Very preliminary

Competitiveness of a Labor-Intensive Industry in a Least Developed Country: A Case of the Knitwear Industry in Bangladesh*

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Abstract

For some low-income countries exportation of labor-intensively manufactured goods has been a hope for economic growth and poverty reduction. A good example is the knitwear industry in Bangladesh. This is a study on such a growing manufacturing industry with firm-level data collected by the authors in 2001. Conclusions are the followings. First, the knitwear industry in Bangladesh contributes to poverty reduction by providing entry-level workers with a great scale of employment opportunities and earnings higher than the national poverty line. Second, the average profitability of the knitwear producing firms is very high. Third, such a dynamic development of the industry entailed great diversity in efficiency even in comparison with the garment industry of other developing countries. Fourth, there is no evidence found supporting positive impacts on competitiveness through industrial upgrading in terms of usage of expensive machines and vertical integration and industrial agglomeration.

Key words: profitability, productivity, knitwear, poverty reduction, Bangladesh, stochastic frontier analysis

JEL classifications: D24, J31, L67, O14, and O53

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1. Introduction

For some low income countries, export of labor intensive manufactures provides the scope for economic growth and poverty reduction (Sachs [2005], UNIDO [forthcoming], World Bank [1990]).

Bangladesh, which is an LDC, has succeeded in developing its export-oriented labor intensive garment industry during the past two decades. This growth was facilitated by the controlled trade regime under the Multi-fiber Arrangement (MFA), which came into effect in 1973. As per WTO Agreement on Textiles and Clothing (ATC), the MFA has been phased out and there has been complete liberalization of trade in textiles and clothing as of January 1, 2005. As a result of this, there was a deep concern whether the garments industry in Bangladesh would be able to survive after the MFA phase out.[1] The concern was all the more serious given the fact that export of garments now accounts for nearly three fourth of total export earnings of Bangladesh.

Fortunately, however, the industry seems to have been successful in withstanding the onslaught of competition. While some garment exporting LDCs such as Nepal and Lesotho have experienced decline in garments-export, Bangladesh along with other LDCs such as Cambodia and Haiti seem to have performed well with double-digit growth in the export of garments to the United States since the phasing out of MFA.

What explains the performance of the garments industry in Bangladesh? What are the sources of its competitive strength? How is the structure of the industry linked to productivity differentials within the industry?

Answers to these questions have been sought in the present paper by focusing on the knitwear industry in Bangladesh, which is an important component of the garment industry in the country.

Initially, woven garments got developed in Bangladesh whose upstream process involves spinning and weaving. Production of knitwear for exports started much later but it grew rapidly. Excluding sweaters and socks, the major output of knitwear industry involves two processes, namely, knitting fabric and making knitwear with this fabric using sewing machine. Production of knit fabric expanded rapidly in Bangladesh triggered by EU's stricter rules of origin requiring greater backward linkage for its Generalized System of Preference (GSP) facility.

The paper is organized in the following manner. After the introductory remarks,

[1] Nordås [2004] was the most cited study of forecast of the world textiles and garments trade after the MFA phase out. The study stated that only China would increase the share of world export in textiles and garments followed by India, and that other garment-exporting countries would reduce the share.

Section 2 provides an overview of the knitwear industry in Bangladesh using published national level data as well as data collected through field survey. In particular, Section 2 examines data on labor wages and analyses the determinants and the implication of the wage structure from the perspective of poverty reduction. Section 3 introduces the analytical model for examining profitability and productivity in the industry, while Section 4 presents the empirical analysis along with the results. The final Section presents the conclusions.

2. Overview of the knitwear industry in Bangladesh

2.1. Development of the knitwear industry

Woven garments and knitwear are two major components of wearing apparels. In the Bengali area as well as other parts of South Asia, most of traditional wearing apparels are made of fabrics woven by handlooms (Iftikhar-ul-Awwal [1982], Latif [1997]). Thus, production of knitwear was minor till the 1980s. A symptom of surge in export-oriented knitwear production, which was mainly oriented to the EU, was seen in the middle of 1990s (Dr. Martelli Associates [1999], pp. 79-87).

Bangladesh and the EU had been signatories of the Multi-Fibre Agreement (MFA) since 1973, under which the EU might impose quantitative import restriction on textile and apparels exported from Bangladesh (Dr. Martelli Associates [1999], pp. 123-129, and Annex I, Islam [2001], pp. 25-28). However, the EU did not negotiate the bilateral textile agreement with Bangladesh by 1986, because of small scale of textile and apparel imports from Bangladesh and Bangladesh's the Least Developed Country (LDC) status. Recognizing expansion in garment imports from Bangladesh, the EU proceeded to conclusion of the bilateral agreement, and the agreement came into effect in the end of 1994. The agreement was accompanied with the "rules of origin" for apparel imports into the EU to entertain import tariff exemption based on the Generalized System of Preferences (GSP), which entered into force on 1 January 1995. The rules of origin for GSP necessitated upstream processes of making garments to be undertaken in Bangladesh, so that it was felt that backward linkages from the most downstream process of making garments to upstream processes such as knitting and weaving fabrics and spinning yarn should be established inside Bangladesh. Entrepreneurs dealing in export-oriented knitwear realized that they should unite and address common agendas collectively, and formed the Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA)[2] in 1996.

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[2] The Bangladesh Garment Manufacturers and Exporters Association (BGMEA), which was

At least partly due to the unison of knitwear manufacturers, the change in the institutional framework between Bangladesh and the EU did not seem to dampen the export drive of knitwear production in Bangladesh. The annual growth rates in value of knitwear exports have recorded two-digit figures since 1996 up to the present except the fiscal year 2001-02 while the September 11 incidence took place (Table 1).

It is noteworthy that knitwear production seems more standardized than that of woven garments in Bangladesh so that market power is not a great issue when productivity is estimated. Except for sweater and socks[3], basic production processes to make knitwear from a yarn are twofold: knitting fabrics with yarns, and making garments with fabrics by sewing machines. Basic technology for sewing is almost the same for knitwear and woven garments. On the other hand, production technology for weaving fabrics varies from handloom through jet loom and rapier loom, while that for knitting fabrics is basically unique if sweater and socks production is ruled out. That is, a circular knitting machine produces a tube-like fabric continuously. The only apparent difference in technology for knitting fabrics is whether low-price and relatively small Indian machines or high-price and sophisticated machines made in East Asia are used. Therefore, it seems easier for knitwear to control technology effect and to single out non-technology firm effect from variation in productivity than for woven garments. This is another reason why knitwear production was selected for this case study.

2.2. Facts from the data collected

Features of the data

The export-oriented garment industry is one of the most important leading industry in Bangladesh in terms of export and employment opportunities for female workers without high educational background in the formal sector. Therefore, the industry attracts attention of the public in the country and has been studied intensively. Many good reviews were published (Ahmed [2002], Bhattacharya and Rahman [2001, 2002], Dr. Martelli Associates [1999], Islam [2001], Nadvi [2003], Quddus and Rashid [2000], Siddiqi [2004] among others), and quite a few field surveys were conducted by interviewing garment workers (see Afsar [2001], Hewett and Amin [2001], Hoque, Murayama and Rahman [1995], Kabeer and Mahmud [2004], Paul-Majumder [2003], and Zohir and Paul-Majumder [1996] among others). On the other hand, a relatively small number of studies have analyzed the production side of the industry. Some of them scrutinized a limited number of firms deeply, while some others used

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established in 1977, is the greatest industrial association for garment manufacturers and exporters dealing in both woven and knit garments in Bangladesh.

[3] A sweater and socks are produced with flat knitting machines and socks knitting machines directly from yarns.

published data such as those collected by the government for the *Census of Manufacturing Industries* (Salim [1999]), or those kept by the Bangladesh Garment Manufacturers and Exporters Association (BGMEA). In addition, there are some studies based on original data collected with tailor-made questionnaires (Hassan [2000], Kee [2005], Project Promotion and Management Associates [2000], Quddus and Rashid [2000], Zohir [2003]). However, most of those data have small sample sizes which do not fit statistical analyses as long as the knitwear industry is concerned. An important exception is Kee [2005], which estimates production function of the garment industry and found that firms with foreign capital are more productive on average.[4]

The purpose of our research is very close to that of Kee [2005]. However, our data set offers important and different information from that of Kee [2005], such as information on wage profile, level of profits, price of machinery, and characteristics of decision makers of sample firms. We collected 232 firm samples from 587 BKMEA member firms for July-October 2001. The details of data are given in Appendix 1 with the questionnaire used for the survey in Appendix 3.

Production and capital

The data set reveals main features of the knitwear industry in Bangladesh. It mainly reflects those of firms located in the principal center of knitwear production, Narayanganj District.

First, present export-oriented garment production in Bangladesh is led by local firms, even though in the beginning of the industry the business was led by foreign direct investments (Rhee [1990]). Moreover, the majority of export-oriented firms are located outside Export Processing Zones (EPZs). In fact, our data set contains only two sample firms located in the Dhaka EPZ, and both of them are 100% foreign-owned. Thus, this export-oriented business is not conducted in the "enclave" from the main body of the Bangladeshi economy. Rather, it involves a spectrum of people from illiterate workers through highly educated managers.

Among garment-producing firms, those producing knitwear tend to be established recently. More than a half of sample firms started knitwear production within five years. However, knitwear producing firms employ a large number of workers. The average number of workers is 245 persons, while the biggest firm employs 1772 workers.

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[4] World Bank's Investment Climate Surveys are another important source of information on sector-wise productivity and profitability. However, it is likely to aggregate textiles, garments, footwear and leather products into a sector. See their web site (http://rru.worldbank.org/InvestmentClimate/) and Eifert, Gelb and Ramachandran [2005] among others.

Contribution to poverty reduction

Although knitwear producing firms are likely to be run by highly educated and male managers, the main workforce is female operators and helpers.[5] In general, the garment industry is known as the first formal industry in Bangladesh to provide a large scale of employment opportunities to female and young workers (Bhattacharya and Rahman [2001, 2002], Siddiqi [2004], Zohir and Paul-Majumder [1996]). In terms of the scale of employment, the knitwear industry as well as the woven garment industry has obviously and greatly contributed to poverty reduction in Bangladesh. What is relatively unclear with respect to role of the garment industry for poverty reduction in Bangladesh is how much wage the least paid workers receive in the industry. Some field works interviewing workers, such as Hoque, Murayama and Rahman [1995], Kabeer and Mahmud [2004], and Zohir and Paul-Majumder [1996], reveal that the lowest paid workers such as helpers who are either probationers for the operator handling sewing machines or engaging in chore receive low but substantially higher than alternative employment opportunities for them. The data collected for this paper present a structural tabulation of monthly earnings of workers in the knitwear industry in Bangladesh for the first time (see Table 2), which was controlled by section, designation, length of experience in the sample firm, and sex. This table of average wage profile is estimated from the data collected by interviews to managers of firms, which is not available through interviews to workers.

Needless to say, the central section of knitwear industry is the sewing section where garments are made from knit fabrics.[6] In the section, the main workforce is the operator, while the number of the helpers is greater than that of the operator for whom the helper works.

Table 2 reveals that the helper with less experience earns the least among employed persons in the knitwear industry. The average monthly earnings[7] of helpers with a year or less experience in the industry amount to around 1000 Bangladeshi taka, irrespective of sex. 1000 taka is equivalent to US$ 17.2 in 2000, which is far below the international poverty line of US$ 1 per day. However, both the food and overall poverty lines in Dhaka, Bangladesh for 2000 were Tk. 649 and Tk. 893 (BBS [2003]), so that the average earnings of least experienced helpers are higher than the poverty lines, again irrespective of sex.

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[5] As detailed in Appendix 3, the knitwear industry seems likely to employ more male workers than the woven garment industry, probably because firms of the former industry tend to maintain the section of knitting fabrics which is often operated overnight.

[6] Table A9 in Appendix 1 shows that about three quarters of employed persons in the sample firms work in the sewing section.

[7] The operator's earnings in the garment industry in Bangladesh usually are based not only on time while the worker attends but also how many pieces she processes. The interviewees were asked to answer their estimates of average earnings of workers, taking into account of both time rates and piece rates.

It is interesting to note that the average earnings of the least experienced helpers are still higher than those of both casual wage laborers and the self-employed in the farm sector in Bangladesh in 1999/2000 (Table 3). Even the earnings of the non-poor in the farm sector are lower than the earnings of helper in the knitwear industry. Thus, for people living in the agricultural areas in Bangladesh, an employment opportunity as a helper in the knitwear industry is more attractive than alternatives available in their home towns. In this way, development of the knitwear industry following the woven garment industry has contributed to poverty reduction of people living in rural areas of Bangladesh.

In order to seek main determinants of workers' earnings, a simple regression analysis is undertaken. Logarithm of monthly earnings of the most typical categories of workers are regressed to variables related to (1) production, (2) status of firm, (3) location of factory, and (4) management.[8] The estimation results are displayed in Table 4. Managers' estimates of average monthly earnings of sewing helpers and operators with 1-5 years of experience by sex are taken for the regression. Since only sample firms employing respective categories of workers are counted[9], the sample sizes for the regression are far smaller than the total sample size, 232. Some variables are dropped from the list of explanatory variables in the case that perfect collinearity takes place because of shortage of the samples.

Two issues appearing in Table 4 have important implications. First, scale of firms in terms of output is not positively associated with the level of earnings irrespective of sex as far as the operators and helpers are concerned. In other words, if other variables are controlled, there is no significant difference in earnings between big and small firms. That is, workers are paid alike no matter how large a firm is.

A second interesting finding is that firms located in an EPZ gives significantly higher earnings to female helpers. In fact, the two firms located in the Dhaka EPZ paid Tk. 2,000 to helpers with 1-5 years of experience, which is almost twice higher than the average earnings of corresponding designation and years of experience, Tk. 1,178. This feature is natural because of strict application of a high level of minimum wage rates to firms located inside EPZs. Tk. 2,000 is roughly equivalent to the minimum wage rate of US$ 38 for unskilled workers applied inside EPZs.

There is no other statistically significant variables of which relations with earnings are explained reasonably. As for female and male helpers with 1-5 years of experience, firms located in Savar and Gazipur which are the neighborhood of the Dhaka EPZ tend to pay to workers lower, while some education and experience dummies of the decision-makers exhibit

[8] Features of explanatory variables are described in detail in section 3.

[9] In addition, sample firms for producing either sweaters or socks, and firms engaging in dyeing exclusively, are dropped from this regression analysis because production technologies of these types of firms are totally different from the main sample firms in the data set. See the footnote of Table 4 for details.

statistically significant relations with earnings of workers. However, there is no persuasive justifications supporting the findings, and those are not robust features of operators as shown in the last two columns of Table 4.

In sum, it is revealed that as long as non-EPZ firms are concerned the sample firms tend to pay similar level of wage to workers.

3. Analytical frameworks for estimation of profitability and productivity

Once the contribution of the knitwear industry to poverty reduction is confirmed, the next question is whether this poverty-reducing industry is internationally competitive. Otherwise, the impact of the industry would be short-lived. In order to examine the competitiveness of the knitwear industry in Bangladesh, profitability and productivity of the industry are analyzed below. Simple economic models for empirical analyses of the competitiveness of the knitwear industry are presented in this section. The analytical frameworks for estimating (1) stochastic production frontier, (2) rate of return, and (3) total factor productivity, are given. They are followed by brief description of variables used for the empirical analyses in the next section.

