Why India is mainly engaged in offshore service activities, while China is disproportionately engaged in manufacturing?

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Abstract

We extend the model of Antra`s and Helpman (2004) by incorporating the merits of Zhang and Markusen (1999) to demonstrate why China has been so successful in disproportionately attracting foreign offshore manufacturing activities, while India has been engaged mainly in offshore service activities. We argue that the host country's industry-specific technology capabilities make the difference in FDI composition between China and India. In addition to incomplete contract frictions, the host country's technological capabilities, which affect technology transfer costs, are essential to FDI inflows. We also find that, after excluding overseas Chinese investment, India is almost on par with China in terms of the market size it offers to marketing-seeking FDI.

Keywords: Foreign direct investment, Outsourcing, Offshore, Technology transfer

JEL Classification: D23, F12, F14, F23, L14, L22, L33

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1. Introduction

China and India have employed several similar economic reforms to attract foreign direct investment (FDI) or offshore production from foreign investors, including outward-looking policies, the attraction of FDI through fiscal incentives, and the creation of free trade zones (Special Economic Zones in China and Export Processing Zones in India), as well as placing emphasis on technology-embodied FDI (Keshava, 2008). However, there are three contrasting features in terms of their FDI inflows.

First, although both countries have enjoyed rapid economic growth since the 1980s, in regards to FDI inflows after the 1990s, in volume and share of GDP, China outperforms India more than ten-fold and five-fold, respectively. However, China's FDI inflows are somewhat inflated due to 'round-tripping' investment through Hong Kong, which poses as a foreign investment in order to acquire the benefits from preferential tax treatment. The World Bank estimates that about 20-30% of FDI in China was due to the round-tripping investment (Wei, 2005). On the other hand, India's FDI inflows are underestimated because the figure excludes reinvested earnings.[1] After adjusting the inward FDI by deducting China's FDI inflow by 25% for 'round-tripping' investment, and adding 40% to India's FDI inflow for the re-invested earnings of foreign investor, China's FDI-GDP ration is only double that of India. In addition, the FDI stock of China relative to India is reduced from more than ten times to about five times after the adjustment (see Table A1 in Appendix).

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[1] At a seminar in 2002, Guy Pfefferman, Chief Economist of the International Finance Corporation, estimated that India's actual FDI inflow might be underestimated by about forty percent for 2001. In contrast to China, FDI inflows into India started over a half century ago. If the retained earnings from all of these are cumulated, the 40% increase in the stock of measured FDI is not overestimated (Planning Commission, 2002).

Regarding the second feature, it is striking that the majority of FDI in China did not come from industrial countries as other countries (e.g., India), but was received from non-resident Chinese (NRC), especially from Hong Kong and Taiwan. These NRC investments brought to China with their overseas markets and customers together with their equipment, knowledge and expertise, allowing China to successfully inherits their sophisticated export-marketing skills and established a well-designed network for exporting to advanced economy markets (Bajpai and Dasgupta, 2004; Zhang , 2005). Without advanced proprietary technology, these NRC investments have managerial and marketing advantages in selling light consumer goods, especially to OECD countries (USCBC, 1990). On the contrary, non-resident India (NRI) investments play an insignificant role in India's total FDI, and their contribution was even shrinking in the late 1990s (Keshava, 2008) .[2]

China's NRC investment boomed in early 1990, contributing more than eighty percent of FDI inflows to China, and then declined slightly in late 1990 to less than seventy percent. Wei (2005) argued that China has much higher FDI from OECD countries, mainly due to its larger domestic market. However, we find that, without these efficiency-seeking overseas Chinese investments, China's FDI-GDP ratio is almost the same as that of India on average in the 1990s (see Table A2 in Appendix). This surprising result seems to imply that: India is not far behind in terms of the size of the market it offers to marketing-seeking FDI.

The third striking contrast is related to the composition of FDI. Table 1 shows that about two-thirds of inward FDI went to the service sector and one-third of inward FDI went to the manufacturing sector in India in 2006, and a similar FDI composition

[2] It has been estimated that there is about 20 million NRIs are scattered in the five continents. In comparison, there are about 45 to 50 million NRC. In 2000, the NRCs invested about $ 32 billions into China, but India has received only $0.2 billions from NRI's (Bajpai and Dasgupta, 2004).

is observed in other developing economies and around the world during 2003~05.[3] To the contrary, over two-thirds of China's inward FDI flew went to the manufacturing sector in 2006 while about one-third went to the service sector, as shown in Table 1. To our knowledge, it has not yet been well documented why India is mostly engaged in offshore service activities, while China is disproportionately engaged in manufacturing. This paper aims to provide a simple model to address the empirical observations.

Table 1 Inward FDI Compositions in China and India by 2006 ($US Million)

Year	Inward FDI		% FDI		2003-2005	
	China	India	China	India	Dev. Econ.	World
Total	63021	12676	100	100	100	100
Primary	1060	n.a.	1.7	n.a	7.4	6.9
Manufacturing	42046	33635	66.7	26.5	20.9	24.5
Services	19915	10679	31.6	73.5	71.7	68.7

Source: The data for China is from China Statistical Yearbook, 2007, and data for India is from Ministry of Commerce and Industry of India. The remaining data is from the World Investment Report, 2007.

