DEPARTMENT OF INTERNATIONAL ECONOMICS,
INTERNATIONAL MANAGEMENT AND DIPLOMACY

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Ludo Cuyvers, Reth Soeng, Joseph Plasmans & Daniël Van den Bulcke

UNIVERSITY OF ANTWERP
Faculty of Applied Economics

Stadscampus
Prinsstraat 13, B.213
BE-2000 Antwerpen
Tel. +32 (0)3 220 40 32
Fax +32 (0)3 220 47 99
http://www.ua.ac.be/tew

FACULTY OF APPLIED ECONOMICS

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University of Antwerp, City Campus, Prinsstraat 13, B-2000 Antwerp, Belgium
Research Administration – room B.213
phone: (32) 3 220 40 32
fax: (32) 3 220 47 99
e-mail: joeri.nys@ua.ac.be

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Productivity Spillovers from Foreign Direct Investment in the Cambodian Manufacturing Sector: Evidence from Establishment-Level Data[1]

Ludo CUYVERS[2]

Reth SOENG[3]

Joseph PLASMANS[4]

Daniel VAN DEN BULCKE[5]

[1] The authors are grateful to National Institute of Statistics (NIS), Ministry of Planning, for providing the primary data set from the Industrial Establishment Survey 2000.
[2] Professor of International Economics, Faculty of Applied Economics, and Director of Centre for ASEAN Studies (CAS), University of Antwerp, Belgium.
[3] Research Fellow, Centre for ASEAN Studies, and Department of International Economics, International Management and Diplomacy, University of Antwerp, Belgium.
[4] Professor of Econometrics, Department of Economics, University of Antwerp, Belgium and CentER, Tilburg University, the Netherlands.
[5] Emeritus Professor, Former President of the Institute of Development Policy and Management, University of Antwerp, Belgium and Chairman of the European International Business Academy (EIBA).

1. Introduction

Foreign Direct Investment (FDI) is generally regarded as an important source of finance, especially for the developing countries. Aitken and Harrison (1999) indicated that the largest source of external finance during the 1990s made available to the developing economies consisted of FDI. However, the role played by FDI in host countries through the transfer of technology, which in turn leads to an increase in labor productivity in the domestic firms via mainly indirect effects, is even more important.

Since FDI is believed to be an important channel through which the international transfer of technology takes place, it has been identified as a major growth-enhancing factor in host countries. With a view to attracting inward FDI, governments in many countries (developed and developing) have liberalized their FDI regulations and adopted an investment-friendly policy. Additionally, handsome incentives such as tax holidays, the absence of import duties on intermediate inputs, low corporate tax rates, etc. are granted to investment projects by foreigners. Cambodia is no exception to such favorable policy for foreign investors.[6] That host countries subsidize FDI activities is based on the expectation that, in addition to the employment generated by

[6] According to the 1994 law on investment, Cambodia has provided generous incentives to eligible investment projects. These incentives include a reduction of corporate income tax from 15-25% to only 9%, a tax holiday of up to 8 years; import tax exemption on construction materials, production equipment including spare parts, intermediate goods and raw materials; no export tax; guarantee against expropriation; no restriction/no tax on repatriation of profits; no withholding tax on dividends; and equal treatment of both domestic and foreign investors. To further improve the investment climate, the investment law of 1994 was amended in 2003 with technical assistance from relevant ministries, international financial institutions such as the International Monetary Fund (IMF) and the World Bank and the country's other international development partners (Hing, 2006). The amendment replaced the 9% corporate tax with 20%. Although the corporate tax has increased, Cambodia is still seen competitive in terms of financial incentives available for foreign investors *vis a vis* many countries in the region. For example, Indonesia has a corporate tax ranging from 15 to 30%, Malaysia 28%, the Philippines 32%, Singapore 22%, Thailand 30% and Vietnam ranging from 25% to 32% (Chap, 2005).

these activities, FDI makes available to the host country a package of capital, modern technology, know-how, and managerial and marketing skills, and consequently fosters productivity growth in the FDI-receiving country. When domestic firms in the host country also have access to the modern technologies and skills introduced by inward FDI, this in turn may lead both to improvements in the host country's labor productivity and to increasing efficiency of domestic firms. However, some local firms may also suffer from the competitive presence of the more efficient foreign counterparts, as they may be forced to reduce their output or stop their activities. When their average cost curve is driven up, productivity is reduced. Certain home country conditions, such as institutions and the degree of competition, and the skill levels of the labor force might also affect the relative magnitudes of the costs and benefits.

Given the benefits and costs, associated with the presence of FDI, the question is whether or not it is justified for the host country to take such generous measures in favor of foreign investors. Yet, Aitken and Harrison (1999) argue that if the benefits generated by FDI in the host country are not completely internalized by those firms, some types of subsidy may be justified.

A large number of studies have been carried out to provide both the theoretical foundations and empirical results about the impact of FDI on the host country economy. The theoretical developments have stirred numerous empirical investigations into the role that FDI has played in the transfer of technology both in developed and developing countries. Data at the levels of the industry, firm, or plant have been used in those studies. The results of these analyses are ambiguous, with the slope parameter estimates of the "spillover" variables ranging from positive to negative. These mixed findings may be due to differences in research design,

methodology, and the quality of data, and even the construction of the spillover variable. However, on balance, it is widely accepted that the entry of multinational enterprises (MNEs) generates a net positive effect on the local firms' productivity in the host countries.

The main objective of this paper is to analyze the net benefits generated by the presence of FDI in the manufacturing sector of the small, open economy of Cambodia. FDI has flowed into Cambodia since the outset of the country's economy opening-up to the outside world after the first general election in 1993. Manufacturing FDI amounted to 43 percent of total FDI in Cambodia (see further below). From 1994 to 2004, the manufacturing sector contributed, on average, more than 70 percent to the total industrial output (Ministry of Planning, 2006).

The importance of FDI in the Cambodian manufacturing sector will be studied to find an answer to the question whether FDI has played a role in improving local manufacturing productivity in Cambodia? Cross-sectional data from the latest and more informative 'Survey of Industrial Establishments 2000' will be used for this purpose.

The remainder of this paper is organized as follows. Section 2 discusses the theoretical developments. The evidence on the FDI impact on productivity spillovers is discussed in section 3, while section 4 describes FDI in Cambodia's manufacturing sector. Section 5 presents a testable econometric model. Data and methodology are discussed in section 6. Estimation results are presented in section 7. Section 8 concludes and provides some policy implications.

2. FDI and Productivity Spillovers: Theoretical Framework

FDI is considered to play an important role in many countries, especially in the developing economies, and has received considerable and renewed interest in international business and international economics research during the past decades. When multinational firms decide to start international operations in a foreign country, they bring with them proprietary and firm-specific knowledge and technology which allow them to compete successfully with the domestic firms which are believed to be more knowledgeable about the domestic markets, the local business environment and local factors of production (Blomström and Kokko, 1998; Blomström and Sjöholm, 1999). These firm-specific advantages provide firms with multiple plants with economies of scale across borders. Foreign firms may give rise to different types of externalities in the host country, which in turn can generate spillovers for the domestic firms. Productivity spillovers can occur both in the sector in which foreign firms are present (horizontal effects) and among related companies such as suppliers (vertical effects).

Barba Navaretti and Venables (2004) provide a detailed overview of the impact of FDI on the host country. The effects of FDI can be classified into three broad groups: product market effects, factor market effects and spillovers, the importance of which lies in the form of FDI (horizontal or vertical) and the country characteristics. The first two are often referred to as direct effects, while the third are called indirect effects/spillovers (see further below).

