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Abstract

While there is consensus that industrial development is imperative in developing countries to reduce poverty and to attain sustainable economic growth, there is no consensus on how to develop industries in developing countries. The emerging literature on cluster-based industrial development, based on successful cases in East Asia, empirically demonstrates that general human capital of a profit seeking entrepreneurs measured by his formal years of schooling, critically determines product upgrading and innovative activities, and, thus, the performance and growth of the industries. The present paper, using primary data, also empirically demonstrates that the application of modern production and marketing techniques is mainly a function of knowledge of an entrepreneurs measured by his years of schooling. Consequently, enterprises manage by relatively highly educated entrepreneurs tend to perform well and grow faster compared to others. Importantly, applying the instrumental variable estimation technique, present paper also demonstrates that the level of education of an entrepreneur is a positive function of the level of education and asset of his father. Based on the findings, present this paper argues that international donor agencies should invest on the accumulation of human capital in developing countries by investing on general education to untie the growth potentials of industries in developing countries.

Keywords: industrial cluster, engineering industry, human capital, Bangladesh

JEL Classifications R11 R12 L26 O24

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Introduction

Industrial development in developing countries is imperative to reduce poverty, and to attain sustainable economic growth (Lin and Chang, 2009; Hayami et al., 1998). This is because, the agriculture sector, which is the major employment provider in many of the developing countries, alone cannot create employment opportunities for a growing labor force. By contrast, enormous employment opportunities can be generated developing industries in developing countries, and, thus, a growing labor force can be absorbed into productive activities, which is instrumental to poverty alleviation and sustainable economic growth (e.g., Hayami et al., 1998, Hayami, 1998; Otsuka et al., 2009; Sonobe and Otsuka, 2006). Unfortunately, there is no consensus on how to develop industries in developing countries.

Since the seminal works of Schultz (1961, 1975), Becker (1964) and Welch (1970), the role of education on overall economic development has been widely tested and acknowledged by the economists (e.g., Romer, 1986, 1990; Lucas, 1988, 1993; Stokey, 1991; Mankiw, Romer and Weil, 1992). For example, Birdsall et al., (1995) and McMahon (1998) empirically demonstrate that rapid industrial and economic development in East Asian countries that contributed to the successful eradication of poverty, is attributed to investment on general education in the 1960s. Using a more direct and rigorous approach, Sonobe and Otsuka (2006) empirically demonstrate that the fundamental determinants of the successful industrial development in East Asian countries is the general education level of the entrepreneurs. It if found that the level of education of the entrepreneurs critically determines their product upgrading efforts, and, thus, the performance and growth of enterprises. Sonobe and Otsuka (2006, 2011). The findings suggest the provision of general education, and also basic managerial knowledge through training to the entrepreneurs in developing countries to facilitate rapid industrial development.

While there may be a little doubt on the role of entrepreneurs' education on firm performance and growth, ample evidence demonstrates that educational outcomes are often affected by family factors, such as parents education and income, in which, educated and wealthy parents tend to provide extra education to their children (e.g., Strauss and Thomas, 1995; Orazem and King, 2008; Barro and Lee 1996; Behrman and Deolalikar, 1988; Schultz, 1990). To our knowledge, very few empirical studies treat the level of education of entrepreneurs as endogenous while exploring the role of entrepreneurs' education on enterprise performance and growth. To strongly suggest investing on general education by the resource poor developing to develop industries to alleviate poverty rapidly, the issue should be examined more rigorously.

To examine the issue, the present study uses primary information collected from 95 entrepreneurs producing spare parts and machineries in Dhaka, the capital city of Bangladesh. Although there is no census, several studies mention that the light engineering industry in Bangladesh consists of 40,000 enterprises and 0.8 million workers, those are mostly concentrated in 20 districts headquarters in Bangladesh (MIDAS, 2008; SEDF, 2007, ITC, 2008). These 20 districts headquarters can be defined as engineering industry clusters in the sense of Sonobe and Otsuka (2006) that is, a collocation of enterprises in a same industry in small geographical areas. The clusters in Dhaka, Bogra and Chittagong districts are large compared to other districts, and the cluster in Dhaka is the largest in terms of the number of entrepreneurs, retail sellers, and raw material suppliers (e. g., MIDAS, 2008). It is mentioned that nearly 40 percent light engineering enterprises are located only in Dhaka (MIDAS, 2008; SEDF, 2007, ITC, 2008). The industry has been fulfilling country's 30 percent of total demand for spare parts and machinery worth US$ 79.7 million and rest 70 percent demand has been fulfilling through import (Rabbani, 2005). It is estimated that the contribution of the industry to GDP is 2.15 percent (SEDF, 2007). Recently, the industry has been exporting its engineering products, such as centrifugal water pumps and compressors to foreign markets (e.g., EPB, 2006-07). Realizing the potential contribution of the industry on overall economic development, the government of Bangladesh designated the industry as the light engineering industry, and declared it as a priority sector in the industrial policy 2003-2006 of Bangladesh (GOB, 2003).

We believe that this is a case worth investigating for two reasons. Firstly, well-developed engineering industries suppose to generate positive spillover effects on economies by facilitating the development of skilled manpower and technology absorption from abroad (e.g., Rosenberg, 1976; Mokyr, 1990, Stewart, 1982). Secondly, the metal works and engineering industries are ubiquitous in developing countries, and with few exceptions, almost all of these industries mainly produce low-quality import-substitute imitated products for domestic buyers, entrepreneurs are mostly less educated, the major channel of learning in the industry is the apprenticeship, and the major marketing method is waiting for customers at the workshop (e.g., Iddrisu, 2006; Sonobe et al., 2011; McCormick, 1999; Altenburg and Myer-Stammer, 1999). The striking similarities across the engineering industries in developing countries provide strong indication of the general applicability of policies that the present paper intends to suggest based on the case of Bangladesh.