3.1. Analytical frameworks

The typical knitwear such as T-shirts, polo shirts, knit underwear, and knit trousers, is made through two processes, *i.e.* knitting fabrics from yarn and making garments from knit fabrics. The standard technology to knit fabrics is to run a circular knitting machine with yarn to produce a tube of fabric. The tube can be used as it is or cut to get flat fabrics. The standard technology to make garments from fabrics is to make an assembly line of sewing machines and operators. Other types of knitwear such as sweater and socks, are made with different machines and ways of production. However, their share of knitwear production is less. Therefore, the analyses in section 4 focus on the typical knitwear which passes through the two processes of knitting-fabrics and making-garments.

Production frontier and technical efficiency

Let us denote the two processes *f* for "knitting fabrics" and *g* for "making garments". In each firm the value of gross output from the two processes $\left(X_s : s = f, g\right)$ is the sum of values of material $\left(M_s\right)$, and energy $\left(E_s\right)$, and value added $\left(V_s\right)$:

$$X_s = M_s + E_s + V_s. \tag{1}$$

If the firm undertake the two processes in-house, and if the fabrics produced in the fabrics process are directly used in the garments process without both buying and selling any fabrics from and to outside, the gross output from the fabric section is equal to the material inputs to the garment section, if other miscellaneous inputs are neglected, $X_f = M_g$. For a composite firm which has the two processes in the same establishment $(s = f + g)$, the value added for the firm is addition of them created in each of the two sectors.

$$V_{f+g} = V_f + V_g. \tag{2}$$

Thus, the value of gross output of knitwear contains V_{f+g}.

$$\begin{aligned} X_g &= M_g + E_g + V_g = X_f + E_g + V_g = M_f + E_f + E_g + V_f + V_g, \\ &= M_f + E_{f+g} + V_{f+g}. \end{aligned} \tag{3}$$

Since this type of composite firms dominate the sample, we mainly focus on sample firms engaging in both knitting fabrics, making garments and nothing else.

There is discussion which should be used as an indicator of output, gross output or value added. Value added is a straightforward definition of output in economics unless there is market power. If the issue of market power is critical, gross output is sometimes preferred (Burnside, Eichenbaum and Rebelo [1995]). In this paper both variables are used to confirm robustness of results.

As for factors of production services of labor and capital are focused. Other inputs are assumed to be perfect complements to the combination of the two factors.[10] The following equations incorporate these assumptions:

$$V_{f+g} = \min\left[F_{f+g}\left(N_{f+g}h, K_{f+g}h\right), \alpha_{f+g} A_{f+g}\right], \tag{4}$$

$$X_g = \min\left[\beta_{f+g} V_{f+g}, \gamma_f \left(M_f / p_M\right), \delta_{f+g}\left(E_{f+g} / p_E\right)\right], \tag{5}$$

where h denotes the operation rate of the composite firm[11] and A denotes the real estates on which the operation takes place. $\alpha_{f+g}, \beta_{f+g}, \gamma_f$ and δ_{f+g} are parameters for the Leontief production function. p_M and p_E are prices of material and energy, respectively. Thus, for the empirical analyses developed next section, the log-linear approximation of the following equations:

$$V_{f+g} = F_{f+g}\left(N_{f+g}h, K_{f+g}h\right), \tag{6}$$

$$X_g = \beta_{f+g} F_{f+g}\left(N_{f+g}h, K_{f+g}h\right), \tag{7}$$

are estimated. That is the equations for estimation are:

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[10] Basu [1996] supports this perfect complement hypothesis.

[11] This type of specification of factor utilization is adopted by Bils and Cho [1994].

$$\ln V_{f+g} = C^v + \lambda_l \ln(N_{f+g}h) + \lambda_k \ln(K_{f+g}h) + u_v, \tag{8}$$

$$\ln X_{f+g} = C^x + \lambda_l \ln(N_{f+g}h) + \lambda_k \ln(K_{f+g}h) + u_x, \tag{9}$$

where $\ln \beta_{f+g} + C^v + u_v = C^x + u_x$.

In order to estimate stochastic production frontier a standard assumptions over the disturbances are made (see Kumbhakar and Lovell [2000], pp. 63-130). It is assumed that u_v and u_x are error terms which contain the symmetric and two-sided disturbances (ε_F) and those incorporating inefficiency of each firm (ε_E) as follows:

$$u_q = \varepsilon_{Fq} - \varepsilon_{Eq}, \quad (q = v, x) \tag{10}$$

$$\varepsilon_{Fq} \sim \text{iid } N(0, \sigma_{Fq}^2), \tag{11}$$

$$\varepsilon_{Eq} \sim \text{iid } N^+(0, \sigma_{Eq}^2), \tag{12}$$

where N^+ denotes the nonnegative half normal distribution. In addition, the statistical independence among ε_{Fq}, ε_{Eq}, and the regressors is assumed. Then, maximum likelihood estimation is applied. A conventional measure of technical efficiency for a firm *i* (TE_i) is the following:[12]

$$TE_i = \exp(-\hat{\varepsilon}_{Ei}), \tag{13}$$

$$\hat{\varepsilon}_{Ei} \equiv E(\varepsilon_{Ei} | u_i) = \frac{\sigma_F^2 \sigma_E^2}{\sigma^2} \left[\frac{\phi(u_i \mu / \sigma)}{1 - \Phi(u_i \mu / \sigma)} - \left(\frac{u_i \mu}{\sigma} \right) \right], \tag{14}$$

where $\sigma \equiv \sqrt{\sigma_F^2 + \sigma_E^2}$ and $\mu \equiv \sigma_E / \sigma_F$. The sample average of TE_i is a focal measure of technical efficiency for the industry which can be used for comparison with that of the same industry in other countries.

Rate of return

Profits are a primary concern of owners of a firm. High profits reflect great revenue and low costs, both of which may incorporate either a large amount of sales, high valuation of the product, or efficient production techniques. All of them are good indicators of competitiveness of a firm.[13] Thus, profits, *alias* price-cost margins, are used as a proxy for competitiveness (Roberts and Tybout [1996] among others).

The amount of profits is defined by section with the data set in this paper.

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[12] The subscript of *q* is dropped for simplicity.

[13] In addition, profits is a main source of investment under the condition of liquidity constraints which are common in developing countries.

$$\pi_s = V_s - W_s - R_s^K - R_s^A, \quad (s = f, g) \tag{15}$$

where W_s, R_s^K and R_s^A are total wage and salary, interest payments, and rent for land and building.[14] A caveat is that some owners of sample firms own land and buildings for the factory and lend money to their own firms. In that case, measured profits according to equation (15) is contaminated with rent and interests which are not captured as they are. This is a common, but critical problem, faced by econometricians handling firm-level data.

The rate of return is defined as the ratio of profits to the present value of installed machines[15] by section.

$$r_s = \frac{\pi_s}{K_s}. \qquad (s = f, g, f+g) \tag{16}$$

Note that for a firm engaging in both knitting fabrics and making garments, profits for the two sections are the sum of those brought about by section. In other words, $\pi_{f+g} = \pi_f + \pi_g$. So is the present value of installed machines $\left(K_{f+g} = K_f + K_g\right)$.

Total factor productivity

As discussed above, it is hard to single out pure profits from this data set. An alternative indicator to measure competitiveness is productivity. Since this is the first firm-level data set of detailed inputs and outputs in the knitwear industry in Bangladesh, time series changes in productivity by firm are hardly attained. Thus, the indicator of productivity used in this paper is the "relative total factor productivity (TFP)" proposed by Caves, Christensen and Diewert [1982], and was used in Baily, Hulten and Campbell [1992] among others. The definition of the relative TFP is the following:

$$\begin{aligned}\ln TFP1_{si} = {} & \left(\ln V_{si} - \frac{1}{n_s}\sum_{j=1}^{n_s}\ln V_{sj}\right) - \frac{1}{2}\left[\lambda_{Nsi} + \frac{1}{n_s}\sum_{j=1}^{n_s}\lambda_{Nsj}\right]\left(\ln N_{si} - \frac{1}{n_s}\sum_{j=1}^{n_s}\ln N_{sj}\right) \\ & - \frac{1}{2}\left[\lambda_{Ksi} + \frac{1}{n_s}\sum_{j=1}^{n_s}\lambda_{Ksj}\right]\left(\ln K_{si} - \frac{1}{n_s}\sum_{j=1}^{n_s}\ln K_{sj}\right) - \left(\ln h_i - \frac{1}{n_s}\sum_{j=1}^{n_s}\ln h_j\right).\end{aligned} \tag{17}$$

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[14] R_s^K does not include costs to purchase machines even for firms which did so for July 1999 - June 2000.

[15] The present value of machines is estimated by the perpetual inventory method. The annual depreciation rate is assumed to be 5%. Unfortunately, detailed price series by machine are not available. Since almost all machines used in this industry are produced abroad and imported, the implicit price deflator of "Special industry machinery, n.e.c." constructed by the Bureau of Economic Analysis of the government of the United States is used as the deflator for all machines in the knitwear industry in Bangladesh. Since the series is available only after the year 1987, for machines purchased before the year, the average rate of change in the series for 1987-2001 of 2.44% is applied.

λ_{Nsi} is the labor share of total factor income of section *s* in firm *i*, while the sum of labor share and capital amounts to one by construction: $\lambda_{Ksi} = 1 - \lambda_{Nsi}$. *h* is the ratio of number of months in operation to twelve.

In order to test robustness of pattern of variation in TFP, the conventional version of relative TFP for which factor utilization is not taken into account, and the Solow residual are also worked out. The former is denoted as TFP2 in this paper and formulated as follows:

$$\ln TFP2_{si} = \left(\ln V_{si} - \frac{1}{n_s}\sum_{j=1}^{n_s} \ln V_{sj} \right) - \frac{1}{2}\left[\lambda_{Nsi} + \frac{1}{n_s}\sum_{j=1}^{n_s} \lambda_{Nsj} \right]\left(\ln N_{si} - \frac{1}{n_s}\sum_{j=1}^{n_s} \ln N_{sj} \right)$$
$$- \frac{1}{2}\left[\lambda_{Ksi} + \frac{1}{n_s}\sum_{j=1}^{n_s} \lambda_{Ksj} \right]\left(\ln K_{si} - \frac{1}{n_s}\sum_{j=1}^{n_s} \ln K_{sj} \right). \qquad (18)$$

The relative Solow residual is defined as follows:

$$Solow_{si} = \left(\ln V_{si} - \frac{1}{n_s}\sum_{j=1}^{n_s} \ln V_{sj} \right) - 0.6 \cdot \left(\ln N_{si} - \frac{1}{n_s}\sum_{j=1}^{n_s} \ln N_{sj} \right) - 0.4 \cdot \left(\ln K_{si} - \frac{1}{n_s}\sum_{j=1}^{n_s} \ln K_{sj} \right)$$
$$- \left(\ln h_i - \frac{1}{n_s}\sum_{j=1}^{n_s} \ln h_j \right). \qquad (19)$$

The reason why the Solow residual is additionally used is that the measured labor share seems to be a little overestimated[16]. The Solow residual will tell us whether the effects of upward bias in labor share matter or not.

4. Empirical analyses of profitability and productivity

Based on the frameworks and measures described in section 3, the following features are demonstrated empirically below: (1) the average profitability of the knitwear producing firms is very high; (2) that development of the industry entailed great diversity in efficiency even in comparison with the garment industry of other LDCs; (3) a main determinant of profitability and productivity is scale of production, and industrial upgrading in terms of usage of expensive machines and vertical integration does not cause improvements in both profitability and productivity.

[16] Note that the denominator of labor share is total factor income rather than value added. It is known that this version of factor share is preferable as a proxy for relative contribution of a factor. However, the sample mean of labor share among firms with positive value added is as high as 0.898 while the median is 0.927. Since rent and interest owed by owners of a sample firm are not explicitly distinguished from profits, measured labor share must be overestimated. In order to test robustness of results depending on values of labor share, the same exercises below were repeated for the Solow residuals with the labor share of 0.6. As a result, main conclusions turn out to be valid.

Level and variability of profitability

The rate of return, which is defined as the ratio of profits to real value of machinery, is calculated according to equation (16), and some indicators of the variable for several sets of samples are displayed in Table 5. A first feature drawing attention is that the mean value of the rate of return is likely to be well greater than unity. That is, the value of profits is likely to exceed that of installed machinery. In other words, profits for one year are more than enough for replacing all machinery. For some subsets of sample such as firms “knitting fabrics only” and those “dyeing fabrics and making final products only”, the mean profit-capital ratios are negative. However, they do not alter the overall tendency of high.

At the same time Table 5 reveals great variation in the profits-capital ratio among the sample firms. There are some interesting features. First, the median is likely to be far smaller than the mean, which implies that the distribution of profits-capital ratio is skewed to the right. Second, the minimum tends to be less than zero while the maximum to exceed unity. That is the range of sample is very wide in general. Third, the figure at the third quartile tends to be greater than two. As a whole, the great variation in profits-capital ratio implies that even in the rapidly growing knitwear industry there are various firms in terms of profitability.

The high variability in performance among knitwear producing firms is further confirmed by Table 6, which displays distribution of sample firms by amount of profits and value added. The table reveals that 56 sample firms out of 230, which amount to 24.3%, indicate negative profits, while even the value added is negative[17] for 13 firms. 13 firms amount to 5.7% of all sample firms, and are not negligible at all. It is interesting that there are firms raising extremely high profits while some firms show negative value added. Again, a wide variability of firms in profitability is indicated.

This observation is consistent to the view of dynamism in entry and exit demonstrated by Aw, Chen and Roberts [2001] for Taiwanese manufacturing. They showed that the Taiwanese manufacturing industry grew amid high turnover of firms which was driven by differences in performance among firms. Our data also indicates that the knitwear industry in Bangladesh has a similar structure of industrial development with high variability in terms of performance among firms to that of the Taiwanese manufacturing industry.

Variability of productivity

This variability in profitability is endorsed by variability in productivity, which is demonstrated below by estimation of stochastic frontier production function and technical

[17] Value added becomes negative if costs for all intermediate inputs exceed gross output. Since the export-oriented garment producing firms purchase materials and undertake production only after they receive order, stock of inventory is negligible. Hence, sales and gross output are treated as identical.

efficiency derived from the estimation.

Stochastic frontier production functions are estimated based on equations (8) and (9). Both value added and gross output are used as dependent variables. Only firms of the most likely combination of production activities, which is engaging in both knitting fabrics and making garments and doing nothing else, are used as samples for this estimation, so that a common production function is applied to all sample firms. Results with and without factor utilization are displayed in Table 7.

The sample size is greater for estimation with gross output than that with value added because logarithm of value added is taken and there are some firms of negative value added in the sample (Table 7). However, main results are the same whether gross output or value added is used and whether factor utilization is taken into account or not. The estimated elasticity of output with respect to capital falls in the range between 0.437 and 0.513 and significantly different from zero, while that with respect to labor varies more. Sum of the two estimates, which incorporates returns to scale, is not significantly different from zero for the all four estimations. Thus, the null hypothesis that the production function exhibits constant returns to scale can not be rejected.

The estimated variance of disturbance incorporating inefficiency, σ_E, is significantly greater than zero for the four estimation (Table 7), so that the stochastic frontier estimation makes sense. The variance of inefficiency even exceeds the variance of two-sided disturbance, σ_F, on average.

