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Jian-Guang Shen

FDI, KNOWLEDGE SPILLOVER AND ECONOMIC GROWTH IN EAST ASIA

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ABSTRACT: The East Asian developing countries in general have experienced rapid economic growth during the past thirty years. In addition to other convincing reas ons, this paper stresses the role played by foreign direct investment (FDI) in the high economic performance of East Asia. In line with the recent development of of new growth theory, which implies that technological advance or knowledge accumulation is the long run determinant of economic growth, this paper highlights the effects of the technology transfer or knowledge spillover of FDI in East Asia. A formal dynamic two-country model is built to demonstrate that developing countries can gain substantially from the technology transfer effects of FDI from industrial countries.

Key words: growth, FDI, technology transfer (knowledge spillover)

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TIIVISTELMÄ: Itä-Aasian kehitysmaat ovat kasvaneet nopeasti kolmen viimeisen vuosikymmenen aikana. Keskustelualoitteessa korostetaan erityisesti suorien sijoitusten (FDI) merkitystä Itä-Aasian hyvässä talouskehityksessä. Tekninen kehitys ja tiedon kasautuminen nähdään uuden kasvuteorian tapaan taloudellisen kasvun perustana pitkällä aikavälillä. Erityisesti korostetaan suorien sijoitusten merkitystä teknologian siirrossa ja tiedon leviämisessä. Lopuksi osoitetaan dynaamisen kahden maan mallin avulla, että kehitysmaat voivat hyötyä olennaisesti teollisuusmaiden suoriin sijoituksiin liittyvästä teknologian siirrosta.

Avainsanat: talouskasvu, FDI, teknologian siirro (tiedon kasautuminen)

Summary

The growing importance of the East Asian developing countries is a prominent feature of the world economy nowadays. The high and sustained economic growth in East Asia since the 1960s increases the weight of this region in the global economy substantially. The impressive economic growth in East Asia started when the Japanese economy took off. In the mid of 1970s NIEs surpassed Japan as leading performers of economic growth. Recently ASEAN and China have the highest growth rates of GDP in the world.

Several reasons are commonly recognized for the 'miracle'. The economic growth of East Asia owes much to an abundant, low-cost and relatively high-quality labor force. High domestic savings and investment, as well as export-oriented development strategy are other important contributors. Generally stable political situations and consistent macroeconomic policies also make it possible for East Asia to achieve a long term economic growth. This paper particularly stresses the roles played by foreign direct investment (hereafter FDI) in East Asia's recent rapid economic growth.

FDI contributes greatly to the rapid economic growth in East Asia. Apart from some general effects of FDI such as the increament of capital supply, the improvement of employment opportunity and the assistance in export expansion, FDI not only is a source of new knowledge for raising productivities of both production and labor force in host countries, but also strengthens economic cooperation among the East Asian countries through intraregional flow of investment.

This paper highlights the influence exerted by FDI as a source of new knowledge or advanced technology. In East Asia, FDI brings new technology and industries to host countries on the basis of comparative advantages. The spillover effects of advanced technology brought out by FDI are deemed to be very important to the rapid economic growth in East Asia. This insight is in line with the new endogenous growth theory.

The new growth theory differs with classical growth theory in the fact that the former makes efforts to model technical advance process. Classical or neoclassical growth theory limits itself to find out the contributions of factor accumulation on economic growth, while taking technical progress as an exogenous factor. New growth theory models and emphasizes the roles played by technical progress which is regarded as the process of knowledge accumulation. Knowledge or human capital turns out to be productive factor in new growth theory. Since knowledge is non-rivalrous, it has the nature of externality. The marginal productivity of knowledge will never fall to zero, thus long run growth process can be sustained. Unlike traditional growth theories, which leave the long run growth process totally to exogenously fixed technical process, new growth theory breaks new ground to investigate fundamental factors of growth process.

Based on new growth theory, a dynamic two-country model is built to demonstrate that FDI from industrial countries is a source of new knowledge which tends to improve the general level of human capital in developing countries through the mechanism of technology transfer or knowledge spillover. The result of the model shows that low income developing countries can benefit from such a process, and grow as fast as industrial countries. This paper highlights the knowledge spillover effects of FDI on host developing countries. Under the assumption of technology transfer induced by FDI, lower income developing countries can attain the same growth rate of human capital as industrial countries, and hence is possible to cut income gap with industrial countries.

Yhteenveto

Itä-Aasian kehitysmaiden kasvava taloudellinen painoarvo on maailmantalouden kehityksen ajankohtaisimpia kehityspiirteitä. 1960-luvulla alkanut Itä-Aasian nopean ja kestävän talouskasvun kausi on lisännyt olennaisesti alueen painoarvoa maailmantaloudessa. Alueen huomattava talouskasvu alkoi 1960-luvulla Japanissa. 1970-luvun puolivälissä myös NIC-maat saavuttivat Japaniin verrattavat kasvunopeudet. 1990-luvulla ASEAN-maiden ja Kiinan talouskasvu on ollut nopeinta koko maailmassa.

Talousihmettä on selitetty useilla syillä. Ensinnäkin Itä-Aasian talouskehitys on nojannut paljolti runsaaseen, halpaan ja suhteellisen korkeasti koulutettuun työvoimaan. Kuitenkin myös korkea kotimainen säästämisaste, korkea investointiaste ja vientiä painottava talousstrategia ovat muita keskeisiä tekijöitä. Yleensä ottaen vakaa poliittinen ympäristö ja johdonmukainen talouspolitiikka ovat mahdollistaneet Itä-Aasian pitkän aikavälin talouskasvun. Keskustelualoitteessa korostetaan erityisesti suorien sijoitusten (tästä lähtien FDI) merkitystä Itä-Aasian nopeassa talouskasvussa.

Suorat sijoitukset vaikuttavat keskeisesti Itä-Aasian ripeään talouskasvuun. Suorilla sijoituksilla on joitakin yleisiä vaikutuksia kuten pääoman tarjonnan lisäys, työllisyysmahdollisuuksien paraneminen ja viennin lisääminen. Työn ja pääoman tuottavuuden parantamisen ohella alueen sisäiset suorat sijoitukset vahvistavat myös alueen taloudellista integraatiota.

Keskustelualoitteessa korostetaan suorien sijoitusten merkitystä uuden tiedon ja edistyneen teknologian lähteenä. Itä-Aasiassa suorat sijoitukset lisäävät kohdemaissa uutta teknologiaa ja uudistavat teollisuudenaloja suhteellisen edun periaatteen mukaisesti. Uuden teknologian kerrannaisvaikutukset ovat hyvin tärkeitä Itä-Aasian nopealle talouskasvulle. Tämä on uuden kasvuteorian keskeisiä havaintoja.

Klassisessa tai uusklassisessa teoriassa tekninen kehitys on exogeenista ja talouskasvu perustuu tuotannontekijöiden varantojen kasvuun. Uusi kasvuteoria eroaa klassisesta kasvuteoriasta siinä, että uudessa kasvuteoriassa tekninen kehitys pyritään mallintamaan. Samalla tekninen kehitys nähdään tiedon kasautumisena. Tieto eli inhimillinen pääoma on uuden kasvuteorian tuotannontekijä. Tieto poikkeaa muista tuotannontekijöistä siinä, että se muistuttaa julkista hyödykettä. Se on siten taloudellisessa mielessä eksternaalista. Tiedon rajatuottavuus ei alene koskaan nollaan, jolloin on mahdollista saada aikaan talouskasvua pitkällä aikavälillä. Klassisessa teoriassa eksogeeninen teknologinen innovaatio saa aikaan kasvua vain rajoitetuksi ajaksi. Tässä suhteessa uusi kasvuteoria murtaa uutta alaa tutkimalla kasvuprosessin perusteita.

Uuteen kasvuteoriaan perustuva kahden maan dynaaminen malli on rakennettu osoittamaan, että teollisuusmaiden suorat sijoitukset kehitysmaihin ovat merkittävä uuden tiedon lähde näissä maissa. Tiedon kasautuminen ja teknologian siirto lisäävät kehitysmaiden inhimillistä pääomaa. Mallin mukaan alhaisen tulotason kehitysmaa voi hyötyä tästä prosessista ja kasvaa yhtä nopeasti kuin teollisuusmaat. Teknologian siirron avulla alhaisen tulotason maa voi saavuttaa saman inhimillisen pääoman kasvunopeuden kuin teollisuusmaat, jolloin tiedon leviämisvaikutusten avulla on mahdollista kaventaa kehitysmaiden ja teollisuusmaiden välistä elintasoeroa.

Table of Contents

1
Introduction

The end of Cold War marked the beginning of a new era: the era of economic development and competition. With the threat of a world war alleviating, now most of the countries in the world are preoccupied with the development of national economies.

Economic development, according to A.P. Thirlwall (1989), occurs "when there has been an improvement in basic needs[1], when economic progress has contributed to a greater sense of self-esteem for the country and individuals within it, and when material advancement has expanded the range of choice for individuals." Economic development is related to the economic, political, socical and cultural situations of a nation, and has become the most important way to improve the living standard.

The world becomes an increasingly integrated Community. International trade, flow of capital and personnel mobility link every economy in the world. One nation's development is dependent on the worldwide economic situation.

Economic growth, which concerns the level and growth rate of per capita income of an economy, is recognized as the most important mean to achieve economic development. Economic growth provides material basis for rising living standard. In addition, the level and growth rate of per capita income can be measured, unlike other aspects of economic development. This paper mainly concentrates on economic growth instead of economic development.

The high and sustained economic growth in East Asia[2] since the 1960s captures the attentions of the whole world. This region has consistently

[1] Basic needs include housing, clothing, food and minimal education.

[2] In this thesis East Asia refers only to these rapidly growing East Asian developing economies, including NIEs (HongKong, Singapore, South Korea and Taiwan), ASEAN (Indonesia, Malaysia, Philippines and Thailand) and China.

achieved a remarkable record of economic growth rate that is higher than any other regions in the world. This trend has become even more marked since the late 1980s when the rest of developing countries were struggling with low economic performance, and industrial countries have been confronted with stagnation. Recently the two-digital growth rate of the Chinese economy has been especially exciting.

If we take a longer perspective and regard the recent economic growth in East Asia as a part of a grand process which began with the Japanese economic take-off, we will find that the pattern of economic growth in East Asia is quite clear: the backward subregions seem to catch up one by one. Following Japan, NIEs achieved impressive economic growth since the 1960s. Currently ASEAN and China have the highest growth rates of GDP in the world.

What are the reasons for the long term economic growth in East Asia? Why there is so clear pattern that these countries realized economic take-off one by one? Can the growth experience in East Asia be generalized?

There are several reasons that are commonly recognized. The economic growth of East Asia owes much to an abundant, low-cost and relatively high-quality labor force. High domestic savings and investment, as well as export-oriented development strategy are other important contributors. Generally stable political situations and consistent macroeconomic policies also make it possible for East Asia to achieve a long term economic growth. In this paper I particularly stress the role played by foreign direct investment (hereafter FDI) in East Asia's recent rapid economic growth.

FDI contributes in several ways to the rapid economic growth in East Asia. Generally speaking, FDI has the following economic effects on East Asian countries: (1) increasing capital supply; (2) improving employment opportunity; (3) assisting in export expansion; (4) as a source of new knowledge to raise productivities of both production and labor force in host countries; (5) strengthening economic cooperation among East Asian countries through intraregional flow of investment.

To further generalize the East Asia's experience, we need to analyse the institutional backgrounds in East Asia. Latin America, another important developing region, is also the target for global FDI. However, the Latin American countries lagged much behind as far as the economic performance is concerned. So it is interesting to compare the economic practices of these two regions. Four institutional factors, which are vital in determining the effects of FDI on host countries, are identified through the comparison. Correct and effective government policies provide a favourable macroeconomic foundation for FDI as well as economic growth. The ability of domestic industries to adopt foreign advanced technology introduced by FDI is important for host countries to improve productivity. Export-oriented development strategy seems to help host countries maximize the beneficial effects of FDI. A successful regional co-operation facilitates massive transfer of technology and even industries.

This thesis highlights the influence exerted by FDI as a source of new knowledge or advanced technology. In East Asia, FDI brings new technology and industries to host countries on the basis of comparative advantages. The spillover effects of advanced technology brought out by FDI are deemed to be very important to the rapid economic growth in East Asia. This insight is in line with the new endogenous growth theory.

