Industrial Development through Tacit Knowledge Seeding: Evidence from the Bangladesh Garment Industry

Romel Mostafa[1] and Steven Klepper[2]

Running Head: Tacit Knowledge Seeding

November 2009

Acknowledgements: We thank Lee Branstetter, Bart Hamilton, Bill Keech, Anne Marie Knott, Jackson Nickerson, Lamar Pierce, Myles Shaver, Jordan Siegel, Francisco Veloso, Todd Zenger, and seminar participants of Carnegie Mellon University and Washington University in St. Louis for their helpful comments. This research undertaking would not have been feasible without the kind cooperation received from about 1,000 entrepreneurs, employees, suppliers and buyers of the Bangladesh garment industry and the industry association, BGMEA. Mostafa gratefully acknowledges a dissertation fellowship from the Kauffman Foundation.

[1] The Olin Business School, Washington University in St. Louis, mostafa@wustl.edu
[2] The Department of Social and Decision Sciences, Carnegie Mellon University, sk3f@andrew.cmu.edu

Abstract

When vital production knowledge is tacit and cannot be generated indigenously, entrepreneurs in developing countries have to rely on international transfer of the knowledge through on-the-job training. Once the initial seeding of tacit knowledge occurs, mechanisms naturally arise in the local economy to propagate the knowledge and seed new firms. A model of the propagation process is developed and its implications are tested on two historical episodes of the Bangladesh garment industry. Empirical findings support the model's predictions, indicating tacit knowledge seeding was essential for the initial establishment and subsequent expansion of the industry.

Keywords: Entrepreneurship, Industry Development, On-the-job Training, Tacit Knowledge Spillover

JEL Classification: L22, L67, M13, O14, O17, P33

1. Introduction

It has been observed that a few narrowly defined products account for the bulk of the exports of developing countries, but these products vary greatly between countries with similar factor endowments (Hausmann and Rodrik, 2003; Schott, 2004). Consider, for example, Bangladesh and Pakistan, which share a common history, rank similarly in the Human Development Index, and are labor-abundant. Their primary exports are garments and their largest foreign market is the US. In 2008, out of 246 garment products, the top 10 products exported to the US from Bangladesh and Pakistan accounted for 70% and 83% of their total US garment exports respectively. According to the theory of comparative advantage, countries like Bangladesh and Pakistan would be expected to export similar products. However, Bangladeshi producers had negligible exports in five of the top 10 garment products exported from Pakistan and Pakistani producers had negligible exports in six of the top 10 products exported from Bangladesh. What factors explain such heterogeneity in products exported and what implications do they have for industrialization?

Rhee and Belot (1990) studied 10 highly successful export industries in 11 developing countries.[3] They found that in each case the industry was jump-started by a single firm that initiated exports on a large scale. They traced the success of the pioneering firms to the training of the firms' workers by a foreign firm or agent.[4] In all but one instance, the success of the pioneer galvanized entry into the industry, which played a key role in the expansion of the industry and its ultimate success. An obvious explanation for the narrow export specialties of developing countries is that such catalysts are few and far between. But what exactly is the mechanism by which catalysts work that might explain why they are few and far between?

Hausmann and Rodrik (2003) provide an explanation for why catalysts are rare. They argue that entrepreneurs have to experiment and discover what a country is good at producing, but once revealed, successes are readily observed and imitated by other entrepreneurs. Since the process of "self-discovery" involves considerable cost uncertainties and imitation limits the returns to the discoverer, private incentive to experiment and diversify the industrial base is limited. Self-discovery becomes a

[3] The 11 cases are: garments in Bangladesh, plywood in Indonesia, flowers in Colombia, uniforms in Zambia, condiments in Honduras, diamonds in India, semi-processed cocoa in Cote d'Ivoire, garments in Jamaica, shoes in Guatemala, software in Hungary, and aircraft in Brazil.

[4] On-the-job training by foreign agents has been argued to be crucial in the development of industries in other countries, such as suppliers of textile machinery in Taiwan (Ranis and Schives, 1985) and garments in Mauritius (Romer, 1993).

random event and when it occurs, imitation leads to explosive growth, resulting in narrow specialization of exports.

An alternative view is that instead of experimentation, entrepreneurs in developing countries need to access "organizational" knowledge generated in industrialized countries in order to be competitive internationally in industries in which they have the potential to enjoy some comparative advantage (e.g. Krugman, 1979; Grossman and Helpman, 1991).[5] While knowledge is often considered to be a public good, we propose that in the typical industry some vital knowledge related to production is tacit and therefore entrepreneurs in developing countries cannot simply imitate the products manufactured in countries with successful firms. To access the relevant tacit knowledge, a domestic firm has to receive extensive on-the-job training by a foreign firm. The success of the pioneering firm then is not based on experimentation but on the voluntary planting of a seed by a foreign firm that provides the key tacit knowledge.

If the formation of the pioneering firm effectively reveals a country's innate advantage in an industry then imitation could occur at a distance, without any direct transfer of knowledge from the pioneering firm to other entrants. But if the transmission of tacit knowledge via on-the-job training is essential for the pioneering firm to be successful, it would be expected that comparable mechanisms would be required for other entrants to be competitive. The growth of the industry then will be catalyzed not by imitation but by the mechanisms that allow the propagation of tacit knowledge from the pioneering firm to new firms. The production of technologically unrelated products is expected to require different tacit knowledge. Hence, further seeding through international transfer of knowledge would be needed to diversify the industrial base.

We test this conception of the development process based on the evolution of the Bangladesh garment industry. With annual exports of $12 billion in 2008, the industry today is one of the leading international suppliers of apparel. But before the formation of Desh Garments in 1978, only a handful of Bangladeshi firms struggled to export garments. Key to Desh's success was a technical partnership it forged at its outset with a South Korean firm, Daewoo, to train 126 of its workers in Korea for six months. After Desh prospered, numerous firms entered the industry. By 1988 there were 664 garment producers and today there are over 4,000 factories exporting various garment products to all major international markets. We contend that key to the explosive growth of the industry was knowledgeable workers leaving Desh and then other successful firms to set up the production of later entrants. These

[5] For a review of the literature investigating the relationship between technology and trade, see Grossman and Helpman (1995) and between technology and growth, see Fagerberg (1994).

workers organized assembly-line production processes, trained workers, and supervised production, effectively diffusing key tacit knowledge to new garment producers.

We develop a simple model of the market for these workers that yields hypotheses concerning the types of firms that hired them and the effects of hiring the workers on the firms' performance. We test these hypotheses using data on the early entrants into the Bangladesh garment industry. Annual lists of producers provided by an industry trade association were used to identify all the entrants through 1988. The backgrounds of the entrants were traced through extensive fieldwork, which also turned up an association of the initial Desh workers trained at Daewoo. The bulk of these workers were still living and were interviewed, which made it possible to reconstruct which of the workers left Desh to set up production at subsequent entrants. We were also able to compile similar information for another firm, Bond Garments, which also had many workers leave to set up production of entrants. We use these data and data on firm exports, number of employees, and number of machines as of 1995 (the first year for which such data were available) to test the implications of the model. We also exploit data for a successful early firm that subcontracted production to many other firms to assess the role of subcontracting in diffusing key tacit knowledge. Later the garment industry expanded into sweaters through a partnership between a foreign firm and a new domestic producer, similar to Desh. We were able to assemble data on workers that left the pioneering firm to set up production of subsequent sweater entrants to test whether the diffusion of critical tacit knowledge through worker mobility repeated itself.

The implications of our theory depart from those of the theory of self-discovery in two important ways. First, in our framework development is not limited by the lack of entrepreneurial experimentation but by the lack of seeds in industries in which a country potentially has a comparative advantage. Second, the growth of the industry following an initial seed is not based on imitation per se but on transfer of tacit knowledge through employee mobility. Similar to Hausmann and Rodrik (2003), though, the process of development is rife with externalities. The seeding of the initial pioneering firm jump-starts an entire industry, and the spillover of knowledge through workers setting up production at entrants allows the initial seed to flower. Private incentives to plant the initial seed are inherently limited, making the experience of the Bangladesh garment industry a rare event.

Bangladesh has always been plagued by numerous problems, including limited literacy, high corruption, and weak institutions. Writing prior to the establishment of the garment industry, Faaland and Parkinson (1976) characterized Bangladesh as "the world's most difficult problem of economic development," and "if the problem of Bangladesh could be solved, there can be reasonable confidence

that less difficult problems of development can also be solved." Our findings suggest that part of the solution involves the seeding of an initial domestic firm with knowledge from a foreign producer. Despite all of its problems, subsequent mechanisms arose in Bangladesh to diffuse the transferred knowledge, which provides some encouragement that the explosive growth of the garment industry might be replicated in other industries and countries without a complete re-engineering of their economies. Whether in fact the lessons of the Bangladesh garment industry apply elsewhere remain to be studied, but the first step is determining exactly what these lessons are.

The paper is organized as follows. Section 2 provides historical background on Bangladesh and its garment industry. Section 3 outlines the model. Section 4 summarizes the data collection methods and provides some descriptive statistics. Section 5 presents the findings, which are discussed in Section 6.

2. Background of Bangladesh and its Garment Industry[6]

In 1971, the people of what was then known as East Pakistan gained their independence after a nine-month bloody war that claimed three million lives and left the infrastructure of the nation severely battered. The new country, Bangladesh, nationalized the few major industries it had and adopted an import-substitution strategy. While subsequent regimes gradually liberalized the economy, only after 1991 did Bangladesh seriously embark on relaxing trade policies (Rana, 1997). The country's effort to establish good governance was almost non-existent. Bangladesh has been characterized as a politically unstable nation where corruption is rampant, government intervention in the economy is frequent, and the enforcement of property rights is weak.[7]

Remarkably, Bangladesh has sustained steady growth since 1980, when its per capita GDP (PPP) was only $601. In the next 25 years its per capita GDP (PPP) grew by an average of 5% per annum to $1,997, putting Bangladesh on the verge of relinquishing its status as a Less Developed Country (LDC). Figure 1 shows that a major impetus to the underlying economic growth was the rise in exports. The share of exports as a percentage of GDP rose from 5% in 1980 to 13% in 2004. This growth was fueled by one industry, garments, which currently accounts for 78% of the country's total exports. In 1978 only a handful of garment producers used a primitive production system in which either all or a large number

[6] The historical description of the industry is based on fieldwork that was conducted between June 2006 and September 2007. A detailed discussion of the industry is provided in Mostafa (2009).