Building on the seminal work of Grossman and Hart (1986) and Hart and Moore (1988), many economists (e.g., Helpman and Antràs, 2004; Grossman and Helpman, 2005; and Antràs, 2005) have shown that, due to the non-verifiability of the relevant state of the world, the presence of incomplete contracts leads the parties involved in offshore production (e.g., foreign direct investment) to acquire returns partially and, thus, they may under-invest *ex ante* in the relationship-specific investments. In their models, the firms in advanced economies (i.e., the North) determine offshore

[3] 'Electrical Equipments' in India's data includes computer software and electronics; however, India's software and services industry has remained in the driver's seat of the country's IT sector. Conservatively, we presume that software occupies less than 50% of this item's total value. Then we split the "Electrical Equipments" equally, and attribute software to the service industry while electronics is assigned to the manufacturing sector. If including this item to the manufacturing sector entirely, the share of manufacturing in total FDI will rise to 37%, reducing service to 62%.

production activities or FDI based on the trade-off between incomplete contract costs and the host country's lower production costs. However, this tradeoff alone cannot well explain why China is a preferred destination for offshore manufacturing activities, but India is comparatively engaged in service.

We argue that the host country's industry-specific technology capability makes the difference. While the North firms "encode" the relevant know-how (e.g., blueprints, drawings, plant layouts, equipment requirements, materials standards and specifications, underlying production know-how, and managerial skills, etc) to their offshore subsidiaries in order to enable the laborers in the subsidiaries to effectively produce good quality low-tech inputs, the laborers in the Southern subsidiaries have to "*decode*" the essential know-how to successfully adapt, digest, and integrate the new technologies in local conditions. Usually due to the technological gap, misunderstandings arise because the implicit assumptions of the "*decoders*" in the South might differ from those of the "*encoders*" in the North during the transfer process (Buckley and Casson, 1976). Avoiding these and other misunderstandings via checking and communication incur substantial costs (Teece, 1977; Kogut and Zander, 1993). Reasonably, language barriers also present obstacles to communication in the technology transfer process, giving rise to many misunderstandings. Therefore, the technological capabilities of the South are greatly enhanced if the South is able to command the North's language.

It takes substantial resources to successfully transfer the associated technologies across national borders, deterring offshore activities. Obviously, the associated technology transfer costs are reduced when a host country is abundant in the industry-specific technological capabilities, which therefore are essential to the FDI inflows in a certain industry.

The remainder of this paper is organized as follows. In Section 2, we address why the incomplete contract cost alone cannot well explain the contrast difference in FDI composition between China and India. The role of technology transfer cost is addressed in Section 3. In Section 4, we extend the seminal model of Antràs and Helpman (2004) by incorporating the merits of Zhang and Markusen (1999) to illustrate how the technology transfer cost interacts with the incomplete contract cost to determine the inward FDI. The equilibrium is shown in Section 5, while Section 6 presents discussion on how the inward FDI of China and India is affected by their industry-specific technological capabilities. In Section 7, we conclude.

2. Incomplete Contract Distortions

Compared to India, China has long been criticized by foreign investors because its local governments and courts do not genuinely enforce laws on property rights, especially with regard to intellectual property protection (Huang and Khanna, 2003).[4] Ownership rights are not well-defined in China,[5] and the enforcement mechanism in China is undermined by factors such as corruption in enforcement at the provincial levels, limited resources and training for enforcement officials, and a lack of public education regarding the economic and social impact of counterfeiting and piracy.[6]

[4] India has been rated as the most preferred destination over China for intellectual property rights protection, according to the report on the semiconductor sector competitiveness conducted by Ernst & Young (E&Y) and the Indian Semiconductor Association (CyberMedia News, 2007).

[5] To comply with international standards after joining the World Trade Organization in December 2001, China extended the scopes of protection in intellectual properties. For example, China's patent law was enacted in 1984 and has been amended twice (1992 and 2000); the trademark law was first adopted in 1982 and subsequently revised in 1993 and 2001; and the copyright law was established in 1990 and amended in October 2001 (International Trade Administration of the U.S. Department of Commerce, 2003).

[6] See the report by the International Trade Administration of the U.S. Department of Commerce (2003).

The lax support from local governments regarding the protection of ownership rights generates insecurity among foreign investors.

Foreign investors can purchase specific rights to Chinese assets to reduce insecurity; however, they cannot obtain all residual rights. In this communist nation, ownership rights over all asset types (e.g., land assets) are ultimately owned by the ruling authority of the People's Republic of China in the name of "the people". Not until March 2007 did China's National People's Congress promulgate the "Property Rights Law" that will become effective in October 2007. Thereafter, the ownership of private properties should find stronger protection in concrete legal terms. The law will definitely increase the protection of the interests of individuals and corporations in terms of both tangible and intangible property. However, prior to enactment of the property rights law, without equitable and well-conceived regulation, sincere enforcement by the local courts, or official capability of verification of property rights, China should have severely impeded offshore activities from the world as a result of its poor contract environment, but it has not. On the contrary, the inflowing stock of foreign direct investment (FDI) in China has become the largest in the world among developing countries since year 2003.

