (six projects with fixed assets of US$ 106 million in 2008). Within the manufacturing industry, the garment sector receives the largest number of FDI projects (38

projects) of US$ 148 million in 2008 (Cambodia Investment Board and ASEAN JAPAN Center, 2008). [2]

Table 3-1 Distribution of Domestic and Foreign Firms in Each Sector

Industries	Code	Sectors	N	N1	FOR	DOC	FOR %	DOC %
MANU-FACTURE	101	Foods	11	9	2	7	22	78
	102	Textile	6	6	5	1	83	17
	103	Garments	92	73	65	8	89	11
	105	Plastics and Rubber	6	5	2	3	40	60
	109	Other Manufacturing	16	14	3	11	21	79
TRADE	201	Wholesale (include export service)	34	29	7	22	24	76
	202	Retail	71	61	2	59	3	97
TOUR	301	Hotels and Restaurants	119	103	9	94	9	91
	302	Other services (travel agencies, tour)	25	20	3	17	15	85
OTHER	401	Construction	9	9	2	7	22	78
	402	Transport	26	21	9	12	43	57
	403	IT	6	5	1	4	20	80
	404	Others	78	61	22	39	36	64
TOTAL			499	416	132	284	31	69

Note: DOC: number of domestic firms; FOR: number of foreign firms; N: original sample; N1: sample after removing observation with missing value.

Source: Author's calculation based on the World Bank Survey on Business and Investment Climate in Cambodia (2006).

In this study, data from a firm survey conducted in 2006 by the World Bank (data available at the website of World Bank enterprise surveys) are used. Although the total sample size of the survey is 499[3], only 416 firms with complete information are used. The surveyed firms consist of both manufacturing firms and non-manufacturing firms. All the firms were asked about their sales and input use in 2005 and 2006. If the foreign share

[2] In terms of the number of project, garment is the top FDI receiver, while agriculture gets a small number of projects with large amount of fixed asset.

[3] The sample size of 499 includes only sectors that have both foreign and domestic firms. The original survey contains 502 firms covering 17 sectors.

exceeds 50 percent, the firm is regarded as a foreign firm. [4] Table 3-1 shows the distribution of observations.

The survey classifies firms based on two criteria: the number of employee and the distribution of shareholding. In terms of the numbers of employees, there are three types of firms: small-size firms with employees less than 20 (171 firms), middle-size firms with employees less than 100 (123 firms) and large-size firms with employees more than 100 (125 firms). All firms are private and profit-oriented. Firms are also categorized as foreign firms or domestic firms based on their distribution of shareholding. If the foreign share is more than 50 percent, the firm is considered as a foreign firm. On the contrary, if it is less than 50 percent, the firm is considered as a domestic one. Totally, there are 132 foreign firms (31%) and 284 domestic firms (69%). There are two types of foreign firms: 100 percent owned (113 firms) and joint-ventured (19 firms).

The distribution of firms in the sample indicates that this survey is suitable for our analysis because it has similar distribution to the whole population of firms in Cambodia. Table 3-1 shows that the sector receiving the largest number of foreign firms is the manufacturing industry (77 firms), and is followed by the service industry (68 firms). Garment products absorb the highest number of foreign firms in the manufacturing industry (65 out of 77 firms). The distribution of the population of firms in Cambodia also follows a similar pattern.

To study the linkages between sectors, the input-output table (I-O table) of Cambodia is used. There have been three different I-O tables of Cambodia. The first I-O table was developed in year 2000 by the Association of Regional Econometrics and Environmental

[4] See article 283 of Cambodian Law on Commercial Enterprise (2005).

Studies (AREES).[5] This I-O table composes of 22 sectors. The second I-O table is developed by a group of researchers in 2006 (Kobayashi, Saito, Tada, Koyama and Tanji, 2009). It composes of 53 different production sectors. The last I-O table is developed in 2003 by Oum and modified in 2008 (Oum, 2007 and 2008). It composes of 22 different production sectors. Input is classified into four factors; capital, unskilled labor, skilled labor and land. This I-O table mainly used the data from the Economic Institute of Cambodia, National Institute of Statistics and National Bank of Cambodia.

In this chapter, the modified I-O table developed by Oum is used for two reasons. Firstly, the classification of sectors in the table is very suitable for studies at the firm level. Secondly, Oum's I-O table is more aggregated than the other two tables. For example, because Kobayashi et al. (2009) aim at analyzing agricultural sector, they divided it into further sub-sectors, which is unsuitable for the analysis in this chapter as data on only the manufacturing and service industry is available. Sambath and Kato (2009) also use this I-O table in their analysis (See Table 3-8 for the aggregated I-O table and Tables 3-14 and 3-15 for the original I-O tables).

To estimate equation (5) the following four main variables are defined. Output Y is taken from the variable total sale in the survey questionnaire, which was measured in current US dollar prices.[6] Labor L is the number of permanent workers in the survey questionnaire. Capital K is measured by spending on investment in land, building and equipment. The

[5] See the working paper of Francisco, Kim, Bui, Vanndy, and Hung (2009).

[6] There are many studies that use deflated sales as dependent variable such as Altomonte and Pennings (2009), Barbosa and Eiriz (2009), Bekes, Kleinert, and Toubal (2009), Buckley, Wang, and Jeremy (2007),Chudnovsky, Lopez, and Ross (2008), Damijan and Knell (2005), Du, Harrison, and Jefferson (2011), Monastiriotis and Alegria (2011).

spending on investment is chosen to represent capital because there is no panel data on the book value of fixed assets. The information on Material *M* and Energy *E* is directly taken from firms' expenditure on material and energy. All relevant variables are deflated using consumer price index (CPI).

The horizontal FDI is calculated by following Javorcik (2004) and Blalock and Gertler (2008).

$$HFDI_{jt} = \frac{\sum_{i \in j} Foreign\_Y_{ijt}}{\sum_{i \in j} Y_{ijt}} \qquad (6)$$

where $\sum_{i \in j}$ indicates the summation is taken over firms in a given sector *j*. $Foreign\_Y_{ijt}$ is equal to the amount of sales Y_{ijt} of firm *i* if this firm is foreign and 0 otherwise.

As defined in the first section, the backward FDI is the FDI in final goods sectors that creates demand for intermediate goods produced by domestic firms. Similarly to Marcin (2008), it is calculated as follows:

$$BFDI_{jt} = \sum_{k(\neq j)} \alpha_{jk} HFDI_{kt} \qquad (7)$$

The coefficient α_{jk} is the share of sector *j*'s output supplied to sector *k* in its total output, which is taken from input-output table[7]. Therefore, we can assume that FDI invested within sector *k* at time *t*, $HFDI_{kt}$, induces the backward FDI of $\alpha_{jk} HFDI_{kt}$ of sector *j* which supplies intermediate goods to sector *k*. If that is the case, $BFDI_{jt}$ defined in equation (7) might be a plausible index of the backward FDI of sector *j* at time *t*.

[7] The coefficients α_{jk} and α_{kj} in equations (7) and (8) do not have a time subscript *t* because we have only one input-output table over the years of analysis.

Furthermore, the forward FDI is the FDI in the input industry that supplies intermediate goods to domestic producers of final products. It is calculated as follows.

$$FFDI_{jt} = \sum_{k(\neq j)} \alpha_{kj} HFDI_{kt} = \sum_{k(\neq j)} \alpha_{kj} \left[\left[\sum_{i \in k} Foreign\_Y_{ikt} \right] / \left[\sum_{i \in k} Y_{ikt} \right] \right] \quad (8)$$

The coefficient α_{kj} is the share of sector *j*'s input bought from sector *k* in its total input, which is taken from the input-output table. Therefore, we can assume that FDI invested within sector *k* at time *t*, $HFDI_{kt}$, induces the forward FDI of $\alpha_{kj} HFDI_{kt}$ of sector *j* which buys intermediate goods from sector *k*. If that is the case, $FFDI_{jt}$ defined in equation (8) might be a plausible index of the forward FDI of sector *j* at time *t*.[8]

Table 3-2 presents horizontal, backward and forward FDI indexes calculated by sector. The results show that textile and garment sectors have higher FDI indexes than other sectors. For example, the horizontal, backward and forward FDI indexes of the garment sector are 0.92, 0.68 and 0.99, respectively. HFDI index of this sector is very high because most of the output is produced by foreign firms. Furthermore, HFDI index in other sectors induces 0.68 units of backward FDI to the garment sector by supplying intermediate goods to them. Similarly, HFDI in other sectors induces 0.99 units of forward FDI to the garment sector by buying intermediate goods from them.

[8] Equation (8) is slightly different from the forward FDI defined by Javorcik (2004): $FFDI_{jt} = \sum_{k(\neq j)} \alpha_{kj} \left[[\sum_{i \in k} ForeignShare_{ikt} * (Y_{ikt} - X_{ikt})] / [\sum_{i \in k} (Y_{ikt} - X_{ikt})] \right]$ where *ForeignShare* is used as weight to sum up over firms, while equation (8) uses zero weight for non-foreign firms whose share of equity owned by foreign investors falls short of 50%. Note also that equation (8) does not subtract export. Equation (8) is used because data on foreign share and export for year 2005 and 2006 is not available.

Table 3-2 Horizontal FDI, Backward FDI and Forward FDI Indexes by Sector

Name of Sector	HFDI2005	BFDI2005	FFDI2005
Foods	0.68	0.08	0.24
Textile	0.99	0.74	1.07
Garments	0.92	0.68	0.99
Plastics and Rubber	0.68	0.57	0.21
Other Manufacturing	0.85	0.14	0.84
Wholesale (include export service)	0.25	0.05	0.11
Retail	0.10	0.02	0.04
Hotels and Restaurants	0.20	0.04	0.00
Other services (travel agencies, tour)	0.33	0.14	0.03
Construction	0.60	0.11	0.07
Transport	0.68	0.39	0.14
IT	0.11	0.06	0.02
Others	0.59	0.25	0.05

Regarding absorptive capacity, this study uses the percentage *H* of workers with lower secondary education (grade 7^{th} or higher) and a dummy variable *TR* which indicates whether or not firms offer training to their workers. Table 3-3 presents means of these variables. Although the garment sector absorbs the largest number of foreign firms, only 46 percent of firms in this sector provide training to their workers. On the other hand, the textile sector, despite its small share in the manufacturing industry, offers the largest amount of training. Sixty-eight percent of training provided in the service industry is done by the wholesale sector. More sectors in the service industry employ workers with secondary education or higher than sectors in manufacturing industry. Within the manufacturing industry, the garment sector hires the least number of workers with this level of education (41 percent).

Table 3-3 Means of Two Proxies of Absorptive Capacity and Labor Productivity Gap

Name of Sector	Number of Firms (domestic and foreign)	Training (TR)	Human Capital (H)	TGap
Foods	9	0.33	0.66	0.53
Textile	6	0.83	0.54	0.13
Garments	73	0.46	0.41	-0.01
Plastics and Rubber	5	0.60	0.54	0.12
Other Manufacturing	14	0.57	0.68	0.45
Wholesale (include export service)	29	0.68	0.87	0.00
Retail	61	0.34	0.90	0.66
Hotels and Restaurants	103	0.47	0.78	0.38
Other services (travel agencies, tour)	20	0.60	0.98	0.49
Construction	9	0.44	0.67	-0.33
Transport	21	0.52	0.95	0.50
IT	5	0.60	1.00	-0.93
Others	61	0.55	0.88	0.29

The technology gap is difference between a firm's average labor productivity over the two-period (2005 and 2006) and that of all foreign firms in the same sector. The technology gap $TGap_{ij}$ can be calculated by the following formula:

$$TGap_{ij} = \frac{LP_j^* - Mean(LP_{ijt})}{LP_j^*} \qquad (9)$$

where $LP_{ijt} = \frac{Y_{ijt}}{L_{ijt}}$ and $Mean(LP_{ijt}) = \frac{(LP_{ij\,2005} + LP_{ij\,2006})}{2}$. LP_j^* is the mean of $Mean(LP_{ijt})$ of all foreign firms i in sector j.[9] Positive technology gap means the firm's productivity is below that of foreign firms. A negative technology gap means the opposite.