Finally, the mean technical efficiency is around 0.5 for the four estimation. The mean technical efficiency incorporates variation in efficiency and has been used for international comparison. Richard E. Caves and his associates summarize industrial efficiency in OECD member countries (Fecher and Perelman [1992]), and Tybout [2000] did the same for developing countries. By comparing the mean technical efficiency in manufacturing industry between developed and developing countries, Tybout [2000] concludes that:

> "(A)verage deviations from the efficient frontier are *not* typically larger than what we observe in the high-income countries studied by Caves et al. (1992)." (Tybout [2000], p. 24.)

However, if the comparison in mean technical efficiency of the garment industry, the figures derived from our estimation, 0.5, is very low. Fecher and Perelman [1992] exhibit the mean technical efficiency of the textile industry of 10 OECD member countries in the 1970s-80s. The all estimates of the variable are distributed in the range between 0.68 and 0.89 except for those of Japan.[18] It is evident that the value of mean technical efficiency of the Bangladeshi knitwear industry displayed in Table 7 is far smaller than this range. Moreover, according to Table 8, even in the comparison with the textile and/or garment industry in other developing countries, the vales in Bangladesh is low. All the figure shown in Table 8 are well above 0.5. Even though this is not a very accurate comparison in the sense that there is no study specializing in the knitwear industry in the table. Still, the figures of 0.5 or lower are obviously low, and testifies the variation in efficiency in the knitwear industry in Bangladesh is great.

Determinants of profitability

Then, a next concern is what determines profitability and productivity of the knitwear industry. If there are any policy related variables affecting them, manipulating the variables may change the competitiveness of the industry.

Candidates for the determinants are the followings. First, production and products related variables are used as explanatory variables for profit-capital ratio, which is the proxy for profitability. As shown in the first column of Table 5, BKMEA member firms engage in either knitting fabrics; making garments; dyeing fabrics; or combinations of these three activities. Since the population mean of the profit-capital ratio may differ across different combination of activities, we need to distinguish each category of firms of different combinations of activities. The policy adopted in this paper is to limit sample firms to those engaging in knitting fabrics; making garments; or doing both, and doing nothing else. Namely, firms engaging in dyeing or making sweater or socks are automatically dropped, whether they engage in knitting fabrics, making garments or not. Then, the sample size becomes 178, and the estimation results for this sample are exhibited in Table 10. Additionally, two subsets of them are examined respectively. The one is any sample firms engaging in knitting fabrics drawn out of the 178 samples, and the other is any sample firms engaging in making garments among the 178 samples. The sample sizes for the former and latter are 152 and 164, respectively, as shown in Tables 10 and 11.

As for production and products related explanatory variables, activity dummies are utilized. Namely, we use a dummy variable which take one if the activity of the sample firm is “knitting fabrics only” and zero otherwise. Similarly, we use another dummy variable which take one if the activity of the sample firm is “making garments only” and zero otherwise.

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[18] Those of the textile industry in Japan for the periods of 1971-79 and 1980-86 are 0.40 and 0.53, respectively. For information, the benchmark estimation equation in Fecher and Perelman [1992] takes the translog function without incorporating factor utilization. If the same functional form and explanatory variables are used, the mean technical efficiency amounts to 0.49. Thus, there isn’t apparent difference from those with the Cobb-Douglas form as displayed in Table 7.

These two dummy variables may reflect impacts of vertical integration of the two activities. By definition of the profit-capital ratio indicated in equation (16), that of a vertically integrated firm can be expressed as a weighted average of notional profit-capital ratios of individual activities as follows:

$$r_{f+g} = \frac{\pi_{f+g}}{K_{f+g}} = \frac{\pi_f + \pi_g}{K_f + K_g} = \frac{K_f}{K_f + K_g} \cdot r_f + \frac{K_g}{K_f + K_g} \cdot r_g . \tag{20}$$

Therefore, if the population means of rates of return for knitting fabrics and making garments in vertically integrated firms are the same with counterpart rates of returns in firms engaging in knitting fabrics only and making garments only, either of the following two inequalities should hold:

$$r_f \geq r_{f+g} \geq r_g \text{, or } r_f \leq r_{f+g} \leq r_g . \tag{21}$$

On the contrary, if r_{f+g} is greater than both r_f and r_g after controlling other determinants, there should have a factor in vertically integrated firms to raise their rate of return systematically. This factor could be interpreted as the vertical integration effect. If the two dummy variables for “knitting fabrics only” and “making garments only” are both significantly greater than zero, this finding will be evidence supporting a favorable “vertical integration effect” in the knitwear industry. This issue is interesting because backward linkage from “making garment” to “knitting fabrics” has been directed in Bangladesh in order both to fulfill the rule of origin requirements for the Generalized System of Preferences (GSP) to be applied by EU and to enhance competitiveness of the industry. The latter argument is based on a hypothesis that low skills suffice labor-intensive production process and that profitability of the process is low, so that proceeding to more capital-intensive process should enhance profitability. Some literature on global value chain tends to advocate this argument (see Gereffi et al. [2001], UNIDO [2002] among others). If the rate of return of vertically integrated firms is systematically greater than those of firms engaging in either one, the above argument looks more plausible. In this respect, estimates of coefficients on these two dummy variables are interesting.

Another pair of dummy variables used as explanatory variables concerning production is on subcontracting. Subcontracting is defined as production without purchasing materials according to an order placed by the client who purchase the materials. The subcontracting dummy variables are made for “knitting fabrics” and “making garments”.

Finally, logarithm of gross output is used as a proxy representing scale of a firm. This variable is conventionally used as an explanatory variable for profitability and productivity.

A second category of explanatory variables are related to status of sample firms. Three dummy variables are defined as dummy variables which take one if the sample firm is a limited company, a BGMEA member firm, and a joint venture with foreigners, respectively, and take zero otherwise. In addition, the number of years since the establishment of a sample firm is adopted as an explanatory variable.

A third category of explanatory variables are all dummy variables on location. The first dummy variable distinguish location of the factory of sample firm located in the greatest knitwear production area, *i.e.* Narayanganj, from those located outside Narayanganj. The second dummy variable is for another pair of areas where knitwear production is actively undertaken, *i.e.* Savar and Gazipur. Savar is located in the north of Dhaka District, where the Dhaka Export Processing Zone takes place. Gazipur District is on the north of Dhaka District. Savar is on the way from central Dhaka to Gazipur, and parts of Savar and Gazipur constitute an industrial area.

There are only two firms located inside the Export Processing Zone (EPZ) in the sample. Both of them are 100% foreign owned. A dummy variable is defined for the two firms. Finally, there is an industrial estate constructed and administrated by the Bangladesh Small and Cottage Industries Corporation (BSCIC) in Narayanganj. A dummy variable is made for sample firms located in the BSCIC Industrial Area in Narayanganj.

A fourth set of explanatory variables characterize the decision-maker of each sample firm. Each interviewee of our field survey was asked who was the “most influential decision-maker” in the firm. Then, questions about the decision-maker’s attributes follow. The attributes used as explanatory variables are about age, education and experience of the decision-maker. Age of the decision-maker is adopted as an explanatory variable as it is. As for education, the highest degree attained are asked and used to make dummy variables. The benchmark is the Secondary School Certificate (SSC) holder, which is the lowest degree for all decision-makers in the sample. Students who have studies for ten years are supposed to attain SSC. Finally, three variables reflecting lengths of working experience of the decision-makers are defined. The first variable is the number of years for the decision-makers to have worked for the firm. The second is the same variable for the decision-makers to work for any firms of the knitwear industry, while the third is for the textile and garment industry which contain the knitwear industry.

The last set of variables are those which can not be included in any categories shown above, and is called “Others”. A first variable in this category is a dummy variable for sample firms answering that that they paid rent for factory/land. If the owner of a firm owns factory and land, and do not count the contribution of the structure and land to production, the measured profits are overestimated. So does the case of the owner of a firm lending money to the firm. Since the imputation of the rent and interest is too difficult to be conducted, this dummy variable is used to capture the effects of failure in the imputation.

The last set of explanatory variables are prices of machinery. It is assumed that prices of machinery reflect quality of it, and symbolize industrial upgrading. As for the activity of knitting fabrics, logarithm of firm average of circular knitting machine is adopted. The circular knitting machine is the state-of-arts technology for mass production of plain knit fabrics. Most of circular knitting machines are imported from either India or East Asian economies such as Singapore, South Korea and Taiwan. There is a huge difference in the price between machines made in India and those made in the East Asian economies. In fact, the typical circular knitting machine made in India is small and looks like an instrument, while those made in East Asia is typically a sophisticated machine numerically controlled. Figure 1 demonstrates that there are two peaks in the distribution of sample firms with respect to firm average price of circular knitting machines. This shape of distribution reflects the dichotomy by exporting countries.

As for the activity of making garments, the price of sewing machines is adopted. Figure 2 shows that the distribution with respect to the price of sewing machines is uni-modal, and quality of the machines is more or less similar. These machine price variables take missing value if those machines are not installed. Therefore, the price of circular knitting machine is used as an explanatory variable only for sample firms engaging in knitting fabrics, while the price of sewing machines is used only for sample firms engaging in making garments.

Table 9 exhibits results of regression of the profit-capital ratio on explanatory variables explained above for the sample firms engaging in knitting fabrics, making garments or both.[19] Figures in parentheses are the White-heteroskedasticity robust standard errors.

The first column of the table shows the result for OLS only with intercept and two dummy variables on production activities. It implies that there is a significant difference in the profit-capital ratio between firms engaging in knitting fabrics only and the other firms. The former exhibits lower value than the remaining sample firms. By contrast, there is no significant difference for firms making garments in the ratio.

The second column is from OLS with all available explanatory variables described above. Once these explanatory variables are introduced, the statistical significant on the dummy variable for firms knitting fabrics only disappear. One of our hypotheses on industrial upgrading was effects of vertical integration incorporating backward linkage. However, this exercise does not provide any evidence supporting the hypothesis.

By contrast, some variables turn out to significantly affect the profit-capital ratio. More concretely, effects of the dummy for firms subcontracting in knitting fabrics, logarithm of output and the dummy for firms located in the EPZ are statistically significant. According to the estimation result placed on the second column of Table 9, subcontracting firms for knitting fabrics are likely to exhibit high, rather than low, profit-capital ratio if the other

[19] See the footnote of the table for details on the sample firms.

explanatory variables described above are controlled. In addition, big firms in terms of gross output are likely to have high profit-capital ratio, and a 1% increase in gross output is associated with 1.755 points increase in the ratio with the 95% significance confidence interval is (0.675, 2.835). Note that this impact is quite large, referring to the mean of profit-capital ratio is around 1.5 as displayed in Table 5. Finally, firms located in the EPZ tend to exhibit low rate of return.

There is no sensible explanation on the significantly positive impact of subcontracting in knitting fabrics and the significantly negative impact of location in the EPZ. What more interesting are that (1) the scale is positively associated with rate of return, which are not generally observed for manufacturing in developing countries[20]; (2) there is no evidence for advantages of vertically integrated firms in the rate of return after other explanatory variables are controlled; (3) there is no evidence for positive geographical agglomeration effect; and (4) attributes of decision-makers of sample firms do not have any significant impact on rate of return.

Skipping the third, the fourth column is for estimation with the dummy for firms paying rent for factory. The effect of the dummy is not significant, and there is no qualitative difference from the estimation without the dummy.

The third and fifth columns exhibit results from the two-stage least squares (2SLS) estimation. Possible endogeneity problem of explanatory variables could be treated with this method. Obviously, however, most of the explanatory variables used for the estimation might be endogenous. Activity, subcontracting, amount of output, status of firm, age of firm, location, and even managers, are all choice variables which are possibly dependent on performance of sample firms which is represented by indicators such as rate of return and productivity. Unfortunately, such a large number of instruments are hard to be found, so that we need a practical solution to test robustness of the results which we obtained by OLS shown in Table 9. For the experiment of 2SLS only logarithm of gross output is assumed to be endogenous. All the other explanatory variables, as well as monthly operation rate and six dummy variables on application of industrial promotion policies regarding (1) bonded warehouse, (2) duty drawback for imported materials, (3) income tax deduction on export earnings, (4) tariff exemption on importation of machinery, (5) allowance for using locally produced fabrics, and (6) preferential interest rate for export-oriented sectors,[21] are used as instruments. Those instruments are considered to affect profits through expansion in output. Monthly operation rate is the ratio of number of months for which a sample firm was operated to total number of months available.

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[20] A firm-level study of the garment industry in Bangladesh, which was conducted in 2003 by a team including one of the authors, missed finding the positive association between the rate of return and scale of production (UNIDO[forthcoming]).

[21] See question 10.1-6 in the questionnaire displayed in Appendix 3.

None of these variables are perfect instruments. Participation in any promotion programs is a choice variable. The monthly operation rate is also dependent on performance of a sample firm. Thus, these 2SLS estimations should be regarded as alternative experiments to examine robustness of the OLS estimation displayed in Table 9. For these 2SLS estimations, the relevancy of instruments is examined by looking into partial R^2 resulted from regression of logarithm of gross output on all the instrumental variables, which is the first stage regression for the 2SLS. Staiger and Stock [1997] demonstrated that 2SLS estimators with low relevancy may have inferior small sample properties to OLS estimators. Then, Shea [1997] proposed the partial R^2 as a good indicator for the relevancy of instrumental variables.

The partial R^2, which is denoted by R_p^2, and those adjusted with the degree of freedom, $\overline{R}_p^2$, are shown in Appendix 2. The values of R_p^2 and $\overline{R}_p^2$ are not high, in general. However, according to Shea [1997], conventional values are as low as those displayed in Appendix 2.

The results of 2SLS estimations appearing in the third and fifth columns of Table 9 show that the significance of impacts of the three explanatory variables, *i.e.* subcontracting dummy in knitting fabrics, gross output and EPZ dummy, by OLS are not robust very much. The F statistics in the last row demonstrate that the residuals are not highly correlated with the instrumental variables.

Table 10 displays results of the same regression analysis with sample firms engaging in knitting fabrics. This sample includes firms engaging in both knitting fabrics and making garments. The EPZ dummy is not applicable because of linear dependency. The OLS estimates reveal that the only significant explanatory variable is logarithm of gross output. Again, however, the significant impact disappears when 2SLS is applied.

A new focal issue featured in Table 10 is that logarithm of firm average price of circular knitting machines is introduced as an explanatory variable. The hypothesis tested with this variable is that firms using more sophisticated technology embodied in expensive machines exhibit high rate of return. However, the sign of estimated coefficients on the variable is negative, though they are not statistically significant. Thus, here again, industrial upgrading is not found critical to raise rate of return.

Table 11 is a mirror image of Table 10 with sample firms engaging in making garments. This sample includes firms engaging in both knitting fabrics and making garments. Again, the coefficient on logarithm of gross output is significantly positive and great in magnitude by OLS. In addition, the coefficient on the EPZ dummy is significantly negative. Other explanatory variables are rarely significant. Then, the 2SLS is applied the effects of gross output and EPZ dummy become insignificant. Note that the logarithm of firm average price of sewing machines is introduced as an explanatory variable for the third and fourth columns. However, the sign is negative, but insignificant.

