FOREIGN DIRECT INVESTMENT AND ECONOMIC DEVELOPMENT: AN INTERACTIVE RELATIONSHIP

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Thesis Summary

With the increasing importance of Foreign Direct Investment (FDI), there have been substantial studies on this issue, both empirically and theoretically. However, most existing studies focus on either the impacts of FDI presence or the determinants of FDI inflows, ignoring the fact that inward FDI and economic development may simultaneously affect each other. This thesis sets out to examine the interactive effects between FDI and economic development.

The whole thesis is composed of five chapters. Chapter One is an overall introduction to the thesis. Chapter two presents a theoretical study and chapter two and three provide two empirical studies. Chapter five concludes.

Chapter two presents a theoretical two-sector model that features the importance of human capital in attracting foreign investment. This model theoretically explains why FDI is more likely to occur among countries that are similar in terms of human capital and technology. On the other hand, MNCs must train local employees to work with firm-specific technology and hence improve the technological skills of local workers.

In Chapter two, an empirical model is constructed to detect whether the productivities of foreign and local firms impact each other. The model is tested on China's data at the industry level. The results indicate that productivity growth of local and foreign firms are jointly determined. Evidence also suggests that the extent to which spillovers occur varies with different technology levels of local firms.

Chapter four investigates the relationship between FDI and economic growth based on a panel of data for 84 countries over the period 1970-1999. Both equations of FDI inflow and GDP growth are examined. The results indicate that FDI not only directly promotes economic growth by itself, but also indirectly does so via its interaction terms. There is a

strong positive interaction effect of FDI with human capital and a strong negative interaction effect of FDI with technology gap on economic growth in developing countries.

Chapter five offers overall conclusions and policy implications. In addition, the limitations and future research are also discussed.

Keywords: Foreign Direct Investment, Economic Growth, Technology Spillovers, Human Capital, Endogenous.

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Chapter One

Overall Introduction

Abstract

This chapter provides an overall introduction to the whole thesis with focus on research context and structure of the thesis. In this chapter, the development of Froeign Direct Investment (FDI) and the existing studies on FDI are briefly discussed. This chapter also offers an introduction to the structure of the thesis.

1.1. Introduction

Over the past decades, the globalisation of economic activity has expanded dramatically. The process by which economic activity becomes more integrated and economies become more interdependent is driven by the international exchange of goods, services and factors of production. While the drivers of globalisation include arms-length trade, migration of workers and cross border investment, the latter is probably the most publicly visible. From an economic standpoint, foreign direct investment (FDI) may also be, at the margin, the most important manifestation of globalisation. Annual flows of FDI now exceed US$ 560 billion and the total stock exceeds US$ 8 trillion (UNCTAD, 2004). Over the last decade FDI flows have grown at least twice as fast as trade.

As with trade, FDI has been taking place in an increasingly liberalised framework. Governments have been taking actions to stimulate FDI and in many cases they have gone beyond creating a more liberal environment to provide substantial public subventions to attract FDI. Why do governments pay attention to FDI in this way? It is motivated by an assumption that the presence of foreign firms yields benefits in various ways, including higher economic development than otherwise.

Because of the importance of FDI, there have been substantial studies on this issue, both empirically and theoretically. However, most of existing studies focus on either the impacts of FDI presence or the determinants of FDI inflows, ignoring the fact that inward FDI and economic development may simultaneously affect each other. Recently, researchers (e.g., Yao and Zhang, 2003; Chakraborty and Basu, 2002; Nair-Reichert and Weinhold, 2001; Zhang, 1999a, 1999b.) have started to pay attention to the simultaneous relationship between FDI and economic development in the host country. This thesis aims to contribute to the literature by examining the interactive effects between FDI and economic development.

This chapter presents an overall introduction to the whole thesis. Section 1.2 briefly discusses the research context of the thesis. Section 1.3 is an introduction to the structure of this thesis.

1.2. Research context

The deepening of worldwide economic integration has depended increasingly on rising FDI flows, especially in the last two decades. Up to the mid 1980s, foreign trade was the most dynamic channel of economic integration. Exports grew much stronger than FDI in the 1950s, 1960s and 1970s. In the 1980s this pattern changed. 16.3% FDI growth exceeded the 6.2% export growth per year by far, an even more dynamic contribution to economic integration came from FDI. Worldwide FDI continued to grow in the 1990s. In 2003 the world FDI stock reached US$8 trillion. FDI inflow has increased from US$13 billion in 1970 to US$560 billion in 2003. Table 1.1 and table 1.2 provide detailed information of FDI inflow and stock over the period 1970-2003.

Among the worldwide FDI, roughly three quarter were invested in developed countries. Especially the FDI boom in the second half of the 1980s was an OECD countries phenomenon. Approximately 85% of the flows had developed countries as source and as host of FDI. In the last decade the share of FDi received by developing countries has been somewhat higher. This higher share results from a FDI boom in China and South-east Asia in the first half of the 1990s. China alone received 9% of all FDI inflows worldwide, or one third of all inflows in the developing countries in 2003.

Table 1.1: FDI inflows, by host region and economy, 1970-2003, billions of USS

	1970	1975	1980	1985	1990	1995	2000	2003
World	13.03	26.61	54.99	58.10	208.65	335.73	1387.95	559.58
Developed countries	9.48	16.97	46.53	42.88	171.11	204.43	1107.99	366.57
- western Europe	5.21	10.16	21.43	16.95	103.36	119.15	697.44	310.23
- North America	3.08	5.95	22.73	21.86	56.00	68.03	380.80	36.35
- other developed countries	1.19	0.86	2.38	4.07	11.74	17.25	29.75	19.99
Developing countries	3.56	9.64	8.42	15.19	36.90	115.95	252.46	172.03
- Africa	0.93	0.85	0.40	2.45	2.43	5.39	8.73	15.03
-Latin America and the Caribbean	1.68	4.30	7.49	7.27	9.62	30.28	97.54	49.72
- Asia	0.81	4.47	0.41	5.39	24.31	79.59	146.07	107.12
- South, East and South-east Asia	0.64	1.86	3.57	4.65	22.15	77.82	142.68	96.91
- China	0.00	0.00	0.06	1.96	3.49	37.52	40.71	53.51

Source: World Investment Report, UNCTAD, 2004

Table 1.2: FDI inward stock, by host region and economy, 1980-2003, billions of USS

	1980	1985	1990	1995	2000	2003
World	692.81	972.20	1950.30	2992.07	6089.88	8245.07
Developed countries	390.74	569.70	1399.51	2035.80	4011.69	5701.63
- western Europe	231.54	285.01	795.81	1213.00	2378.17	3538.13
- North America	137.21	249.27	507.79	658.84	1427.07	1829.73
- other developed countries	21.99	35.42	95.91	163.95	206.44	333.76
Developing countries	302.07	402.46	547.96	916.70	1939.93	2280.17
- Africa	32.14	33.81	50.85	77.33	140.89	167.11
-Latin America and the Caribbean	50.41	80.11	116.87	200.08	512.46	647.68
- Asia	218.32	287.33	378.00	636.47	1283.08	1461.52
- South, East and South-east Asia	211.04	249.96	337.08	581.01	1195.69	1352.41
- China	1.08	6.06	20.69	134.87	348.35	501.47

Source: World Investment Report, UNCTAD, 2004

Given the rapid expansion of FDI, there has been a well established literature addressing the issue of why multinational corporations (MNCs) choose to set up production overseas rather than export directly and/or license their product/technology. One of the most persuasive explanations is the co-existence of proprietary knowledge of some form and market failures in protecting that knowledge. This literature has been extensively surveyed (Caves, 1996; Markusen, 1995). Other studies also suggest that MNCs choose to set up subsidiaries overseas to get access to the host-country market or reduce the production costs.

The presence of foreign firms can affect economic development of the host country by various ways. The existing literature identifies four channels through which the host country can boost its economic development via spillovers: imitation; skill acquisition; competition; and enhanced export propensity. 1) Imitation is the classic transmission mechanism for new products and process. In the theoretical literature, a transmission mechanism commonly alluded to technology transfer (Das, 1987; Wang and Blomstrom, 1992). Clearly the scope here depends very much on product/process complexity, with simple manufactures and production processes rather easier to imitate than more complex ones. Any upgrading to local technology deriving from imitation could result in productivity spillovers from the MNCs to the local economy, with consequent benefits for the productivity of local firms. 2) Adoption of new technology can also occur through acquisition of human capital. Even MNCs usually pay lower wages than in the home country, they nevertheless demand relatively skilled labour in the host country. Generally they will provide training and hence improve the skills of local labour force. Some analysts argue that this is potentially the most important channel for spillovers (Haaker, 1999; Fosfuri, Motta and Ronde, 2000; Chen, 1983; Djankov and Hoekmann, 2000). 3) Recently, some theoretical models of spillovers emphasise the key role which competition can play (Glass and Saggi, 1998) although empirical investigations on this spillover effects are still scarce. Unless an incoming firm is offered monopoly status, which can and does happen in highly protected markets, it will produce in competition with indigenous firms. Even if the latter are not in a position to imitate the MNCs' technology/production processes, they are under pressure to use existing technology more efficiently. Thus, greater competition can be identified as one of the major channels for technology spillovers. In addition, competition may increase the speed of adopting new technology or the speed with which it is imitated. 4) A further indirect source of productivity gain might be via market access or export spillovers. Domestic firms may learn how to export from MNCs (Aitken, Hanson and Harrison, 1997). Meanwhile, MNCs will generally utilise their already established networks and will often exploit them to export from the new host. Through collaboration, or more likely imitation, domestic firms can learn how to penetrate export markets. Thus, learning to export may be another vehicle for productivity spillovers.

Existing studies suggest that location specific characteristics affect the speed of adoption of new technology or spillovers of production gains (Findlay, 1978; Glass and Saggi, 1998; Borensztein et al., 1998; Mengoa and Sanchez-Robles, 2003; Durham, 2004). Among the host country characteristics, the most important is human capital. Countries may need a minimum threshold stock of human capital in order to experience positive effects from FDI. Moreover, technological distance between the host and home country, or technology gap, signals something to the MNcs about absorptive capacity. Specifically, the bigger the gap and the lower the quality of technology transferred, the lower the potential for productivity spillovers.

The host country characteristics influence not only the spillover effects from FDI, but also the decision of MNCs to invest. Empirical studies suggest that most of FDI flows are between developed countries. Among developing countries, the largest recipients of FDI are those enjoying fast economic development. Also, a host country needs to have human capital, physical infrastructure and distribution networks to attract and support inward investment. That is, there is a two-way relationship between inward FDI and economic development.

However, most existing studies focus on either the determinants or impacts of FDI in the host country. This thesis emphasise the interactive/endogenous relationship between FDI and the host country and the competition effects between foreign and local firms. Both empirical and theoretical studies are conducted.

1.3. The structure of the thesis

The whole thesis is composed of five chapters. This chapter, Chapter One, is an overall introductory chapter. Chapter 2 presents a theoretical model, chapter 3 and chapter 4 are empirical studies.

Chapter 2 presents a theoretical two-sector model that features the importance of human capital in attracting foreign investment. This model theoretically explains why FDI is more likely to occur among countries that are similar in terms of human capital and technology. On the other hand, MNCs must train local employees to work with firm-specific technology and hence improve the technological skills of local workers.

In Chapter 3, an empirical model is constructed to detect whether the productivities of foreign and local firms impact each other. The model is tested on China's data at the industry level. The results indicate that productivity growth of local and foreign firms are jointly determined. Evidence also suggests that the extent to which spillovers occur varies with different technology levels of local firms.

Chapter 4 investigates the relationship between FDI and economic growth based on a panel of data for 84 countries over the period 1970-1999. Both single-equation and simultaneous equation system techniques are applied. The significant endogenous relationship between FDI and economic growth is identified from the mid-1980s onwards. The results indicate that FDI not only directly promotes economic growth by itself, but also indirectly does so via its interaction terms. There is a strong positive interaction effect of FDI with human capital and a strong negative interaction effect of FDI with technology gap on economic growth in developing countries.

Chapter 5 offers overall conclusions and policy implications. In addition, the limitations and future research are also discussed.

Chapter Two
Firm Location, Human Capital and Training

Abstract

This chapter presents a theoretical two-sector model to examine the effect of human capital on attracting FDI and the role of FDI in improving the technological skills of workers in the host country through providing training. The role of technology gap is also considered. The model explains why similar countries are more likely to receive FDI. Countries that do not provide a minimum level of human capital can not attract technologically superior FDI, because MNCs find that the average training cost is too high. This model also explains that the individual skills of workers in the host country can improve through the training provided by foreign firms.

2.1. Introduction

Before proceeding to the empirical studies, I present a theoretical model to examine the relationship between FDI and human capital of the host country, the role of the technology gap is also considered.

In the literature, there have been substantial empirical analyses of the determinants and effects of foreign direct investment (FDI). Recent work points to a possible two-way causality between a country's stock of skilled labour and FDI. Existing studies also show that increased foreign direct investment (FDI) into developing countries may promote economic development by transferring knowledge through multinational firms. Multinational firms may also increase the demand for skilled labour in developing countries, as their plants are often more knowledge-intensive than the rest of the economy (Feenstra and Hanson, 1995, 1997) and hence promote the economic growth in the host country through the growth of human capital. Other empirical evidence suggests that a developing country with higher stock of human capital and higher economic growth tends to attract more FDI. For example, in their cross-country regression analysis, Borensztein, Gregorio and Lee (1998) conclude that FDI contributes to economic growth only when a sufficient absorptive capability of the advanced technologies is available in the host country.

Theoretically, there are also important findings on the endogenous relationship between FDI and economic development in the host country although existing studies on this issue are still scarce. Markusen and Venables (1999) show FDI can work as a catalyst for industrial development in a theoretical model where FDI and local industries are complementary. Baldwin, Martin, Ottaviano (1998) and Martin and Ottaviano (1999) explore the connection between growth and firm location by incorporating features from the endogenous growth model in their models with endogenous industry location. However, none of them pay attention to the role of human capital or worker quality in attracting FDI and benefiting from FDI. In a very recent study, Hoffmann (2003) constructs a general equilibrium model that allows for endogenous firm and plant-location decisions and the endogenous accumulation of skilled labour. Hoffmann (2003) focuses on the effect of an education subsidy when trade is liberalised and investment is restricted and vice versa.

This chapter presents a theoretical two-sector model that features the importance of human capital in attracting foreign investment, the role of the technology gap is also considered. This model examines the effect of human capital on attracting FDI and the role of FDI in improving the technological skills of workers in the host country through providing training. Different from Hoffmann (2003), MNCs in this model must train local employees to work with firm-specific technology and hence improve the technological skills of local workers. The model explains why similar countries are more likely to receive FDI. Countries that do not provide a minimum level of human capital can not attract technologically superior FDI, because MNCs find that the average training cost is too high. This model also implies that the individual skills of workers in the host country can improve through the training provided by foreign firms.