Table 3-3 also presents the mean of the technology gap for each sector. On average, a large majority of firms are below the international frontier with the exception of garment,

[9] $TGap_{ij}$ has no subscript for time because labor productivity is averaged over the two years.

construction and IT sectors. Technology in the garment sector is just slightly above that of foreign firms. IT has technology of a much higher standard than the international frontier.

3.3 Estimation Results

Since horizontal, backward and forward FDI are strongly correlated, they are estimated separately (see Table 3-4). On the other hand, proxies of absorptive capacity and technology gap are included in the same estimation equations because they have low correlation each other (see Table 3-5).

Table 3-4 Correlation among Horizontal FDI, Backward FDI and Forward FDI

	Horizontal FDI (HFDI)	Backward FDI (BFDI)	Forward FDI (FFDI)
Horizontal FDI	1.00		
Backward FDI	0.90***	1.00	
Forward FDI	0.86***	0.88***	1.00

Table 3-5 Correlation among Proxies of the Absorptive Capacity and Technology Gap

	Training (TR)	Human Capital (H)	Technology Gap (TGap)
Training	1.00		
Human Capital	0.03	1.00	
Technology Gap	-0.01	-0.03	1.00

Note: Sample of domestic firms

The two-year panel data are used to estimate equation (5). To deal with unobservable effects, we adopt random effect (RE) and fixed effect (FE) estimation as well as pooled OLS estimation. The Hausman test is run to test the random effect model (RE) against the fixed effect model (FE) estimator for the three types of FDI (horizontal, backward and forward). Table 3-6 presents results of estimated coefficients as well as Hausman test. The result shows that the null hypothesis is strongly rejected. Therefore, FE is preferred to RE.

Based on the results for FE estimation, we now examine the interaction terms between technology gap or absorptive capacity and the three types of FDI in Table 3-6. The coefficients of horizontal FDI (HFDI), backward FDI (BFDI) and forward FDI (FFDI) are negative but statistically insignificant. However, the coefficients become positive and statistically significant when all the three types of FDI are interacted with the technology gap (TGap*HFDI, TGap*BFDI and TGap*FFDI). The coefficients of the interaction terms between FDI and human capital (H*HFDI, H*BFDI and H*FFDI) and between FDI and training (TR*HFDI, TR*BFDI and TR*FFDI) are not statistically significant.

The estimation results can be interpreted as follows. In the case of horizontal FDI, the positive and statistically significant coefficient of the interaction terms between horizontal FDI and the technology gap (TGap*HFDI) suggests the potential role of the technology gap in enabling the horizontal productivity spillover. When the technology gap exists, it indicates an available learning opportunity from their foreign competitors for domestic firms. Similarly, the positive and statistically significant coefficient of the interaction term between backward FDI and the technology gap (TGap*BFDI) implies that the technology gap leads to backward productivity spillover in two ways. In the case of contracted foreign buyers, they need to improve productivity of their domestic suppliers, since they want higher quality intermediate goods. In another relationship, domestic suppliers aiming at attracting foreign buyers must improve their productivity up to a level that enables them to gain confidence from potential foreign buyers. Finally, the positive and statistically significant coefficient of the interaction term between forward FDI and the technology gap (TGap*FFDI) shows that, due to the presence of the technology gap between

the domestic firms in the final goods sector and their foreign competitors, domestic firms need to improve their productivity by using higher quality intermediate goods produced by foreign suppliers. This purchasing channel leads to forward productivity spillover.

On the other hand, the statistically insignificant coefficients of the interaction term between FDI and two proxies of absorptive capacity may be explained in the following way. It may be caused partly by relatively small variations in H (percentage of workers with higher education) and TR (training dummy). In addition, the survey used in this study reports that less than 50% of domestic firms offered training. It also reports that most of the domestic firms (about 70% of domestic firms) still needed more workers with higher skill and education for their operation, which means their workers do not have the sufficient skills for their jobs. These situations are likely to weaken effects of those proxies on productivity spillover from increased FDI.

To check robustness of these results, value added $V_{ijt} = Y_{ijt} - M_{ijt} - E_{ijt}$, instead of the gross output Y_{ijt}, is used to estimate the following equation.

$$\ln\left(\frac{V_{ijt}}{L_{ijt}}\right) = \gamma_0 + \delta \ln L_{ijt} + \gamma_2 \ln\left(\frac{K_{ijt}}{L_{ijt}}\right) + \gamma_3 FDI_{jt} + \gamma_4 FDI_{jt} * AC_{ijt} + \gamma_5 AC_{ijt} + \gamma_6 FDI_{jt} * TGap_{ijt} + \gamma_7 TGap_{ijt} + d_t + \alpha_i + \varepsilon_{ijt} \quad (10)$$

where $\delta = \gamma_1 + \gamma_2 - 1$. The technology gap in equation (10) is calculated based on equation (9) where value-added based labor productivity is used instead of output per worker. Table 3-7 presents the estimation results of equation (10). It shows quite similar results to Table 3-6 regarding coefficients of the interaction terms between TGap, H, TR and FDI indexes, suggesting robustness of the estimation results.

Table 3-6 Effect of FDI on Labor Productivity of Domestic Firms

	(1) Horizontal FDI				(2) Backward FDI				(3) Forward FDI		
Independent Variables	Log(Sale/Labor)			Independent Variables	Log(Sale/Labor)			Independent Variables	Log(Sale/Labor)		
	OLS	RE	FE		OLS	RE	FE		OLS	RE	FE
Constant	3.79***	3.36***	5.31***	Constant	3.57***	3.34***	5.29***	Constant	4.46***	3.36	5.58***
	(0.45)	(0.25)	(0.49)		(0.28)	(0.20)	(0.48)		(1.28)	(0.20)	(0.58)
lnL	0.04	-0.02	-0.45***	lnL	0.04	-0.03	-0.45***	lnL	0.04	-0.02	-0.44***
	(0.03)	(0.04)	(0.14)		(0.03)	(0.04)	(0.14)		(0.03)	(0.04)	(0.14)
ln(K/L)	-0.01	-0.00	0.05	ln(K/L)	-0.01	-0.01	0.05	ln(K/L)	-0.01	-0.01	0.05
	(0.01)	(0.02)	(0.06)		(0.01)	(0.02)	(0.06)		(0.01)	(0.02)	(0.06)
ln(M/L)	0.21***	0.24***	0.07	ln(M/L)	0.21***	0.24***	0.07	ln(M/L)	0.21***	0.23***	0.07
	(0.01)	(0.02)	(0.06)		(0.01)	(0.02)	(0.06)		(0.01)	(0.02)	(0.06)
ln(E/L)	0.22***	0.20***	0.19**	ln(E/L)	0.22***	0.20***	0.19**	ln(E/L)	0.22***	0.20***	0.19**
	(0.02)	(0.03)	(0.07)		(0.02)	(0.03)	(0.07)		(0.02)	(0.03)	(0.07)
HFDI	-0.45	0.17	-0.52	BFDI	-0.89	0.90	-1.17	FFDI	-4.08	0.52	-6.91
	(0.62)	(0.46)	(1.08)		(1.42)	(0.87)	(2.67)		(5.34)	(0.44)	(9.52)
H	0.10	0.39		H	0.14	0.40**		H	0.15	0.36*	
	(0.19)	(0.25)			(0.15)	(0.19)			(0.13)	(0.18)	
TR	-0.09	0.02		TR	-0.03	0.08		TR	0.01	0.11	
	(0.11)	(0.13)			(0.08)	(0.11)			(0.07)	(0.10)	
TGap	-0.49***	-0.56***		TGap	-0.49***	-0.54***		TGap	-0.52***	-0.52***	
	(0.05)	(0.06)			(0.04)	(0.05)			(0.03)	(0.04)	
H*HFDI	0.25	-0.13	0.11	H*BFDI	0.66	-0.53	0.15	H*FFDI	0.43	0.17	1.98
	(0.45)	(0.51)	(1.17)		(0.94)	(0.98)	(2.86)		(0.41)	(0.55)	(10.61)
TR*HFDI	0.21	0.16	0.27	TR*BFDI	0.05	-0.17	0.63	TR*FFDI	-0.35	-0.47	1.99
	(0.29)	(0.32)	(0.54)		(0.48)	(0.58)	(1.28)		(0.30)	(0.42)	(5.82)
TGap*HFDI	-0.12	0.09	0.37**	TGap*BFDI	-0.39	0.09	0.91**	TGap*FFDI	-0.15	-0.17	3.76*
	(0.12)	(0.13)	(0.17)		(0.23)	(0.26)	(0.42)		(0.14)	(0.19)	(1.92)
R^2	0.69		0.19	R^2	0.69		0.19	R^2	0.69		0.19
N	568	568	568	*N*	568	568	568	*N*	568	568	568
Hausman test of RE against FE				Hausman test of RE against FE				Hausman test of RE against FE			
Chi-square		29.54		Chi-square		29.87		Chi-square		26.83	
P-value		0.00		P-value		0.00		P-value		0.00	

Note: 1) In OLS sectors and time dummies are included while in RE and FE time dummy and firm fixed effect are taken into account.

2) *,**,***: significant at 10, 5 and 1%; ( ): standard error.

3) Hausman test with null hypothesis H_0: RE gives a consistent estimator.

Table 3-7 Effect of FDI on Labor Productivity of Domestic Firms Using Value Added Per Worker

	(1) Horizontal FDI				(2) Backward FDI				(3) Forward FDI		
Independent Variables	Log(Value added/Labor)			Independent Variables	Log(Value added/Labor)			Independent Variables	Log(Value added/Labor)		
	OLS	RE	FE		OLS	RE	FE		OLS	RE	FE
Constant	4.13***	3.79***	5.78***	Constant	3.63***	3.42***	5.78***	Constant	5.26***	3.40***	5.95***
	(0.51)	(0.30)	(0.34)		(0.33)	(0.25)	(0.33)		(1.51)	(0.24)	(0.45)
ln(L)	0.07*	-0.02	-0.68***	ln(L)	0.10**	-0.05	-0.67***	ln(L)	0.11***	-0.04	-0.66***
	(0.04)	(0.05)	(0.12)		(0.04)	(0.05)	(0.12)		(0.04)	(0.05)	(0.12)
ln(K/L)	0.02	0.02	0.05	ln(K/L)	0.01	0.01	0.06	ln(K/L)	0.01	0.01	0.06
	(0.02)	(0.02)	(0.06)		(0.02)	(0.03)	(0.06)		(0.02)	(0.03)	(0.06)
HFDI	-0.85	-0.34	-0.02	BFDI	-0.89	1.80*	-1.23	FFDI	-7.42	0.59	-0.99
	(0.72)	(0.54)	(1.04)		(1.69)	(1.08)	(2.56)		(6.33)	(0.58)	(9.13)
H	0.22	0.38		H	0.37**	0.67***		H	0.32**	0.58**	
	(0.23)	(0.31)			(0.18)	(0.25)			(0.16)	(0.24)	
TR	-0.13	-0.03		TR	-0.11	0.08		TR	-0.17**	0.02	
	(0.13)	(0.16)			(0.10)	(0.14)			(0.09)	(0.13)	
TGap	-0.93***	-0.89***		TGap	-0.61***	-0.67***		TGap	-0.57***	-0.53***	
	(0.06)	(0.07)			(0.05)	(0.06)			(0.04)	(0.05)	
H* HFDI	0.09	-0.20	-0.55	H*BFDI	-0.34	-2.30*	-0.36	H*FFDI	0.18	-0.13	-2.49
	(0.52)	(0.60)	(1.14)		(1.11)	(1.18)	(2.76)		(0.49)	(0.73)	(10.37)
TR *HFDI	0.01	0.14	-0.03	TR*BFDI	-0.37	-0.56	0.08	TR *FFDI	0.21	-0.13	-3.52
	(0.34)	(0.37)	(0.52)		(0.58)	(0.71)	(1.23)		(0.38)	(0.55)	(5.63)
TGap *HFDI	0.75***	0.73***	0.52***	TGap *BFDI	0.14	0.92***	1.55***	TGap *FFDI	-0.26	-0.12	4.43***
	(0.13)	(0.12)	(0.15)		(0.25)	(0.27)	(0.39)		(0.21)	(0.28)	(1.50)
R^2	0.55		0.19	R^2	0.52		0.20	R^2	0.52		0.18
N	560	560	560	*N*	560	560	560	*N*	560	560	560
	Hausman test of RE against FE				Hausman test of RE against FE				Hausman test of RE against FE		
Chi-square	57.01			Chi-square	63.05			Chi-square	64.96		
P-value	0.00			P-value	0.00			P-value	0.00		