The present study demonstrates a positive relationship between entrepreneurs' formal education, product upgrading efforts, enterprise performance and growth in term of the number of workers. The findings hold true even if we treat entrepreneurs' education as endogenous. The findings reminiscent the successful industrial development in China, Korea, Japan, and Vietnam articulated by Sonobe and Otsuka (2006, 2011) and Nam et al., (2009). The present paper thus urged to enhance investment on general education in developing countries to facilitate rapid industrial development to eradicate extreme poverty quickly.

Next section presents data sources and sampling. Analytical issues and hypotheses related to the role of entrepreneurs' education on enterprise performance and growth are presented Section 3. Section 4 presents descriptive analyses and model specification, and conclusion and policy implications are presented in Section 5.

2.0 Evolution and Expansion of the Engineering Industry in Bangladesh

The light engineering industry in Bangladesh, that started to develop in the 1950s, mainly produce crude machineries, spare parts, and provides repairing services to the formal industries and vehicle owners. The industry started to develop in the 1950s in Dhaka when mills and factories were developing rapidly in Dhaka and its suburb both

in public and private initiatives, such as the machine tools factory and the diesel engine plant in Dhaka in the public sector and "Adamjee jute mill" the largest jute mill in the world, in the private sector (Huq, et al., 1993). Later, the rapid expansion of the green-revolution in the late 1070s mainly to produce high-yielding variety of rice also enhanced the demand for spare parts and agriculture machineries, and thus contributed to the expansion of the light engineering industry in Bangladesh (Huq, et al., 1993). Moreover, the availability of steel, which is the major raw material of the engineering industry, from the ship breaking industry in Bangladesh, also contributed to the expansion of the industry recently. It is worth mentioning here is that Bangladesh is one of the largest scrap-ship purchasers in the world. According to Bangladesh Bureau of Statistics (2009) in 2007-08 the country imported US$ 266. 42 million of scrap ships (four digit HS code: 7204) to break into steel.

At present, Bangladesh's engineering industry consists of 40,000 entrepreneurs, in which nearly 40 percent of the total entrepreneurs are located in Dhaka (MIDAS, 2008; SEDF, 2007, ITC, 2008). The light engineering cluster in Dhaka is mainly located in Sutrapur and Lalbagh sub districts of Dhaka city. The area is popularly known as Old Dhaka, one of the most populous places in the world, and infamous for slow traffic and narrow roads. Recently, a number of entrepreneurs, mostly due to intolerable congestion in the old Dhaka, have relocated their plants to other less congested areas, while keeping head their offices in Old Dhaka.

The light engineering industry in Dhaka is consists of four types of entrepreneurs. The most traditional entrepreneurs are the blacksmiths, who provide necessary supports including heat treatment and surface treatment to increase the durability and strength of the products without using any sophisticated method instead by using experience. The second type entrepreneurs in the industry are the repairing workshop owners, who mainly provide repairing services to the private car owners, and other vehicles and industries. It is noted that Bangladesh is one of the largest markets for the Japanese reconditioned cars. In 2009, the country imported more than 37,000 reconditioned cars mostly from Japan (Bangladesh Business News, November 10, 2011). For spare parts and other services the reconditioned car owners mostly depend on repairing workshop owners in Dhaka. The third type of entrepreneurs in the industry is the foundry owners. They produce products made of iron casting. The

major foundry products are the centrifugal water pumps, liner, piston and piston rings for marine engines and diesel engines used for irrigation. The fourth type entrepreneurs in the industry are the machinists. Using lathe, shaper, drilling, grinding and milling machines, machinist make the raw-cast metal products into usable finished products. The entrepreneurs in the Dhaka light engineering industry, thus, enjoy the benefits of specialization and division of labor what Marshall (1920mentioned as one of the major benefits of industrial clusters.

It is found that a number of machinists are engaged into production of spare parts for sugar, jute, textiles, gas, power generation and railway industries, and also produce complete machineries, such as large gas woven for the food and beverage industry and the construction machineries, such as concrete mixers and stone crushers for the construction industry. Bangladesh Small and Cottage Industries Corporation (BSCIC) has identified a total of 3814 spare parts that are produced by the light engineering cluster in Dhaka (e.g., SEDF, 2007; MIDAS 2008). The entrepreneurs in the cluster however, are less educated and only few of them are formally trained. Most of the machines they use are age old second hand machine imported from India and Pakistan (e.g, SEDF, 2007). It is found that only 15 percent of the entrepreneurs use technical drawings and five percent use process sheets, and only a few entrepreneurs use jigs and fixtures (SEDF, 2007). Nonetheless, the effort to upgrading product quality is visible in the cluster. A few entrepreneurs are trying to produce high quality homogeneous products in a large quantity by employing computerized and numerically controlled (CNC) lathe machines and hiring designers and engineers from India to run CNC machines, as skilled manpower is seriously in scarce in Bangladesh to operate sophisticated machines. Recently, a few machinists have been successful in selling their products to the government and large private companies by competing with large importers, and even successful in exporting to foreign markets. For example, in 2005-06 Bangladesh exported US$ 15.15 million of machinery, including compressors and diesel engines (EPB, 2006-07). Due to its dynamic growth pattern, our study solely focuses on the spare parts and machinery producer in the Dhaka light-engineering cluster to examine the role of human capital on firm performance and growth.

