

Technology Spillovers of FDI in ASEAN Sourcing from Local and Abroad

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Abstract

The effect of technology spillovers is widely considered as one of the main channels through which domestic firms benefit from FDI, and plays an important role in economic development of host countries. Based on the analysis framework for technology spillovers established by Borensztein et al. (1998), this paper will analyse and try to figure out the development patterns of ASEAN by utilizing time-series data between 1990 and 2008 in ASEAN countries. The empirical results render a support to the existence of technology spillovers in ASEAN, which has a positive effect on the economic development of ASEAN. China's FDI in ASEAN requires lower education threshold, also has positive effect on economy growth in six countries of ASEAN.

Keywords: FDI (Foreign Direct Investment), Technology Spillovers, Human Capital, ASEAN (Association of Southeast Asian Nations), China

JEL Classification: F15, F21

1. Introduction

The Asian development model in global economy has three characteristics: governments play relatively important roles in resource allocation; achieve technological progress and industrial upgrade through the introduction of foreign capital; develop export-oriented economies. China and ASEAN have both followed this development model, thus FDI is critical in stimulating their economies.

In November 2002, "Framework Agreement on Comprehensive Economic Co-operation" was signed in Phnom Penh, Cambodia, by Chinese Premier Zhu Rongji and ASEAN leaders, launching the building process of China-ASEAN Free Trade Area that would be completed in 2010. China had increased its direct investment in ASEAN, and in January 2010, China-ASEAN Free Trade Area started. China would not levy tariffs on 93% of ASEAN goods. This area covered 11 countries and 1.9 billion people, had a GDP of USD 6 trillion in total, and created tremendous opportunities of promoting bilateral investment, improving the efficiency of resource utilization, and achieving rapid economic growth.

ASEAN was established in 1961, and has 10 member countries now. Since the 1990s, they began to open capital markets, and hardly imposed any restrictions on capital flows. It attracted investments mainly from developed countries including Japan, USA and European countries, accounting for around 8% of global FDI in total before the outbreak of Asian financial crisis. Afterwards, foreign capital flew out of ASEAN, and towards China and Eastern Europe. Until 2005, the FDI inflow of ASEAN began to rise. In November 2007, ASEAN leaders signed the "ASEAN Charter" to render itself a legal status, which effectively promoted regional economic integration, and substantially increased the intra-investment among ASEAN member countries.

The outbreak of global financial crisis in 2008 and the on-going European sovereign debt crisis, heavily stroke the ASEAN economy that mainly relied on external demand. How to improve the economic vulnerability? It was ASEAN's consensus to make increasing efforts to attract foreign investment, and adjust its internal industrial structure and external trade structure. Due to the differences in economic benefits that FDI from different sources brought to ASEAN countries, the governments of Thailand and Viet Nam et cetera made it clear in 2010 that they had a value-oriented preference of foreign investment, that is, preferred high value-added FDI, and would impose restrictions on

labour-intensive FDI to a certain extent. This paper will perform an in-depth comparative analysis on economic benefits generated by FDI from different sources, and conduct an objective assessment on the role and competitiveness of China's FDI towards ASEAN, thus providing a scientific basis for China's future investment towards ASEAN.

2. Literature Review

2.1. FDI has both positive and negative spillover effects on enterprises

Hymer (1976) believed that multinational corporations play important roles in promoting the process of global industrialization. FDI is considered "transnational" in industrial organization, representing an international cooperation including capital, management, and new technologies.

Caves (1974) examined what impacts the presence of foreign capital (foreign presence) had on the value added per worker in Australian domestic manufacturing sector. He pointed out that as foreign firms hired more domestic labours, the differences in value added per worker between foreign and domestic firms would be narrowing, which complied with the hypothesis of "spillover effect".

Blomstrom and Persson (1983), Blomstrom (1986) and Blomstrom and Wolff (1989) analysed scenarios in Mexico, and found that productivity gap and the "spillover effect" are even larger between foreign and domestic firms. They pointed out that, those sectors with a higher proportion of foreign ownership had higher productivity levels that accelerated faster as well.

Aitken and Harrison (1999) conducted a research on more than 4,000 Venezuelan companies, and showed that, the higher the foreign equity ratio, the better the performance of corporate profits, that is, FDI had a positive "own-plant effect". However, as FDI increased, the productivity level of domestic firms decreased, that is, FDI generated an obvious negative "market-stealing effect", thus the net effect was very small after the two offset each other.