Notes: 1) In OLS the dummy for sectors and time are included while in RE and FE, time dummy and firm fixed effect are taken into account.
2) *,**,***: significant at 10, 5 and 1%; ( ): standard error.
3) Hausman test with null hypothesis H_0: RE is a consistent estimator.
4) The variable TR denotes a dummy variable which indicates whether or not firms offer training to their workers. The variable H denotes the percentage of workers with lower secondary education (grade 7^{th} or higher).
5) The number of observations is 560 because eight observations have negative value added.

Table 3-8 Coefficients of Input-Output Table

	101	102	103	105	109	201	202	301	302	401	402	403	404
101	0.2376	0.0000	0.0000	0.0022	0.0003	0.0544	0.0544	0.0544	0.0859	0.0000	0.0073	0.0073	0.0859
102	0.0024	0.6457	0.6457	0.1971	0.0427	0.0345	0.0345	0.0345	0.0264	0.0046	0.0150	0.0150	0.0264
103	0.0024	0.6457	0.6457	0.1971	0.0427	0.0345	0.0345	0.0345	0.0264	0.0046	0.0150	0.0150	0.0264
105	0.0070	0.0056	0.0056	0.1673	0.0052	0.0026	0.0026	0.0026	0.0073	0.0045	0.1304	0.1304	0.0073
109	0.0153	0.0158	0.0158	0.0543	0.5028	0.0251	0.0251	0.0251	0.0417	0.1024	0.3161	0.3161	0.0417
201	0.0336	0.0238	0.0238	0.1452	0.0304	0.0044	0.0044	0.0044	0.0691	0.0205	0.0113	0.0113	0.0691
202	0.0336	0.0238	0.0238	0.1452	0.0304	0.0044	0.0044	0.0044	0.0691	0.0205	0.0113	0.0113	0.0691
301	0.0004	0.0003	0.0003	0.0016	0.0003	0.0001	0.0001	0.0000	0.0008	0.0002	0.0001	0.0001	0.0008
302	0.0014	0.0027	0.0027	0.0086	0.0019	0.0080	0.0080	0.0080	0.0297	0.0034	0.0077	0.0077	0.0297
401	0.0010	0.0005	0.0005	0.0043	0.0007	0.0027	0.0027	0.0027	0.0536	0.0059	0.0023	0.0023	0.0536
402	0.0134	0.0110	0.0110	0.0363	0.0060	0.0194	0.0194	0.0194	0.0078	0.0128	0.0461	0.0461	0.0078
403	0.0134	0.0110	0.0110	0.0363	0.0060	0.0194	0.0194	0.0194	0.0078	0.0128	0.0461	0.0461	0.0078
404	0.0014	0.0027	0.0027	0.0086	0.0019	0.0080	0.0080	0.0028	0.0297	0.0034	0.0077	0.0077	0.0297

Notes:

1) See the code number in Table 3-1 for the sector name.
2) Coefficients in the table show the share of output produced by row sector that is supplied to the column sector or the share of input used by column sector that is supplied by row sector. For example, the coefficient 0.0336 for row 201 and column 101 means that sector 201 (wholesale) supplies 3.36% of its output to sector 101 (food). The same coefficient also means that sector 101 (food) uses 3.36% of input from sector 201 (textile).
3) Sector 102 (textile) and 103 (garment) have the same coefficients because the original input-output table considered these two sectors as only one sector (textile and garment). Sector 201 (wholesale) and 202 (retail) which is categorized as trade in the original input-output table also has the same coefficients. Sector 402 (transport) and 403 (IT) is grouped together as transportation and telecommunication in original input-output table. Therefore, they are assumed to have the same coefficients. There are no coefficients for sector 302 (tour services) in the original input-output table. Therefore, it takes the coefficients from sector 404 (other services). Sector 101 (food), 105 (plastic and rubber), 109 (other manufacturing), 301 (hotel and restaurant), 401 (construction) have their own coefficients.

Source: Oum (2008)

3.4 Using Total Factor Productivity to Estimate Productivity Spillovers from FDI

3.4.1 Specification for Total Factor Productivity Model

To further check robustness of the analysis in the previous section, productivity spillover from FDI is also estimated using total factor productivity (TFP). Following Pavcnik (2002), the below specification to assess the productivity spillover of FDI on TFP is used.

$$lnTFP_{ijt} = \gamma_0 + \gamma_1 FDI_{jt} + \gamma_2 FDI_{jt} * AC_{ijt} + \gamma_3 AC_{ijt} + \gamma_4 FDI_{jt} * TFPGap_{ijt} + \gamma_5 TFPGap_{ijt} + a_i + d_t + \varepsilon_{ijt} \quad (11)$$

where $TFPGap$ is technology gap based on TFP, which will be introduced in Section 3.4.3. a_i and d_t are dummies of sectors and time, respectively. ε_{ijt} is the error term.

Similarly to Schoar (2002) and Blalock and Gertler (2009), I use a method developed by Levinsohn and Petrin (2003) to calculate TFP.

$$TFP_{ijt} = exp\left(lnY_{ijt} - \hat{\beta}_1 lnK_{ijt} - \hat{\beta}_2 lnL_{ijt} - \hat{\beta}_3 lnM_{it} - \hat{\beta}_4 lnE_{ijt}\right) \quad (12)$$

$\hat{\beta}_i$ is the estimate of β_i of the following production function.

$$lnY_{ijt} = \beta_0 + \beta_1 lnK_{ijt} + \beta_2 lnL_{ijt} + \beta_3 lnM_{it} + \beta_4 lnE_{ijt} + \omega_{ijt} + \eta_{ijt} \quad (13)$$

ω_{ijt} is productivity shock observed by the firms but not by econometrician, and η_{ijt} is error term.

3.4.2 Detailed Estimation Methods and Calculation of TFP

For the calculation of TFP, I use the method proposed by Levinsohn and Petrin (2003) which uses intermediate input as an instrument to estimate production function. The estimation is based on the assumptions that firms adjust input usage across time according to the change in productivity. There is an alternative method proposed by Olley and Pakes (1996). It is similar to that of Levinsohn and Petrin (2003), but it uses investment as an instrument. However, Olley and Pakes (1996) control for survival and use unbalanced panel data, which is not suitable for the

balanced panel data used in this paper. Moreover, data on investment are not available. Recently, Ackerberg, Caves, and Frazer (2006) have suggested the use of dynamic estimation structure for production parameters, but the estimation requires a long lag-length, which is impossible for two-year panel data in this study. Due to the limited availability of data and the absence of data on investment, this study uses the method developed by Levinsohn and Petrin (2003).

To simplify the notation, equation (13) is rewritten as

$$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + \beta_m m_t + \omega_t + \eta_t \qquad (14)$$

where y_t, l_t, k_t ,and m_t are the logarithm of Y_t, L_t, K_t ,and M_t, respectively. For simplicity of explanation, E_t is omitted and subscripts for firms and sectors are omitted. The error has two components: the transmitted productivity component (ω_t) and the error term which is uncorrelated with the input's choice (η_t). ω_t is not observed by econometricians and affects firm's decision of input, which leads to the simultaneity problem in estimating the production function. Ignoring this problem will yield inconsistent estimates. Firm's demand for intermediate input m_t is assumed to depend on k_t and ω_t:

$$m_t = m_t(k_t, \omega_t) \qquad (15)$$

The assumption that the demand function (15) monotonically increases in ω_t allows the inversion of this function. Hence, ω_t can be written as a function of k_t and m_t.

$$\omega_t = \omega_t(k_t, m_t) \qquad (16)$$

That ω_t can now be expressed as a function of observed variables k_t and m_t enables us to rewrite equation (14) as below:

$$y_t = \beta_l l_t + \phi_t(k_t, m_t) + \eta_t \qquad (17)$$

where $\phi_t(k_t, m_t) = \beta_0 + \beta_k k_t + \beta_m m_t + \omega_t(k_t, m_t)$.

Estimation of $\hat{\beta}_l$ proceeds by using OLS with a third-order polynomial approximation in k_t and m_t in place of $\phi_t(k_t, m_t)$. For any candidate of the first step estimates of β_k^* and β_m^*, we can estimate $\widehat{\omega}_t$ as

$$\widehat{\omega}_t = \hat{\phi}_t - \beta_k^* k_t - \beta_m^* m_t \quad \text{where } \hat{\phi}_t = y_t - \hat{\beta}_l l_t$$

If we assume that ω_t follows the first order Makovian process, then we get:

$$E[\widehat{\omega_t|\omega_{t-1}}] = \gamma_0 + \gamma_1 \omega_{t-1} \qquad (18)$$

Now, the original equation (13) can be re-written as:

$$y_t - \beta_l l_t = \beta_0 + \beta_k k_t + \beta_m m_t + E[\widehat{\omega_t|\omega_{t-1}}] + (\eta_t + \xi_t) \qquad (19)$$

where $\xi_t = \omega_t - E[\widehat{\omega_t|\omega_{t-1}}]$.

The residual in equation (19) can be computed as

$$\widehat{\eta_t + \xi_t} = y_t - \widehat{\beta}_l l_t - \beta_k^* k_t - \beta_m^* l_t - E[\widehat{\omega_t|\omega_{t-1}}] \qquad (20)$$

In order to estimate β_k and β_m, Levinsohn and Petrin (2003) use these two moment conditions.

$$E[(\eta_t + \xi_t)|k_t] = 0 \text{ and } E[(\eta_t + \xi_t)|m_{t-1}] = 0 \qquad (21)$$

Therefore, there are two instruments (k_t, m_{t-1}) for the estimation of β_k and β_m. Over-identification moments are given by$E[(\eta_t + \xi_t)|l_{t-1}] = 0 \; and \; E[(\eta_t + \xi_t)|k_{t-1}] = 0$. These can be used to improve efficiency and test specification in the Generalized Method of Moments (GMM). The standard error is estimated using bootstrap method.

$$\min_{(\beta_k^*, \beta_m^*)} \sum_h \left[\sum_t (\widehat{\eta_t + \xi_t}) \boldsymbol{Z}_{ht} \right]^2 \; where \; \boldsymbol{Z_t} \equiv (k_t, m_{t-1}, l_{t-1}, k_{t-1}) \quad (22)$$

3.4.3 Calculation of Technology Gap Using TFP

To calculate the TFP gap, a formula similar to equation (9) is used.

$$TFPGap_{ij} = \frac{TFP_j^* - Mean(TFP_{ijt})}{TFP_j^*} \quad (23)$$

where $Mean(TFP_{ijt}) = \frac{(TFP_{ij\,2005} + TFP_{ij\,2006})}{2}$. TFP_j^* is the mean of $Mean(TFP_{ijt})$ of all foreign firms i in sector j. Positive technology gap means the firm's productivity is below that of foreign firms. A negative technology gap means the opposite.