To sum up, the scale of firm and location in EPZ are the factors associated with rate of return most significantly. It is noteworthy that all the sample firms located in EPZ are 100% foreign owned, and that there is no other 100% foreign owned firm in our sample. Therefore, we can not distinguish effects of location in EPZ and those of foreign ownership. In any event, a great amount of gross output is associated with high rate of return, and either location in EPZ or ownership by foreigners is associated with low rate of return. However, these two observations are not apparent with the 2SLS estimation.

Determinants of productivity

As mentioned above, there are difficulties to measure profits accurately. Even though the profits variable of our data set were carefully constructed, it is far from impeccable. Thus, another indicator of performance of a firm, that is productivity, is examined in order to shed light to determinants of firm's performance from another angle. The indicators for productivity used in this paper are TFP1, TFP2, and the Solow residual, which were introduced with equations (17)-(19). The benchmark productivity indicator is TFP1 which incorporates factor utilization and for which actual data of labor share by firm is used as labor share. As for TFP2, factor utilization is dropped from the list of inputs, so that differences in factor utilization is contained in TFP2. For the Solow residual, the labor share is assumed to be 0.6 to any firms in fear of upward bias in measured labor share by firm.

Table 12 displays results of regression of those productivity indicators to the same set of explanatory variables used for the regression analyses of rate of return. It is notable that the patterns of appearance of statistically significant explanatory variables are similar among the three productivity indicators and estimation methods. As is the case for regression of rate of return, estimates of the coefficient of logarithm of gross output are significantly positive for five estimations out of six. New features of this series of regression analyses which did not appear for the regression of rate of return are (a) positive association with joint venture, (b) negative correlation with age of firms, (c) positive correlation with age of decision makers, (d) positive correlation with duration for decision makers to continue serving for firms where they are currently, and (e) negative correlation with duration for decision makers to work in the textile and garment industry as a whole.

The first feature of positive correlation between gross output and productivity confirms the same positive association between gross output and rate of return. This positive correlation may imply scale economy. By contrast, if a reverse causality such as expansion in production due to high productivity and a great amount of profits, works, that positive correlation appears without scale economy. If the 2SLS successfully dispose of the reverse causality, only the scale effect remains.

It makes sense that joint venture exhibits high productivity. This result is consistent with a finding of Kee [2005] on productivity of the garment industry in Bangladesh. There is no prior knowledge about relation between productivity and age of firms in the garment industry in Bangladesh. Aw, Chen and Roberts [2001] find that new firms have lower productivity than incumbents in Taiwan manufacturing.

As for experience of decision makers, physical age and tenure in the sample firm are positively correlated. These observation may reflect positive impacts of those types of experiences on productivity of the firm. On the other hand, there is no sensible interpretation on significantly negative correlation between the length of experience of decision makers of sample firms in the textile and garment industry and productivity.

In sum, positive evidence is not found for industrial development strategies, such as geographical agglomeration and industrial upgrading. Some externality caused by agglomeration might enhance profitability and productivity of a firm located close to other firms (see Fujita and Thisse [2002] among others). However, our data does not show any evidence supporting this argument. The impacts of vertical integration and upgrading machinery are also invisible in our data. The scale of firm which is represented by gross output is the most outstanding factor being correlated with profitability and productivity.

5. Concluding remarks

In the past labor-intensive industries drew attention as an entry point for low income countries to initiate industrialization. The textile industry played that role in the United Kingdom, Japan, and India by the 19th century, while the garment industry and electrical and electronic machinery industry took over the role for export-oriented industrialization in East and Southeast Asia in the 1970s-90s. World Bank [1990] expected that labor-intensive industries would contribute to poverty reduction substantially.

In these years, however, possibility of export-oriented industrialization of low income countries led by labor-intensive industries have not been lively discussed and almost forgotten. There are several reasons of this neglect of the industrialization strategy. First, in the 1990s the export-oriented industrialization achieved in East Asia was discussed in relation to active government intervention, and establishment of WTO in 1995 limited scope of industrial promotion policy directed only to local firms. Thus, current low income countries feel that they are not able to mimic the active intervention for export promotion. Second, East Asia, which had been an illuminating role model of the export-oriented industrialization stumbled at the Asian financial crisis in 1997. Third, some research emphasizing distinct initial conditions favoring East Asia was consecutively published. World Bank [1993] pointed out high capability of government officers in East Asia, while Wood [1994] argued high level of educational attainment of workers employed by manufacturing industry in East Asia. In addition, Wood [2003] highlighted a difference in combination of factor endowment between East Asia and sub-Saharan Africa where LDCs gather. Finally, a big competitor, *i.e.* China, has emerged as an almost omnipotent and omnipresent supplier of manufactures. These observations make LDCs to give up attempting to facilitate export-oriented industrialization.

On the contrary, a labor intensive industry in LDCs has succeeded in penetrating into markets of developed countries. It is the garment industry, which led export-oriented industrialization in East Asia for decades. However, most of observers were pessimistic about competitiveness of the industry in LDCs, because the international trade in textiles and garments were not fully liberalized and complete liberalization was scheduled in the beginning of the year 2005. They expected that sooner or later the industry in LDCs would lose once the trade was liberalized.

As a matter of fact, an immediate collapse of the industry did not take place in most of LDCs by the third quarter of the year 2005. That is natural because even in the era of controlled trade regime which was sustained by the Multi-Fibre Arrangement (MFA) and a succeeding agreement, there was export competition up to the ceiling known as quota among exporting countries to a certain extent.

This study sought mechanisms and features of an internationally competitive manufacturing industry in a LDC. Since Bangladesh is known as a really poor country which constantly hit by natural disasters, it is meaningful to examine prospects of industrialization of this country. The knitwear industry is growing rapidly in Bangladesh and a typically labor-intensive and export-oriented industry in the country. Thus, examination of prospects of the industry will afford rich lessons to industrialization of LDCs in general.

With this motivation, the knitwear industry in Bangladesh was scrutinized. Main conclusions are fourfold. First, development of the knitwear industry in Bangladesh facilitates poverty reduction by providing entry-level workers with a great scale of employment opportunities and earnings higher than the national poverty line and those offered by alternative employment opportunities. Second, the average profitability of the knitwear producing firms is very high. Some firms earn profits several times higher than amount which afford replacement of all installed machinery. Third, by contrast there are many firms making a loss. In other words, the diversity in efficiency among firms is great. The stochastic production frontier analysis reveals that the diversity in efficiency is greater than those of the garment industry in other developing countries. Fourth, there is no evidence found supporting significantly positive impacts on profitability and productivity through industrial upgrading in terms of usage of expensive machines and vertical integration and industrial agglomeration.

The knitwear industry might no be the one that those effects are apparent.

The bottom line of this paper is that the East Asian pattern of export-oriented industrialization still has great promise for an entry point of industrialization of present low-income countries even without active government interventions. As Aw, Chen and Roberts [2001] and Roberts and Tybout [1996] demonstrated for other developing countries, there is great diversity in profitability and productivity among firms even in a growing industry, and frequent entry and exit may take place. Amidst that high turnover a competitive industry may grow and contribute to poverty reduction as a whole. The knitwear industry in Bangladesh is one of those industries. Since Bangladesh has not had any physical and institutional advantages[22] in promoting industries over other LDCs, there is no reason why we need to doubt possibility of replication of the pattern and mechanism of development of the knitwear industry in Bangladesh at some other LDCs in the near future.

[22] For unfavorable investment climate in Bangladesh, see Batra, Kaufmann and Stone [2003], and World Bank [2004]. Poor governance in Bangladesh is symbolized by the Corruption Perceptions Index constructed by the Transparency International. Bangladesh is ranked at the bottom since the country appeared in the ratings for the first time in 2001. See the web site: http://www.transparency.org/cpi/2004/cpi2004.en.html#cpi2004, for details.

Reference

Afsar, Rita [2001], "Female Labour Migration and Urban Adaptation," in Pratima Paul-Majumder and Binayak Sen, eds., *Growth of Garment Industry in Bangladesh: Economic and Social Dimensions*, Dhaka: Bangladesh Institute of Development Studies, pp. 106-131.

Ahmed, Khandker Habib [2002], *Backward Linkage to Ready Made Garments: Bangladesh Perspective*, Dhaka: Academic Press and Publishers Limited.

Aw, Bee Yan; Xiaomin Chen; and Mark J. Roberts [2001], "Firm-level Evidence on Productivity Differentials and Turnover in Taiwanese Manufacturing," *Journal of Development Economics*, Vol. 66, No. 1, October, pp. 51-86.

Baily, Martin Neil; Charles Hulten; and David Campbell [1992], "Productivity Dynamics in Manufacturing Plants," *Brookings Papers on Economic Activity, Microeconomics*, pp. 187-267.

Bakht, Zaid; Mohammad Yunus; and Md. Salimullah [2002], *Machinery Industry in Bangladesh*, IDEAS Machinery Industry Study Report No. 4, Chiba, Japan: Institute of Developing Economies Advanced School (IDEAS) (http://www.ide.go.jp/English/Publish/Ideas/machine_04.html).

Bangladesh Bureau of Statistics (BBS) [2003], *Report of the Household Income and Expenditure Survey 2000*, Dhaka: BBS.

Bangladesh Bureau of Statistics (BBS) [2004], *Report on Bangladesh Census of manufacturing Industries (CMI), 1999-2000*, Dhaka: BBS.

Bangladesh Garment Manufacturers and Exporters Association (BGMEA) [2001], *BGMEA Members Directory 2000-2001*, Dhaka: BGMEA.

Bangladesh Garment Manufacturers and Exporters Association (BGMEA) [2003], *BGMEA Members Directory 2002-2003,* Dhaka: BGMEA.

Basu, Susanto [1996], "Procyclical Productivity: Increasing Returns or Cyclical Utilization?" *Quarterly Journal of Economics*, Vol. 111, Issue 3, August, pp. 719-751.

Batra, Geeta; Daniel Kaufmann; and Andrew H. Stone [2003], *Investment Climate around the World: Voices of the Firms from the World Business Environment Survey*, Washington, D.C.: World Bank.

Bhattacharya, Debapriya; and Mustafizur Rahman [2001], "Bangladesh's Apparel Sector: Growth Trends and the Post-MFA Challenges," in Pratima Paul-Majumder and Binayak Sen, eds., *Growth of Garment Industry in Bangladesh: Economic and Social Dimensions*, Dhaka: Bangladesh Institute of Development Studies (BIDS), pp. 2-26.

Bhattacharya, Debapriya; and Mustafizur Rahman [2002], "Female Employment undr Export-Propelled Industrialization: Prospects for Internalizing Global Opportunities in the Apparel Sector in Bangladesh," in Carol Miller and Jessica Vivian, eds., *Women's Employment in the Textile Manufacturing Sectors of Bangladesh and Morocco*, Geneva: United Nations Research Institute for Social Development, Chapter 7, pp. 219-262.

Bils, Mark; and Jang-Ok Cho [1994], "Cyclical Factor Utilization," *Journal of Monetary Economics*, Vol. 33, No. 2, April, 319-354.

Burnside, Craig; Martin Eichenbaum and Sergio Rebelo [1995], "Capital Utilization and

Returns to Scale," in Ben S. Bernanke and Julio J. Rotemberg eds., *NBER Macroeconomics Annual 1995*, Cambridge: MIT Press, pp. 67-110.

Caves, Douglas W.; Laurits R. Christensen; and W. Erwin Diewert [1982], "Multilateral Comparisons of Output, Input, and Productivity Using Superlative Index Numbers," *Economic Journal*, Vol. 92, No. 365, March, pp. 73-86.

Dr. Martelli Associates [1999], *Bangladesh, Textile Study (Phase II), Interim Report*, Washington, D.C.: International Finance Corporation (IFC).

Eifert, Benn; Alan Gelb; and Vijaya Ramachandran [2005], "Business Environment and Comparative Advantage in Africa: Evidence from the Investment Climate Data," Washington, D.C.: World Bank (http://www1.worldbank.org/rped/documents/rped126.pdf).

Fecher, Fabienne; and Sergio Perelman [1992], "Productivity Growth and Technical Efficiency in OECD Industrial Activities," in Richard E. Caves and associates, *Industrial Efficiency in Six Nations*, Cambridge, Massachusetts, and London: MIT Press, Chapter 12, pp. 459-488.

Fujita, Masahisa; and Jacques-François Thisse [2002], *Economics of Agglomeration: Cities, Industrial Location, and Regional Growth*, Cambridge: Cambridge University Press.

Gereffi, Gary; John Humphrey; Raphael Kaplinsky; and Timothy J. Sturgeon [2001], "Introduction: Globalisation, Value Chains and Development," *IDS Bulletin*, Vol. 32, No. 3, July, pp. 1-8.

Hassan, M. Kabir [2000], "The Impact of Trade Liberalization on Technical Progress and Efficiency Change on Industry in Bangladesh," Mimeographed, New Orleans: Department of Economics and Finance, University of New Orleans.

Hewett, Paul; and Sajeda Amin [2001], "Assessing the Impact of Garment Work on Quality of Life Measures," in Pratima Paul-Majumder and Binayak Sen, eds., *Growth of Garment Industry in Bangladesh: Economic and Social Dimensions*, Dhaka: Bangladesh Institute of Development Studies, pp. 145-171.

Hill, Hal; and K. P. Kalirajan [1993], "Small Enterprise and Firm-level Technical Efficiency in the Indonesian Garment Industry," *Applied Economics*, Vol. 25, No. 9, September, pp. 1137-1144.

Hoque, Khondoker Bazlul; Mayumi Murayama; and S. M. Mahfuzur Rahman [1995], *Garment Industry in Bangladesh: Its Socio-Economic Implications*, Joint Research Program Series No. 116, Tokyo: Institute of Developing Economies.

Iftikhar-ul-Awwal, A. Z. M. [1982], *The Industrial Development of Bengal, 1900-1939*, New Delhi: Vikas Publishing House.

Islam, Sadequl [2001], *The Textile and Clothing Industry of Bangladesh in a Changing World Economy*, Dhaka: University Press.

Kabeer, Naila; and Simeen Mahmud [2004], "Globalization, Gender and Poverty: Bangladeshi Women Workers in Export and Local Markets," *Journal of International Development*, Vol. 16, No. 1, January, pp. 93-109.

Kee, Hiau Looi [2005], "Foreign Ownership and Firm Productivity in Bangladesh Garment Sector," Mimeographed, Development Research Group, World Bank.

Kumbhakar, Subal C.; and C. A. Knox Lovell [2000], *Stochastic Frontier Analysis*, Cambridge, UK: Cambridge University Press.

Larry, Hal B. [1968], *Imports of Manufactures from Less Developed Countries*, New York: National Bureau of Economic Research.

Latif, Muhammad Abdul [1997], *Handloom Industry of Bangladesh, 1947-90*, Dhaka: University Press Limited.

Little, Ian M. D.; Dipak Mazumdar; and John M. Page, Jr. [1987], *Small Manufacturing Enterprises: A Comparative Analysis of India and Other Economies*, New York: Oxford University Press.

Mazumdar, Dipak; and Ata Mazaheri [2003], *The African Manufacturing Firm: An Analysis Based on Firm Surveys in Seven Countries in Sub-Saharan Africa*, London: Routledge.

Nadvi, Khalid [2003], Globalisation and the Challenges to Bangladesh's Garment Industry," Paper presented at the Seminar on "A Value Chain Analysis of the RMG Sector in Bangladesh: Beyond MFA," jointly organized by the Bangladesh Institute of Development Studies (BIDS) and Oxfam-GB Bangladesh Programme on January 18-19, 2003.