[7] Bangladesh ranks poorly on perceived corruption by Transparency International and on institutional indicators by The Heritage Foundation.

of operations of making garments were carried out by tailors using outdated machines. Today the industry has more than 4,000 factories using sophisticated assembly-line methods of production. In 2006, Bangladesh was the third and sixth largest exporter of garments to the EU and US respectively.

The modern garment industry was effectively started by Desh Garments (Quddus and Rashid, 2000). Desh introduced assembly-line manufacturing of garments, which paved the way for mass production and improved quality. Desh learned how to conduct an assembly-line process from Daewoo, a leading South Korean garment producer. Daewoo's garment export growth was on the decline due to rising domestic wages and quotas imposed by governments in major markets. Daewoo was reluctant to invest in Bangladesh, but was willing to train Desh's workers and market its products in exchange for a share of Desh's export sales.

Figure 1 somewhere here

As part of the partnership, Desh sent 126 of its initial workers to Daewoo's state-of-the-art facility in Pusan, Korea. Of those 126 Desh workers, 10 held upper management positions, 17 were line chiefs, and the other 99 constituted the workforce. Almost all the recruits had no prior experience in garments but most of them had at least a high school degree. Trainees received on-the-job training in Daewoo's actual export production lines. Then, under the supervision of their Korean trainers, Desh workers set up assembly-lines at Daewoo's facility initially to produce uniforms for Daewoo's workers and subsequently to execute some of Daewoo's export orders. Toward the end of their training, Desh workers were able to produce at an impressive rate of about three shirts per minute from a single production line.

Upon their return, the Desh workers along with a few technicians from Daewoo set up Desh's factory in Chittagong. When the construction of the factory was complete in 1980, Desh had the largest garment factory in Bangladesh with 450 machines and 500 workers. It initially exported men's shirts and subsequently diversified into other woven items, such as trousers and women's blouses. On June 30, 1980, Desh terminated the contract with Daewoo, but it continued to perform strongly. By the fiscal year 1986-87, Desh's total exports reached $5.28 million, registering a 91.7% average annual growth since its first export in 1980.

By 1984 when the total number of firms in the industry had shot up to 294, about 75% of the 126 original Desh workers had left Desh. Many of the workers were hired away by other entrants to help set up their factories and head production. They were involved in installing machines, setting up

assembly lines, and recruiting and training workers. By 1988, 59 new firms had hired Desh workers to help set up their factories. Some of the workers trained by Desh technicians later were involved in training workers of other firms. For example, Bond Garments, which hired a couple of Desh workers to head its production during its formative years, became very successful and by 1988 many of its initial workers had left to set up factories for other entrepreneurs. To attract Desh and Bond workers, entrepreneurs offered salaries that were multiples of what the workers earned at Desh or Bond. Salary data disclosed by some of these workers indicate that entrepreneurs were willing to pay a higher premium for Desh than Bond workers, suggesting that the former were the preferred choice in setting up factories.

Daewoo's involvement and the subsequent success of Desh attracted international buyers to Bangladesh. They were reluctant, however, to place orders in factories that did not have sound production managers. Early on, there were more entrants than qualified domestic workers available to set up production of new factories. Some entrants hired foreign technicians to set up production, although this did not generally work smoothly. Language barriers often made it difficult to communicate with foreign technicians. Furthermore, foreign technicians required high salaries and perks to compensate for extended stays away from their cultures, and they did not always perform as expected. Such challenges were less pronounced when entrepreneurs hired domestic technicians from distinguished firms.

Initially, there were no allied industries to support garment exports. Producers had to rely on imported machines, fabrics, and accessories. Garment entrepreneurs pressed the government to implement three policies to help the industry: duty-free importation of machines, bonded warehouses, and back-to-back credit facilities. Bonded warehouses allowed garment manufacturers to import fabric and accessories without paying duties, while back-to-back credit facilities provided the working capital to procure imported inputs.[8] Beyond those three policies, the government of Bangladesh did not aid the industry in any significant way.

Infrastructural support in the country was weak. Almost all factories sprang out around two busy cities, Dhaka, the capital where Bond was located, and Chittagong, the port city where Desh was located. Many entrepreneurs rented floors and turned them into factory shops. These factories suffered from acute shortages of electricity and gas. Communication links were poor and congestion at ports

[8] Interestingly, similar types of policies were also in place in countries like South Korea and Taiwan. Rhee (1986) points out that Desh and Daewoo played an important role in formulating these policies in Bangladesh.

common. Procedures for obtaining import-export and business licenses were complicated and entrepreneurs had to bribe officials to obtain the necessary documents.

Established firms that were behind schedule resorted to subcontractors to meet their export deadlines. During the industry's formative years, quite a few high performing firms, including Bond, Mohammadi, and Stylecraft, were involved in employing new firms as subcontractors. Established in 1983, Stylecraft hired a Desh worker to head its production and between 1983 and 1988 employed 20 entrants as subcontractors and provided them with extensive training.

The industry attracted entrepreneurs from all walks of life. Initially a large number of small business owners entered the garment industry by quitting their previous businesses. Some entrepreneurs who had larger businesses, such as construction and transportation firms, diversified into garments. Many professionals, including lawyers, retired military personnel, teachers, doctors, politicians, and even a few fresh college graduates who had access to family money also jumped on the bandwagon.

Influenced by Desh and Daewoo, Bangladeshi manufacturers initially produced shirts and related woven products for the US market. Starting in 1986, the US started imposing quota restrictions on garment products manufactured from Bangladesh and firms began to diversify into the European market, which was not under any quota restrictions. A few years after the imposition of quotas in the US market, exports of knitwear and sweater products took off. To manufacture products in these new industry segments, firms required production processes different from the technology available in the woven segment. The expansion of the new segments was led by entrants that had no prior woven manufacturing experience.[9]

A key event in the sweater segment of the industry was the establishment of Cheung Heung Sweater Bangladesh in 1986. Cheung Heung was formed as a joint venture between a local entrepreneur and a Chinese marketer that had been sourcing woven products from Bangladesh and had international clients that were eager to buy sweaters too. The Chinese partner provided imported machines and brought a team of about 30 foreign technicians to set up Cheung Heung's factory in Dhaka. With 1,045 machines, it was then the largest sweater factory in Bangladesh. It took about a year to hire 2,800 workers and bring the sweater factory to full capacity. Like Daewoo, the Chinese marketer did the entire marketing for the joint venture and then a few years later a disagreement led to the Bangladeshi entrepreneur assuming 100% ownership of the company. Subsequently, the firm's domestic workers began to assume greater responsibility in the firm and were hired away to set up production of

[9] For a discussion of the development of the knitwear segment see Mostafa (2009).

other sweater entrants. As of 1994, 25 of the 52 firms that established sweater factories had hired experienced workers from Cheung Heung to head their production.

3. Theory of the Diffusion of the Initial Seed

The main contention of the paper is that the initial seeding of tacit knowledge by Daewoo through the creation of Desh was essential to get the garment industry going in Bangladesh. Prior to the formation of Desh, the productivity of garment producers was such that they could not compete internationally—i.e., the profits of potential Bangladesh entrants into garments was less than the earnings they could generate in alternative endeavors. This all changed with the partnership between Desh and Daewoo. Desh was able to attain a level of productivity that made it competitive internationally and enabled it to become a successful exporter of garments. In turn, workers at Desh learned about how to set up and manage garment production in order to be competitive internationally, which made these workers valuable to entrants that wanted to establish their own garment factories.

The purpose of this section is to model the market for such knowledgeable workers to derive a few testable propositions if indeed the emergence of such a market was key to growth of the garment industry following the formation of Desh. The alternative hypothesis is that the establishment of Desh demonstrated Bangladesh's innate advantage in garments, enabling entrepreneurs to imitate Desh without the need for any transfer of knowledge. In that case, mechanisms that allow for the inter-firm transfer of tacit knowledge would not be expected to affect firm performance.

Research on tacit knowledge suggests that it is difficult to articulate, formalize, and communicate (Polanyi, 1962). Since the knowledge becomes embedded within the worker's skills, abilities, and intuition, its inter-firm diffusion requires individuals possessing the knowledge to physically move to new organizations and transmit their knowledge through on-the-job training (Winter, 1987). Within a new organization, the diffusion of tacit knowledge is considered a gradual process of dissemination (Szulanski, 1996) and its successful transfer requires the experienced transmitter to train workers at the recipient organization. By hiring an experienced technician from a successful firm to "set up" its factory, an entrant could effectively access the tacit knowledge. Initially, Desh was the main source of domestic workers that were capable of setting up factories for other entrants. The knowledge transferred by hiring Desh workers to set up factories is called primary diffusion.

Once an entrant accesses the tacit knowledge through primary diffusion, the knowledge becomes embedded in workers of the new firm, which over time become another source of transmitters

of tacit knowledge. The knowledge transferred by hiring workers from such a source to help set up factories is called secondary diffusion. We will focus in particular on one such firm, Bond Garments, that itself initially hired a couple of Desh workers to oversee its production and then served as the source for a number of workers that helped set up production of other firms.

Firms that become successful by accessing tacit knowledge via primary or secondary diffusion can transfer this knowledge to entrants by hiring them as subcontractors. Firms have a vested interest in training their subcontractors to produce export quality goods on their behalf in order to complete their export orders. We will focus on one such firm, Stylecraft, which hired a Desh worker to set up its factory and later was actively involved in employing entrants as subcontractors. We analyze the performance of Stylecraft's subcontractors to gain insight into the role of subcontracting in diffusing tacit knowledge to entrants.

A more direct way by which tacit knowledge embodied in workers can diffuse to new entrants is by those workers founding their own garment firms, which we call intra-industry spinoffs.[10] Capital markets were inefficient in Bangladesh, and skilled technicians had limited opportunity to seek outside financing. Therefore, spinoffs were not a prominent source of entrants during the early stage of the industry and are not featured in our analysis.[11] According to our fieldwork, the contribution of foreign technicians in transmitting tacit knowledge to entrants was limited and so this mechanism is also not featured in our theoretical model but is analyzed in the empirical section.