2.1 Comparative Perspective: Human Capital and Enterprise Performance

Emerging literature on the cluster-based industrial development, based on a number of cases in Asian and African countries, argues that the majority of the enterprises in developing countries do not grow partly because of the congestion in the cluster, and partly because of the lack of entrepreneurial ability of managers (e.g., Sonobe et al., 2009, Sonobe and Otsuka, 2006, 2011). Such entrepreneurial ability is the function of general and specific knowledge, where general knowledge comes from formal education of the entrepreneurs, and specific knowledge may come from prior related experience, and also from learning by doing.

East Asian countries experience articulated by Sonobe and Otsuka (2006), however, vividly demonstrates that enterprises managed by relatively high educated entrepreneurs tend to grow successfully, as highly educated entrepreneurs can assess profitability more accurately, and thus can take calculative risks in the form of upgrading the product quality using the latest technology and improved quality raw materials and machine. It is also found that relatively highly educated entrepreneurs are also active to explore new marketing channels to sell their improved-quality products or establish own brand names to avoid asymmetric information problem that arise between buyers and sellers due to difficulties in examining the product quality (e. g., Sonobe et al., 2009, 2011; Sonobe and Otsuka, 2006; Iddrisu, 2006; Nam et al., 2009; Nam et al., 2010; Sonobe, Hu and Otsuka, 2004, 2006; Yamamura et al., 2005).

Most of the light engineering entrepreneurs in Dhaka provide repairing services to the industries and private vehicle owners. Only a few entrepreneurs produce and stock spare parts and complete machinery for future sell. Recently, a few entrepreneurs have been actively trying to produce high quality spare parts and machineries by using computerized and numerically controlled (CNC) lathe machines and hiring programmers and designers mainly from India to operate sophisticated machines. To maintain necessary strength and temper of their products, entrepreneurs also provide heat treatment and surface treatment to their products using sophisticated machine. Entrepreneurs also actively try to sell to public and large private companies as public or large private companies appreciate high quality products and pay relatively higher prices. Thus, the product upgrading efforts of the entrepreneurs might reward by higher sales revenue and profit. Thus, the entrepreneurs who adopt product upgrading

efforts may be able to employ more workers, earn higher sales revenue, and, eventually, grow faster compared to others. To ascertain the role of the formal education on product upgrading efforts, firm performance and growth, the following two hypotheses have been formulated:

H1. Relatively highly educated entrepreneurs are more likely to use computerized and numerically controlled machine to produce high quality homogeneous products, and provide heat treatment to their products using modern machine to maintain necessary strength and durability of the products.

H2. As rewards of producing high quality products using modern production methods, relatively highly educated entrepreneurs are more likely to be successful in receiving orders from public and large private companies and thus tend to receive higher sales revenue, employ more workers over the time.

3.0 Materials and Method

3.1 Data Sources and Sampling

As entrepreneur specific information is not available from secondary sources, we mostly rely on primary data collected through our own surveys. During the last week of September 2009, we conducted unstructured interviews with entrepreneurs, the Chairperson and executive members of the Light Engineering Owners' Association. After grasping the general situation in the light engineering cluster in Dhaka and consulting a few published materials by Bangladesh Bureau of Statistics (BBS), and Micro Industries Development Assistance and Services (MIDAS), we formed the above mentioned hypotheses, and conducted a formal survey during October-November, 2009, using a list containing the name of 153 entrepreneurs who mainly produce spare parts, and machineries in the Dhaka light engineering cluster. The list was prepared by the owners' association following our request. Out of 153 enlisted entrepreneurs, we randomly selected 100 entrepreneurs as our sample. Using a standard questionnaire we collected information on enterprise history, such as years of establishment , the number of major machines, workers, major marketing channels, main products, yearly sales revenue in 2005, 2008 and 2009, and age, prior

occupation and years of schooling of the entrepreneur. Due to incomplete information, we dropped five questionnaires from our sample. Thus, this present paper is based on information from 95 light engineering enterprises in Dhaka.

3.2 Background Attributes of the Entrepreneurs, Product Upgrading Efforts and Performance

Table 1 presents socio-economic background of the entrepreneurs. In Table 1 and in the subsequent tables, we divided the sample entrepreneurs into two groups: with having a father in the engineering industry either as worker, entrepreneur or trader, or with having a father in other sectors except the engineering industry. Table 1 shows that out of 95 entrepreneurs, a total of 20 of them are the second generation entrepreneurs in the sense that their father was in the same industry either as entrepreneurs, workers or traders. Table 1 shows that on average an entrepreneur is 44 years old with nine years of schooling, and have worked in the industry either as paid workers in others factories or unpaid workers in their family businesses for 12 years before starting their own enterprises, and operating their enterprises in the industry for nearly 18 years. Table 1 also presents information on entrepreneurs' father. It shows that more than 60 percent of entrepreneurs were born in Dhaka district where the capital city of Bangladesh is located, the average years of schooling of father of the entrepreneurs' is more than five years, and, on average entrepreneurs' father owned nearly 1800 square meter of land.