The new growth theory differs with classical growth theory in the fact that the former makes efforts to model technical advance process. Classical or neo-classical growth theory limits itself to find out the contributions of factor accumulation on economic growth, while taking technical progress as an exogenous factor. New growth theory models and emphasises the roles played by technical progress which is regarded as the process of knowledge accumulation. Knowledge becomes productive factor in new growth theory. Since knowledge is non-rivalrous, it has the nature of externality. The marginal productivity of knowledge will never fall to zero. By this way long run growth process can be sustained. Unlike traditional growth theories, which leave the long run growth process totally to exogenously fixed technical process, new growth theory breaks new ground to investigate fundamental factors of growth process.

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The human capital model is very prominent among several other new growth models. According to the human capital theory, knowledge in an economy is measured by the human capital of an individual worker. Building from schooling and learning, human capital determines the productivity of individuals. Lucas (1988) built a model to show that under these assumptions the accumulation of human capital becomes the 'engine of growth'.

Utilizing human capital theory, a dynamic two-country model is built to demonstrate that FDI from industrial countries is a source of new knowledge which tends to improve the general level of human capital in developing countries through the mechanism of technology transfer or knowledge spillover. The result of the model shows that low income developing countries can benefit from such a process, and grow as fast as industrial countries. This model serves as a theoretical support for the claim that FDI is an important contributor to the unusual economic performance in East Asia.

This paper focuses on the role played by FDI on economic growth experience in East Asia. I highlight the knowledge spillover effects of FDI on host developing countries. Section 2 introduces the general situation of economic growth in East Asia. I discuss the reasons for high and sustained economic growth in East Asia, with an emphasis on the contributions of FDI. Section 3 examines the institutional specifications under which the 'catch-up' will actually happen. A comparison of Latin America and East Asia is given as the basis for furthur discussion. The conclusion is that several institutional factors have important roles to play in stimulaing positive spillover effects of FDI. Section 4 briefly reviews the development of modern growth theory, the basic neoclassical model and huamn capital theory are paid particular attention. This section serves as a theoretical background (or microeconomic foundation) for Section 5, where a formal dynamic two-country model is built to demonstrate the decisive effects of FDI on economic growth of developing countries. Under the assumption of technology transfer induced by FDI, lower income

industrial countries, and hence is possible to cut income gap with industrial countries.

2
Growth Experience in East Asia

2.1 Economic Growth in East Asia

East Asia has experienced steady and high economic growth over the past three decades. Currently, East Asia is economically the most dynamic region in the world.

The following table shows the growth performance of the East Asian countries.

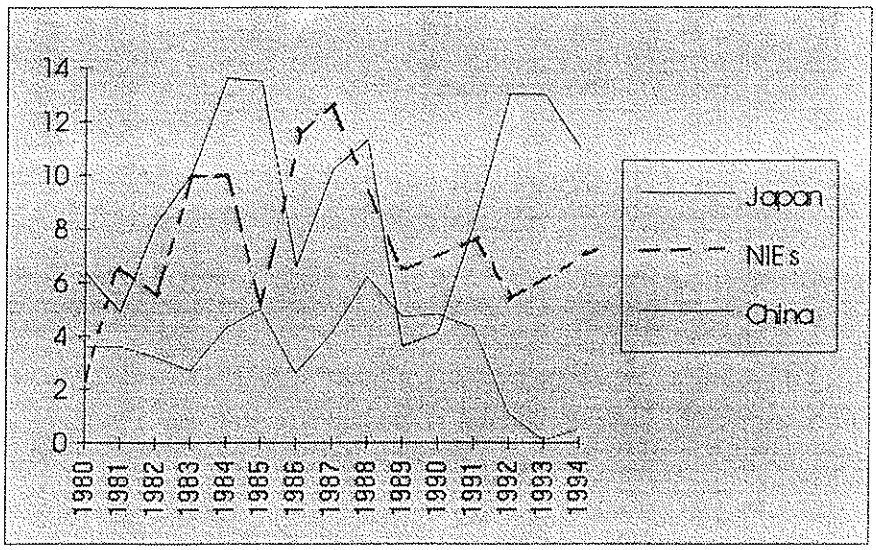
table 2.1: Growth Rate of GDP in East Asia

	Base Year	Average 1971-80	Average 1981-90	1988	1989	1990	1991	1992
Hongkong	1980	9.3	7.2	8.3	2.8	3.2	4.1	5.3
South Korea	1985	9.0	8.8	11.5	6.2	9.2	8.5	4.8
Singapore	1985	7.9	6.3	11.1	9.2	8.3	6.7	5.8
Taiwan	1986	9.3	8.5	7.3	7.6	4.9	7.2	6.6
Indonesia	1983	7.7	5.5	5.8	7.5	7.2	6.9	6.4
Malaysia	1978	7.8	5.2	8.9	9.2	9.7	8.7	7.8
Philippines	1985	6.0	1.0	6.3	6.1	2.7	-0.5	0.1
Thailand	1988	7.9	7.9	13.3	12.3	11.6	8.1	7.6
China	1978	7.9	10.4	11.8	4.4	3.9	8.0	13.2

Source: Asian Development Outlook 1994.

Over the past twenty years, East Asia, on average achieved an annual growth rate near 10 percent. This record is close to what was attained by Japan in the 1950s. Figure 2.1 compares the growth performances of NIEs and China with that of Japan over the past ten years.

Figure 2.1 Growth Performance: NIEs, China versus Japan



Source: ETLA,1994.

In the process of economic development, countries catch up one by one in East Asia. This regional phenomenon is very interesting. In the 1950s and 1960s, Japan had a very high growth rate, later the growth champion was replaced by NIEs, and in the later 1980s ASEAN (except Philippines) surpassed NIEs. Currently China has the highest growth rate in the world. As a result of such widespread and sustained growth, East Asia as a whole has an increasingly important status in the world economy. It is not surprising to hear that "this is the world most dynamic economic region", "the centre of global economy is shifting, or has already shifted from the Atlantic and U.S./Europe to Asia Pacific Region."

It is noteworthy that while East Asia as a whole enjoys "the East Asian Miracle", the individual countries in this region are so different in political, economic and social systems as well as economic development level. What

makes this 'miracle' happen? What are the factors behind the success of East Asia as the superstar of economic growth?

2.2 Reasons for High and Sustained Growth in East Asia

Some factors are identified by economists as the main reasons for the high and sustained economic growth in this region.

First, East Asia has an abundant and low-cost labor force, which makes East Asia extremely competitive in labor-intensive industries at the beginning stage of economic take-off. Countries in this region have a tradition of emphasizing primary and secondary education, so the labor force are relatively high-quality. The government policy is also very important in building up human capital.

In East Asia, the tradition of emphasizing general education results in relatively high-quality labor force. In addition, owe to the cultural reasons, the labor in East Asia are hardworking, obedient and thrift, which are regarded as beneficial to economic growth.

Second, the East Asian countries tend to save more than any other regions. Since the 1960s, the saving rates of most East Asian countries have increased steadily. Now most of them have very high saving rates (only Philippines has a saving rate below 20 percent), with the rates near or over 30 percent compared with only a little over 20 percent of world average.

Table 2.2 Gross Domestic Saving in East Asia (per cent of GDP)

	Average 1971-80	Average 1981-90	1991	1992	1993
Hongkong	28.4	31.0	31.2	31.0	30.2
S. Korea	22.3	32.0	36.7	35.2	34.8
Singapore	30.0	42.6	45.8	47.1	48.3
Taiwan	32.1	32.9	27.9	26.7	27.0

Indonesia	21.6	31.8	35.4	37.3	38.0
Malaysia	29.1	33.0	31.1	35.5	38.3
Philippines	26.5	22.3	16.4	14.7	14.6
Thailand	22.2	27.2	35.2	34.8	37.1
China	35.8	34.4	38.3	35.9	35.5

Source: Asia Development Outlook 1994.

High domestic savings support high level investment. A huge amount of capital is needed to build up a modern infrastructure such as transportation facilities, energy and telecommunications network. A proper infrastructure able to sustain massive manufacturing activities is vital when a pre-industrial economy is moving towards economic take-off. In East Asia, high domestic savings are the main source to fund large scale constructions.

Third, East Asia has long pursued an export-oriented strategy. The governments encourage and help domestic manufacturers to compete in international market. The stories of ship-building industry in South Korea, computer industry in Taiwan are very familiar to us. Taking part in the tough competition in international market helps these countries adopt advanced technologies and improve productivity. The foreign exchange earned through export makes it possible for East Asia to import large quantity of capital goods and, at the same time avoid external debt crises.

Fourth, in East Asia, governments play an important role in building up their economies. Apart from Hongkong, all governments in this region are deeply involved in economic activities. According to a report "East Asian Miracle" by World Bank (1993), government intervention in East Asia is one of the reasons for the "miracle". In sum, government policies have the following functions:

1. The East Asian countries mostly have autocratic governments. Changes in government leadership were rare in the past 20 years. A stable government with a business-friendly view is very advantageous.

Furthermore, the East Asian governments are particularly development-oriented. They usually pursue prudent and consistent macroeconomic policies, with fiscal deficits limited to certain tolerable levels. In East Asia, macroeconomic stability is maintained.

2. Governments in East Asia have played an important role in accumulating human and physical capital. Without any strong opposition forces, governments in East Asia are quite free to choose policies that are conductive to domestic savings and investment. Governments seem to commit themselves to invest in infrastructure and education. All East Asian countries have ambitious infrastructure-building plans. For example, China alone plans to invest about US$ 100 billions in infrastructure-related projects before 2000. Education (or human capital) is another area where the East Asian countries have taken utmost efforts to invest. As a result, the general education level and labor condition in East Asia are far above other developing regions.

3. Government policies have achieved effective allocation of factors and swift productivity change in East Asia. Trade unions are under tight control, so that wage increases are normally not out of line with increases in labor productivity. Specific industries that are considered important to national economy are promoted and export-oriented development strategy is diligently pursued. Investment environment is improved to attract FDI and foreign technology receives warm welcome. All these efforts made by governments have beneficial effects on rapid economic growth in East Asia.

The government intervention is really important, but there is one equally important factor, foreign direct investment (hereafter FDI) which contributes greatly to the East Asian economic development. This is the fifth reason for high and sustained economic growth in East Asia. This thesis mainly concentrates on FDI as a decisive factor to the economic growth in East Asia.

2.3 FDI in East Asia

FDI, according to The OECD Detailed Benchmark Definition of Foreign Direct Investment (1992), refers to "investments that involve a long-term relationship reflecting a lasting interest of a resident entity in one economy(direct investor) in an entity resident in an economy other than that of the investor." The direct investors have a significant influence on the operation and management of the enterprise in host countries.

Foreign direct investment grew rapidly during the 1980s. According to a report by OECD (International Direct Investment: Policy and Trends in the 1980s 1992), the steady economic growth, the globalisation of business, the integration of regional economies and technological innovation are the reasons behind this rapid expansion of FDI.

During the 1980s the share of FDI to developing countries was generally on a downward trend, with their share of FDI inflows falling from 25% to 19%.[3] OECD countries, on the contrary, accounted for a greater share of both inward and outward investment. It is mainly because that the high competition between industrial countries and the rise in protectionism in these countries prompted increasing multilateral direct investment among themselves as a mean to circumvent trade restriction. In spite of the downward trend of developing countries' FDI share, the growth of total FDI in developing countries was still quite significant. Average annual FDI inflows almost doubled during that period.[4]

Since the beginning of 1990s, flows of FDI into developing countries have risen sharply. In 1990, the volume of FDI flow into developing countries amounted to US$ 32 billion, which accounted for about 17 percent of the

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[3] Source: International Direct Investment: Policy and Trends in the 1980s (1992).

[4] Source: UN (1994).

world's total FDI. In 1993, flows of FDI into developing countries amounted to US$ 80 billion, which accounted for 41 percent of the world's total FDI. See Table 2.3 for detail.

Table 2.3: Inflows and Outflows of Foreign Direct Investment,1981-1993 ($bn)

Country	1981-1986	1985-1990	1988	89	90	91	92	93
	Annual average							
Developed countries								
Inflows	37	130	131	168	176	121	102	109
Outflows	47	163	162	212	222	185	162	181
Developing countries								
Inflows	13	25	28	27	31	39	51	80
Outflows	1	6	6	10	10	7	9	14

Source:UNCTAD,1994.

