Competitiveness of the knitwear industry in Bangladesh : a study of industrial development amid global competition

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JEL classification: D24, J31, L67, O14, O53

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Competitiveness of the Knitwear Industry in Bangladesh: A Study of Industrial Development amid Global Competition [*]

Zaid Bakht[a], Md. Salimullah[a], Tatsufumi Yamagata[b], and Mohammad Yunus[a]

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Abstract

This paper assesses the technical efficiency and profitability of the knitwear industry in Bangladesh taking into account the sector's role in poverty reduction. While stochastic frontier analysis was invoked to assess technical efficiency, three alternative measures, namely the rate of return, total factor productivity and the Solow residual, were used to gauge the extent and determinants of the profitability of the industry based on firm-level data collected in 2001. The estimation results indicate the high profitability of the knitwear firms. In Bangladesh, the dynamic development of the industry has entailed great diversity in efficiency in comparison with the garment industries of other developing countries. While there is a significant scale effect in profitability and productivity, no supporting evidence was found for the positive impact on competitiveness of industrial upgrading in terms of usage of expensive machinery and vertical integration and industrial agglomeration.

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1. Introduction

For some low-income countries, exports of labor-intensive manufactured goods have held out the promise of economic growth and poverty reduction (World Bank, 1990; Sachs, 2005). During the last two and a half decades, Bangladesh has succeeded in developing an export-oriented garment industry, facilitated by the Multi-Fiber Arrangement (MFA) that came into effect in 1973. Because exports of garments account for nearly three quarters of the total export earnings of Bangladesh, there have been serious concerns over whether the industry would survive the post-MFA onslaught of competition. Further, the sector accounts for the employment of two million unskilled and semi-skilled workers. Most of them are female and have migrated to urban areas from the countryside. Fortunately, the industry seems to have withstood the challenges that have confronted it, and has performed well, with double-digit growth in exports of garments to the United States since the phasing out of the MFA in 2005.

The industry's contribution to exports and the abundant employment opportunities for female workers without high educational backgrounds have been studied intensively. See, for example, Paul-Majumder (2003), Kabeer and Mahmud (2004), and Siddiqi (2004), and the references cited in these works. On the other hand, only a few studies have analyzed the production side of the industry. Some of these studies used published data, while others were based on data collected by means of tailor-made questionnaires. See for instance, Salim (1999), Hassan (2000), Quddus and Rashid (2000), Zohir (2003), Kee (2005) and Fukunishi et al. (2006). However, most of these studies except Kee (2005) and Fukunishi et al. (2006) used small data samples that were not adequate for statistical analyses capable of taking into account the diverse nature of the knitwear industry.[1]

Initially, Bangladesh developed woven garments on the basis of an upstream process that involved spinning and weaving. Production of knitwear for exports started much later but then grew rapidly. Besides sweaters and socks, the major output of the knitwear industry involves two processes, namely the knitting of fabric and the making of knitwear using the fabric thus knitted. Production of knit fabric in Bangladesh

[1] The World Bank's Investment Climate Surveys are another important source of information on sector-wise productivity and profitability (see http://rru.worldbank.org/InvestmentClimate).

expanded rapidly following the introduction in 1995 of the European Union's (EU) stricter Rules of Origin (RoO), that require greater backward linkage to meet the terms of its Generalized System of Preferences (GSP) facility.

What explains the successful performance of the garments industry in Bangladesh? What are the sources of the industry's competitive strength? How is the structure of the industry linked to productivity differentials within the manufacturing sector? This paper attempts to answer these questions by focusing on Bangladesh's knitwear industry. To obtain the information needed to carry out the study, in 2001 we collected relevant data from 232 firms and used these data to supplement those provided by Kee (2005) and Fukunishi et al. (2006). Our data contain more information than Kee's and Fukunishi's on production processes and on the machinery used in the knitwear industry. The sample firms, by and large, exhibit all the main features that characterize the Bangladeshi knitwear industry. Almost all of the sample firms are located in the principal centers of knitwear production in the districts of Dhaka, Gazipur, and Narayanganj.