A closer scrutiny on Table 1 reveals the fact that the entrepreneurs having a father in the same industry are relatively young and better educated in term of average years of schooling compared to other entrepreneurs. Moreover, their fathers are also better educated in terms of years of schooling, and land rich compared to fathers of the other group of entrepreneurs. Sonobe and Otsuka (2006) articulated that in the East Asian case, the children of the pioneering entrepreneurs tend to me more educated, and in many cases, more educated sons of the pioneers adopted the product upgrading efforts and lead development of indusial clusters, in which clusters did not grow only because of the number of entrepreneurs, but also because of the improvement of product quality and the size of the enterprises. Similar to the findings of Sonobe and Otsuka (2006, 2011) we found that relatively highly educated second generation

entrepreneurs in the case of the light engineering cluster in Dhaka also are more likely to adopt product upgrading efforts and also are more likely to perform well. Table 2 presents the fact.

Table 2 presents information on major products, product upgrading efforts, and performance of the entrepreneurs. While most of the entrepreneurs in the cluster produce spare parts and repair machinery according to the order of their customers, Table 2 shows that 70 percent of the entrepreneurs, having a father in the engineering industry, produce complete machineries to add to their inventories for future sell. Whereas, only 41 percent of the entrepreneurs in the other group produce complete machineries. We consider an entrepreneur produces complete machineries if more than 50 percent of his sales revenue comes from selling the products from his inventory not sell by order. Table 2 further shows that a total of 80 percent of the entrepreneurs with a father in the industry produce machinery and spare parts for agriculture, textile, jute and power generation sectors, which are relatively vibrant and large sectors in Bangladesh. Agriculture machinery and spare parts mainly includes centrifugal pumps, pistons and piston rings for the irrigation and marine engines, crank-shafts for deep sea fishing trawlers, and other parts for marine engines. During our survey, we found that the Dhaka light engineering cluster supplies blister machine to the pharmaceutical industry, rubber sandal and shoe production machines to the Vairab shoe cluster in Narisigdi district, and concrete mixtures and stone crushers to the construction industry in Bangladesh. The demand for these machines is relatively high in Bangladesh. We were also informed by one of our interviewees that that Assam, a province in the Eastern part of India, also imports the Dhaka engineering cluster made stone crushers and concrete mixtures.

To produce machinery and spare parts in a batch to add to inventories for future sell, or to supply to large factories and industries in a large numbers, products should be homogeneous in size and durable. Selling to large private or public companies is more profitable as entrepreneurs can get stable work orders and can sell in a large volume. To produce homogenous machineries and parts in a large amount, entrepreneurs started using computerized and numerically controlled (CNC) lathe machines. Compared to manually controlled lathe machines, by using CNC machines, it is possible to produce homogeneous machineries and parts in a large amount, as a CNC

machine automatically produce machineries and parts following the design set by programmers and designers. Table 2 shows that only a few entrepreneurs are equipped with the CNC machine. During our interview, entrepreneurs informed us that due to the shortages of skilled programmers and designers and also due to high price of the machine, entrepreneurs hesitate to take the high risk of buying CNC machine. We found that a total of five entrepreneurs in our sample are equipped with CNC lathe machines, among which two of them bought second hand machine from Taiwan and rest bought second hand machine from India. We also found that one of our sample entrepreneurs, who is a second generation highly educated entrepreneurs, employed Indian designer and programmer to operate his CNC machine. He informed us that the designer and programmer are the graduates of Odisha engineering university, India, as such skilled technician is highly scarce in Bangladesh.

The produced long lasting durable machineries and parts products treat with sophisticated heat treatment machine. Also, there are some products that do not require heat treatment at all. Usually, most of the producers in the cluster send their products to blacksmiths if their products require heat treatment or surface treatment. We asked sampled entrepreneurs, whether their products require heat treatment, and if require, do they provide it using modern machine or not. Table 2 shows that 40 percent of the entrepreneurs, having a father in the engineering industry, provide heat treatment to their products if required, and only 24 percent of the entrepreneurs without having a father in the industry do so. Table 2 also shows that the entrepreneurs having a father in the industry also perform well in the sense that they are more likely to work as suppliers to large private or public companies, by which they can earn higher prices of their products that leads to earn higher sales revenue, and, thus, enable them to employ more workers.

In Table 3, we examined the growth performance of enterprises. As the information on sales revenue in the earlier period is not available as most of the entrepreneurs do not maintain their records, we rely only on the number of workers to see the growth trends of the enterprises. We calculate growth trends in the number of workers from 2005 as a base to 2009 of 89 entrepreneurs excluding six entrepreneurs who started their businesses later than 2005. Table 3 shows that out of 89 sample entrepreneurs, seven of them face negative growth rate that is, their total number of workers in 2009

was less than their total number of workers in 2005, and 37 entrepreneurs have not changed in terms of the number of workers from 2005 to 2009 and 47 of them have grown positively, in which 11 are the entrepreneurs with having a father in the engineering industry.

In Table 2 and 3, we demonstrate that the second generation entrepreneurs, who are also relatively highly educated, tend to adopt more product upgrading efforts, and employ more workers over the years. Importantly, they are also more likely to produce complete machineries, provide heat treatment to their products if necessary and successful in dealing with the large private and public companies, and their enterprises also grow positively in terms of the number of workers. Table 4 demonstrate that whether the production of complete machinery, and the product quality upgrading efforts, such as providing heat treat treatment contributes positively to enterprises performance. To check the issue, in Table 4 we divide the sample entrepreneurs in two groups: the first group consists of 54 entrepreneurs those who provide heat treatment to their products, as well as, produce complete machineries , and the second group consists of 41 other entrepreneurs who are not doing so. Table 4 shows that the entrepreneurs who provide heat treatment to their products, and produce complete machineries are more likely to be highly educated, they employ more workers, they earn higher sales revenue, they are more likely to deal with large private and public companies and employ more workers over the years compared to others. Table 4 further shows that the differences in the sample means are all statistically significant and positive. The findings in Table 4 together with Tables 2 and 3 provide support to Hypotheses 1 and 2.