Flows of FDI into developing countries distribute unevenly. Ten developing countries receive some 70 percent of total FDI inflows to developing countries. In the 1970s, Latin America was the main target region for FDI, since then there has been a clearly tendency for FDI to shift from Latin America to East Asia, because of "the international debt crisis, the receptiveness of Asian economics to foreign direct investment and the macroeconomic prospects of Asian economies"[5]. In the 1980s, among top ten FDI recipients in developing economies, there were six East Asian economies. See table 2.4. Recently, East Asia's status as No.1 target for FDI has been strengthened. Particularly in 1993, China received inward FDI amounting to US$ 26 billion and thus became the world second largest FDI recipient. (The United States remained the world largest FDI recipient)

[5] See Ruffin (1993), page 13.

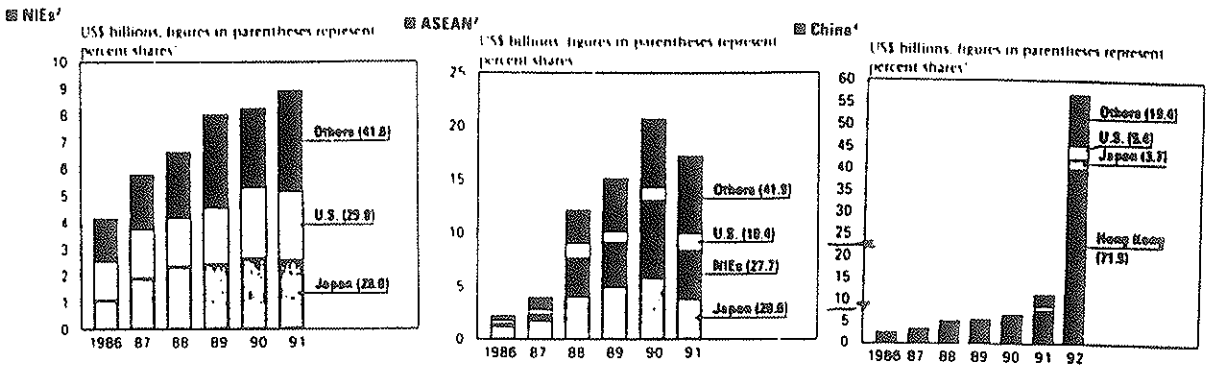
Table 2.4 Ten biggest FDI recipients within developing countries

Recipient	1970-1979	Recipient	1980-1990
Brazil	11.3	Singapore	2.3
Mexico	0.6	Mexico	1.9
Egypt	0.3	Brazil	1.8
Malaysia	0.3	China	1.7
Nigeria	0.3	Malaysia	1.1
Singapore	0.3	Hongkong	1.1
Indonesia	0.2	Egypt	0.9
Hongkong	0.1	Argentina	0.7
Iran	0.1	Thailand	0.7
Uruguay	0.1	Taiwan	0.5
Share of Flows	66		68

Source: United Nations, World Investment Report 1992 .

Now let us look at the recent FDI situation in East Asia. NIEs, ASEAN and China are grouped as subregions for FDI. Figure 2.2 present a clear picture of recent FDI situation in three subregions in East Asia.

Figure 2.2 FDI in East Asia



Source: Bank of Japan. 1994.

The pattern of FDI in East Asia has changed substantially. First, there is a substantial increase in intraregional investment. Industrial countries are not the only investors in this region, NIEs succeeded in a shift in their industrial structure with FDI and then their capital joins that from industrial countries flowing into ASEAN and China. Japan and NIEs have become major sources of FDI in this region. This overlapping flow of FDI within the region is a very prominent characteristic in East Asia. It is also related to the "flying geese pattern" of industrial development, which I will discuss later.

Second, in East Asia, each subregion has upgraded its preferential industries for FDI. Due to the rising labor cost, NIEs became less attractive to foreign investors, meanwhile, NIEs' enterprises aggressively moved labor-intensive industries to ASEAN and China. As a consequence, NIEs are the most important investors in ASEAN and China. FDI in NIEs has recently focused on high-tech industries, services and financial sectors. As a result of rapid expansion of manufacturing sector and strong commitment to international trade during the past three decades, trade-related and finance-related service sectors have contributed increasingly to the economic growth in NIEs. FDI currently focuses on these sectors. In NIEs, Japan and the United State are the primary sources of FDI, which increased rapidly from US$ 2.7 billion in 1986 to US$ 8.2 billion in 1989, but slowed down afterwards.

In ASEAN, FDI is focusing on manufacturing, both labor-intensive and relatively capital-intensive industries. From 1988 to 1990, FDI in ASEAN increased from US$ 3.9 billion to US$ 26.1 billion, the momentum, somehow, slowed down in 1991. In order to compete with China and other Asian developing countries, ASEAN made efforts to upgrade their industries towards more capital and technology intensive industries. Originally, Japan is the most important investor in ASEAN, but since 1990, NIEs have aggressively moved their labor-intensive industries to ASEAN, as a consequence, FDI from NIEs exceeded that of Japan.

Since China adopted "economic reform and open door" policy, a large amount of FDI has continued to flow in. China has abundant labor and natural resources, which makes china very suitable to receive FDI. Besides, there are 5.5 million overseas Chinese, from whom China received FDI as soon as new policy was adopted. Originally FDI concentrated on labor-intensive industries and property development (principally hotels catering to foreign visitors). After 1990, driven by China's vast economic potential, FDI poured into China. A number of world leading enterprises began to invest in China. Infrastructure projects as well as high technology and capital-intensive industries received more and more FDI. The major source of FDI to China is Hongkong, which accounts for over 50 per cent of the total FDI.[6] Japan and the United States competed for the place of second biggest investor. Other NIEs are also very important investors. See Table 2.5 for FDI by source in China.

Table2.5: FDI in China by Source (Contracted Investment in US$ Million)

	1979-84	1985	1987	1989	1991
National Total	11,791	6,333	4,319	6,294	11,977
Hong Kong	6,495	4,134	2,466	3,645	7,215
United States	1,025	1,152	361	646	548
Japan	1,158	471	385	515	812
Taiwan	...	...	100	480	...
Singapore	117	77	80	148	155
Canada	66	9	34	49	31
Australia	91	14	47	84	44
S. Korea	...	0.1	6	14.5	...

... = not available

Source: Asian Development Bank, 1993.

[6] FDI from Hongkong includes those from Hongkong based subsidiaries of multinational enterprises.

2.4 FDI and Economic Growth in East Asia.

The rapid increase in FDI in East Asia has great impacts on the economic growth in this region. In general, FDI has the following beneficial effects on host countries.

FDI is an additional source of capital that is needed urgently in the early stage of industrialization. Developing countries are hardly able to finance construction on a large scale by their own sources. When huge sums of capital are needed to build modern infrastructure and industries, borrowing from international capital market is inevitable. By introducing FDI, developing countries are accessible to not only capital without future liabilities, but also skills of managing these modern facilities.

FDI improves employment opportunity in host countries. As foreign investors build up or expand their business, local staffs are recruited and trained. To East Asian labor-abundant developing countries, the labor intensive industries introduced by FDI are especially helpful. Currently FDI, mostly from Hongkong, contributes to 5 million workplaces in South China. Even to small countries like Singapore, the role of FDI in employment opportunity is quite significant.

FDI plays a crucial role in East Asia's export success. In East Asia, FDI represents the shift of production lines or exporting bases to other countries. As local plants start production, they export most of finished products to industrial or other East Asian countries. For example, the export of household electric appliances has grown strongly in East Asia. The original production lines were mostly built up by FDI from Japan as well as other NIEs. FDI effectively creates external demand that matches the economic expansion in East Asia.

2.4.1 FDI and Knowledge Spillover in East Asia

In addition to those above-mentioned advantages of FDI, there are two other very prominent beneficial impacts associated with FDI in East Asia. This section I discuss the knowledge spillover effect of FDI in East Asia, next section is devoted to the role played by FDI in the East Asia's regional economic co-operation.

FDI represents not only capital, but also a source of new technology, managerial skill and other knowledge. To host countries the inflow of FDI is likely to facilitate technology transfer, improve productivity, create positive linkage effects and give rise to competitive division of labor in the world economy.

Before I go on, I should clarify the concepts of knowledge and technology in this thesis, for they will be repeatedly used in later chapters. Knowledge is an extremely complex concept, it is connected with all kinds of things at all kinds of levels. In this thesis, (or in other growth models), the concept of knowledge is usually limited only to the idea of new technology or technical advance. Technology is one kind of knowledge, but it also includes physical assets, human capital and capabilities. According to Dunning (1993), technology is something that "enables the efficient organization and production of goods and services within a particular competitive advantage." In growth models, knowledge or technology usually gets reduced simply to factor productivity. The new growth theory emphasizes that the ability to improve technological capacity is one of the key ingredients of economic success. In this thesis, technology and knowledge share virtually the same concept. In the theoretical model in Chapter 5, technology transfer and knowledge spillover or diffusion all describe the same process that tends to raise human capital level of one economy.

The world leading enterprises are reluctant to share their advanced technology

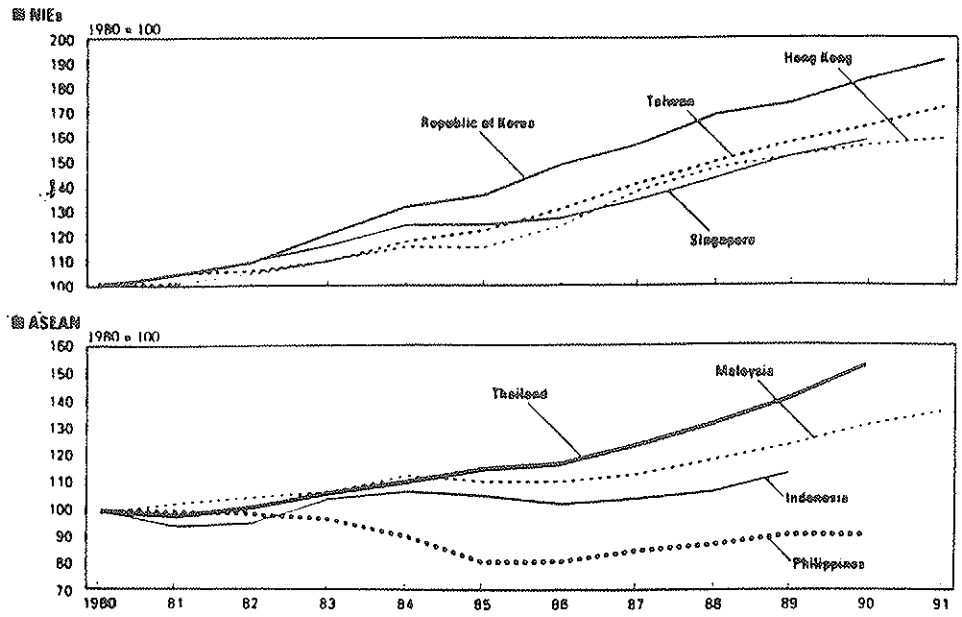
as well as managerial and marketing skills with developing countries. To these enterprises the best way to achieve high profitability is to utilize their advantages through export of products. In East Asia, foreign investment enterprises establish subsidiaries and joint ventures due to trade barriers or other reasons (except for Hongkong). Incoming FDI has been intended either for production to export or for massive domestic market.

All of the East Asian countries welcome FDI with advanced technology. Some countries (for example, China) also use administrative measures to encourage high-tech foreign investment enterprises.

FDI makes technological and managerial knowledge available to host countries, as local labor learns from the presence of advanced practices. For developing countries, mere purchasing of advanced technology is costly and difficult to assimilate. In addition, not all knowledge can be codified and diffused in certain form. To understand and utilize advanced technology, 'doing and learning', 'learning by doing' and 'experience' are indispensable in some industries. This reinforces the advantages of foreign investment enterprises. FDI facilitates knowledge diffusion in host countries. In East Asia, the beneficial effects of FDI on knowledge diffusion can be demonstrated in two ways.

First, FDI results in improved labor productivity in East Asia. According to a study by Bank of Japan, in East Asia accelerating labor productivity coincides with the rapid increase in FDI.

Figure 2.3 Real GDP per Worker in East Asia.



Source: Bank of Japan, 1994.

In Singapore, on average, wholly foreign enterprises had an average labor productivity 2.3 times higher than that of wholly local enterprises. The average labor productivity of joint ventures was also higher than wholly local enterprises.

Second, FDI accelerates economic restructuring and improves production technology in host countries. Because it is very difficult to measure progress in production technology, here I adopt one method by Bank of Japan, which uses exports of high value-added goods to industrial countries to measure progress in production technology. The reason for this practice is that higher value-added goods require higher production technology. The following table shows Japan's machinery imports from East Asian countries.