3.1 Basic Model Set-up

We first consider the process of primary and secondary diffusion. We assume that firms can hire three types of local workers to set up and oversee their production: Desh (D) and Bond (B) workers and "Other" (O) workers from various sources. Suppose that on its own a firm's production function is of the Cobb-Douglas form: $Q_i = \gamma_i L_i^{\alpha} K_i^{\beta}$, where Q_i is the output of firm *i*, L_i and K_i are the amount of labor and capital employed by firm *i*, γ_i is the innate productivity of firm *i,* and $\alpha + \beta < 1$, so that production is subject to decreasing returns to scale. Furthermore, suppose that a firm can hire a qualified worker from Desh, Bond, or elsewhere to increase its productivity by an amount θ_j to $\gamma_i + \theta_j$, where the increase from hiring a worker from Desh, denoted as θ_D, is greater than the increase from

[10] See Klepper (2001) for a review of the literature on spinoffs.

[11] For a detailed analysis of spinoffs during the later stage of the evolution of the industry when they were more prevalent, see Mostafa (2009). He provides suggestive evidence that over time some of the early Desh workers accumulated sufficient assets to start their own ventures.

hiring a worker from Bond, which is denoted as θ_B, which in turn is greater than the increase from hiring an "Other" technician, which is denoted as θ_O. This ordering of workers corresponds to the premiums that were typically paid to workers to set up and oversee production at entrants: Desh workers commanded the highest premiums, followed by Bond workers and then workers from other firms.

Our analysis focuses on the determination of the premiums paid to these workers and on the firms that hired them to set up and oversee their production. We assume that firms differed in terms of their innate productivity γ_i based on their backgrounds. Some firms diversified from other industries, adding garments to their product line. We assume that *ceteris paribus*, these firms had greater productivity than the average new firm by dint of their prior organizational experience and greater access to complementary assets (Teece, 1986). Among new firms, we assume that those that were founded by individuals with experience working in other garment firms—i.e., intra-industry spinoffs—had greater productivity than other new firms with "inexperienced" founders. Last, we assume that the education of the founder of the firm also conditioned the firm's productivity, with those headed by college graduates, and especially ones with an engineering degree, having greater productivity.

We model the market for workers that could set up and oversee production at new firms at each time *t*. Let the number of entrants at time *t* with the requisite productivity to be competitive internationally if they hired a qualified Desh, Bond, or Other worker to set up their production be denoted as T_P. We assume that the number of qualified set-up workers from Desh, denoted as T_D, and the number of qualified set-up workers from Bond, denoted as T_B, are such that $T_D + T_B < T_P$, so that not all entrants could hire Desh or Bond workers to set up their production. To simplify, we assume that the number of "Other" set-up workers T_O is such that $T_O + T_D + T_B > T_P$, so that all firms could hire some type of worker to help set up their production.

3.2 Market Equilibrium

Our analysis focuses on the premiums that are paid by entrants to have their production set up by Desh and Bond workers and the firms that hire these workers at each time *t*. Let PR_j be the premium at time *t* paid to workers from firm *j* = *D*, *B*, or *O* that are qualified to set up and oversee the production of entrants. The premium paid to set-up workers from firm *j* is assumed to be greater than the wage they receive at firm *j*, reflecting that set-up knowledge is not valuable to already established firms. The market for set-up workers was new during the early evolution of the industry and participants

presumably had limited ability to anticipate how the market would evolve over time. Accordingly, we assume that at time *t* entrants made decisions about hiring set-up workers based on the premiums paid to these workers at time *t* and the expected effect of hiring them on their profitability at entry, choosing to hire the set-up worker that maximized their profits at entry net of the premium paid to the worker. Analogously, we assume that at time *t* qualified set-up workers made employment decisions based on the premiums offered for their set-up services at time *t*.

Consider first the gross profits earned by hiring set-up workers from firm *j = D, B, or O* given by $\Pi_i = (\gamma_i + \theta_j) L_i^{\alpha} K_i^{\beta} P_x - wL_i - rK_i$, where P_x is the price of the product, w is the wage of labor, and r is the cost of capital. We assume that P_x is determined in the world market and Bangladesh producers take P_x as given. Differentiating with respect to L_i and K_i and solving the first-order conditions yields the optimal amount of labor and capital:

$$L_i^{*} = \left\{ \frac{\alpha(\gamma_i + \theta_j) s^{\beta} P_X}{w} \right\}^{\frac{1}{1-\alpha-\beta}} \text{ and } K_i^{*} = \left\{ \frac{\beta(\gamma_i + \theta_j) s^{1-\alpha} P_X}{w} \right\}^{\frac{1}{1-\alpha-\beta}},$$

where $s = \frac{w\beta}{r\alpha}$ is the technical rate of substitution between K_i and L_i. Substituting L_i^{*} and K_i^{*} in the expressions for Q_i and Π_i yields the optimal levels of output and gross profit as functions of γ_i and θ_j:

$$Q_{i,\theta_j}{}^{*} = (\gamma_i + \theta_j)^{\frac{1}{1-\alpha-\beta}} Z \quad \text{and} \quad \Pi_{i,\theta_j}{}^{*} = (\gamma_i + \theta_j)^{\frac{1}{1-\alpha-\beta}} M,$$

where $Z \equiv s^{\frac{\beta}{1-\alpha-\beta}} \left(\frac{\alpha P_x}{w} \right)^{\frac{\alpha+\beta}{1-\alpha-\beta}}$ and $M \equiv \left[s^{\beta} P_x \left(\frac{\alpha}{w} \right)^{\alpha+\beta} \right]^{\frac{1}{1-\alpha-\beta}}$ $(1-\alpha-\beta) > 0$.

The maximum amount a firm would be willing to pay to hire a Desh set-up worker relative to a Bond set-up worker is the difference between the firm's gross profits from hiring a Desh and Bond set-up worker. Likewise, the maximum amount it would pay for a Bond versus Other set-up worker is the difference between its gross profits from hiring these respective workers. Figure 2 presents three curves that plot firm gross profits from hiring a Desh, Bond, and Other set-up worker as a function of the firm's innate productivity, γ_i. Differentiating the profit function with respect to γ_i yields:

$$\frac{\delta \Pi_{i,\theta_j}{}^{*}}{\delta \gamma_i} = \frac{1}{1-\alpha-\beta} \left(\theta_j + \gamma_i \right)^{\frac{\alpha+\beta}{1-\alpha-\beta}} M > 0.$$

Since $\theta_D > \theta_B > \theta_O$ it follows that

$$\frac{\delta \Pi_{i,\theta_D}^{*}}{\partial \gamma_i} > \frac{\delta \Pi_{i,\theta_B}^{*}}{\partial \gamma_i} > \frac{\delta \Pi_{i,\theta_O}^{*}}{\partial \gamma_i}.$$

This is reflected in Figure 2 by the steeper slope of the gross profit function from hiring a Desh than Bond set-up worker, which in turn is steeper than the gross profit function from hiring an Other set-up worker. Hence the difference in gross profit from hiring a Desh versus Bond set-up worker and a Bond versus Other set-up worker is an increasing function of the firm's innate productivity.[12] Therefore, the greater a firm's innate productivity then the greater amount it will pay for a Desh versus a Bond set-up worker and a Bond versus an Other set-up worker.

Consider the premiums paid to Desh and Bond set-up workers. The most productive firms are willing to pay the most for a Desh versus Bond set-up worker and so the T_D firms with the greatest productivity hire a Desh set-up worker. The marginal firm must be indifferent between hiring a Desh and Bond worker in order for the market for these workers to clear. In Figure 2, the productivity of this firm is denoted by γ_D. Therefore, the difference in the premiums paid to a Desh and Bond worker, (PR_D-PR_B), must equal the difference in the gross profits from hiring a Desh and Bond set-up worker for the marginal firm. An entrant with an innate productivity γ_i such that $\gamma_D < \gamma_i$ will hire a Desh set-up worker since the extra gross profit earned by hiring a Desh set-up worker minus the premium for a Desh set-up worker is greater than the extra gross profit earned by hiring a Bond set-up worker minus the premium paid for a Bond set-up worker.

Figure 2 somewhere here

The difference in the premiums for Bond and Other set-up workers, (PR_B-PR_o), can be derived similarly. It is determined by the marginal firm with productivity γ_B as illustrated in Figure 2. Firms with innate productivity γ_i such that $\gamma_B < \gamma_i \leq \gamma_D$ earn greater profits net of the premium for the set-up worker by hiring a Bond versus Other worker. The firm with productivity γ_B is indifferent between hiring a Bond and Other set-up worker and all those with productivity less than γ_B hire an Other set-up worker.

[12] This reflects that firms that are more productive produce a larger level of output and thus benefit more from any given boost in their productivity, which follows directly from $\frac{\delta^2 \Pi_{i,\theta_j}^{*}}{\delta \theta_j \delta \gamma_i} = \frac{1}{(1-\alpha-\beta)^2}\left(\theta_j + \gamma_i\right)^{\frac{2\alpha+2\beta-1}{1-\alpha-\beta}} M > 0.$

We posited that diversifiers and intra-industry spinoffs have more valuable pre-entry experience, providing them with greater innate productivity than other entrants. Furthermore, we conjectured that a firm's productivity would also be determined by the education of its founder. With the most productive firms hiring Desh set-up workers and the next most productive Bond set-up workers, this implies:

Hypothesis 1: Diversifiers and intra-industry spinoffs and firms with more educated founders were most likely to hire Desh set-up workers followed by Bond set-up workers.

The firm's output is given by $Q_{i,\theta_j}{}^{*} = \left(\theta_j + \gamma_i\right)^{\frac{1}{1-\alpha-\beta}} Z$. Since $\frac{\partial Q_{i,\theta_j}{}^{*}}{\partial \gamma_i} > 0$ and γ_i is related to the firm's pre-entry experience and the education of its founder, it follows that:

Hypothesis 2: Controlling for the productivity of workers hired to set up production, the output of producers is greater for diversifiers and intra-industry spinoffs and those with more educated founders.

Since $\frac{\delta Q_{i,\theta_j}{}^{*}}{\delta \theta_j} = \frac{1}{1-\alpha-\beta}\left(\theta_j + \gamma_i\right)^{\frac{\alpha+\beta}{1-\alpha-\beta}} Z > 0$ and $\theta_D > \theta_B > \theta_O$, it readily follows that $Q_{i,\theta_D}{}^{*} > Q_{i,\theta_B}{}^{*} > Q_{i,\theta_O}{}^{*}$, which implies:

Hypothesis 3: Controlling for firm pre-entry experience and the education of founders, firms hiring Desh set-up workers have a larger output than firms hiring Bond set-up workers, which in turn have a larger output than firms hiring Other set-up workers.