Tu and Li (2007) added a variable of foreign penetration into the Cobb-Douglas production function, and quantitatively analysed the impact of technology spillover effects from foreign firms on the economic growth in China's provinces. The study found that foreign technology spillover effect outweighed crowding-out effect. However, due to successful business strategy of foreign firms, the share of domestic firms was reduced in developed regions. Therefore, the paper suggested

that domestic firms can strengthen independent R&D, forcing foreign firms to introduce more advanced technology.

2.2. FDI is conducive to the technological progress in developing countries

According to Gerschenkron's (1962) hypothesis, the larger the gap between development levels of developed and developing countries, the faster the catch-up rate. Findlay (1978) constructed a model to test the relationship between FDI and the technological progress in developing countries. He believed that catch rate was an increasing function of the technology gap between regions, and technology diffusion was similar to the spread of diseases. Therefore, the larger the gap between domestic and foreign firms, the more obvious the technology spillovers were. In those regions with more frequent exchanges of knowledge between people, technology diffusion was faster. This view led to a new assumption that the speed of technological progress in developing countries were in proportion to their degree of acceptance towards FDI. The ratio of capital stock of foreign firms to that of domestic firms was used to measure penetration of foreign capital (foreign penetration). Findlay also studied the relative growth rate between foreign and domestic capital, and he found that this rate would to some extent be affected by the savings propensity in developing countries, the tax rate for foreign firms, and foreign capital dependence.

De Gregorio (1992) studied the role of technology diffusion in economic development of Latin American countries, and found that the efficiency of FDI was 3 times higher than that of domestic investment. Blomstrom et al. (1992) also found that FDI was very helpful for the development of less developed countries. Through the "contagion effect" generated by more advanced technology and managerial experience, FDI accelerated the speed of technological progress in host countries.

Kokko (1994) pointed out that foreign firms brought advanced technologies through their support to local suppliers and consumers, technical support, and the process in which high-skilled workers trained by foreign firms transferred to domestic firms. In addition, the competitive pressure brought by foreign firms also stimulated the operational efficiency of domestic firms, and forced them to accelerate the introduction of advanced production technology. As foreign firms could not transfer all

the benefits, this effect was called "technology spillovers".

2.3. Human capital is crucial to determine FDI

Wang (1990) proposed that FDI determined the improvement of knowledge levels in production, through the analytical framework of neo-classical growth theory. Borensztein et al. (1998) conducted an empirical analysis on FDI towards 69 developing countries from developed industrial countries in 1970-1989, emphasizing that FDI had a complementary relationship with human capital in the improvement process of productivity, and that the level of human capital in host countries was positive to the level of contribution that FDI made to economic growth. Only when the human capital in host countries exceeded a minimum threshold, FDI was more efficient than domestic investment.

Mencinger (2003) selected 8 Eastern European countries that were in the phase of transition, and studied whether FDI inflows would promote economic growth in these countries. The results showed that, in 7 countries other than Lithuania, FDI was negatively correlated to economic growth. And, through the analysis of the annual cross-sectional data, the relationship was also negative except in 1997.

Wang and Li (2004) established an endogenous growth model, which examined FDI spillover effects by analysing data of 29 provinces in China in 1982-2001. They found that the ratio of FDI to domestic capital was one of the key factors affecting the domestic long-term economic growth, and that FDI spillovers could be positive only in regions which exceeded the threshold of human capital.

Dai and Bie (2006) examined the impact of FDI on China's economic growth in 1979-2003. They found that, the positive effects of FDI were mainly short-term positive effects, and the effects of human capital should be more apparent in the long term. The fact that highly-skilled labour forces including university graduates entered the labour market could improve the positive effect generated by FDI.

2.4. Factors that attract FDI

Kumar (2001) found that in 66 countries, the high quality of infrastructures played a key role in attracting FDI, including roads, electricity, communications and other "hard infrastructure", and efficient governments, customs and other "soft infrastructure".

Globerman and Shapiro (2002) studied that, the construction of corporate governance has played an important role in determining both inflows and outflows of FDI. Not only did it

attract capital inflows, but also created suitable conditions of governance and investment for multinational firms in host countries.

Dunning (2002) believed that, traditional economic factors still had a major impact on large developing countries. However, FDI from the more industrialized countries, were seeking more complementary knowledge-intensive resources, transparent business environment, communications infrastructure, and government policies that were conducive to globalization, innovation, entrepreneurship, which has not been empirically tested yet.

Dongs (2005) categorised the following factors into "traditional factors" affecting FDI: market size, openness, wage rates, human capital, political stability, infrastructure, and policy considerations. He also noted that, the role and importance of these factors were changing because of globalization, which in the literature was not paid close attention.