2.2.The model

2.2.1.The basic assumptions

This model considers two countries, a and b, with labour internationally immobile. Following Kim and Kim (2000), I assume that there are two classes of human capital. One is general human capital H, which represents the human capital level of a country and is raised through school education. The other is specific human capital, h^i, which takes the form of an industry- or a sector-specific knowledge, skill and know-how and is the only factor of production for the corresponding product. Unlike Kim and Kim (2000), who assume each agent has a different level of general human capital and specific human capital, I assume that the general human capital level of all agents in a country is the same, wh ile the specific human capital of each agent is different. The two countries have identical labour size and level of general human capital. Initially it is also assumed that the two countries have identical technology level, which will be released in the later discussions in section 5, where country a is a developed country while country b is a developing country. I have assumed there are two industries in the economy, industry X and industry Y. Each individual agent can become employed in either industry X or industry Y. In this model, industry X is labour-intensive with lower salary while industry Y is knowledge-intensive industry with relatively higher salary. This implies that agents choose to work in industry X only when they cannot get employed in industry Y. For simplicity, It is assumed that the only factor of production is labour.

2.2.2. The consumers

The model economy consists of a large number of infinitely-lived identical agents who consume two different types of goods, X and Y. I will present the production of X and Y in the next subsection. Each agent maximizes the following utility function:

$$U = a\ln X + \ln Y, \tag{2.1}$$

The agents' current income is derived solely from the supply of their effective labour. The agents spend the current labour income on the current consumption of X and Y. Hence, the utility function is subject to their individual budget constraints which are determined by their income derived from employment in industry X, plus their efficiency wage income. utility maximisation yields the standard relation between relative demand and relative price:

$$a\frac{Y}{X} = p^{X}. \tag{2.2}$$

where p^{X} is the price of good X.

2.2.3. The industries

In this model, there are two industries, industry X and industry Y.

Industry X produces good X with a linear production function. The total output in this industry is given by:

$$X = \sum_{i=0}^{L^X} G(h^i, H), \quad \text{where } i \in [0, L], \tag{2.3}$$

where, L denotes the total labour in the country, which is divided into two parts, L^X and L^Y. L^X and L^Y are the employment in industry X and industry Y respectively. $G(h^i, H)$ represents the productivity and depends on the quality of the individual worker which consists of two components: General human capital H and individual ability h^i. $G(h^i, H)$ also has positive partial derivatives, that is, $G_H > 0, G_{h^i} > 0$, which indicate that production is the increasing function of labour input.

As introduced above, industry X is labour-intensive industry, which implies that employers can easily observe the labour productivity. Hence, in this industry, I assume the return to labour is known with certainty to each individual agent, the wage level represents the technology level that the agent possesses. Supposing the reservation wage of worker i is ω^i, the price of the good X is p^X, It can be shown that:

$$\omega^i = p^X G(h^i, H), \tag{2.4}$$

Since higher quality workers are assumed to have higher productivity, the following derivatives are straightforward: $\partial\omega^i/\partial H > 0, \partial\omega^i/\partial p^X > 0,$ and $\partial\omega^i/\partial h^i > 0.$

Industry Y is relatively knowledge-intensive. For simplicity, I assume that countries a and b have one firm and one representative technology, A . The firm's production function for manufacturing output, Y, is as follows:

$$F = AL^Y \tag{2.5}$$

As usual, $F' > 0, F'' < 0. A$ is the technology level of the country. To be able to work with technology A , the labour must have firm specific skills. Since skills are firm specific, the employer must pay the training cost. It is assumed that training costs are a function of labour quality. Specifically, training cost of labour i is as follows:

$$\overline{C} = AC(q(h^i), H) \tag{2.6}$$

where, for simplicity, training costs depend linearly on the amount of training required for each specific technology, A . The training efficiency, $q(h^i)$, of worker i is determined by the worker's quality, h^i and H .

In this industry, employers may observe the general human capital, H , but not the exact ability of individual workers, h^i. Although the firms can not observe the quality of worker i , they are able to estimate the expected quality of the workers based on their reservation wages. Since the reservation wage is an increasing function of

h^i, firm may use the manufacturing wage, w, to influence the expected quality of their workers. Following Weiss (1990), firms base their hiring decisions on the expected quality, Q,

$$Q(w,H,p^X) = \frac{\int_0^w q(\omega^i,p^X,H)D(\omega^i)d\omega^i}{\int_0^w D(\omega^i)d\omega^i} \tag{2.7}$$

where $D(\omega^i)$ gives the mass of workers with reservation wage ω^i. The above equation states that at a given relative price p^X, firms can expect an worker with observable human capital H to possess quality Q, at a given wage offer, w. From $q_\omega > 0$ and $q_{p^X} < 0$, it follows that $Q_w > 0$ and $Q_{p^X} < 0$. In addition, I assume that, at a given wage, the expected quality increases in the level of observable human capital, or $Q_H > 0$. I also assume that $Q_{p^X p^X} < 0, Q_{ww} < 0,$ and $Q_{wp^X} = 0.$ Thus, I can now rewrite the firm's training cost per worker as:

$$\overline{C} = AC(Q(w,H,p^X)) \tag{2.8}$$

The firm's profit equation as follows. In this equation, firm tries to maximise its profits over employment L^Y and wage w.

$$\max \pi = F(AL^Y) - (w + AC(Q(w,H,p^X)))L^Y \tag{2.9}$$

The first order conditions of the above maximising problem can then be derived as follows:

$$AC'(Q(w,H,p^X))Q_w(w,H,p^X) = -1 \tag{2.10}$$

$$AF'(AL^Y) = w + AC(Q(w,H,p^X)) \tag{2.11}$$

From the above equation, the optimal number of labours employed at any given wage can be determined. It simply states that the marginal product must equal the marginal cost to firms, where the cost depends on both the wage and the expected training costs. Equation (2.11) can be rewritten as:

$$F'(AL^Y) = \frac{w + AC(Q(w,H,p^X))}{A} = \frac{w}{A} + C(Q(w,H,p^X)) \tag{2.12}$$

$F'(AL^Y)$ represents the productivity adjusted cost of the firm. From equation (2.12), higher level of general human capital can lead to lower production cost of a firm. It is convenient to define $F'(AL^Y)$ as C_A.

From equation (2.11), or equivalently, equation (2.12), the efficiency wage can be derived as $w^* = w^*(A,H,p^X)$, which is a function of the exogenous parameters: technology, observable human capital, and the (partial equilibrium) price of good X. From equation (2.10), the typical efficiency wage condition is known, that is, at equilibrium, a decrease in the wage cost must generate an equal increase in the training cost. Also, equation (2.10) and

(2.11) replicate the usual efficiency wage result, that is, as long as the labour constraint is not binding at w^*, the wage determines the amount of labour employed, instead of vice versa. That is, firms choose productivity and training efficiency of their workers optimally and independently of the amount of labour supplied at any given wage.

To look at the impacts of technology A, human capital H and price p^X on the efficiency wage w^*, I first differentiate equation (2.10) to obtain the following:

$$\frac{\partial w^*}{\partial p^X} = -\frac{C''(Q)Q_{p^X}Q_{p^X}}{\partial^2 C_A/\partial w^2} > 0,$$
$$\frac{\partial w^*}{\partial H} = -\frac{C''(Q)Q_H Q_w + C'(Q)Q_{wH}}{\partial^2 C_A/\partial w^2} > 0,$$
$$\frac{\partial w^*}{\partial A} = \frac{T'(A)}{T(A)^2(\partial^2 C_A/\partial w^2)} > 0. \qquad (2.13)$$

Similarly, differentiating equation (2.12) gives:

$$\frac{\partial C_A^*}{\partial p^X} = C'(Q)Q_{p^X} > 0,$$
$$\frac{\partial C_A^*}{\partial H} = C'(Q)Q_H < 0,$$
$$\frac{\partial C_A^*}{\partial A} = -\frac{wT'(A)}{T(A)^2} < 0. \qquad (2.14)$$

From (2.13) and (2.14), if wages rise due to an increase in the price, then C_A increases because firms see the quality of their workers deteriorate as the value of the marginal product in industry X rises. If , however, wages increase because firms face higher levels of observable human capital or technology, C_A declines. In response to an increase in technology, firms raise the efficiency wage to offset increased training costs with higher quality workers. Since higher quality workers possess a comparative advantage in training and learning about more sophisticated technologies, C_A declines.

An increase in human capital, at any given level of technology, implies two effects akin to a change in the relative price and technology. While higher human capital workers also have higher reservation wage, firms see the average quality of the workers increase. Since high human capital workers also possess a comparative advantage in learning about new technologies, the net effect of an increase in the level of human capital is upward pressure on the efficiency wage, but lower C_A.

In competitive models, when wages are directly tied to the marginal product of workers, or in models of perfect information, wages and output (employment) are usually inversely related. This need not be so cases when firms pay efficiency wages that are influenced by worker quality or technological skill requirement. From equations (2.5) and (2.11), I can have the relations of output in Y and the three key variables as follows:

$$\frac{\partial Y^*}{\partial p^X} = AF' \frac{\partial L^{Y^*}}{\partial p^X} = \frac{F'}{F''} \frac{\partial C_A^*}{\partial p^X} < 0,$$
$$\frac{\partial Y^*}{\partial H} = AF' \frac{\partial L^{Y^*}}{\partial H} = \frac{F'}{F''} \frac{\partial C_A^*}{\partial H} > 0,$$
$$\frac{\partial Y^*}{\partial A} = F'(L^Y + \frac{\partial L^{Y^*}}{\partial A}) = \frac{F'}{F''} \frac{\partial C_A^*}{\partial A} > 0. \tag{2.15}$$

From the above equations, output in industry Y falls as the relative price increases, since the increase in the value of the marginal product in industry X lowers the quality of the workers in industry Y. Firms have to increase the efficiency wage to keep the training costs constant. The increase in the average and total cost decreases profits which induces a contraction in output through employment. The partial equilibrium effects of increases in human capital and technology are positive on output in the industry Y. Output in the industry Y increases in both cases because workers are more productive. However, in the case of increased technology firms also face higher training costs. As a result, they raise the efficiency wage to attract more able workers with a comparative advantage in training.

2.3. The economy without FDI

The condition that supply must equal demand in a closed economy without FDI, or

$$a\frac{F(T(A)L^Y)}{\sum_{i=0}^{L-L^Y} G(\theta(i),H)} = p^X = a\frac{Y}{X} \qquad (2.16)$$

renders the equilibrium relative price in the economy, that is, $p^{X*} = p^{X*}(A,H,L,a)$, a function of technology, observable human capital, the population size, preferences and the ability distribution of a country. I refrain from assuming any specific distribution for θ and assert these distributions are identical across countries. The comparative static that involve the size of the labour force, L, are then based on the assumption of mean and spread preserving increases in the population and its abilities. Differentiation of the above equation yields the following insights into the static comparative advantage:

$$\frac{\partial p^{X*}}{\partial L} = -\frac{a\frac{Y}{X^2}\frac{\partial X^2}{\partial L}}{1 - a\frac{\partial (Y/X)}{\partial p^X}} < 0,$$

$$\frac{\partial p^{X*}}{\partial H} = \frac{\frac{a}{X^2}(X\frac{\partial Y^*}{\partial H} - Y\frac{\partial X^*}{\partial H})}{1 - a\frac{\partial (Y/X)}{\partial p^X}} > 0$$

$$\frac{\partial p^{X*}}{\partial A} = \frac{\frac{a}{X^2}(X\frac{\partial Y^*}{\partial A} - Y\frac{\partial X^*}{\partial A})}{1 - a\frac{\partial (Y/X)}{\partial p^X}} > 0$$

$$\frac{\partial p^{X*}}{\partial a} = -\frac{\frac{Y}{X}}{1 - a\frac{\partial (Y/X)}{\partial p^X}} > 0 \qquad (2.17)$$

The denominator is positive in all cases, as it is simply one minus the slope of the relative supply curve. An increase in p^X has two separate effects. First, it decreases employment in industry Y, as explained in equation (2.11); second, it depresses the expected quality of the workers, which increases C_A. Despite a firms' attempts to raise the efficiency wage to diminish the deterioration in the quality of their workers, quality declines. Output of X rises and output of Y falls unambiguously.

Once the sign of the denominator is establishes, the responses of the relative price due to changes in population and preferences are simple. Initially, all new workers would start in industry X, since the labour demand in industry Y is solely determined by the efficiency wage condition. As the marginal product in industry X declines, firms can offer lower efficiency wages and attract workers of the same expected quality, which in turn encourages employment in industry Y. However, since the efficiency wage is independent of the amount of labour in the economy, or even the amount of labour supplied at any given wage offered, increased supply in industry X dominates and the relative price falls. Hence countries with larger populations, even if they have the same level of observable human capital, exhibit lower efficiency wages and have a comparative advantage in industry X.

Dynamic elements are now introduced into the model, namely technological change and endogenous adoption, thus providing a foundation for the later discussion of firm location. I begin by examining the equilibrium for the case where technological change evolves exogenously at rate γ, or $dA/dt = \gamma A$.

In this section, the assumption of one "world technology", A_t, that evolves exogenous is identical to the assumption in Mankiw, Romer and Weil (1992), which produced good fits in cross country growth regressions. From the above discussion, the effects of a change in technology on equilibrium profits and output are:

$$\frac{d\pi_t}{dA_t} = -L_t^Y \frac{dC_{At}^*}{dA_t}, \tag{2.18}$$

$$\frac{dY_t}{dA_t} = -\frac{F'}{F''}\frac{dC_{At}^*}{dA_t} \tag{2.19}$$

The dynamic analysis of production and adoption implies a minimum C_A that depends only on the exogenous parameters of the model. Equation (2.18) and (2.19) imply that firms adopt new technologies only up to the point where $\overline{C_A^*}$ is at its minimum. If firms continued to adopt technology beyond the minimum $\overline{C_A^*}$, output and profits would contract. Hence, the dynamic analysis can rule out all cases where firms would ever be on the upward part of the $\overline{C_A^*}$.

2.4. Firm location

This section examines the firm location when countries have different levels of human capital and technology.

I define the country a as a developed country with higher level of human capital, H_a and country b as a developing with lower level of human capital H_b. Existing studies suggest that a prerequisite to the analysis of firm location is that there exists (1) a factor that is internal to the firm (in this case firm-specific training), and (2) a factor that provides a unique ownership advantage to the firm (in this case technology. To examine the firm location decision, I must introduce countries that differ not only in observable human capital, but also in technology. This is a natural assumption in light of the discussion of endogenous adoption, where It is shown that the countries with higher levels of human capital also adopt higher levels of technology in the long run. Similarly, developed country a has a relatively higher level of technology A_a, while the developing country b has relatively lower level of technology A_b. Both countries have identical preferences and population sizes.

The introduction of technological differences in addition to human capital differences, intensifies the developed country's comparative advantage in industry Y. The developed country now features an even greater relative supply of good Y, and its industry Y pays an even greater efficiency wage, compared to the developing country (equation (4.17)). In the developing country, an increase in the value of the marginal product in industry X increases the reservation wage and makes it even more difficult to attract workers for industry Y. the developing country's industry Y is disadvantaged not only by the price effect but also by a decline in the quality of workers. This will lead to wage convergence across countries.