The paper is organized as follows. After the Introduction, Section 2 provides an overview of the knitwear industry in Bangladesh. In particular, the section examines data on laborers' wages, and analyzes the implications of the wage structure from the perspective of poverty reduction. Section 3 introduces an analytical model for examining productivity and profitability in the industry, while Section 4 presents and interprets the empirical results. The final section presents our conclusions.

2. Some Features of the Knitwear Industry in Bangladesh

The knitwear industry of Bangladesh is characterized by several distinct features. Most of the manufacturers are located in the principal centers of knitwear production in Chittagong, and in suburban Dhaka, Gazipur, and Narayanganj districts outside the Export Processing Zones (EPZs). Thus, most of these enterprises are outside the "enclave" environments provided for EPZ enterprises in Bangladesh. In the ready-made garments sector, the knitwear firms tend to be of recent origin. The Bangladesh Institute of Development Studies and the Institute of Developing Economies, Japan, jointly undertook a field survey of 232 knitwear producing firms[2] in

[2] The sample firms are members of the Bangladesh Knitwear Manufacturers and Exporters Association

2001 (see Bakht et al. (2007) for details). The data show that more than a half of the sample firms began knitwear production within five years or less of our survey being carried out. Knitwear manufacturers employ a large number of workers. A typical firm employs 245 workers with the largest company employing as many as 1,772.

The knitwear firms employ female operators and helpers who work under the supervision of male managers.[3] Most observers agree that the ready-made garment industry is the first formal industry in Bangladesh to provide abundant employment opportunities for female and young workers (see, for instance, Zohir and Paul-Majumder, 1996; Siddiqi, 2004). In terms of the size of the employment that they provide, the knitwear and the woven garment industry have obviously contributed to poverty reduction in Bangladesh. What is relatively unclear is the level of the wages paid to the least paid workers in the industry. Studies by Khondker, Murayama and Rahman (1995), Zohir and Paul-Majumder (1996), and Kabeer and Mahmud (2004) report that the lowest paid workers, such as helpers, receive low wages, but ones that provide a substantially higher income than the alternative employment opportunities that are available to them.

Table 1 shows that in 2001, the average monthly earnings[4] of helpers with a work experience of a year or less in the industry amounted to around Tk.1,000 (US$ 17.2). This 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 respectively (BBS, 2003) and thus the average earnings of the least experienced helpers are higher than the local poverty lines. Further, in 1999/2000, the average earnings of the least experienced helpers in the knitwear industry were still higher than those of both casual wage laborers and the self-employed in the farm sector of Bangladesh (Table 2). Viewed from this perspective, the knitwear industry has undoubtedly contributed to poverty reduction among people living in rural areas of

(BKMEA) which is an industrial association of knitwear producing firms.

[3] The knitwear industry seems to employ more male workers than the woven garment industry, probably because firms in the former industry tend to incorporate a fabric-knitting section that is often operated overnight.

[4] The earnings of an operator in the garment industry are usually based not only on the length of time the worker attends but also on how many pieces s/he processes. The interviewees were asked to estimate their average earnings taking into account both time rates and piece rates.

Bangladesh.

3. Frameworks for Estimation of Productivity and Profitability

In the context of the industry's contribution to poverty reduction, it is essential to assess whether or not the knitwear industry of Bangladesh is internationally competitive. To that end, we analyzed productivity and profitability of the industry using (1) the stochastic production frontier, (2) the rate of return, and (3) total factor productivity.

Typical knitwear products such as T-shirts, polo shirts, knit underwear, and knit trousers are made in two processes, namely knitting fabrics from yarn, and making garments from knit fabrics. The standard method for knitting fabrics is to run a circular knitting machine loaded with yarn to produce fabrics, while the standard method for making garments from fabrics is to use an assembly line of sewing machines and operators. In addition, other types of knitwear, such as sweaters and socks, are made with different machines and different methods of production. As the share of the former category of knitwear production is dominant in terms of the number of factories involved, the following analyses focus on typical knitwear establishments that combine the two processes of knitting fabrics and making garments.