4.0. Regression Analysis

4.1 Model Specification

The analysis in the previous section demonstrate that the entrepreneurs having a father in the same industry, tend to be relatively more educated, and they are also adopt product quality upgrading efforts, perform well, and their enterprises tend to grow over time in terms of the number of workers. To characterize the entrepreneurs who are more likely to produce complete machineries, provide heat treatment to their products, deal with large private or public companies, and perform well, we estimate

the following functions, showing the product quality upgrading efforts and performance are the direct function of the level of education of the entrepreneurs, on the other hand, the level of education of the entrepreneurs is determined by their fathers attributes:

$$SC_i = \beta_0 + (FA_i)\beta_i + \varphi_i(BD_i) + \varsigma_i \text{ ----------(1)}$$

$$Y_i = \alpha_0 + \delta_i(\overline{\overline{SC}_i}) + (ET_i)\phi_i + \alpha_1(OP_i) + \sum_{i=1}^{3}(PD_i)\lambda_i + \alpha_2(LOP) + \xi_i \text{ ------(2)}$$

where SC is the years of schooling of the entrepreneur, FA is a vector of variables that includes father's attributes, which are father's years of schooling, a dummy that assumes value 1 if father was in the same industry, and 0 otherwise, BD is a dummy that assumes value 1, if the entrepreneur was born in Dhaka district, or 0 otherwise, Y is a vector of dependent variables that includes size and performance indicators, which are the log of the sales revenue and the log of number of workers, a dummy that assumes value 1, if an entrepreneur produces complete machinery, or 0 otherwise, a dummy that assumes value 1, if an entrepreneur provides heat treatment to his products, or 0 otherwise, a dummy that assumes value 1, if an entrepreneur deals with large private or public companies, or 0 otherwise. In the right hand side of the equation (2), ET is a vector of variables that includes other characteristics of an entrepreneurs, such as age, years of prior experience before starting his present business, OP is the years of operation, PD is the dummies for products that assumes value 0, if the entrepreneur mainly produce mould for the plastic sector, assumes value 1 if produces mainly the agriculture machineries, assumes value 2 if produces machineries mainly for the construction, textile, and jute sectors, and assumes value 3 if produces fire extinguishers, locks and compressors, LOP is the land owned by father of the entrepreneur, β_0 and α_0 are the scalar parameters and β_i φ, δ_i, ϕ_i α_1, λ_I, α_2, are the parameters of interest and ς_i and ξ_i are the error terms with white noise property.

The data are available for year 2008 and 2009, and also employment data for year 2005, but the major exogenous variables such as, years of schooling, years of prior

experience and product dummies are time invariant. Essentially, we cannot use fixed effect model. Rather we apply the instrumental variable GMM estimation with cluster robust standard error corrected at the enterprise level as suggested by Wooldridge (2001) to get the efficient estimators using only one year information that is year 2009. We also apply OLS estimation process to check the robustness of our findings.

4.2 Estimation Results

In Table 5, column (1) presents the first stage OLS regression results that present the determinants of years of schooling of the entrepreneurs, columns (2) to (4) present the determinants of sales revenue, and columns (5) to (7) present the determinants of the number of workers employed by the entrepreneurs in 2009. The estimation results in column (1) in Table 5 indicates that the entrepreneurs' having a father in the same industry, and entrepreneurs having a father with more years of schooling, tend have higher years of schooling. Column (1) in Table 5 also shows that relatively new enterprises are more likely to be managed by the entrepreneurs with higher years of schooling, as the coefficient of years of operation in the function explaining entrepreneurs' years of schooling is negative and significant.

Columns (2) to (7) in Table 5 present the determinants of firm size measured by sales revenue and the number of workers. In the case of column (2) that presents the determinants of sales revenue, and column (5) that presents the determinants of the number of workers, we include all of the possible exogenous variable in the model, whereas in column (3) and in column (6) we omit some of the exogenous variables from the model, such as fathers years of schooling, a dummy for father in the same industry, and a birth district is Dhaka dummy to check the sensitivity of the findings. Finally, in column (4) that presents the determinants of sales revenue and in column (7) that presents the determinants of the number of workers, we presents instrumental variable estimation results, in which we treat years of schooling of the entrepreneurs as endogenous, and use fathers' years of schooling, same industry dummy and Dhaka birth district dummy as instruments. In every case, our results demonstrate that entrepreneur's schooling significantly and positively determines his firm size, as

entrepreneurs with relatively higher years of schooling tend to earn higher sales revenue and employ more workers.

Table 6 presents the determinants of product upgrading efforts and selling to large private and public companies. Similar to the findings in Table 5, it shows that entrepreneurs' years of schooling is positive and significant across the estimated functions explaining their production of complete machinery, heat treatment to their products and sell to large private and public companies. Thus, the findings in Table 5 and 6 confirms that relatively highly educated entrepreneurs are more likely to perform well in the sense that they earn higher sales revenue, and, this is because relatively highly educated entrepreneurs are more likely produce high quality complete products by using modern techniques, and to earn higher prices of their products by selling to quality conscious buyer, such as large private or public companies who appreciate high quality products and buy in a large number.