From equations (2.13),

$$C_A^*(H_b,A_b,p^X) > C_A^*(H_b,A_a,p^X) > C_A^*(H_a,A_a,p^X) \qquad (2.20)$$

$$w^*(H_b,A_b,p^X) < w^*(H_b,A_a,p^X) < w^*(H_a,A_a,p^X) \qquad (2.21)$$

That is, if the firm in the developed country's industry Y were to locate part of its production to the developing country, the relocation would require that the firm to train workers to use technology of developed country. As the skills of the workers in developing country are of observably lower quality, the firm's C_A in the developing country is higher than in the home country, while the efficient wage is lower than in the home country. Also, the developed country's firm in the developing country trains workers to produce with higher technology, A_a , than the developing country's firm uses, A_b . As a result, the developed country's subsidiary in the developing country pays a higher wage, thus attracting higher quality workers and providing more training than the developing country's firm.

However, with two firms, a strategic interaction enters into the wage setting mechanism, because firms offering low wages improve the quality of distribution of workers applying to higher wage firms. This problem is well known and has previously been addressed by Weiss (1990). To proxy the labour market interaction between domestic and foreign firms, it is useful to assume that expected quality is also a negative function of the wage offered by a competitor firm, w^c , or $Q(w,H,p^X,w^c)$ with $\partial Q/\partial w^c < 0$. This implies that if a competitor enters with a high wage, $w^c > w$, the competitor firm skims the cream of the crop workers from the distribution and lowers the expected quality of workers attracted by the firm offering wage w.

The wage setting mechanism is analysed for the case where the MNC enters with a higher technology than the domestic firm. Formally, I require a sequence of actions where first, each firm announces a wage offer and the number of vacancies. It is assumed that workers have rational beliefs and can not apply to more than one firm. Second, workers decide where to apply after examining the wage offers and the probability of being employed. The higher wage and technology of the MNC forces the local firm to offer higher wage than before to avoid quality deterioration of its workers. More formally, first order conditions of the C_A minimisation problem for the domestic firm and the MNC are respectively:

$$A_0C'(Q(w,H,p^X,w^c))Q_w(w,H,p^X,w^c) = -1,$$
$$A_1C^{c'}(Q(w,H,p^X,w^c))Q^c_{w^c}(w,H,p^X,w^c) = -1, \tag{2.22}$$

where superscript c denotes the MNC, and H represents the domestic country's level of observable human capital that both firms utilise. Given the properties of the cost function, $T(A_0) < T(A_1)$ implies $w^c > w$. Note that the greater technology gap, the larger the differential in the wage offers. The first above equation represents the reaction of the local firm. It determines the wage it offers at each level of the MNC's wage, taking the latter as given. The same holds for the second equation. The Nash equilibrium of the model is then given by the solution of the above system of equations:

$$w = w(A_0,H,p^X,w^c(A_1,H,p^X,w)), \tag{2.23}$$

$$w^c = w^c(A_0,H,p^X,w^c(A_1,H,p^X,w^c)) \tag{2.24}$$

but from the above system of equations, I know that:

$$\frac{dw}{dw^c} = -\frac{C_{ww^c}}{C_{ww}} > 0, \text{ and } \frac{dw^c}{dw} = -\frac{C^c_{w^cw}}{C_{w^cw^c}} > 0 \tag{2.25}$$

Hence the equilibrium can be easily characterised, since both reaction functions are upward sloping in the w,w^c space, with each intercept being the wage a firm would offer if no competitor was in the market.

To ascertain if opening a subsidiary in the developing country is profitable, It is necessary to examine the first order condition of the MNC and assess if opening a plant in the developing country would provide profits. It is obvious from the profit condition that, depending on the developed country's level of technology and the developing country's level of human capital, a production location in the developing country might not be profitable for a developed country firm. This is because the high training cost for the MNC would not be covered by its revenue. Hence, relocation becomes less and less likely the farther apart the levels of human capital and technology are, because training costs increase as technology levels rise and/or observable human capital levels decline. This also explains why the large share of FDI occurs among countries showing relatively similar technology level.

The entry of foreign firms may also drive the firm in the developing country out of the industry Y. As the subsidiary of the firm of developed country pays a higher efficiency wage and attracts higher quality workers, the quality of workers for the domestic firms declines, that is, $\partial Q / \partial w^c > 0$. This diminishes the incentives for developing country firm to produce and hence increases the likelihood that it will be driven out of business because it can not generate profits.

2.5. Conclusion

This chapter explores the two-way relationship of host country characters and FDI, in particular this model examines the relationship of human capital in the host country and FDI. First, it exhibits that the country with the comparative advantage in training enjoys higher quality workers and lower efficiency wages. Second it has found that the larger the technology gap between the two countries, the less likely FDI will be. This explains why

FDI are more likely to occur between countries at similar technology level. Countries that do not provide a certain level of human capital can not attract technologically superior FDI because MNCs may find that the average cost of training is too high.

This study also demonstrates that the MNC pays a higher wage than the domestic firm, because the MNC introduces a superior technology, and incurs higher training costs. This provides incentives to raise the wages in order to increase the quality of its workers. Despite working with the same technology, workers in the developing country receive a lower wage than in the MNC's home country.

Despite of the important findings, this model can be improved in several ways. Further modification can be done by incorporating economic growth into the model and hence allowing FDI and economic growth to have impacts on each other within one framework. Moreover, dynamic elements of firm location decision and human capital accumulation can be introduced into the model.

In the empirical studies of the following two chapters, I will empirically investigate the two-way relationship between foreign firms and domestic firms, as well as Foreign Direct Investment (FDI) and economic development in the host country. The empirical studies will also pay attention to the role of human capital and labour quality in the host country. Results of Chapter three indicate that labour quality is one of the significant determinants of productivity in foreign firms. In chapter four, I find a strong positive interaction effect of FDI with human capital and a strong negative interaction effect of FDI with technology gap on economic growth in developing countries. These empirical results are consistent with the theoretical implications discussed in this chapter.

Chapter Three
Foreign Direct Investment and Productivity Spillovers in the Chinese Manufacturing Sector

Abstract

In this chapter a simple simultaneous model is constructed to examine whether there are productivity spillovers from both the presence of foreign direct investment and competition between local and foreign firms. The model is tested on the data from China's latest industrial census in 1995. The results indicate that the extent to which spillovers occur varies with different types of ownership of local firms. While collective- and private-owned enterprises benefit from demonstration and contagion effects from foreign presence, productivity gains of state-owned enterprises largely come from competition with foreign firms. Productivities of local and foreign firms are jointly determined. Evidence also suggests that the market-oriented FDI tends to generate spillovers mainly via competition with local firms.

3.1. Introduction

With rapid expansion in foreign direct investment (FDI) throughout the world economy, the role of multinational enterprises in technology transfer and spillovers has received increasing attention. Using an extended production function that includes capital intensity, labour quality and the presence of FDI, Caves (1974) examined the impact of FDI on the productivity of Australian manufacturing. Following his pioneering work, a number of further empirical studies of the impact of FDI were published. Examples include Globerman (1979) for Canada; Blomstrom and Persson (1983), Blomstrom (1986), Blomstrom and Wolff (1994) and Kokko (1994) and (1996) for Mexico; Aiken and Harrison (1991) and (1999) for Venezuela; Haddad and Harrison (1993) for Morocco; Kokko, Tansini and Zejan (1996) for Uruguay; and Liu et al. (2000) for the UK. Blomstrom and Sjoholm (1998) discuss the issue whether joint ventures have different effects than wholly-owned foreign affiliates.

Since opening its economy to the outside world in late 1978, China has absorbed an increasing amount of FDI. It is now among the world's largest host of FDI inflows. Although the impact of FDI on the Chinese economy is recognised to be significant (Chen, Chang and Zhang, 1995; Liu and Song, 1997; MacBean, 1998; Strange, 1998; Wei and Liu, 2001), surprisingly little econometric assessment of its role in productivity spillovers has been carried out. How have state- and other local-owned firms in China responded to the presence of FDI? Have market-motivated FDI and export-oriented FDI affected indigenous Chinese firms in different ways?

In this study a simple simultaneous model is constructed to examine whether there are productivity spillovers from both the presence of foreign direct investment and competition between local and foreign firms. The current study differs from the existing literature in the following two aspects: (1) in the simultaneous equation system three different groups of the firms are included: foreign-owned enterprises (FOEs), state-owned enterprises (SOEs) and other-locally-owned enterprises (OLOEs). The division of indigenous Chinese firms into these two groups is based on the following argument: SOEs are still perceived as being faced with soft-budget constraints and privileged access to financial capital (Coady and Wang 2000) and OLOEs are much more market-oriented than SOEs (Lo, 1999). Local Chinese firms of different ownership could behave differently with respect to imitation, innovation and competition. (2) In addition to an analysis based on the whole sample, a comparison is made of the spillover effects from different types of FDI, i.e. market-motivated and export-oriented. The competition effect on indigenous Chinese firms from market-motivated FDI is expected to be fiercer than that from export-oriented FDI.

Given these features the current study should contribute to the empirical evidence on spillovers, not only in China but elsewhere, where the host country is a large, developing and transitional economy. The rest of the chapter is organised as follows. Section 3.2 reviews the literature. A brief survey of FDI in China is then provided in section 3.3, especially on market-motivated and export-oriented FDI. Section 3.4 describes data, models and methodology. The empirical results will be presented in section 3.5. Finally, section 3.6 provides concluding remarks and a discussion of the study's main policy implications.

3.2. Literature Review

Caves (1974, p.176) noted that productivity spillovers occurred when the multinational firm 'cannot capture all quasi-rents due to its productive activities, or to the removal of distortions by the subsidiary's competitive pressure.' Firstly, spillovers can occur when multinational firms raise productivity levels among locally-owned by improving the allocation of resources. Second, through either the multinational's competitive force or demonstration effect, locally-owned firms operating in imperfect markets may be induced to produce at a higher level of technical or X-efficiency (Leibenstein, 1966). Third, the presence of multinational subsidiaries in an industry may speed up the process or lower the cost of the transfer of technology. Imitation effects and the movement of personnel trained by multinational subsidiaries may also enhance the transfer of technology to domestic firms (Bennett, *et.al.*, 1999).

In some theoretical models, the rate at which new technology is diffused is regarded as an increasing function of the degree to which the host country is open to FDI (Findlay, 1978; Baron, 1990 and Ethier and Markusen, 1996). Ethier and Markusen (1996) argued that technical innovations are most effectively copied when there is personal contact between those who already have the knowledge of the innovation and those who eventually adopt it. Productivity spillovers are considered, therefore, to be proportional to the presence of foreign firms.

Recent theoretical literature, however, suggests that spillovers from competition are not necessarily proportional to foreign presence. In Wang and Blomstrom (1992), spillovers are basically endogenous outcomes of the interactions between local and foreign firms. This is because the degree of technology or productivity spillovers depends both on the technology gap between foreign and local firms and the technological capabilities of local firms. Cantwell (1989, 1995) argues that if local firms do not lag too far behind MNCs they can embark on a catch-up process and benefit from the presence of FDI. However, local firms may be so far behind foreign firms that it is impractical for them to benefit substantially from foreign firms' knowledge and consequently the local firms may be crowded out by the foreign firms. In this case, foreign firms displace local firms. Therefore, foreign firms' activities in the developing country can generate both virtuous and vicious impacts. Taking the perspective of evolutionary theory, Perez (1997) maintains that the capacity of domestic-owned firms to 'catch up' depends on their level of competitiveness.

The above discussion indicates that FDI may influence the productivity of domestic firms via a number of channels. While spillovers from demonstration and contagion effects may be proportional to foreign presence, those from competition may be determined by the size of the technology gap and by interactions between foreign and local firms. Also, such characteristics as motivation and the technological capability of local firms can be expected to affect their behaviour with respect to learning from and imitating advanced foreign technology and to competing with foreign firms. In sum, spillovers from competition seem to be influenced by a number of factors and are not necessarily proportional to foreign presence.

Empirical studies examining the contagion and demonstration effects of foreign presence typically estimate a production function for domestic firms. The foreign share of an industry is included as one of the explanatory variables to see if it has a significant positive impact on local productivity. The results reported in the literature are mixed. While Caves (1974), Globerman (1979), Blomstrom and Persson (1983) and Liu et al. (2000) provide evidence of positive spillovers, Aitken and Harrison (1991) and Haddad and Harrison (1993) conclude to the contrary. Kokko, Tansini and Zejan (1996) find a positive and statistically significant spillover effect only in a sub-sample of locally-owned plants – those with a moderate technology gap vis-à-vis foreign firms. Their interpretation is that there are firm-specific differences in the ability to absorb spillovers.

Kokko (1996) argues that the previous empirical tests have not distinguished between the effects of contagion and demonstration and those of competition between foreign and local firms. In his simple simultaneous model, the productivity of foreign firms appears as an endogenous variable and the labour productivity of foreign and domestic firms is simultaneously determined because of competition. The spillovers are not strictly proportional to foreign presence.

3.3. FDI at the Chinese Industrial Level

Since the adoption of the "open-door" policy in late 1978, China has experienced rapid expansion in FDI inflows. In fact, China has become the largest recipient of FDI among the developing world since 1978 and globally, the second only next to the US since 1993. By the end of 2003, China had accumulated US$ 500 billion in FDI (UNCTAD, 2004). China is now among the world's largest host of FDI inflows.

China's FDI boom did not take place until the early of 1990s although the economic reform had been initiated in 1978. One of the most impressive characters of the trends is the sharp rise in the 1990s in contrast with the moderate growth in the 1980s. Although a surge of interest among foreign investors in China emerged after 1979, large FDI inflow did not occur in the initial period because of the poor infrastructure and the lack of experience in dealing with foreign investors. The period of 1984-1992 saw a steady growth of FDI and relatively large amount, due in part to the extensions of the special economic zones from four to another fourteen cities in 1984, and FDI incentives introduced in 1986. In 1993, China seemed to reach its critical threshold of attracting FDI on a large scale. The one-year FDI inflow in 1993 (US$26 billion) exceeded the cumulative flows (US$23 billion). In

1995, FDI inflow in China was US$38 billion and in 2003, FDI inflow in China has increased to US$115 billion (UNCTAD, 2004). Table 3.1 presents the FDI inflow from 1979 to 2003.

One of the characteristics of FDI in China is that most FDI is in the manufacturing industry. As indicated in Table 3.2, by the end of 2003, FDI in manufacturing sector accounted for 72.9% of total FDI projects and 63.7% of the contracted FDI in China. In the services sector, FDI is mainly poured into the real estate industry. The investment in the primary industry occupies a rather low proportion of the total FDI. A majority of FDI has gone into the manufacturing sector because China possesses a competitive edge thanks to its lower cost of production and relatively powerful supporting ability. In contrast, China has strictly controlled the flow of FDI into the services sector for a long period.