3.1.1 Production Frontier and Technical Efficiency

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

$$X_s = M_s + E_s + V_s . \qquad (1)$$

If the firm undertakes the two processes in-house, and if the fabrics produced in the upstream process are exclusively used in the garments making process, the gross output from the fabrics section is equal to the material inputs into the garment section: $X_f = M_g$. For a composite firm which has the two processes in the same establishment, $(s = f + g)$, the value added for the firm is the sum of the value added in each of the two sectors.

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

It is thus obvious that

$$X_g = M_g + E_g + V_g \equiv X_f + E_g + V_g \equiv M_f + E_f + E_g + V_f + V_g \equiv M_f + E_{f+g} + V_{f+g} \tag{3}$$

As there are different opinions as to whether gross output or value added should be used as an indicator of output (Burnside, Eichenbaum and Rebelo, 1995), both variables are alternatively used to confirm the robustness of the results. Further, services of labor and capital are focused on, as the only factors of production. The following equations incorporate these assumptions:

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

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

Here *K*, *N*, *h*, and *A*, denote respectively capital stock, the number of workers, the operation rate and the real estate on which the operation takes place. α_{f+g}, β_{f+g}, γ_f, and δ_{f+g} are parameters for the Leontief production function (see Bils and Cho, 1994). For the empirical analyses developed in the next section, the following functions were used:

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

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

with their log-linear approximations as:

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

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

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

In order to estimate the stochastic production frontier, standard assumptions about the disturbances are made as follows: u_v and u_x are composite error terms containing the symmetric and two-sided disturbances, ε_F, and the firm-specific inefficiency, ε_E (see Kumbhakar and Lovell, 2000):

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

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

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

where N^{+} denotes the non-negative half of normal distribution[5]. The statistical independence among ε_{Fq}, ε_{Eq}, and the covariates is assumed. A conventional measure of technical efficiency for a firm i $\left(TE_i\right)$ is as follows:[6]

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

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

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 each firm of the industry, and can be used for comparison with respect to variation in efficiency with that of the same industry in other countries.

3.2.1 Rate of Return

Profits are a primary concern for owners of firms. High profits reflect more revenue and less costs, both of which may incorporate either a large amount of sales, high valuation of the product, or efficient production techniques. All of these are good indicators of the competitiveness of a firm. Thus, profits defined as price-cost margins by processes are used as a proxy for competitiveness (Roberts and Tybout, 1996):

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

where W_s, R_s^K and R_s^A are total wages and salaries, interest payments, and rents for land and buildings.[7] It should be borne in mind that some of the firms have their own land and buildings to accommodate the factory and are able to draw on their own equity capital. In cases such as these, the measure of profits according to equation (15) is a gross approximate with the imputation of rents and interests. In either case, the rate of

[5] As an alternative to this, the stochastic frontier was estimated assuming that error terms follow an exponential distribution. However, there was no perceptible change in the results.

[6] Subscript *q* is dropped for simplicity.

[7] R_s^K does not include costs of purchasing machines even for firms which did so during the survey.

return is defined as the ratio of profits to the present value of installed machinery by process.[8]

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

For a firm engaged in both knitting fabrics and making garments, profits for the two processes are the sum of those generated in each process: $\pi_{f+g} = \pi_f + \pi_g$. Similar treatment is also given to the present value of installed machines $\left(K_{f+g} = K_f + K_g\right)$.

3.2.2 Total Factor Productivity

As alluded to above, it is hard to single out pure profits from the data at hand. An alternative indicator for the measurement of competitiveness is productivity. Since this study is the first of its kind relating to Bangladesh, time series changes in the productivity of firms can hardly be available. Because of this, "relative total factor productivity (TFP)" following Caves, Christensen and Diewert (1982) is used as an alternative indicator of productivity defined as follows:

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

Here λ_{Nsi} is the labor share of total factor income of firm *i* and process *s*. It may be noted that the shares of labor and capital add up to one owing to the homogeneity assumption: $\lambda_{Ksi} = 1 - \lambda_{Nsi}$.