India has a similarly large population, but its labor costs are about one-half of those in China on average. As a democracy, India has a more developed legal system for supporting private enterprise. Huang and Khanna (2003) emphasized that "(India's) legal system is considerably more advanced (than China). Although India's courts are inefficient, they at least comprise a functioning independent judiciary. Property rights are not fully secure, but the protection of private ownership is certainly fair stronger than in China. The rule of law, a legacy of British rule, generally prevails."

In terms of China's weak property rights protection and higher labor costs in comparison to India, a trade-off between incomplete contract friction and wage costs implied in the incomplete contract models seems insufficient to explain why China is renowned as the "factory of the world" while India is not. In stead, China has attracted ten times more FDI than India since the 1980s. Further, the incomplete contract model also cannot explain why India is engaged mostly in offshore services (e.g., call centers, software outsourcing, and so on), while China specializes disproportionately in offshore manufacturing.[7] Note that each of these two largest population countries in the world has sufficient "redundant" labor to alone take over all of the world's offshore activities: both manufacturing and service outsourcing. Instead, China outpaces India in almost all commodities except for outsourced services (software services form a large part). We argue that the difference results from the host country's industry-specific technological capabilities.

3. Technology Transfer Costs and Technological Capabilities

Technology transfer costs are incurred when a Northern firm carries out offshore production in order to capitalize on the South's lower wage costs while attempting to maintain quality overseas output. While transferring the technological know-how, substantial resources are required to educate and train the subsidiary's labor force, as well as to solve whatever problems occur in the production processes (Blomström and Kokko, 1995). The technology transfer costs will be less when the host country is endowed with better trained technical, scientific, and managerial workers. That is, a host country's human capital is crucial to the Northern firm's location choices for its offshore activities. Generally, a country's technological

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[7] For example, the net exports of India's software services ($16.5 billion) accounted for more than half of India's total service exports in 2004-05 (Srinivasan, 2006).

capabilities are constructed by the country's investment in education and R&D (research and development), and the technology transfer costs decrease with an increase in the host country' technological capabilities. This implies that a host country endowed with more human capital and R&D resources is more attractive for offshore activities than other countries.

In comparison to India, China is not only endowed with more human capital, but also devotes more resources to the development of technological capabilities that can facilitate China's absorption of new technologies. For example, The People Daily (1996) reported that, in an effort to foster industrial upgrading and restructuring, China spent heavily on imports of technology, advanced machinery, and equipment worth $18.4 billion U.S. dollars during 1979-1994 period. The technology imports and transfers are strongly encouraged in China (Keshava, 2008).

Table 2 Enrollment Rate of China relative to India

China/India Ratio	1991	1999-2004
Literacy Rates, Adult (15+)	1.6	1.5
Secondary Enrollment Rates	1.1	1.4
Tertiary Enrollment Rates	0.5	1.2

Data Source: UNESCO
Note: The literacy rate is for 1990 and 2000-2004 respectively.

As shown in Table 2, China has achieved a higher adult literacy rate, which was about fifty percent higher than that in India during the 1990s. In the same period, China had higher secondary and tertiary enrollment rates than India. A manufacturing job, as well known, requires basic scientific knowledge, logical thinking, and some verbal and written communication skills, and a worker with a solid basic education simply works better (Hu, 2007). The relative abundance of human capital makes China more able to absorb and digest technologies from advanced nations, reducing technology transfer costs and encouraging FDI inflows (Blomström and Kokko, 1995).

Table 3 China accrues more resources than India in technological capability

Year 1988	China	India	China/India
R&D personnel (FTE) per million	609	341	1.8
Researchers (FTE) per million	391	121	3.2
R&D Spending ($Billions)	6.5	3.1	2.1
Per capita R&D Spending	22.7	16	1.4

Data Source: UNESCO
Note: FTE denotes full-time equivalent.

Table 3 presents the statistics related to R&D personnel and R&D spending, wherein China substantially exceeded India in the 1990s on all aspects, indicating that China is more capable than India of narrowing the technology gap that exists between them and the advanced nations. With higher R&D intensity and more R&D resources than India, China accrues a higher level of competitiveness, which erodes the technological advantages of Northern firms, forcing them to transfer more advanced technologies to their local subsidiaries in order to restore technological advantages (Blomström and Kokko, 1995; Either and Markusen, 1996).[8] Overall, the relative abundance of technological capabilities in terms of human capital (e.g., literacy rates, enrollment rates, density of trained scientists and engineers) and R&D intensity make China a more attractive location for offshore production, at least in hardware manufacturing industries.