Table 7 presents the determinants of firm growth approximated by taking the differences between the log number of workers in 2009 and the log number of workers in 2005. In addition to the variables that we already explained in the case of Table 5 and 6, we include the log of total number of workers in 2005 as an additional explanatory variable in estimating the function explaining firm growth in Table 7, to capture the effect of initial size of the firms. The estimated functions explaining firm growth in Table 7 show that education of the entrepreneurs positively related with increase in the number of workers during the sample period. Thus, enterprises run by relatively highly educated entrepreneurs are more likely to grow over the years compared to others. Unfortunately, in column (6) of Table 7, the coefficient of the years of schooling that we treat as endogenous is positive but not statistically significant. This is probably because of the weak explanation power of the instruments that is presented by the R squared in the first stage regression that states that the present explanatory variables can explain even less than 50 percent of the years of schooling attainment of the entrepreneurs.

One important finding is that the coefficient of land owned by father is positive and highly significant across the estimated functions explaining firm size in Table 5 and firm growth in Table 7, however mostly insignificant in the estimated functions

explaining product upgrading efforts and selling to large private and public companies in Table 6. The finding is plausible in the sense that land inherited from the parents can be used as collateral for bank loan or can be sold out to finance big investment, such as investment for CNC lathe machine. Among other important variables, the coefficient of years of operating the present business, and years of prior experience related to engineering industry are mostly insignificant in Table 5 to 7. Engineering products are the special kind of products, where buyers pay more attention on the quality of a product rather than the price (Pack, 1981). Probably, in producing high quality engineering products, general knowledge that comes from formal years of schooling is more important compared to knowledge from learning by doing and prior experience that mostly enhance imitation capabilities rather than innovation ability. All of the product dummies, in which the default product was mould and dice products, are found insignificant and in some cases negative across the estimated functions in Table 5 and 6. Table 7, however, demonstrates that the entrepreneurs producing agriculture, construction, jute and power generation machineries tend to grow positively compared to the entrepreneurs producing mould for plastic industry.

5. Conclusion and Policy Implications

While poverty-stricken developing countries usually face severe financial constraints to meet their development demand, Schultz (1961, 1975) suggests investing on general education by the governments in developing countries to remove extreme poverty quickly arguing that education enhances general human capital accumulation that facilitates faster economic growth. Emerging literature on cluster-based industrial development empirically demonstrates that education enhances the managerial ability of the entrepreneurs, thus relatively highly educated entrepreneur tend to adopt product quality upgrading initiatives and tend to perform better, and, thus, create more employment opportunities. Thus, the argument to invest on education in developing countries to develop industries rapidly to reduce poverty has been strengthening day by day.

Using primary information collected from 95 machinery and spare parts produces in the Dhaka light-engineering cluster in Bangladesh, this present paper also demonstrates that relatively highly educated entrepreneurs in Dhaka light-engineering

cluster are more likely to adopt product upgrading initiatives. While majority of the entrepreneurs in the cluster produce spare parts based on orders by the customer, and provide repairing services to the vehicle owners and industries, relatively highly educated entrepreneurs produce complete machineries to add to their inventories for future sell. Importantly, to produce high quality, durable and homogeneous products, relatively highly educated entrepreneurs are also more likely to use sophisticated machineries, such as CNC lathe machine and provide heat treatment to the their products to enhance durability and strength of the products. It is also found that relatively highly educated entrepreneurs are more likely to sell to large private or public companies, which appreciate high quality products and pay higher prices and buy a large number in a single deal. Consequently, relatively highly educated entrepreneurs earn higher sales revenue, employ more workers and their enterprises grow bigger over time. The findings hold true even under the assumption that the schooling attainment of the entrepreneurs is endogenous that is determined by father's education and occupation.

To achieve rapid industrial development in developing countries to alleviate poverty quickly, the present paper also suggest investing on general education in developing countries that will enhance general human capital and managerial knowledge of the people. Importantly, there are a numerous entrepreneurs in developing countries who cannot come back to school anymore. To enhance managerial capability, a need-based managerial training can be provided to the existing entrepreneurs in developing countries. Development partners of the developing countries can work together with governments of developing countries to identify the potential sectors, and selecting the trainee entrepreneurs under the assumption that the total social cost of conducting such training programme will be lower than the net social benefit.

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Table-1: Background Information on the Sample Entrepreneur by the Type of the Entrepreneur in 2009 (per entrepreneur average)

	Overall	Father was not in the same industry	Father was in the same industry
No. of Entrepreneurs	95	75	20
Age	44.39	45.1	41.7
Years of schooling	8.96	8.1	12.2
Years of prior related experience	11.73	12.1	10.2
Years of operation under current manager	17.20	16.9	18.3
Percentage born in Dhaka	63.2	60.0	75.0
Father's years of schooling	5.27	4.6	8.0
Land owned by father (in square meter)	1796.55	1600.4	2532.2

Source: Survey 2009

Table-2: Firm Size, Product types and the Use of Modern Production Techniques and Marketing Channel by the Type of the Entrepreneurs in 2009 (per enterprise average)

	Overall	Father was not in the same industry	Father was in the same industry
% Produce complete machinery	47.4	41.0	70.0
% produce mould for plastic industry	20.0	24.0	5.0
% Produce agriculture machinery	31.6	29.3	40.0
% Produce construction, textile, jute, power generation machineries (yes=1)	37.9	37.3	40.0
% Produce fire extinguisher, lock and compressors	10.5	9.3	15.0
% Own a CNC lathe machine	5.30	4.0	10.0
% Provide heat treatment when it requires	27.4	24.0	40.0
% Deal with public or private company	34.7	31.0	50.0
Sales revenue (million BDT)	3.58	2.70	6.87
No. of workers	13.52	10.23	25.85