Table 2.6 Japan's Machinery Imports from East Asian Countries

	NIEs			ASEAN			China		
	Total imports to Japan (A)	Machin-ery Imports (B)	B/A %	Total imports to Japan (A)	Machin-ery Imports (B)	B/A %	Total imports to Japan (A)	Machin-ery Imports (B)	B/A %
1985	9.84	1.27	12.9	16.72	0.15	0.9	6.48	0.02	0.3
1986	12.52	1.69	13.5	13.77	0.19	1.4	5.65	0.04	0.7
1987	18.81	2.82	15.0	16.35	0.24	1.5	7.40	0.06	0.9
1988	25.00	4.42	17.7	19.0	0.40	2.1	9.86	0.15	1.5
1989	27.14	5.41	19.9	21.77	0.83	3.8	11.15	0.34	3.1
1990	25.95	5.49	21.2	24.43	1.47	6.0	12.05	0.51	4.3
1991	27.31	6.36	23.3	26.84	2.70	10.0	14.22	0.82	5.8
1992	26.17	6.36	24.3	27.10	3.25	12.0	16.95	1.11	6.5

Source: Bank of Japan. 1994.

This table shows that the share of machinery exports in all three subregions in East Asia has continuously increased since 1985, which also coincides with the increase in FDI. Thus roughly speaking, FDI influences production technology in East Asia.

The idea in this section is a very important point in the theoretical model in Chapter 5, where the assumption that FDI improves labor productivity in host countries through technology transfer is key to the result of cutting income gap between industrial countries and developing countries.

2.42 FDI and Economic Co-operation in East Asia

An increase in the intraregional flows of investment strengthens the regional economic co-operation and creates a high degree of subregional division of labor among the East Asian countries. As Chen (1993)[7] observed, the intraregional FDI also "facilitated an extensive industrial restructuring" and "brought about a closely interrelated vertical production structure in the region". Akamatsu(1962) proposed the hypotheses of "flying-geese" pattern to describe the industrial development in eastern Asia.

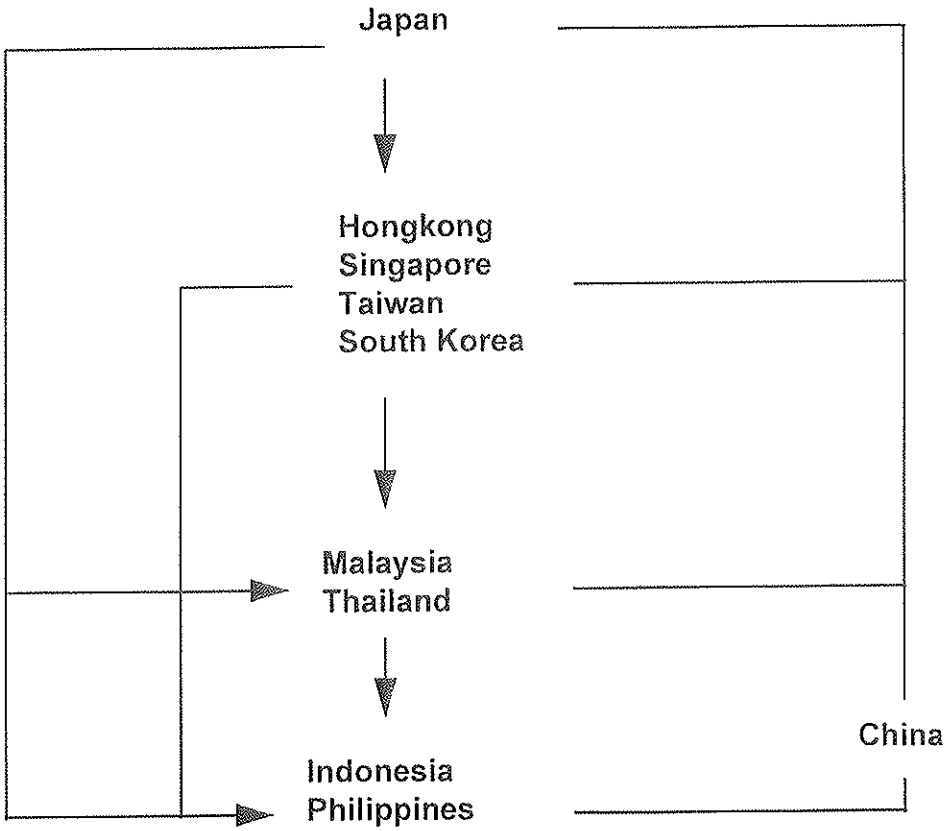
In this thesis, I concentrate on East Asian developing countries, so East Asia only refers to Asian NIEs, ASEAN and China. However, Japan is located in eastern Asia and has extensive economic as well as historical and cultural ties with East Asia. Japan is the most advanced economy in eastern Asia and is very important to other economies in the region. If we look at intraregional FDI and economic co-operation in eastern Asia, we have to include Japan. So I use Asian Pacific region to stand for East Asia plus Japan.

The "flying-geese" pattern of industrial development in Asian Pacific region can be illustrated in figure 2.4[8].

Figure 2.4 "Flying-geese" Pattern of Industrial Development.

[7] See Chen E. K.Y. (1993).

[8] I modify the picture in Lessons in Development (1989). Page 71.



In Asian Pacific region, Japan, as the world second biggest economy, has always been a major investor. Especially since 1985, as a result of sharp revaluation of Japanese Yen, many Japanese manufacturing giants have set up numerous production bases in East Asia to lower production cost and reduce direct export from Japan to the United States. According to Ozawa (1979), Japanese manufacturing firms tends to transfer more appropriate technology that is easy for host countries to absorb. Other developing countries in the region reach different stages of economic development and have different types of industrial products. NIEs, to some extent have gone through the stage of industrialization, and currently are working hard to catch up with other developed countries. In the late 1970s, with the economy growing and labor cost rising, NIEs began to invest in ASEAN and China. Recently, NIEs have become the biggest investors in ASEAN and China. Within ASEAN, Malaysia and Thailand are undergoing industrialization, their economies are prosperous.

Indonesia and Philippines lag a little bit behind. Japan, NIEs and ASEAN form the "flying geese". China is virtually in the same development stage as Indonesia and Philippines, but as E. K.Y. Chen observed, "China is not a goose, But some other huge bird flying side by side with the geese. China has the potential of complementing and competing with the various layers of the flying geese at various levels of industrial production."

Thus within Asian Pacific region, a complimentary market exists and encourages intraregional trade and flows of FDI. The difference in development stages and strong complementarity in the process of industrialization allow this region to pursue the export-oriented strategy at the same time without hurting each other. The strategy of export-oriented development is commonly deemed as a very important factor that contributes to the successful story of the Asian Pacific economies.

It is worth noting that "flying geese" have been formed without deliberate regional co-operation schemes, which is a very recent phenomenon. The different stages of economic development in different countries and changing pattern of comparative advantages in countries over time are the main forces behind the "flying geese" pattern. Intraregional FDI is the main vehicle that fulfilled the formidable task of transferring certain industries from more advanced economies to less advanced one. In this sense, what FDI has achieved in East Asia is not only facilitating technology transfer, but assisting host countries in establishing certain industries which host countries have comparative advantages and which are internationally competitive.

Intraregional investment and trade reinforce each other and give rise to strong interdependence among the Asian Pacific economies. Import and export trends of Asian Pacific region show that almost half of the region's trade is now with other economies of the region, up from about 40 percent in the early 1960s.

Table 2.7 Trade Pattern of Asian Pacific Region(percent)

Partner:	Europe		Asian Pacific		North-America		Rest-of-World	
Reporter	1963--89		1963--89		1963--89		1963--89	
Asian Pacific								
Exports	31	20	44	43	19	29	6	8
Imports	31	20	36	50	25	20	8	10

Source: GATT (1987, 1990)

Although the Asian Pacific economies have not been enthusiastic about formal economic integration, they are moving toward co-operative regionalism, sometimes called 'open regionalism'.

The intensification of regional co-operation justifies the calls for an formal institutional framework within Asian Pacific region (see Kim 1992). Proposes are advanced that various forms of economic union should be chosen to promote regional welfare.

Asian Pacific region is recently strengthening its economic co-operation. In this region there is one orgenization---Asia-Pacific Economic Co-operation (APEC), which serves as a multilateral forum in which the Asian Pacific economies plus the United States and Canada can promote economic co-operation and mutual assistance in developing key economic sectors. In 1992 a small permanent secretariat of APEC was established.

The expansion of intraregional trade and flow of FDI have stimulated economic growth over Asian Pacific region. A formal institutional framework may further foster economic growth in the region if it can create new trade opportunity and facilitate further capital flows---especially direct investment. Somehow, whatever regional economic zones may come into being, it is certain that a freer and opener regional co-operation system is the right choice.

3
Analysis of Institutional Specifications

Since the technology innovative capacity of developing countries is quite weak, the ability of developing countries to adopt foreign advanced technology is very important. It is interesting to ask what are the circumstances, or what are the institutional specifications under which FDI can exert a substantial influence on the economic growth in East Asia.

This chapter tries to analyse the institutional factors in developing countries that influence the ability to maximize the benefits of FDI. A comparison of East Asia and Latin America provides the basis for further discussion.

3.1 Comparison of Economic Performance between East Asia and Latin America

East Asia and Latin America both are two very important regions in the world. During the 1950s to 1960s, some Latin American countries, such as Argentina, Brazil and Mexico, achieved rapid economic growth. These countries have rich natural resources, and are always the target for international investment. It seemed this region was likely to achieve long-term high economic growth. On the contrary, during that period, most of East Asian developing countries were beset with poverty.

But in the late 1970s and throughout the 1980s, a different picture appeared. As I described in Chapter 2, East Asia achieved a remarkable record of swift economic growth. whereas most Latin American economies stagnated, some countries even experienced negative economic growth.

Let us compare the economic performance of East Asia and Latin America via some representative countries and regions. Brazil and Mexico were rapidly industrializing during the 1960s to 1970s, South Korea and Taiwan are Asian NIEs. These two Latin American countries are compatible in many ways to two

East Asian regions. Table 3.1 shows the difference in economic performance of these countries.

Table 3.1 Difference in the Economic Performance

		S. Korea	Taiwan	Mexico	Brazil
Population					
(millions)	1986	41.6	19.4	79.6	138.5
Per capita	1975	580	955	1360	1070
nominal	1980	1520	2323	2090	2050
GDP(US$)	1985	2150	3276	2080	1640
	1990	5400	7906	2490	2680
Annual	1975-80	7.5	10.6	6.7	6.6
growth					
rate of real	80-85	8.4	6.7	1.8	1.1
GDP (%)	85-90	10.2	8.7	1.4	2.0

Sources: IMF, "International Financial Statistics";
The World Bank, "World Development Report".

In 1975, in term of per capita nominal GDP, South Korea and Taiwan lagged behind Mexico and Brazil. Over the past 15 years, the economic growth in South Korea and Taiwan was much faster. In 1990, the per capita nominal GDP of Mexico and Brazil was only near half of that South Korea, and one third of that of Taiwan.

The reasons for this sharp contrast are very complicated. I have discussed the reasons for "the East Asian Miracle" in Chapter 2, here I briefly point out some problems that are identified to explain the unsatisfactory economic performance of Latin America.[9]

[9] See Lessons in Development: a comparative study of Asia and Latin America (1989).

- A too big public sector has not been able to promote productivity, but creates huge external debt. In general, the public sector is inflexible and inoperative.

- The import-substitution development strategy results in low level of industrial exports. Latin America is quite dependent on a handful of primary commodities.

- The low domestic savings and investment result in the over dependence on external capital. Local resources are not fully utilized to supplement FDI.

- The ambitious regional co-operation framework has not achieved satisfactory division of production and labor among the region.

- High concentration of income, wealth and higher education gives rise to social and political tension.

I believe a deep understanding of the contrast between Latin America and East Asia will greatly improve our insight into economic development. In this chapter I try to make a comparison between institutional factors that affect the effects of FDI in each region. The lessons drawn from a crude comparison between East Asia and Latin America are summarized in the following section.

3.2 Institutional factors affecting the result of FDI

There are four factors that are very important in determining host countries' abilities to facilitate technology transfer process induced by FDI.

- **Government Role**

A good macroeconomic environment is vital to attract FDI. however, FDI does not benefit host countries per se, government policies play an important role in providing stable macroeconomic environment and facilitating the beneficial technological spillover effects of FDI.

The East Asian countries usually have autocratic governments. A development-oriented "hard line" state provides a stable environment for investment and ensures the effective implementation of macroeconomic policies. The government plays an important role in correcting pricing and overvalued exchange rate, in removing labor and capital market imperfections and in building up infrastructure. All these efforts create a favourable general investment environment in East Asian countries.