In order to assess the robustness of the pattern of variation in TFP, a more conventional version of relative TFP for which factor utilization is not taken into

[8] The present value of machines is estimated following the perpetual inventory method assuming a 5 per cent annual depreciation rate. Insofar as detailed price series by types of machine are not available and 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 United States is used as the deflator. It should be noted that the above series is available only after 1987. Thus, the average rate of change in the series for 1987-2001of 2.44 per cent is applied for machines purchased before 1987.

account, and the Solow residual are also worked out. The conventional relative TFP is denoted as TFP2:

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

While the relative Solow residual is defined as:

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

The Solow residual is appended to the conventional measures of TFP due to the possible overestimation of measured labor share. This shows whether or not the extent of upward bias in the share of labor is a cause for concern.

4. Empirical Analyses of Profitability and Productivity

Based on the frameworks and measures described in the previous section, this section presents the empirical results of (1) average profitability of the knitwear firms; (2) diversity in efficiency in comparison with the garment industry of other developed and developing countries; and (3) the determinants of profitability and productivity.

4.1 Level and Variability of Profitability

Table 3 presents the salient features of the rates of return defined by equation (16) for the whole sample as well as different subsets of it. First, the mean value of the rate of return is likely to be far 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. Even though for some subsets of sample firms such as “knitting fabrics only” and “dyeing fabrics and making final products only” the mean profits-capital ratios are negative, they do not alter the overall tendency towards high profitability. Second, the median is likely to be smaller than the mean. This implies that the distribution of the profits-capital ratio is skewed to the right. Third, the minimum

tends to be less than zero while the maximum tends to far exceed unity. As a whole, the large variation in the profits-capital ratio implies that not all firms in the rapidly growing knitwear industry are on an even keel.

This observation is consistent with the view of dynamism in entry and exit documented by Aw, Chen and Roberts (2001) for Taiwanese manufacturing. They showed that the Taiwanese manufacturing industry grew amid a high turnover of firms that was driven by differences in performance among firms.

4.2 Variability of Productivity

Stochastic frontier production functions are estimated, based on equations (8) and (9). Both value added and gross outputs were used as dependent variables. Only firms of the most likely combination of production activities (engaged in both knitting fabrics and making garments) are used as sample units for this purpose so that a common production function is applied to all sample firms. Results of both, with and without factor utilization are presented in Table 4.

Owing to the logarithmic transformation of the value added, the sample size for it is smaller than that with gross output. However, the main results are the same whether gross output or value added is used and whether or not factor utilization is taken into account. The estimated elasticity of output with respect to capital ranges between 0.437 and 0.513 and departs significantly from zero, while that with respect to labor tends to show large variations. The sum of the two estimates is not significantly different from zero in any of the four sets of results implying constant returns to scale in the production function.

The estimated variance of disturbance incorporating inefficiency, σ_E , is significantly greater than zero for all the four estimations, so that the stochastic frontier estimation makes sense. The variance of inefficiency even exceeds the variance of two-sided disturbance, σ_F , on average. The mean technical efficiency is around 0.50 for all four estimates.

These estimates may be compared with those found in other countries. Fecher and Perelman (1992) report the mean technical efficiency of the textile industries of 10 OECD member countries in the 1970s-80s. Their estimates range between 0.68 and 0.89

except for those relating to Japan.[9] It is evident that the mean technical efficiency of the knitwear industry in Bangladesh is far off this range. This comparison between the developed and the developing countries is not misplaced as Tybout (2000, p. 24) concludes that "…average deviations from the efficient frontier are not typically larger than what we observe in the high-income countries…."