3.3 Diffusion of Tacit Knowledge through Subcontracting

Suppose a potential entrant had sufficiently low innate productivity that it could not profitably enter even if it hired a qualified worker to help set up its production. Nonetheless, it might be profitable for the firm to enter as a subcontractor if it expected to receive training that would increase sufficiently its productivity. Suppose that while it is a subcontractor, its output is less than the average output of exporters, but if its training as a subcontractor is sufficiently good then its productivity would rise to the level of the average exporter, in which case its output would be equal to that of the average exporter. Furthermore, suppose that entrants cannot distinguish a priori the quality of the training they will be provided by a firm for which they work as a subcontractor. Assuming that the size of a subcontractor's (future) output is less than that of an average exporter if it does not receive good training as a subcontractor, it follows that:

Hypothesis 4a: At a later date, the expected output of firms that begin as subcontractors is less than the expected output of firms that begin as exporters.

The better a firm is as a trainer, the greater the probability that its subcontractors will become exporters and thus the greater the expected future exports of its subcontractors. However, on average the best subcontractors will do is to produce as large an output as exporters. Therefore:

Hypothesis 4b: Entrants that receive better training through subcontracting have greater future output, but on average entrants that begin as subcontractors will have exports less than or equal to the exports of firms that began as exporters.

Stylecraft was a successful firm that initially hired a Desh worker to help set up its factory and then later extensively used subcontractors to produce its output. Because it relied heavily on subcontractors, it devoted a lot of effort to trainings its subcontractors. Consequently, based on Hypothesis 4b it would be expected that its subcontractors would later have greater exports than other firms that began as subcontractors but no greater exports than firms that began as exporters.

3.4 Probability of a Worker Being Hired to Set up an Entrant

Not all workers at Desh, Bond, or elsewhere in any given period *t* would be qualified to set up production at other firms. Suppose that workers have to acquire sufficient set-up skills to be qualified to set up the production of entrants. Assume that the set-up skills of workers depend on their innate ability and their work experience. Initially, suppose that there are two levels of workers—high and low ability workers. The average set-up ability of high ability workers is greater than that of the low ability workers. Suppose that as they gain experience over time, all workers improve their set-up skills, with high and low ability workers improving their set-up skills at the same rate. Assuming that eventually workers attain sufficient set-up skills to be able to set up the production of entrants, it follows that:

Hypothesis 5: At every point in time, the fraction of workers setting up production at entrants is higher for high than low ability workers and over time the fraction of workers at each level that are hired to set up production at entrants rises.

4. Data Collection Strategy and Summary Statistics

We test the implications of our theoretical model on two episodes of the industry. The first episode spans the early evolution of the industry through 1988, which is 10 years after the establishment of Desh. The second episode involves the expansion of the industry into sweaters, which was spurred by the formation of Cheung Heung, and covers the eight years after the establishment of Cheung Heung through 1994. For each episode we identified all the entrants and their year of entry and collected information on the backgrounds of their entrepreneurs (i.e., founders), key workers they hired to set up their factories, and whether the entrants started production as exporters or subcontractors. We also constructed measures of firm performance based on firm data on exports, employees, and machines. Data were assembled from three sources: Bangladesh Garment Manufacturers and Exporters Association (BGMEA), the main association of the industry; interviews of entrepreneurs and key workers; and third party sources, such as employees, suppliers, and buyers.

4.1 Archival Data and Membership Catalogs

Data from BGMEA were used to identify all entrants in the industry through 1988 and their year of entry. Starting in 1990, BGMEA published yearly catalogs that reported all factories in the industry, the name of their managing directors, their location, and type of products they produced, and since 1995 the number of machines and number of employees used in production. BGMEA also provided data on annual exports beginning in 1995 for each factory in Dhaka, which constitute about 85% of all factories in the industry. Using the product information in the annual catalogs and our industry sources, all firms that entered the sweater segment through 1994 and their year of entry were identified.[13]

All data from BGMEA are at the factory level. Factories were grouped into firms using information collected from interviews of founders and industry veterans, by matching founder names and addresses in the directory, and using semi-annual BGMEA election voter lists, which contained pictures and names of entrepreneurs along with names of their factories.

Although the catalogs report all existing and new factories established in a year, they usually do not drop inactive factories as long as entrepreneurs continue to pay their nominal membership fees. Consequently, years of survival is not a reliable measure of firm performance. Instead, we use exports,

[13] Prior to 1990 when catalogs were not published, there were very few sweater factories in the industry and these were well known and are included in our sample.

number of employees, and number of machines in the first year they were available, 1995, as alternative measures of performance.[14]

4.2 Field Data

To collect information on the backgrounds of firms, an extensive on-site field study was carried out between June 2006 and August 2007. Initially, a few entrepreneurs were approached to carry out a pilot study, which helped refine the interview questions. Cell phone numbers of about 1,000 entrepreneurs were collected from various sources. Initially a phone call was made to explain the purpose of the research. Interviews were carried out on site or by phone, whichever the entrepreneur preferred. Interviews usually lasted between 25-30 minutes and entrepreneurs were asked a series of questions to elicit information on the factories they owned, their education and pre-entry experience (including if the entrant diversified into garments from other businesses), the key workers they hired to set up their factories, the type of work they initially carried out (whether they worked as subcontractors or exporters), and so on.

Using phone and on-site interviews, only 21.9% of the early entrepreneurs agreed to be interviewed. Furthermore, even those that agreed to be interviewed were unwilling to talk about who they hired to head production in their factories. Consequently, an alternative approach was pursued to collect data. A few knowledgeable early entrepreneurs and employees in the industry were asked to provide information on the backgrounds of early entrants. In particular, we were interested in whether entrants were diversifiers or spinoffs and the level of education of their founders, all of which were expected to influence their performance. We also wanted to identify firms with foreign investors or that employed foreign technicians to set up their production to gauge the extent to which such sources could substitute for acquiring knowledge by hiring domestic workers to set up production. Diversifiers, spinoffs, and firms with foreign partners and/or technicians were well known to our informants and were readily identified. In the end, we were able to identify the pre-entry experience and level of education of 71.1% and 58.9% of early founders respectively. [15]

Our informants had much less knowledge about the initial organization of firms and the type of work they carried out. Fortunately, the fieldwork revealed another way to collect this information. The initial Desh workers trained in Korea formed an association that published a directory of its members in 2004. Using this directory, 88 of the 126 Desh workers trained In Korea were contacted and interviewed.

[14] The reported number of employees and machines for firms that do not produce but continue to pay their membership fees is likely to overstate their size and so has to be used carefully.

[15] Information on an entrepreneur from at least two different sources was obtained and cross-checked.

They provided information about their education, the training they received in Korea, and their subsequent careers outside Desh, including the firms they helped set up and the backgrounds of the entrepreneurs that hired them. They also provided similar information on the bulk of their peers who were deceased or could not be found. We initially interviewed a few Bond workers and collected contact information for other Bond workers, who were also interviewed. In total the work histories of 33 of the 55 initial Bond workers were traced, including the firms they helped set up.

Information on whether an entrant began production as a subcontractor or an exporter was collected through interviews of the founders and workers who set up factories. Detailed information on the subcontractors of Stylecraft was obtained from an individual who had worked in a high level position in Stylecraft.

A similar strategy was employed to identify the prior experience and level of education for entrants in the sweater segment. We were able to collect this information for 90.4% and 92.3% of the entrants respectively. Firms that hired Cheung Heung workers to help set up their sweater factories were identified by a former senior manager who had helped place experienced Cheung Heung workers in other factories. These data were corroborated by two other ex-employees of Cheung Heung.

4.3 Summary Statistics of Early Entrants

Table 1 summarizes the data assembled for entrants through 1988. We classify entrants into four groups according to the pre-entry experience of their founders: *Diversifier* (the firm diversified into garments from other businesses); *Spinoff* (the entrepreneur previously worked in the garment industry); *Foreign Investor* (the entrepreneur was of foreign origin); and *Inexperienced* (the rest of the entrepreneurs). Each category is defined by a dummy variable that takes a value of 1 if the entrepreneur had the relevant pre-entry experience and 0 otherwise. The table indicates that during the early years of the industry there were few spinoffs and foreign investors but many diversifiers.

We have two measures of an entrepreneur's education: *College*, which is equal to 1 if the entrepreneur had at least a college degree and 0 otherwise, and *Engineer*, which is equal to 1 if the entrepreneur had an engineering degree and 0 otherwise. About 62% of the entrepreneurs whose level of education could be identified had a college degree, which is a much higher percentage than in the country overall.

Our two variables that identify primary and secondary diffusion are *Desh Set-up*, which is equal to 1 if the entrant hired a Desh worker to set up its factory and 0 otherwise, and *Bond Set-up*, which is equal to 1 if the entrant hired a Bond worker to set up its factory and 0 otherwise. We also identified

entrants that hired foreign technicians to set up their factories; the variable *Foreign Technician Set-up* is equal to 1 if the entrant hired a foreign technician and 0 otherwise. In the sample, 59, 18 and 69 entrants hired Desh, Bond and foreign workers, respectively, to set up their factories.

Table 1 somewhere here

There are four dummy variables that characterize the type of initial production of entrants: *Subcontractor* is equal to 1 if the entrant started production as a subcontractor and 0 otherwise; *Subcontractor of Stylecra*ft is equal to 1 if the entrant started production by subcontracting from Stylecraft and 0 otherwise; *Exporter* is equal to 1 if the entrant began production by directly serving foreign markets and 0 otherwise; and *Initial Production Unknown* is equal to 1 if there is no information on the first production of the entrant and 0 otherwise. For 25% of the entrants in our sample we were able to identify their initial type of production. Among these firms, 105 began as subcontractors, including 20 that were subcontractors of Stylecraft, and 55 began as exporters.

Garment firms were located in two areas, Dhaka and Chittagong, and the variable *Location* is equal to 1 if the firm was located in Chittagong and 0 otherwise. Only 17.8% of the entrants were located in Chittagong. Table 1 also reports descriptive statistics on firm *Exports*, *Employees* (number of employees) and *Machines* (number of machines) in 1995.