On the contrary, India produces about two times more English-speaking college graduates than China each year (Ruth, 2007), which enhances the nation's capabilities to decode the technological know-how embodied in service industries from

[8] They argue that the rent a northern firm can realize is positively related to the technology gap between the subsidiary and competing host country firms. To prevent the rent from eroding, the Northern firm might carry out more advanced technological transfers to its subsidiary in order to restore the technology gap while faced with high competition due to the host country's technological advancement.

English-speaking countries. Specifically, in 2000, informational technology (IT) software professionals constituted as much as fifteen percent of approximately 2.4 million engineering degree or diploma holders in India.[9] The relative abundance of IT software professionals makes India more attractive than China for offshoring software products. Furthermore, the widespread use of English makes India more conducive than China for offshore activities that require communication in English.[10] In contrast, language barriers, which are essential in relocation choices, prevent multinational firms from English-speaking countries to relocate these service industries (e.g., call centers) to China.

In the same manner, more than two-thirds of FDI inflows to China come from overseas Chinese firms (i.e., either from Chinese-speaking nations such as Hong Kong, Taiwan, and Singapore, or from overseas Chinese that inhabit South Asia and North America, etc.). Sharing the same language and culture with China makes overseas Chinese more able to smoothly relocate their production to China, and the corresponding transfer in technology and managerial know-how is less costly and more easily accomplished. Especially, overseas Chinese are primarily engaged in manufacturing activities (e.g., Taiwan).[11] It turns out that China is disproportionately engaged in the manufacturing offshore.

4. The Model

Zhang and Markusen (1999) argued that a country becomes more attractive for inflow FDI if this country has a good-quality physical infrastructure (e.g., reliable electricity and water supplies; good-quality telecommunication and transport links), a

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[9] There were about 360,000 IT software professionals in India in 2000 (Wyckoff and Schaaper, 2005).

[10] Most, if not all, software programming languages (e.g., C++) have been developed based on English syntax and logic.

[11] About two-thirds of the personal computers in the world market are manufactured by Taiwanese firms located in China.

reliable legal infrastructure, and a sufficient supply of qualified engineers and managers, in addition to the FDI-targeted fiscal incentives.[12] Implicitly, a country's technological capability is positively related to its supply of skilled labor (engineers, managers, and other professionals) as well as to its R&D investments. Therefore, we incorporate the merits of Zhang and Markusen (1999) into the seminal model of Antràs and Helpman (2004) to illustrate how the offshore activities (inward FDI) are affected by the three country-specific factors (physical infrastructure, contract environment and labor costs) and the two industry-specific factors (technological capability and FDI-target fiscal incentives).

Suppose that, in a world of North and South, labor is a unique factor of production. Consumers have homogeneous preferences over all differentiated goods. Each consumer maximizes a utility function as $u = \sum_{i=1}^{n} y_i^{\alpha}$, and $0 < \alpha < 1$. Here y_i is consumption of product i, and n measures the number of product varieties. There exists a constant elasticity of substitution among these differentiated goods. With these preferences, the demand function for one representative final good i is given by $y_i = \lambda p_i^{-1/(1-\alpha)}$, where p_i is the price of the final-goods i and $\lambda \equiv E \Big/ \sum_{i=1}^{n} p_i^{\frac{-1}{1-\alpha}}$. Here E denotes a consumer's total spending. As argued by Grossman and Helpman (2004), the unique supplier of variety i treats λ as a constant.

A differentiated good is fragmented into many stages of production, indexed by $z \in [0,1]$. The Northern firm detaches these production stages into two parts: high- and low-tech inputs. Components along $[z,1]$ are considered high-tech inputs, while

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[12] We focus on cost-saving FDI, so that the host country's market size is not the concern in this paper.

those along $[0, z]$ are considered low-tech inputs. Suppose that the South lacks the firm-specific technology required to produce the qualified low-tech inputs until there is a proper technology transfer; this, however, requires real resources in the technology transfer process, which depends on the host country's technological capabilities.

It takes one Northern worker to produce one unit of high-tech inputs (i.e., x_{iH}) and one unit of low-tech inputs (i.e., x_{iL}). However, the high-tech inputs cannot be relocated to the South because the associated technology transfer costs are prohibitively high. Let the wages of the North and South be denoted as w_N and w_S respectively, and $w_N > w_S$. Furthermore, it is a common practice for developing countries to apply various favorable fiscal incentives (e.g., tax holidays and tax exemptions) to attract FDI, so we assume τ_S to denote the host country's tax-related costs, and τ_S decreases with an increase in the favorable fiscal incentives. Then the unit production cost is given by $w_S + \tau_S$ in the South. The production function under successful offshore contract is given by

(1) $$y_i = \theta x_{iH}^{1-z} x_{iL}^{z}, \qquad 0 \le z < 1,$$

where the firm-specific parameter θ denotes the firm's productivity level. Antràs and Helpman (2004) defined that the industries are skill-intensive when $0 < z < 0.5$, and labor-intensive while $0.5 < z < 1$.