Nordås, Hildegumn Kyvik [2004], "The Global Textile and Clothing Industry Post the Agreement on Textiles and Clothing," WTO Discussion Paper No. 5, Geneva: World Trade Organization (WTO).

Osmani, S.R.; Wahiduddin Mahmud; Binayak Sen; Hulya Dagdeviren; and Anuradha Seth [2003], *The Macroeconomics of Poverty Reduction: The Case Study of Bangladesh*, Dhaka: United Nations Development Programme (UNDP).

Paul-Majumder, Pratima [2003], *Health Status of the Garment Workers in Bangladesh*, Dhaka: Bangladesh Institute of Development Studies.

Project Promotion and Management Associates [2000], *Report on Survey to Assess the Requirement of Technologists/Technicians for Textile Sector of Bangladesh During Next 10 Years, Volume - II*, Dhaka: Department of Textiles, Government of the People's Republic of Bangladesh.

Quddus, Munir; and Salim Rashid [2000], *Entrepreneurs and Economic Development: The Remarkable Story of Garment Exports from Bangladesh*, Dhaka: University Press.

Rhee, Yung Whee [1990], "The Catalyst Model of Development: Lessons from Bangladesh's Success with Garment Exports," *World Development*, Vol. 18, No. 2, February, pp. 333-346.

Roberts, Mark J.; and James R. Tybout [1996], "Industrial Evolution in Developing Countries: A Preview," in Mark J. Roberts and James R. Tybout, eds., *Industrial Evolution in Developing Countries: Micro Patterns of Turnover, Productivity, and Market Structure*, New York: Oxford University Press, pp. 1-15.

Sachs, Jeffrey D. [2005], *The End of Poverty: Economic Possibilities for Out Time*, New York: Penguin Press.

Salim, Ruhul A. [1999], *Capacity Realization and Productivity Growth in a Developing Country: Has Economic Reform Had Impact?*, Aldershot, UK: Ashgate.

Shea, John [1997], "Instrument Relevance in Multivariate Linear Models: A Simple Measure," *Review of Economics and Statistics*, Vol. 79, No. 2, May, pp. 348-352.

Siddiqi, Hafiz G. A. [2004], *The Readymade Garment Industry of Bangladesh*, Dhaka: University Press.

Staiger, Douglas; and James H. Stock [1997], "Instrumental Variables Regression with Weak

Instruments," *Econometrica*, Vol. 65, No. 3, May, pp. 557-586.

Tybout, James R. [2000], "Manufacturing Firms in Developing Countries: How Well Do They Do, and Why?" *Journal of Economic Literature*, Vol. 38, No. 1, March, pp. 11-44.

Tyler, William G.; and Lung-Fei Lee [1979], "On Estimating Stochastic Frontier Production Functions and Average Efficiency: An Empirical Analysis with Columbian Micro Data," *Review of Economics and Statistics*, Vol. 61, No. 3, August, pp. 436-438.

United Nations Industrial Development Organization (UNIDO) [2002], *Industrial Development Report 2002/2003: Competing through Innovation and Learning*, Vienna: UNIDO.

United Nations Industrial Development Organization (UNIDO) [forthcoming], *Industrialization and Poverty Alleviation: Pro-Poor Industrialization Strategies Revisited*, a report for the UNIDO Research Programme of Combating Marginalization and Poverty through Industrial Development, Vienna: UNIDO.

Wood, Adrian [1994], *North-South Trade, Employment and Inequality*: *Changing Fortunes in a Skill-Driven World*, Oxford: Clarendon Press.

Wood, Adrian [2003], "Could Africa Be Like America?" in Boris Pleskovic and Nicholas Stern, eds., *Annual World Bank Conference on Development Economics 2003: The New Reform Agenda*, Washington, D.C.: World Bank and New York: Oxford University Press, pp. 163-200.

World Bank [1990], *World Development Report 1990: Poverty*, New York: Oxford University Press.

World Bank [1993], *The East Asian Miracle*, New York: Oxford University Press.

World Bank [2004], *World Development Report 2005: A Better Investment Climate for Everyone*, Washington, D.C.: World Bank and New York: Oxford University Press.

Zohir, Salma Chaudhuri [2003], "Emerging Issues in the RMG Sector of Bangladesh: Insights from an Enterprise Survey," Paper presented at the Seminar on "A Value Chain Analysis of the RMG Sector in Bangladesh: Beyond MFA," jointly organized by the Bangladesh Institute of Development Studies (BIDS) and Oxfam-GB Bangladesh Programme on January 18-19, 2003.

Zohir, Salma Chaudhuri; and Pratima Paul-Majumder [1996], *Garment Workers in Bangladesh: Economic, Social and Health Condition*, Dhaka: Bangladesh Institute of Development Studies.

Table 1. Annual growth rates of export value of woven and knit garments from Bangladesh in terms of US dollar (Unit: %)

Fiscal year	Woven garments	Knitwear
1996-97	14.8	27.6
1997-98	27.1	23.2
1998-99	5.0	10.1
1999-00	3.3	22.6
2000-01	9.1	17.8
2001-02	-7.1	-2.5
2002-03	4.3	13.3
2003-04	8.6	29.9
2004-05	1.7	31.2

Source: Ministry of Finance (MOF), *Bangladesh Economic Review 2005*, Dhaka: MOF, 2005.

Table 2. Average monthly wage of sample firms (Unit: Taka)

	Experience	less than 1 year		1-5 years		6 years +		Total		
	Sex	M	F	M	F	M	F	M	F	Both
Administration Section	Managerial/ Executive	4000	15000	9661	7500	13695	9423	12415	9210	12293
	Other Officer	3688	-	5139	5673	8669	15000	7131	8005	7142
Knitting Section (Knit Fabrics)	Engineer	-	-	6962	-	8295	8000	8153	8000	8152
	Supervisor	-	-	4053	-	4923	5000	4632	5000	4633
	Operator	1583	-	3349	-	3343	4000	3334	4000	3334
	Helper	1512	1500	1518	-	1919	2000	1600	1625	1600
Knitting Section (Knit Goods)	Engineer	4000	-	-	-	9286	-	8625	-	8625
	Supervisor	4500	-	4914	4000	5346	4941	5151	4800	5085
	Operator	2500	2500	4515	3271	7053	3603	5269	3454	4979
	Helper	1026	1015	1386	1166	-	-	1311	1110	1213
Sewing Section	Engineer	4875	-	4789	5000	7764	-	7203	5000	7190
	Supervisor	-	2000	3405	4684	4270	4907	3974	4738	4015
	Operator	1686	1600	3008	3053	3394	2995	3218	3015	3153
	Helper	1051	1160	1122	1178	1333	1256	1136	1183	1158
Other Production Sections	Engineer	-	-	9538	-	26222	-	22985	-	22985
	Supervisor	3000	-	3691	4500	4915	4250	4541	4400	4539
	Operator	1758	1527	2911	2339	3823	2500	3325	2243	3114
	Helper	1536	1390	1443	1283	1900	1450	1514	1303	1422

Note: The overall sample size is 232, even though the typical sample firm employs only certain categories of workers classified in the table. The average is taken cell by cell. In other words, all the above figures are conditional mean among firms which employ persons of each combination of features such as section, designation, sex, and experience.

Table 3. Average earnings for work by mode and sector of employment and poverty status in rural areas of Bangladesh in 1999/2000 (Unit: Taka per month per worker)

Status	Farm		Non-Farm		
	Self-employment	Casual Wage Labor	Casual Wage Labor	Self-employment	Salaried Wage Labor
Extreme Poor	411	754	1,013	962	1,403
Moderate Poor	644	898	1,248	1,640	1,785
Moderate Non-Poor	902	893	1,429	2,144	2,146
Rich Non-Poor	1,193	935	1,811	5,990	3,133
All Poor	569	833	1,143	1,431	1,594
All Non-Poor	1,013	918	1,528	3,942	2,682
All Households	829	846	1,300	2,902	2,407

Note: The original source is the *Household Income and Expenditure Survey 2000* (BBS [2003]). The original figures are in terms of daily wage. 25 is multiplied to the daily wage rates in order to derive the monthly earnings.
Source: Osmani *et al*. [2003], Table IV.2, p. 40.

Table 4. Regression of workers' monthly earnings

	Female sewing helper	Male sewing helper	Female sewing operator	Male sewing operator
Intercept	6.837** (0.272)	6.524** (0.356)	7.948** (1.166)	7.440** (1.037)
Production				
Dummy: Making knitwear only	-0.036 (0.044)	-0.066 (0.047)	0.231 (0.147)	
Dummy: Subcontracting in knitting fabrics	0.060 (0.219)	0.105 (0.251)	-0.036 (0.187)	0.304 (0.200)
Dummy: Subcontracting in making garments	0.101 (0.103)	0.175 (0.119)	-0.165 (0.216)	0.028 (0.172)
Log(output)	0.008 (0.014)	0.024 (0.019)	0.007 (0.056)	0.046 (0.053)
Status				
Dummy: Limited company	0.021 (0.033)	-0.024 (0.034)	0.018 (0.116)	-0.060 (0.098)
Dummy: BGMEA member	0.055 (0.370)	0.036 (0.035)	0.134 (0.184)	0.164 (0.107)
Dummy: Joint Venture	0.007 (0.057)	-0.008 (0.048)		0.131 (0.110)
Years since establishment	-0.007 (0.008)	-0.016* (0.008)	0.063 (0.075)	-0.024 (0.083)
Location				
Dummy: Outside Narayanganj	-0.028 (0.038)	-0.001 (0.036)	-0.207 (0.169)	-0.134 (0.124)
Dummy: Savar and Gazipur	-0.181* (0.088)	-0.185** (0.070)	0.491 (0.376)	
Dummy: EPZ (=Foreign-owned)	1.516** (0.109)			
Dummy: BSIC Industrial Area	-0.011 (0.039)	-0.016 (0.035)	0.216 (0.125)	0.248* (0.100)
Management				
Age	0.001 (0.002)	0.001 (0.002)	-0.009 (0.007)	-0.007 (0.006)
Dummy: Education: Higher Secondary Certificate (HSC)	-0.142* (0.068)	-0.122* (0.057)	0.128 (0.464)	-0.060 (0.424)
Dummy: Education: BA	-0.007 (0.063)	0.034 (0.056)	0.205 (0.459)	-0.050 (0.408)
Dummy: Education: MA or higher	-0.079 (0.069)	-0.042 (0.060)	0.010 (0.474)	-0.166 (0.429)
Experience: In the same firm	0.014 (0.009)	0.019* (0.008)	-0.070 (0.072)	0.007 (0.079)
Experience: For knitwear	0.011** (0.004)	0.007 (0.004)	0.021 (0.027)	0.024 (0.021)
Experience: For textile and garment	-0.010** (0.003)	-0.006 (0.004)	-0.012 (0.026)	-0.014 (0.019)
Sample size	145	147	64	84
R^2	0.388	0.209	0.327	0.260
$\bar{R}^2$	0.295	0.098	0.078	0.083

Note: Sample firms engage in making garments with fabrics by either buying fabrics from outside or by producing fabrics by themselves. Firms producing sweaters and socks are excluded. The dependent variable is the logarithm of monthly workers' earnings of workers whose experiences are between 1 year and 5 years. The figures in parentheses are White heteroskedasticity-consistent standard errors. Those with ** and * are significantly different from zero at the 1% and 5% significance levels, respectively.

Table 5. Profit-capital ratio of export-oriented knitwear industry

Sample	Min.	25%	Median	75%	Max.	Mean	s.d.	Negative values	*n*
All	-7.098	0.011	0.673	2.120	37.954	1.570	3.729	55	229
Positive value added	-1.843	0.061	0.744	2.239	37.954	1.820	3.660	42	216
Positive rent	-7.098	-0.014	0.668	1.989	16.328	1.422	3.067	40	159
Positive interest	-4.721	0.053	0.746	2.495	37.954	1.673	4.269	21	101
Knitting fabrics only	-1.953	-0.264	-0.009	0.109	1.385	-0.010	0.834	7	13
Making garments only	-1.500	-0.370	0.099	2.149	15.702	1.819	3.922	12	29
Dyeing fabrics only	0.271	-	0.662	-	1.278	0.737	0.508	0	3
Knitting fabrics and making garments only	-7.098	0.141	0.827	2.495	37.954	1.758	4.189	29	142
Knitting and dyeing fabrics only	-0.147	-	0.010	-	0.610	0.158	0.399	1	3
Dyeing fabrics and making final products only	-1.843	-	0.246	-	0.890	-0.018	1.107	2	5
Knitting and dyeing fabrics, and making final products	-1.344	0.187	0.790	1.736	11.510	1.648	2.445	4	35

Note: The profit-capital ratio is defined as profits divided by the present value of machinery owned by sample firms. s.d. stands for standard deviation. *n* stands for the sample size.

Table 6. Distribution of sample firms by value added and profits (Unit: Number of firms)

		Value added		
		Negative	Positive	Total
Profit	Negative	13	43	56
	Positive	0	174	174
	Total	13	217	230

Note: Two samples are dropped because of some figures to work out value added are not available.

Table 7. Estimation of stochastic frontier of production function:
Firms engaging in both knitting fabrics and making garments only

Output	Gross output	Gross output	Value added	Value added
Factor utilization	Omitted	Included	Omitted	Included
Intercept	8.441**	9.667**	6.699**	8.108**
	(1.606)	(1.512)	(1.829)	(1.737)
Labor	0.552**	0.385*	0.457	0.246
	(0.204)	(0.186)	(0.242)	(0.221)
Capital	0.455**	0.437**	0.513**	0.497**
	(0.120)	(0.122)	(0.140)	(0.142)
Sample size	142	142	134	134
Constant returns to scale:	0.000	1.470	0.020	2.250
χ^2-statistic and [p-value]	[0.971]	[0.226]	[0.880]	[0.133]
Log likelihood	-185.678	-186.631	-190.379	-192.167
σ_F	0.624	0.638	0.741	0.766
	(0.093)	(0.091)	(0.099)	(0.100)
σ_E	1.092	1.082	1.143	1.127
	(0.177)	(0.175)	(0.202)	(0.209)
$\mu \equiv \sigma_E / \sigma_F$	1.749	1.697	1.543	1.473
	(0.251)	(0.246)	(0.278)	(0.286)
Mean technical efficiency	0.503	0.506	0.491	0.495

Note: The mean technical efficiency is the average of $\exp[-E(\varepsilon_{Ei}|u_i)]$. The figures in parentheses are standard errors. Those with ** and * are significantly different from zero at the 1% and 5% significance levels, respectively.

Table 8. Mean technical efficiency of the garment making firms in other developing countries

Country	Mean technical efficiency	Sample size	Survey year	Literature
Columbia	0.554	103	1974	Tyler and Lee [1979]
Indonesia	0.626	2250	1986	Hill and Kalirajan [1993]
Ghana*	0.69	n.a.	n.a.	Mazumdar and Mazaheri [2003]
Kenya*	0.61	n.a.	n.a.	Mazumdar and Mazaheri [2003]
Tanzania*	0.58	n.a.	n.a.	Mazumdar and Mazaheri [2003]
Zambia*	0.63	n.a.	n.a.	Mazumdar and Mazaheri [2003]
Zimbabwe*	0.56	89	1993-95	Mazumdar and Mazaheri [2003]

Note: Countries with * include not only garments but also textile, leather and footwear.