The product market effects are due to FDI causing firms to change the quantities of goods sold. For instance, horizontal FDI, which is likely to replace imports by local production in the host country, may crowd out the local competitors who were previously producing close substitutes, meaning that the local firms may be forced to

reduce their sales or might be forced out altogether (see further below). In addition, when FDI enters the host country through mergers and acquisitions (M&As), there is a competition-reducing impact which might harm the interests of consumers (Barba Navaretti and Venables, 2004). However, the foreign presence may increase competition in the local market, and increase the variety or quality of the products, raising local consumer welfare because of a continuing downward pressure on the product price and increased product quality and varieties.

Factor market effects of FDI alter the composition of the labor markets of the host and home countries. Theory predicts that FDI will continue to the point where factor prices (wages) are equalized across countries. This occurs because FDI puts an upward pressure on wages of, especially, unskilled workers in the FDI-receiving countries, accompanied by a downward pressure on wages of the unskilled workers in the FDI-sending countries (Barba Navaretti and Venables, 2004). FDI may also help to upgrade the skills of the local workers by providing on-the-job training.

As multinational firms often use superior production technology, they are likely to be more productive than the local counterparts, who are then forced to become more efficient in the presence of these foreign firms. The host country may benefit in different ways from the higher productivity of the foreign-owned firms. For instance, while the workers may receive higher wages, the host country's government can generate more tax revenue.

In the literature, it is often argued that the most important benefits to the host country from the foreign presence are a variety of spillovers. There are several channels through which knowledge and technology are spilled over from the foreign-owned to domestically-owned firms in host economies. Kokko (1992), Blomström and Kokko

(1998), Blomström et al. (2000), and Saggi (2002) show that multinational firms may:

- contribute to higher productive efficiency and to a better use of existing technology and resources;
- break down local monopolies, and lead to fiercer competition and higher efficiency;
- introduce new know-how by demonstrating new technologies and provide on-the-job training to employees who might transfer important knowledge, skills and information to local firms by shifting employers;
- force domestic firms to increase their managerial efforts, to adopt some of the marketing techniques used by their foreign counterparts, and to search for new, modern technologies; and
- transfer technology to the firms that are potential suppliers of intermediate goods or buyers of other own products.

Foreign enterprises may provide allocative efficiency in the host country by entering into industries where entry barriers for new firms are high (Caves, 1974). The presence of MNCs may reduce monopolistic distortions, and raise productivity by improving resource allocations in the host economy. In addition, foreign subsidiaries induce higher technical efficiency when upward competitive pressures or demonstration effects by the presence of foreign firms force domestically owned firms to make a better use of the existing resources. Similarly, Saggi (2002) indicated that the most simple form of the technology transfer from foreign to domestically owned firms may be by means of demonstration effects. The demonstration effect argument states that the exposure of modern technologies by foreign subsidiaries to domestic firms may induce the latter to update their own production methods introduced by the former. Aitken and Harrison (1999) indicate that, in some cases,

domestic firms may increase their productivity by simply observing the nearby foreign firms.

Another channel of technology transfer may be through labor turnover from foreign to domestic firms. When employees previously trained by foreign firms change employment and move to domestic firms, they bring with them specific technological and managerial knowledge and expertise. Caves (1996) reported that managers mobility in particular contributed to the diffusion of management practices from Japan to the United States. When the presence of foreign firms creates new demand for local firms to supply intermediate goods or services to them, more local firms may enter the market, which may lead to product improvements and diversity. de Mello (1997) noted that FDI is an important source of human capital augmentation and technological change, especially in the developing countries, as it provides specific productivity-increasing training and skill acquisition to domestic workers who later might be employed by local firms or even start up their own business.

Saggi (2002) reviewed the evidence about turnover by employees from foreign subsidiaries to domestically owned firms for several countries. In Taiwan, almost 50 percent of all engineers and about 63 percent of all skilled workers moved from foreign owned subsidiaries to domestic firms. Likewise, in the case of Bangladesh, about 88 percent of workers of Desk, a Bangladeshi garment firm, which received technology and credit from Daewoo, the Korean company, left Desk to join other garment firms or to set up their own business. This higher labor turnover may play an important role in assisting to speed up technology transfer. However, Glass and Saggi (2002) have argued that foreign subsidiaries may limit labor turnover (or technology diffusion) by paying higher wages relative to their domestic competitors. Due to fear of losing its technology to domestic firms, MNCs may bring into the host economy,

technology that is only slightly ahead of that available there in order to minimize leakages (Glass and Saggi, 1998).

The presence of foreign owned subsidiaries may benefit the host economy through backward and forward linkages. Since MNCs may purchase intermediate inputs from domestic suppliers to economize on transportation costs or to meet local content requirement, they create demand for the domestic intermediate goods and allow local suppliers to realize economies of scale. Spillovers may take place when MNCs are imposing higher requirements for product quality and reliable delivery. In order for domestic suppliers to deliver good quality of inputs, MNCs might provide technical assistance or transfer technological know-how to them by joint product development, training, etc.. Lall (1978) showed that foreign subsidiaries helped to improve the productivity of domestic firms by providing training and by putting pressure on local suppliers to meet quality standards and delivery reliability.

However, some domestic firms may be hurt by the presence of foreign subsidiaries as they cannot meet the input quality requirements set by MNCs, and face competition from other local competitors that are also suppliers of MNCs. Therefore, the uncompetitive local firms may be displaced by the entry of foreign firms. Rodriguez-Clare (1996) showed that the presence of MNCs is favorable if they generate linkage spillovers beyond those generated by the local firms they displace.

Similar to backward linkage effects, MNCs might generate forward linkage spillovers in several ways (Meyer, 2003). Foreign subsidiaries might e.g., provide domestic firms (sellers of their products) sales support in the form of sales techniques and marketing. Other domestic firms in the host country industry might benefit from the better quality of intermediate goods imposed by MNCs.

Blomström and Kokko (1998) indicated that FDI can benefit the host country even when foreign firms prefer wholly owned production facilities. Relatively superior technologies owned by multinational firms may, to some extent, be considered as 'public good'. Domestic firms may also learn to export from foreign export oriented firms which are believed to possess experience and information on export market access.[7]

On the other hand, the presence of multinational firms can, in the short run, also reduce the productivity of the domestically-owned firms in the host country. Aitken and Harrison (1999) provide a simple, but useful illustration of negative effects arising from the entry of the multinational firms into an imperfect competition market with fixed costs of production, such that firms in the market are faced with a downward-sloping average cost curve (see Figure 1).

Assuming also that, in the absence of foreign presence, the average cost curve associated with domestic firms is AC_0, firm i produces output at the level of Q_0. The presence of foreign firms in the host country is assumed to generate spillovers, which cause the average cost curve of domestic firms to fall, shifting from AC_0 to AC_1. *Ceteris paribus*, productivity of the local firm is higher, due to reduced average costs arising from the spillover effects from the foreign firms. The competitive pressure by foreign firms, however, forces the local counterparts to reduce output or even to exit the market. This causes the output of domestic firms to move back up the new average cost curve AC_1, resulting in an increase of the average cost of production.

[7] A number of studies empirically investigate the relationship between firm productivity and exports (see, for example, Greenaway and Kneller, 2005, for a good review).

Aitken and Harrison (1999) indicate that if the productivity decline (rise in average costs) from this demand effect is large enough, net productivity may drop even if foreign firms generate technology spillovers for the domestically-owned firms. Yet, these results are relevant only when domestic and foreign firms compete with one another in the same market. Based on the review above, the benefits generated by inward FDI are likely to outweigh the costs of foreign ownership of local factors of production in the host country.