In Latin America, the political systems have become increasingly open, but in the process, macroeconomic management is not so stable. The governments have done little to encourage internal saving, instead, they rely on external borrowing and inflationary financing. As a result, the Latin American countries are much more liable to external shocks. FDI does not favour this kind of environment.

A promising macroeconomic environment resulting from political stability and prudent macroeconomic policies is conducive to FDI, foreign investors also tend to compromise their global objectives with the needs and requirements of host countries. In East Asia, the governments usually have high requirements to FDI, for example FDI should utilize advanced technology or the products should be internationally competitive. Even so, lured by a bright prospect in East Asia, foreign investors are willing to fulfil the expectation and requirements of host countries. Thus the governments in East Asia are able to ensure the beneficial effects of FDI.

Government policies play a crucial role in facilitating technology transfer process. Proper policies are important not only in attracting FDI and ensuring the introduction of advanced technology, but also in promoting the adoptive capability of domestic enterprises for advanced technology and modern

managerial skill. Government policies in East Asia emphasize the importance of building up human capital. As a result, the competence of domestic labor force to receive new skill is strengthened. East Asia seems to achieve the rapid expansion of indigenous technological capacity.

- **Development Strategy**

East Asia and Latin America differ in development strategy. East Asia has pursued export-oriented development strategy, while Latin America has emphasized import-substitution development strategy.

The experiences of these two regions demonstrate clearly that export-oriented strategy is advantageous in maximizing knowledge spillover effects of FDI. In an export-oriented host country, foreign investors are forced to use local resources in the most appropriate way to maintain international competitiveness. The less protected domestic environment stimulates domestic enterprises to learn and absorb advanced technology due to the exposion to international competition. This is a crucial condition for successful technology transfer to host countries.

The East Asian countries diligently implement export-oriented strategy and encourage foreign investment enterprises as well as domestic firms to compete in international market. Under this competitive environment, the knowledge spillover effects are maximized. FDI in East Asia improves production efficiency and labor productivity, which accounts for much the rapid economic growth.

Export-oriented strategy also has other advantages, such as helping overcome balance of payments constraint and creating external demand.

The import-substitution policies adopted by the Latin American countries discriminate against exports and create market distortion. In such a protected market, foreign investment enterprises tend to operate in the enclave and monopolistic environment. Domestic firms do not have much incentive to

assimilate advanced technology. As a result, the beneficial knowledge spillover effects of FDI are quite limited.

- **Supplement by Domestic Resources**

The integration of domestic firms with foreign investment enterprises is another crucial factor that determines the effects of FDI on host countries. Fully and properly utilizing domestic resources to supplement FDI will improve production efficiency as well as labor productivity and further prevent the formation of a foreign enclave.

To developing countries, FDI is an additional source of capital as well as advanced technology. The backbone of the economy is vast amounts of domestic enterprises. Developing countries are lack of capital and are backward in technology and human capital. The advent of FDI provides the inexpensive and convenient access to advanced technology and new knowledge. East Asia seems to be successful in mobilizing domestic resources to supplement FDI. East Asia has very high domestic investment and abundant labor. By encouraging the linkage effects of FDI, foreign investment enterprises are fully integrated into domestic economy, and knowledge spillover effects of FDI are multiplied.

In Latin America, domestic resources are not fully utilized. The existence of a foreign enclave leads to increasing degree of foreign dependency. Under this circumstance, all beneficial effects of FDI can not be maximized.

- **Regional Co-operation**

Regional co-operation in East Asia has developed spontaneously from mutual dependence to vertical division of production and labor. It is a result of free trade and capital transfer within the region, rather than any deliberate efforts by the governments.

Section 2.4.2 discussed the "flying-geese" pattern of industrial development in East Asia, the flows of FDI bring about not only capital transfer and technology transfer, but also the transfer of entire new industries. All these are based on comparative advantage of individual country within the region. Under such a framework, the transfer of advanced technology is likely to be complete and human capital accumulation tends to accelerate in less developed countries.

Latin America has longer experience of regional cooperation. The Central American Common Market was formed in the 1950s. Later, there were several regional cooperation schemes. These ambitious plans endeavor to pursue industrialization of designated division of production and labor within Latin America. As a region, Latin America absorbs foreign investment from outside, there are few intraregional flows of investment.

These regional cooperation attempts were successful at beginning, somehow later the process stagnated. It seems that the regional cooperation plans are too ambitious, which exhausted Latin America's capacity to continue economic integration. Additionally, any political changes in each member country caused strain for whole regional integration schemes. The regional cooperation within Latin America is not driven totally by market force, and the positive influence exerted by regional cooperation framework on FDI is less satisfactory.

As we learn from the previous chapters, FDI contributes greatly to the economic growth of the East Asian developing countries. The role played by FDI as a source of advanced technology is highlighted. Fortunately, recent development of economic growth theory provides robust supports to the insight that technical progress or human capital accumulation is the fundamental factor behind successful economic growth. The next chapter briefly reviews the development of economic growth theory which serves as a theoretical background for this paper.

4
Review of Growth Theory

4.1 Introduction

Economic growth theory, as a branch of economics, is regaining its popularity. Intensive attentions are paid by leading economists to this field and numerous articles have been published on this topic.

The importance of economic growth theory can not be exaggerated. Economic growth, in the narrow sense, is the growth rate of per capita income of a country. The level of per capita income is used to represent the welfare or living standard of one country. Countries are grouped into different categories according to their per capita incomes. According to the standard of the United Nations, rich countries (or industrial countries) have a per capita income of over US$ 7,500 while the world poorest countries (or low-income developing countries) have a per capita income of less than US$ 500. For example, as an industrial country, Finland has a per capita income of US$ 20,000 compared with US$ 500 in many low-income developing countries.

However the dollar face value is illusive. For example, a person with an income of US$ 1000 per year can live quite well in those low-income developing countries, but this amount of money is not enough to feed a person in any industrial countries. Per capita income measured by purchasing power is a more satisfactory indicator. In an article by Summers and Heston (1991), per capita income of many countries is recalculated by using purchasing power instead of dollar face value. The result shows that the income gap between rich and poor countries is narrowed to some degree, but there still exists enormous difference in per capita income. The enormous diversity of living standard is a self-evident phenomenon.

Economic growth seems to be the main force that improves the current living standard in long term. A low-income country, if it consistently grows faster

than other countries, will totally change its situation in 30 years or so. The industrialization of Asian "four tigers" is a good example. Starting as very poor regions, all of them (Hongkong, Singapore, South Korea and Taiwan) have managed to maintain high level economic growth over three decades and hence have achieved what is called "the East Asian Miracle". Barro and Sala-i-Martin(1994) showed some figures about the growth rates of many countries. For the period of 1960--1990, South Korea had an average growth rate of 6.7 percent per year compared with the -2.1 percent per year of Iraq. As a result, South Korea raised its real per capita income from US$ 883 in 1960 (ranking 83 out of 118 countries) to US$ 6578 in 1990 (ranking 35 out of 129). While Iraq dropped from US$ 3320 in 1960 (ranking 23 of 118) to US$ 1783 in 1990 (ranking 82 of 129). This example demonstrates how differences in growth rates will in long term have such great consequences for standard of living and underscores how growth theory, which searches for the fundamental determinants of long run economic growth, is important.

Growth theory, owing to its significance, was studied even by classical economists. The idea of growth can be found in "The Wealth of Nations". As Romer (1986) put it, "The idea that increasing returns are central to the explanation of long-run growth is at least as old as Adam Smith's story of the pin factory". However, due to the shifting research interest in economics, growth theory was neglected for a long period of time.

The most significant contribution to modern growth theory was made by Robert Solow, whose work set up the framework of neo-classical growth theory. Later, Cass (1965) brought Ramsey's analysis of consumer optimization into Solow's model and completed the basic neo-classical growth model.

The counterfactual prediction of the neo-classical theory provides a stimulus to an unceasing progress in growth theory. Arrow(1962) and Sheshinski(1967) constructed a model with a mechanism called "learning-by-doing". Based on their work, Romer(1986) constructed a model in which long run endogenous growth is driven not by capital accumulation, but by the accumulation of knowledge. In addition, Romer proved that a sub-optimal equilibrium growth

path exists. Later, Lucas(1988) has added human capital into growth model and shown how human capital becomes the engine of economic growth.

Inspired by their work, growth economists have incorporated R&D theories and imperfect competition into growth framework. Intercountry technology diffusion and imitation have also become popular topics in growth theory.

This chapter briefly describes the development of growth theory and introduces some influential models. The emphasis is on those models' assumptions, results and implications. Only some key mathematical equations are provided, detailed calculations are to be found in the references.

4.2 Basic Neo-classical Growth Theory

Solow (1956) has made great contributions to the formation of modern growth theory. Assuming a fixed saving rate, the growth process in Solow's model can be described as follows. The variation in the capital level depends on the output level. Due to the decreasing return to capital, the higher capital accumulation it is, the less capital contributes to the increasing production. In the steady state, in the absence of technological progress and labor augmentation, the economy stops growing.

Thus one implication of Solow's model is that long run growth depends totally on exogenous factors such as technological progress and labor augmentation, which are not explained by the model itself. Another important implication of Solow's model is that under the hypothesis that all firms have the same technology and all consumers have the same tastes, all countries must converge towards the same level of capital and income per capita. Poor countries will totally catch up with rich countries. This prediction is obviously counterfactual.

In Solow's model, the saving rate is treated as exogenously given factor. This is obviously an unsatisfactory solution. In the following paragraphs I will introduce a basic neo-classical growth model, in which the saving rate is determined by solving an intertemporal maximisation problem of a utility function.

For simplicity, we assume that an economy is composed of identical consumers and firms. The economy produces one product using two inputs, capital K and labor L. Neglecting technological progress, production function is

(1) $$Y = F(K, L).$$

The function $F(\cdot)$ is supposed to be constant return to scale, diminishing returns to each input and some positive and smooth elasticity of substitution between inputs. These properties can be expressed in mathematical forms as follows.

The property of diminishing return to each input can be expressed as

(2) $$\partial F/\partial K > 0, \qquad \partial^2 F/\partial K^2 < 0,$$
$$\partial F/\partial L > 0, \qquad \partial^2 F/\partial L^2 < 0.$$

The property of constant returns to scale can be expressed as

(3) $$F(\lambda k, \lambda L) = \lambda F(k, L) \text{ for all } \lambda > 0.$$

An additional property of the production function is called Inada conditions, which means that the marginal product of one input (capital or labor) approaches infinity as the input goes to zero and approaches zero as it goes to infinity. This property can be expressed as

(4) $$\lim_{K \to 0}(F_K) = \lim_{L \to 0}(F_L) = \infty,$$

$$\lim_{K\to\infty}(F_K) = \lim_{L\to\infty}(F_L) = 0.$$

A production function is called a neo-classical production function if it satisfies all of these properties. The neo-classical production function implies that each input is essential for production.

The neo-classical growth model lets the saving rate be determined as a result of an inter temporal maximization of a consumer utility function. It is Cass (1965) that brought Ramsey's analysis of consumer optimization into Solow's growth model and successfully modelled endogenous growth while retaining the assumption of constant returns to scale, perfect competition and optimality of the market equilibrium.

The utility function for a representative consumer is

$$U(c) = \int_0^\infty e^{-\rho t} \frac{C(t)^{1-\sigma} - 1}{1-\sigma} dt \qquad (5)$$

where ρ is the rate of time preference and σ is the inter temporal elasticity of substitution which is equal to the risk aversion. c is real per capita consumption.

The production function has the same properties of equation (1). The Cobb-Douglas function,

$$Y = A \circ K^{\beta} \circ L^{1-\beta} \qquad (6)$$

is a neat form of neo-classical production function. A is a constant that represents the level of technology. $u = \dot{A}/A > 0$, is defined as the exogenously given rate of technical change. β is a constant with $0 < \beta < 1$.

Output in the economy is divided into consumption and investment, so

(7) $$Y = A \circ K^{\beta} \circ L^{1-\beta} = \mathrm{L}\cdot\mathrm{c}+\mathrm{K}$$

where L is the population with an exogenously given rate of growth λ.

The optimization problem is to choose a time path c(t) for per capital consumption subject to the technology. This is a typital optimal allocation problem. Following Lucas(1988), a current-value Hamiltonian H is defined by

(8) $$H(K,\theta,c,t) = \frac{L}{1-\sigma}(c^{1-\sigma}-1)+\theta(AK^{\beta}L^{1-\beta}-L\cdot c),$$

which is the sum of two parts: the current-period utility from equation (5), and the new investment (or the growth rate of capital) from equation (7) valued at the shadow price θ(t).