As introduced above, China is now the largest recipient of FDI in the developing world. Examining the role of FDI in the economic development in China has immediate policy implications both for China and other developing countries. Moreover, as the majority of FDI is in the manufacturing sector, it is important to investigate the spillover effects of FDI in China's manufacturing industry. Ideally, it would be interesting to look at the issue using dis-aggregated panel data over a long period. Unfortunately, due to data limitation, this study is based on industry level data from the Third Industrial Census, published by the State Statistical Bureau of China (SSB) in 1997. The Census reports data for 1995 on a cross-section of branches of Chinese industry. It is the latest and most comprehensive industrial survey published and provides relatively detailed information on FDI in the 191 sectors.

Table 3.1. FDI in China, 1979-2003

	No. of Project	Contracted value (Billions of US$)	Amount realised (Billions of US$)
Total	465,277	943.131	501.47
1979-1982	920	4.96	1.77
1983	638	1.92	0.92
1984	2,166	2.88	1.42
1985	3,073	6.33	1.96
1986	1,498	3.33	2.24
1987	2,233	3.71	2.31
1988	5,945	5.30	3.19
1989	5,779	5.60	3.39
1990	7,273	6.60	3.49
1991	12,978	11.98	4.37
1992	48,764	58.12	11.00
1993	83,437	111.44	27.52
1994	47,549	82.68	33.77
1995	37,011	91.28	37.52
1996	24,556	73.28	41.73
1997	21,001	51.00	45.26
1998	19,799	52.10	45.46
1999	16,918	41.22	40.32
2000	22,347	62.38	40.72
2001	26,140	60.11	46.88
2002	34,171	82.74	52.74
2003	41,081	115.07	53.51

Source: China Statistical Yearbook 2004, State Statistical Bureau, China.

Table 3.2. Cumulative FDI by Sector, by the End of 2003, billions of US$

Sector	No. of Project	Share (%)	Contracted value	Share (%)
Total	465,277	100	943,131	100
Agriculture, Forestry, Animal Husbandry & Fishing	13,333	2.87	18.036	1.91
Mining	524	0.11	1.681	0.18
Manufacturing	338,952	72.85	600.398	63.66
Electricity, gas and water	654	0.14	5.682	0.6
Construction	10,040	2.16	24.249	2.57
Transport, Warehousing, Post & Communications	5,235	1.13	23.813	2.52
Wholesale & Retail, Catering	23,565	5.06	28.842	3.06
Finance and Insurance	48	0.01	0.865	0.09
Real Estate	40,941	8.8	180.896	19.18
Health Care, Sports & Social Welfare	1,204	0.26	5.433	0.58
Education, Culture, Arts, Broadcasting, Film & TV Industry	1,482	0.32	2.586	0.27
Scientific Research & Technical Services	3,528	0.76	4.159	0.44

Source: China Statistical Yearbook 2004, State Statistical Bureau, China.

Based on the motivations of the investment, FDI can be divided into two categories: export-oriented FDI and market-oriented FDI. Different types of FDI are expected to have different impact on the host economy. In terms of productivity spillovers in China, the market-oriented FDI, which aims to China's domestic market by selling their products locally, may generate spillovers through intensifying competition, in addition to demonstration spillovers. The export-oriented FDI, which produces goods for exporting, may not have competition spillover effects on domestic firms. One rough way to identify the export and market-oriented FDI is to examine the ratio of exports to total sales in FOEs. Table 3.3 provides examples of the export shares of FOEs across the 191 sub-manufacturing sectors in China. It is evident that FDI in computer manufacturing is highly export oriented while FDI in petroleum refining & coking is mainly market oriented.

Table 3.3. Shares of export in total sales in foreign firms by industry

Industries	Total sales (100m $)	Export (100m $)	Shares (%)
Computer manufacturing	229.18	196.22	85.6
Electronics & tele. equipment	6.68	5.33	79.8
Leather products manufacturing	375.48	299.03	79.6
Clock manufacturing	39.77	30.91	77.7
Leather and fur products	482.86	355.28	73.6
Clothing and other fibre products	684.13	490.80	71.7
Bicycle manufacturing	49.65	31.52	63.5
Electronic appliances manufacturing	404.21	251.87	62.3
Sea food processing	95.86	56.76	59.4
Can food manufacturing	20.99	10.50	50.0
Special machinery	147.13	40.72	27.7
Chemical material & products	453.36	102.77	22.7
Non-metal mineral products	316.37	67.72	21.0
Paper & paper products	163.88	34.08	20.8
Printing	64.41	11.99	18.6
Tobacco processing	5.56	0.96	17.3
Non-ferrous metal smelting & pressing	234.62	21.9	9.3
Petroleum refining & coking	24.03	0.01	4.2

Source: Statistical Bureau of China (1997) China's Third Industrial Census in 1995.

3.4. Data, Model and Method

The data for this study come from China's Third Industrial Census undertaken in 1995 (Statistical Bureau of China, 1997). The data cover the entire manufacturing sector with a further breakdown according to different ownership categories: namely, foreign-owned, state-owned, collective-owned, private-operated, individually owned, joint ventures, joint stock companies and 'others'. Although the formation and expansion of small business has been an important feature of all transitional economies, the Chinese economy has relied more heavily since 1978 on collective-owned business than other transitional economies, which have built mainly upon growth in traditional private sector enterprises (Perkins, 1994). However, in China a number of the collectives operate like private sector firms, so the distinction is not quite as marked as might at first appear to be the case (Krug, 1997; Steinfeld, 1998). The development of collective enterprises and private-owned firms has led to growing competition for the state-owned enterprises over the last two decades and has helped drive market expansion (Shi, 1998). The result has been a sharp decline in the share of production accounted for by the state sector. For example, in 1981 state-owned firms accounted for around 75% of industrial production; by 1995 this had fallen to about 43% (*China Statistical Yearbook 1995*). In this study, due to a lack of complete data for the collective-owned sector, I set up a category called 'other local-owned', which includes the collective-owned, private-owned and other firms that do not fall into either the foreign-owned or state-owned categories in the census.

Different from Kokko's (1996) study of Mexico, where SOEs are treated as "enclaves" and excluded from the model, SOEs are included in the model below. Our argument is that the criteria for "enclave" industries may be arbitrary. A high foreign share in an industry may not necessarily mean the absence of local competition. In addition, the current study is interested not only in the effect of competition but also that of foreign presence. The exclusion of industries with high foreign presence would distort the results.

In Kokko (1996) the simultaneous system consists of two equations for foreign and local firms. In the current study three equations are included, encompassing FOEs, SOEs and OLOEs. The division of endogenous Chinese firms into the two groups is based on the argument that SOEs and OLOEs can be motivated and behave differently with respect to imitation, innovation and competition. SOEs are observed to have softer budget constraints than their collective counterparts, and have privileged access to fiscal subsidies and financial capital (Qian and Roland, 1996, Coady and Wang, 2000). Technical capabilities are relatively higher in SOEs than in OLOEs given the average size of, and the government's financial support to, the former. While OLOEs are less restricted by administrative directives and have been allowed to "grow out of plan" more quickly, SOEs are generally more capable of generating economies of scale and scope. However, the relatively substantial level of in-kind transfers in SOEs, which are often lost on moving to another enterprise, has operated to restrict labour mobility (Coady and Wang, 2000). SOEs appear to behave significantly differently from other local-owned firms (Child, 1994; Pan and Parker, 1997). Thus, the distinctive institutional features of the different enterprise sectors within have their own merits and defects with respect to the impact on efficiency performance (Lo, 1999).

To examine the effects of different types of FDI on the spillover, the whole manufacturing sector is divided into two groups: the one where FDI is mainly market-oriented and the other where FDI is basically export-oriented.

During the regression analyses a few industries were automatically discarded because of missing data. The exact sample size for each individual equation is indicated in the corresponding regression result table. Using these data the following variables were constructed.

VAL_{soe}, VAL_{for} and VAL_{oth} - these variables represent labour productivity in state-, foreign- and other local- owned enterprises. In each case the variable is measured as the ratio of value added to employment in each industry (this is similar to Kokko, 1994, 1996). Higher value added per capita means higher capital intensity. Furthermore, as value added per capita rises with the employment of superior technology in production, value added is a proxy for technology. Caves (1974) used value added per capita as an explanatory variable to capture the inter-industry differences in technology and capital intensity.

KL_{soe}, KL_{for} and KL_{oth} - these are the average capital intensities and are measured as the ratio of the book value of average net fixed assets to employment in each industry. Although it is accepted that the book values of capital may not accurately reflect the true capital intensities in the different manufacturing sectors, being affected by accounting and reporting practices, these values were used in the absence of a superior published measure of capital values in Chinese statistics.

LQ_{soe}, LQ_{for} and LQ_{oth} - these are the proxies for labour quality and are measured as the ratio of employees with a degree of college level or above to total employment in each industry.

FOR is a proxy for foreign presence. To acquire more information, two different variables to measure foreign presence were used. FOR_1 and FOR_2 are the ratio of foreign firms' employment to total employment and the ratio of foreign firms' assets to total assets, respectively. In other words, foreign presence may be reflected in terms of labour employment or capital usage within industries and this is taken into account in the study.

RDL is average R&D (research and development) per employee in state-owned firms. Unfortunately, for foreign-owned enterprises the census does not provide relevant data; although R&D may prove to be important in determining the long-term labour productivity of foreign firms in China (Bennett, *et.al.*, 1999). Therefore, R&D in foreign-owned firms had to be omitted from the modelling. In the other local-owned firm category, reported R&D levels are very low. This is consistent with the relatively small size of these firms.

The following simple simultaneous system was established:

$$VAL_{oth} = C_1 + C_2 VAL_{soe} + C_3 VAL_{for} + C_4 KL_{oth} + C_5 LQ_{oth} + C_6 FOR + \varepsilon_1 \qquad (3.1)$$

$$VAL_{soe} = C_7 + C_8 VAL_{oth} + C_9 VAL_{for} + C_{10} KL_{soe} + C_{11} LQ_{soe} + C_{12} FOR + C_{13} RDL + \varepsilon_2 \quad (3.2)$$

$$VAL_{for} = C_{14} + C_{15} VAL_{soe} + C_{16} VAL_{oth} + C_{17} KL_{for} + C_{18} LQ_{for} + \varepsilon_3 \quad (3.3)$$

Equation (3.1) suggests that the average value added per employee in the other local-owned category, VAL_{oth}, is determined by capital intensity, KL_{oth}, the quality of labour, LQ_{oth}, the demonstration and contagion effects of foreign presence, FOR, and competition both from state-owned enterprises, VAL_{soe} and foreign firms, VAL_{for}. Positive relationships are expected between labour productivity, on the one hand, and capital intensity, labour quality and foreign presence on the other. The competition effects on labour productivity may be either significantly positive or negative, or insignificant, depending on the nature of the technologies and local firms' ability to absorb spillovers.

Equation (3.2) is concerned with labour productivity in state-owned enterprises. One unique variable in Equation (3.2) is the average R&D per employee. A positive impact of R&D on labour productivity is expected. In Equation (3.3), labour productivity in foreign-owned firms is determined by (a) their capital intensity and labour quality, and (b) competition from both state- and other local-owned firms.

It must be noted that because of the lack of data I am unable to control for market characteristics that affect pricing decisions, such as concentration and trade barriers. Before these equations were estimated tests were carried out to determine whether a simultaneous equation system was appropriate. A test for simultaneity in the model implies a test for the possible existence of competition among state-, other local- and foreign-owned firms. Geroski (1982) suggests a test method, which takes the form that two equations are likely to be simultaneously determined if the residual of the reduced form of one equation has a significant impact on the dependent variable in the other equation. This method was extended to the system of three equations. To test for endogeneity of VAL_{oth} and VAL_{for}, the following equation was estimated:

$$VAL_{soe} = \beta_1 + \beta_2 VAL_{for} + \beta_3 VAL_{oth} + \beta_4 KL_{soe} + \beta_5 LQ_{soe} + \beta_6 RDL_{soe} + \beta_7 FOR + \\ + \theta_1 R_1 + \theta_2 R_2 + \zeta \quad (3.4)$$

Where R_1 and R_2 are the residuals from the reduced form OLS estimates of VAL_{for} and VAL_{oth} respectively. If θ_1 and θ_2 were statistically significant, it could be concluded that VAL_{for} and VAL_{oth} were endogenous. Using the same method, a test was carried out to discover if VAL_{soe} and VAL_{for} were endogenous in the VAL_{oth} equation, and if VAL_{soe} and VAL_{oth} were endogenous in the VAL_{for} equation.

If the Geroski test supported the use of a simultaneous system for Equations (3.1), (3.2) and (3.3), the method of three-stage least squares (3SLS) could be used to estimate the simultaneous equations consistently and efficiently. All three equations in this system would be over-identified and therefore OLS would not provide unique estimates of the parameters.

The estimation of Equation (3.4) indicated that θ_1 and θ_2 were statistically significant at the 1% and 5% levels respectively. This meant that VAL_{for} and VAL_{oth} were endogenous. Using the same method, VAL_{soe} was also found to be endogenous. Thus, the Geroski test results supported the adoption of a simultaneous equation system in the modelling.

3.5. Empirical Results

Table 3.4 presents the 3SLS estimation results when FOR_1 is used to measure foreign presence. For comparison, the OLS estimates are also provided. It seems that the results from the two different estimation methods do not differ appreciably. The magnitudes and significance levels of the estimated coefficients obtained from the OLS and 3SLS are generally quite close.

TABLE 3.4: Result of OLS and 3SLS: Spillovers from FDI in Chinese manufacturing section in 1995, when FOR_1 is employed

	OLS			3SLS		
	Eq(3.1)	Eq(3.2)	Eq(3.3)	Eq(3.1)	Eq(3.2)	Eq(3.3)
Dependent variable	VAL_{oth}	VAL_{soe}	VAL_{for}	VAL_{oth}	VAL_{soe}	VAL_{for}
Constant	4.58E-05 (4.26)***	1.97E-05 (0.71)	-0.001073 (-4.15)***	4.26E-05 (4.04)***	2.43E-05 (0.90)	-0.001077 (-4.23)***
VAL_{soe}	0.147224 (4.51)***		1.767905 (1.96)**	0.201811 (6.34)***		3.450856 (3.91)***
VAL_{for}	-0.008722 (-2.28)**	0.011322 (2.11)**		-0.007713 (-2.06)**	0.019424 (3.73)***	
VAL_{oth}		0.287972 (2.48)***	2.324607 (1.81)*		0.420013 (3.74)***	1.660245 (1.31)
LQ_{soe}		-0.000314 (-0.99)			-0.000530 (-1.74)*	
LQ_{for}			0.010947 (6.01)***			0.010125 (5.67)***
LQ_{oth}	0.001160 (8.24)***			0.001118 (8.11)***		
KL_{soe}		0.275262 (5.81)***			0.238114 (5.08)***	
KL_{for}			-0.067474 (-0.68)			-0.120828 (-1.23)
KL_{oth}	0.255641 (7.12)***			0.231613 (6.60)***		
RDL		0.000109 (2.08)**			9.35E-05 (1.86)**	
FOR_1	9.96E-05 (1.81)*	-4.19E-05 (-0.38)		0.000107 (1.97)**	-4.66E-05 (-0.43)	
R^2	0.611156	0.374629	0.296664	0.604663	0.357951	0.282994
$\overline{R}^2$	0.600109	0.353549	0.280947	0.593432	0.336308	0.266972
No of Obs	182	185	184	182	182	182

Notes: Estimated coefficients are shown together with t-statistics in parentheses. *, ** and *** denote 10, 5 and 1 percent levels of significance (two-tailed tests).