Table 3-9 Comparing Technology Gap Using TFP and Labor Productivity

Name of Sector	Number of Firms (domestic and foreign)	TFP Gap	Labor Productivity Gap
Foods	9	-0.77	0.53
Textile	6	0.16	0.13
Garments	73	0.02	-0.01
Plastics and Rubber	5	-1.42	0.12
Other Manufacturing	14	0.44	0.45
Wholesale (include export service)	29	0.01	0.00
Retail	61	0.23	0.66
Hotels and Restaurants	103	-0.99	0.38
Other services (travel agencies, tour)	20	0.10	0.49
Construction	9	0.23	-0.33
Transport	21	0.34	0.50
IT	5	-0.16	-0.93
Others	61	-1.46	0.29

Table 3-9 presents that the technology gap calculated by using labor productivity and TFP. Column 3 shows the results of the technology gap measured by TFP while column 4 shows the results of the technology gap measured by labor productivity. By comparing them, we find that TFP gap resulted in more sectors having higher technology than labor productivity gap. Using TFP, firms in food, plastic, hotel and restaurants, and IT sectors tend to have the higher gap than their

foreign competitors. However, using labor productivity, firms in garments, construction and IT sectors have the negative gap.

3.4.4 Estimation Results

Similarly to the case of using labor productivity gap in the previous section, TFP Gap is insignificantly correlated with both proxies of absorptive capacity (See Table 3-10).

Table 3-10 Correlation among Proxies of Absorptive Capacity and TFP Gap

	Training (TR)	Human Capital (H)	TFP Gap (TFPGap)
Training (TR)	1.00		
Human Capital (H)	0.02	1.00	
TFP Gap (TFPGap)	-0.05	-0.09	1.00

The estimation results for equation (11) for the interaction terms between the technology gap and absorptive capacity and FDI, as well as the Husman test are presented in Tables 3-11, 3-12 and 3-13, with asymptotic standard errors in parentheses and bootstrap standard errors in square brackets. The Hausman tests strongly reject the null hypothesis that random effect model is as efficient as the fixed effect model. Therefore, the FE is preferred to RE method as before. We found similar results to the previous ones based on labor productivity: only the interaction term with the technology gap is statistically significant.

Table 3-11 Effect of FDI on TFP

Horizontal FDI				Backward FDI				Forward FDI			
Independent Variables	ln(TFP)			Independent Variables	ln(TFP)			Independent Variables	ln(TFP)		
	OLS	RE	FE		OLS	RE	FE		OLS	RE	FE
Constant	5.59 (0.64)*** [0.66]***	4.27 (0.34)*** [0.37]***	4.70 (0.10)*** [0.12]***	Constant	5.49 (0.37)*** [0.35]***	4.31 (0.27)*** [0.25]***	4.68 (0.09)*** [0.11]***	Constant	6.85 (1.92)*** [1.64]***	4.27 (0.26)*** [0.19]***	5.08 (0.38)*** [0.39]***
HFDI	0.35 (0.93) [0.89]	0.77 (0.62) [0.82]	-1.39 (1.02) [1.11]	BFDI	2.04 (2.11) [2.16]	2.16 (1.17)* [1.62]	-3.10 (2.53) [2.90]	FFDI	-5.61 (8.10) [6.68]	1.50 (0.70)** [0.68]**	-14.29 (8.90) [9.85]
H	0.33 (0.29) [0.29]	0.14 (0.37) [0.36]		H	0.33 (0.21) [0.20]	0.13 (0.29) [0.25]		H	0.32 (0.20) [0.19]*	0.07 (0.29) [0.19]	
TR	-0.04 (0.16) [0.12]	0.07 (0.19) [0.16]		TR	0.05 (0.12) [0.10]	0.12 (0.17) [0.15]		TR	0.07 (0.10) [0.09]	0.18 (0.16) [0.14]	
TFPGap	-0.21 (0.02)*** [0.11]*	-0.16 (0.01)*** [0.05]***		TFPGap	-0.22 (0.01)*** [0.07]***	-0.16 (0.01)*** [0.06]**		TFPGap	-0.11 (0.01)*** [0.04]**	-0.13 (0.01)*** [0.05]**	
H*HFDI	-0.43 (0.66) [0.73]	-0.83 (0.70) [0.86]	1.24 (1.15) [1.17]	H*BFDI	-1.87 (1.32) [1.53]	-2.62 (1.28) [1.67]	2.70 (2.80) [3.01]	H*FFDI	-0.58 (0.62) [0.47]	-0.55 (0.86) [0.84]	12.04 (10.28) [11.22]
TR*HFDI	0.38 (0.43) [0.35]	0.37 (0.41) [0.34]	0.41 (0.54) [0.44]	TR*BFDI	0.20 (0.72) [0.63]	0.41 (0.81) [0.73]	0.95 (1.28) [1.07]	TR*FFDI	-0.29 (0.46) [0.31]	-0.37 (0.67) [0.74]	3.21 (5.75) [4.47]
TFPGap* HFDI	0.21 (0.04)*** [0.33]	0.08 (0.02)*** [0.08]	0.07 (0.02)*** [0.03]**	TFPGap* BFDI	0.54 (0.10)*** [0.42]	0.19 (0.04)*** [0.11]*	0.17 (0.05)*** [0.08]*	TGap* FFDI	-0.82 (0.25)*** [0.69]	0.11 (0.20) [0.78]	0.83 (0.25)*** [0.47]*
R^2	0.44		0.06	R^2	0.45		0.06	R^2	0.43		0.06
N	568	568	568	*N*	568	568	568	*N*	568	568	568
Hausman test of RE against FE				Hausman test of RE against FE				Hausman test of RE against FE			
Chi-square Boot		13.53		Chi-square Boot		16.64		Chi-square Boot		28.01	
P-value Boot		0.09		P-value Boot		0.03		P-value Boot		0.00	
Chi-quare		20.32		Chi-square		48.60		Chi-square		34.84	
P-value		0.00		P-value		0.00		P-value		0.00	

Note: 1) In OLS sectors and time dummies are included while in RE and FE time dummy and firm fixed effect are taken into account.

2) * p<0.10; **p<0.05;***p<0.01. 3) ( ): asymptotic standard errors, [ ]: bootstrap standard errors.

Table 3-12 Effect of FDI on TFP (H and TR Used in TFP Calculation)

Horizontal FDI				Backward FDI				Forward FDI			
Independent Variables	ln(TFP)			Independent Variables	ln(TFP)			Independent Variables	ln(TFP)		
	OLS	RE	FE		OLS	RE	FE		OLS	RE	FE
Constant	5.25 (0.55)*** [0.60]***	3.90 (0.10)*** [0.09]***	4.19 (0.10)*** [0.12]***	Constant	5.21 (0.32)*** [0.27]***	3.96 (0.08)*** [0.06]***	4.17 (0.09)*** [0.11]***	Constant	6.53 (1.81)*** [1.61]***	3.90 (0.08)*** [0.06]***	4.60 (0.37)*** [0.39]***
HFDI	0.62 (0.76) [0.69]	1.17 (0.41)*** [0.49]**	-1.40 (1.02) [1.03]	BFDI	2.50 (1.87) [1.78]	2.81 (0.94)*** [1.24]**	-3.11 (2.53) [2.66]	FFDI	-5.78 (7.64) [6.45]	1.86 (0.57)*** [0.56]***	-14.76 (8.89) [9.62]
TFPGap	-0.27 (0.02)*** [0.12]**	-0.21 (0.01)*** [0.05]***		TFPGap	-0.27 (0.02)*** [0.07]***	-0.20 (0.01)*** [0.05]***		TFPGap	-0.14 (0.01)*** [0.04]***	-0.17 (0.01)*** [0.05]***	
H*HFDI	-0.63 (0.38)* [0.39]	-1.27 (0.45)*** [0.50]**	1.23 (1.14) [1.10]	H*BFDI	-2.42 (1.00)* [1.08]**	-3.37 (1.02)*** [1.29]**	2.67 (2.80) [2.79]	H*FFDI	-0.48 (0.51) [0.35]	-0.98 (0.72) [0.76]	12.36 (10.26) [11.05]
TR*HFDI	0.02 (0.24) [0.26]	0.29 (0.29) [0.27]	0.42 (0.54) [0.43]	TR*BFDI	-0.14 (0.53) [0.52]	0.30 (0.66) [0.64]	0.98 (1.28) [1.04]	TR*FFDI	-0.25 (0.40) [0.32]	-0.26 (0.58) [0.63]	3.20 (5.74) [4.38]
TFPGap* HFDI	0.24 (0.05)*** [0.37]	0.10 (0.02)*** [0.10]	0.09 (0.02)*** [0.04]*	TFPGap* BFDI	0.64 (0.11)*** [0.49]	0.25 (0.06)*** [0.15]	0.21 (0.06)*** [0.11]*	TFPGap* FFDI	-1.09 (0.26)*** [0.61]*	-0.11 (0.25) [0.91]	1.05 (0.32)*** [0.61]*
R^2	0.47		0.06	R^2	0.48		0.06	R^2	0.47		0.06
N	568	568	568	*N*	568	568	568	*N*	568	568	568
Hausman test of RE against FE				Hausman test of RE against FE				Hausman test of RE against FE			
Chi-square Boot		14.78		Chi-square Boot		14.01		Chi-square Boot		21.31	
P-value Boot		0.02		P-value Boot		0.02		P-value Boot		0.00	
Chi-square		18.14		Chi-square		32.54		Chi-square		40.47	
P-value		0.00		P-value		0.00		P-value		0.00	

Note:

1) In OLS sectors and time dummies are included while in RE and FE time dummy and firm fixed effect are taken into account.
2) * p<0.10; **p<0.05;***p<0.01
3) ( ): asymptotic standard errors, [ ]: bootstrap standard errors.