5. Equilibrium

The incomplete contract distortion implies that the northern firm can not appropriate full factor returns in the offshore production,[13] and the parties involved bargain over the surplus of revenue in order to reduce distortions from the incomplete

[13] See Antràs and Helpman (2004) for a detailed discussion.

contract. The Southern firm could acquire a share of surplus in the bargaining, β, and the Northern firm would receive the remainder, where $0 < \beta < 1$. Before making an order, the two parties must make an initial investment, $T(q)$, to dissolve the associated technology gaps between the North and South firms in order to ensure that the Southern partner is able to make a good quality prototype. The industry-specific $T(q)$, referred to as a technology transfer cost, is decreasing with the host country's technological capability. To reduce as many potential hold-ups as possible, the Northern firm would make a part of the investment in the technology transfer, say $1-\beta$; and the remaining β share of investment is undertaken by the Southern firm.[14] Note that, as implied in (4) and (5), relaxing this assumption will not alter our results.

Additionally, as documented by Zhang and Markusen (1999), the South usually has a poor physical infrastructure, which adds an additional cost to offshore production by I_S. The country-specific I_S is reduced with an improvement in the host country's physical infrastructure. Then, a representative Northern firm in industry i that carries out offshore production has a profit maximization function as

$$Max_{x_{iH}} (1-\beta)(p_i y_i - T(q_S)) - w_N x_{iH} - I_S, \quad (2)$$

where the industry-specific technological capability q_S represents the South's stock of dedicated R&D resources, managerial skills, and other assets. If there is sufficient technological capability, less effort is required in the technology transfer and adaptation for the firm, implying $T'(q_S) < 0$.

The profit maximization of the low-tech inputs producer is then given by

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[14] Grossman and Helpman (2002) assume $\beta = 0.5$ for outsourcing activities and also assume an equal share of the initial investment costs for both parties.

(3) $$Max_{x_{iL}}\, \beta(p_i y_i - T(q_S)) - (w_S + \tau_S)x_{iL}.$$

Combining (2) and (3), the joint profit maximization leads to

(4) $$\pi_S = \theta^{\alpha}\lambda^{1-\alpha}x_H^{\alpha(1-z)}x_L^{\alpha z} - w_N x_H - (w_S + \tau_S)x_L - (T(q_S) + I_S).$$

Taking first order conditions of (4) with x_H and x_L, and plugging these results back into (4), we obtain the optimal profit for the Northern firm that applying offshore production:

(5) $$\pi_S = \lambda\theta^{\frac{\alpha}{1-\alpha}} \frac{1-\alpha[(1-z)(1-\beta+z\beta]}{[(\frac{1}{\alpha})(\frac{w_N}{(1-z)(1-\beta)})^{1-z}(\frac{w_S+\tau_S}{z\beta})^{z}]^{\frac{\alpha}{1-\alpha}}} - (T(q_S) + I_S).$$

As shown in Figure 1, the profit π_S has a slope of ψ_S with respect to $\theta^{\frac{\alpha}{1-\alpha}}$ and an intercept of $-[(T(q_S) + I_S]$, where $\psi_S = \lambda \frac{1-\alpha[(1-z)(1-\beta+z\beta]}{[(\frac{1}{\alpha})(\frac{w_N}{(1-z)(1-\beta)})^{1-z}(\frac{w_S+\tau_S}{z\beta})^{z}]^{\frac{\alpha}{1-\alpha}}}$.

The steeper the slope, the larger is the profit. The slope ψ_S increases while the host country has lower production costs (i.e., a lower $w_S + \tau_S$) and better legal infrastructure (i.e., a larger β). Further, if the host country is endowed with better technological capabilities (i.e., a higher q_S) in a specific industry or a better physical infrastructure, the intercept of $-[(T(q_S) + I_S]$ shifts upward, leading to more FDI (i.e., $T'(q_S) < 0$ and a lower I_S). Note that the slope ψ_S increases with β while the industries are skill-intensive, but decreases with β while the industries are labor-intensive (see Antra`s and Helpman, 2004).

6. China vs. India

As argued above, India's contract environment is not worse than that in China, so we assume $\beta_C \le \beta_I$, where C denotes China and I denotes India. Furthermore, the labor costs in India are much less than those in China (about one-half on average), although China offers a more favorable tax scheme to FDI inflows, we presume that the general production cost in India is still lower than in China to focus on the trade-off between incomplete contract and technology capability. Nevertheless, relaxing this assumption can only enforce our argument. With the above perception, we have $\psi_I > \psi_C$ when the industries are skill-intensive as in Figure 1.

China is endowed with a more abundant human capital than India, especially in manufacturing industries, allowing China to narrow the industry-specific technology gap between itself and the advanced North more than India is able to. Thus, China can adapt the transferred technologies into local conditions easier than India, implying $q_C > q_I$. Moreover, it is generally acknowledged that China's infrastructure is more complete and competitive than India, implying $I_C < I_I$. In aggregate, it implies that China has a higher intercept in the manufacturing sector than India, as shown by the solid lines in Figure 1. That is, in manufacturing sectors, India has an advantage in its both legal infrastructure and unit production cost (production cost advantage), but China has an advantage in both industry-specific technological capability and in its physical infrastructure (technology advantage).