Starting with Equation (3.1) of the 3SLS results reported in Table 3.4, the productivity in other local-owned firms is positively and significantly affected by labour quality, capital intensity and competition from state-owned enterprises, at the 1% level. There is also evidence at the 5% level that productivity is positively affected by foreign presence. Interestingly, however, productivity in other local-owned firms appears to be negatively related to the technology gap with foreign-owned firms, as reflected by the labour productivity variable VAL_{for}. The results indicate that, while non-state owned local firms may have benefited from contagion and demonstration effects of foreign presence and competition effects from state-owned firms, they may have suffered from fierce competition from foreign-owned enterprises.

The above outcomes are consistent with the current pattern of competition among different types of firms in China. As mentioned earlier, other local-owned firms are generally small sized; therefore their expenditure on R&D and their technological capability can be expected to be relatively low. While it is possible that they can perform well when competing with state-owned firms, the above results suggest that they do not compete so effectively with foreign firms because of differences in labour productivity reflecting the technology gap. At the same time, these other local-owned firms may be more motivated than state-owned firms to learn and imitate from others as a result of the harder budget constraints that they face. In addition, they appear to have much more autonomy in recruitment and salary and welfare arrangements than state-owned firms and are able to attract technical and management personnel from other types of firms, including foreign-owned firms (Pan and Parker, 1997).

All of this should help local-owned firms to gain from contagion and demonstration effects of foreign presence.

Equation (3.2) of 3SLS of Table 3.4 shows that the productivity in state-owned firms is positively and significantly associated with their capital intensity and R&D expenditures. These results are not unexpected: the more investment in capital equipment and R&D, the higher the labour productivity should be. One apparently puzzling result is the significantly negative relationship between the productivity and labour quality (as reflected in the percentage of employees with a degree of college level or above). One possible explanation is that the rigidity of personnel management system in state-owned firms prevents well-educated employees from contributing fully to the firm's performance. Also, because of the less flexible reward system in, an individual graduate may have less incentive to work harder in SOEs and OLOEs. With the deepening of economic reform in China, more and more incentive mechanisms have been introduced into state-owned firms, however, state-owned firms still lack flexibility in various aspects of management (Pan and Parker, 1997; Ji, 1998; Steinfeld, 1998).

The significant coefficients on VAL_{for} and VAL_{oth} indicate that state-owned firms appear to have gained from competition with both foreign- and other local-owned firms. This is perhaps not too surprising when it is remembered that state-owned firms are on average relatively large in size and have privileged access to resources to fund adaptation, notably finance from state banks, and have been encouraged by government to improve their technological capacity (Bennett, *et.al.*, 1999). The technology gap between state-owned and foreign-owned firms can be expected to be smaller than that between other local-owned and foreign-owned firms. However, the coefficient on foreign presence is negative, although statistically insignificant at the 10% level or better. This suggests that state-owned firms have not benefited from the contagion and demonstration effects of foreign firms. State-owned firms have traditionally obtained significant government support and protection and have been used to implement production tasks specified by the government. They may not, therefore, have been as strongly motivated as other local-owned firms to learn and imitate from foreign-invested companies. In addition, a rigid system of personnel management has been a barrier to the free flow of labour between foreign and state-owned firms.

From Equation (3.3) of 3SLS in Table 3.4, the significant determinants of productivity in foreign-owned firms are labour quality and competition with state-owned firms. This may be explained as follows: first, on labour quality, foreign-owned firms are able to attract highly qualified technical and management personnel. These well-educated employees often play a very important role in foreign-owned firms. Turning to competition from state-owned firms, large amounts of government investment in state-owned firms have enhanced their technological capability and this appears, from our results, to have enabled some of them to compete with foreign-owned firms. In this competitive environment, foreign- and state-owned firms will treat each other as rivals and improve their level of technology through competition. It may look peculiar that the capital intensity variable has no effect on labour productivity in FOEs but this may be rational. The Chinese government has encouraged both export-promoting and import-substituting FDI. In the latter case FDI has been attracted to industries that are protected from international competition. These types of FDI are qualified for preferential treatment in terms of tax and tariff reductions. China's special FDI policy may well distort the relation between productivity and capital intensity.

The adjusted R^2 of 0.59 for Equation (3.1) of the 3SLS results is reasonably high for a cross section data set. Compared with Equation (3.1), the adjusted R^2 values for Equation (3.2) and especially Equation (3.3) are relatively low. The R^2 figures are explained by the fact that some independent variables which may be expected to affect value added are neglected in the modelling due to the unavailability of data, such as R&D expenditure of foreign- and other local-owned firms, and advertising and market conditions for all firms. Future research would be usefully directed at developing data sets that include such variables.

Table 3.5 shows the empirical results when FOR_2 is employed (the ratio of foreign firms' assets to total assets) rather then FOR_1 (the ratio of foreign firms' employment to total employment). The differences in the magnitudes and significance levels of the corresponding estimated coefficients between the two tables are small. This suggests that the values of the employment ratio proxy and the asset ratio proxy for foreign presence are close.

TABLE 3.5: Result of OLS and 3SLS: Spillovers from FDI in Chinese manufacturing section in 1995, when FOR_2 is employed

	OLS			3SLS		
	Eq(3.1)	Eq(3.2)	Eq(3.3)	Eq(3.1)	Eq(3.2)	Eq(3.3)
Dependent variable	VAL_{oth}	VAL_{soe}	VAL_{for}	VAL_{oth}	VAL_{soe}	VAL_{for}
Constant	3.97E-05	2.74E-05	-0.001073	3.61E-05	3.19E-05	-0.001078
	(3.25)***	(0.90)	(-4.15)***	(3.01)***	(1.07)	(-4.23)***
VAL_{soe}	0.149013		1.767905	0.204140		3.429511
	(4.56)***		(1.95)**	(6.41)***		(3.88)***
VAL_{for}	-0.009124	0.011287		-0.008096	0.019289	
	(-2.38)**	(2.11)**		(-2.16)**	(3.71)***	
VAL_{oth}		0.293360	2.324607		0.426387	1.679984
		(2.48)***	(1.80)*		(3.80)***	(1.32)
LQ_{soe}		-0.000326			-0.000541	
		(1.04)			(-1.79)*	
LQ_{for}			0.010947			0.010116
			(6.00)***			(5.67)***
LQ_{oth}	0.001170			0.001128		
	(8.39)***			(8.26)***		
KL_{soe}		0.270140			0.232687	
		(5.65)***			(5.02)***	
KL_{for}			-0.067474			-0.119396
			(-0.67)			(-1.22)
KL_{oth}	0.260689			0.236624		
	(7.12)***			(6.69)***		
RDL		0.000107			9.18E-05	
		(2.06)**			(1.83)**	
FOR_2	5.71E-05	-3.77E-05		6.12E-05	-3.98E-05	
	(2.03)*	(-0.69)		(2.21)**	(0.75)	
R^2	0.612988	0.375815	0.296664	0.606374	0.359313	0.283319
$\overline{R}^2$	0.601994	0.354775	0.280947	0.595192	0.337717	0.267304
No of Obs	182	185	184	182	182	182

Notes: Estimated coefficients are shown together with t-statistics in parentheses. *, ** and *** denote 10, 5 and 1 percent levels of significance (two-tailed tests).

Tables 3.6 and 3.7 present the regression results of market-oriented and export-oriented FDI respectively. To save space only the 3SLS results are provided here. The first set of equations presents the results when FOR_1 is included while the second set presents those when FOR_2 is included. Again the results from the use of different measures of foreign presence are very similar.

As discussed in section 3.2, the market-oriented FDI is expected to generate spillovers through intensifying competition, in addition to demonstration spillovers, while the export-oriented FDI may not have competition spillovers effects on domestic firms. The empirical results tend to support the hypotheses to some extent. Equation (3.1) in Table 3.5 shows that in the industries where FDI is mainly market-oriented, the productivity variable of SOEs has a positive and significant impact, and that of FOEs has a negative and significant impact, on the productivity of OLOEs. This may indicate that in the market-oriented industries, the OLOEs are still unable to compete with foreign firms technologically. In Equation (3.2), the productivity of SOEs is affected by the productivity of the other two types of firms positively but not significantly. From Equation (3.3) the productivity of FOEs seems to be positively affected by the productivity variables in both SOEs and OLOEs.

In Table 3.7 the productivity variable from FOEs is insignificant in any case. This suggests that when FDI is mainly export-oriented, the competition effects on local productivity are no longer substantial. The main focus of foreign owned enterprises is now not the Chinese market, but somewhere else in the world. Table 3.7 also indicates that the impact of foreign presence on OLOEs is positive and significant. This suggests that FOEs tend to enhance the productivity in OLOEs via the demonstration and contagion effects. As indicated in Table 3.3, the export-oriented FDI is mainly located in China's labour intensive industries. This is consistent with the comparative advantage that China enjoys. FOEs combine their advanced technology and managerial and marketing skills with relatively cheap labour in Chain to produce for the world market. Local Chinese firms learn from foreign owned enterprise. Because OLOEs are more market-oriented and allowed to grow out of plan more quickly than SOEs, the former benefit more from FDI than the latter in terms of productivity improvement.

TABLE 3.6: Result of 3SLS: Spillover Effects of the Market-oriented FDI in Chinese Manufacturing in 1995

	3SLS (For_1)			3SLS (For_2)		
	Eq(3.1)	**Eq(3.2)**	**Eq(3.3)**	**Eq(3.1)**	**Eq(3.2)**	**Eq(3.3)**
Dependent variable	VAL_{oth}	VAL_{soe}	VAL_{for}	VAL_{oth}	VAL_{soe}	VAL_{for}
Constant	2.51E-05	3.26E-05	-0.000109	1.22E-05	3.28E-05	-0.000235
	(1.09)	(1.19)	(-0.43)	(0.45)	(1.21)	(-0.75)
VAL_{soe}	1.127392		9.969085	1.246688		11.44148
	(3.68)***		(3.52)***	(3.68)***		(2.97)***
VAL_{for}	-0.075232	0.049866		-0.081513	0.061648	
	(-2.49)**	(1.02)		(-2.64)***	(1.26)	
VAL_{oth}		0.307282	-4.630299		0.294115	-4.647159
		(1.29)	(-2.28)**		(1.23)	(-2.03)***
LQ_{soe}		6.34E-05			4.58E-05	
		(1.40)			(0.28)	
LQ_{for}			0.000727			0.000419
			(0.93)			(0.46)
LQ_{oth}	0.000262			0.000257		
	(1.50)			(1.58)		
KL_{soe}		0.008707			0.012206	
		(0.28)			(0.44)	
KL_{for}			0.015927			0.004286
			(0.28)			(0.08)
KL_{oth}	0.097406			0.092075		
	(2.04)**			(1.93)**		
RDL		2.91E-05			1.60E-05	
		(0.70)			(0.37)	
FOR_1	9.77E-06	5.30E-05				
	(0.14)	(0.70)				
FOR_2				1.78E-05	1.13E-05	
				(0.81)	(0.39)	
No of Obs	90	90	90	90	90	90

Notes: Estimated coefficients are shown together with t-statistics in parentheses. *, ** and *** denote 10, 5 and 1 percent levels of significance (two-tailed tests).

TABLE 3.7: Result of 3SLS: Spillover Effects of the Export-Oriented FDI in Chinese Manufacturing in 1995

	3SLS (For_1)			3SLS (For_2)		
	Eq(3.1)	**Eq(3.2)**	**Eq(3.3)**	**Eq(3.1)**	**Eq(3.2)**	**Eq(3.3)**
Dependent variable	VAL_{oth}	VAL_{soe}	VAL_{for}	VAL_{oth}	VAL_{soe}	VAL_{for}
Constant	5.28E-05	7.31E-05	-0.001092	1.64E-05	7.36E-05	-0.001140
	(1.02)	(2.66)***	(-1.03)	(0.27)	0***	(-1.05)
VAL_{soe}	0.365397		14.62131	0.638963		14.62800
	(0.72)		(1.52)	(1.12)		(1.52)
VAL_{for}	-0.028742	0.087118		-0.040048	0.101383	
	(-1.05)	(1.21)		(-1.44)	(1.45)	
VAL_{oth}		0.004913	-0.324181		-0.014984	-0.034766
		(0.02)	(-0.14)		(-0.06)	(-0.01)
LQ_{soe}		2.13E-05			6.51E-07	
		(0.16)			(0.01)	
LQ_{for}			-0.000103			-7.57E-05
			(-0.07)			(-0.05)
LQ_{oth}	0.000900			0.000926		
	(4.24)***			(4.38)***		
KL_{soe}		0.006010			0.010905	
		(0.13)			(1.45)	
KL_{for}						-0.054053
						(-0.48)
KL_{oth}	0.117752		-0.054417	0.134404		
	(3.66)		(-0.50)	(3.95)***		
RDL		-2.64E-05			-4.76E-05	
		(-0.29)			(-0.52)	
FOR_1	0.000104	-2.75E-06				
	(1.95)**	(-0.06)			-	
				6.54E-05	-2.25E-06	
FOR_2				(2.33)**	(-0.13)	
No of Obs	71	71	71	71	71	71

Notes: Estimated coefficients are shown together with t-statistics in parentheses. *, ** and *** denote 10, 5 and 1 percent levels of significance (two-tailed tests).

3.6. Conclusions

In this study a simultaneous equation model has been constructed to detect empirically whether there are productivity spillovers from the presence of FDI and from competition between local and foreign-owned firms in the Chinese manufacturing sector. The model was tested using the latest census data set, from 1995, covering 191 industries. The most important finding is that the extent to which spillovers occur varies with the different types of ownership of local firms. State-owned enterprises have improved their technical levels via competition with foreign-owned firms, while the collectives and private-owned enterprises - grouped together as 'other local-owned firms' - have gained from the demonstration and contagion effects of foreign presence. The productivities of local- and foreign-owned firms were found to be jointly determined. In addition, the market-oriented FDI tends to generate spillover effects via competition with local Chinese enterprises while the export-oriented FDI does not seem to significantly compete with local Chinese enterprises.

The above patterns of spillovers are largely consistent with the current configuration of the ownership structure and with knowledge about the nature of economic structure and reforms in the Chinese manufacturing sector. On average, state-owned firms are larger and technologically more competitive, but less flexible in various aspects of management than other local-owned firms. In addition, although the Chinese government has been trying to vitalise state-owned enterprises, it is generally considered that this can only be achieved with a further deepening of economic reforms, including the introduction of effective property rights and enforced hard budget constraints (for a recent restatement of this view see

Steinfeld, 1998). Institutional changes are needed that introduce incentives for management in state-owned firms to be at least as highly motivated as collective- and private-owned firms in China to learn from and imitate the commercial practices necessary to survive in a competitive market economy.