UNCTAD (2006) pointed out that FDI from developing countries were positive for those developing host countries, because of the smaller technology gap between the source and host countries, and the more similarities between large firms and organizations among these countries. Thus, these investments could be more easily integrated into local economic environment.

2.5. The FDI in China-ASEAN

Wong and Chan (2003) thought that, the China-ASEAN Free Trade Agreement had stimulated FDI inflows from China to ASEAN countries, and predicted that in the near future, China would be following the Western countries, Japan, the four Asian Tigers to bring the ASEAN countries a fourth surge of FDI inflows. ASEAN countries came to realize that China's investment had brought more opportunities, thus they had taken more measures to attract investments from China.

Du and Song (2004) put forward a two-level model of investment creation and transfer, through the study on status and trends of the ASEAN and China's FDI, and noted that the creation by investment and intra-region transfer would dominate FDI effects in the China-ASEAN Free Trade Area.

Dong (2006) constructed a three-country model through Cournot model, and put forward that cross-tariff investment could be promoted by reducing trade barriers. She tested FDI in ASEAN and China in 1992-2004, and proposed that market openness, wages, import quotas and market size had impacts on FDI inflows.

Zhou and Lall (2005) analyzed the impacts that China attracted investment from ASEAN and the reverse process, by adopting the location-

factor model and the fixed-effect analytical method, and believed that China did not squeeze other foreign investment into ASEAN countries, but had a stimulating effect on its complementary investment, and that the investment effect created by the Free Trade Area was larger than the transfer effect.

Chandararot and Dannet (2009) studied that FDI from China did not pay enough attention to the training of local labours, and local seniors could only get limited on-the-job training, which reflected the lack of a systematic training system.

In summary, previous literatures fully discussed the positive and negative spillover effects of FDI, and the necessary conditions that FDI promoted economic growth in host countries, and did a lot of empirical studies. However, most of these studies were on the perspective of developed countries, analysing effects of FDI on their own and those invested countries. In their studies of the economic benefits of FDI in ASEAN, they neither distinguished sources of FDI and the resulting differences, nor examined the impacts of education threshold on technology spillover effects of FDI. And, those studies about investment effects from China to ASEAN did not consider the differences between host countries. Therefore, this paper is innovative in that it distinguishes the sources of FDI to ASEAN, examines FDIs respectively from all over the world (total FDI), intra-ASEAN, and China. It aims to answer the following three questions: (1) Whether FDI has technology spillovers to ASEAN countries? (2) Whether human capital will promote the FDI technology spillover effect? (3) Whether the FDIs from all over the world (total FDI), intra-ASEAN, and China have the same effect in stimulating ASEAN economic growth?

3. The status and trends of FDI inflows to ASEAN

3.1. FDI from all over the world (total FDI)

From 1995 to 2006, FDI inflows to ASEAN nearly tripled, from USD 343 billion to 1.31 trillion, nearly tripled, and reached a peak of USD 1.4 trillion in 2000. Before the Asian financial crisis, ASEAN once became a hot host in emerging markets for FDI from developed countries, and its amount of FDI inflows accounted for 8% of global FDI. After the Asian financial crisis triggered by Thailand, ASEAN countries were battered, and foreign investment retreated by a large scale. In 2008, it only took a 4% share of global FDI inflows. The situations of economic development of ASEAN countries were unbalanced, with wide disparities for attracting FDI. Singapore accounted for 50% of total FDI

inflows to ASEAN countries. As ASEAN four tigers, Thailand, Malaysia, Indonesia, the

Philippines were the main FDI recipient countries (see Figure 1).

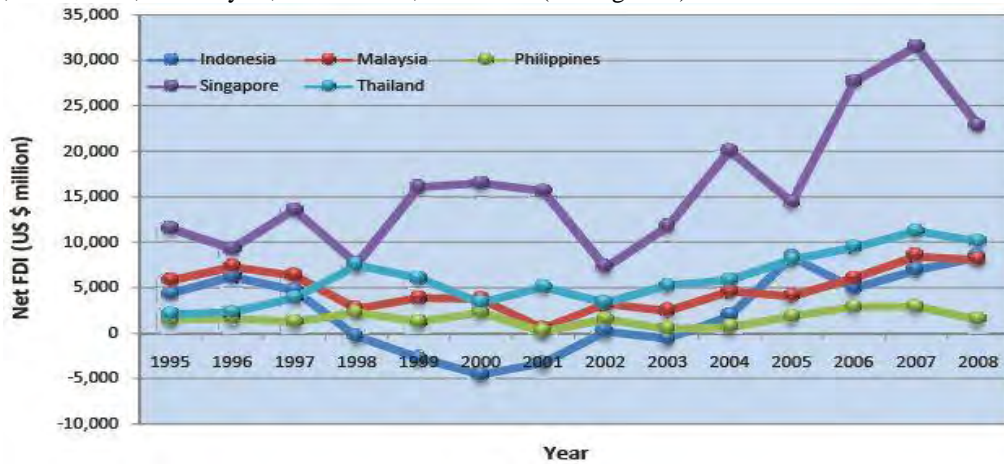


Figure 1: FDI inflows of five major ASEAN countries in 1995-2008, by host countries. Unit: USD millions
 Source: ASEAN Statistical Yearbook 2008