Table 2 presents descriptive statistics for all 52 sweater manufacturers that entered by 1994. Among the sweater entrepreneurs whose backgrounds we could identify, 38% and 73% diversified from other businesses and had a college degree, respectively, suggesting that sweater entrepreneurs were more experienced than early entrepreneurs (for early entrants, these figures were 24% and 62%, respectively). The variable *Ex-CH Set-up* is equal to 1 if a factory was set up by a former employee of Cheung Heung and 0 otherwise and the variable *Foreign Technician Set-up* is equal to 1 if a firm hired a foreign technician to set up its factory and 0 otherwise. Twenty-five entrants hired Cheung Heung workers while only eight hired foreign technicians to set up their factories.

Table 2 somewhere here

The variable *Sweater First Factory* is equal to 1 if the factory is the entrepreneur's first in the garment industry and 0 otherwise. About 73% of the firms that entered in this segment did not previously manufacture garments. *Location* again equals 1 for firms located in Chittagong and 0

otherwise, with seven entrants (13.5% of the sample) located in Chittagong. The value of exports, number of employees, and number of machines are reported for sweaters only. For firms that diversified from other garment products, these values were obtained by accessing the factory level data, which had information on the product the factory produced.

The data are not a random sample of firms. In particular, information obtained from third party sources is likely to be biased towards better known firms. Fortunately, the backgrounds of a large fraction of entrepreneurs were identified. When they could not be identified, the variables *Unknown Experience*, which equals 1 if the pre-entry experience of their founders could not be identified and 0 otherwise, and *Unknown Education*, which equals 1 if the level of education of the founder could not be identified and 0 otherwise, are included in the analysis.

5. Results

5.1 Characteristics of Early Entrepreneurs that Hired Desh and Bond Workers to Set up Their Factories

To investigate how the industry initially developed, we first examine which early entrepreneurs hired Desh or Bond workers to set up their factories. According to hypothesis 1, more experienced firms and entrepreneurs with greater education would be expected to hire the most qualified workers to set up their production, with the most experienced firms and educated experienced entrepreneurs hiring Desh workers and the next most experienced firms and educated entrepreneurs hiring Bond workers. We test this hypothesis by estimating separate Probit models for hiring a Desh set-up worker and a Bond set-up worker. In the equation for hiring a Desh set-up worker, the explanatory variables include the pre-entry experience variables *Diversifier, Spinoff* and *Foreign Investor*, with *Inexperienced* the omitted category, the two education variables *College* and *Engineer*, and *Firm Age* and *Location*. In the Probit model for hiring a Bond set-up worker the variables *Spinoff* and *Foreign Investor* were excluded along with the observations for these firms because no spinoff or firm with a foreign investor hired a Bond set-up worker. Additionally, no firm with an unknown background or with a founder whose education was unknown hired a Desh or Bond set-up worker; hence observations for these firms had to be dropped, which reduced the samples for analyzing hiring of Desh and Bond set-up workers to 384 and 348 respectively. Desh entered before Bond and thus it was expected that older firms would be more likely to hire Desh than Bond workers. Desh was located in Chittagong and Bond in Dhaka and so it was expected that firms located in Chittagong would be more likely to hire Desh workers and firms located in Dhaka would be more likely to hire Bond workers.

Table 3 provides the coefficient estimates for the Probit models, with the first column reporting results for hiring Desh workers and the second column for hiring Bond workers. Consistent with hypothesis 1, the coefficient estimates of *Diversifier* and *College* are positive and significant for both types of workers, indicating that diversifiers and firms with more educated founders were more likely to hire these workers to set up their production. As hypothesized, the effects of both variables are larger for Desh than Bond workers: the predicted probabilities of hiring Desh and Bond set-up workers are 0.22 and 0.06 respectively for diversifiers and 0.15 and 0.05 respectively for firms with a college educated founder. In the Desh analysis, the coefficient estimate of *Spinoff* is positive and *Foreign Investor* is negative but neither estimate is significant. In both analyses, the coefficient estimate of *Engineer* is negative but not significant. The coefficient estimates of *Firm Age* and *Location* are positive in the Desh equation and negative in the Bond equation, with all but the coefficient estimate of *Firm Age* in the Bond equation significant. This is consistent with our conjecture that older firms and firms located in Chittagong were more likely to hire Desh than Bond workers.

5.2 Primary and Secondary Diffusion and Subcontracting

Our model predicts that firm output is greater for diversifiers and spinoffs and firms with more educated founders (hypothesis 2) and also for firms that hired Desh and Bond set-up workers, with the Desh effect larger than the Bond effect (hypothesis 3). We test these predictions using exports in 1995 as our measure of firm output. Export data were only available for firms in Dhaka and so the sample is restricted to the 546 entrants through 1988 that were located in Dhaka. First, a model was estimated with the firm background variables *Diversifier, Spinoff*, *Foreign Investor*, *College*, and *Engineer*. The variables *Unknown Experience* and *Unknown Education* were also included to allow for the possibility that firms whose backgrounds could not be identified were worse performers. Older firms had longer to grow and thus were expected to have greater exports in 1995, and so the variable *Firm Age* was included as an explanatory variable. The dependent variable is censored at 0 and so Tobit estimation is employed.

The coefficient estimates are presented in Table 4 under the column headed Model 1. The coefficient estimates of *Diversifier* and *Spinoff* are positive and significant, as predicted. The coefficient estimates of *College* and *Engineer* are both positive, with the former significant, which also conforms with the predictions. The coefficient estimate of *Foreign Investor* is positive but small and insignificant, which suggests that firms founded by foreigners did not fare better than domestic firms. The coefficient

estimate of *Firm Age* is positive, as expected, but not significant and the coefficient estimates of *Unknown Experience and Unknown Education* are negative, as expected, although neither is significant.

In model 2, we add the variables *Desh Set-up* and *Bond Set-up* to test whether firms that hired these workers had a larger output after controlling for their backgrounds. We also include the variable *Foreign Technician Set-up.* Consistent with hypothesis 3, the coefficient estimates of *Desh Set-up* and *Bond Set-up* are both positive and significant, with the coefficient estimate of *Desh Set-up* significantly larger than the coefficient estimate of *Bond Set-up* ($F(2, 535)=19.15$, $p<0.00$). The average exports of firms in 1995 were $3.2 million. The estimates imply that an entrant that hired a Desh worker or a Bond worker to set up its factory received a boost in its 1995 exports of $12.9 Million and $6.4 Million respectively relative to firms that hired "Other" workers. The coefficient estimate of *Foreign Technician Set-up* is positive but small and insignificant, which is consistent with our earlier observation that foreign technicians were not a particularly useful source of tacit knowledge.

Table 4 somewhere here

Model 3 adds the variables pertaining to subcontracting, including *Subcontractor*, *Subcontractor of Stylecra*ft, and *Initial Production Unknown*, with firms that began as exporters the omitted category. Consistent with hypothesis 4a, the coefficient of *Subcontractor* is negative and significant, indicating that firms that began as subcontractors had lower exports in 1995 than firms that began as exporters. Consistent with hypothesis 4b, the coefficient estimate of *Subcontractor of Stylecraft* is positive and significant, indicating that Stylecraft's subcontractors fared better than the average firm that began as a subcontractor. The coefficient estimate of *Subcontractor of Stylecra*ft plus the coefficient estimate of *Subcontractor* is negative but not significant, which conforms with hypothesis 4b that even subcontractors of the best firms do not perform better than firms that begin as exporters. The coefficient estimate of *Initial Production Unknown* is negative and significant and its magnitude is significantly greater than that of *Subcontractor* ($F(2, 532) =9.67$, $p<0.00$), indicating that firms for which we were unable to identify their type of initial production performed worst. The coefficient estimates of *Desh Set-up* and *Bond Set-up* continue to be positive, significant, and substantial.

We were concerned that the coefficient estimates of *Desh Set-up* and *Bond Set-up* in Models 2 and 3 might be biased upward and thus could overstate the effect of hiring Desh and Bond workers on firm output. The firm background variables crudely control for differences in firm productivity and since firms with greater productivity were more likely to hire Desh and Bond set-up workers, part of the effect

of firm productivity on exports may be picked up by the variables *Desh Set-up* and *Bond Set-up*. We can address this for *Desh Set-up* by exploiting the fact that firms in Chittagong were more likely to hire Desh workers to set up their production. Assuming that the distribution of innate productivity of firms located in Chittagong was similar to that of firms located elsewhere, we can use the variable *Location* as an instrument for *Desh Set-up* to get a consistent estimate of the effect of *Desh Set-up* on firm performance. Since we have no export data for firms located in Chittagong, we use *Employees* and *Machines* in 1995 as our measures of firm performance.[16]

We follow the instrumental variable strategy outlined in Wooldridge (2002). First, a Probit model for *Desh Set-up* as a function of the same variables as in Table 3, including *Location*, is estimated. Observations with unknown background and missing data on employees/machines had to be dropped, reducing the sample for analyzing *Employees* and *Machines* to 256 and 274 firms respectively.[17] Second, the predicted values from the Probit estimation are used as instruments in a linear probability model for *Desh Set-up* with the same explanatory variables. Finally, the predicted value of *Desh Set-up* from the linear probability model is used in lieu of *Desh Set-up* in the Tobit model with *Employees* and *Machines* as the dependent variables and the same explanatory variables as in Table 4 excluding *Unknown Experience* and *Unknown Education*.

Table 5 presents the main findings. The first column of each panel reports the Tobit estimates of the full model without the instrument for hiring Desh workers. The estimates broadly replicate previous analyses on exports of Dhaka firms. The coefficient of *Spinoff* for both *Employees* and *Machines* is positive and significant, indicating that spinoffs were better performers than inexperienced entrepreneurs. The coefficient estimates of *Diversifier* and *College* are positive for both *Employees* and *Machines* and significant for *Machines*, suggesting that firms with more experience and with more experienced founders were better performers. The coefficient estimates of *Engineer* and *Subcontractor of Stylecraft* are positive but not significant in either analysis. Finally, the coefficient of *Desh Set-up* is positive and significant for both *Employees* and *Machines,* indicating that firms that hired Desh workers to set up factories had significantly more employees and machines than firms that hired "Other" workers.

The second column of each panel reports coefficient estimates of our instrumental variable (IV) approach. The coefficient estimates of *Desh Set-up* for both *Employees* and *Machines* are positive and significant and they are smaller than those of the corresponding coefficient estimates in the Tobit

[16] A similar strategy was not employed for *Bond Set-up* because only one firm located in Chittagong hired a Bond worker to set up its production and its data on machines and employees were missing.
[17] 36% and 31% of firms in the sample had missing data on employees and machines.

models. Nonetheless, the estimated effects of *Desh Set-up* remain large. By hiring a Desh worker, a firm received a boost of 771 employees and 374 machines relative to a firm that hired an "Other" worker, which is 157% and 166% more than the average number of employees and machines respectively.