To solve this optimization problem, we need to find a solution that maximizes the Hamiltonian H at each date t, given the shadow price θ(t) is correctly chosen. The results of the optimization problem contain the growth rate of per capita comsumption or capital g and the saving rate s,[12]

(9) $$g = \dot{c}(t)/c(t) = \frac{u}{1-\beta}.$$

u is the rate of technical change which is defined as fixed, 1-β is also exogenously given, so the growth rate g is determined exogenously.

The saving rate is determined by the system,

(10) $$s = \frac{\beta\cdot(g+\lambda)}{\rho+\sigma\cdot g}$$

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[14] For the detailed deduction, see Lucas (1988). Page 8-10.

These results are summarized by Lucas as, "Hence along a balanced path, the rate of growth of per capita magnitudes is simply proportional to the given rate of technical change u, where the constant of proportionality is the inverse of labour's share, 1-β. The rate of time preference ρ and the degree of risk aversion σ have no bearing on this long-run growth rate. Low time preference ρ and risk aversion σ include a high savings rate s, and high savings is, in turn, associated with relatively high output levels on a balanced path. A thrift society will, in the long run, be wealthier than an impatient one, but it will not grow faster."

Thus we can conclude that growth rate is determined only by exogenous technical change *u*. As long as we assume that all countries have the same technology and consumer tastes, the introduction of consumer optimization into Solow's model preserves the hypothesis of conditional convergence. The endogeneity of savings also does not eliminate the dependence of the long run growth rate on the exogenous technical change.

In this sense neo-classical growth theory is unable to account for obvious diversity in growth rate across countries. It is evident that countries have different growth rates and different capital-labor ratios and factor prices under the condition of international trade. In addition, the introduction of technical progress serves to reconcile the theory with a positive, possible constant growth rate in the long run. So neo-classical growth model seems to explain the long-run growth totally depending on the exogenous factor: technological progress. This is a severe shortcoming of neo-classical growth theory.

4.3 Beginning of Endogenous Growth Model

In order to find the answers to large and sustained international difference in productivity and living standards, growth economists have so far identified the differential access to proprietary technology, economies and scale, and durable influences of the investment rate on growth rate as the main causes. As Nelson (1994) argued, in as early as 1952, Abramovitz had already put forth most of

these wisdom of today's growth theory, like "technical change is largely endogenous", "technology is to at least some extent proprietary, and market structures supporting technical advance are not perfectly competitive", "growth fuelled by technical advance involves externalities and economies of scale" and "the investment rate may matter in the long run". These ideas represent a deep insight into the growth process, but it is not easy to construct a model of endogenous growth which is able to analyse how and why growth rates may vary over time.

It is Arrow (1962) who first constructed a formal model that takes technological progress as an outgrowth of activities in the economic realm. Inspired by the work of Kaldor (1957) who proposed a technical progress function where productivity increased with the rate of investment, Arrow took into account of the learning-by-doing effect. "Learning by doing", in growth theory, means that the productivity of a given firm or worker increases as the cumulative aggregate investment for the industry increases. So the knowledge is an unintended by-product of the investment, with its benefits immediately spreading throughout the whole economy.

Sheshinski(1967) proposed a model that is essentially close to Arrow's idea. The production function of a representative firm is

(11) $$y = F (k, A(K)L)$$

where K is the total capital stock in the economy.

The production function is linear of its inputs such as capital and effective labor. The difference from the neo-classical model is that the productivity of labor now depends on the economywide, cumulative investment activities. A(K) is a function of the available knowledge in the economy, which can be specified as

(12) $$A(K) = A^{r}$$

where r is a constant with $0 < r < 1$.

There is thus an externality. Each firm benefits from the knowledge accumulated by other firms. The positive externalities linked to knowledge accumulation become the source of endogenous growth, while at the same time the assumption of perfect competition is retained.

However, as Romer (1986) argued, Arrow and Sheshinski avoided discussion on the existence of a social optimum by assuming that the marginal product of capital is diminishing given an exogenous labor level. Thus although the production function exhibits increasing returns to scale, the growth rate of output is limited by the growth rate of labor force. So Sheshinski's model has the unsatisfactory implication that the growth rate of an economy depends on the labor growth.

4.4 Two Important Papers on Endogenous Growth Model

In the 1970s and early 1980s, probably due to its lack of empirical relevance, formal growth theory was no longer an active research field. Another reason for this is that though theorists understood that technical change needed to be made endogenous in growth model, the clear treatment of encompassing externality within a general equilibrium framework was not available.

Since the mid 1980s, stimulated by the work of Romer and Lucas, research on economic growth has enjoyed a new boom. The surge of writings on endogenous growth models reflects the growing awareness that the fundamental determinants of long-run economic growth are crucial issues, much more important than immediate factors like physical capital and labor. Just as Lucas said, "Is there some action a government of India could take that would lead the Indian economy to grow like Indonesia's or Egypt's ? If so,

what, exactly? If not, what is it about the nature of India that makes it so? ... This is what we need a theory of economic development for: to provide some kind of framework for organizing facts like these, for judging which represent opportunities and which necessities."

The essence of emerging new growth models is that long-run growth is made possible by introducing increasing returns to scale or externalities which guarantee that marginal productivity in the accumulation of factors will not reduce to zero as economy grows.

4.4.1 Romer's Model of Growth

Romer's pioneering work "Increasing Returns and Long-run Growth" lays the foundation for new growth theory. As Romer (1986) pointed out, though in static models it is clear that equilibrium can exist if the increasing returns are external to the firm, former endogenous growth models do not solve the problem that arises in the presence of increasing returns in dynamic optimizing model of growth. "In a standard optimizing growth model that maximizes a discounted sum or integral over an infinite horizon, the presence of increasing returns raises the possibility that feasible consumption paths may grow so fast that the objective function is not finite."

Romer set out to solve this problem by assuming that knowledge K is a capital good with an increasing marginal productivity. In Romer's model, K is knowledge, rather than physical capital. Firms invest in private knowledge, which contributes positively to public knowledge. Knowledge, private and public, together with labor and physical capital, produces final output and additional knowledge.

The production function F (k, K, x) is homogenous in k and x, whereas F(•) is increasing in the aggregate stock of knowledge K. So that

(13) $F(zk,zK,zx) > F(zk,K,zx) = zF(k,K,x), \quad z > 1,$

where k is individual firm's knowledge, x is a set of additional factors such as physical capital, labor and so forth. K equals $\sum$ k. In this model, x is assumed to be fixed.

Romer proved that a finite-valued social optimum could exist. Because of diminishing returns in producing knowledge, a maximum technologically feasible rate of growth for knowledge exists, which in turn implies the existence of a maximum feasible growth rate for per capita output.

Romer's model is summarised by Amable (1994) using specific utility and production function for representative consumer and firm

(14) $U(c) = \ln(c)$

and

(15) $f(k, K) = k^{\alpha} K^{\eta}$

where k is the level of capital per worker in the firm, K equals $\sum$k.

(I) When $\alpha + \eta < 1$, the function shows diminishing returns to scale. The positive externality is not strong enough to offset the effects of marginal decreasing returns. In the long run, this model behaves like the models of Solow and Arrow.

(II) When $\alpha + \eta = 1$, the production function shows constant return to scale, therefore, endogenous growth is possible. With an initial condition, production function may be written as

(16) $F(K, L) = T_0 e^{ut} \cdot K^{\alpha} \cdot L^{1-\alpha}$

where T_0 is the initial technology level, u is the rate of exogenous technical change. Although the model looks like the neo-classical growth model with an

exogenous technical progress trend u, the properties of the model are different. Romer's model deals with externality. In addition, the saving rate has an effect on growth rate.

(III) When $\alpha + \eta > 1$, the production function has the character of increasing returns to the accumulated factors. The growth is unstable because the growth rate of economy keeps increasing all the time.

So Romer's model rules out exogenous technological change. The engine of long-run growth is the accumulation of knowledge by forward-looking profit-maximizing agents. By assuming externalities, increasing returns in the production of output and decreasing returns in the production of new knowledge, Romer produced a well-specified competitive equilibrium model of growth. Romer also proved that in spite of the presence of increasing returns, a competitive equilibrium with externalities will exist. This equilibrium is not Pareto optimal, but it is the outcome of a well-behaved positive model and is capable of explaining historical growth in the absence of government intervention. This is probably the main contributions of Romer's 1986 paper.

Romer's model assumes that positive technological externalities are a by-product of the accumulation of knowledge, which is also an input. What is the mechanism that provides the foundation for the externalities? In his celebrated paper "On the Mechanics of Economic Development", Lucas proposed one solution to this problem.

4.4.2 Lucas' Model of Human Capital

In Lucas' model, human capital is an accumulable productive factor, which finally becomes the engine of growth. According to Lucas (1988), to incorporate technology into growth model, the knowledge of particular people, or particular subcultures of people is relevant. "We want a formalism that leads us to think about individual decisions to acquire knowledge, and about the

consequences of these decisions for productivity. The body of theory that does this is called the theory of 'human capital' · · · ."

Thus in Lucas' model, an individual's human capital is simply the individual's general skill level. So one worker with human capital h is as productive as two workers together if each of them has the human capital of 1/2 h. Each worker can allocate his time in various kinds of activities, for example, he can work to earn income or study to increase human capital. For simplicity, it is assumed that he can either work or study, no other choices. So if he decides to do more work today, he has to allocate less time to learning. As a result, his productivity or human capital will be lower in the future. "Introducing human capital into the model then involve spelling out both the way human capital level affect current production and the way the current time allocation affects the accumulation of human capital." Lucas(1988). There is more than one way to formulate both aspects of human capital into model. In the following paragraphs I introduce the model briefly.

For simplicity, suppose in an economy there are N identical workers. Each of them has a human capital h and devotes the fraction u(h) of his time to the production of final goods. We assume the remaining time 1 - u(h) is spent totally on human capital accumulation. The economywide average human capital level h_a is thus h_a = N·h / N = h, though h_a and h have different roles in the production function.[1]

The production function is

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[1] If we allow the difference of workers, the effective work force is $N^e = \int_0^\infty u(h) \cdot N(h) \cdot h dh$, the average human capital level ha is $h_a = \frac{\int_0^\infty hN(h)dh}{\int_0^\infty N(h)dh}$, this does not change the results of the model, but will complicate the analysis considerably.

(17) $$Y = AK(t)^{\beta}[u(t)h(t)N]^{1-\beta} h_a(t)^{\gamma}$$

where $0 < \beta < 1$ and $r > 0$.

The inclusion of $h_a(t)^{\gamma}$ in the production function indicates that an individual will be more productive when he is working with people with a higher level of human capital. This represents a positive externality.

The growth of human capital is supposed to take this form[12]

(18) $$\dot{h}(t) = h(t)\xi[1-u(t)].$$

The physical capital K accumulates in this way

(19) $$\dot{K} = Y - N \cdot c$$

where c is per capita consumption. Individual's utility function is the same as in equation (5).

Due to the externality caused by h_a, the optimal growth path and competitive equilibrium path do not coincide. According to Lucas, the optimal path is a choice of physical capital K, human capital h, average human capital h_a, consumption c(t) and time spent on work u(t) that maximizes the individual's consumption utility subject to current technology. The equilibrium path is a choice of K(t), h(t), c(t) and u(t) so as to maximize consumption utility subject to technology, taking h_a(t) as exogenously determined. "When the solution path h(t) for this problem coincides with the given path h_a(t)--so that actual and

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[12] This form is first used by Uzawa (1965). The general form of human capital accumulation is

(18a) $$\dot{h}(t) = h(t)^{\xi} \cdot G[1-u(t)]$$

where G is increasing and G(0)=0. ξ is a constant with value equal to or greater than 1.

expected behaviour are the same--we say that the system is in equilibrium." (Lucas 1988)

Solving the current-value Hamiltonian for the optimal problem, we get two results:[13]

(20a) $$v = \frac{(1-\beta)(\delta-\rho+\lambda)}{\sigma(1-\beta+r)-r},$$

(20b) $$v^* = \sigma^{-1}\left[\delta - \frac{(1-\beta)(\rho-\lambda)}{1-\beta+r}\right]$$

are the rates of growth of human capital for equilibrium path and optimal path, respectively, and

(21a) $$g = (1+\frac{r}{1-\beta})\cdot v,$$

(21b) $$g^* = (1+\frac{r}{1-\beta})\cdot v^*$$

are the growth rates of final product for the equilibrium and optimal path, respectively.