As highlight by the bold lines in Figure 1, only the most productive firms in the North (with productivities $\theta > \theta_I$) can overcome the inherent disadvantages of FDI to carry out offshore production to India, which has only a production cost advantage, while the other firms (with productivities $\theta_C < \theta < \theta_I$) can easily relocate production to China, which has a technological advantage. In Figure 1, as illustrated by the dashed line in bold, with an increase in technological capabilities in China, the productivity threshold for FDI inflow to China expands from $[\theta_C, \theta_I]$ to $[\hat{\theta}_C, \hat{\theta}_I]$ at the sacrifice of India's production range.

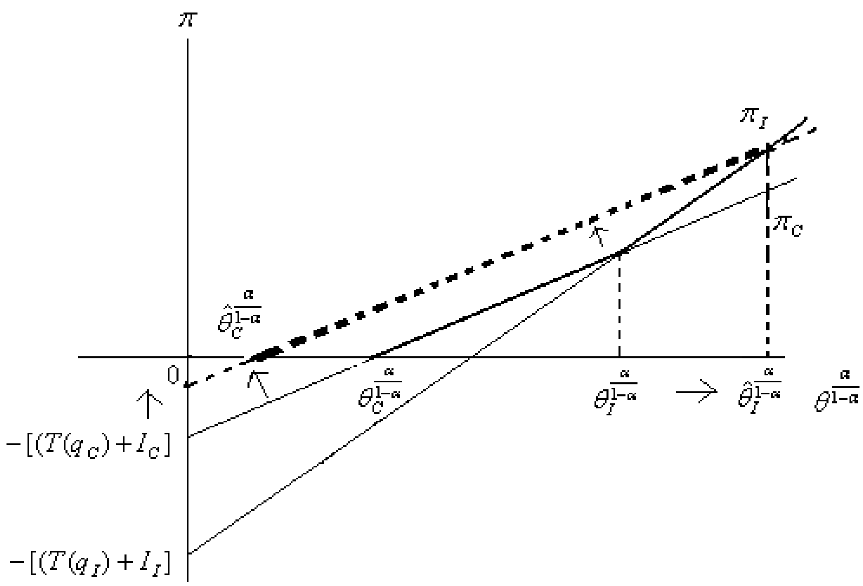

Figure 1. When manufacturing industries are skill-intensive

As for the labor-intensive industries, China may dominate India in attracting offshore manufacturing activities as shown in Figure 2, because ψ_C may be larger than ψ_I.[15] This finding is in line with the fact that the non-resident Chinese investment, that has no advanced proprietary technology and specializes in manufacturing light consumer goods, contributes more than eighty percent of the FDI inflows to China. In all, as implied in Figures 1 and 2, only the most productive firms in the North can overcome the inherent disadvantages of FDI to carry out offshore production to India, while a wider range of manufacturing industries find it beneficial to carry out offshore production in China. This causes the share of offshore manufacturing activities in China's inflow FDI composition to be exceedingly high.

[15] Note that ψ_S decreases with β while the industries are labor-intensive. See Antra`s and Helpman (2004) for the proof.

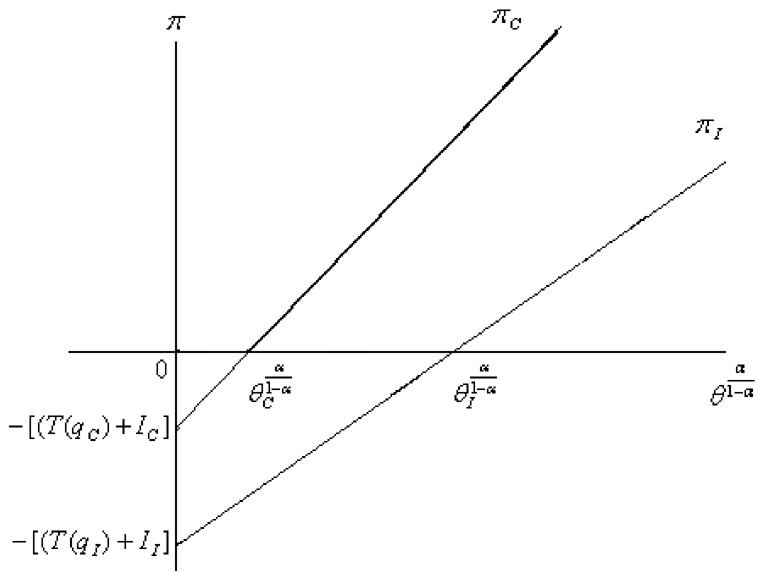

Figure 2. When manufacturing industries are labor-intensive

On the other hand, India annually produces about twice as many English-speaking college graduates as China (Ruth, 2007), which enhances India's capabilities to decode the technological knowledge of service industries from English-speaking countries (e.g., software engineers and call centers). Specifically, India is endowed with much more informational technology (IT) software professionals than China, and one important factor that they count on in securing software contracts is their mastery of English. The Chinese, meanwhile, have only recently begun to emphasize English in their schools (Manu, 2002).[16]

It also has been widely acknowledged that India's industry is "substantially ahead of the Chinese software industry, not only in terms of revenue but also quality, skilled manpower, project management capabilities and execution skills."[17] For example, India occupies about seventy-five percent of the global market for outsourced software while China software industry has only achieved a tiny share of

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[16] In the past, Russian was the major foreign language taught in Chinese schools.