Table 5 somewhere here

5.3 The Likelihood of Desh Workers Being Hired Away to Set up Factories

To investigate the process by which experienced workers were hired away from established firms by entrants, we analyze the departure of Desh workers to set up other factories. Recall that workers at Desh initially were assigned to three hierarchical positions—upper management, line chief, and the workforce. The few workers assigned to upper management left Desh to work for multinational companies or to found their own firms. Consequently, we limit the analysis to line chiefs and the workforce, with the variable *Level* equal to 1 if the worker was a line chief and 0 if the worker was assigned to the workforce.

Figure 3 shows the "survival" curve of Desh workers by their initial position, where survival is defined as not having left Desh to help set up the factory of an entrant. Consistent with hypothesis 5, at every point in time the fraction of Desh workers setting up factories is higher for mid-level than low-level workers, and over time the fraction of workers at every level that are hired to set up factories rises.

Figure 4 and table 6 somewhere here

We estimate a Cox hazard of exit model, where exit corresponds to leaving Desh to set up production at another firm. The explanatory variables include *Employee College*, which equals 1 if the worker had a college degree and 0 otherwise, *Employee Age*, which is the age of the worker in 1979 when hired by Desh, *Male*, which equals 1 for male workers and 0 otherwise, and *Level*. Table 6 presents the findings. The coefficient estimates of *Employee College and Male* are both positive and significant, indicating that males and more educated workers were more likely to be hired to set up production of other firms. Most important, consistent with the survival curves, higher level workers were more likely to be hired to set up production of other firms.

5.4 Diversification into the Sweater Segment

If the patterns observed in the early development of the industry were repeated in the subsequent evolution of a different segment of the industry, it would provide further support for the theory. Accordingly, we analyze the evolution of the sweater segment, which required technological capabilities different from those possessed by firms in the industry when sweater production began. Our sample contains all 52 firms that entered the sweater segment by 1994. Cheung Heung was conjectured to be the seed for the development of the sweater segment of the industry and so attention focuses on which firms hired Cheung Heung workers to set up their sweater production and the effects of hiring these workers on their performance.

Table 7 reports the coefficient estimates of a Probit model of hiring a Cheung Heung worker for set up in which the explanatory variables include *Diversifier*, *College*, *Engineer*, *Firm Age, Sweater Factory Age*, which is the number of years since the firm established its sweater factory, and *Sweater First Factory,* which equals 1 for firms that did not produce other garments before sweaters and 0 otherwise. No spinoff, firm with a foreign investor, unknown background, unknown education of its founder, or that located in Chittagong hired a Cheung Heung worker to set up its factory so these firms had to be dropped from the analysis, reducing the sample to 35 entrants. The coefficient estimate of *Diversifier* is positive and significant, which accords with the results for hiring Desh and Bond workers to set up the production of early entrants. The other coefficient estimates are insignificant, including the coefficient estimate of *College*, which was significant in the analysis of hiring Desh and Bond set-up workers. This may be because most of the founders of sweater firms were college educated and so *College* does not vary much within the sample.

Table 7 somewhere here

To test if hiring experienced workers from Cheung Heung affected the performance of firms, we estimated Tobit models for firm *Exports*, *Employees*, and *Machines* in the years 1995, 1996, and 1997. All three output measures pertain to the firm's sweater output only. We include as explanatory variables *Diversifier*, *Spinoff*, *Foreign Investor*, *Unknown Experience*, *College*, *Engineer* and *Unknown Education*. We also include the variables *Ex-CH Set-up* and *Foreign Technician Set-up* to test whether hiring Cheung Heung workers and foreign technicians increased a firm's productivity. To probe whether having prior experience in other garments influenced firm performance, we include as an explanatory variable *Sweater First Factory*. Older sweater factories were expected to have a greater opportunity to grow.

Accordingly, we include *Sweater Factory Age* as an explanatory variable. Last, we included *Firm Age* as an explanatory variable to test if overall garment experience influenced the performance of sweater producers. Observations with missing data on employees or machines were dropped from the respective analyses.

Table 8 presents the coefficient estimates. One difference from the results concerning the early entrants is that diversifiers and spinoffs do not seem to have been superior performers; all but one of the coefficient estimates for these two variables are insignificant. The same is true for *College*, although this variable does not vary much within the sample. In contrast, there is some evidence that founders with an engineering degree performed better; the coefficient estimate of *Engineer* is positive and significant in a number of the analyses. There is also some evidence that firms with foreign investors performed better, which also differs from the results for the early entrants, but this seems largely to reflect the great success of Cheung Heung itself—when Cheung Heung is dropped from the sample the coefficient estimate of *Foreign Investor* drops sharply and becomes insignificant. The coefficient estimate of *Sweater Factory Age* is consistently positive and significant whereas the coefficient estimates of *Firm Age* and *Sweater First Factory* are generally not significant, suggesting that only experience in sweater production and not garments more generally affected firm performance.

Table 8 somewhere here

The coefficient of *Ex-CH Set-up* is consistently positive and significant, indicating that firms that hired Cheung Heung workers to set up their sweater production performed better than those that hired "Other" workers. By hiring a Cheung Heung worker, firms received an export boost of about $3.6 million, $4.4 million and $5.4 million in the years 1995, 1996, and 1997 respectively. These values are more than 148%, 97%, and 104% of the average sweater exports in the respective years. Last, the coefficient estimate of *Foreign Technician Set-up* is only significant in one analysis, where it is negative. Consistent with the findings for the early entrants, hiring foreign technicians does not appear to have been an effective mechanism for transmitting tacit knowledge to sweater entrants.

6. Discussion

Over the last 30 years, Bangladesh has become a significant player in the international apparel market. The effective beginning of the industry was in 1978 with the creation of Desh Garments, which received an extensive infusion of tacit knowledge about the production of shirts and related woven items from the Korean firm Daewoo. We investigated how the formation of Desh catalyzed the subsequent growth of the Bangladesh garment industry. A model featuring mechanisms through which tacit knowledge diffused from Desh to other entrants was developed and its implications were tested on a dataset of early entrants into the industry.

Consistent with the model's prediction, we found that local entrepreneurs diversifying from other businesses and having greater education were more likely to hire set-up workers from Desh (primary diffusion) and Bond (secondary diffusion). Based on the IV estimates, firms that hired Desh workers to set up their factories had 771 more employees and 374 more machines in 1995, which is 157% and 166% more than the average number of employees and machines respectively. In contrast, firms with foreign investors or that hired foreign technicians did not fare particularly well, suggesting that these were not particularly useful sources of tacit knowledge. Entrants that worked as subcontractors for Stylecraft, which itself hired a Desh worker to set up its production, performed better than other entrants that began as subcontractors, which is suggestive that this was another important mechanism by which tacit knowledge diffused to entrants from Desh. Our findings for the sweater segment of the industry concerning the hiring of Cheung Heung workers to set up production replicate those for the early entrants concerning the hiring of Desh and Bond workers to set up their production, reinforcing our confidence in the role of trained workers being key conduits for diffusing tacit knowledge.

Bangladesh's success in garments is especially noteworthy given that it was, and still is, severely lacking in some of the prerequisites of growth envisioned by modern economists, such as human capital and good governance. The experience of the Bangladesh garment industry suggests that once an exemplary performer is seeded, such factors may not be necessary for tacit knowledge to propagate to other firms. Despite having limited literacy, Bangladesh had a sufficient number of educated entrepreneurs with some prior business experience who could gather the relevant resources and establish garment factories, which helps explain the tremendous number of entrants in the industry after Desh's success. The vast majority of garment workers had limited formal education, but the industry was relatively low-tech and they could pick up the necessary skills through on-the-job training.

Mostafa (2009) finds that entrepreneurs that previously worked in the industry were less daunted by challenges such as corruption and port delays, which could help explain why these challenges did not pose major impediments to the growth of the industry.

In both the episodes that were studied, a single seed catalyzed the growth of the industry. The seeds became exemplary performers due to their partnership with successful foreign firms, which wanted to establish suppliers from Bangladesh to service their own customers. The initial seeds were big, local firms and they became breeding grounds for developing a large pool of domestic workers, who were trained across the relevant organizational functions, had the opportunity to climb up the organizational ladder, and, in the process, accumulate supervisory experience to train new entrants. Otherwise, the role of foreign firms in the growth of the Bangladesh garment industry was limited,[18] which is consistent with prior empirical research on the contribution of foreign firms to the productivity of domestic entrants in their industry (Aitken and Harrison, 1999; Javorcik, 2004).

Our findings indicate that the potential spillovers from seeding an initial firm can be great, suggesting that government subsidies to induce foreign firms to bring technology to developing countries might be warranted. Policies such as providing tax breaks or reducing set-up costs through the establishment of industrial parks, however, may not be sufficient to catalyze growth. The challenge is to craft policies that induce foreign firms to train local workers to the point that the workers become capable of training others in new organizations. An interesting case in this regard is the way the government of Taiwan dealt with Singer, which received extensive incentives for setting up its facility in Taiwan but at the same time was forced to train local workers and those of its local suppliers (Ranis and Schive, 1985). It remains to be seen if such a carrot and stick approach would be effective in another industry or country.

The phenomenal success of the garment industry in historically such a dysfunctional economy as Bangladesh suggests that tacit knowledge seeding can be a powerful force for industrial development. Rhee and Belot's (1990) findings suggest that Bangladesh was hardly alone in developing a vibrant export-oriented industry from a single seed. Whether the seed catalyzed other industries they studied in the same way that tacit knowledge diffused in Bangladesh remains to be studied. Such a research undertaking has the promise of advancing our understanding of how seeds flower in different settings

[18] The example of Youngone, a Korean multinational, is instructive. In 1980, Youngone established a garment factory in Bangladesh by bringing in its own technicians and managers to lead its production. The training it provided to domestic workers was narrow and they assumed low level positions in the company. During the industry's formative years not a single worker from Youngone was hired away by other entrepreneurs to set up their factories.

and what it will take to advance the development of other LDCs without reengineering their entire societies. If an industrial miracle can be achieved in a country like Bangladesh, then there can be reasonable confidence that similar miracles can be created by planting seeds elsewhere.