In order to maximise positive spillovers from foreign firms, the study confirms the Chinese government needs to enhance the autonomy and incentive of state-owned enterprises because state-owned firms have traditionally been less strongly motivated to learn and imitate from foreign-invested companies. In additon, the The rigid personnel system of state-owned enterprises may have prevented the free flow of workers between foreign firms and state-owned firms and hence prohibit the technology diffusion through worker mobility. Moreover, both investment in R&D and the upgrading of technological capability in other local-owned firms need to be encouraged. With continuous improvement in local technological levels, it can be expected that a further introduction of FDI with appropriate advanced technology will produce more positive contagion, demonstration and competition effects.

Given that the market and export-oriented FDI can generate productivity spillovers via different effects, the Chinese government may target FDI based on the development strategy of a particular industry. If an export-promotion strategy is formed for an industry, more export-oriented FDI should be encouraged. If the import-substitution strategy is adopted for an industry, more market-oriented FDI needs to be introduced. Of course, these two types of FDI are not necessarily exclusive to or competing with each other. If local productivity is enhanced via the competition effects from FDI, the export capabilities of the industry will be enhanced.

In this chapter, an empirical study is conducated to look at the relationship of foreign firms and local firms in China. Given that China is the largest recipient of FDI in the developing world, the results have immediate policy implications for other developing countries. In the next chapter, I will extend the study to both developing and developed countries, the two-way relationship between FDI and economic development using a large-scale panel data over a long period.

Chapter Four
Foreign Direct Investment and Economic Growth: An Increasingly Endogenous Relationship

Abstract

This chapter investigates whether foreign direct investment (FDI) affects economic growth based on a panel of data for 84 countries over the period 1970-1999. Both equations of FDI inflow and GDP growth are examined to investigate the relationship between FDI and economic growth. FDI not only directly promotes economic growth by itself, but also indirectly does so via its interaction terms. There is a strong positive interaction effect of FDI with human capital and a strong negative interaction effect of FDI with technology gap on economic growth in developing countries.

4.1. Introduction

In the last chapter, I empirically investigate the relationship of local firms and foreign firms at industry level. In this chapter, I will focus on the two-way relationship between FDI and economic growth at country level. In the recent literature, much attention has been devoted to the impact of FDI on economic growth in host countries. Theoretically, FDI in the neo-classical growth model promotes economic growth by increasing the volume of investment and/or its efficiency. In the endogenous growth model, FDI raises economic growth by generating technological diffusion from the developed world to the host country (Borensztein et al, 1998). As summarized in Balasubramanyam et al (1996) and De Mello (1999), FDI is a composite bundle of capital stock, know-how and technology, and can augment the existing stock of knowledge in the recipient economy through labor training, skill acquisition and diffusion, and the introduction of alternative management practices and organizational arrangement.

Unfortunately, the impact of FDI on growth remains more contention in empirical than in theoretical studies. While some studies observe a positive impact of FDI on economic growth, others detect a negative relationship between these two variables. The controversy has partially arisen due to data insufficiency in either cross-country or time-series investigations. More recent empirical studies (Islam, 1995; Blomstrom et al., 1996; Nair-Reichert and Weinhold, 2001; Bende-Nabende et al, 1998, 2002, 2003; Choe, 2003) make use of panel data to correct for continuously evolving country-specific differences in technology, production and socio-economic factors, thus eliminating many of the difficulties encountered in cross-country estimations.

This chapter examines whether FDI affects economic growth in the host country. It differs from existing studies in the following aspects. Firstly, it uses a larger cross-country (84 countries) sample over a longer time period (1970-1999). Secondly, the roles of FDI in the developed and developing world are compared. Thirdly, interactions of FDI with human capital, infrastructure and the technology gap are introduced to examine whether FDI affects growth by itself or through the interaction terms. The next section proceeds to offer a review of literature on FDI and economic growth. Section 4.3 provides an introduction to the methodology and data used in the empirical study. Section 4.4 discusses the regression results and section 4.5 draws conclusions.

3.2. Literature Review

The impact of FDI on growth is manifold. Through capital accumulation in the recipient economy, FDI is expected to be growth-enhancing through encouraging the incorporation of new inputs and technologies in the production process. In the case of new inputs, output growth can result from the use of a wider range of intermediate goods in FDI-related manufacturing (Feenstra and Markusen, 1994). In the case of technologies, FDI is expected to be a potential source of productivity gains via spillovers to domestic firms.

Empirically, Blomstrom et al (1996) find positive growth effects of FDI using FDI inflows in a developing country as a measure of its interchange with other countries. The study by Balasubramanyam et al. (1996) finds significant results supporting the assumption that FDI is more important for economic growth in export-promoting than in importing-substituting countries. This implies that the impact of FDI varies across countries and that trade policy can affect the role of FDI in economic growth. UNCTAD (1999) finds that FDI has either a positive or negative impact on output depending on the variables that are entered alongside it in the test equation. These variables include the initial per capita GDP, education attainment, domestic investment ratio, political instability, terms of trade, black market premium and the state of financial development.

Borensztein et al. (1998) suggest that the differences in the technological absorptive ability may explain the variation in growth effects of FDI across countries. In their analytical framework, the level of human capital determines the ability to adopt foreign technology. Thus, larger endowments of human capital are assumed to induce higher growth rates given the amount of FDI. This hypothesis is supported by their empirical findings. Borensztein et al. (1998) suggest further that countries may need a minimum threshold stock of human capital in order to experience positive effects of FDI. Similarly, Olofsdotter (1998) considers the absorptive capability of FDI receiving countries, and finds that the beneficiary effects of

FDI are stronger in those with a higher level of institutional capability, the importance of bureaucratic efficiency being especially pronounced. Bengoa and Sanchez-Robles (2003) show that FDI is positively correlated with economic growth, but host countries require human capital, economic stability and liberalized markets in order to benefit from long term FDI inflows. Using data on 80 countries for the period 1979-1998, Durham (2004) fails to identify a positive relationship between FDI and economic growth, but instead suggests that the effects of FDI are contingent on the "absorptive capability" of host countries.

Developed countries are expected to have a higher level of human capital and hence to benefit more from FDI than developing countries. This seems to be confirmed by Xu (2000) who investigates US multinational enterprises as a channel of international technology diffusion in 40 countries from 1966 to 1994. The main finding is that technology transfer provided by US multinationals contributes to the productivity growth in developed but not in developing countries. As most less developed countries do not meet the threshold requirement, they may find it difficult to benefit from inward FDI. However, there is empirical evidence that advantageous effects of FDI are not necessarily positively related to the absorptive ability. For instance, Bende-Nabende et al (2003) find that the direct long-term impact of FDI on output is significant and positive for comparatively economically less advanced Asian countries such as Philippines and Thailand, but negative in the more economically advanced Japan and Taiwan. The absorptive abilities of Philippines and Thailand are clearly lower than those of Japan and Taiwan. The finding of Bende-Nabende et al (2003) seems to be consistent with that of Sjoholm (1999) at the micro level; the larger the technology gap between domestic and foreign establishments, the greater the productivity spillovers.

The above discussion shows that the impact of FDI on economic growth is far from conclusive. The role of FDI seems to be country-based, and can be positive, negative or insignificant, depending on the economic, institutional and technological conditions in the recipient economy.

When estimating the impact of FDI on economic growth, one important problem is the possible two-way relationship of the two variables. To deal with this issue, the most common approache is to test the bilateral causality. Using data from ten East Asian economies, Kholdy (1995) carries out Granger causality tests but does not find causation between FDI and productivity. The explanation offered is that FDI may generate only limited efficiency spillovers, and may be a less important vehicle for technology transfer than was previously thought. Zhang (1999a) investigates the causation in ten East Asian countries, and finds that FDI appears to enhance economic growth in the long run for five economies (China, Hong Kong, Indonesia, Japan, and Taiwan) and in the short run for one country (Singapore). In another study, Zhang (1999b) applies co-integration and error-correlation models to investigate the long-term relationship and short-term dynamics between FDI and economic growth in China. The findings support the existence of both a long-run equilibrium link and a two-way Granger causal relationship between FDI and Chinese economic growth. Chakraborty and Basu (2002) utilize the technique of co-integration and error-correction modeling to examine the link between FDI and economic growth in India. The results suggest that GDP in India is not Granger caused by FDI, and the causality runs more from GDP to FDI. Nair-Reichert and Weinhold (2001) apply mixed fixed and random estimation to examine the relationship between FDI and growth in developing countries and find that there is a causal link between FDI and growth. Hsiao and Shen (2003) find a feedback association between FDI and GDP in their time-series analysis of the data from China. Using data on 80 countries for the period 1971-1995, Choe (2003) detects two-way causation between FDI and growth, but the effects are more apparent from growth to FDI.

The results from these bilateral causality tests are mixed. This again indicates that the relationship between FDI and economic growth is far from straightforward. It varies across countries and time periods. In addition, there are some drawbacks to the causality tests reviewed above. Most of these studies employ Granger causality tests in a bivariate framework. While these tests are computationally easy, the omission of other relevant variables could result in spurious causality (Granger 1969; Sims, 1972; Lutkepohl, 1982). On the other hand, Wickens (1996) draws attention to the difficulty of structural interpretation of a cointegrated vector if the model is mis-specified by the omission of an endogenous variable. More recently, Caporale and Pittis (1997) have shown such an omission can result in invalid inference about the causality structure of a bivariate system. Furthermore, Caporale et al. (1998) show that this results in invalid inferences about the causality structure of the system, unless causality is in the direction of the omitted variable but not vice versa.

The above literature review suggests that the impact of FDI on economic growth remains extremely controversial. This is partly due to the use of different samples by different authors and partly due to various methodological problems. Like many existing studies, the current research aims to test the hypothesis that FDI can have a positive impact in the host country. Given the shortcomings in existing studies, however, this investigation uses a larger sample and tests for the effects of different country groups. Furthermore, as human capital, infrastructure and the technology gap are identified in the literature to be important determinants of economic growth, this study introduces interactions of FDI with these parameters to identify whether it affects growth by itself or through these interactions.

4.3. Methodology and Data

4.3.1. The growth equation

Following the contributions of Romer (1990) and others to the development of new growth theory, and of Levine and Renelt (1992) to the search for a set of robust variables for modeling growth, a degree of convergence on the most appropriate empirical specification has occurred. The "core explanatory variables" for economic growth identified in these and other studies include investment, population growth, initial per capita GDP, and initial human capital. This study includes these variables, together with FDI inflow as a percentage of GDP. Also included is a group of variables, *X*, to test the robustness of the results. The basic specification for the model is therefore:

$$g_{i,t} = \beta_0 + \beta_1 \ln y_{i,65} + \beta_2 POP_{i,t} + \beta_3 SCH_{i,65} + \beta_4 INV_{i,t} + \beta_5 FDI_{i,t} + B X_{i,t} + \varepsilon$$

(4.1)

where $g_{i,t}$ is real GDP per capita growth of country *i*. $y_{i,65}$ is real GDP per capita in 1965. $POP_{i,t}$ is the population growth. $SCH_{i,t}$ is the level of secondary school attainment[1] in 1965. This is suggested by Barro and Lee (1993) and is found to be significantly correlated with growth (Barro and Lee, 1994) and as a result is used to proxy human capital in the host economy. $INV_{i,t}$ is the ratio of gross domestic investment to GDP. $FDI_{i,t}$ is the ratio of FDI inflow to GDP.

The group of variables **X** comprises the country-group dummies, and policy variables that are frequently included as the determinants of growth in cross-country studies (Barro and Sala-i-Martin, 1995). In constructing the country-group dummies, developed countries are used as the base group and four dummy variables are then created: Latin American, African, fast growing and other developing countries[2]. For instance, if a country is within the group of Latin America, then the Latin American dummy is equal to 1 for this country, and the other dummies are equal to 0. The group of **X** also includes interest rates, inflation rates, the black market premium and riots. The riot variable is measured by the number of riots in a

[1] This is the secondary school average attainment of the population above 25 years old. It is calculated using Barro and Lee's (1993) human capital attainment tables. For example, suppose that 10 percent of a population above 25 has at some point attended secondary school, and out of this group only 75 percent completed secondary school (6 years), with the remaining going only through the first cycle (3 years). Then, the secondary school attainment is 0.10 x [3x0.25 + 6x0.75] + 0.9x0 = 0.53. We also experimented using average school years and the ratio of attending secondary school as measures of human capital attainment, and obtained similar results from the first of these proxies, but somewhat different results from the second. Due to data limitation, I use the data of school attainment in 1965.

[2] Details for the country classifications can be found in Appendix 2.

given year, and is used as a proxy for the political stability of the country[3]. Also included are interactions of FDI with other variables in the group of **X** to examine its combined effects on economic growth in the recipient economy. These include the interactions of FDI with educational attainment, the technology gap, and infrastructure per capita.

It is difficult to measure technology gap, here I use productivity as the following to measure the technology gap:

$$GAP_{i,t} = (y\max_t - y_{i,t})/y_{i,t}$$

where GDP per capita of the United States is used as $y\max_t$.

Therefore, this is an endogenous growth model where human capital and the technological gap are included as the two important determinants of growth. The interactions of FDI with human capital and the technology gap help to examine the absorptive capacity of foreign technology through FDI.

4.3.2. The FDI equation

[3] Different measures can be used to approximate political stability in the existing literature. For example, Alesina et al. (1996) and Barro (1991) use average numbers of violent political events such as riots or political assassinations. Londregan and Poole (1990) and Cukierman et al. (1992) use the number of orderly or disorderly changes in government or estimated probability of a change in government. In this study, the number of riots is used to measure the political stability of a country.

The following equation is used to assess the effect of growth on FDI:

$$FDI_{i,t} = \alpha_0 + \alpha_1 g_{i,t} + \alpha_2 \ln y_{i,t} + \alpha_3 SCH_{i,65} + \alpha_4 Trade_{i,t} + \mathrm{A} X_{i,t} + \varepsilon \tag{4.2}$$

where $FDI_{i,t}$ is the ratio of FDI inflow to GDP, $Trade_{i,t}$ is the ratio of trade to GDP. $\ln y_{i,t}$ is the log of GDP of current year, and is used here to approximate market size of the host economy. The group of variables **X** includes inflation rate, interest rate, fluctuation of foreign exchange rate, the black market premium and regional dummies. Telephone lines per capita are incorporated into the model to measure infrastructure of the host economy[4]. The correlation matrix of all the variables used in the two equations indicates no serious problem except in one case where the correlation coefficient of human capital and infrastructure is 0.73.

4.3.3. Unit root test

Before proceeding to estimate with panel data, we carry out unit root tests to examine whether the variables are stationary. It is by now generally accepted that the commonly used unit root tests like the Dickey-Fuller (DF), augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) lack power in distinguishing the unit root null from stationary alternatives.

[4] There is substantial evidence that infrastructure is fundamental to economic activity (for a wide range of results for the effects of infrastructure, see an earlier survey of the World Bank, 1994). Infrastructure is defined to include transport, telecommunications, water and sanitation, power and gas, and major water works and can be measured with various indicators. The adoption of telephone lines has advantages over other indicators (Bougheas et al. 2000). It has a more direct impact on production cost and is less susceptible to comparability problems across countries.