Because of the existence of an external effect r, the optimal rate of growth is higher than the market rate of growth, that is $g^* > g$. The smaller r is, the less difference between these two paths. In addition, the growth rate in both cases increases with σ, the effectiveness of investment in human capital. The negative relation between the growth rate and discount rate ρ in both cases indicates that growth is connected to 'thriftiness'.

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[13] See Lucas (1988) for the detailed calculation.

An interesting implication of this model is about international disparities in per capita income. Countries with higher levels of human capital will have higher growth rates of human capital. Workers in these economies have higher productivity resulting from the positive human capital externality. So under the assumption that developed countries and developing countries have the same technology (or production function) and consumer tastes, all countries will not converge towards the same level of income per capita. Capital accumulation and growth will be more rapid in initially better endowed countries, so that a tendency to divergence exists.

4.5 Further Development of Growth Theory

From neo-classical growth theory to endogenous growth theory, our understanding of economic growth process becomes much more comprehensive. Needless to say, new endogenous growth models certainly represent an important advance over the neo-classical growth models. New growth models focus on the sources of growth and try to incorporate technological progress into growth process. So far, growth economists have discovered and modelled several sources of growth.

One source of the endogenous growth is the accumulation of human capital. Lucas presented this idea in his 1988 paper and we have discussed it in the previous section.

A second source of endogenous growth is technological innovation resulting from R&D. Thus, investment in R&D will affect the growth rate. Romer (1990) proposed a model where there are three sectors in an economy: research, intermediate goods and final good. The technological level is assumed to grow without bounds. Capital input is not a homogeneous good. The investments by firms in R&D result in new intermediate goods, which will improve the productivity of production. In this way endogenous technological advance becomes the engine of growth.

A third source is known as "creative destruction". As we described in the previous paragraph, there are three sectors in the economy. The technological advance induced by investment in R&D results in rising productivity of the intermediate goods. Each new innovation replaces the old one, this is the mechanism by which the economy keeps growing.

Endogenous growth models have an important application in international economics. Grossman and Helpman (1991) constructed a variety of models in which endogenous growth theory is incorporated. They showed that international trade and capital flow may affect growth rate and a persistent difference in the growth rate may become possible.

In spite of all the improvements brought about by the endogenous growth models, we have to admit that our understanding of growth process is still quite limited. For example, growth economists cannot explain the slowdown of U.S. economy in the 1960s. Growth theory fails to provide convincing insights into how Japan was able to establish itself as super economic power within thirty years. What is the reason that East Asia has a high and sustained economic growth while many African countries have to struggle to maintain status quo? These kinds of questions constitute a challenge to as well as an opportunity for the further development of growth theory.

To be a vivid field of economics, growth theory needs to advance in new directions, such as how to master technical change, how to understand the behaviour of firms and how to model social institutions. As Nelson (1994) put it, "We need to improve our understanding of the nature of technology and of technical advance as a process. We must find a way of seeing into the capabilities of the firms and other organizations that employ the technologies and the material inputs that are the immediate determinants of growth, as well as play a major role in their creation. And we must better comprehend the economic institutions that mould, support, and constrain firms and other organisations in their own actions and interactions with each other."

5
FDI, Knowledge Spillover and Economic Growth

In Section 2, I clamed that foreign direct investment is a very important factor that boosts the economic growth of these East Asian countries. In this section I will introduce a model that provides theoretical basis for my claims. The following presentation is largely based on a dynamic two-country model built by Wang(1990).

In his paper "Growth, Technology Transfer and the Long-run Theory of International Capital Movements", Wang constructs a model that relates economic growth to free international capital movements. Under the assumption of perfect capital mobility, the industrial country will invest in the developing country. To the developing country, FDI not only raises its capital stock, but also facilitates the transfer of advanced technology from the industrial country. The model actually utilize human capital theory which we have discussed in Section 4.4.2. The model assumes that the technology level of one country is measured by its human capital level, so human capital plays an important role in determining the production or income of both countries. Thus higher human capital accumulation induced by FDI raises the long-run growth rate as well as per capita income in the developing country. The income gap[14] between the industrial and developing countries will be narrowed and become constant in the steady state.

The following model is of dynamic two-country nature. Since the previous chapter has provided the theoretical background and the model itself adopts some assumptions[15] that simplify the analysis greatly, we can understand the model easily.

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[14] The income gap is defined as the per capita income ratio of these two countries.

[15] Some assumptions are unrealistic, for example, the assumption of perfect capital mobility between the industrial country and developing country is not consistent with the reality. The model sticks to this assumption is simply that there are no other manageable alternatives. I will analyze these assumptions in the following sections.

5.1 FDI and National Economies: A Static View

The static model here serves as a basis for the later dynamic analysis. We assume that two countries are closely related to each other through capital market. One country is an industrial country, which is abundant in physical capital and high-quality labor. The other one is a developing country with less physical capital and inferior labor force. For simplicity, these two countries produce one identical good. The model further assumes that two countries have the same amounts of labor force[16] and the same production function.

Usually we know that industrial countries and developing countries differ in their production functions. Industrial countries utilize advanced technology which tends to economize raw materials and energy in production, so even with the same amount of physical capital and same quality labor force, industrial countries can produce more output. However, how to model endogenous technological advance is still an unsolved problem. In this model, we use the level of human capital as an indicator of the technology level, so the detailed form of production function does not matter. The assumption of identical production productions simplifies the analysis.

As we mentioned above, this model stresses the role played by human capital. Here the concept of "human capital" is the same as we discussed in Section 4.4.2. It is human knowledge or skill which reflects the productivity of one individual worker. In aggregate, the average human capital of one economy measures the technology level there. Later I will show that human capital determines the effective rate of return for physical capital and hence affects the magnitude of foreign investment. In this model we assume that the industrial country has higher average human capital than the developing country. We also

[16] Allowing differences in labor forces will not alter the basic results, but only complicate the per capita term by carrying L_I/L_D throughout.

assume that within an economy each worker is identical, which infers each worker has the identical level of human capital.[17]

The production function is a neo-classical one that satisfies equation (2)-(4). The simplest Cobb-Douglas form is

(22) $$Y = K^{\beta} \cdot (hL)^{1-\beta}$$

where β is a constant with $0 < \beta < 1$. This model also assumes that β is identical for both countries.

If we compare this form of production function with the previous

(17) $$Y = AK(t)^{\beta}[u(t)h(t)N]^{1-\beta} h_a(t)^{r},$$

we can see immediately that equation (22) is a very simple form of equation (17). As I argued before, this model makes some assumptions that simplify our task. Here the adoption of equation (22) as production function implies the savings of the economies are fixed, so we do not need to solve a consumer utility maximization problem to determine saving rate endogenously.

We can write the standard per capita output as

(23) $$Y / L = h^{1-\beta}(K / L)^{\beta} = \Omega(h)\, f(k).$$

The contribution of human capital is summarized by $\Omega(h) = h^{1-\beta}$.

Let the subscripts I and D denote Industrial country (source of FDI) and Developing country (host of FDI), respectively. The industrial country which has higher income, is endowed with higher amounts of both physical and human capital than the lower-income developing country, that is

[17] See Section 4.4.2 for reference.

(24) $Y_I > Y_D$, $K_I > K_D$, $h_I > h_D$.

There are two important variables defined as follows.

(25) $k = K_D / K_I$, $q = h_I / h_D$.

From the definition, we know that k is the relative physical capital intensity and q is the technology gap between the two countries. It is obvious that $k < 1$, $q > 1$.

The industrial country will invest in the developing country in order to utilize cheap labor or seek high returns or explore market potential, so on and so forth. In East Asia, intraregional direct investment is very active. As we know from Chapter 2, currently apart from Japan, Asian NIEs also invest heavily in this region. In this model we suppose Z is the amount of investment from the industrial country to the developing country. Since we have assumed these two countries have the same amount of labor force L, so in per capita term, $z = Z/L$.

The foreign direct investment to developing country actually means the movement of physical capital from the industrial country to the developing country. So the per capita production function for the developing country is $\Omega(h_D) \cdot f(k_D+z)$, industrial country has such form: $\Omega(h_I) \cdot f(k_I-z)$.

Foreign investors usually repatriate profit back to their home countries. So for the developing country, its national income is its output minus foreign investment earning. By the same token, national income of the industrial country is its output plus foreign investment earning. The investment earning is determined by the rate of investment return, r.

So in per capita terms,

(26) $y_D = \Omega(h_D) f(k_D + z) - rz$,

(27) $y_I = \Omega(h_I) f(k_I - z) + rz$.

Under the perfect capital mobility[18], the rental rate of physical capital is equalized:

(28) $$\Omega(h_D)\, f'(k_D+z) = \Omega(h_I)\, f'(k_I-z) = r.$$

Given the production function, endowments k_D, k_I, h_D and h_I, z and r can be endogenously determined by the system (26)-(28). Then y_D and y_I are determined if we know z and r.

If we multiply both sides of equation (28) by $k_D^{1-\beta}$, we get

(29) $$f'(1 + z/k_D) = [\Omega(h_I / \Omega(h_D)]\, f'(k_I / k_D - z / k_D).$$

Let $x = z/k_D$, which measures the magnitude of foreign investment in the developing (host) country. We know $\Omega(h_I) / \Omega(h_D) = q^{1-\beta}$ by previous assumptions ($\Omega(h) = h^{1-\beta}$ and $q = h_I/h_D$). Noting $k = K_D / K_I$ and $q = h_I / h_D$, we obtain the following equations

(30) $$x = x(k, q),$$

$$\partial x / \partial k = -g'' q^{1-\beta} k^{-2} / (f'' + g'' q^{1-\beta}) < 0,$$

$$\partial x / \partial q = g' (1-\beta) q^{-\beta} / (f'' + g'' q^{1-\beta}) < 0.$$

The equation shows that the magnitude of foreign investment is determined by the configuration of relative capital intensity and technology gap. The industrial country tends to invest more in the developing country when the physical capital gap is larger or the technology gap is smaller. The prediction is

[18] The model uses "perfect capital mobility" to obtain the static equilibrium. In the real world, there are always some obstacles to free capital mobility. Besides, the rewards for FDI are not only rental rate of physical capital. Actually in this model we do not necessarily stick to the assumption of " perfect capital mobility", instead we can regard 'r' as the rate of return to FDI.

consistent with the observation that where the lack of capital is very severe, where the return to capital is high and hence is very attractive to foreign direct investment. Meanwhile, high-quality labor force or high technology level is also very attractive to foreign direct investment.

The static model does not take into account economic growth and augmentation of physical or human capital. The presentation of this static model prepares the ground for the dynamic analysis that follows.

5.2 FDI and Economic Growth: A Dynamic Process

In the dynamic setting, the outputs, physical and human capitals of both countries will increase according to the production and factor accumulation functions. In autarky, the industrial country will consistently grow faster due to the higher initial human capital. In the dynamic model, human capital is the engine of growth. If we allow physical capital (FDI) move from the industrial country to the developing country, FDI will bring about a process of technology transfer and hence have a positive effect on the accumulation of human capital in the developing country. In the steady state, the human capital in the developing country will grow at the same rate as that of the industrial country. This implies that FDI will eventually raise the growth rate of the developing country and narrow the income gap between these two countries.

In order to build a long-run dynamic model, we have to specify the accumulation functions of physical capital k and human capital h.

The change in physical capital per worker is

(31) $$\dot{k}_i = s_i \cdot y_i - b_i \cdot k_i.$$

where $i = I, R$, s_i is the fixed propensity to save out of income and b_i is the sum of growth rate of labor and the capital depreciation rate. For simplicity we assume that b_i is fixed and the same for both countries.

The assumption about how human capital accumulate over time is of significant importance in this model. As we know from Section 4.4.2, the human capital accumulation function is

(18) $$h(t) = h(t)\,\delta[1-u(t)].$$

The equation indicates that aggregate human knowledge can be increased through devoting resources to it. If the worker devotes all his time on improving his huamn capital, the human capital will grow at its maximal rate δ. Here we assume that in autarky, human capital in each country grows at an exogenously determined rate V_i, $i = D, I$.

So for industrial country the human capital accumulation function is

(32) $$h_I = V_I h_I .$$

It is easy to find out that this form is weakly justified. Here "the human capital accumulation" means the creation of new knowledge. As we know, the creation and spread of new knowledge is often connected with physical capital investment. In some new growth models, profit-seeking firms invest in R&D and hence get access to new technology or knowledge, which in turn allows the firms to explore monopolistic profit. See e.g. Grossman G.M. and Helpman E.(1991). Since it is quite evident that the expansion of physical capital leads to the simultaneous creation of new knowledge which will have positive spillover effects[21], we could link h_I to the level of physical capital investment in the industrial country. Because equation (32) is relatively easy to handle, I still use this form as human capital accumulation function of the industrial country.