References

Aitken, B. and A. Harrison (1999). "Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela." *American Economic Review 89*, 605-618.

Faaland, J. and J. Parkinson (1976). *Bangladesh: The Test Case of Development*, London, UK: C Hurst and Company.

Fagerberg, J. (1994). "Technology and International Differences in Growth Rates." *Journal of Economic Literature XXXII*, 1147-1175.

Grossman, G. M. and E. Helpman (1991). "Quality Ladders and Product Cycles." *Quarterly Journal of Economics 106,* 557-586.

Grossman, G. M. and E. Helpman. (1995). "Technology and trade." In *Handbook of International Economics Volume 3*, G. M. Grossman and K. Rogoff, eds., Amsterdam, Netherlands: North Holland.

Hausmann, R. and D. Rodrik (2003). "Economic Development as Self-Discovery." *Journal of Development Economics 72,* 603-633.

Javorcik, B. S. (2004). "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages." *American Economic Review 94*, 605-627.

Klepper, S. (2001). "Employee startups in high-tech industries." *Industrial and Corporate Change 10,* 639-674.

Krugman, P. (1979). "A Model of Innovation, Technology Transfer, and the World Distribution of Income." *Journal of Political Economy 87,* 253-266.

Mostafa, R. (2009). *Economic Growth One Industry at a Time: Entrepreneurship in the Bangladesh Garment Industry*. Unpublished Doctoral Dissertation, Carnegie Mellon University, Pittsburgh, PA.

Polanyi, M. (1966). *The Tacit Dimension*, New York, NY: Anchor Books.

Quddus, M. and S. Rashid (2000). *Entrepreneurs and Economic Development: The Remarkable Story of Garment Exports from Bangladesh,* Dhaka, Bangladesh: University Press limited.

Rana, P. (1997). "Reforms in Bangladesh: A Comparative Assessment in Relation to other South Asian Countries." In *The Bangladesh Economy in Transition*, M.G. Quibria, ed., Delhi, India: Oxford University Press.

Ranis, G. and C. Schive (1985). "Direct Foreign Investment in Taiwan's Development." In *Foreign Trade and Investment Economic Development in the Newly Industrializing Asian Countries*, W. Galenson, ed., Madison, WI: University of Wisconsin Press.

Rhee, Y. (1986). "Bangladesh: Export Policy and Administration." *World Bank Discussion Paper*, Washington, DC: World Bank.

Rhee, Y. and T. Belot (1990), "Export Catalysts in Low-Income Countries: A Review of Eleven Success Stories." *World Bank Discussion Paper*, Washington, DC: World Bank.

Romer, P. M. (1993). "Two Strategies for Economic Development: Using Ideas and Producing Ideas." In *The Strategic Management of Intellectual Capital*, D. A. Klein, ed., Woburn, MA: Butterworth-Heinemann.

Schott, P. K. (2004). "Across-Product versus Within-Product Specialization in International Trade." *Quarterly Journal of Economics* 119, 647-678.

Szulanski, G. (1996). "Exploring Internal Stickiness: Impediments to the Transfer of Best Practice within the Firm." *Strategic Management Journal 17*, 27-43.

Teece, D. J. (1986). "Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy." *Research Policy 15*, 285-305.

Winter, S. (1987). "Knowledge and Competence as Strategic Assets." In *The Competitive Challenge*, D. Teece, ed., Cambridge, MA: Ballinger Publishing.

Wooldridge, J. (2002). *Econometric Analysis of Cross Section and Panel Data*, Boston, MA: MIT Press.

Figure 1: Exports and Number of Garment Factories

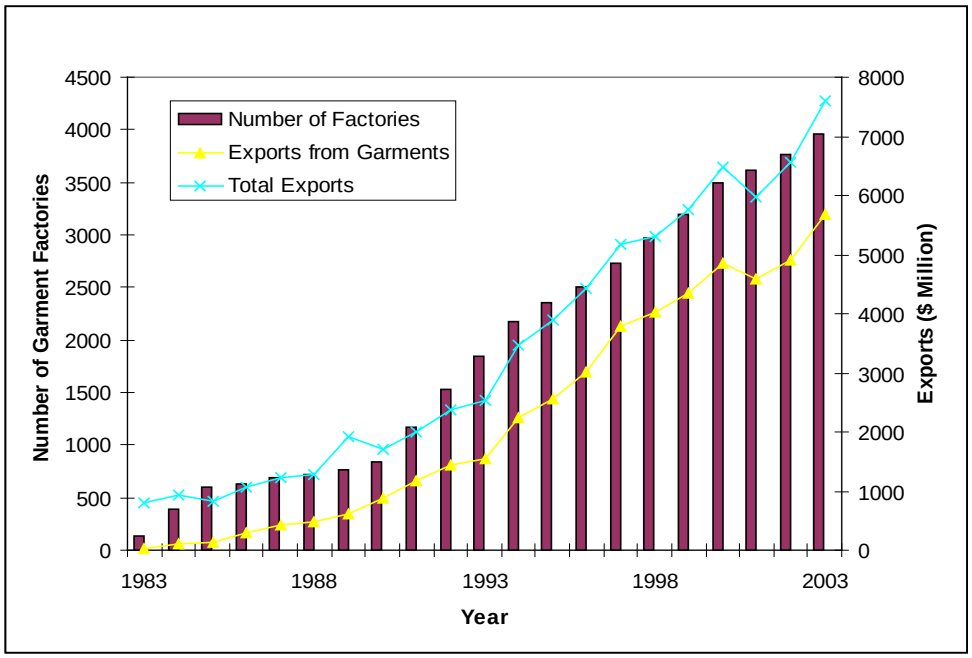


Figure 2: Gross Profit Functions and Premiums

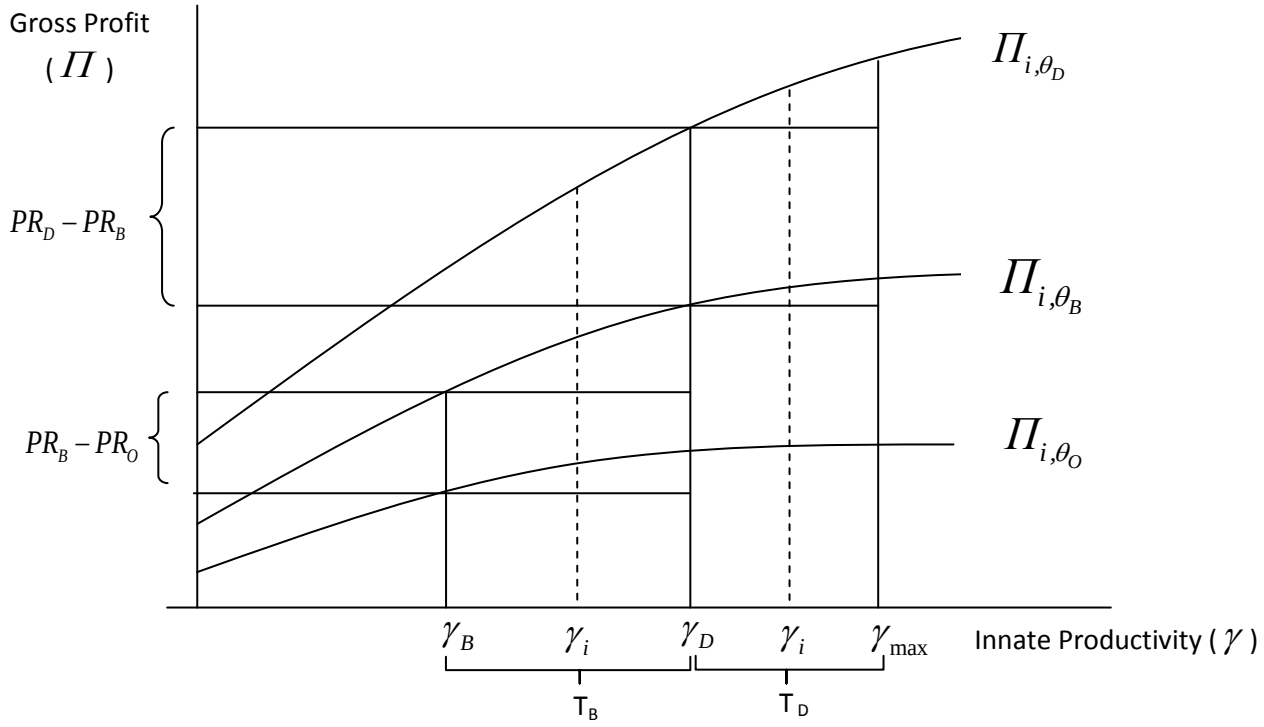
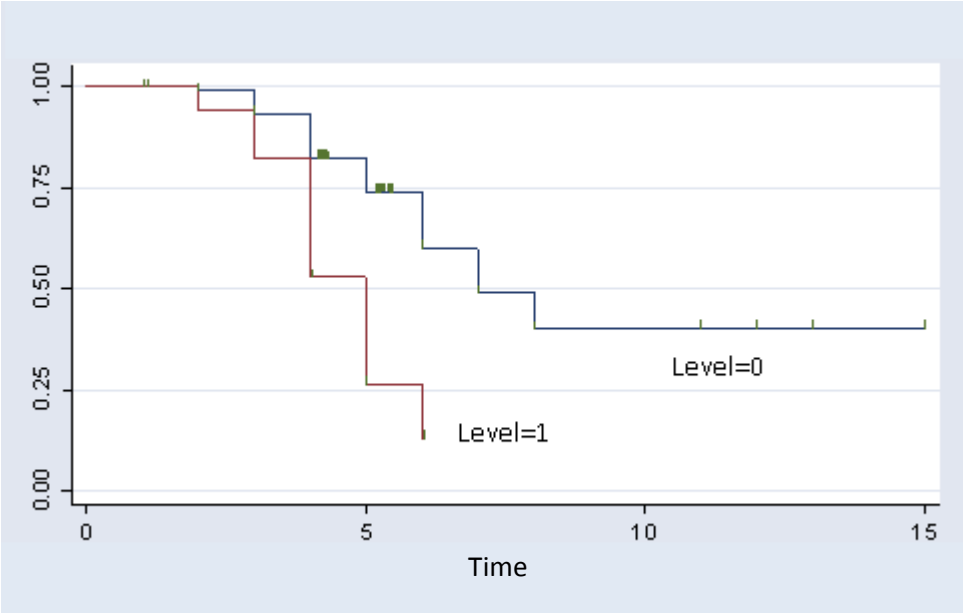