The main sources of ASEAN's FDI are developed countries, of which those from the United States and the European Union almost account for more than half. In 2006, the EU was the largest source of FDI inflows, reaching USD 102 billion, more than double the amount of the United States (USD 50 billion), and 1.8 times of Japan (USD 55 billion). China's FDI into ASEAN was only USD 2.8 billion, accounting for only a small portion (see Figure 2). In Singapore and other developed ASEAN countries, FDI from the United States and Japan accounted for the vast

majority. In 2008, the instability of financial markets caused by the economic crisis had different levels of impacts on each of those developed countries, FDI outflows from which declined obviously. FDI from the United States was most negatively affected, plunging by 53 percent to USD 3 billion. Other large declines came from the EU, and its outflow declined by 29% to USD 13 billion, compared with a positive increase of 73% in 2007. FDI from Asia also declined, and China, Japan and South Korea were 9%, 15% and 48% respectively.

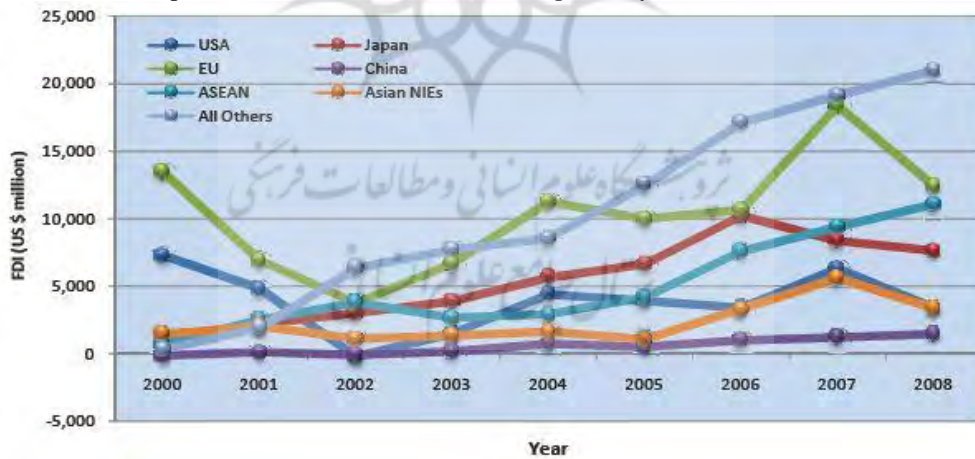


Figure 2: FDI inflows to ten ASEAN countries in 2000-2008, by host countries. Unit: USD millions
 Source: ASEAN Statistical Yearbook 2008

3.2. Intra-ASEAN FDI

Thanks to the geographical and cultural similarities among ASEAN countries, the strengthening of economic integration, and the remove of trade and investment barriers, the scale of FDI within ASEAN region (intra- ASEAN FDI) was increasing. While FDI from developed countries were declining, intra-ASEAN FDI

remained stable. Intra-ASEAN FDI increased by 14.5% in 2008, reaching USD 10.8 billion. Intra-ASEAN FDI took 18.2% share of global FDI in 2008, compared with 13.5% in 2007. Most of the intra-ASEAN FDI flew into Indonesia, Thailand, Vietnam and Malaysia in 2008, accounting for 27.3%, 22.6%, 21% and 14.8%. Quantitatively, FDI into these four countries increased by USD

2.9 billion, 2.4 billion, 2.3 billion and 1.6 billion respectively.¹

3.3. FDI from China

Before China joined the WTO, China was basically a host country for foreign investment, and the scale of its outward investment was quite small. In 2001, China began to encourage domestic firms to investment abroad, that is, a “going out” strategy. After the China-ASEAN Free Trade Area launched, China's direct investment into ASEAN accelerated significantly. As of 2008, China's FDI into ASEAN countries had accounted for 17% of total FDI they received, compared with 5% in 2002. (UNCTAD 2010)

FDI from China mainly flew into its neighbouring countries, such as Cambodia, Laos, Myanmar and Thailand. In 2009, China was the largest investor in Cambodia; in Laos and Burma, China's FDI accounted for 9% and 22% of the total FDI they received (UNCTAD 2010a). Frost (2005) believed that FDI from China was far more than that. Taking Vietnam as an example, a large part of its total FDI inflows came from Hong Kong (China) and British Virgin Islands. Therefore, he thought that a greater part of China's investment was carried out bypassing these offshore financial centres.