Using panel data unit root tests is one way of increasing the test power based on a single time series, as argued in Oh (1996), Wu (1996), MacDonald (1996) and Frankel and Rose (1996).

The Levin and Lin (1992, 1993) (LL) and the revised Levin, Lin and Chu (2002) and Im et al (1997, 2003) (IPS) tests are the most widely used methods for panel data unit root tests in the literature. The Levin-Lin approach is powerful when applied to panels of moderate size but has its limitations: the test depends crucially on the somewhat restrictive independence and identical assumptions across individuals. Im et al (1997, 2003) relax the identical assumption and estimate an ADF test equation for each individual[5]. Maddala and Wu (1999) compare these two tests together with a simple alternative as suggested by Fisher (1932) (Fisher test). They find that, first, when there is no cross-sectional correlation in the errors, the IPS test is slightly more powerful than the Fisher test, and both are more powerful than the LL test. Second, for the issues of heteroscedasticity and serial correlation in the errors, the Fisher test is better than the LL or IPS test. On the over hand, for the medium values of T and large N, the scale of distortion of the Fisher test is on the same level as that of the IPS

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[5] Levin-Lin's (1992, 1993, 2002) null hypothesis is that $\rho_i = 1, i = 1, ..., N$. Under the alternative hypothesis, $\rho_1 = \rho_2 = ... = \rho_N < 1$. While it is perfectly sensible to reject the null that all the individuals have unit roots, it is unreasonable to assume that they all have the same degree of stationarity. Im et al (1997) relax the alternative that $\rho_1 = \rho_2 = ... = \rho_N$. and estimate the following ADF test equation for each individual. $\Delta y_{it} = \alpha_i + (\rho_i - 1) y_{i,t-1} + \sum_{j=1}^{p} \Delta y_{i,t-1} + \varepsilon_{it}$ The test for a unit root consists of a t-test of the coefficient on the lagged level. To test the null of a unit root across all individuals, one merely takes the average of the t-ratios ("t-bar test") $\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^{N} t_{iT}$ where t_{iN} is the t-ratio for the individual i using all T time series observations. IPS also propose an "LM-bar" test where they compute an average Lagrange multiplier test of the null hypothesis that the lagged level has no explanatory power (its coefficient is zero so that $\rho_i = 1$, for all i) across all individuals. The Monte Carlo results indicate that the t-bar test is somewhat more powerful.

test. Third, in cases where there is a mixture of stationary and non-stationary series in the group, the Fisher test is the best. The disadvantage of the Fisher test is that the critical values have to be derived by Monte Carlo simulation. The IPS test is easy to use because tables of the critical values are made available in the same paper (Im et al, 1997, 2003).

In this study, we use the t-bar test of IPS for unit roots in the data and the results are presented in table 3.1. These show that the test statistics are all negative and greater than the critical values in absolute term. This confirms that all of the variables we use in the following estimations are stationary and that the regression results are not spurious.

Table 4.1: Unit root test of panel data (1970-1999)

	GDP growth	FDI inflow	Log(GDP)	Domestic investment	Interest rate	Inflation rate	Telephone line	Pop growth
Developing countries	-1.96	-11.97	-17.77	-12.79	-1.98	-2.97	-3.31	-5.41
Developed countries	-5.97	-7.06	-15.11	-9.99	-5.68	-5.87	-2.29	-13.29

Note: The critical values of the 10 percent confidence level are 1.75 and –1.69 for developed and developing countries respectively.

Before proceeding to the empirical results, we also conduct a poolability test for both the whole and sub-samples. Using the standard Breusch-Pagan Lagrange Multiplier Test for the adequacy of the poolability assumption, a high value of LM is found which favors the fixed effect model/random effect model over the cross section model. The Hausman test is then conducted to choose between the random effect and fixed effect models. The test produces high statistics that lead to the rejection of the fixed effect model.

4.3.5. The data

The data set used covers 84 countries over the period 1970-1999, including 21 developed and 63 developing countries. Appendix 3 reports the mean and variances of FDI inflows and GDP growth in developed and developing countries respectively. From the table it can be seen that the mean of FDI inflows in developed countries was increasing continuously over the sample period of 1970-1999, and the variance of these years was around the mean and not widely dispersed. The mean of FDI inflows in developing countries was relatively smaller than that in developed countries before 1990 but caught up subsequently while the variance is relatively larger than that of developed countries. This reflects the fact that the distribution of FDI inflows in developing countries was more uneven. The mean and variance of GDP growth display a similar pattern. On average, GDP growth in developed countries over the sample period was higher than that of developing countries and the variance is relatively small whilst the variance of GDP growth in developing countries was more widely dispersed. To account for the differences among developing countries, we group them into Latin American, African, fast growing and others, thus add the dummies to the equations.

The data on FDI are collected from *World Investment Directory* published by the United Nations and the missing data are appended from *World Investment Report.* While these two publications provide data for all countries, those whose data are of poor quality are excluded. National account data, such as the growth rates of income, initial incomes, interest rates, inflation rates and financial depth are taken from the Growth Data Resources on the web maintained by the World Bank. This allows us to consider a 30-year period for the empirical investigation. For education attainment, the data constructed by Barro and Lee (2000) are used.

4.4. Empirical Results

In this section, the estimation results for this paper are discussed. We first present the results of single equations for all countries in the sample, and then compare the results for the sub-samples of developed and developing countries. The third sub-section addresses the results of the simultaneous-equation system.

4.4.1. The results of the equations for all countries in the sample

The results from the single equations are reported in tables 4.2 and 4.3. Table 4.2 presents the estimation results of equation (4.1). Specification 4.2.1 refers to the basic model with the core variables, all of which have the predicted signs. Thus, a low initial GDP and a high initial level of education attainment are associated with fast growth in GDP per capita as is a higher investment ratio. All three coefficient estimates are statistically significant. The coefficient on population growth is negative although insignificant, which is also consistent with growth theory if we bear in mind that the dependent variable is GDP per capita growth.

Table 4.2: Impact of FDI on per capita GDP growth, 1970-1999

	All countries in the sample							
	4.2.1	4.2.2	4.2.3	4.2.4	4.2.5	4.2.6	4.2.7	4.2.8
constant	3.15 (1.38)	3.00 (1.33)	5.11 (2.81)***	4.26 (1.39)	13.45 (3.74)***	13.88 (3.82)***	13.58 (3.76)***	13.44 (3.80)***
Log (Initial GDP)	-0.79 (-2.65)***	-0.77 (-2.65)***	-0.88 (-4.01)***	-0.84 (-2.27)**	-1.80 (-4.34)***	-1.83 (-4.37)***	-1.80 (-4.34)	-1.82 (-4.49)***
Population growth	-0.19 (-1.36)	-0.11 (-0.73)	-0.30 (-2.51)***	-0.21 (-1.30)	-0.18 (-1.11)	-0.16 (-1.00)	-0.17 (-1.08)	-0.16 (-1.00)
Capital growth	0.21 (14.75)***	0.19 (12.73)***	0.17 (12.35)***	0.18 (10.46)***	0.15 (8.39)***	0.15 (8.44)***	0.15 (8.49)***	0.15 (8.40)***
Secondary school Attainment	1.03 (2.44)**	1.05 (2.58)***	0.70 (2.80)***	0.64 (1.53)	0.66 (1.65)*	0.62 (1.52)	0.62 (1.56)	0.59 (1.51)
FDI		0.094 (2.56)***	0.81 (2.27)**	0.14 (3.40)***	0.15 (3.53)***	0.04 (0.54)	0.15 (1.28)	0.27 (2.03)**
Africa dummy			-0.64 (-1.29)	-0.80 (-0.94)	-0.34 (-0.41)	-0.49 (-0.59)	-0.56 (-0.67)	-0.50 (-0.63)
Latin America dummy			-0.77 (-2.04)**	-0.96 (-1.43)	-1.32 (-2.00)**	-1.51 (-2.25)***	-1.53 (2.30)**	-1.42 (-2.19)**
Fast growing dummy			1.21 (1.99)**	0.93 (0.92)	0.41 (0.042)	-0.17 (-0.17)	-0.35 (-0.35)	-0.02 (-0.02)
Other developing dummy			-0.94 (-0.23)	-0.11 (0.15)	-0.51 (0.74)	-0.72 (-1.02)	-0.76 (-1.09)	-0.68 (-1.00)
Telephone lines				0.54E-3 (0.41)	0.24E-3 (0.17)	-0.52E-3 (0.37)	-61E-3 (0.44)	0.73E-3 (0.48)
riots				-0.031 (-0.62)	-0.030 (-0.61)	-0.03 (0.59)	-0.025 (0.52)	-0.02 (-0.43)
Technology gap					-0.18 (-4.27)***	-0.18 (-4.35)***	-0.17 (-3.90)***	-0.15 (-3.59)***
FDI*School						0.14 (1.98)**	0.11 (1.41)	0.19 (2.15)**
FDI*Technology gap							-0.009 (-1.19)	-0.02 (-2.13)**
FDI*Telephone line								-0.91E-3 (-1.98)**
R squared	0.14	0.16	0.17	0.17	0.17	0.17	0.17	0.18
countries	84	84	84	84	84	84	84	84
observations	2520	2520	2520	2520	2520	2520	2520	2520

*Notes: 1) For this sample, a Hausman test favors random effects, therefore all models are estimated using a random effects method. 2) Values in parentheses are t-statistics, ***, **, * indicate significance at the 1, 5 and 10 percent levels respectively.*

From specification 4.2.2, we include FDI in the equations. The results show that FDI has a positive impact on economic growth except in 4.2.6 and 4.2.7. In 4.2.3, country-group dummies are included. All coefficients in 4.2.3 have the predicted signs, and those on the Latin American and fast growing country dummies are statistically negative and positive respectively. In 4.2.4, we include the infrastructure and the riot variables, and the signs of coefficients are as predicted, although they are statistically insignificant. Compared to the existing literature on economic growth, the results obtained here are not surprising. While some studies have found strong evidence of a negative relationship between political instability and growth (e.g. Alesina et al., 1996; Fosu, 2001), there is still much controversy in the literature (e.g. Ali, 2001). Infrastructure has been found to be a significant positive contribution to economic growth in some studies, but as addressed in *World Development Report* (1994), many countries, particularly developing ones, do not have shortages as such, but need to improve the effective use of infrastructure stocks and services. Later papers such as Alexander and Estache (2000), Reinikka and Svensson (1999), and Canning and Bennathan (2000) confirm that the link between infrastructure investment and economic growth is "at best ambiguous" (Reinikka and Svensson 1999).

In specification 4.2.5, the technology gap enters the equation and results in a significantly negative coefficient, which implies that a large technology gap tends to slow up economic growth.

To look more closely at the impact of FDI on economic growth, we also include, from 4.2.6, the interactions of FDI with education attainment, the technology gap and infrastructure in the equations. The coefficient on the interaction of FDI with education attainment is positive and statistically significant in 4.2.6 and 4.2.8. The interaction of FDI with the technology gap is both negative in 4.2.7 and 4.2.8 although it is not statistically significant in 4.2.7. This suggests that the impact of FDI on economic growth is associated with the technology gap between the home and host country countries.

Table 4.3 reports the regression results of the FDI equation. In all six different specifications, GDP growth has a significant and positive impact on FDI inflows in the recipient economy. The coefficients of log (GDP) and trade are all positive and statistically significant, suggesting that FDI inflows are determined by the market size and openness to trade of the host country. This is perfectly in line with FDI theory.

Table 4.3: Impact of growth on FDI inflow, 1970-1999

	All countries in the sample					
	4.3.1	4.3.2	4.3.3	4.3.4	4.3.5	4.3.6
Constant	-4.90 (-4.43)***	-6.16 (-5.02)***	-6.76 (-3.84)	-6.49 (-3.02)***	-7.94 (-3.79)***	-11.02 (-4.90)***
GDPgrowth	0.053 (4.43)***	0.048 (4.70)***	0.05 (3.40)***	0.055 (4.31)***	0.060 (5.74)***	0.061 (5.80)***
Log(GDP)	0.18 (3.83)***	0.24 (4.46)***	0.26 (3.44)***	0.24 (2.61)***	0.29 (3.29)***	0.38 (4.07)***
Secondary school attainment	-0.02 (-0.18)	0.01 (0.07)	0.0067 (0.03)	-0.023 (-0.122)	-0.15 (-0.95)	-0.102 (-0.63)
Trade	0.028 (15.97)***	0.028 (14.17)***	0.03 (12.09)***	0.031 (11.54)***	0.032 (10.53)***	0.032 (10.27)***
Inflation rate		-0.19E-3 (-2.00)**	-0.30E-3 (-2.61)***	-0.21E-3 (12.29)**	-0.17E-3 (-2.41)**	-0.17E-3 (-2.46)**
Interest rate			0.0036 (1.46)	0.0019 (1.04)	0.0012 (0.83)	0.88E-3 (0.62)
Telephone line				0.51E-3 (0.58)	0.0013 (1.64)*	0.0016 (1.98)**
Black market premium					0.27E-3 (1.04)	0.25E-3 (0.96)
Africa dummy						1.73 (2.80)***
Latin America dummy						2.09 (4.05)***
Fast growing country dummy						-0.28 (-0.26)
Other developing Country dummy						0.80 (1.49)
R squared	0.19	0.14	0.11	0.11	0.10	0.17
countries	84	84	84	84	84	84
observations	2520	2520	2520	2520	2520	2520

*Notes: 1) For this sample, a Hausman test favors fixed effects, therefore all models are estimated using a fixed effects method. 2) Values in parentheses are t-statistics, ***, **, * indicate significance at the 1, 5 and 10 percent levels respectively.*

Inflation rate is negative as expected and statistically significant. The negative macroeconomic environment discourages FDI inflows. Interest rate has no impact on FDI inflows, as FDI is direct rather than portfolio investment. In addition, the infrastructure variable is always positive and statistically significant in specifications 4.3.5 and 4.3.6, indicating its importance for attracting FDI.

4.4.2. The comparison of developed and developing countries

In tables 4.4 and 4.5, we report the estimation results using the sub-samples of developed and developing countries to compare the roles of FDI in these two groups.

Table 4.4 presents the results of the growth equation. Notice that most coefficients are qualitatively the same as those from the whole sample. The initial level of GDP and population growth have negative impacts on economic growth per capita as expected, although the latter impact is statistically significant in developed but not in developing countries. Capital growth has a positive impact on economic growth in both developed and developing countries. One interesting finding is that secondary school attainment is negative but insignificant for developed countries. This may be because second school attainment tends to be very high for all developed countries and there is little variation across these countries. Thus, there is no strong correlation between this variable and economic growth.