Source: Survey 2009

Table 3: Information on Employment Growth from 2005 to 2009

Status of Employment growth	Overall	Father was not in the same industry	Father was in the same industry
Negative growth rate	7	5	2
No change	37	29	6
Positive growth rate	47	36	11
Started later than 2005	6	5	1
Total	95	75	20

Table 4: Differences in the Schooling and Performance based on Product Quality Upgrading Efforts in 2009

	Provide heat treatment, and produce complete machineries	Others	Differences in mean values [a] and corresponding t-values [b]
No. of entrepreneurs	54	41	
Years of schooling	10.9	7.49	2.60*** (4.07)
Sales revenue (million BDT)	5.10	1.57	3.53*** (2.65)
No. of workers	18.56	6.88	11.68*** (3.57)
% Deal with public or private company	53.7	9.8	43.9*** (4.95)

a. Difference= Mean (A) – Mean (B)

b. H0: Diff=0 , Ha: Diff>0 (one sided t-test), ***, ** and * indicate the 1, 5, and 10 percent levels of significance, respectively

Table 5: The Determinants of Schooling of the Entrepreneurs and Firm Size

Estimation method	First Stage OLS	OLS	OLS	IVGMM	OLS	OLS	IVGMM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable	Schooling	ln(Sales revenue)			ln(No. of workers)		
Years of schooling		0.10**	0.11**	0.11*	0.06*	0.08***	0.10**
		(2.33)	(2.62)	(1.74)	(1.71)	(2.88)	(2.08)
Age	0.10**	0.01	-0.001	0.01	0.02	0.01	0.01
	(2.08)	(0.20)	(-0.01)	(0.33)	(1.05)	(0.55)	(0.87)
Years of prior working	-0.10**	0.001	0.01	0.002	0.01	0.02	0.02
experience	(-2.28)	(0.03)	(0.28)	(0.11)	(0.61)	(1.19)	(1.22)
Years of operation under current	-0.11**	0.03	0.03*	0.03*	-0.002	0.01	0.01
manger	(-2.26)	(1.44)	(1.74)	(1.69)	(-0.11)	(0.61)	(0.72)
Agro machinery product dummy	-0.07	0.01	0.03	0.04	0.13	0.20	0.12
(yes=1)	(-0.08)	(0.04)	(0.12)	(0.15)	(0.53)	(0.82)	(0.47)
Construction, textile, jute, power	-0.23	0.13	0.12	0.12	-0.13	-0.11	-0.14
generation product dummy	(-0.30)	(0.49)	(0.45)	(0.49)	(-0.62)	(-0.50)	(-0.64)
(yes=1)							
Fire extinguisher, lock and	-1.56	0.14	0.12	0.15	-0.33	-0.28	-0.37
compressor dummy (yes=1)	(-1.42)	(0.40)	(0.39)	(0.49)	(-1.16)	(-0.93)	(-1.32)
Land owned by father	0.002	0.002***	0.002***	0.002***	0.002**	0.002**	0.002***
	(1.24)	(2.70)	(2.88)	(3.05)	(2.46)	(2.43)	(2.66)
Entrepreneur was born in Dhaka	0.55	0.12			0.20		
(yes=1)	(0.88)	(0.43)			(1.00)		
Dummy for father in the same	3.50***	0.17			0.38		
industry (yes=1)	(4.40)	(0.41)			(1.10)		
Fathers years of schooling	0.24***	-0.02			-0.01		
	(3.57)	(-0.52)			(-0.45)		
Constant	5.33	12.5***	12.6***	12.4***	0.65	0.729	0.436
	3.09	(16.26)	(18.05)	(16.15)	(1.18)	(1.49)	(0.67)
Number of enterprises	95	95	95	95	95	95	95
R-squared	0.46	0.22	0.22		0.25	0.22	
First stage F	6.89						
Anderson canon. corr. LR	46.06						
statistic (identification/IV	(0.00)						
relevance test) $\chi^2(3)$ *P-val*							
Hansen J statistic				0.56			2.31
(overidentification test of all				(0.76)			(0.31)
instruments): $\chi^2(2)$ *P-val*							

Note: Numbers in parentheses are t/z-statistics calculated based on White standard errors robust to heteroskedasticity. *, ** and *** indicate 10%, 5% and 1% levels of statistical significance, respectively.

In the Instrumental Variable GMM estimation, I instrumented years of schooling of the entrepreneur. The instruments are: father's years of schooling, a dummy for father in the same business, and a dummy for entrepreneur were born in Dhaka.