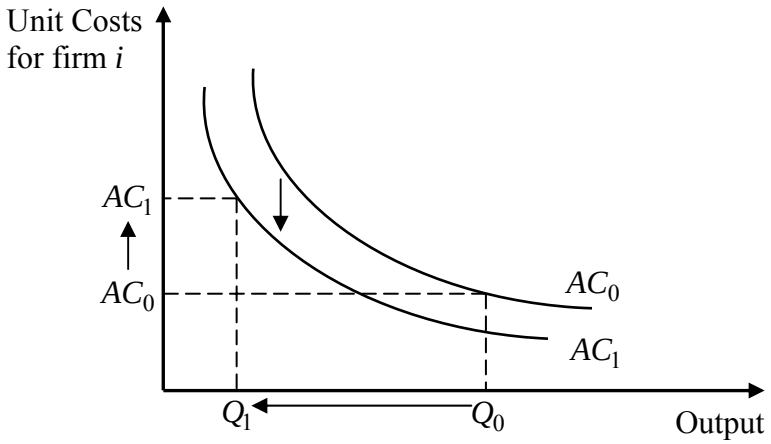


Figure 1: Spillovers and Crowding-out Effects of FDI.
Source: Aitken and Harrison (1999).

Since FDI is supposed to be a growth-enhancing factor, a number of empirical studies have tested this by investigating the impact of FDI on economic growth. Incorporating FDI into the augmented production function as an additional explanatory variable, Balasubramanyam et al. (1996) examined the impact of FDI on growth in 46 developing countries adopting different trade regimes, and found that the FDI effects on economic growth are higher in outward-oriented countries with export promotion trade policies than in inward-oriented economies relying on import

substitution policies. Kokko et al. (2001) investigated spillover effects of FDI in host countries under different trade regimes. They found that foreign firms established during the inward-oriented trade regimes are more likely to generate spillovers to local firms, and that there were no productivity spillovers from foreign firms to locally-owned firms in the outward-oriented trade regimes. However, local firms benefited from the export spillovers as multinational firms played an important role in facilitating exports by local firms.

An empirical study by Borensztein et al. (1998) about the impact of FDI flows from industrial countries to 69 developing countries over the last two decades suggests that FDI is an important source of technology transfer, contributing relatively more to growth than domestic investment, but indicates that the FDI contribution to economic growth occurs only when there is a sufficient absorptive capacity of advanced technologies, or a minimum threshold stock of human capital to make such transfer possible. This threshold is estimated to range between 0.75 and 1 year of post primary schooling. Similarly, Barrios and Strobl (2002) found that only domestic firms with high levels of absorptive capacity can experience positive spillovers from FDI.

Li and Liu (2004) examined the impact of FDI on economic growth both in developing and developed economies using panel data from 1970 to 1999, and found no endogenous relationship between FDI and economic growth during that period. They, however, established that FDI does positively affect growth for the sub-period from 1985 to 1999. Carkovic and Levine (2005), however, came to opposite conclusions. Using a panel data set from both developing and developed countries during 1960-1995, and applying dynamic panel estimation techniques, no significant support for a positive relationship between FDI and economic growth was found. The

different results among these studies may be due to the use of different estimation methods and to the quality of the available data.

On the other hand, several studies focused on the FDI impact on local productivity spillovers. Caves (1974) suggested that gains from FDI take different forms. Tangible gains to the host government consist of the corporate income tax collected from the subsidiaries of multinational firms and the benefits from the effects of FDI on the productivity of resources in the host country. Productivity spillovers are generated when multinational firms cannot capture all quasi-rents as a result of their productive activities. Multinational firms may also exert a significant pressure on competition, thereby reducing distortions and raising productivity of the host country's economy by improving resource allocation. Using a similar argument, Wei and Liu (2001) indicated that the presence of multinational firms may speed up the technology transfer process and reduce the costs of the technology transfer. Competition by multinationals may encourage local firms to innovate and to operate more efficiently. As mentioned earlier, competition, demonstration, learning-by-imitation, contagion effects and the training of workers by foreign firms may help facilitate the speed of the transfer of technology to domestic firms via labor turnover. Therefore, FDI is expected to serve as a vehicle for technology transfer and productivity growth in the host economy.

3. FDI and Productivity Spillovers: Empirical Evidence

In examining the effects of the presence of FDI on domestic firms, firm-level performance is regressed on a foreign-presence variable and a set of control variables measuring the characteristics of the firms. The following general model is often

applied in empirical analyses (see, among others, Kokko, 1992, 1996; Blomström and Sjöholm, 1999; Wei and Liu, 2001; Dimelis and Louri, 2004):

$$LP = f(KL, FP, LQ, CU, SIZE, OV) \quad (1)$$

where LP measures firm performance, usually representing local labor productivity; KL is the capital-labor ratio which measures capital intensity; FP is a variable representing foreign presence, defined as the ratio of foreign firms' employment in a sector to the total employment of that sector, or the share of total sectoral output produced in firms with foreign ownership; LQ measures labor quality in each firm; CU is capital utilization, defined as the share of actual output to potential output; $SIZE$ is the firm's output as a share of the average output in the sector to which the firm belongs, and OV represents other explanatory variables that affect labor productivity.

Many studies have confirmed productivity spillovers generated by FDI, using the type of model specified above. The results, however, are far from conclusive. This may again be due to different methodologies and varying data quality (cross sectional versus panel data); the results of which can be seen in Figure 2. An early study by Caves (1974) found that the presence of multinational firms positively affected labor productivity in Australian manufacturing industries. Following Caves, a large number of studies were undertaken for a host of both developed and developing countries,[8] confirming local productivity spillovers on domestic firms (see Figure 2).

[8] These studies include, among others Globerman (1979) for Canada, Blomstrom and Persson (1983), Kokko (1994) for Mexico, Kokko et al (1996) for Uruguay, Kathuria (1998) for India, Chuang and Lin (1999) for Taiwan, Liu et al (2000), Haskel et al. (2007) for the United Kingdom, Wei and Liu (2001) for the Chinese electronic industry, Li et al. (2001) for the Chinese manufacturing sector, Barrios and Strobl (2002) for Spain, and Dimelis and Louri (2001, 2004) for Greece.

Figure 2: Productivity Spillovers from FDI in Selected Economies: Methodologies and Results

No	Author(s)	Country	Year(s)	Data	Aggregation	Result
	Developing Countries					
1	Blomstrom and Persson (1983)	Mexico	1970	CS	Industry	+
2	Blomstrom (1986)	Mexico	1970/75	CS	Industry	+
3	Blomstrom and Wolff (1994)	Mexico	1970/75	CS	Industry	+
4	Kokko (1994)	Mexico	1970	CS	Industry	+
5	Kokko (1996)	Mexico	1970	CS	Industry	+
6	Haddad and Harrison (1993)	Morroco	1985-89	Panel	Firm and Industry	?
7	Kokko et al. (1996)	Uruguay	1990	CS	Firm	?
8	Blomstrom and Sjoholm (1999)	Indonesia	1991	CS	Firm	+
9	Sjoholm (1999a)	Indonesia	1980-91	CS	Firm	+
10	Sjoholm (1999b)	Indonesia	1980-91	CS	Firm	+
11	Chuang and Lin (1999)	Taiwan	1991	CS	Firm	+
12	Aitken and Harrison (1999)	Venezuela	1976-89	Panel	Firm	–
13	Kathuria (2000)	India	1976-89	Panel	Firm	?
14	Sasidharan and Ramanathan (2007)	India	1994-02	Panel	Firm	?, –
15	Kokko et al. (2001)	Uruguay	1988	CS	Firm	?
16	Wei and Liu (2001)	China	1996-98	Panel	Industry	+
17	Li, et al. (2001)	China	1995	CS	Industry	+
18	Liu (2002)	China	1993-98	Panel	Industry	+
19	Liu (2008)	China	1995-99	Panel	firm	–/+
	Developed Countries					
20	Caves (1974)	Australia	1966	CS	Industry	+
21	Globerman (1979)	Canada	1972	CS	Industry	+
22	Liu et al. (2000)	UK	1991-95	Panel	Industry	+
23	Driffield (2001)	UK	1989-92	CS	Industry	+
24	Girma et al. (2001)	UK	1991-96	Panel	Firm	?
25	Girma and Wakelin (2000)	UK	1988-96	Panel	Firm	?
26	Girma and Wakelin (2001)	UK	1980-92	Panel	Firm	?