Table 9. Regression of Profit-Capital Ratio: Knitting fabrics, making garments or both

Method	OLS	OLS	2SLS	OLS	2SLS
Intercept	1.765**	-30.174**	-10.906	-30.286**	-9.705
	(0.358)	(10.814)	(9.592)	(10.716)	(9.467)
Production					
Dummy: Knitting fabrics only	-1.861**	-0.452	-1.485	-0.431	-1.540
	(0.422)	(0.942)	(1.232)	(1.047)	(1.276)
Dummy: Making knitwear only	0.287	1.554	1.169	1.441	1.083
	(0.885)	(0.796)	(0.937)	(0.825)	(0.989)
Dummy: Subcontracting in knitting fabrics		3.908*	1.651	4.004*	1.556
		(1.767)	(1.200)	(1.849)	(1.204)
Dummy: Subcontracting in making garments		2.246	-0.361	2.536	-0.374
		(1.695)	(1.455)	(1.903)	(1.471)
Log(output)		1.755**	0.621	1.807**	0.575
		(0.551)	(0.591)	(0.581)	(0.588)
Status					
Dummy: Limited company		-1.377	-1.166	-1.266	-1.092
		(0.976)	(0.926)	(0.894)	(0.868)
Dummy: BGMEA member		0.620	1.371	0.420	1.311
		(0.795)	(1.233)	(0.707)	(1.179)
Dummy: Joint Venture		0.729	0.623	0.878	0.696
		(0.632)	(0.741)	(0.596)	(0.713)
Years since establishment		-0.064	-0.020	-0.084	-0.003
		(0.131)	(0.150)	(0.131)	(0.159)
Location					
Dummy: Outside Narayanganj		-1.130	-1.268	-0.993	-1.203
		(0.643)	(0.711)	(0.656)	(0.723)
Dummy: Savar and Gazipur		-0.482	-0.240	-0.845	-0.421
		(1.101)	(0.808)	(1.235)	(1.006)
Dummy: EPZ (=Foreign-owned)		-4.701**	-2.817	-4.370**	-2.514
		(1.526)	(2.114)	(1.577)	(2.322)
Dummy: BSCIC Industrial Area		0.604	0.324	0.592	0.299
		(1.174)	(1.111)	(1.147)	(1.090)
Management					
Age		0.053	0.056	0.051	0.055
		(0.046)	(0.053)	(0.045)	(0.053)
Dummy: Education: Higher Secondary Certificate (HSC)		0.601	0.788	0.641	0.822
		(0.644)	(0.757)	(0.646)	(0.784)
Dummy: Education: BA		0.630	0.530	0.766	0.597
		(0.918)	(0.939)	(0.991)	(1.011)
Dummy: Education: MA or higher		0.942	0.982	1.015	1.025
		(0.768)	(0.845)	(0.797)	(0.892)
Experience: In the same firm		0.102	0.065	0.131	0.078
		(0.144)	(0.164)	(0.139)	(0.167)
Experience: For knitwear		-0.044	-0.048	-0.082	-0.054
		(0.071)	(0.079)	(0.049)	(0.085)
Experience: For textile and garment		-0.076	-0.056	-0.937	-0.058
		(0.048)	(0.061)	(0.953)	(0.062)
Others					
Dummy: Factory rented				-0.937	-0.508
				(0.953)	(0.864)
Sample size	178	177	177	177	177
R^2	0.016	0.280	0.205	0.288	0.201
$\bar{R}^2$	0.004	0.188	0.103	0.192	0.093
F-statistic: Error on instruments			0.215		0.210
			[1.000]		[1.000]

Note: The sample includes firms knitting fabrics, making knitwear, and engaging in the two activities. Those engaging in other activities such as dyeing fabrics, knitting sweater, or knitting socks are excluded. The profit-capital ratio is defined as profits divided by the present value of machinery owned by sample firms. Leasing machinery is not common in Bangladesh as far as main machines are concerned. The depreciation rate used for the perpetual inventory method is 5%. As for 2SLS, instrumental variables are all explanatory variables but log (output); monthly operation rate, and industrial-policy-related variables detailed in the text. The figures in parentheses are White heteroskedasticity-consistent standard errors. Those in square brackets are p-values. The estimates with ** and * are significantly different from zero at the 1% and 5% significance levels, respectively.

Table 10. Regression of Profit-Capital Ratio: Knitting fabrics or both knitting fabrics and making garments

Method	OLS	2SLS	OLS	2SLS
Intercept	-31.121*	3.571	-28.184*	4.263
	(13.908)	(19.478)	(12.006)	(18.687)
Production				
Dummy: Knitting fabrics only	-0.860	-2.462	-0.716	-2.484
	(1.172)	(2.023)	(1.143)	(2.049)
Dummy: Subcontracting in knitting fabrics	4.796	0.226	5.357	0.406
	(2.532)	(2.435)	(2.748)	(2.692)
Dummy: Subcontracting in making garments	2.425	-1.289	2.677	-1.034
	(1.620)	(2.270)	(1.837)	(2.248)
Log(output)	1.831*	-0.299	1.956*	-0.267
	(0.739)	(1.291)	(0.795)	(1.308)
Status				
Dummy: Limited company	-1.755	-1.407	-1.480	-1.282
	(1.149)	(1.093)	(0.990)	(1.026)
Dummy: BGMEA member	0.665	2.095	0.424	1.972
	(0.784)	(1.782)	(0.729)	(1.688)
Dummy: Joint Venture	0.663	0.445	1.052	0.599
	(0.683)	(0.904)	(0.622)	(0.855)
Years since establishment	0.041	0.226	-0.038	0.197
	(0.326)	(0.455)	(0.292)	(0.437)
Location				
Dummy: Outside Narayanganj	-0.473	-1.268	-0.177	-1.154
	(0.765)	(0.997)	(0.822)	(0.997)
Dummy: Savar and Gazipur	-1.126	-0.707	-1.567	-1.011
	(1.303)	(1.202)	(1.371)	(1.391)
Dummy: BSCIC Industrial Area	0.766	0.281	0.740	-1.011
	(1.361)	(1.277)	(1.307)	(1.391)
Manamement				
Age	0.051	0.079	0.046	0.077
	(0.051)	(0.082)	(0.048)	(0.080)
Dummy: Education: Higher Secondary Certificate (HSC)	0.306	0.903	0.203	0.930
	(0.811)	(1.050)	(0.839)	(1.128)
Dummy: Education: BA	0.292	0.670	0.371	0.787
	(0.834)	(1.165)	(0.821)	(1.248)
Dummy: Education: MA or higher	0.946	1.756	0.905	1.817
	(0.743)	(1.172)	(0.718)	(1.233)
Experience: In the same firm	-0.011	-0.189	0.082	-0.150
	(0.355)	(0.491)	(0.313)	(0.464)
Experience: For knitwear	-0.024	-0.052	-0.047	-0.061
	(0.072)	(0.101)	(0.081)	(0.106)
Experience: For textile and garment	-0.088	-0.023	-0.093	-0.028
	(0.048)	(0.095)	(0.050)	(0.092)
Others				
Log(machine price): Circular knitting machine			-0.309	-0.046
			(0.265)	(0.246)
Dummy: Factory rented			-1.341	-0.795
			(1.039)	(1.043)
Sample size	152	152	152	152
R^2	0.264	0.057	0.287	0.069
$\bar{R}^2$	0.165	-0.071	0.178	-0.073
F-statistic: Error on instruments		0.216		0.205
		[1.000]		[1.000]

Note: The sample includes firms engaging in only knitting fabrics, and those engaging in both knitting fabrics and making knitwear. Those that do not engage in knitting fabrics are excluded as well as those engaging in other activities such as dyeing fabrics, knitting sweater, or knitting socks. The profit-capital ratio is defined as profits divided by the present value of machinery owned by sample firms. Leasing machinery is not common in Bangladesh as far as main machines are concerned. The depreciation rate used for the perpetual inventory method is 5%. As for 2SLS, instrumental variables are all explanatory variables but log (output); monthly operation rate, and industrial-policy-related variables detailed in the text. The figures in parentheses are White heteroskedasticity-consistent standard errors. Those in square brackets are *p*-values. The estimates with ** and * are significantly different from zero at the 1% and 5% significance levels, respectively.

Table 11. Regression of Profit-Capital Ratio: Making garments or both knitting fabrics and making garments

Method	OLS	2SLS	OLS	2SLS
Intercept	-33.374**	-8.937	-32.049	5.060
	(11.810)	(17.039)	(23.477)	(22.169)
Production				
Dummy: Making knitwear only	1.637*	2.161	1.543	1.741
	(0.813)	(4.137)	(0.923)	(4.223)
Dummy: Subcontracting in knitting fabrics	3.930	0.545	3.621	0.241
	(2.181)	(2.118)	(2.026)	(2.097)
Dummy: Subcontracting in making garments	2.698	-1.041	3.019	-0.908
	(1.852)	(1.937)	(2.029)	(1.862)
Log(output)	1.932**	0.494	1.977**	0.426
	(0.598)	(1.024)	(0.621)	(1.023)
Status				
Dummy: Limited company	-1.415	-1.265	-1.320	-1.192
	(1.033)	(0.968)	(0.962)	(0.914)
Dummy: BGMEA member	0.462	1.523	0.280	1.500
	(0.802)	(1.546)	(0.720)	(1.453)
Dummy: Joint Venture	0.688	0.658	0.845	0.704
	(0.675)	(1.009)	(0.636)	(1.001)
Years since establishment	-0.035	-0.027	-0.063	-0.047
	(0.147)	(0.185)	(0.178)	(0.213)
Location				
Dummy: Outside Narayanganj	-1.244	-1.544	-1.124	-1.433
	(0.689)	(1.099)	(0.701)	(1.126)
Dummy: Savar and Gazipur	-0.625	0.286	-1.087	-0.138
	(1.050)	(2.132)	(1.270)	(2.037)
Dummy: EPZ (=Foreign-owned)	-4.909**	-3.784	-4.436*	-2.876
	(1.515)	(6.440)	(1.810)	(6.199)
Dummy: BSCIC Industrial Area	0.595	0.258	0.548	0.218
	(1.250)	(1.154)	(1.161)	(1.085)
Management				
Age	0.060	0.060	0.056	0.057
	(0.051)	(0.056)	(0.050)	(0.058)
Dummy: Education: Higher Secondary Certificate (HSC)	0.757	0.927	0.810	0.921
	(0.670)	(0.733)	(0.719)	(0.826)
Dummy: Education: BA	0.564	0.507	0.666	0.538
	(0.969)	(0.970)	(1.058)	(1.127)
Dummy: Education: MA or higher	1.005	1.049	1.028	1.007
	(0.848)	(0.817)	(0.905)	(0.963)
Experience: In the same firm	0.061	0.058	0.092	0.078
	(0.160)	(0.197)	(0.182)	(0.221)
Experience: For knitwear	-0.043	-0.054	-0.051	-0.056
	(0.072)	(0.081)	(0.082)	(0.093)
Experience: For textile and garment	-0.084	-0.046	-0.091	-0.050
	(0.048)	(0.063)	(0.050)	(0.0650)
Others				
Log(machine price): Sewing machine			-0.107	-0.198
			(1.459)	(1.483)
Dummy: Factory rented			-0.966	-0.470
			(1.016)	(1.020)
Sample size	164	164	164	164
R^2	0.285	0.169	0.293	0.165
$\overline{R}^2$	0.191	0.060	0.189	0.042
F-statistic: Error on instruments		0.272		0.223
		[1.000]		[1.000]

Note: The sample includes firms engaging in only making knitwear, and those engaging in both knitting fabrics and making knitwear. Those that do not engage in making knitwear are excluded as well as those engaging in other activities such as dyeing fabrics, knitting sweater, or knitting socks. The profit-capital ratio is defined as profits divided by the present value of machinery owned by sample firms. Leasing machinery is not common in Bangladesh as far as main machines are concerned. The depreciation rate used for the perpetual inventory method is 5%. As for 2SLS, instrumental variables are all explanatory variables but log (output); monthly operation rate, and industrial-policy-related variables detailed in the text. The figures in parentheses are White heteroskedasticity-consistent standard errors. Those in square brackets are p-values. The estimates with ** and * are significantly different from zero at the 1% and 5% significance levels, respectively.

Table 12. Regression of productivity: Knitting fabrics, making garments or both

Dependent variable	TFP1	TFP1	TFP2	TFP2	Solow	Solow
Method	OLS	2SLS	OLS	2SLS	OLS	2SLS
Intercept	-14.876**	-7.068*	-16.745**	-15.466**	-13.980**	-5.796
	(1.282)	(3.151)	(1.118)	(2.523)	(1.299)	(3.180)
Production						
Dummy: Knitting fabrics only	0.620	0.508	0.617	0.604	-0.117	-0.234
	(0.846)	(0.760)	(0.885)	(0.871)	(0.840)	(0.746)
Dummy: Making knitwear only	-0.211	-0.372	-0.303	-0.321	-0.043	-0.213
	(0.243)	(0.310)	(0.202)	(0.222)	(0.234)	(0.304)
Dummy: Subcontracting in knitting fabrics	1.281	0.112	1.610	1.474	1.262	0.369
	(0.878)	(0.914)	(0.906)	(0.985)	(0.867)	(0.895)
Dummy: Subcontracting in making garments	0.291	-0.867	0.537	0.402	0.172	-1.041
	(0.540)	(0.742)	(0.527)	(0.585)	(0.524)	(0.758)
Log(output)	0.809**	0.358*	0.895**	0.842**	0.763**	0.290
	(0.071)	(0.179)	(0.059)	(0.142)	(0.070)	(0.182)
Status						
Dummy: Limited company	-0.198	-0.133	-0.140	-0.133	-0.241	-0.172
	(0.142)	(0.164)	(0.127)	(0.129)	(0.139)	(0.164)
Dummy: BGMEA member	0.104	0.440	0.091	0.131	0.074	0.426
	(0.141)	(0.231)	(0.131)	(0.171)	(0.143)	(0.221)
Dummy: Joint Venture	0.995**	0.957**	0.886**	0.882**	0.928**	0.888**
	(0.378)	(0.341)	(0.227)	(0.223)	(0.283)	(0.254)
Years since establishment	-0.084*	-0.074	-0.077*	-0.076*	-0.064	-0.054
	(0.038)	(0.048)	(0.038)	(0.036)	(0.040)	(0.044)
Location						
Dummy: Outside Narayanganj	0.064	0.088	0.065	0.068	-0.081	-0.056
	(0.182)	(0.223)	(0.149)	(0.150)	(0.182)	(0.226)
Dummy: Savar and Gazipur	-0.928	-0.484	-0.852	-0.800	0.921	-0.455
	(0.728)	(0.854)	(0.686)	(0.701)	(0.654)	(0.785)
Dummy: EPZ (=Foreign-owned)	-0.785	-0.446	-0.786	-0.746	-1.098	-0.743
	(0.747)	(0.936)	(0.702)	(0.732)	(0.681)	(0.870)
Dummy: BSCIC Industrial Area	0.013	-0.104	0.049	0.036	0.005	-0.118
	(0.173)	(0.188)	(0.157)	(0.162)	(0.174)	(0.188)
Management						
Age	0.024*	0.022*	0.017*	0.017*	0.024**	0.022*
	(0.009)	(0.010)	(0.007)	(0.007)	(0.009)	(0.010)
Dummy: Education: Higher Secondary Certificate (HSC)	0.058	0.181	0.062	0.077	0.176	0.305
	(0.210)	(0.263)	(0.205)	(0.209)	(0.236)	(0.267)
Dummy: Education: BA	-0.086	-0.124	-0.126	-0.130	0.016	-0.024
	(0.185)	(0.249)	(0.183)	(0.186)	(0.220)	(0.263)
Dummy: Education: MA or higher	0.240	0.203	0.124	0.119	0.371	0.332
	(0.207)	(0.250)	(0.185)	(0.187)	(0.230)	(0.259)
Experience: In the same firm	0.110**	0.105*	0.104*	0.104*	0.092*	0.087
	(0.042)	(0.051)	(0.042)	(0.040)	(0.044)	(0.046)
Experience: For knitwear	0.005	-0.003	0.001	0.000	0.004	-0.005
	(0.019)	(0.022)	(0.019)	(0.019)	(0.018)	(0.020)
Experience: For textile and garment	-0.041**	-0.030	-0.036*	-0.035*	-0.042**	-0.030
	(0.016)	(0.178)	(0.015)	(0.015)	(0.015)	(0.017)
Sample size	166	166	166	166	166	166
R^2	0.645	0.534	0.707	0.705	0.626	0.498
$\bar{R}^2$	0.596	0.469	0.667	0.665	0.574	0.429
F-statistic: Error on instruments		0.558		0.185		0.530
		[0.958]		[1.000]		[0.970]

Note: The sample includes firms knitting fabrics, making knitwear, and engaging in the two activities. Those engaging in other activities such as dyeing fabrics, knitting sweater, or knitting socks are dropped. As for 2SLS, instrumental variables are all explanatory variables but log (output); monthly operation rate, and industrial-policy-related variables detailed in the text. The figures in parentheses are White heteroskedasticity-consistent standard errors. Those in square brackets are p-values. The estimates with ** and * are significantly different from zero at the 1% and 5% significance levels, respectively.