Table 3-13 Effect of FDI on TFP with H*FDI and TR*FDI Dropped (H and TR Used in TFP Calculation)

Horizontal FDI				Backward FDI				Forward FDI			
Independent Variables	Log(TFP)			Independent Variables	Log(TFP)			Independent Variables	Log(TFP)		
	OLS	RE	FE		OLS	RE	FE		OLS	RE	FE
Constant	5.35 (0.55)*** [0.58]***	3.88 (0.10)*** [0.10]***	4.16 (0.09)*** [0.11]***	Constant	5.27 (0.32)*** [0.26]***	3.93 (0.08)*** [0.07]***	4.15 (0.08)*** [0.10]***	Constant	6.57 (1.81)*** [1.64]***	3.88 (0.07)*** [0.07]***	4.46 (0.33)*** [0.27]***
HFDI	0.09 (0.69) [0.61]	0.37 (0.20)* [0.21]*	-0.16 (0.28) [0.19]	BFDI	0.31 (1.64) [1.46]	0.63 (0.39) [0.38]*	-0.39 (0.67) [0.46]	FFDI	-6.33 (7.62) [6.62]	1.17 (0.30)*** [0.46]**	-3.51 (3.09) [2.16]
TFPGap	-0.27 (0.02)*** [0.12]**	-0.21 (0.01)*** [0.05]***		TFPGap	-0.27 (0.02)*** [0.07]***	-0.20 (0.01)*** [0.05]***		TFPGap	-0.14 (0.01)*** [0.04]***	-0.16 (0.01)*** [0.05]***	
TFPGap* HFDI	0.24 (0.05)*** [0.37]	0.10 (0.02)*** [0.11]	0.09 (0.02)*** [0.05]*	TFPGap* BFDI	0.63 (0.11)*** [0.51]	0.26 (0.06)*** [0.16]	0.20 (0.06)*** [0.12]*	TGap* FFDI	-1.12 (0.26)*** [0.58]*	-0.14 (0.25) [0.90]	0.97 (0.31)*** [0.62]
R^2	0.47		0.05	R^2	0.48		0.05	R^2	0.47		0.05
N	568	568	568	*N*	568	568	568	*N*	568	568	568
Hausman test of RE against FE				Hausman test of RE against FE				Hausman test of RE gainst FE			
Chi-square Boot		20.34		Chi-square Boot		19.78		Chi-square Boot		15.85	
P-value Boot		0.00		P-value Boot		0.00		P-value Boot		0.00	
Chi-square		16.13		Chi-square		20.60		Chi-square		40.90	
P-value		0.00		P-value		0.00		P-value		0.00	

Note:

1) In OLS sectors and time dummies are included while in RE and FE time dummy and firm fixed effect are taken into account.
2) * p<0.10; **p<0.05;***p<0.01
3) ( ): asymptotic standard errors, [ ]: bootstrap standard errors.

Table 3-11, which provides a basic result, shows that the interaction term of horizontal FDI (HFDI), backward FDI (BFDI) and forward FDI (FFDI) with technology gap (TFPGap) are still statistically significant at 10% significance level. The interaction terms of FDI with human capital and those of FDI with training dummy are not statistically significant.

Results in Table 3-12 are obtained by including human capital H and the training dummy TR in estimating equation (13). Table 3-12 shows that the interaction terms of horizontal FDI, backward FDI, and forward FDI with the technology gap are still statistically significant at 10% significance level. The interaction terms of FDI with H and TR are statistically insignificant.

Results in Table 3-13 are obtained by dropping the interaction terms of FDI with human capital and training dummy variables from the estimation equation. The results shows that for horizontal FDI and backward FDI, the interaction terms with technology gap are statically significant at 10% level, but for forward FDI, the interaction term becomes statistically insignificant.

3.5 Conclusions and Implications

This chapter aims at studying the effects of horizontal and vertical productivity spillover from FDI to domestic firms. By using the data of 416 firms in the enterprise survey of the World Bank conducted in 2006 and regression analysis of the random effect and fixed effect models, the study lends support to findings of existing studies on the effects of the technology gap on productivity spillover. The estimation results show that FDI leads to productivity spillover only under the condition of a positive technology gap. Only a few existing studies examine this effect in the contexts of both horizontal and vertical FDI. This study finds the technology gap has positive

effects on productivity spillover from horizontal and vertical FDI to domestic firms. This finding adds more evidence to a scarce literature on the effect of the technology gap in the context of vertical FDI. On the other hand, this study could not find the significant effect of education and training on productivity spillover.

The finding on the effect of the technology gap provides a significant policy implication for the Cambodian government. Similarly to most developing countries, domestic firms in Cambodia still have a technology gap when compared to foreign competitors. The gap indicates the need for domestic firms to improve their productivity. In their position as competitors, buyers or suppliers of domestic firms, FDI can help domestic firms directly or indirectly to overcome this technology gap and thus lead to improvement in domestic firms' productivity. Therefore, with the existence of the technology gap, the Cambodian government should aim at policies that attract both horizontal and vertical FDI.

To produce a better estimation result, future research should focus on three things. Firstly, this study estimates the productivity spillover by pooling firms across sectors due to the problem of small sample size. The findings can be enriched by using a large sample, which enables the estimation of production function for each sector separately. Secondly, this paper uses a simple method of fixed effect model to deal with endogeneity issues. One limitation of this method is that it works well only with unobservable variables that are invariant across time. Future studies should therefore, also take care of the unobservable variables that are time-variant. Alternative methods proposed by Blundell and Bond (2000) and Bond (2002) should be used if it is possible[10]. Thirdly, it might be better to investigate alternative forms of production technology because all the

[10] The method of Blundell and Bond (2000) and Bond (2002) needs at least 3-year data so that the lag of level and lag of first difference of dependent variables can be used as instruments to deal with endogenity.

coefficients of capital-labor ratio in Table 3-6 and Table 3-7 are insignificant. Finally, since deflators for each sector are not available, the study uses the overall consumer price index (CPI) to deflate relevant variables. Although deflating with overall CPI may at least give better estimated coefficients than those without deflating, future studies should use deflators for each sector.

Table 3-14 Cambodia Coefficient of Input-Output Table 2008 (Standardized)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1 Paddy	0.0512	0.0049	0.0081	0.0000	0.0000	0.0000	0.4675	0.0000	0.0019	0.0000	0.0000	0.0000	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0077	0.0007	0.0007
2 OthCrops	0.0000	0.0040	0.0000	0.0000	0.0000	0.0000	0.0148	0.0027	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0000	0.0002
3 Livestock	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0464	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4 Forestry	0.0008	0.0040	0.0056	0.0016	0.0012	0.0258	0.0069	0.0003	0.4964	0.0722	0.3118	0.0055	0.0074	0.0000	0.0374	0.0003	0.0001	0.0003	0.0001	0.0328	0.0012	0.0033
5 Fishery	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0272	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6 Mining	0.0004	0.0000	0.0000	0.0000	0.0000	0.0170	0.0001	0.0000	0.0006	0.0130	0.0903	0.0403	0.0009	0.0014	0.0371	0.0000	0.0001	0.0000	0.0000	0.0016	0.0002	0.0000
7 FoodBevTbaco	0.0023	0.0009	0.1502	0.0000	0.0060	0.0000	0.2376	0.0000	0.0000	0.0022	0.0285	0.0000	0.0003	0.0000	0.0000	0.0544	0.0073	0.0544	0.0094	0.1061	0.0297	0.0859
8 TCF	0.0064	0.0121	0.0001	0.0000	0.0004	0.0047	0.0024	0.6457	0.0152	0.1971	0.0063	0.0062	0.0427	0.0545	0.0046	0.0345	0.0150	0.0345	0.0622	0.0808	0.0085	0.0264
9 WoodPaperPrt	0.0002	0.0000	0.0000	0.0000	0.0000	0.0008	0.0016	0.0011	0.0154	0.0056	0.0068	0.0015	0.0010	0.0075	0.0003	0.0010	0.0019	0.0010	0.0190	0.0220	0.0090	0.0035
10 ChemRubPlas	0.1238	0.0358	0.0007	0.0001	0.0174	0.0223	0.0070	0.0056	0.0113	0.1673	0.0237	0.0424	0.0052	0.1627	0.0045	0.0026	0.1304	0.0026	0.0063	0.0316	0.0095	0.0073
11 NonMetlMin	0.0059	0.0009	0.0001	0.0000	0.0002	0.0015	0.0031	0.0001	0.0010	0.0090	0.0424	0.0080	0.0034	0.0056	0.1836	0.0008	0.0010	0.0008	0.0011	0.0168	0.0018	0.0070
12 BasFabMtlPrd	0.0100	0.0045	0.0002	0.0000	0.0001	0.0302	0.0060	0.0007	0.0045	0.0075	0.0294	0.6004	0.0772	0.0414	0.0815	0.0009	0.0028	0.0008	0.0007	0.0176	0.0016	0.0135
13 OthManuf	0.0434	0.0133	0.0008	0.0002	0.0074	0.3282	0.0153	0.0158	0.0450	0.0543	0.0675	0.0443	0.5028	0.3928	0.1024	0.0251	0.3161	0.0251	0.1845	0.1932	0.2405	0.0417
14 ElecGasWater	0.0039	0.0002	0.0001	0.0000	0.0001	0.0048	0.0046	0.0068	0.0050	0.0282	0.0148	0.0362	0.0793	0.0878	0.0006	0.0288	0.0041	0.0288	0.0256	0.0152	0.0146	0.0107
15 Construction	0.0086	0.0014	0.0003	0.0000	0.0000	0.0082	0.0010	0.0005	0.0032	0.0043	0.0059	0.0024	0.0007	0.0452	0.0059	0.0027	0.0023	0.0027	0.0239	0.0151	0.0138	0.0536
16 Trade	0.2108	0.0227	0.0032	0.0001	0.0043	0.0225	0.0336	0.0238	0.0368	0.1452	0.0373	0.0602	0.0304	0.0207	0.0205	0.0044	0.0113	0.0044	0.0296	0.0757	0.0154	0.0691
17 TranspComm	0.0233	0.0183	0.0002	0.0003	0.0018	0.1043	0.0134	0.0110	0.0227	0.0363	0.0814	0.0391	0.0060	0.0275	0.0128	0.0194	0.0461	0.0194	0.0681	0.0376	0.0244	0.0078
18 HotelRest	0.0001	0.0002	0.0000	0.0000	0.0001	0.0002	0.0004	0.0003	0.0004	0.0016	0.0004	0.0007	0.0003	0.0002	0.0002	0.0001	0.0001	0.0000	0.0003	0.0008	0.0002	0.0008
19 Finance	0.0130	0.0067	0.0001	0.0000	0.0006	0.0045	0.0026	0.0020	0.0049	0.0153	0.0059	0.0088	0.0028	0.0326	0.0034	0.0189	0.0087	0.0189	0.0346	0.0215	0.0022	0.0410
20 RealEstBus	0.0483	0.0220	0.0000	0.0000	0.0008	0.0237	0.0024	0.0016	0.0018	0.0082	0.0039	0.0034	0.0015	0.0152	0.0050	0.0118	0.0155	0.0118	0.0521	0.0198	0.0145	0.0044
21 PubAdmin	0.0001	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000	0.0003	0.0001	0.0001	0.0000	0.0018	0.0002	0.0001	0.0001	0.0001	0.0008	0.0013	0.0033	0.0001
22 OtherServ	0.0140	0.0080	0.0000	0.0000	0.0003	0.0030	0.0014	0.0027	0.0016	0.0086	0.0037	0.0039	0.0019	0.0157	0.0034	0.0080	0.0077	0.0080	0.0774	0.0320	0.1317	0.0297
24 DomGoods	0.3781	0.0899	0.1641	0.0020	0.0152	0.2392	0.8431	0.1119	0.5684	0.3547	0.5954	0.4404	0.2194	0.3211	0.2465	0.1542	0.1140	0.1543	0.3193	0.3760	0.2662	0.3104
25 ImpGoods	0.1757	0.0649	0.0050	0.0003	0.0228	0.3352	0.0464	0.6005	0.0764	0.3976	0.1434	0.4404	0.5049	0.5411	0.2438	0.0549	0.4193	0.0549	0.2527	0.3248	0.2302	0.0842
27 TotalGoods	0.5664	0.1599	0.1696	0.0024	0.0405	0.6022	0.8954	0.7209	0.6679	0.7762	0.7600	0.9033	0.7656	0.9127	0.5034	0.2138	0.5706	0.2138	0.5956	0.7298	0.5225	0.4066
29 UnSkLab	0.2643	0.6384	0.5603	0.0634	0.3665	0.1048	0.0295	0.0770	0.0321	0.0423	0.0410	0.0228	0.0471	0.0105	0.1378	0.2164	0.0350	0.2164	0.0288	0.0597	0.0795	0.0606
30 SkLab	0.0008	0.0013	0.0020	0.0002	0.0014	0.0155	0.0057	0.0114	0.0047	0.0099	0.0070	0.0040	0.0080	0.0051	0.0247	0.0455	0.0089	0.0455	0.0222	0.0454	0.1223	0.0436
31 Capital	0.0200	0.0241	0.0323	0.7769	0.2979	0.2157	0.0588	0.1819	0.2795	0.1309	0.1835	0.0681	0.1708	0.0687	0.3214	0.5096	0.3796	0.5096	0.3352	0.1568	0.2756	0.4704
32 Land	0.1457	0.1756	0.2351	0.1194	0.2905	0.0537	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
33 TaxOnDomPrd	0.0027	0.0006	0.0006	0.0377	0.0032	0.0082	0.0106	0.0088	0.0158	0.0369	0.0085	0.0018	0.0084	0.0030	0.0127	0.0154	0.0058	0.0154	0.0182	0.0083	0.0000	0.0188
35 TotalCost	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 3-15 Industry IDs and Variable Names in the I-O Table