27	Harris and Robinson (2003)	UK	1974-95	Panel	Firm	?
28	Griffith et al. (2003)	UK	1980-92	Panel	Firm	+
29	Haskel et al. (2007)	UK	1973-92	Panel	Firm	+
30	Ruane and Ugur (2004)	Ireland	1991-98	Panel	Firm	?
31	Barry et al. (2005)	Ireland	1990-98	Panel	Firm	–
32	Piscitello and Rabbiosi (2005)	Italy	1994-97	Panel	Firm	+
33	Barrios and Strobl (2002)	Spain	1990-94	Panel	Firm	?
34	Dimelis and Louri (2001a)	Greece	1997	CS	Firm	+
35	Dimelis and Louri (2004b)	Greece	1997	CS	Firm	+
36	Dimelis (2005)	Greece	1992/97	CS	Firm	+
37	Siler et al. (2003)	Scotland	1992-95	Panel	Firm	+
	Transition Countries					
38	Djankov and Hoekman (2000)	Czech Rep.	1993-96	Panel	Firm	–
39	Kinoshita (2001)	Czech Rep.	1995-98	Panel	Firm	?
40	Bosco (2001)	Hungary	1993-97	Panel	Firm	?
41	Konings (2001)	Bulgaria	1993-97	Panel	Firm	–
		Poland	1994-97			?
		Romania	1993-97			–
42	Damijan et al. (2003)	Bulgaria	1994-98	Panel	Firm	?, –,+
		Czech Rep.				only for
		Estonia				Romania
		Hungary				
		Romania				
		Slovak Rep.				
		Slovenia				
43	Yudaeva, et al (2003)	Russia	1993-97	Panel	Firm	–/+
44	Sinani and Meyer (2004)	Estonia	1994-99	Panel	Firm	+

Notes:

1. "CS" and "Panel" stands for cross sectional data and panel data, respectively.
2. Aggregation refers to the use of either industry or firm-level data.
3. +, – and ? refer to the coefficient of the spillover variable that is positive and statistically significant, negative and statistically significant, and statistically insignificant, respectively.

Source: Extended and updated from Barba Navaretti and Venables (2004), p. 177.

Using survey data of 60 firms operating in Cambodia, Chap (2005) found some indication of technology transfers in the form of imported machinery.[9] However, the conclusion drawn in this survey about the technology transfer in Cambodia may be somewhat misleading. Even without the presence of foreign firms, the domestic firms may have semi-computerized or computerized operations in their production process because the technology-embodied machinery may have been imported.

Although many studies have confirmed that FDI is a catalyst for enhancing labor productivity in the host economy, FDI activities can also have a negative impact on domestic labor productivity according to recent empirical investigations (see Figure 2). Aitken and Harrison (1999) using a firm-level panel data set of over 4,000 plants for the period 1976-1989, have shown that an increase in foreign ownership is negatively related to the productivity of wholly domestically-owned firms in the same industry. The entry of foreign firms producing for the domestic market can force domestic firms to reduce output, especially when domestic and foreign firms are active in the same market. As a result, the productivity of domestic firms may fall as they are moving towards lower output levels along their average cost curves (see above).

Several other studies have not provided support for the hypothesis that higher foreign presence leads to higher labor productivity growth. For instance, an empirical study by Haddad and Harrison (1993) showed no evidence supporting this hypothesis. However, this same study suggested that knowledge is transferred from foreign firms to domestic counterparts in jointly-invested projects. Joint ventures exhibit higher

[9] The sources of technology identified by the survey are from the United States, representing 25%, ASEAN countries 23.3%, European Union countries 18.3%, Newly industrialized countries 13%, Japan 9%, China and Australia 5% (Chap, 2005).

levels of productivity than domestically wholly-owned firms. The importance of joint ventures in productivity spillovers is also indicated by Dimelis and Louri (2004).

The collaboration between domestic firm and multinational counterparts may help to reveal the latter's proprietary knowledge and facilitate technology spillovers from foreign to domestic firms. Using a large dataset of 13,663 establishments in the Indonesian manufacturing sector, Blomström and Sjöholm (1999) did not find support for the hypothesis, as the degree of local ownership in FDI did neither affect the productivity nor the degree of spillovers to the domestic sector. In contrast, a study by Dimelis and Louris (2004) for Greece showed that there is a significant positive spillover, stemming from firms with minority foreign ownership,[10] which can be ascribed to small foreign firms interacting more with their small, domestic counterparts. According to this study, firm size therefore seems to matter as to benefits gained from the presence of FDI activities.

The literature review so far provides mixed results, showing both positive and negative impacts of FDI on local labor productivity. However, on balance the positive effects seem to outweigh the negative ones.

4. Foreign Direct Investment in Cambodia's Manufacturing Sector

Since 1989, Cambodia moved from a predominantly centrally controlled to a market-oriented economy by gradually liberalizing investment and trade policies. From 1991 to 1993, the country attracted inward FDI amounting to US$638 million in 1,200

[10] Minority foreign ownership refers to foreign equity of less than or equal to 50 percent while majority foreign ownership refers to more than 50 percent of equity owned by foreign investors. See also Blomstrom and Sjoholm (1999).

approved projects, mainly from Asian countries (Thailand, Malaysia, Singapore, and Hong Kong) and France—the former colonizer of Cambodia (Chap, 2005).

After the UN-sponsored election in 1993, the Royal Government of Cambodia (RGC), in consultation with international institutions such as the World Bank and the International Monetary Fund (IMF), implemented an economic and structural adjustment program, aiming at stabilizing the Kingdom's economy and attracting foreign direct investment. A law on investment was drafted and approved by the National Assembly in 1994, and the Council for the Development of Cambodia (CDC) was created and assigned with the authorization of investment projects, both domestic and foreign.[11]

As a result of its policy of investment liberalization, the country has encouraged FDI inflows since late 1994. The country's policy towards foreign investment and international trade became quite liberal. The 1994 Law on Investment, amended in 2003, since then further eased the approval of the investment applications.[12] Between 1994 and 2004, Cambodia's approved FDI amounted to US$5,313 millions for 1,147 projects (for more information, see Cuyvers et al., 2006, 2008).[13]

[11] According to the law, the projects approved by CDC are eligible to receive a wide range of benefits which include a concessional 9% rate of corporate income tax, tax holiday, tax-free reinvestment of profits, tax-free repatriation of earnings and tax-free imports of capital goods and intermediate goods used in the production of exports. There is no discriminatory treatment between Cambodian and foreign investors, with respect to incentives and the benefits are available to all CDC-approved investment projects. In addition, foreign investors can have up to 100 percent ownership of investment projects. An amendment to the 1994 law on investment was made in 2003 by replacing the concessional 9% corporate income tax by a 20% corporate income tax, however with significantly improved application procedures.

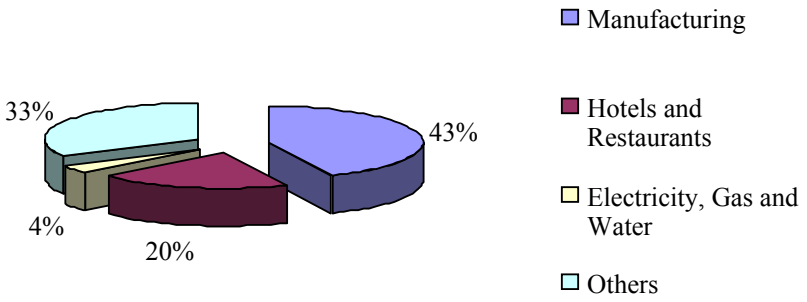
[12] National treatment has been adopted in Cambodia, meaning that domestic and foreign investors are treated on a non-discriminatory basis. Additionally, no restriction is placed in terms of foreign ownership, except land ownership. Foreign investors can wholly own investment project(s) in Cambodia.