Figure 3: Kaplan-Meier Survival Estimates of Desh Set-up



Level = 0 for the Workforce and = 1 for Line Chiefs

Table 1: Descriptive Statistics of Firms that Entered the Industry by 1988

	Number	% of early entrants
All Firms	664	100
Background of Founders (472 identified, 71.08%)	Number identified	% of total identified
Diversifier	114	24.2
Spinoff	28	5.9
Foreign Investor	16	3.4
Inexperienced	314	66.5
Formal Education (391 identified, 58.9%)	Number identified	% of total identified
College	240	62.4
Engineer	38	9.7
Factory Set-up	Number	% of early entrants
Desh Set-up	59	8.9
Bond Set-up	18	2.7
Foreign Technician Set-up	69	10.4
Start Production as	Number	% of early entrants
Subcontractor	105	16.3
Subcontractor of Stylecraft	20	3.0
Initial Production Unknown	504	75.9
Exporter	55	8.3
Location (Chittagong)	118	17.8
Performance in 1995	Mean	Std. Dev.
Exports ($000)*	3,186	7,854
Machines	225	323
Employees	492	696
% exporting	51%	

**Dhaka firms only*

Table 2: Descriptive Statistics of Sweater Producers that Entered by 1994

	Number	%
All Firms	52	100
Background of Founders (47 identified, 90.4%)	Number identified	% of total identified
Diversifier	18	38.3
Spinoff	2	4.3
Foreign Investor	3	6.4
Inexperienced	24	51
Formal Education (48 identified, 92.3%)	Number identified	% of total identified
College	35	72.9
Engineer	3	6.3
Factory Set-up	Number	% of early entrants
Ex-CH Set-up	25	48.1
Foreign Technician Set-up	8	15.4
Sweater First Factory	38	73.1
Location (Chittagong)	7	13.5
Performance in 1995	Mean	Std. Dev.
Exports ($000)*	2,414	3,648
Machines	305	223
Employees	582	403
% exporting	84%	
Performance in 1996	Mean	Std. Dev.
Exports ($000)*	4,538	4,770
Machines	353	293
Employees	577	446
% exporting	96%	
Performance in 1997	Mean	Std. Dev.
Exports ($000)*	5,204	5,065
Machines	353	274
Employees	587	432
% exporting	91%	

**Dhaka firms only*

Table 3: Characteristics of Entrepreneurs that Hired Desh and Bond Set-up Workers

Probit Estimation		
	Desh	Bond
Location	1.00***	-0.73*
	(0.19)	(0.43)
Firm Age	0.16***	-0.11
	(0.05)	(0.08)
Diversifier	0.69***	0.43**
	(0.19)	(0.25)
Spinoff	0.004	---
	(0.38)	
Foreign Investor	-0.24	---
	(0.54)	
College	0.71***	0.52*
	(0.21)	(0.29)
Engineer	-0.58	-0.27
	(0.39)	(0.47)
Constant	-2.64***	-1.65***
	(0.30)	(0.37)
# Observation	384	348

**p<.10, **p<0.5, ***p<.01 ; Standard errors in parentheses*

Table 4: Analyses of Exports in 1995 of Early Entrants (Dhaka Firms only)

	Tobit Estimations		
	1	2	3
	($000)	($000)	($000)
Firm Age	497	202	-4
	(367)	(327)	(323)
Diversifier	6,244***	4,505***	5,260***
	(1,494)	(1,453)	(1,432)
Spinoff	5,664**	6,249**	5,517**
	(2,581)	(2,452)	(2,414)
Foreign Investor	881	724	2,186
	(3,928)	(3,773)	(3,664)
Unknown Experience	-1,640	-1,656	-974
	(1,811)	(1,714)	(1,685)
College	6,194***	3,874***	3,187**
	(1,464)	(1,451)	(1,428)
Engineer	1,510	3,444	3,355
	(2,252)	(2,160)	(2,112)
Unknown Education	-1,766	-1,467	-1,099
	(1856)	(1756)	(1730)
Desh Set-up		12,892***	11,149***
		(2,154)	(2,119)
Bond Set-up		6,417**	5,719**
		(2,697)	(2,622)
Foreign Technician Set-up		561	-551
		(1,860)	(1,843)
Subcontractor			-6,836***
			(2,087)
Subcontractor of Stylecraft			6,308**
			(2,832)
Initial Production Unknown			-7,902***
			(1,805)
Constant	-5,884***	-4,776***	2,780
	(1,758)	(1,684)	(2,374)
# of Observations	546	546	546

**p<.10, **p<0.05, ***p<.01; Standard errors in parentheses*

Table 5: Analyses of Number of Machines and Employees in 1995 of Early Entrants

	Employees		Machines	
	Tobit	IV-Tobit	Tobit	IV-Tobit
Firm Age	-1.33	2.17	1.45	1.74
	(37.60)	(39.28)	(17.05)	(18.09)
Diversifier	206.96	226.91	118.64**	120.18**
	(132.71)	(146.60)	(59.09)	(67.45)
Spinoff	438.01**	432.67**	173.97**	173.73*
	(217.15)	(218.01)	(104.49)	(104.61)
Foreign Investor	13.86	23.42	92.63	93.29
	(359.86)	(360.93)	(157.51)	(158.13)
College	168.44	180.32	93.56*	94.54
	(120.44)	(126.76)	(55.15)	(58.90)
Engineer	236.61	224.25	89.95	89.05
	(171.97)	(176.65)	(79.91)	(82.19)
Desh Set-up	877.51 ***	770.73**	381.88***	373.73**
	(150.69)	(374.96)	(69.71)	(186.25)
Bond Set-up	558.07*	518.54	129.59	127.37
	(256.50)	(319.79)	(132.38)	(140.47)
Foreign Technician Set-up	-68.8	-88.11	-44.74	-45.90
	(133.58)	(175.31)	(76.06)	(79.93)
Subcontractor	-514.30***	-528.09***	-251.87***	-252.48***
	(189.58)	(194.88)	(89.71)	(90.62)
Subcontractor of Stylecraft	164.23	172.10	120.79	121.95
	(290.57)	(291.94)	(131.65)	(133.95)
Initial Production Unknown	-708.21***	-727.13***	-326.67***	-327.57***
	(176.82)	(187.17)	(83.66)	(85.82)
Constant	724.75***	737.60***	333.56***	333.84***
	(257.35)	(206.84)	(118.54)	(118.69)
# Observation	256	256	274	274

*p<.10, **p<0.5, ***p<.01; Standard errors in parentheses*

Table 6: Hazard Analysis of Leaving Desh to Set up Production of Entrants

Cox Hazard Regression	
Employee College	0.71*
	(0.40)
Male	0.99**
	(0.60)
Employee Age	0.16
	(0.11)
Level	0.94***
	(0.35)
# Observation	108

**p<.10, **p<0.5, ***p<.01; Standard errors in parentheses*

Table 7: Characteristics of Entrepreneurs that Hired Cheung Heung Workers to Set up Their Sweater Production

Probit Estimation	
Firm Age	-0.09
	(0.19)
Sweater Factory Age	-0.70
	(0.43)
Sweater First Factory	-2.65
	(1.76)
Diversifier	1.60**
	(0.79)
College	1.17
	(0.76)
Engineer	-2.34
	(1.85)
Constant	3.07
	(2.33)
# Observation	35

**p<.10, **p<0.5, ***p<.01; Standard errors in parentheses*

Table 8: Performance Analyses of Sweater Firms in 1995, 1996, and 1997

	Tobit Estimations								
	1995			1996			1997		
	Export (000)	Employees	Machines	Export (000)	Employees	Machines	Export (000)	Employees	Machines
Firm Age	-819***	-34	-9	-764**	-89***	-51**	-534	-77***	-42**
	(255)	(25)	(14)	(294)	(28)	(20)	(366)	(27)	(18)
Sweater Factory Age	2,422***	150***	68***	1,520***	208***	112***	1,268**	199***	108***
	(461)	(38)	(22)	(458)	(42)	(29)	(569)	(41)	(27)
Sweater First Factory	737	53	45	-2,631	15	-69	-2,012	10	-88
	(1,549)	(125)	(72)	(1,561)	(135)	(94)	(1,944)	(139)	(93)
Diversifier	1,519	60	70	2,283*	120	116	2,073	74	99
	(1,093)	(115)	(64)	(1,350)	(120)	(84)	(1,707)	(124)	(83)
Spinoff	-727	-7	44	-1,319	31	21	-657,	35	93
	(2,022)	(210)	(120)	(2,554)	(237)	(165)	(3,175)	(245)	(164)
Foreign Investor	2,187	521***	276**	4,600*	512**	245	3,320	568**	332**
	(3,742)	(182)	(106)	(2,302)	(209)	(146)	(2,857)	(216)	(144)
Unknown Experience	728	15	62	1,509	127	155	2,544	32	34
	(2,280)	(227)	(133)	(2,779)	(216)	(150)	(3,501)	(221)	(147)
College	2,664*	10	-66	1,643	64	61	1,940	-14	-6
	(1,360)	(126)	(73)	(1,514)	(133)	(93)	(1,908)	(137)	(92)
Engineer	2,885	307	184	1,860	665**	338*	578	527*	330*
	(2,305)	(246)	(141)	(2,820)	(271)	(189)	(3,503)	(263)	(176)
Unknown Education	-30	33	-62	-103	71	75	-1,508	-41	-38
	(1,940)	(178)	(133)	(2,346)	(199)	(139)	(3,068)	(206)	(138)
Ex-CH Set-up	3,561***	422***	288***	4,389***	509**	344***	5,417***	473***	282***
	(1,174)	(118)	(69)	(1,360)	(134)	(93)	(1,713)	(135)	(91)
Foreign Technician Set-up	-7,241***	98	124	-4,389**	210	180	-3,278	-17	2
	(2,134)	(134)	(87)	(1,743)	(158)	(110)	(2,146)	(148)	(99)
Constant	-5,389***	-63	-60	1,337	-115	-43	566	35	76
	(2,509)	(187)	(110)	(2,220)	(209)	(145)	(2,796)	(213)	(142)
# Observation	45	39	39	45	44	44	45	46	46

**p<.10, **p<0.5, ***p<.01; Standard errors in parentheses*