Similarly, Tyler and Lee (1979) report mean technical efficiency for the garment industry of Colombia at 0.55, Hill and Kalirajan (1993) report the mean technical efficiency for the garment industry in Indonesia at 0.63, while Mazumdar and Mazaheri (2003) report the mean technical efficiency for the garment industries in five African countries (Ghana, Kenya, Tanzania, Zambia and Zimbabwe) as ranging between 0.69 and 0.56. It should be noted that the range of these estimates is well above 0.50. This is, however, not an accurate comparison as the above list is based on all types of garment industry in which the knitwear industry comprises only one category. Despite this caveat, the mean technical efficiency of the knitwear industry in Bangladesh is obviously low, which implies high variability of technical efficiency[10].

4.3 Determinants of Profitability

Insofar as the knitwear industry in Bangladesh is profitable, it is important to identify the factors that determine its profitability and productivity. If many of these variables are policy related, then a judicious manipulation of them may enhance the competitiveness of the industry. To that end, some candidate variables are selected. First, production and product related issues are captured through output level as an indicator of scale effect, and dummies are used for 'knitting fabrics only[11]', 'making garments only', 'subcontracting in knitting fabrics', and 'subcontracting in making garments', as indicators of the diverse activities undertaken by the knitwear firms. If the two dummy

[9] The estimates of the textile industry in Japan for the periods of 1971-79 and 1980-86 are 0.40 and 0.53, respectively. Fecher and Perelman (1992) applied translog function without factor utilization. However, if the functional form used in this paper is used, the mean technical efficiency falls to 0.49. This estimate is not far off the ones found in the present paper.

[10] Note that a low average technical efficiency in Bangladesh does not imply that the technical efficiency is lower in the country than in others, because frontiers were estimated country by country.

[11] This and all other dummies that follow are dichotomous and assume a value of one when the attribute is present and zero otherwise.

variables for “knitting fabrics only” and “making garments only” are both significantly greater than zero, this will provide strong support for the existence of the “vertical integration effect” in the knitwear industry as warranted by the EU’s stricter Rules of Origin for the GSP facility. Second, besides the age of the firm (measured in years since establishment), a set of dummies were included to address the legal and financial status of the firms. These include dummies for ‘limited company’, BGMEA[12] member’, ‘joint venture’ and firms that use their own factory and/or land, or their own equity capital. Third, four locational dummies differentiating ‘outside Narayanganj’, ‘Savar and Gazipur’, ‘DEPZ (Dhaka Export Processing Zone)’ and ‘BSCIC industrial area[13]’ are included to assess whether or not there are locational effects. Fourth, management issues were captured by including the age of the top management official (decision maker), her/his length of experience in the same firm (measured in numbers of years), with knitwear, with textile and garments, and three categorical dummies reflecting the educational background of the decision maker. The benchmark for the categorical dummies is the Secondary School Certificate (SSC), which is the lowest qualification for all decision-makers in the sample. Fifth, the price of knitting and sewing machines is used to reflect the overall technology of garment manufacture within the firm. The price variable takes a missing value if machines are not installed. Therefore, the price of circular knitting machines is used as an explanatory variable only for sample firms engaged in knitting fabrics, while the price of sewing machines is used only for sample firms engaged in making garments.

Table 5A presents the results of regression of the profits-capital ratio on explanatory variables explained above for the whole sample of firms. It may be noted that several 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 the performance of sample firms, which is represented by indicators such as rate of return and productivity. Checking endogeneity of so many variables poses a formidable task. As an experiment,

[12] The sample firms may be members of the Bangladesh Garment Manufacturers and Exporters Association (BGMEA), the apex industrial association for both woven and knit garment producers, as well as of BKMEA.

[13] These industrial zones are administered by the Bangladesh Small and Cottage Industries Corporation (BSCIC).

a test of endogeneity was conducted on the level of output following Hausman (1978) [14]. As the results towards the bottom of the Table show, output level is not endogenous; hence discussions of results involve only the OLS estimates.

It may be noted that there is a significant difference in the profits-capital ratio between firms engaged in making knitwear only and other firms, with the former exhibiting a higher ratio than the latter. In contrast, the ratio is not significantly different between firms engaged in knitting fabrics and others. Thus, industrial upgrading does not seem to affect vertical integration incorporating backward linkage.