[13] The figure is based on approved FDI data, kindly provided by the Project Monitoring Department, Cambodian Investment Board.

In the period 1994-2004, the sectoral distribution of FDI in Cambodia was very uneven[14], with manufacturing, particularly the garments sector attracting most FDI. This can largely be attributed to the Most Favored Nation (NFN) status granted to Cambodia, as well as to benefits to which Cambodian exports were eligible under the Generalized System of Preferences (GSP) of the United States, the European Union and other developed countries.

Although Cambodia has opened its economy to foreign investment, irrespective of the industrial sector in which it takes place, negligible amounts have been attracted by the more capital intensive sectors such as infrastructure and transportation. Also, agriculture has attracted few projects. As shown in Figure 3, manufacturing accounted for 43% of the total FDI in the country while the share of hotel and restaurant branches, and utilities (electricity, gas and water) was 20%, and 4%, respectively, evidencing the importance of FDI in capital formation in Cambodia's manufacturing sector.

Percentage Distribution of FDI in Fixed Assets by Industry



[14] See also Cuyvers, et al. (2006).

Figure3: Percentage Distribution of Realized FDI in Fixed Assets by Industry, 1994-2004.

Source: Cambodia Investment Statistics (1994-2004), Project Monitoring Department, Cambodian Investment Board.

Table 1 presents the 1994-2004 percentage distribution of industrial value added. As can be seen, the more heavily foreign-invested manufacturing sector shows a higher value added than other industries which are less preferred by the foreign investors. The share of manufacturing in total industrial value added amounted to about 59 percent in 1994. This share increased to 73 percent in 2000 and reached 75 percent in 2004 (Table 1). Garments take up more than half of industrial value added. Contrary to textiles, its share has continuously increased from less than 3 percent in 1994 to 38 percent in 2000 and 53 percent in 2004.

In this paper, we will investigate the impact of FDI on productivity improvement in Cambodia's manufacturing sector, using firm-level primary data from the survey of industry establishments conducted by the National Institute of Statistics, Ministry of Planning, in cooperation with the Asian Development Bank, for the year 2000.

Table 1: Distribution of Industrial Value Added (in Percentage), 1994-2004

Industry	1994	1997	2000	2001	2002	2003	2004
Mining	1.83	1.28	1.09	0.98	1.04	1.00	0.94
Manufacturing	*59.22*	*68.86*	*73.25*	*76.26*	*74.46*	*74.60*	*75.41*
Food	21.65	19.32	12.16	11.29	9.49	9.00	7.54
Beverages	4.28	2.14	1.02	0.93	0.81	0.74	0.65
Tobacco	1.19	1.62	1.42	1.44	1.21	1.12	0.96
Textiles	3.03	3.17	2.62	2.56	2.51	2.42	2.18
Garments	2.79	18.11	38.34	44.81	46.37	48.65	52.78

Footwear	0.45	0.62	1.18	1.28	1.40	1.45	1.51
Wood, Paper & Publishing	9.93	9.71	4.30	2.72	2.33	1.79	1.47
Rubber Manufacturing	1.71	1.70	2.25	2.04	1.72	1.39	1.06
Other Manufacturing	14.18	12.46	9.96	9.19	8.61	8.05	7.27
Electricity, Gas & Water	2.21	2.56	1.89	1.78	1.77	1.84	1.66
Construction	36.74	27.30	23.77	20.98	22.73	22.57	22.00
Total	100	100	100	100	100	100	100

Source: National Accounts of Cambodia 1993-2005, National Institute of Statistics (NIS), Ministry of Planning.

5. Economic Model of Productivity Spillovers

Based on the above review of the literature, it can be assumed that FDI is likely to bring to the host country superior technology, marketing and managerial practices and other intangible assets, which can "leak" to local partners and other domestic firms. The most commonly-used approach to test productivity spillovers to the locally-owned firms is by estimating an augmented Cobb-Douglas production function. Following Dimelis and Louri (2004), a simple form of an augmented production function for the manufacturing sector is used as starting point:

$$Y_i = L_i^{\alpha} K_i^{\beta} M_i^{\gamma} e^{\sum \lambda_i X_i + \lambda_0 + \varepsilon_i} \qquad (2)$$
$$i = 1,2,...,n$$

with Y_i the output of firm i, measured by gross value added; L_i, K_i and M_i representing labor, fixed capital and other material inputs employed in each firm i; α, β and γ output elasticities with respect to labor, fixed capital and other inputs,

respectively. X_i represents exogenous production shocks, including these associated with FDI, which are observable; λ_0 is a constant and ε_i is an error term which captures the unobservable factors affecting output of each firm. Log-linearizing equation (2) leads to the following econometric specification (3):

$$\ln Y_i = \lambda_0 + \alpha \ln L_i + \beta \ln K_i + \gamma \ln M + \sum_{i=1}^{n} \lambda_i X_i + \varepsilon_i \qquad (3)$$

In (3) X is a matrix of exogenous factors, which are believed to influence output of each firm i in the manufacturing sector, with effects equal to λ_i. To obtain the labor productivity equation, $\ln L_i$ is subtracted from both sides, which leads to equation (4):

$$\ln(Y_i / L_i) = \lambda_0 + \beta \ln(K_i / L_i) + \gamma \ln(M_i / L_i) + (\alpha + \beta + \gamma - 1) \ln L_i + \sum_{i=1}^{n} \lambda_i X_i + \varepsilon_i \qquad (4)$$

This equation can be rewritten with explicit exogenous factors, as follows:

$$\begin{aligned} \ln LP_i = {} & \alpha_0 + \alpha_1 \ln KI_i + \alpha_2 \ln MI_i + \alpha_3 \ln L_i + \alpha_4 FOR_i + \alpha_5 \ln LQ_i \\ & + \alpha_6 SIZE_i + \alpha_7 PAT_i + \varepsilon_i \\ & i = 1,2,...,n \end{aligned} \qquad (5)$$

In equation (5), labor productivity (LP) is influenced by capital intensity (KI), material inputs intensity (MI), foreign presence (FOR), labor inputs (L), labor quality (LQ), firm size ($SIZE$), and use of intangible assets (PAT). Positive relationships between the dependent and independent variables are expected.

6. Data, Variables and Methodology

In our econometric investigation into the indirect effect of FDI on local productivity, we used a detailed data set at firm level from the 2000 Survey of Industrial Establishments in Cambodia. This data set was kindly provided by Cambodia's National Institute of Statistics (NIS), Cambodian Ministry of Planning.[15] With financial and technical support from the Asian Development Bank (ADB), NIS conducted three surveys on Industrial Establishments namely:

- The Survey of Industrial Establishments in Cambodia (1993), conducted during 1994-1995, with 1993 as reference year;
- The Survey of Industrial Establishments (1995), conducted during 1996–1997, with reference year 1995; and
- The Survey of Industrial Establishments (2000), conducted during 2001–2002, with reference year 2000.[16]

The Survey of Industrial Establishments 2000 covers establishments in two cities and nine provinces in Cambodia (Ministry of Planning, 2003).[17] The original sample size consists of 932 establishments operating during the 2002–2003 period, of which about 11 percent are wholly foreign owned, and 2 percent is partially owned by

[15] The NIS is the government agency responsible for the collection and compilation of data obtained from relevant Cambodian ministries and institutions.
[16] The Asian Development Bank provided both financial and technical support for the surveys. Technical support for data processing for the Survey of Industrial Establishments 2000 was also provided by the Japan International Cooperation Agency (JICA). The detailed data for 1993 and 1995 are not available.
[17] The two cities and nine provinces are Phnom Penh, Sihanouk Ville, Banteay Meanchey, Battambang, Kampong Cham, Kampong Chhnang, Kampot, Kandal, Kratie, Pursat, and Siem Reap. The provinces that were excluded had too small size to warrant a survey.

foreign investors. Due to missing information of some key variables for certain companies, the data set for the estimation of the difference in labor productivity between establishments with local and foreign ownerships is reduced to 704 observations. Similarly, during the estimations of the impact of FDI presence on local productivity in the Cambodian manufacturing sector at 4-digit level, the number of observations was further reduced to 469.