ASEAN countries have various appeals in different industries for China. Pangestu (2004) found that, China's FDI into Cambodia, Indonesia and Laos mainly went to primary industry. Chia / Sussangkarn (2006) pointed out that Singapore had unique appeal for Chinese investors in tertiary industry including financial services, trade, shipping and logistics. In countries with lower wages such as Vietnam and Cambodia, their labour-intensive manufacturing sector had received a lot from China's FDI.

4. Empirical Analysis of Technology Spillovers of ASEAN FDI

4.1 Model and Variable Selection

The paper is based on the analytical framework of Borensztein et al. (1998), and establishes following econometric models:

$$GGDP = c_0 + c_1 LGDP + c_2 SCH + c_3 GOV + c_4 FDI \quad (1)$$

$$GGDP = c_0 + c_1 LGDP + c_2 SCH + c_3 GOV + c_4 FDI * SCH \quad (2)$$

$$GGDP = c_0 + c_1 LGDP + c_2 SCH + c_3 GOV + c_4 FDI + c_5 FDI * SCH \quad (3)$$

$$GGDP = c_0 + c_1 LGDP + c_2 SCH + c_3 GOV + c_4 FDI + c_5 FDI * SCH + I(\text{year}) \quad (4)$$

in which:

1) GGDP: growth rate of GDP per capita

2) LGDP: log of GDP per capita, which indicates the economic level, and is used to analyse the technology gap between domestic and abroad (N/N*)

3) SCH: human capital stock, which is represented by national gross enrolment rate of secondary education each year, and is globally recognized to be quite highly correlated with economic growth.

4) GOV: the ratio of government spending to GDP, which indicates the impact of government spending behaviour on the country's economic growth; meanwhile, it represents the level of government intervention in the economy.

5) FDI: the ratio of FDI to GDP, which replaces foreign presence (N^f/N) in the analytical framework. Here we use the data of overall amount of FDI provided by statistical yearbooks of ASEAN and each country. As the emphasis of this paper is on the impact of FDI on host countries through technology transfer and other spillover effects, we do not take into account the outflow of FDI and the resulting “technology loss”. We take total FDI, intra-ASEAN FDI and FDI from China into FDI variable respectively.

6) I: year dummy variable.

The basic model (1) is based on the variables of LGDP, SCH, GOV, and we add FDI, FDI interaction term with SCH, and year dummy variables one by one, to identify the final model that is the most significant and has the strongest explanatory power.

4.2. Sources of Data

This paper uses time series data of 10 countries in Southeast Asia in 1990-2008. The data mainly come from World Bank - World Development Indicators, UNCTAD (United Nations Conference on Trade and Development), ASEAN Statistical Yearbook, UNESCO STATS, the ASEAN-Japan Centre, the ASEAN-Korea Centre, and the statistical yearbooks of each ASEAN countries. As there are some unavoidable differences in the statistical sources and the calibre of data, it is inevitable to have some inaccuracies. This paper tries to process the data into similar calibres and units.

4.3. Empirical Results and Analysis

Models (1)-(3) estimate parameters by adopting OLS, and Model (4) uses dummy saturation methods in PC Give, Oxmetrics 6 to determine significant dummy variables automatically. By

¹ Data in 3.1 and 3.2 come from ASEAN Statistical Yearbook 2008, and Statistics of Foreign Direct Investment in ASEAN 2006

judging the overall significance of each variable and the model, Model (4) has a substantial improvement, compared with Models (1)-(3). Thus finally, we select Model (4) to judge the education threshold of each country.

We respectively take data of total FDI, intra-ASEAN FDI, FDI from China into the FDI

variable in Model (4), and get three sets of results for each country. Table 1 lists the signs of coefficients. Table 2 lists the automatically-determined year dummy variables, F statistics, adjusted R-square, education threshold, and whether the threshold is exceeded.