Table 4.4: Impact of FDI on per capita GDP growth, 1970-1999

	Developed countries			Developing countries		
	4.4.1	4.4.2	4.4.3	4.4.4	4.4.5	4.4.6
Constant	-4.41 (-1.08)	21.92 (3.51)***	21.25 (3.70)***	6.30 (2.11)**	16.60 (4.21)***	16.44 (4.31)***
Log (Initial GDP)	0.09 (0.20)	-2.59 (-3.88)***	-2.45 (-4.01)***	-1.30 (-3.15)***	-2.41 (-5.04)***	-2.43 (-5.29)***
Population growth	-0.54 (-2.52)**	-0.43 (-1.94)**	-0.34 (-1.63)	-4.70 (-0.52)	-8.28 (-0.85)	-9.23 (-0.95)
Capital growth	0.25 (9.42)***	0.18 (6.43)***	0.16 (5.82)***	0.19 (10.41)***	0.15 (6.94)***	0.15 (7.04)***
Secondary school Attainment	-0.046 (-0.18)	-0.074 (-0.35)	-0.112 (-0.61)	2.48 (2.90)***	1.77 (1.98)**	1.64 (1.91)**
FDI	0.42 (4.45)***	0.42 (4.58)***	0.36 (0.65)	0.078 (1.80)*	0.14 (2.68)***	0.29 (1.69)*
Telephone lines		-0.80E-3 (-0.76)	-0.20E-3 (-0.14)		0.15E-3 (0.06)	0.0016 (0.57)
Technology gap		-2.30 (-4.48)***	-2.66 (-4.62)***		-0.17 (-3.70)***	-0.15 (-3.07)***
FDI*School			0.22 (1.80)*			0.22 (1.99)**
FDI*Technology gap			0.55 (1.47)			-0.023 (-2.04)**
FDI*Telephone line			-0.0013 (-1.32)			-0.0013 (-2.01)**
R squared	0.15	0.18	0.18	0.14	0.17	0.18
countries	21	21	21	63	63	63
observations	630	630	630	1890	1890	1890

*Notes: 1) For this sample, a Hausman test favors random effects, therefore all models are estimated using a random effects method. 2) Values in parentheses are t-statistics, ***, **, * indicate significance at the 1, 5 and 10 percent levels respectively.*

FDI has a positive and significant impact on economic growth in both developed and developing countries. Furthermore, the interaction term of FDI and secondary school attainment has a significant and positive impact on economic growth. The coefficient on the technology gap is significant and negative for both developed and developing countries, indicating the importance of the host country's technology-absorbing ability in economic growth.

However, it is interesting to note that the interaction of FDI with the technology gap behaves differently in developed and developing countries. In specification 4.4.3, we can see that the interaction has a positive but insignificant impact on growth in developed countries, while in 4.4.6, the coefficient is significantly negative. This confirms our previous finding in table 4.2. In developed countries where the general technology-absorptive capability is high, a larger technology gap would assist FDI in generating more benefits for economic growth. In developing countries, the technology-absorptive ability is generally low. Then, a wide technology gap would exert a negative impact on economic growth.

Table 4.5 reports the estimation results of the FDI equation. We can see that the results are quite similar for developed and developing countries. From both sub-samples, GDP and its growth are the important determinants of FDI inflows. This further confirms that the market size and its expansion are essential for attracting inward FDI. International trade is again significantly complementary to inward FDI. The only difference between the two groups of countries is the role of inflation. The coefficient on inflation rate is negative, but statistically significant in developing countries while insignificant in developed countries. This may be because in developed countries, high growth rates are often associated with high inflation rates. Therefore, the negative effect of inflation on FDI inflows is partly offset by the positive impact of high economic growth in developed countries.

Table 4.5: Impact of growth on FDI inflow, 1970-1999

	Developed countries			Developing countries		
	4.5.1	4.5.2	4.5.3	4.5.4	4.5.5	4.5.6
Constant	-12.51 (-5.88)***	-9.89 (-3.97)***	-3.35 (-1.98)**	-5.67 (-4.21)***	-5.52 (-3.47)***	-7.78 (-2.66)***
GDPgrowth	0.095 (2.90)***	0.094 (2.85)***	0.050 (2.18)**	0.053 (3.88)***	0.046 (4.14)***	0.060 (4.20)***
Log(GDP)	0.42 (5.30)***	0.34 (3.80)***	0.10 (1.70)*	0.23 (3.95)***	0.22 (3.11)***	0.31 (2.49)***
Secondary school attainment	0.20 (0.89)	-0.010 (-0.059)	0.22 (1.68)*	-0.70 (-1.68)*	0.27 (1.16)	-1.32 (1.51)
Trade	0.041 (8.33)***	0.038 (7.68)***	0.019 (5.90)***	0.029 (14.45)***	0.025 (10.78)***	0.034 (8.38)***
Inflation rate		-0.017 (-1.33)	-0.0038 (-0.39)		-0.20E-3 (-2.04)**	-0.17E-3 (1.86)*
Interest rate			0.022 (1.34)			0.0011 (0.60)
Telephone line			0.84E-3 (1.42)			0.66E-3 (0.45)
Black market premium						0.26E-3 (0.79)
R squared	0.11	0.12	0.18	0.21	0.25	0.19
countries	21	21	21	63	63	63
observations	630	630	630	1890	1890	1890

*Notes: 1) For this sample, a Hausman test favors random effects, therefore all models are estimated using a random effects method. 2) Values in parentheses are t-statistics, ***, **, * indicate significance at the 1, 5 and 10 percent levels respectively.*

4.5. Conclusions

This study investigates the impact of FDI on economic growth in both developed and developing countries using a large cross-country sample for the period 1970-1999. The results shows that there is a strong complementary connection between FDI and economic growth in both developed and developing countries. Furthermore, FDI not only directly promotes economic growth by itself, but also indirectly does so via its interaction terms. There is a strong positive interaction effect of FDI with human capital and a strong negative interaction effect of FDI with the technology gap on economic growth in developing countries.

The empirical results from this study lend strong support to new FDI and economic growth theories, as they confirm that inward FDI tends to be attracted to any host country with a large market size. In addition human capital and technology-absorptive ability are very important for inward FDI to positively promote economic growth in developing countries. The policy implications of this study are relatively straightforward. As FDI and economic growth have two-way relationship, the promotion of human capital, technological capabilities and economic development will lead to more FDI inflows. This in turn will promote further economic growth and enhance competitiveness.

Chapter Five
Overall Conclusion

Abstract

This Chapter is the concluding chapter of the whole thesis. In this chapter, I summarise the findings of this thesis and discuss the policy implications of these results. Limitations of this thesis and future improvement are also covered.

5.1. Introduction

This thesis examines the two-way relationship between Foreign Direct Investment (FDI) and economic development in the host country both empirically and theoretically. Compared with the existing studies in this area, the main features of the thesis include the competition between foreign firms and local firms, the endogenisation of FDI and firm location, and the impacts of the level of human capital and technology gap between the home and host country on the location decision of FDI and technology spillovers. Chapter 1 provides a brief preview of research context and introduces the three main studies in the thesis. Chapter 2 provides a simple simultaneous model to examine whether there are productivity spillovers from both the presence of foreign direct investment and competition between local and foreign firms based on the industry level data of China. Chapter 3 investigates the endogenous relationship between FDI and economic growth based on a panel of data for 84 countries over the period 1970-1999. Chapter 4 presents a theoretical model to examine how FDI promotes the level of human capital through worker training and how the location decision of foreign firms is affected by the level of human capital in the host country.

The remainder of this chapter is organised as follows. Section 5.2 provides an overall summary of the results of this thesis. Section 5.3 discusses the policy implications for attracting FDI and for enhancing the positive impact of FDI on economic development. Finally, section 5.4 discusses the contributions and limitations of the thesis and suggests future research topics.

5.2. Overall summary

There have been substantial empirical and theoretical studies on the determinants and impacts of FDI in the literature. Theoretically, FDI is expected to have positive impacts on the economic development of the host country. However, the empirical results have been mixed. This thesis contributes to the literature both empirically and theoretically by looking at the two-way relationship between foreign firms and local firms and the two-way relationship between FDI and the host country characteristics.

In Chapter two, a simultaneous equation model has been constructed to detect empirically whether there are productivity spillovers from the presence of FDI and from competition between local and foreign-owned firms in the Chinese manufacturing sector. The model was tested using the latest census data set, from 1995, covering 191 industries. The most important finding is that the extent to which spillovers occur varies with the different types of ownership of local firms. State-owned enterprises have improved their technical levels via competition with foreign-owned firms, while the collectives and private-owned enterprises -

grouped together as 'other local-owned firms' - have gained from the demonstration and contagion effects of foreign presence. The productivities of local- and foreign-owned firms were found to be jointly determined. In addition, the market-oriented FDI tends to generate spillover effects via competition with local Chinese enterprises while the export-oriented FDI does not seem to significantly compete with local Chinese enterprises.

Chapter three investigates the impact of FDI on economic growth in both developed and developing countries using a large cross-country sample for the period 1970-1999. The test results suggest that the endogeniety between FDI and economic growth does not exist for the whole sample period. Only from the mid-1980s, FDI and economic growth became significantly complementary to each other, and formed an increasingly endogenous relationship. This study shows that there is a strong complementary relationship between FDI and economic growth in both developed and developing countries. Furthermore, FDI not only directly promotes economic growth by itself, but also indirectly does so via its interaction terms. There is a strong positive interaction effect of FDI with human capital and a strong negative interaction effect of FDI with technology gap on economic growth in developing countries.

In the theoretical analysis of Chapter 4, I present a two-sector model to examine the relationship between firm location and human capital level of the host country. In this model, there are two countries with different technology levels. Foreign investment from the developed country must train workers to work with its firm-specific technology. The model explains why countries with similar technology capabilities are more likely to receive FDI.

Countries that do not provide a minimum level of human capital can not attract technologically superior FDI, because MNCs find that the average training cost is too high. This model also implies that the individual skills of workers in the host country can improve through the training provided by foreign firms.

5.3. Policy and managerial implications

The findings from this thesis have important policy implications for attracting FDI and benefiting more from FDI, especially for developing countries.

In general, FDI would be seen by most governments as having the potential to impact economic development to an even greater extent than an equivalent amount of indigenous investment. The reason for this is a belief that foreign firms are more likely to bring with them better technology and/or management. This would be taken as true in developing countries. This naturally leads to the questions: How can governments attract more FDI through policy intervention? Can particular policies maximise the potential for spillovers, and what are the possible policies?

The role of policy in influencing the level and composition of FDI has been extensively studied (Balasubramanyam and Salisu 2001; Pain, 2000; Gorg and Greenaway 2001). The key points that seem to emerge from this thesis are 1) The potential for economic growth in the host country is vitally important. MNCs are more likely to invest in those countries that are enjoying fast economic growth; 2) Availability of a ready supply of relatively skilled labour is an important magnet to FDI; 3) Host countries are more likely to benefit from spillovers if they have a large supply of skilled labour and if domestic firms have a high level of technological capacity. 4) Worker mobility is another important way to benefit from FDI as foreign firms provide training for their workers. 5) Host governments should encourage the upgrading of technological capability in local firms in order to make them more competitive in the market and benefit more from the competition with the foreign firms.

The managerial implications from this thesis are also straightforward: technology spillovers from FDI have their greatest impact when local firms are technologically competent, therefore, local firms should invest more in R&D and adopt more advanced technology in the production. The technological capabilities of local firms ensure that they are able to absorb the technology used by foreign firms through contagion and demonstration effects. These capabilities also enable them to compete with foreign firms and to benefit from the competition.

In conclusion, government authorities and local firms concerned with maximising technology spillovers from FDI should not ignore their own economic base. Instead measures which help to develop the local business capabilities through spending on R&Ds or updating of skills and knowledge should be emphasised. By doing so virtuous cycles of economic in the locations affected by foreign firms, as well as more technology spillovers from FDI, may be generated.

5.4. Limitations and Future Research

The most important limitation of the empirical studies is the data. In Chapter 3, cross-section of China at industry is used to investigate the interactive relationship between foreign firms and domestic firms. It would be better if firm level panel data could be used to examine this issue, unfortunately this data is not available for China. The same limitation lies in the empirical study of Chapter 4, in which country level data is used.

Second, it would be ideal if economic growth could be endogenised in the theoretical model of Chapter 2, which would enable the model to examine the endogenous relationship between FDI and economic growth within one framework.

Despite its limitations the thesis is believed to contribute to the literature in several aspects. As far as I am aware, the empirical study in Chapter 3 is the first one to examine the competition between foreign firms and domestic firms in China formally. The results are thoughtful to be useful for China, other developing countries and transition economies such as Brazil and Poland, which are also large recipients of FDI. The empirical investigation of endogenous relationship between FDI and economic growth in the Chapter 4 is also highly timely and for the first time, thoroughly examines the issue using a large world-wide data set. Chapter theoretically formalise the role of human capital in attracting FDI and the role of FDI in promoting human capital level through worker training, which makes itself an important complementary to the existing empirical studies.

Future research can be carried out in several ways. First, firm level data can be used to examine the competitive effects between foreign firms and domestic firms. Second, economic growth can be incorporated into the theoretical model in Chapter 2 and hence makes economic growth and FDI work in one framework. Third, Further empirical investigations can be carried out to find out the role of work mobility from foreign firms to domestic firms in promoting technology level and human capital level in the host country.

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Appendix 1: Abbreviations

Foreign-owned Enterprises (FOEs)

State-owned enterprises (SOEs)

Other-locally-owned enterprises (OLOEs)

Contractual Joint Venture (CJV)

Foreign Direct Investment (FDI)

Multinational Corporations (MNCs)

Ordinary Least Square (OLS)

Three Stage Least Square (3SLS)

Appendix 2: Classification of country groups in chapter 3

Developed countries:

Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

Latin-American countries:

Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, Venezuela.

African countries:

Benin, Botswana, Ghana, Kenya, Lesotho, Mauritania, Mauritius, Mozambique, Namibia, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Uganda, Zambia.

Fast growing countries:

Hong Kong, Korea, Singapore, Taiwan, Thailand,

Other developing countries:

Algeria, Bangladesh, Cyprus, Estonia, Fiji, Hungary, India, Indonesia, Iran, Israel, Jordan, Latvia, Malaysia, Malta, Nepal, Pakistan, Papua New Guinea, Philippines, Sri Lanka, Tunisia, Turkey.

Appendix 3: Descriptive analysis of the key variables in chapter 3: FDI inflow and GDP growth

Table A.1

	FDI inflow in developed countries		FDI inflow in developing countries		GDP growth in developed countries		GDP growth in developing countries	
	Mean	Variance	Mean	Variance	Mean	Variance	Mean	Variance
1970	1.14	0.67	0.75	11.26	5.33	6.94	3.32	15.87
1975	0.80	0.36	0.41	17.15	1.59	7.07	3.66	12.54
1980	0.79	0.40	1.18	4.50	3.05	2.98	1.85	36.27
1985	0.89	1.46	0.77	1.75	2.83	3.16	1.37	18.19
1990	1.75	1.80	1.57	5.79	2.72	4.18	1.56	27.83
1995	1.90	3.06	2.87	19.28	2.94	3.09	2.47	11.06
1999	2.81	4.52	3.40	16.53	2.58	2.79	0.51	13.61