Effects of the dummy for firms subcontracting the knitting of fabrics, the logarithm of output, and the dummy for firms located in the EPZ, are statistically significant. In particular, firms subcontracting the knitting of fabrics are likely to exhibit a high, rather than a low, profits-capital ratio if the other factors are controlled for. In addition, large firms measured in terms of gross output are likely to have a high profits-capital ratio; a 1 percent increase in gross output is associated with 1.755 to 1.977 points increase in the ratio. Note that this impact is quite large given that the mean profits-capital ratio is around 1.5. Finally, firms located in the EPZ tend to exhibit low rates of return.

There is no sensible explanation of the significantly positive impact of subcontracting the knitting of fabrics and the significantly negative impact of location in the EPZ. What is more interesting to note is that (1) scale is positively associated with the rates of return, a relationship that is not generally observed for manufacturing in developing countries[15]; (2) there is no evidence for advantages of vertically integrated firms in the rate of return after other factors are controlled for; (3) there is no evidence for a positive geographical agglomeration effect; and (4) attributes of decision-makers of the firms do not have any significant impact on the rates of return. The effect of the dummy for firms paying rent for their factories is not significant.

[14] See section 4.4 for the instrumental variables. See Bakht et al. (2006) for the relevance of the instrumental variables.

[15] A firm-level study of the garment industry in Bangladesh conducted in 2003 did not find any positive association between the rates of return and the scale of production (Fukunishi et al., 2006). Note that Table 4 shows that there is no scale economy in the frontier production function. Thus, the scale economy found in Table 5A, 5B, and 5C appears to be related to inefficiency.

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A new focal issue that features in this study (Table 5B) is that the logarithm of firm average price of circular knitting machines is introduced as an explanatory variable. However, the hypothesis that firms using more sophisticated technology (as embodied in expensive machines) exhibit high rates of return was not borne out; even though the sign of estimated coefficient is negative, they are not statistically significant. A similar observation holds for the logarithm of firm average price of sewing machines introduced as an explanatory variable (Table 5C). As before, the sign is negative, but insignificant. Thus, industrial upgrading is not found to be a critical factor in enhancing the rate of return.

4.4 Determinants of Productivity

As mentioned above, there are difficulties in measuring profits accurately. Thus, as an alternative, productivity, under different rubrics such as TFP1, TFP2, and the Solow residual defined in (17)-(19), is examined in order to shed light on the determinants of firm performance. Note that the benchmark productivity indicator is TFP1, and that this incorporates factor utilization and uses actual data of labor share by firm. Factor utilization is dropped from the list of inputs in TFP2, while for the Solow residual, the labor share is assumed to be 0.6 for any firm taking account of the likelihood of upward bias in measured labor share by firm.

Table 6 presents the results of regression of the productivity indicators on the same set of explanatory variables used for the regression of the rate of return. Again the test of endogeneity was conducted for the level of output. As the results towards the bottom of the Table show, the output level in this case is endogenous. Hence, the 2SLS results are preferable. However, finding exogenous instruments is a difficult task and critically hinges on the orthogonal condition between the instruments and the error term. As instruments for output level, participation in promotion programs and monthly operation rate are used. As there was more than one instrument for the *endogenous* output level, Hansen's (1982) *J*-test of overidentifying restrictions was conducted to check the exogeneity of the instruments. As the results at the bottom of the Table show, the instruments satisfy the exogeneity condition.

None of these variables is a perfect instrument. Participation in any promotion program 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 the robustness of the OLS estimation displayed in Table 6. As a check for the relevance of the instruments, Shea's (1997), R_p^2 and those adjusted with the degree of freedom, $\overline{R}_p^2$, were used. It may be noted that R_p^2 and $\overline{R}_p^2$ are not high. However, the values of R_p^2 and $\overline{R}_p^2$ found in this paper[16] are not far off the ranges suggested by Shea (1997).