Figure 1. Distribution of sample firms in average price of circular knitting machines

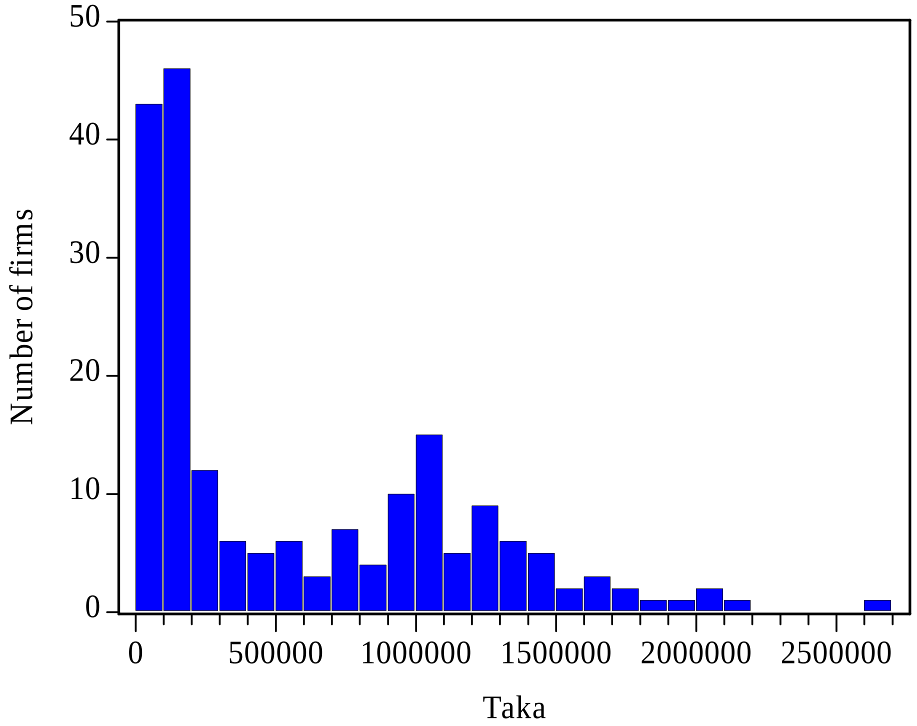
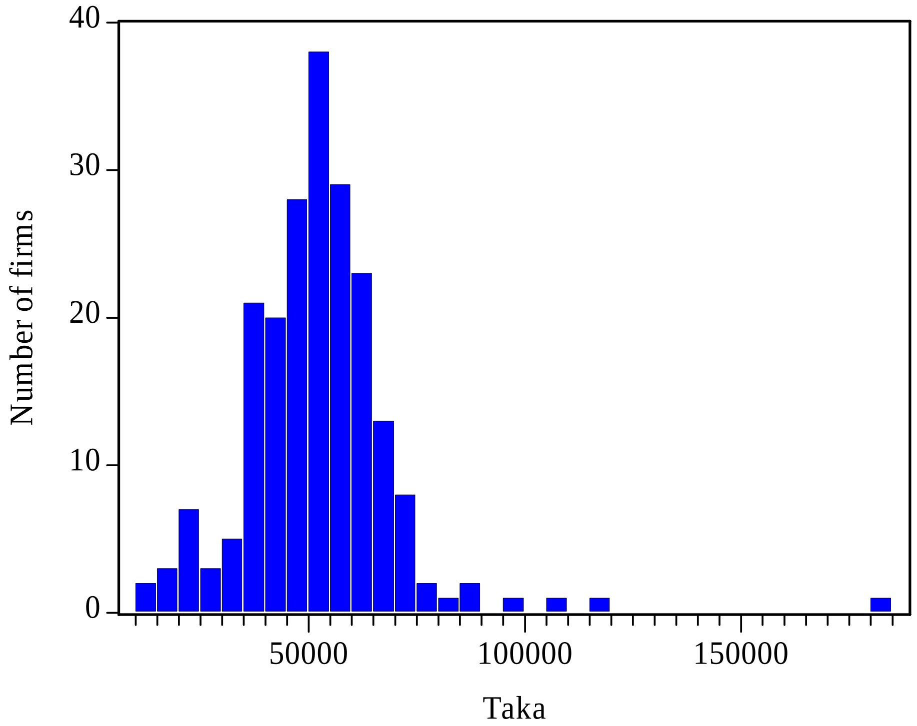


Figure 2. Distribution of sample firms in average price of sewing machines



Appendix 1. Data

A1.1. Sampling method

The data used in this paper was collected for a joint research project of the Institute of Developing Economies (IDE), Japan, and the Bangladesh Institute of Development Studies (BIDS) for July-October 2001. The Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA) fully cooperated the project. Part of study using this data set is summarized in Bakht, Yunus and Salimullah [2002].

All export-oriented knitwear producers were members of either BKMEA or the Bangladesh Garment Manufacturers and Exporters Association (BGMEA). Before January 1, 2005, firms needed to have a "visa" to export most of textiles and wearing apparels to the United States because the U.S. imposed import ceilings to Bangladesh by commodity, which is called "quota". Any knitwear producing firms need to belong to either association or both to attain visas for the U.S. market. In 2001 there were 587 member establishments in BKMEA, while 599 firms out of total 3205 BGMEA member firms engaged in knitwear production (BGMEA [2001]). Since some firms have memberships of the two associations, the upper bound of number of export-oriented knitwear producing firms in Bangladesh was 1,186 in 2001.

All BKMEA member firms whose factories were located in the Dhaka Division, which is one of five geographical divisions in Bangladesh, were supposed to be covered by the survey. The Dhaka Division covers main districts where export-oriented garment production is flowering, such as Dhaka, Narayanganj and Gazipur Districts. A caveat is that firms operating in Chittagong which is the second greatest garment producing division, were not covered for efficient allocation of resources. However, as Table A1 shows BKMEA members are concentrated to the Narayanganj District, and the number of Chittagong members is small. Finally, it should be noted that we did not visit knitwear producing firms which were members of BGMEA and not of BKMEA.

Table A1. Geographical distribution of BKMEA members firms by contact address

District	Number of firms	Share (%)
Narayanganj	418	71.2
Dhaka	142	24.2
Chittagong	13	2.2
Gazipur	12	2.0
Khulna	1	0.0
Mymensingh	1	0.0
Total	587	100.0

Source: The member list of the Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA) in 2001.

Our survey team attempted to visit all BKMEA member firms located in the Dhaka

Division, which amounts to 573. It turned out that 16 firms had been closed down out of 573. In the end, we collected 251 questionnaires. However, we could not help but drop 19 of them due to inconsistencies in record on those questionnaires. Finally, 232 questionnaires remain eligible for empirical analyses.

Table A2. Geographical distribution of sample firms

Area			# of firms	Share (%)
Narayanganj District			200	86.2
	Chashara		12	
	Fatullah	All	85	
		Masdair	12	
		BSCIC Industrial Area	43	
	City	All	43	
		Bangabandhu Road	27	
		Nayamati	16	
Dhaka District			26	11.2
	Mirpur		7	
	Savar	All	6	
		EPZ	2	
Gazipur District			5	2.2
Unknown			1	0.4
Total			232	100.0

Note: BSCIC is the abbreviation of the Bangladesh Small and Cottage Industries Corporation. EPZ stands for Export Processing Zone.

Table A3. Composition of interviewees

Title	# of firms	Share (%)
Managing Director	50	21.55
General Manager	33	14.22
Director	32	13.79
Commercial Manager	21	9.05
Production Manager	20	8.62
Manager	17	7.33
Proprietor	10	4.31
Chairman	9	3.88
Executive Director	8	3.45
Managing Partner	4	1.72
Advisor	2	0.86
Chief Accountant	2	0.86
CEO	1	0.43
Factory Manager	1	0.43
Others	22	9.48
Total	232	100

Table A2 displays geographical distribution of sample firms in the data set. The combination of shares of sample firms in Narayanganj and Dhaka are roughly comparable between all BKMEA members and the sample. In this sense, the data set which we constructed generally represents the set of BKMEA member firms. A possibly critical under-representation in the sample lies in the number of foreign-owned firms. This issue will be detailed shortly.

Table A3 confirms that most questionnaires were answered by responsible officers in each firm.

A1.2. Overview of sample firms

This section provides basic statistical facts derived from the survey data. Main topics are sources of capital, variety of products, age of firms since establishment, scale of operation, characters of management, and structure of employment.

Sources of capital

First, even though the export-oriented garment production was triggered by South Korean FDIs (Rhee [1990]), foreign firms currently present relatively low profile in the garment industry in Bangladesh. This was partly because the export-oriented garment business was somehow regarded to be in “excess competition” for visa to export to the United States, so that it was hard for new foreign entrants to secure the visas, even though the export-oriented garment business was growing rapidly. In other words, an increase in local capital sufficed that rapid growth of the industry. Thus, right after the MFA phase out was completed in January 1, 2005, some influential foreign investors in India and the Middle East publicized their intention to invest in export-oriented garment production in Bangladesh.

Table A4. Composition of firms by source of capital

Source of capital	# of firms	Share (%)
Local	224	96.55
Joint venture	2	0.86
Foreign owners	2	0.86
Trust	1	0.43
Others	3	1.29
Total	232	100

Table A4 testifies the low profile of FDIs and joint ventures. Their share of sample firms is less than 2% in total. However, it should be noted that this share in terms of number of firms with foreign capital seems to be underestimated because there was a tendency that foreign owned firms often refused our interview, as well as large scale firms and those located in EPZs. They appeared to be more cautious in disclosing any information of themselves than ordinary, small and local firms.

Variety of products

BKMEA member firms engage in four activities at most: (1) Making final products, which is further divided into two types, namely making final products from fabrics and doing so from yarn. Most knitwear such as T-shirts, polo shirts, and trousers is categorized as the former. By contrast, sweaters and socks are made directly from yarns; (2) Knitting fabrics; (3) Dyeing knit fabrics; and (4) Finishing knit fabrics through physical and chemical treatments. The sample firms engage in a combination of these four activities. Table A5 shows that more than a half sample firms engage in the following two production processes only: knitting fabrics and making final products with sewing machines.

Table A5. Composition of firms by production process

Production processes	# of firms	Share (%)
Knitting fabrics only	13	5.6
Final products only	29	12.5
Dyeing only	3	1.3
Knitting fabrics and making final products	144	62.1
Knitting and Dyeing fabrics	3	1.3
Dyeing fabrics and making final products	5	2.2
Knitting and dyeing fabrics, and making final products	35	15.1
Total	232	100.0

Note: Firms producing sweaters and socks are categorized under "Final products only".

Age of firms since establishment

Table A6 indicates that the knitwear industry is a very young sector, that more than a half of sample firms were established within five years from the date of interview. Firms operating for longer than ten years amount to only a little greater than 10%.

Table A6. Chronological distribution of sample firms

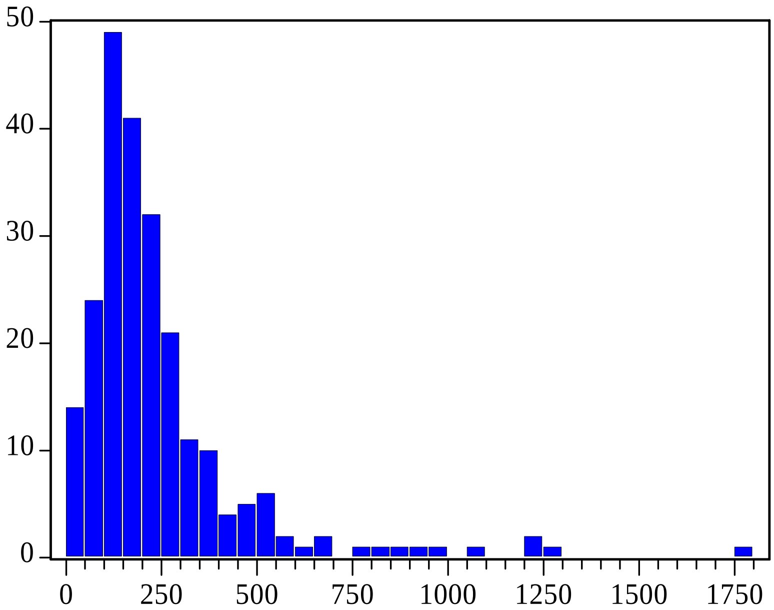
	# of firms	Share (%)
before 1976	4	1.7
1976 - 1980	0	0.0
1981 - 1985	3	1.3
1986 - 1990	19	8.2
1991 - 1995	67	28.9
1996 - 2000	133	57.3
2001	6	2.6
Total	232	100.0

Scale of operation

The scale of export-oriented garment producing firms is greater than those in other manufacturing industries partly because of its labor-intensiveness. The average number of employees of 2891 BGMEA member firms which filed the number to BGMEA in 2002/03 was 399 (BGMEA [2003]). According to Little, Mazumdar and Page [1987], "small" firms are likely to be defined as those with fewer than 50 workers, and "medium-sized" firms to be those with 50-99 workers for developing economies (Little, Mazumdar and Page [1987], p. 8). Compared with those standards, the scale of average export-oriented garment producer in terms of the number of workers is great. 96 firms out of the 2891 BGME members employed 1000 employees or more, and the greatest firm employed 7600 employees.