The data set contains information of individual firms in the manufacturing sector on employment (management and workers), wages and salaries, value added, input materials used, labor inputs (men and women), fixed assets, depreciation, ownership, number of days worked, year of commencement of operation, payments for copyrights, royalties and patents, etc..

The explanatory variables adopted in the econometric investigation basically follow the theoretical and empirical literature reviewed in section 5. However, two different spillover variables are used with regard to the presence of foreign firms (see further).

The explanatory variables are defined as follows:

KI Capital intensity, measured as the ratio of fixed assets to the number of employees in each firm.[18] *KI* indicates the average physical capital stock per worker. It is expected that, *ceteris paribus,* output per worker will increase with a rise in capital intensity and that the estimated *KI* parameter is positive.

[18] We are using "firm" and "establishment" interchangeably.

MI Material input intensity,[19] defined as the ratio of material input purchases of each individual establishment to total number of workers in that establishment. The estimated parameter *MI* is expected to be positive.

L Labor inputs employed in each establishment. A positive coefficient estimate is expected.

FOR Share of foreign ownership (percentage of capital equity held by foreign investors in firm *i*) at the establishment level, which varies from 0 to 1 (100 percent).[20] A statistically significant positive coefficient associated with *FOR* suggests that establishments with foreign ownership enjoy higher labor productivity gains than their domestically-owned counterparts.

EFOR Proxy for foreign presence, defined as the ratio of the employment of foreign firms to total employment in each subsector at the 4-digit industry level, following Blomström et al. (2000). The variable measures the spillover effect.

QFOR Proxy for foreign presence, defined as the ratio of the output of foreign firms to total gross output in each subsector at the 4-digit industry level. The variable measures the spillover effect, following Blomström and Sjöholm (1999).

SIZE Firm size, measured as an establishment's sales over the average sales in the sector at 4 digit industry level, following Blomström and Sjöholm (1999). The variable is used to control for economies of scale. The slope coefficient on *SIZE* is expected to be positive.

[19] Haskel et al. (2007) included both energy and non-energy inputs (intermediate inputs) purchases as one of the control variables in their econometric estimations on productivity spillovers.

[20] A dummy variable, equal to 1 for a firm with foreign equity and 0 otherwise, was used to capture the difference between domestically owned and foreign owned firms. However, the foreign ownership share is preferred as it captures more detailed information about the role of foreign presence (Aitken and Harrison, 1999; Dimelis and Louri, 2004).

LQ Labor quality, measured as the share of male workers in the total workforce in each firm.[21] Lacking sufficient data on the number of managers, technicians, or engineers (white-collar workers), this proxy was chosen as on average males benefit from much higher education than females in Cambodia (Ministry of Planning, 2006, Tables 6.9-10). Similarly, Yamagata (2006) conducted a field survey of 164 garment companies in 2003, with 2000 as the reference year, and reported that engineers, executives and managerial staff are more likely to be men than women. A higher *LQ* index is assumed to represent a higher quality of employees in a firm, which in turn translates into higher productivity. A positive sign of the coefficient associated with LQ is expected.

PAT Proxy for use of proprietary technology/ intangible assets per capita in each firm, defined as the ratio of payments for copyrights, royalties, and patents to total employees in each firm, following Kokko (1992, 1996) and Blomström et al. (2000). A positive coefficient on the variable is expected.

As mentioned before, the presence of technology spillovers will be checked by two variables, *EFOR* and *QFOR*, which function as proxies for the presence of foreign firms.[22] It is believed that the presence of foreign firms may be reflected in employment and output levels in the industrial sub-sectors. The main purpose of this

[21] Some authors have defined labor quality as the ratio of managers, scientists, engineers and technicians to total workers or the ratio of white-collar workers to blue-collar workers (see, for example, Kokko, 1992,1996; Blomström and Sjöholm, 1999;Wei and Liu, 2001; Li et al., 2001). However, this variable, being the ratio of white-collar workers to blue-collar workers, is only a proxy for labor quality. A better measurement of the variable should reflect skills and education attainment of all workers. In the Cambodian context the ratio of male workers to total workers can be a reasonable proxy for labor quality.

[22] Both variables are widely used, separately, in empirical research. For example, Kokko (1996), Aitken and Harrison (1999), Blomström et al. (2000), Ruane and Ugur (2004), and Haskel, et al. (2007) used *EFOR*, while e.g., Blomström and Sjöholm (1999), Sasidharan and Ramanathan (2007), Javorcik and Spatareanu (2008) defined the spillover variable as the share of total gross output produced with foreign ownership (*QFOR*).

paper is to study the impact of foreign enterprises on labor productivity of all firms in Cambodia, including domestic firms, and to test whether FDI positively influences labor productivity in Cambodia's manufacturing sector.

As indicated before, cross-sectional data are used for the analysis of technology transfer from foreign to domestically owned firms. Heteroskedasticity is often present when cross-sectional data are used. This is why the usual OLS estimator is not the best linear unbiased estimator (BLUE) and the $t-$statistics are not $t-$distributed. These problems can not be resolved by using a large sample size (Wooldridge 2002, 2006). Similarly, $F-$statistics are no longer $F-$distributed. To sum up, the statistics used to test hypotheses under the standard Gauss-Markov assumptions are invalid in the presence of heteroskedasticity. We are using a more efficient estimation method employed for the validity of the usual statistics for hypothesis tests.

Statistical diagnostic tests are of vital importance to determine the appropriate statistical models and estimation techniques to avoid misleading econometric results and hypothesis tests. Many previous papers on spillovers failed to carry out the relevant statistical diagnostic tests such as the collinearity test and functional form misspecification tests (see e.g. Kokko, 1992, 1996; Blomström and Sjöholm, 1999; Blomström et al., 2000; Dimelis and Louri, 2004).

Before reviewing our econometric results, we report on several tests such as for multicollinearity (VIF and Belsley's condition number), heteroskedasticity and Ramsey's regression specification error (RESET) for functional form misspecification. The more common tests for multicollinearity are often based on the collinearity index or variance inflation factor (VIF) or on Belsley's condition number. The variance inflation factor (VIF_i) has been shown to be equal to $1/(1-R_i^2)$, where

R_i^2 is obtained from the multiple correlation coefficient of an explanatory variable X_i regressed on the remaining explanatory variables. Evidently, a higher VIF_i indicates that the R_i^2 approaches unity and therefore points to high collinearity.

Taking all explanatory variables into consideration simultaneously, Belsley's condition number of a matrix $X^T X$ is the square root of the ratio of the largest to the smallest eigenvalues.[23] A large condition number of $X^T X$ reflects the existence of one or more near linear dependencies among columns of X. It is generally accepted that VIF $\leq$ 10 or Belsley's condition number < 30, are of no concern (Belsley, 1991, Coenders and Saez, 2000; Douglass et al, 2003).

There are a number of suggested tests for heteroskedasticity (Wooldridge, 2002, 2006). Only the modern tests are briefly discussed here. The first one is the Breusch and Pagan test for heteroskedasticity, which is based on an LM statistic, shown to be equal to $LM = n.R_{\hat{u}^2}^2$, where $R_{\hat{u}^2}^2$ is obtained by regressing the OLS squared residual on all k dependent variables, and n being the sample size. Under the null hypothesis of homoskedasticity, the LM statistic is asymptotically χ^2 distributed with k degrees of freedom. The second test is known as the general White test for heteroskedasticity and is based on an estimation of the OLS squared residual on all independent variables, squares of independent variables, and all their cross products. The general White test consists of the LM statistic for testing all the coefficients in the squared residual estimation on all independent variables, their squares and cross products, being zero, except for the intercept. However, the general White test clearly suffers

[23] X^T is the transpose of matrix X.

from a weakness in the pure form of the test because it employs many degrees of freedom.