ID	Industry
1	Paddy
2	Other Crops
3	Livestock
4	Forestry
5	Fishery
6	Mining
7	Food, Beverage & Tobacco
8	Textile & Garment
9	Wood, Paper & Publishing
10	Chemical, Rubber & Plastic
11	Non Metallic Mineral
12	Basic Metals
13	Other Manufacturing
14	Electricity & Water
15	Construction
16	Trade
17	Transport & Communication
18	Hotel & Restaurants
19	Finance
20	Real Estate & Business
21	Public Administration
22	Other Services

Abbreviation	**Meaning**
Inter	Total Intermediate Goods
DomGoods	Domestic Intermediate Goods Produced
ImpGoods	Imported Intermediate Goods
Fin Dem	Final Demand

Chapter 4: FDI, Industry Linkages and Tariff on Imported Intermediate Goods: A Theoretical Analysis

4.1 Introduction

Foreign Direct Investment (FDI) is seen by many developing countries as a means to promote economic development. FDI can induce growth in the host country by providing both capital and job opportunities. Another benefit of FDI is its role in promoting industrial development in the host country. This happens because FDI is seen not just as traditional capital but as a knowledge capital (Penrose, 1956). Moreover, FDI is believed to bring superior technology to compete with the domestic firms in the host country (Markusen and Venables, 1999). The arrival of FDI thus can bring the possibilities of knowledge and technology spillover to domestic firms in addition to job creation. Empirical evidence also finds that FDI might lead to technology spillover in the host country (Gorg and Greenaway, 2004; Smeets, 2008).

Also, FDI can lead to industrial development because arrival of FDI will provide its linkages with domestic firms through downstream and upstream linkages. When foreign firms purchase intermediate goods from domestic suppliers, this generates backward linkages with domestic suppliers which will provide many benefits to domestic suppliers in the upstream industries such as indirect employment in supplying industries, technology transfer from foreign firms to its suppliers, and entrance of new firms in the supplying industries (Rodriguez-Clare, 1996; Markusen and Venables, 1999; Lin and Saggi, 2007).

Furthermore, the success in some developing countries that enjoy growth through FDI, such as Newly Industrialized Economies (NIEs) (Markusen and Venables,1999), and the evidence on

vertical technology spillover from multinational firms to local suppliers (Javorcik, 2004; Jabbour and Mucchilli, 2007; Bitzer, Geishecker, and Gorg, 2008; Blalock and Gertler, 2008) encourage host governments to provide many incentives to attract FDI. Among the incentives, tariff exemption on imported intermediate goods is relevant in many developing countries. This study aims at analyzing how such a tariff exemption or reduction policy affects the backward linkages in host countries and thus their industrial development.

Although FDI comes with the benefits as mentioned above, this does not mean there is no disadvantages to host countries. Markusen and Venables (1999) mentioned that the arrival of multinational firms may bring crowding-out of the domestic firms. Some empirical evidence on the crowding-out effect on domestic firms caused by the competition between domestic and foreign firms supported this proposition (Aitken and Harrison, 1999). Furthermore, competition between domestic and multinational firms may also displace the existing backward linkages of domestic firms. This is likely to be the case if domestic firms purchase intermediate goods from domestic suppliers (Lin and Saggi, 2007).

There are only few theoretical economic models on the impact of FDI on industry linkages in the host countries. Lin and Saggi (2007) address the issues of how competition between domestic and foreign firms affects the backward linkages in the host country. However, their model is limited on two aspects: (1) foreign firms purchase the intermediate goods in the host country only (2) there is no role of tariff on intermediate goods. This chapter will try to extend their model by incorporating these two aspects. The reason is that for many multinational firms some intermediate goods have to be purchased in the host country and others have to be imported for their production process. Furthermore, tariff reduction on imported intermediate goods is

widely used policies to attract FDI in many developing countries. Incorporating such a policy instrument in the model will give more policy implications for economic development in many developing countries. It is believed that these extensions can help explain more about the effect of FDI on industrial development in host countries.

In order to explain the effect of competition in downstream industries and tariff reduction on imported intermediate goods on backward industry linkages in the host countries, this study will develop a model that allows the oligopolistic competition by comparing the scenario before multinational firm's entry with the scenario after opening the country for multinational firms.

In Cambodia, the government has provided several incentives to attract FDI. Among those incentives, tariff reduction and exemption on imported intermediate goods is considered to play an important role in attracting FDI to Cambodia, especially in the garment sectors. Moreover, the government is also encouraging domestic firms, particularly small and medium-size enterprises (SMEs). One important strategy for Cambodia is to build the linkages for domestic SMEs with large firms. Domestic firms can play the role as suppliers for large firms. Such kind of linkages could help encourage domestic suppliers and enhance their productivity.

Incentives of reducing the tariff on imported intermediate goods could attract FDI, but it also impacts the industry linkages in other ways because it encourages firms with FDI to import intermediate goods rather than sourcing from domestic suppliers. The situation would be worse if the arrival of FDI has a crowding-out effect on domestic firms in the downstream sector that are buying intermediate goods from domestic suppliers.

Therefore, we need to find out whether tariff reduction on imported intermediate goods does not reduce the existing industry linkages. This type of analysis can give policy implications

that could firstly support the existing domestic industry linkages by promoting SMEs' growth, and secondly attract more FDI to Cambodia to generate more jobs and more transfer of technology.

4.2 Model

4.2.1 Basic Assumption

Consumer's preference in the domestic economy is assumed to be quasi-linear over two goods x and y. The consumer's utility can be written as $U(x, y) = u(x) + y$. Goods y serves as a numeraire, and it is produced under perfect competition using constant returns to scale technology, which requires only labor as an input. Wage rate in the host economy in terms of numeraire goods is assumed to be 1.

There are n local (or domestic) firms and one foreign (or multinational) firm that produce goods x. The multinational and local firms choose the output level in a Cournot fashion, in which each firm chooses output by taking as given the output level of its rivals.

To produce one unit of x, the foreign firm needs λ_f units of labor and μ_f units of intermediate goods z. The corresponding units for local firms are λ_h and μ_h $(h = 1, \dots, n)$. For the convenience, μ_h is normalized to one. Furthermore, it is assumed that $\lambda_h \geq \lambda_f$ and $\mu_h = 1 \geq \mu_f$. This assumption implies the superior technology of the foreign firm in two aspects. The foreign firms requires fewer workers and fewer units of intermediate goods z to produce one unit of goods x.

As in Markusen and Venables (1999) and Lin and Saggi (2007), if $\mu_f < \frac{\lambda_f}{\lambda_h}$ then the multinational firm is less intensive user of intermeidate goods than the domestic firms. Moreover, it is assumed that producing one unit of intermediate goods z requires θ units of labor. Unlike Lin and Saggi (2007), this study allows foreign firm to import intermediates goods z from abroad. The

goods z can be imported from home country of the foreign firm or the rest of the world. Moreover, imported intermediate goods z are subjected to tariff t. The marginal cost of each firm can be rewritten as:

$$c_i^j = \lambda_i^j + \mu_i^j \omega_i \quad (i = h, f) \qquad (1)$$

where $j = A$ (Autarky) represents the case without FDI and $j = F$ (FDI) represents the case with FDI. The price ω_i of intermediate goods z is equal to ω_h for domestic firms and is equal to $\omega_f = \omega_h + t$ for the multinational firm.

Let $p(Q)$ is the inverse demand function for goods x. Q is total consumption of goods x and p denotes its price. Let q_i denotes the output produced by firm $(i = h, f)$. Given the demand function, firm i's profit function under regime $j(= A, F)$ is given by

$$\pi_i^j(q_i, q_{-i}) = [p(Q) - c_i^j]q_i \qquad (2)$$

For simplicity, the inverse demand function is assumed to have a linear form:

$$p(Q) = \alpha - Q \qquad (3)$$

where α denotes home market size. In order to study how the arrival of the multinational firm affects the backward industry linkages in the host country, we first discuss the case of closed economy without any trade. This case is contrasted by the open economy case, under which there is trade in intermediate goods and the multinational is willing to invest in the host country.

4.2.2 The Case of Autarky (before the Multinational Firm's Entry)

This case means there is no trade in intermediate goods and no multinational firms, thus $q_f = 0$. Taking the price ω_h of intermediate goods as given, a typical domestic firm h chooses its output q_i to maximize its profit.

$$\max_{q_i} \ [p(Q) - c_i^A]q_i^A \qquad (4)$$

For simplicity, omitting the superscript and substituting (1) into (4), we have

$$\pi_i = [p(Q) - \lambda_h - \mu_h \omega_h]q_i \qquad (5)$$

Given $\mu_h = 1$, the first order condition for profit maximization is:

$$\frac{\partial \pi}{\partial q_i} = p(Q) + p'q_i - \lambda_h - \omega_h = 0 \qquad (6)$$

where λ_h and ω_h are common to all firms. Using the linear demand function (3), the optimal output for firm i is:

$$q_i = \frac{[\alpha - \lambda_h - \omega_h]}{(n+1)} \qquad (7)$$

When $\mu_h = 1$, firm i needs $q_i$units of intermediate goods to produce q_i units of goods x. Therefore, equation (7) can also be regarded as the demand function for intermediate goods.

Summing equation (7) over all domestic firms, the market demand function for intermediate goods can be written as

$$\omega_h = \alpha - \lambda_h - \frac{(n+1)}{n}Q \qquad (8)$$

Facing the above market demand function, suppliers of the intermediate goods choose the quantities in Cournot fashion. Again noting that q_k also represents the amount to be produced of intermediate inputs by firm k, the supplier k of intermediate goods maximizes the following profit.

$$\max_{q_k} \quad \pi_k = (\omega_h - \theta)q_k \qquad (k = 1 \ldots m) \qquad (9)$$

Solving the first-order condition, a typical supplier produces the following output:

$$q_k = \frac{n[\alpha - \lambda_h - \theta]}{(n+1)(m+1)} \qquad (10)$$

Since there are totally m local suppliers, the total supplies of intermediate goods, which is the industry backward linkages (BL) equals

$$BL^A = \mu_h m q_k = \frac{nm\mu_h[\alpha - \lambda_h - \theta]}{(n+1)(m+1)}, \ \ \mu_h = 1 \qquad (11)$$

Remark: The degree of backward linkages before the entry of a multinational firm increases in home market size (α) but decreases in unit of the labor requirements to produce intermediate goods (θ). It also decreases in the labor unit requirement to produce final goods (λ_h).