Table 1: Signs of each coefficient

When the variable FDI is represented by intra-ASEAN FDI:			
Positive coefficient of FDI-related variable:	Brunei, Laos, Myanmar, Philippines, Thailand	Negative coefficient of FDI-related variable:	Indonesia, Malaysia, Singapore, Viet Nam
Positive coefficient of GOV:	Brunei, Laos, Myanmar, Indonesia, Malaysia	Negative coefficient of GOV:	Philippines, Singapore, Thailand, Viet Nam
When the variable FDI is represented by FDI from China:			
Positive coefficient of FDI-related variable:	Cambodia, Laos, Philippines, Singapore, Thailand, Viet Nam	Negative coefficient of FDI-related variable:	Brunei, Indonesia, Malaysia, Myanmar
Positive coefficient of GOV:	Cambodia, Indonesia, Malaysia	Negative coefficient of GOV:	Brunei, Laos, Myanmar, Philippines, Singapore, Thailand, Viet Nam

Source: Authors

4.3.1. FDI-related variables (FDI, FDI*SCH)

It can be seen from Table 2 that, when the FDI and FDI*SCH interaction term are present, the signs of the two coefficients are always opposite. Thus, we need to add up the two coefficients to determine the total effect of FDI-related variables on economic growth. That is, the total effect of FDI-related variables is the sum of the direct impact of FDI technology spillovers, and the indirect impact of FDI on economy through the conduction of human capital.

As can be seen from Table 1, for Laos, Philippines and Thailand, the coefficients of FDI-related variables are always positive no matter when the FDI variable is represented by intra-ASEAN FDI or FDI from China, but for Indonesia and Malaysia, the coefficients are always negative. The coefficient for Brunei is positive only when using intra-ASEAN FDI, while the coefficients for Singapore and Viet Nam are positive only when using FDI from China.

4.3.2. GOV variable

4.3.3. Human capital threshold

Based on researches of previous literature, a certain level of economic development and education made it possible for host countries to imitate and learn advanced technologies and experiences brought by FDI. However, when host countries could not reach this level, not only could domestic firms hardly effectively learn technologies from foreign firms, their market share also would be eroded by foreign firms. That

Table 1 also shows that for Indonesia and Malaysia, the coefficients of GOV variable are always positive no matter when the FDI variable is represented by intra-ASEAN FDI or FDI from China, but for Philippines, Singapore, Thailand and Viet Nam, the coefficients are always negative. The coefficients for Brunei, Laos and Myanmar are positive only when using intra-ASEAN FDI. The reason is that, Singapore has the most similar economic structure to the characteristics of developed countries. Philippines and Thailand have high levels of economic development, and complete market mechanisms as well. Those excessive interventions from governments will likely to reduce the self-adjusting function of markets, and impair production efficiency. In countries such as Indonesia, Laos, Myanmar and Cambodia, their economies are dominated by agriculture, but their industrial systems are incomplete. Thus, governments need to impose strong macro-control policies on the economy, through a leaning support to some industries.

is, the inflows of FDI could not help host countries improve their technologies, but help foreign firms make use of the domestic low-cost raw materials and labours, and transfer all the profit out of host countries. Borensztein (1998) called this phenomenon the "threshold effect."

The formula for calculating education threshold:

$$\frac{\text{Coefficient of FDI}}{\text{Coefficient of FDI*SCH}} \times 100 \quad (5)$$

From Table 2, Brunei, Thailand and Singapore exceed all thresholds, indicating that people in these countries generally have higher education level, which can be adapted to the labour requirement of FDIs from different regions. Intra-ASEAN FDIs generally set a higher education threshold, and only Singapore, Vietnam, Brunei, and Thailand exceed the threshold. In contrast,

FDI from China set a relatively lower threshold, all ASEAN countries but Singapore exceeds- The threshold results for Singapore are abnormal, which may lie in that the data of FDI from China to Singapore is not accurate enough.