To conserve degrees of freedom, especially when a model consists of a moderate or large number of independent variables, Wooldridge (2002, 2006) proposed the special White test for heteroskedasticity, which incorporates the Breusch-Pagan and the general White tests. The special White test, also based on the LM statistic, suggests testing for heteroskedasticity by estimating the OLS squared residual on fitted values and squared fitted values. Under the null hypothesis, the LM statistic for the special White test is chi-square distributed with 2 degrees of freedom, regardless of the number of independent variables in the model. This is why the special White test for heteroskedasticity is to be preferred.

A multiple regression model may suffer from functional form misspecification when it does not or insufficiently account for the relationship between the dependent and independent variables. Important or relevant variables may be excluded from the regression equation or the model, when a non-linear model is estimated as a linear model. Such misspecification will be detected by using the RESET test (F statistic), which is based on Ramsey (1969). Under the null hypothesis that the model is correctly specified, the F statistic distribution is approximately $F_{3,n-k-3}$ in large samples. Rejection of RESET implies that the model under consideration is misspecified.

7. Econometric Estimation Results

Since we use two different proxies for the presence of foreign owned firms, it may be interesting to present the basic statistics separately. Tables 2-3 show the Pearson

correlation coefficient matrix for the two proxies: *EFOR* and *QFOR*, respectively. As can be seen from these tables, the correlation coefficients between the independent variables are reasonably low, implying that there is no damaging multicollinearity. To confirm this, collinearity tests are carried out, which are based on *VIF* and condition number statistics. The statistics for *VIF* (≈ 1.40) are much lower than 10, and these for Belsley's condition number (≈ 19) are much lower than 30, confirming the absence of harmful multicollinearity. Therefore, the coefficients of the independent variables to be estimated are considered to be stable.

Table 2: Pearson Correlation Coefficient Matrix with EFOR

	lnLP	lnKI	lnMI	lnL	lnEFOR	lnLQ	SIZE	PAT
lnLP	1							
lnKI	0.421	1						
lnMI	0.668	0.257	1					
lnL	0.268	–0.026	0.304	1				
lnEFOR	0.223	0.089	0.120	0.286	1			
lnLQ	0.026	–0.027	0.078	–0.472	–0.239	1		
SIZE	0.288	0.074	0.368	0.204	–0.019	0.059	1	
PAT	0.135	0.078	0.096	–0.010	0.020	0.053	–0.019	1

Notes:
1. ln demotes the natural logarithm.
2. LP = ratio of gross value added to total workers; MI = ratio of material inputs to total workers; KI= ratio of fixed assets to total workers; L=Labor EFOR = ratio of foreign firms' employment to total employment; LQ = ratio of male workers to total workers; SIZE = establishment's sales over the average sales; and PAT = payments for copyrights, royalties, and patents per employee.

Table 3: Pearson Correlation Coefficient Matrix with QFOR

	lnLP	lnKI	lnM	lnL	lnQFOR	lnLQ	SIZE	PAT

lnLP	1							
lnKI	0.421	1						
lnMI	0.668	0.257	1					
lnL	0.268	–0.026	0.304	1				
lnQFOR	0.250	0.053	0.148	0.579	1			
lnLQ	0.026	–0.027	0.078	–0.472	–0.339	1		
SIZE	0.288	0.074	0.368	0.204	–0.033	0.059	1	
PAT	0.135	0.078	0.096	–0.010	–0.011	0.053	–0.019	1

Notes:
1. ln denotes natural logarithm.
2. QFOR = ratio of foreign firms' output to total gross output.
3. See notes in Table 2 for other variable names.

Table 4 presents the labor productivity differences for firms in the Cambodian manufacturing industry by ownership. Model 1 is the regression of labor productivity on all explanatory variables, except the ownership variable *FOR*. All coefficient estimates have the expected sign. Coefficients on capital intensity, material input purchases per capita, and labor input variables are positive, and are highly significant at the 1% level, suggesting that these three variables are significant determinants of labor productivity. The variable for intangible assists (*PAT*) is positive and statistically different from zero at the 10% level, indicating that the use of proprietary technology may enhance productivity. Slope parameters of other variables are not different from zero at any conventional significance level.

Table 4: Impact of Foreign Ownership on Productivity
Dependent variable: Per-worker value added for all Establishments

Independent Variables	Model 1	Model 2
Constant	2.1690***	2.2491***
	(0.2570)	(0.2596)

lnKI	0.1970***	0.1994***
	(0.0238)	(0.0238)
lnMI	0.4350***	0.4309***
	(0.0285)	(0.0285)
lnL	0.2382***	0.1934***
	(0.0404)	(0.0463)
lnLQ	0.1212	0.1957*
	(0.0966)	(0.1035)
FOR	—	0.5042**
		(0.2544)
SIZE	0.0120	0.0139
	(0.0087)	(0.0088)
PAT	0.0013*	0.0013*
	(0.0008)	(0.0008)
No. of Observations	701	701
Adjusted R^2	0.4919	0.4940
Special White test for heteroskedasticity	3.852	3.778
RESET	1.490	2.480

Notes:
1. Standard Errors are in parentheses.
2. *, **, and *** denote that the coefficient is statistically different from zero at less than the levels of 10%, 5% and 1%, respectively.
3. FOR is share of foreign equity in each establishment, values range from 0 to 1.
4. See notes in Table 2 for other variable names.

That labor quality is not a significant determinant should not come as a surprise as Cambodian industry is low-tech and requires relatively low skills and educational levels. The empirical findings with respect to the labor quality are consistent with the results of a field survey by Yamagata (2006) in 164 garment companies operating in Cambodia in 2003, where it was reported that most firms do not set any educational level requirements for hiring their personnel and that the average education level is primary schooling. Sok, Chea and Sik (2001) come to a similar conclusion in Cambodia.

Following the methodological discussion above about the use of cross-sectional data, two additional diagnostic tests were performed: BP and RESET tests. With heteroskedasticity, a regression with White-robust standard error should be applied for the relevant tests under Gauss-Markov assumptions to be valid. The insignificant χ^2 statistics of BP at reasonably small significance levels show the absence of heteroskedasticity (Tables 4-6).[24] Likewise, the insignificant χ^2 values of Ramey's RESET statistic suggest that the model does not suffer from functional form misspecification.

In Model 2, *FOR* is included to control for the effect of foreign ownership on labor productivity. The introduction of the variable slightly changes the magnitudes of the estimated slope parameters, signifying low correlation between the variable and other explanatory variables, which is confirmed by VIF (2.12) and Belsley's condition number index (14.83). The coefficient of foreign ownership *FOR* is positive and statistically significant at the 5% level, which suggests that there are productivity gains associated with foreign equity participation at the establishment level. The coefficient of 0.5042 indicates that an increase in foreign equity participation from 0 to 100 percent, *ceteris paribus*, will lead to about 66 percentage points higher productivity ($e^{0.5042} - 1 \approx 0.66$) for foreign owned firms compared to domestically owned counterparts.

[24] The special White test for heteroskedasticity, which incorporates the general White test and BP test (see Wooldridge 2002, 2006) is used. Under the null hypothesis of the special White test of homoskedasticity, the test statistic is χ^2 distributed with 2 degrees of freedom. Based on the computed χ^2 values, the null hypothesis is not rejected at the 5% level, suggesting that heteroskedasticity is not a concern.