[21] See e.g. Romer (1987).

developing countries. To those countries, FDI not only supplements large scale investment need, but also introduces advanced technology, improves local human capital and modernises or upgrades host countries' industries. In sum, FDI generates positive technology spillovers to developing countries.

There are several ways to model the phenomena of technology spillovers. Here we adopt a hypothesis proposed by Findlay (1978) that the technology spillover effects of FDI in the developing country will be an increasing function of the amount of FDI operating in developing country. Meanwhile, the larger initial technology (or human capital) gap between two countries, the more effective the technology transfer will be. As we have defined in previous section, the amount of FDI in the developing country is measured by x, the ratio of FDI to demestically owned capital. The technology gap between these two countries is measured by q, the human capital gap.

Let the technology transfer function in developing country be $\theta(\cdot)$, then the accumulation function of human capital in developing country is specified as[20]

(33) $$h_D = V_D\theta(x,q)h_D,$$

$$\theta_1 = \partial\theta/\partial x > 0, \qquad \theta_2 = \partial\theta/\partial q > 0, \qquad 0 < \theta < 1.$$

It is reasonable to assume $\theta_1 > 0$, for larger amount of FDI tend to bring about higher probability of efficient technology transfer, but it is dubious to assume $\theta_2 > 0$. The hypothesis that the more relative advanced technology possessed by the industrial country, the faster the rate at which the developing country will catch up does not take into account some empirical evidents. To countries like China, the introduction of telecommunications technology may take very long time to have any positive spillover effects on the rest of economy, instead, some less advanced technologies can spread out rapidly and upgrade several

[20] As long as x >= 0 (therefore FDI exists in developing country) and q>=0 (it is always satisfied), equation (33) is well defined.

catch up does not take into account some empirical evidence. To countries like China, the introduction of telecommunications technology may take very long time to have any positive spillover effects on the rest of economy, instead, some less advanced technologies can spread out rapidly and upgrade several key industries. In East Asia, NIEs invest heavily in the developing countries. Their technology level is obvious lower than that of the United State, European Union or Japan, but the technology introduced by NIEs-based FDI is still relatively advanced by developing countries' standard and is easy for host countries to assimilate. Thus it has better spillover effects, host countries master the technology quickly and catch up at a faster rate. In this case suitable and relatively advanced technology is more useful than very advanced technology.

This is the argument concerning technology (or knowledge) diffusion in the developing country. In the extreme case, we can suppose that only the industrial country produce or create new technology. Human capital does not grow in the developing country unless foreign investment from the industry country brings about technology transfer. Then we can regard V_D as the technological diffusion rate (or technology adaptive efficiency) in the developing country.[21]

Actually, developing countries do contribute very little to the global advance in technology (or accumulation of human capital). Industrial countries possess most of the human and physical assets necessary to produce technology. Generally, one country's technological or innovative capacity is measured by its expenditure on R&D. According to one report by National Science Foundation (1989), in 1986-1987, industrial countries accounted for more than 95 percent of world-wide R&D expenditure. See Table 5.1 for the details.[22]

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[21] As Wang (1990) argued, "strictly speaking, 'technological diffusion rate' should be a shift parameter, say τ, in $\theta(\cdot)$, with the property $d\theta/d\tau > 0$. Because τ has the same qualitative effects as V_D on k and q, introducing τ into the model unnecessarily complicates the notion."

[22] This table is contained in Dunning(1993), Page 300. I use 'industrial countries' instead of 'developed countries'.

Table 5.1 Geographical Distribution of R&D expenditure in Constant (1982) US$ billion, 1986-1987.

	$b	%	$b	%
Industrial countries			**218**	**95.7**
North America			105.6	46.3
of which:				
US	100.8	44.2		
Western Europe			71.1	31.2
of which:				
West Germany	19.4	8.5		
UK	13.8	6.1		
France	13.7	6.0		
Italy	7.4	3.2		
Sweden	4.0	1.8		
Japan			39.1	17.2
Other industrial countries			2.2	1.0
Developing countries[23]			**9.9**	**4.3**
of which:				
India	1.5	0.7		
Brazil	1.4	0.6		
South Korea	1.3	0.6		
Argentina	1.1	0.5		
All countries			**227.9**	**100.0**

Source: National Science Foundation (1989).

Somehow the data in this table may be inaccurate, or is "fragmentary and rarely directly comparable"[24], for instance, R&D expenditure in the former centrally planned economies and developing countries is likely to be miscalculated, and

[23] Including Yugoslavia.

[24] Dunning (1993), p.300.

how to divide the R&D expenditure of multinational enterprises among home and several different host countries remains unsettled. But the evidence given by the data is overwhelming: technological capacity is really concentrated in industrial countries.

Since the technology innovative capacity of developing countries is rather weak, the ability of developing countries to introduce, assimilate and utilize foreign advanced technology becomes decisive. Government policies have an important role to play, as I have elaborated in Chapter 3. In this thesis I stress on the channels through which FDI assists host country with technology diffusion.

FDI will facilitate technology transfer in host country via the following linkages[25]:

1) FDI affects the technological capability, managerial initiative and competence of local suppliers, this is called 'Upstream Linkages'.

2) FDI exerts influence on the local customers, this is called 'Downstream Linkages'.

3) FDI may form external linkages with local suppliers and customers through a value-added network, this is called 'the Network of Vertical Linkages'.

4) FDI has a profound influence on the competitors of local relevant industry and is likely to "stimulates technological capacity and encourage a market structure in the host country conducive to the promotion of dynamic comparative advantage."

5) FDI helps to train local staffs who may promulgate the attributes, ideas and entrepreneurial culture of investors.

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[25] See Dunning (1993) page 446.

The diffusion of advanced technology is a process which is related to the political, economic, social system and cultural heritage of host country. For developing countries, how to attract FDI and escalate the technology diffusion process is a formidable task for the governments.

Whatever we assume V_D is -- the natural growth rate of human capital in autarkic or technology diffusion rate, it is obvious that V_I is greater than V_D, that is $V_I > V_D$.

Equations (30)-(33) form the dynamic system. It is necessary to write them again,

(30) $x = x(k, q),$

(31) $\dot{k}_i = s_i y_i - b_i k_i, \qquad i = I, D,$

(32) $\dot{h}_I = V_I h_I,$

(33) $\dot{h}_D = V_D \theta(x,q) h_D.$

If we substitute (28) into (26) and (27), and define $C = (h_D / k_D)^{1-\beta} > 0$, we have:

(34a) $$y_D/k_D = \Omega(h_D) k_D^{\beta-1}[f(1+x)-f'(1+x)x]$$
$$= C\cdot\hat{Y}(k, q)$$

(34b) $$y_I/k_I = \Omega(h_D) k_D^{\beta-1}\left[q^{1-\beta} f(k^{-1} - x) + f'(1+x)x\right]$$
$$= C \cdot\hat{Y}(k, q)$$

The results of equations (34) help us convert the dynamic system into another system in terms of k, q and C. The new system is

(35a) $$\dot{k}/k = C[s_D\hat{Y}_D(k,q) - s_I\hat{Y}_I(k,q)]$$

$$= C\phi(k,q;\ s_D,\ s_I)$$

(35b) $$\dot{q}/q = V_I - V_D\theta(x(k,q),q)$$

$$= \varphi(k,q;\ V_D, V_I)$$

(35c) $$\dot{C}/C = (1-\beta)\{V_D \cdot \theta(x(k,q)\ q) - [Cs_D\hat{Y}_D(k,q)] - \lambda\}$$

$$= \Gamma(k,q,C;\ V_D,\ s_D)$$

where s_D, s_I, V_D and V_I are known.

Wang shows that if $\theta 2 > |\theta 1(\partial x/\partial q)|$ is assumed, the above three equations satisfy the Routh-Hurwitz stability conditions and in the steady state, $\dot{k}/k = \dot{q}/q = \dot{C}/C = 0$, the system (35) becomes[26]

(36a) $$C^* \phi(k^*, q^*) = 0,$$

(36b) $$\varphi(k^*, q^*) = 0,$$

(36c) $$\Gamma(k^*, q^*, C^*) = 0.$$

The state (k*, q*, C*) characterizes that steady state. From (36a) and (36b), it is sufficient to determine the steady-state values of k* and q*. With k* and q* determined, there exists a unique constant, C*,that satisfies (36c). So the system can be resolved and the steady-state values can be deduced.

---

[26] See Appendix 2 in Wang (1990).

5.3 Results of the Model

In this model, the steady state does not mean that each country's capital-labor ratio is really still. Technological innovation and knowledge accumulation will go on without bound, so each country's capital-labor ratio will increase all the time. Here in the steady state, a constant k* means that both k_D and k_I grow at an equal rate, V_I. A constant q* means that both q_D and q_I also grow at the same rate, V_I. As defined in the equation (32), V_I is the growth rate of human capital in the industrial country.

While in autarky, there is no FDI moving from the industrial country to the developing country. So let z = 0, we can deduce the autarky steady-state growth rates of the capital-labor ratios in both countries from the system composed of equations (30)-(33):

(37) $$\dot{k}_i / k_i = \dot{h}_i / h_i$$

where i = D, I.

The steady state requires $s_i y_i = b_i k_i$, which together with equation (37) implies that y_i and k_i both grow at the same rate, V_i, i = D, I. So it is clear that the developing country will grow more slowly than the industrial country as long as $V_D < V_I$.

The comparison between the steady states under intraregional FDI and autarky yields the following results: intraregional FDI raises the long-run steady-state growth rates of capital-labor ratio (both physical and human capital) and per capita income in the developing country from its autarkic growth rate of human capital (or technology diffusion rate), V_D to that of the industrial country, V_I. The corresponding growth rates of the industrial country remain at its original rate, V_I. The income gap between the industrial and developing country is

narrowed to a certain extent which is determined by these two countries' saving propensities si, autarkic growth rate of human capital Vi[29], i = D, I.

The above model incorporates the hypothesis that technology transfer process is related to the amount of FDI in the host country and relative technology gap (or human capital gap) between two countries. This hypothesis is very much simplified, the real world is much more complicated.

The endogenous growth theory clearly indicates that technological innovations and human capital accumulations are becoming ever more important contributors to economic development. As I argued in Section 5.2, the technology innovative capacity of developing countries is quite weak. Thus the ability of developing countries to accommodate and adopt foreign advanced technology becomes decisive. Chapter 3 has analyzed the circumstances, or the institutional specifications under which FDI has been able to exert such influence on the economic growth in East Asia. However this field needs much thorough and careful research.

The model presented in this section is actually a simple application of endogenous growth model which stresses the role of human capital as "engine of growth". To developing countries, foreign investment is not only an additional source of capital, but also a source of new knowledge that enhances the human capital level of host countries. Lower income developing countries can catch up with industral countries under the free flow of DFI. The result of the model is encouraging, for it admits that under certain circumstances, the income gap between these two regions can be cut.

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[29] As I point out repeatedly that the developing country's autarky growth rate of human capital can also be regarded as technology diffusion rate in developing country.

6
Conclusions

East Asian economies are booming. Although the prospective seem quite bright, the "East Asian Miracle" is likely to continue, it is far from clear whether East Asia can maintain the current momentum. Nevertheless, the past experience is still very worth studying.

FDI plays an important role in the economic growth of East Asia. The growth experience of East Asian developing countries clearly demonstrates that FDI has extensive influences on the host developing countries. Particularly, developing countries are backward in technology and human capital. FDI not only increases capital supply in host countries, but also is an important source of advanced technology and new knowledge. The technology transfer or knowledge spillover effects are vital to the improvement of general technology as well as human capital level. In East Asia, FDI contributes greatly to the rapid economic growth.

The new growth theory sets out to investigate the fundamental determinants of economic development. The results and implications of new growth models provide theoretical supports to the insight that the technological innovative capacity and accumulation of human capital is the real force behind the successful growth process.

International flows of FDI do not deliberately intend to benefit developing countries. Thus the government policies of developing countries have a crucial role to play. How to maintain macroeconomic stability and provide a favourable investment environment? How to stimulate effective linkages between FDI and domestic enterprises? How to integrate FDI into domestic economy and maximize the beneficial effects of FDI?

In order to answer all these questions, we need to have a deeper understandings of technology transfer process, the behaviours of multinational enterprises and all the complicated relationship among economic growth process.

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