[17] This quotation is from a vice president of National Association of Software and Services Companies (Manu, 2002).

the global market.[18] The more revenue generated and more skilled manpower in the software industry, the more resources that can be placed with the associated R&D. These make India's technological capabilities superior to those of China in offshore service industries (especial software industry) with $q_I^* > h_C^*$. The strong evidence to support this assumption can be also found on their attained certificate of the Software Engineering Institute's (SEI) Capability Maturity Model (CMM).[19] The SEI CMM has five rating levels, with the highest being Level 5. Almost fifty percent of the world's SEI CMM Level 5 companies are located in India, while few Chinese firms are able to attain the highest SEI CMM Level so far.

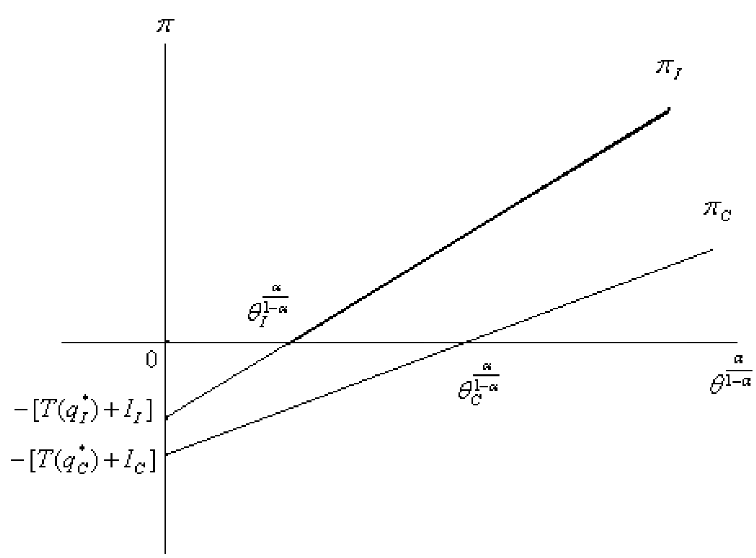

Figure 3. China vs. India in Software Offshoring

Therefore, we argue that India has superior technological capabilities relative to China in the service sectors (e.g., software) with $T(q_C^*) + I_C \geq T(q_I^*) + I_I$ as illustrated in Figure 3. For simplicity, let's assume that most of the software and

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[18] See http://www.ebusinessforum.com.

[19] The Software Engineering Institute is an integral component of Carnegie Mellon University. It was funded in 1984 by the U.S. Department of Defense with a broad charter to address the transition of software engineering technology. The software's Capability Maturity Model (CMM) is a model for judging the maturity of the software processes of an organization and for identifying the key practices required to increase the maturity of these processes (see SEI website).

service industries are skill-intensive, so that $\psi_I > \psi_C$. Figure 3 shows that India dominates China in service outsourcing, at least in software services. However, physical infrastructure of China is much better than that in India, which might lead to $T(q_C^*) + I_C < T(q_I^*) + I_I$ in some service industry sectors. Then, in these service industries, some firms may outsource to China as implied in Figure 1. It turns out that India has been engaged mainly in offshore service activities, while China can still play an important role on offshore service activities.

7. Conclusions

It has been well documented that the size of the domestic market has been the most important factor relate to the China fever, inducing a large number of multinational corporations from OECD countries to move into China for investment opportunities. However, it is surprising that after excluding those overseas Chinese (non-resident Chinese) investors, India is almost in par with China in terms of the size of the market it offers to market-seeking FDI. Although the share of NRC investment in total FDI is decreasing while market-seeking FDI increases (Zhang, 2002), the amount of NRC investment should continue increasing while some of them gradually transfer themselves into market-seeking investors.

In this paper, we extend the model of Antra`s and Helpman (2004) by incorporating the merits of Zhang and Markusen (1999) to argue that, in addition to incomplete contract frictions, a host country's industry-specific technological capabilities, which affect technology transfer costs, are essential to a firm's location choice regarding its offshore production. This difference in industry-specific technological capability between China and India makes the difference in the two countries' FDI composition. China has superior technological capabilities in manufacturing sectors, while India has superior technology in the service (software by a large) sectors. It turns out that, in manufacturing sectors, only the most productive firms in the North can overcome the inherent disadvantages of FDI to carry out offshore production to India, while a much wider range of industries find it beneficial to carry out offshore production in China. This makes the share of offshore manufacturing activities in China's inflow FDI composition be exceedingly high. On the contrary, India's technological capability dominates that of China in service outsourcing (at least in software services), so that India is mainly engaged in offshore service activities. However, a better physical infrastructure makes China be able to play a significant role in some other offshore service activities.