Table 2: Summary of estimation results

	Brunei			Cambodia		
	Total FDI	Intra-ASEAN FDI	China's FDI	Total FDI	Intra-ASEAN FDI	China's FDI
Year Dummy I	98,00	95,01,06,07,08	98,00	90,93,95,99		90,93,95,99
Adj. R-Square	0.5296	0.9238	0.6568	0.8661		0.8586
F-Stat	3.895*	22.81**	5.921**	13.94**		13.14*
Edu. Threshold	92.0177	96.5172	89.7884	61.8195		36.5564
Pass threshold?	Yes	Yes	Yes	No		Yes
	Indonesia			Laos		
	Total FDI	Intra-ASEAN FDI	China's FDI	Total FDI	Intra-ASEAN FDI	China's FDI
Year Dummy I	97,98,99,01,04,06	98,99,00	98,99	97,98	98	98,02
Adj. R-Square	0.9895	0.9354	0.8459	0.7145	0.5844	0.6947
F-Stat	154.6**	33.58**	15.12**	7.435**	5.218**	6.851**
Edu. Threshold	54.0523	76.7876	33.4246	39.4094	66.577	42.5000
Pass threshold?	Yes	No	Yes	Yes	No	Yes
	Malaysia			Myanmar		
	Total FDI	Intra-ASEAN FDI	China's FDI	Total FDI	Intra-ASEAN FDI	China's FDI
Year Dummy I	91,96,99,00	91,96,99,00	91,96,99,00	99,02	98,99,02,03,04,07	
Adj. R-Square	0.9691	0.9584	0.9724	0.7758	0.9694	0.4225
F-Stat	47.91**	47.11**	71.47**	9.896**	52.81**	3.634*
Edu. Threshold	81.5668	69.5619	64.8315	25.2939	77.0827	39.6296
Pass threshold?	No	No	Yes	Yes	No	Yes
	Philippines			Singapore		
	Total FDI	Intra-ASEAN FDI	China's FDI	Total FDI	Intra-ASEAN FDI	China's FDI
Year Dummy I	92,98	94,95,98,99	99	97,98,99,00,01	98,99,01	98,99,01
Adj. R-Square	0.7519	0.9284	0.7122	0.9104	0.6695	0.8465
F-Stat	8.792**	26.91**	8.423**	19.30**	5.557**	13.41**
Edu. Threshold	84.8352	89.8706	76.4136	52.0406	74.684	103.5703
Pass threshold?	No	No	Yes	Yes	Yes	No
	Thailand			Viet Nam		
	Total FDI	Intra-ASEAN FDI	China's FDI	Total FDI	Intra-ASEAN FDI	China's FDI
Year Dummy I	97,98,00,01	90,97,98,00	97,98,00,01,06	91,92,06	91,92	91,92,98,04
Adj. R-Square	0.8935	0.9682	0.9677	0.9400	0.8142	0.9225
F-Stat	17.79**	61.92**	54.87**	32.26**	12.27**	24.81**
Edu. Threshold	67.418	65.6958	67.4397	30.733	45.9730	78.7956
Pass threshold?	Yes	Yes	Yes	Yes	Yes	No

** F-stat is significant in 99% confidence interval

* F-stat is significant in 95% confidence interval

Source: Authors

The reason why differences in the education threshold level exist is that, for ASEAN as a whole, FDIs from different countries of origin flow into different sectors. Table 3 reflects which sectors FDIs flew into in 2005, categorized by countries of origin. Most of FDI from China went

to financial intermediation and services sector, accounting for 58.95%; Intra-ASEAN FDI mainly flew to services, real estate and manufacturing sectors, accounting for more than 20%. Particularly, manufacturing sector has a high-skill requirement for human capital.

Table 3: FDI inflows to ASEAN in 2005, by country of origin and economic sectors, unit: USD millions

Sectors	EU		USA		Japan		China		ASEAN	
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
Agriculture, fishery, forestry	148.03	2.06%	-0.07	0.00%	1.68	0.05%	3.64	0.78%	6.46	0.31%
Mining, Quarrying	329.34	4.59%	2600.04	29.70%	-3.93	-0.12%	43.96	9.42%	-11.35	-0.54%
Manufacturing	1455.51	20.29%	1470.19	16.79%	1474.53	46.61%	29.95	6.42%	427.84	20.33%
Construction	-10.6	-0.15%	-1.3	-0.01%	8.54	0.27%	2.1	0.45%	26.75	1.27%
Trade / Commerce	1407.04	19.61%	2753.37	31.45%	480.33	15.18%	-3.02	-0.65%	-23.56	-1.12%
Financial Intermediation and Services	1955.53	27.26%	829.5	9.48%	-95.66	-3.02%	274.98	58.95%	251.84	11.96%
Real Estate	626.39	8.73%	402.79	4.60%	14.6	0.46%	88.22	18.91%	515.02	24.47%
Services	1205.55	16.80%	522.04	5.96%	1177.82	37.23%	18.23	3.91%	790.05	37.54%
Others	57.56	0.80%	177.42	2.03%	105.51	3.34%	8.43	1.81%	121.77	5.79%
Total	7174.35	100.00%	8753.98	100.00%	3163.42	100.00%	466.49	100.00%	2104.82	100.00%

Source: Statistics of Foreign Direct Investment in ASEAN 2006

As each member country of ASEAN is quite different, we now penetrate into FDI from China. Table 4 divides FDI from China into more detailed parts by host countries and recipient economic sectors. 58.95% of China's FDI flows into financial intermediation and services sector (see Table 3), but the vast majority go to Indonesia (see Table 4). (The education level of

Indonesia reaches the requirement by financial intermediaries and service sectors). For sectors that do not require much for education level, such as agriculture, forestry, fishery, mining and quarrying, China's FDI flows to relatively less developed countries like Laos, Myanmar and Vietnam.