Table 6: The Determinants of Product Upgrading Efforts and Marketing

Estimation method	OLS	OLS	IVGMM	OLS	OLS	IVGMM	OLS	OLS	IVGMM
	(1)	(2)	(3)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Producing complete machinery (yes=1_			Provide heat treatment when necessary (yes=1)			Deal with large private of public company (yes=1)		
Years of schooling	0.10***	0.10***	0.10**	0.03*	0.04***	0.05**	0.10***	0.06***	0.04*
	(3.17)	(3.88)	(2.33)	(1.80)	(3.01)	(2.14)	(3.74)	(4.18)	(1.81)
Age	0.01	0.01	0.01	0.01	0.01	0.01	-0.001	0.003	0.003
	(0.78)	(0.65)	(0.82)	(0.96)	(0.67)	(0.66)	(-0.00)	(0.54)	(0.53)
Years of prior working experience	-0.01	-0.002	-0.003	0.01	0.01	0.01	0.01	0.002	-0.001
	(-0.59)	(-0.30)	(-0.47)	(0.64)	(0.95)	(1.16)	(0.43)	(0.24)	(-0.12)
Years of operation under current manger	0.01	0.01	0.01	0.001	0.01	0.01	0.01	0.01	0.01
	(0.65)	(0.99)	(0.97)	(0.10)	(0.60)	(0.88)	(1.34)	(0.83)	(0.79)
Agro machinery product dummy (yes=1)	-0.03	-0.02	-0.02	-0.18	-0.16	-0.18	-0.001	-0.02	-0.03
	(-0.19)	(-0.15)	(-0.14)	(-1.33)	(-1.20)	(-1.45)	(-0.01)	(-0.15)	(-0.22)
Construction, textile, jute, power generation product dummy (yes=1)	0.16	0.15	0.15	-0.17	-0.16	-0.17	-0.02	-0.03	-0.03
	(1.22)	(1.20)	(1.24)	(-1.38)	(-1.37)	(-1.45)	(-0.14)	(-0.22)	(-0.27)
Fire extinguisher, lock and compressor dummy (yes=1)	0.14	0.13	0.13	-0.38***	-0.37***	-0.37***	0.21	0.19	0.17
	(0.91)	(0.84)	(0.84)	(-3.13)	(-3.33)	(-3.40)	(1.06)	(1.05)	(1.00)
Land owned by father	0.0001	0.0002	0.0002	0.001***	0.001**	0.001***	-0.001	-0.001	-0.001
	(0.37)	(0.44)	(0.46)	(2.73)	(2.62)	(2.58)	(-0.35)	(-0.17)	(-0.08)
Entrepreneur was born in Dhaka (yes=1)	0.04			0.10	-0.30		-0.10		
	(0.34)			(0.82)	(-1.36)		(-0.94)		
Dummy for father in the same industry (yes=1)	0.08			0.07			-0.05		
	(0.57)			(0.46)			(-0.34)		
Fathers years of schooling	-0.01			0.002			-0.01		
	(-0.95)			(0.13)			(-0.54)		
Constant	-0.34	-0.34	-0.33	-0.33		-0.40	-0.33	-0.41*	-0.24
	(-1.32)	(-1.44)	(-1.18)	(-1.56)		(-1.47)	(-1.34)	(-1.68)	(-0.82)
Number of enterprises	95	95	95	95	95	95	95	95	95
R-squared	0.22	0.23		0.21			0.20	0.18	
Hansen J statistic (overidentification test of all instruments): χ^2(2) P-val			1.30 0.52			0.60 0.74			0.81 0.67

Note: Numbers in parentheses are t/z-statistics calculated based on White standard errors robust to heteroskedasticity. *, ** and *** indicate 10%, 5% and 1% levels of statistical significance, respectively.

Table 7: The Determinants of Firm Growth

	OLS	OLS	OLS	OLS	IVGMM
	(1)	(2)	(3)	(4)	(5)
	ln(worker 2009)- ln(worker 2005)				
lntw2005	0.01	0.01	-0.02	-0.03	-0.01
	(0.19)	(0.21)	(-0.37)	(-0.63)	(-0.18)
Years of schooling	0.05**	0.04**	0.03*	0.03*	0.003
	(2.12)	(1.99)	(1.88)	(1.72)	(0.13)
Age	-0.01	-0.01	-0.01	-0.004	-0.001
	(-1.19)	(-1.19)	(-0.68)	(-0.50)	(-0.09)
Years of prior working experience	0.01	0.012	0.01	0.01	0.003
	(1.61)	(1.65)	(1.43)	(1.06)	(0.57)
Years of operation under current manger	0.01	0.01	0.003	-0.0001	-0.01
	(0.82)	(0.79)	(0.38)	(-0.02)	(-0.58)
Agro machinery product dummy (yes=1)	0.29**	0.29**	0.26*	0.25*	0.28**
	(2.08)	(2.07)	(1.95)	(1.89)	(2.20)
Construction, textile, jute, power generation product dummy (yes=1)	0.28**	0.27**	0.23*	0.23*	0.28**
	(2.10)	(2.08)	(1.80)	(1.80)	(2.44)
Fire extinguisher, lock and compressor dummy (yes=1)	0.08	0.06	-0.01	-0.004	-0.02
	(0.47)	(0.34)	(-0.08)	(-0.03)	(-0.13)
Land owned by father	0.001	0.001*	0.001*	0.001**	0.001**
	(1.58)	(1.71)	(1.81)	(2.08)	(2.14)
Entrepreneur was born in Dhaka (yes=1)	-0.14	-0.13	-0.12		
	(-1.24)	(-1.25)	(-1.01)		
Dummy for father in the same industry (yes=1)	-0.21	-0.21			
	(-1.15)	(-1.16)			
Fathers years of schooling	-0.01				
	(-0.57)				
Constant	-0.10	-0.11	-0.06	-0.12	-0.01
	(-0.27)	(-0.30)	(-0.19)	(-0.38)	(-0.03)
Number of enterprises	89	89	89	89	89
R-squared	0.24	0.23	0.21	0.19	
Hansen J statistic					1.68
(overidentification test of all instruments): χ^2(2) P-val					0.43

Note: Numbers in parentheses are t/z-statistics calculated based on White standard errors robust to heteroskedasticity. *, ** and *** indicate 10%, 5% and 1% levels of statistical significance, respectively. In the Instrumental Variable GMM estimation, I instrumented years of schooling of the entrepreneur. The instruments are: father's years of schooling, a dummy for father in the same business, and a dummy for entrepreneur were born in Dhaka.