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Appendix

Table A1 below shows that unadjusted FDI-GDP ratio of China is more than three times larger than that of India, on average, from 1982 to 2006.

Table A1 FDI Inflows to China and India (in Billion U.S. Dollars)

Year	FDI Inflow		% of GDP		Adjusted FDI *		% of GDP	
	China	India	China	India	China	India	China	India
1982	0.32	0.07	0.4	0.2	0.24	0.10	0.3	0.3
1983	0.92	0.01	1.1	0.0	0.69	0.01	0.9	0.0
1984	1.42	0.02	1.6	0.0	1.06	0.03	1.2	0.1
1985	1.96	0.11	1.9	0.2	1.47	0.15	1.4	0.3
1986	2.24	0.12	2.1	0.2	1.68	0.16	1.6	0.3
1987	2.31	0.21	2.3	0.4	1.74	0.30	1.7	0.5
1988	3.19	0.09	2.8	0.1	2.4	0.13	2.1	0.2
1989	3.39	0.25	2.7	0.4	2.54	0.35	2.0	0.5
1990	3.49	0.24	2.5	0.3	2.62	0.33	1.8	0.5
1991	4.37	0.08	2.9	0.1	3.27	0.11	2.2	0.2
1992	11.01	0.25	6.6	0.4	8.26	0.35	5.0	0.6
1993	27.51	0.53	14.7	0.9	20.64	0.74	11.0	1.3
1994	33.77	0.97	13.7	1.3	25.32	1.36	10.3	1.8
1995	37.52	2.15	11.7	2.4	28.14	3.01	8.8	3.3
1996	41.73	2.53	11.5	3.1	31.29	3.54	8.6	4.3
1997	45.26	3.62	11.2	3.9	33.94	5.07	8.4	5.4
1998	45.46	2.63	10.8	3.0	34.10	3.69	8.1	4.2
1999	40.32	2.17	9.4	2.0	30.24	3.04	7.1	2.8
2000	40.71	3.59	9.1	3.4	30.54	5.02	6.8	4.7
2001	46.88	5.47	9.2	4.9	35.16	7.66	6.9	6.9
2002	52.74	5.63	9.0	4.6	39.56	7.88	6.7	6.4
2003	53.51	4.32	7.5	2.8	40.13	6.05	5.6	4.0
2004	60.63	5.77	6.9	2.8	45.47	8.08	5.1	3.9
2005	72.41	6.68	6.5	2.6	54.30	9.35	4.9	3.6
2006	69.47	16.88	5.0	5.6	52.10	23.63	3.8	7.8
Stock	702.54	64.39			526.9	90.1		
Ave.			6.5	1.8			4.9	2.6

*China's FDI inflow has been adjusted by deducting 25% for round-tripping FDI. India's FDI inflow has been adjusted by adding 40% for the re-invested earnings of foreign investors.

Source: World Development Indicators, 2008.

In the third column of Table A1, we adjust the inward FDI by deducting China's FDI inflow by 25 percent for 'round-tripping' investment, but add 40 percent to India's FDI inflow for re-invested earnings of foreign investors. After the adjustment, the fourth column shows that, China's FDI-GDP ratio is double that of India (i.e., $4.9 \div 2.6 \cong 1.9$) on average. The FDI stock of China relative to India is reduced from more than ten times to about five times. However, the estimation above might still be overestimated because the import capital and other IMF-defined items are not taken into account into India's FDI inflows, while China includes all components of IMF in its definition of FDI, and classifies imported capital equipment as FDI (Bajpai and Dasgupta, 2004).

Table A2 Non-Resident Investment in China and India (in Billion U.S. Dollars)

Year	% of FDI		Adjusted FDI		FDI (without NR)		% GDP	
	NRC	NRI	China	India	China	India	China	India
1991	71.28	45.59	3.27	0.11	0.94	0.06	0.6	0.1
1992	80.34	22.17	8.26	0.35	1.62	0.27	1.0	0.5
1993	82.91	31.36	20.64	0.74	3.53	0.51	1.9	0.9
1994	77.98	34.00	25.32	1.36	5.58	0.90	2.3	1.2
1995	72.09	28.89	28.14	3.01	7.85	2.12	2.4	2.4
1996	69.28	19.65	31.29	3.54	9.61	2.84	2.6	3.5
1997	64.96	6.32	33.94	5.07	11.89	4.75	2.9	5.1
Ave.			6.5	1.8			2.0	1.9

Note: FDI (without non-resident investment)= Adjusted FDI x(1-NR%).
Source: NRC and NRI data are from UNCTAD, 2003.

Table A2 shows that, without the overseas Chinese investments, China's FDI-GDP ratio is almost the same as that of India on average in the 1990s (i.e., 2.0% vs. 1.9%). This surprising result seems to imply that: India is not far behind in terms of the size of market it offers to marketing-seeking FDI. Note that most of those overseas Chinese investments are efficiency-seeking investors, and surge into China for cheaper labor and land, in addition to favorable fiscal incentives (World Bank, 2003).