Table 4: FDI inflow to ASEAN from China in 2005, by economic sectors, unit: USD millions

Origin: China	Agriculture, fishery, forestry	Mining, Quarrying	Manufacturing	Construction	Trade / Commerce	Financial Intermediation and Services	Real Estate	Services
Brunei				0.01	0.04			
Cambodia								
Indonesia						292.36		
Laos	1.68	1.30	1.37				0.12	
Malaysia			-1.31			2.39		-3.17
Myanmar		34.32						
Philippines							-0.11	
Singapore	0.10		6.10	0.70	-4.60	-21.00	87.20	8.00
Thailand			4.09	0.39	0.24	0.02	1.02	
Viet Nam	1.86	8.34	19.70	1.00	1.30	1.20		13.40

Source: Statistics of Foreign Direct Investment in ASEAN 2006

4.3.4. Dummy Variables

Typically, if there are relatively large changes in macro-economic environment in a sample interval, such as frequent policy changes, fluctuations in economic output, specific economic events et cetera, those dependent variables will be hugely affected. Through an automatic selection of dummy variables representing each year, some of the year dummy

variables are significant, indicating that the model captured some incidents that were not predicted.

It can be seen by Table 2 that, in those automatically-determined significant dummy variables in each model, the years of 1998 and 1999 emerge most frequently in all the models, indicating that the models capture the fact that during this period when the Asian financial crisis

had greater abnormal impact on the economic growth of and inflows of FDI into the major countries in Southeast Asia.

In particular, we can also observe some special years in some countries: Cambodia (90, 93, 95, 99) achieved a ceasefire in the civil war for the first time in 1990 under the United Nations intervention, which was extremely important to the stability of domestic economic situation and provided investors with good investment environment. In 1993, a coalition government emerged in Cambodia for the first time, and in September, the Sihanouk dynasty reigned again, thus the frequent changes of regime this year had a significant effect on the economic environment. In 1999, Cambodia formally joined ASEAN. As for Vietnam (1991, 1992), it amended a new constitution in 1991 that was passed by Congress in 1992, and one of the most important part was to promote market-oriented economy gradually and confirm the basic mode of market economy. Therefore, the inflows of FDI fluctuated obviously in the two years.

5. Conclusion

First, the existence of FDI technology spillovers in most ASEAN countries has played a significant role in promoting economic development in host countries. The regression results also show that only when combined with human capital in host countries, can the FDI technology spillover effects be maximized. Therefore, for countries other than Brunei and Singapore, they should strengthen investment in education, attract highly-skilled talents, and thus complete the accumulation of human capital, all of which are very important to economic growth.

Second, the "human capital threshold" hypothesis proposed by Borensztein has been supported by actual data in most ASEAN countries. The combination of FDI with human capital in host countries can more effectively serve the economic growth only if the host country must exceed the "threshold" of human capital, otherwise the inflow of FDI is more likely to just utilize the local cheap labour force, erode the market share of domestic firms, and thus hinder economic development.

Third, from the aspect of institutional construction, the ASEAN government investment policies, the construction of local infrastructure, market openness, and the transformation of economic development model will all be positive to local economic growth. In addition, when market mechanisms are relatively perfect, it is also effective to improve ASEAN's economic growth potential by means of reducing the proportion of government spending in GDP, that

is, lowering the level of government intervention in the economy, and creating a more suitable environment for the development of market economy.

Fourth, FDI from China to Cambodia, Laos, Philippines, Singapore, Thailand, and Vietnam has positive technology spillover benefits. Therefore, there is clearly a lack of factual basis for the Western media to criticize China's FDI as "new colonialism", that is, threatening the long-term interests of ASEAN. In addition, the education threshold of China's FDI to ASEAN is lower, thus the FDI has a positive effect to solve the problem of unemployment in countries with lower education level such as Burma, Indonesia, and Laos. Needless to say, there are also some problems in the investment from China. For instance, the wages paid by firms from China are not high; those firms seldom interact with local ones, and mainly depend on the business network of their parent companies, which limit the spillover effects of FDI to some extent. Therefore, the investment in ASEAN countries from China should focus on improving the living standards of the local labour forces, and providing more pre-job and on-the-job training to address the key issue of "absorption capacity". In turn, this could improve the investment efficiency of Chinese firms in these countries, achieving a "win-win" situation between FDI source and host countries.

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