4.2.3 The Case of Open Economy (after the Multinational Firm's Entry)

To simplify the analysis, let $m = n = 1$. In this case, the backward linkages in the autarky case can be written as:

$$BL^A = \mu_h q_k = \frac{\mu_h(\alpha - \lambda_h - \theta)}{4}, \quad \mu_h = 1 \qquad (12)$$

Entry of the multinational firm leads to oligopolistic competition between domestic and foreign firms. Each type of firm will try to maximize its profits. The first-order condition for the domestic firm is:

$$\frac{\partial \pi_h}{\partial q_h} = p(Q) + p'q_h - \lambda_h - \mu_h \omega_h = 0 \qquad (13)$$

The first order condition for the foreign firm is:

$$\frac{\partial \pi_f}{\partial q_f} = p(Q) + p'q_f - \lambda_f - \mu_f(\omega_h + t) = 0 \qquad (14)$$

The equilibrium solution for both firms can be obtained by solving the system of equation (13) and (14) with the following solution:

$$q_h = \frac{\alpha - 2\lambda_h - 2\mu_h\omega_h + \lambda_f + \mu_f(\omega_h + t)}{3} \qquad (15)$$

$$q_f = \frac{\alpha - 2\lambda_f - 2\mu_f(\omega_h + t) + \lambda_h + \mu_h\omega_h}{3} \qquad (16)$$

The total demand for intermediate goods is the sum of the demand by both types of firms in the final goods industry.

$$q_s = \mu_h q_h + \mu_f q_f \qquad (17)$$

The monopolist supplier of intermediate goods will maximize its profit subjected to (17):

$$\max_{\omega_h} \pi_s(\omega_h) = (\omega_h - \theta)q_s \qquad (18)$$

The first-order condition for the intermediate goods supplier is:

$$\frac{\partial \pi_s}{\partial \omega_h} = \mu_h q_h + \mu_f q_f + (\omega_h - \theta)\left[\mu_h \frac{\partial q_h}{\partial \omega_h} + \mu_f \frac{\partial q_f}{\partial \omega_h}\right] = 0 \qquad (19)$$

By using (15) and (16) with the assumptions $\lambda_h = \lambda_f = 0$ to simplify the expression, the optimal intermediate price set by supplier is:

$$\omega_h = \frac{\alpha(\mu_h + \mu_f) + (\mu_h - 2\mu_f)\mu_f t}{4(\mu_h^2 - \mu_h\mu_f + \mu_f^2)} + \frac{\theta}{2} \qquad (20)$$

The backward linkages in the presence of FDI can be expressed as:

$$BL^F = \mu_h q_h + \mu_f q_f \qquad (21)$$

By substituting (20) into (15) and (16), we can rewrite (21) as:

$$BL^F = \frac{\alpha(\mu_h + \mu_f) + (\mu_h - 2\mu_f)\mu_f t - 2\theta(\mu_h^2 - \mu_h\mu_f + \mu_f^2)}{6} \qquad (22)$$

The effect of the multinational's entry on the backward industry linkages is non-negative if and only if

$$BL^F - BL^A \geq 0 \qquad (23)$$

By substituting (12) and (22) into (23), we obtain:

$$BL^F - BL^A = \frac{\alpha(2\mu_f - \mu_h)}{12} - \frac{(2\mu_f - \mu_h)\mu_f t}{6} + \frac{\theta\{3\mu_h - 4(\mu_h^2 - \mu_h\mu_f + \mu_f^2)\}}{12} \quad (24)$$

$$BL^F - BL^A = \frac{(2\mu_f - \mu_h)(\alpha - 2\mu_f t)}{12} + \frac{\theta\{3\mu_h - 4(\mu_h^2 - \mu_h\mu_f + \mu_f^2)\}}{12} \quad (25)$$

4.3 Effect of Tariff on Imported Intermediate Goods on Backward Industry Linkages

By using expression (25) we can determine the effect of tariff on the backward linkages. This effect can be derived by differentiating both sides of equation (25) with respect to t.

$$\frac{\partial(BL^F - BL^A)}{\partial t} = -\frac{(2\mu_f - \mu_h)\mu_f t}{6} \quad (26)$$

Equation (26) shows that the sign of this effect depends on the term $(2\mu_f - \mu_h)$. Therefore we obtain the following proposition.

Proposition 1: *Higher tariff on imported intermediate goods has a positive effect on the backward linkages if the technological gap between the domestic and foreign firms is large enough.*

To consider the meaning of Proposition 1 in more details, we examine two cases. The first is the case where the technology gap between domestic and foreign firms is large. The second is the case where the technology gap is small.

(1) The case of large technology gap: $\mu_h - 2\mu_f > 0$ *or* $\mu_f < 2\mu_f < \mu_h$

When the technology gap between domestic and foreign firms is large, the crowding-out effect of the foreign firm's entry is high. When the tariff on imported intermediate goods is lowered, the foreign firm will occupy a bigger share in the market for goods x because it is able to increase the amount of output q_f as the cost of intermediate goods becomes lower.

As a result of the increase in q_f , domestic firms will lose their share in the market for goods x. Although the total market demand for goods x is not changed, the replacement of q_h with q_f will lower the industrial linkages because the foreign firm uses less intermediate goods μ_f to

produce one unit of final goods. As a result, the domestic industrial linkages will be lowered. This explanation reveals that lower tariff has a negative impact on domestic industry linkages.

The situation is reversed if higher tariff is imposed on imported intermediate goods. Higher tariff on imported intermediate goods will reduce q_f and increase q_h . The higher tariff plays the role of minimizing the crowding-out effect. The higher the tariff, the smaller share of domestic firms in the final goods market will be lost to the foreign firm. In other words, higher tariff on imported intermediate goods can help minimize the negative impact of competition between domestic and foreign firms in final goods market on domestic industry linkages in the host country.

In developing countries, the technology gap between domestic and foreign firms is often large. In this case, the crowding-out effect can be much stronger because the host government receiving FDI in downstream industries tends to reduce the tariff on imported intermediate goods.

(2) The case of small technology gap: $\mu_h - 2\mu_f < 0$ *or* $\mu_f < \mu_h < 2\mu_f$

When the technology gap between domestic and foreign firms is small, there is no crowding-out effect but rather there is an opposite effect on domestic firms. If the tariff on intermediate goods is lowered, the foreign firm might want to increase its output q_f . However, this output increase might be smaller because domestic firms have the ability to compete with the foreign firm. Because they use larger units of intermediate goods to produce final goods, the domestic industrial linkages in the host country will increase. This explanation reveals that lower tariff increases domestic industrial linkages in the host country. Similar discussion applies to the case when tariff is raised.

4.4 Conclusion and Policy Implication

The model in this chapter studies effects of tariff on imported intermediate goods on the backward industry linkages in the host country. We have derived conditions under which higher tariff on imported intermediate goods has a positive or a negative effect on industry linkages in the host country.

In the least-developed and developing counties, domestic firms tend to have the lower level of technology than that of foreign firms. The governments in those countries tend to give less attention to competition between domestic and foreign firms. However, tariff reduction on imported intermediate goods does have effects on competition in the industries.

The main implication of the theoretical analysis is that when the crowding-out effect is remarkable (i.e., when the technology gap between foreign and domestic firms is large), the host government should increase tariff on intermediate goods to mitigate the crowding-out effect. On the other hand, when no crowding-out effect is found (i.e., when the technology gap is small), the government can reduce the tariff on intermediate goods to increase the backward industry linkages.

For the case of Cambodia, there seems to be no evidence of crowding-out of domestic firms so far. Consequently, reduction in tariff on intermediate goods is expected to increase the backward industry linkages to benefit the country. Nonetheless, this relation could be changed over time because domestic firms are catching up with foreign firms by taking advantage of FDI to Cambodia. Also, the enhancement of human capital by providing more education and training could help domestic firms not only imitate or learn new technologies brought by FDI but also reduce the technology gap to enhance the domestic industry linkages.

There are some limitations on this study. First, the model can be extended to the case where foreign suppliers exist in the intermediate goods market. Second, the domestic firm may also import intermediate goods. Third, there is also the case where the foreign firm is vertically integrated with domestic suppliers, which might reduce the role of tariff on intermediate goods. Fourth, although the model can allow for the crowing-out effect in the downstream sector, it cannot fully capture the technology spillover from the foreign firm because the input coefficient is assumed to be exogenous. Finally, an empirical analysis using tariff data is needed to add more evidence.

Chapter 5: Concluding Remarks

Investment is needed to promote economic growth in a country. Foreign direct investment is needed for a country that lacks domestic investment. However, FDI is more important because it has been long recognized as knowledge capital. The arrival of FDI could bring knowledge and technology. This thesis aims at verifying if the arrival of FDI in Cambodia could help increase productivity of domestic firms, or if it brings technology spillover to domestic firms. The thesis approaches this issue by addressing not only horizontal but also vertical spillover.

In addition, the thesis tries to find factors enhancing productivity spillover from FDI to domestic firms in both upstream and downstream industries. For these factors, technology gap and absorptive capacity of domestic firms are considered. Regarding the technology gap, this study uses indexes based on labor productivity and total factor productivity (TFP). Regarding the absorptive capacity, this study introduces two proxies of workers' education level and training offered by the firm.

By using the unique firm level-data from Cambodia, we have found empirical evidence that there is productivity spillover in both horizontal and vertical linkages. Firms with technology level below its foreign competitors tend to benefit from the technology brought by FDI. The finding confirms the important role of FDI that brings productivity spillover to domestic suppliers of intermediate goods and to domestic buyers of high quality intermediate goods from foreign suppliers.

In many least-developed countries such as Cambodia, the domestic firms tend to have the technology below that of the foreign competitors. Opening the economy or globalization does bring cross-border flow of technology to domestic firms in those countries. The domestic firms

will be able to gain new knowledge by means of imitation, a very cost-saving strategy for a country which lacks financial resources to invest in R&D and innovation. The results of the regression analysis in Chapter 3 of this thesis show that promotion of FDI in both upstream and downstream sectors helps domestic firms improve their productivity.

On the other hand, in an attempt to promote FDI, many countries including Cambodia have started to provide various incentives to attract FDI. One common policy is tariff reduction on imported intermediate goods. Lower tariff on intermediate goods is likely to encourage foreign firms to use imported intermediate goods rather than domestic produced intermediate goods. This effect can be strong when the technology gap between foreign and domestic firms is large.

Chapter 4 of this thesis attempts to construct a theoretical model which evaluates the impact of the tariff on the backward industry linkages. It reveals that tariff reduction on imported intermediate goods could actually have an adverse effect on the industry linkages, which depends on size of the technology gap of domestic and foreign firms. More specifically, when the technology gap is not so large, tariff reduction on imported intermediate goods does not have any negative impact on the domestic industry linkages. On the other hand, when the technology gap is large enough, care is needed to use tariff reduction on intermediate goods. Since there seems to be no evidence of crowding-out in Cambodia so far, the country may use tariff reduction on imported intermediate goods to attract FDI.

References

Ackerberg, D., Caves, K., and Frazer, G. (2006). Structural Identification of Production Functions. *Working Paper, Univesity of California, Lost Angeles* , pp. 1-42.

Aitken, B., and Harrison, A. E. (1999). Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela. *American Economic Reivew , 89* (3), 605-618.

Altomonte, C., and Pennings, E. (2009). Domestic Plant Productivity and Incremental Spillovers from Foreign Direct Investment. *Journal of International Business Studies , 40,* 1131–1148.

Asian Development Bank, ADB. (2011). *Key Indicators* .

Barbosa, N., and Eiriz, V. (2009). Linking Corporate Productivity to Foreign Direct Investment: An Empirical Assessment. *International Business Review , 18* (1), 1-13.