The coefficient of capital intensity has the expected positive sign, and is highly statistically significant at less than 1%. This implies that *ceteris paribus* firms employing more capital per worker have higher labor productivity. The coefficients on the PAT and labor quality variables are positive and statistically different from zero at the 10% level, indicating weak evidence that the two variables positively affect productivity in the manufacturing sector. The firm size variable, however, is insignificant in both models at any conventional significance level. To sum up, foreign ownership appears to be a significant determinant of labor productivity in the Cambodian manufacturing sector. Based on model 2, firms with foreign ownership are shown to enjoy higher labor productivity gains than the domestically owned counterparts.

Based on the previous discussion, it is expected that the presence of multinational enterprises in the host economy will allow for the transfer of intangible assets by these firms to locally owned ones through different channels, as discussed in the literature above. Table 5 presents the econometric results of productivity spillovers from foreign presence on domestically owned establishments in the Cambodian manufacturing industry. In Models 3–4, only wholly domestically-owned establishments are included in the estimations. Local labor productivity (*LP*) is influenced by capital intensity, material inputs intensity and labor inputs, labor quality, size of the establishment, and the use of intangible assets.

Table 5: Productivity Spillovers towards wholly domestically-owned establishments.

Dependent Variable: Per-worker Value Added in Domestic Establishments

Independent Variables	Model 3	Model 4
Constant	2.5759*** (0.3663)	2.7209*** (0.3706)

lnKI	0.2333*** (0.0455)	0.2311*** (0.0456)
lnMI	0.4533*** (0.0359)	0.4592*** (0.0364)
lnL	0.1458** (0.0600)	0.0491 (0.0690)
lnLQ	0.2605# (0.1750)	0.2265## (0.1772)
SIZE	0.0143 (0.0118)	0.0181* (0.0109)
PAT	0.0016 (0.0010)	0.0017 (0.0010)
lnEFOR	0.2024*** (0.0529)	—
lnQFOR	—	0.1466*** (0.0341)
Number of Observations	469	469
Adjusted R^2	0.5430	0.5458
Special White test for heteroskedasticity	6.8328**	7.2254**
RESET	0.43	0.17

Notes:
1. Standard errors are White heteroskedasticity-corrected standard errors in parentheses.
2. *, **, and *** indicate that the coefficient is statistically significant at less than the level of 10%, 5% and 1%, respectively.
3. # and ## refer to the coefficient being statistically different from zero at 13.7% and 20%, respectively.
4. See notes in Table 2 for other variable names.

The coefficients in Model 3 of capital intensity, material inputs intensity and the labor input variables have the expected positive signs, and are highly significant at the levels of 1% and 5% respectively, while firm size, payments for intangible assets, and labor quality are statistically insignificant (see Table 5).[25] The coefficient of capital

[25] There is evidence (at 10% significance level) that local productivity is positively affected by firm size.

intensity suggests that a one percent increase in the capital stock per worker *ceteris paribus* raises local productivity with about 0.23 percent. Likewise, the coefficient of material inputs implies that a one percent increase in these inputs per worker will result in an increase of 0.45 percent in the labor productivity.

In Model 3, the coefficient of the spillover variable *EFOR* has the expected positive sign, and is different from zero at the 1% significance level, confirming that domestically-owned establishments do benefit from the presence of multinational enterprises in the same industry. The magnitude of the foreign presence variable is about 0.20. Since *EFOR* is in natural logarithm, a one-percent increases in foreign presence increases local labor productivity in the manufacturing sector in Cambodia with 0.20 percent. The economic significance of the foreign presence is relatively low, compared to those found in empirical studies in some other developing economies (see, for example, Blomström and Sjöholm (1999) for Malaysia; Liu et al. (2001) for China). This may not be too surprising given that the level of economic development of China and Malaysia is higher, and that total FDI in those countries is also much higher.

The small coefficient estimates of the spillover variables in Cambodia might be due to few cases with minority ownership (less than 50%) and majority ownership with more than 50% of the equity share. There are only five establishments with minority foreign ownership compared to 116 companies with majority foreign ownership in the total sample of 932 firms. It has been argued in the literature that a higher degree of foreign ownership may limit the scope for technology transfer to local firms. Haddad and Harrison (1993), Dimelis and Louris (2004) and Bishop (2007) have confirmed that host countries benefit more from joint ventures where foreign partners

own a minority part of equity because they are less concerned of losing technology and know-how to the partners.

As was pointed out in section 3 and more particularly in Figure 2, the empirical evidence of the impact of FDI on local labor productivity is far from conclusive, i.e., some authors find positive spillovers while others fail to do so. These different results may be partly due to different constructions of the spillover variables. To check this, *QFOR* was used in Model 4, in stead of *EFOR*. The econometric results of Model 4 are consistent with these of Model 3, and the existence of positive spillovers from foreign owned subsidiaries in the manufacturing sector in Cambodia is confirmed.

Our findings consequently suggest that FDI in the Cambodian manufacturing sector plays an important and positive role in enhancing local labor productivity. Capital and material inputs intensity are very significant determinants of productivity. Other variables such as labor quality, firm size (proxy for economies of scale), and payments for royalties, copyrights and patents, however, do not appear to affect labor productivity in the industrial sector of Cambodia.

8. Concluding Remarks

This paper has investigated the impact of FDI on local labor productivity in the Cambodian manufacturing sector, using unique, unpublished data from the latest Survey of Industrial Establishments (2000) in the Kingdom. The original sample size of the data consists of almost one thousand firms in Cambodia during 2002–2003, of which about 11 percent is wholly foreign owned, and 2 percent is minority joint ventures and only partially owned by foreign investors.

Our major finding is that increases in foreign equity participation are positively correlated with increases in labor productivity.

The impact of FDI on local labor productivity in Cambodia's manufacturing sector was examined on the basis of a number of control variables such as capital intensity, material and labor inputs, labor equality, size of establishment, and payments for royalties, copyrights and patents. Two proxies for the presence of foreign owned enterprises were used as it was expected that such presence could be reflected in terms of either the employment or the output level. The main contribution of this paper, compared to other empirical studies is that several statistical diagnostic tests were carried out to avoid misleading econometric results. The analysis shows that the coefficients of the two proxy variables for the influence of foreign owned enterprises are positive and highly significant, signifying that FDI played a positive role in enhancing labor productivity in the Cambodian manufacturing sector. Similarly, capital intensity was also shown to positively affect domestic labor productivity. On the other hand, variables such as labor quality, labor inputs, size of establishment, material inputs and payments for royalties, copyrights and patents do not seem to be related to labor productivity in Cambodia.

This study also allows to draw attention to some policy implications for Cambodian government representatives and business managers. Since FDI has a positive impact on productivity, the country's investment-friendly policy should continue to be adopted and implemented so that more inward FDI might be attracted into the Kingdom. Also, the removal of the remaining administrative barriers, as well as the introduction of an anti-corruption law and an active anti-corruption campaign, including the elimination of the general business practice of the payment of "speed money", among others, may have a positive impact. Improvement of the business

environment in the country might convince foreign investors to locate production activities in Cambodia. More inward FDI will give rise to an increase in the capital stock, which in turn will raise labor productivity, as shown by the positive and significant coefficient on the capital intensity variable in all the models used in the paper.

Although statistically insignificant at the conventional significance level (only significant at the 13.7% level), the estimated labour quality coefficient is positive. This suggests that more investment in education and in the training of the vast pool of low skilled labor in Cambodia might also enhance labor productivity. Admittedly, labor quality in the estimations had to be measured by a proxy because of limitations of data on skills and education levels. The availability of more skilled labor and the introduction of more formal or informal training programs would be beneficial to Cambodia in the longer term by upgrading the technological competences. Foreign owned firms might speed up the training of workers, which would allow them to use more advanced technology in their subsidiaries and increase spillovers to domestic counterparts.

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