Figure A1 displays the distribution of our 232 sample firms. The average and median number of employed persons are 245 and 230, respectively. The magnitude of the average figure is roughly comparable to that of the BGMEA member firms in 2002/03.

Figure A1. Distribution of sample firms by the number of employed persons



Note: The mean of the number of employed persons is 245, while the median, maximum, minimum, and standard deviation, are 184, 1772, 8, and 230, respectively. The sample size is 232.

Characters of management

It was not easy to understand the structure of corporate governance of each sample firm. Typically, the director general is the top manager of a firm. However, in some firms the top manager is called by a different title such as general manager, chief executive officer (CEO), chairman and so on. Therefore, we asked who the "most influential decision-maker" was, to specify the top manager, and filled in designation of the person. Then, attributes of the top manager were asked (see Appendix 3 for the questionnaire).

Tables A7 and A8 present a general overview of the attributes of management. It turns out that the average age of the “most influential decision-maker” is a little over 40 years old, whose experience is 5.9 years in the sample firm on average. Their experiences in the knitwear industry and the broadest definition of textile industry (which includes the wearing apparel industry) are as short as 10.3 and 11.8 years, respectively. Since the knitwear industry itself is young, experiences of managers in the industry are naturally short.

Table A7. Age and experiences of management

	Age	Years of experience		
		Sample firm	Knitwear industry	Textile and garment industries
Mean	43.2	5.9	10.3	11.8
Median	42	4	9	10
Maximum	65	37	42	42
Minimum	21	1	1	1
Standard Deviation	8.9	6.0	7.9	8.2

Note: “Management” is identified as “the most influential decision-maker” in the questionnaire.

Table A8. Educational attainment of management

	Number of firms	Share (%)
No SSC	2	0.9
SSC	3	1.2
HSC	37	16.2
Bachelor	113	49.6
Master	72	31.6
Doctor	1	0.4
Total	228	100.0

Note: SSC is the abbreviation of the Secondary School Certificate, and HSC is that of the Higher Secondary Certificate.

The top manager is likely to have distinctly higher degrees of education than that of the average Bangladeshi. Table A8 reveals that the highest degree of top managers of a half of the sample firms are bachelor, while more than 80% of top managers attain bachelor degree or higher. That is, the average difference in the level of educational attainment between top managers and employees working under them is very wide.

Structure of employment

The garment industry is known as the first formal sector in Bangladesh which presented a large scale of employment opportunities to female workers. In fact, according to the data from a Census of Manufacturing Industries, the female workers’ share of total employment in the garment industry[26] reaches to 67.6% (BBS [2004]). The female workers' share in our sample of the knitwear industry is as small as 33.4% (Table A9). This relative under-presence of female workers is partly because our sample includes firms engaging in knitting fabrics where male workers are dominant. However, it is interesting to note that even among operators and helpers in the sewing section the number of male workers is greater than that of female. This might be a feature of BKMEA member firms.

Table A9. Composition of total number of employed persons of sample firms
(Unit: persons)

	Experience	less than 1 year		1-5 years		6 years +		Total	
	Sex	M	F	M	F	M	F	M	F
Administration Section	Managerial/ Executive	3	2	295	10	655	26	953	38
	Other Officers	8	0	655	15	866	5	1529	20
Knitting Section (Knit Fabrics)	Engineer	0	0	13	0	109	1	122	1
	Supervisor	0	0	126	0	251	1	377	1
	Operator	12	0	705	0	1183	1	1900	1
	Helper	56	3	499	0	144	1	699	4
Knitting Section (Knit Goods)	Engineer	2	0	0	0	14	0	16	0
	Supervisor	2	0	35	3	49	17	86	20
	Operator	2	2	1532	180	650	233	2184	415
	Helper	61	104	233	176	0	0	294	280
Sewing Section	Engineer	4	0	28	1	137	0	169	1
	Supervisor	0	1	496	49	954	32	1450	82
	Operator	35	30	4954	2523	6225	2711	11214	5264
	Helper	1331	1418	9992	8588	1317	988	12640	10994
Other Production Sections	Engineer	0	0	13	0	54	0	67	0
	Supervisor	2	0	130	3	303	2	435	5
	Operator	26	55	979	371	813	15	1818	441
	Helper	133	155	1444	1184	257	70	1834	1409
Total		1677	1770	22129	13103	13981	4103	37787	18976

Profitability of sweater and socks making firms

In the analyses undertaken in the main text, production of sweaters and socks are ruled out, because the machines and technologies used to make them are distinct from those for the main types of knitwear. The former types of knitwear are made directly from yarn while the latter types are made from knit fabrics.

For information, the profits-machines ratio of the excluded types of knitwear

[26] The corresponding Bangladesh Standard Industrial Code is 3231.

production is summarized in Table A10. There are only 15 firms making either sweaters or socks. A similar variety in profitability is seen among sweaters and socks making firms in BKMEA. The differences between the minimum and maximum of profits-machines ratio among the 15 firms are quite big.

Table A10. Profits-machines ratio of sweater and socks making firms

Sample	Min.	25%	Median	75%	Max.	Mean	s.d.	Negative values	n
All	-1.843	-0.170	0.011	0.246	2.556	0.131	0.992	5	15
Automated flat knitting machines only	-1.344	0.000	0.187	0.197	2.556	0.345	1.172	1	7
Manual flat knitting machines only	-1.843	-	-0.170	-	0.788	-0.242	0.984	3	5
Automated socks machines only	-0.139	-	0.011	-	0.890	0.254	0.556	1	3
Manual socks machines only	-	-	-	-	-	-	-	-	0

Appendix 2. Relevancy of instruments

Production processes	Explanatory variables	Instruments	n	k	R_p^2	$\overline{R}_p^2$
a, b, ab	Benchmark	(Expl. Var.)-log(output)+operation rate+policy variables	177	27	0.182	0.041
a, b, ab	Benchmark+dummy(factory rented)	(Expl. Var.)-log(output)+operation rate+policy variables	177	28	0.192	0.046
a, ab	Benchmark-dummy(making garments only)-dummy(EPZ)	(Expl. Var.)-log(output)+operation rate+policy variables	152	25	0.101	-0.069
a, ab	Benchmark+log (knitting machine price)-dummy(making garments only)-dummy(EPZ)	(Expl. Var.)-log(output)+operation rate+policy variables	152	27	0.092	-0.099
b, ab	Benchmark-dummy(knitting fabrics only)	(Expl. Var.)-log(output)+operation rate+policy variables	164	26	0.177	0.028
b, ab	Benchmark+log(sewing machine price)+dummy(factory rented)-dummy(knitting fabrics only)	(Expl. Var.)-log(output)+operation rate+policy variables	164	28	0.183	0.021

Note: Production processes are all symbolized with “a”, “b”, and “ab”, which signify “knitting fabrics only”, “making garments only” and “knitting fabrics and making garments only”, respectively. The benchmark explanatory variables are all variables related to “production”, “status”, “location”, and “management”. The samples are chosen according to the availability of profit-capital ratio as the dependent variable of 2SLS. n and k denote the sample size and the number of instruments, respectively. R_p^2 is partial R^2 defined by Shea [1997], while $\overline{R}_p^2$ is that adjusted with the degree of freedom by the following formulation: $\overline{R}_p^2 = 1 - [(n-1)/(n-k)] \cdot (1 - R_p^2)$.

Appendix 3. Questionnaire

Institute of Developing Economies

3-2-2 Wakaba, Mihama-ku, Chiba-shi, 261-8545, Japan

and

Bangladesh Institute of Development Studies

E-17, Agargaon, Sher-e-Bangla Nagar
Dhaka 1207

The purpose of this survey is to better understand the current situation of knitwear firms and to promote knitwear production in Bangladesh. Information of your company will be treated as strictly confidential and the information you provide will be used for research only. Neither your nor your company's name will be used in any document prepared based on this survey. This questionnaire is applied for a factory. If your company has multiple factories, please fill as many questionnaires as is the number of your factories.

Schedule No. /__/__/__/

1. Basic Information

Name of the Company ________________________________
Name of the Group (if applicable) ________________________________
Legal Status of the Company ______________________________
Codes: 1 = Sole Proprietorship; 2 = Partnership; 3 = Private Limited Company; and
4 = Public Limited Company

Address

(a) Office: ____

(b) Factory: ____

Telephone

(a) Office: ______________________

(b) Factory: ______________________

Fax

(a) Office: ______________________

(b) Factory: ______________________

E-Mail _______________________

Contact Person: Name __________________________ Designation ____________
(It is ideal that the contact person fills this questionnaire.)

2. History of the Company

2.1 Year of establishment of the company _______________

2.2 Year in which operation started __________________

3. Ownership Status

☐ Private (Local) ☐ Joint Venture ☐ Foreign Owned
☐ Cooperative ☐ Trust ☐ Others (specify)_________________________

4. Sources of Finance

4.1 What was the ratio of equity to debt of your company by June 2000? (adds to 100%)

% Equity _______________ % Debt _______________

4.2 What were the sources of debt of your company by June 2000? (adds to 100%)

% Financial Institutions ______ % Informal _______ % Others ________

5. Management

5.1 Who is the most influential decision-maker on business of your company?
Name ____ Designation _________________
Age _______ (in Years); Academic Qualification (Exam Passed) __________________

5.2 How long has s/he been involved in your company? ______________ years
5.3 How long has s/he been involved in knitting industry? ______________ years
5.4 How long has s/he been involved in textile and garment industry? ____________ years

6. Production

6.1 Which production process does your company undertake? Circle the letter of the applicable item(s).

A. Knitting: Fabrics
B. Knitting: Knit-Products (Sweater, T-shirts, Other Shirts, Trousers, Ladies' Tops, Collar, Socks, etc.)
C. Dyeing
D. Printing
E. Finishing
F. Other

(specify)____
____

6.2 Production Level (Fabrics): What kind of knit fabrics did your company produce in FY2000-2001? How much of each knit fabric did your company produce in FY2000-2001? How much was the price? How much was the price of the yarn used? What percentage of the yarn was wasted in the process of the production?

Types of Fabrics		Fabrics Produced			Yarn Used		
		Unit	Quantity	Price (Tk)	Unit	Price (Tk)	Rate of Waste (%)
Grey Fabrics	Single Jersey						
	Rib						
	Fleece						
	Pique						
	Lacoste						
	Interlock						
	Others (specify) __________						
	Others (specify) __________						
	Others (specify) __________						
Dyed Fabrics	Single Jersey						
	Rib						
	Fleece						
	Pique						
	Lacoste						
	Interlock						
	Others (specify) __________						
	Others (specify) __________						
	Others (specify) __________						
Yarn-Dyed Fabrics	Single Jersey						
	Rib						
	Fleece						
	Pique						
	Lacoste						
	Interlock						
	Others (specify) __________						
	Others (specify) __________						
	Others (specify) __________						

6.3 Production Level (Knit Goods): How many pieces of each knit goods did your company produce in FY2000-2001? How much was the price? How much was the price of the yarn used? What percentage of the yarn was wasted in the process of the production?

Types of Knit Goods	Knit Goods Produced			Yarn	
	Dozens	Unit Price (Tk)	Value (Tk)	Price (Tk)	Rate of Waste (%)
Sweater					
T-shirts					
Other shirts					
Trousers					
Ladies' Tops					
Socks					
Others (specify) ____________					
Others (specify) ____________					

7. Market

How much of the knit fabrics that your company produced was directly exported in FY2000-2001? And, how much was sold to domestic garments companies or used in the garment section of your company, whether or not the garments were eventually exported?

7.1 Directly Exported (a) ______________ taka

7.2 Used in the Other Units of Your Company (b) ______________ taka

7.3 Sold to Other Domestic Garment Companies (c) ______________ taka

8. Equipment

What kind of and how many knitting machines did your company have AND were in operation at the end of June 2000? Please fill the following table for all machines in operation by their type and vintage.

No.	Type	Numbers	Country Made	Year Made	Year Bought	Purchase Price
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

Legends for types of machinery: 1 = Circular Knitting Machine; 2 = Automated Flat Knitting Machine; 3 = Manual Flat Knitting Machine; 4 = Automated Socks Knitting Machine; 5 = Manual Socks Knitting Machine; 6 = Sewing Machines; 7 = Dyeing Machines; 8 = Finishing Machines; 9 = Printing Machines.

9. Employment, Wage Level, Working Days and Working Hours

9.1 Employment: How many workers of the following categories were employed on average in FY2000-2001?

(numbers)

	Experience / Designation	less than 1 year		1-5 years		6-9 years		10 years +		Total	
		M	F	M	F	M	F	M	F	M	F
Administration Section	Managerial/ Executive										
	Other Officers										
Knitting Section (Knit Fabrics)	Engineer										
	Supervisor										
	Operator										
	Helper										
Knitting Section (Knit Goods)	Engineer										
	Supervisor										
	Operator										
	Helper										
Sewing Section	Engineer										
	Supervisor										
	Operator										
	Helper										
Other Production Sections	Engineer										
	Supervisor										
	Operator										
	Helper										

Legends: M = Male and F = Female

9.2 Wage Level: What were the monthly wage rates of the following categories of workers in FY2000-2001?

(Tk.)

	Experience / Designation	less than 1 year		1-5 years		6-9 years		10 years +		Total	
		M	F	M	F	M	F	M	F	M	F
Administration Section	Managerial/ Executive										
	Other Officer										
Knitting Section (Knit Fabrics)	Engineer										
	Supervisor										
	Operator										
	Helper										
Knitting Section (Knit Goods)	Engineer										
	Supervisor										
	Operator										
	Helper										
Sewing Section	Engineer										
	Supervisor										
	Operator										
	Helper										
Other Production Sections	Engineer										
	Supervisor										
	Operator										
	Helper										

9.3 Working Days: How many days in FY2000-2001 did your company operate?

________ days

9.4 Working Hours: How long did a typical worker of knitting/knit goods section work in each shift (including overtime) on average in FY2000-2001?

Shift A ____ hours; Shift B ____ hours; Shift C ____ hours

10. Policy Related Issues

10.1 Did your company have a bonded warehouse during FY2000-2001?
□ Yes □ No

10.2 Did your company receive a duty drawback concerning exported component of imported materials during FY2000-2001? □ Yes □ No

10.3 Was the advance income tax deduction on export earnings applied to your company during FY2000-2001? □ Yes □ No

10.4 Was tariff exemption on imports of capital machinery for export-oriented sector applied to your company during FY2000-2001? □ Yes □ No

10.5 Did your company, or any RMG companies to which your company sold knit fabrics, receive the 25% cash compensation from the Government of Bangladesh for usage of domestically produced fabrics into export-oriented RMG during FY2000-2001?
□ Yes □ No

10.6 Were any preferential interest rate to export oriented sectors applied for loans granted to your company during FY2000-2001? □ Yes □ No

10.7 Is your company a member of BGMEA? □ Yes □ No

11. Flow Data for 2000-2001

Items	Value (Tk)
A: Gross Value of Output	
B: Industrial Costs	
B1: Costs of imported raw materials	
B2: Costs of domestic raw materials	
B3: Costs of fuel and electricity (production)	
C: Non-industrial Costs	
C1: Utilities (water/electricity/telephones)	
C2: Printing Stationery	
C3: Insurance	
C4: Interests	
C5: Rent	
C6: Others	

Name of the Field Investigator ____________________________Date /__/__/__/__/__/__/