Barrios, S., and Strobl, E. (2002). Foreign Direct Investment and Productivity Spillovers: Evidence from the Spanish Experience. *Weltwirtschaftliches Archiv , 138* (3), 459-481.

Barro, J. R., and Sala-i-Martin, X. (1995). Economic Growth. United States: McGraw-Hill.

Bekes, G., Kleinert, J., and Toubal, F. (2009). Spillovers from Multinationals to Heterogeneous Domestic Firms: Evidence from Hungary. *The World Economy , 32* (10), 1408–1433.

Bitzer, J., Geishecker, I., and Gorg, H. (2008). Productivity Spillovers through Vertical Linkages: Evidence from 17 OECD countries. *Economics Letters , 99* (2), 328-331.

Blalock, G., and Gertler, J. P. (2008). Welfare Gains from Foreign Direct Investment through Technology Transfers to Local Suppliers. *Journal of International Economics , 74* (2), 402-421.

Blalock, G., and Gertler, J. P. (2009). How Firm Capabilities Affect Who Benefits from Foriegn Technology. *Journal of Development Economics , 90* (2), 192-199.

Blomstrom, M., and Kokko, A. (1998). Multinational Corporations and Spillovers. *Journal of Economic Surveys , 12* (3), 247-277.

Blundell, R., and Bond, Stephen R. (2000), "GMM Estimation with Persistent Panel Data: An Application to Production Functions", *Econometric Reviews*, Vol. 19, No. 3, pp. 321-340.

Bond, Stephen R. (2002), "Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice", *Portuguese Economic Journal*, Vol. 1, No. 2, pp. 141-162.

Buckley, P. J., Wang, C., and Jeremy, C. (2007). The Impact of Foreign Ownership, Local Ownership and Industry Characteristics on Spillover Benefits from Foreign Direct Investment in China. *International Business Review , 16* (2), 142–158.

Cambodia Development Resource Institute, CDRI. (2009-2010). *Annual Development Review* .

Cambodia Law on Commercial Enterprises. (2005).

Cambodia Special Economic Zone Board,CSEZB. (2011).

Castellani, D., and Zanfei, A. (2003). Technology Gaps, Absorptive Capacity and the Impact of Inward Investment on Productivity of European Firms. *Economics of Innovation and New Technology , 12* (6), 555-576.

Chudnovsky, D., Lopez, A., and Rossi, G. (2008). FDI Spillovers and the Absoprtive Capabilities of Domestic Firms in the Argentine Manufacturing Sector (1992-2001). *Journal of Development Studies , 44* (5), 645-677.

Cohen, W., and Levinthal, D. (1989). Innovation and Learning: The Two Faces of R&D. *Economic Journal , 99* (397), 569-596.

Cohen, W., and Levinthal, D. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. *Adminstrative Science Quarterly , 35* (1), 128-152.

Cuyvers, L., Plasmans, J., Soeng, R., and Bulcke, D. V. (2008a). Determinants of Foreign Direct Investment in Cambodia: Country Specific-Factor Differentials. *Research Paper , 2008-003*.

Cuyvers, L., Soeng, R., Plasmans, J., and Bulcke, D. V. (2008b). Productivity Spillovers from Foreign Direct Investment in Cambodian Manufacturing Sector: Evidence from Establishment-Level Data. *Research Paper , 2008-004*.

Damijan, J. P., and Knell, M. (2005). How Important Is Trade and Foreign Ownership in Closing the Technology Gap? Evidence from Estonia and Slovenia. *Review of World Economics , 141* (2), 271-295.

Dimelis, S., and Louri, H. (2004). Foreign Direct Investemnt and Technology Spillovers: Which Firms Really Benefit? *Review of World Economics , 140* (2), 230-253.

Du, L., Harrison, A., and Jefferson, G. H. (2011). Testing for Horizontal and Vertical Foreign Investment Spillovers in China,1998–2007. *Journal of Asian Economics* , 1-10.

Dunning, H. J. (1977). Trade, Location of Economic Activity and the MNE: A Search for an Eclectic Approach. *The International Allocation of Economic Activity: Proceedings of a Nobel Symposium* (pp. 395-418). London: Macmillan Press.

Economic Institute of Cambodia, EIC. (2007). *Export Diversification and Value Addition for Human Development: Addressing the Impact of the Aggreement on Textile and Clothing Expiration on Cambodia* . Cambodia.

Findlay, R. (1978). Relative Backwardness, Direct Foreign Investment, and the Transfer of Technology: A Simple Dynamic Model. *Quarterly Journal of Economics , 92* (1), 1-16.

Francisco, S., Kim, K., Bui, T., Vanndy, N., and Hung, D. M. (2009). Comparative Studies of Indochia Economies (Cambodia,Thailand and Vietnam): An Input-Output (I-O) Approach. *Working Paper* (10), pp. 1-33.

Garment Manufacturing Association of Cambodia, GMAC. (2010). *Annual Bulletin* .

Girma, S. (2005). Absoprtive Capacity and Productivity Spillovers from FDI: A Threshold Regression Analysis. *Oxford Bulletin of Economics and Statistics , 67* (3), 281-306.

Girma, S., and Gong, Y. (2008). FDI, Linkages and Efficiency of State-Owned Enteprises in China. *Journal of Development Studies , 44* (5), 728-749.

Girma, S., and Gorg, H. (2007). The Role of the Effeciency Gap for Spillovers from FDI: Evidence from the U.K Electronic and Engineering Sectors. *Open Economies Review , 18*, 215-232.

Girma, S., Gorg, H., and Pisu, M. (2008). Exporting, Linkages and Productivity Spillovers from Foreign Direct Investment. *Canadian Journal of Economics , 41* (1), 320-340.

Giuliani, E. (2008). Multinational Corporations and Patterns of Local Knowledge Transfer in Costa Rica High-Tech Industries. *Development and Change , 39* (3), 385-407.

Glass, A. J., and Saggi, K. (1998). International Technology Transfer and Technology Gap. *Journal of Development Economics , 55* (2), 369-398.

Gorg, H., and Greenaway, D. (2004). Much Ado about Nothing? Do Domestic Firms Really Benefit from Foreign Direct Investment? *The World Bank Research Observer , 19* (2), 171-197.

Griffith, R., Redding, S., and Reenen, J. V. (2004). Mapping the Two Faces of R&D: Productivity Growth in a Pannel of OECD Industries. *The Review of Economics and Statistics , 86* (4), 883-895.

Hing, T. (2006). *The Cambodian Investment Challenges in Global Competitiveness.* Phnom Penh: Japan International Cooporation Agency, JICA.

Hirschman, O. A. (1958). The Strategy of Economic Development. New York: Vail-Ballou Press.

Jabbour, L., and Mucchielli, J. L. (2007). Technology Transfer through Vertical Linkages: The Case of the Spanish Manufacturing Industry. *Journal of Applied Economics , 10* (1), 115-136.

Japan ASEAN Center. (2009-2010). *ASEAN-Japan Statistics* .

Javorcik, B. S. (2004). Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages. *American Economic Review , 94* (3), 605-627.

Kinoshita, Y. (2000). R&D and Technology Spillovers via FDI: Innovation and Absorptive Capacity. *Working Paper , 349*.

Kobayashi, S., Tanji, H., Saito, K., Haung, W., and Tada, M. (2009). Industrial Structure of Cambodia and the Role of Agriculture and Fishery in Its Development. *Japan Agricultural Research Quartely , 43* (4), 309-316.

Kokko, A. (1994). Technology, Market Characteristics, and Spillovers. *Journal of Development Economics*, 43 (2), 279-293.

Law of Investment of the Kingdom of Cambodia. (2007).

Levinsohn, J., and Petrin, A. (2003). Estimating Production Functions Using Inputs to Control for Unobservables. *Review of Economic Studies , 70* (2), 317-341.

Levinsohn, J., Petrin, A., and Poi, B. (2004). Production Function Estimation in Stata Using Inputs to Control For Unobservables. *The Stata Journal , 4* (2), 113-123.

Lin, P., and Saggi, K. (2007). Multinational Firms and Backward Linkages: A Critical Survey and A Simple Model. In *Does FDI Promote Economic Development?* (pp. 159-174). Institute of International Economics.

Marcin, K. (2008). How Does FDI Inflow Affect Productivity of Domestic Firms? The Role of Horizontal and Vertical Spillover, Absorptive Capacity and Competition. *Journal of International Trade and Economic Development , 17* (1), 155-173.

Markusen, J., and Venables, A. J. (1999). Foreign Direct Investment as a Catalyst for Industrial Development. *European Economic Review , 43* (2), 335-356.

Ministry of Industry, Mines and Energy. (2008). Cambodia.

Ministry of Posts and Telecommunications, MPTC. (2008). Cambodia.

Ministry of Tourism. (2011). *Tourism Statistics Report* . Cambodia.

Monastiriotis, V., and Alegria, R. (2011). Origin of FDI and Intra-Industry Domestic Spillovers: The Case of Greek and European FDI in Bulgaria. *Review of Development Economics , 15* (2), 326–339.

National Bank of Cambodia, NBC. (2004-2011). *Qurterly Bulletin* .

National Institute of Statistics. (2009). *Establishment Survey* . Cambodia.

National Institute of Statistics, NIS. (2008). *Year Book* . Cambodia.

Olley, G., and Pakes, A. (1996). The Dynamics of Productivity in the Telecommunications Equipment Industry. *Econometrica , 64* (6), 1263-1297.

Oum, S. (2007). A CGE Model for Poverty and Policy Analysis in Cambodia. *PhD Dissertation* , 1-20.

Oum, S. (2008). An Estimation of Input-Output Table for Cambodian Economy 2003. *V6.2 Documentation - I-O Tables: Cambodia, Center for Global Trade Analysis, Documentation, Purdue University* .

Pavcnik, N. (2002). Trade Liberalization, Exit and Productivity Improvement: Evidence from Chilean Plants. *Review of Economic Studies , 69* (1), 245-277.

Penrose, E. F. (1956). Foreign Investment and the Growth of the Firm. *Ecomomic Journal , 66* (262), 220-235.

Rodriguez-Clare, A. (1996). Multinationals, Linkages, and Economic Development. *American Economic Review , 86* (4), 852-873.

Royal Government of Cambodia. (2004). *Retangular Strategy Phase Two* . Cambodia.

Royal Government of Cambodia. (2005). *Small and Medium Enterprise (SMEs) Development Framework* . Cambodia.

Sambath, S., and Kato, R. R. (2009). Future Prospects of the Garment Industry of Cambodia. *CRR Working Paper Series A , Working Paper No. A-16,* pp. 1-76.

Schoar, A. (2002). Effects of Corporate Diversification on Productivity. *Journal of Finance , 57* (6), 2379-2403.

Smeets, R. (2008). Collecting the Pieces of the FDI Knowledge Spillovers Puzzle. *The World Bank Research Observer , 23* (2), 107-138.

Wang, J. Y., and Blomstrom, M. (1992). Foreign Investment and Technology Transfer: A Simple Model. *European Economic Review , 36*, 137-155.

Wang, Y. (2010). FDI and Productivity Growth: the Role of Inter-industry Linkages. *Canadian Journal of Economics , 43* (4), 1243-1272.

World Bank Group, International Finance Corporation, IFC. (2008). *Financial Sector Diagnostic* .

World Bank Survey on Business and Investment Climate in Cambodia. (2006).

Yamagata, T. (2006). The Garment Industry in Cambodia: Its Role in Poverty Reduction through Export-Oriented Development. *IDE Discussion Papers , 62*.