It is evident that the patterns of statistical significance of explanatory variables are similar across the three productivity indicators and estimation methods. As found in the case of regression for rates of return, estimates of the logarithm of gross output are significantly positive for five of the six specifications. New features of this series of regression analyses which did not appear in the regression for the rates of return are (a) positive association with joint venture, (b) negative correlation with the age of firms, (c) positive correlation with the age of decision makers, (d) positive correlation with the length of association of the decision maker with the same firm, and (e) negative correlation with the length of association of the decision maker in the textile and garments 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 high profits works, the positive correlation appears without scale economy. If the 2SLS successfully disposes of the reverse causality, only the scale effect remains.

It makes sense that joint venture exhibits high productivity. This result is consistent with the finding by Kee (2005) on productivity of the garment industry in Bangladesh. There are no other estimates of this aspect of the garment industry in Bangladesh. However, Aw, Chen and Roberts (2001) report that in Taiwan manufacturing, new firms have lower productivity than incumbents.

Experience of decision makers, and physical age and tenure in the same firm are positively correlated. This may reflect the positive impacts of these types of

[16] Sheas' test statistics are shown in Bakht et al. (2007).

experience on the productivity of the firm. On the other hand, there is no sensible interpretation of the significantly negative correlation between the length of experience of decision makers of firms in the textile and garment industry and productivity.

In sum, no supportive evidence is found for a positive association of industrial development strategies, such as geographical agglomeration and industrial upgrading. Some externality caused by agglomeration might enhance the profitability and productivity of a firm located close to other firms (see, Fujita and Thisse, 2002). The impact of vertical integration and of upgrading of machinery are also not evident in the sector. The scale of firm represented by gross output is the most outstanding factor to be positively correlated with profitability and productivity.

5. Some Concluding Remarks

In the past, labor-intensive industries drew attention as they seemed to offer an entry point for low income countries to initiate industrialization. The textile industry played that role in the United Kingdom and Japan during the nineteenth century, while the garments industry and electrical and electronic machinery industries took over the role for export-oriented industrialization in the East and Southeast Asian countries from the 1970s through the 1990s (see, Amjad, 1989). It was expected that this kind of contribution to poverty reduction by the labor-intensive sector would replicated in other labor-abundant countries (World Bank, 1990). During theintervening years, however, the possibility of export-oriented industrialization of low income countries led by labor-intensive industries has not been thoroughly scrutinized and for several reasons has almost been forgotten.

In the context of an elliptical world environment, the labor intensive readymade garments industry in Least Developed Countries (LDCs) has succeeded in penetrating the markets of developed countries. However, most observers have been pessimistic about the competitiveness of the industry in the LDCs because international trade in textiles and garments was not fully liberalized. Complete liberalization was scheduled for the beginning of the year 2005, and it was widely expected that sooner or later the industry in the LDCs would lose out, once trade was liberalized.

As a matter of fact, however, an immediate collapse of the industry did not occur among LDC garment exporters such as Bangladesh and Cambodia, not by the

year 2007 at any rate. This is only to be expected because to a certain extent, even in the era of controlled trade regimes sustained by the MFA and succeeding agreements, there was export competition among exporting countries up to quota ceilings.

This study assesses the mechanisms and features of an internationally competitive manufacturing industry in an LDC, namely Bangladesh. The knitwear industry in Bangladesh is growing rapidly and is one of the country's typically labor-intensive and export-oriented industries. Thus, examination of prospects of the industry will provide valuable lessons relating to industrialization in other LDCs.

With this possibility in mind, the knitwear industry in Bangladesh has been scrutinized in detail. The main conclusions of the study are fourfold. First, development of the knitwear industry in Bangladesh facilitates the reduction of poverty by providing entry-level workers with a range of employment opportunities and earnings higher than the national poverty line and higher than those offered by alternative types of employment in Bangladesh. Second, the average profitability of the knitwear firms is very high. Within this general environment, however, some firms earn profits several times higher than the amount needed for replacement of all installed machinery, while others are operating at a loss. In other words, substantial diversity in efficiency among firms exists. Third, the stochastic production frontier analysis implies that the variability in technical efficiency indicated by average technical efficiency is higher in Bangladesh than in other developing countries. Fourth, no evidence was found to support significantly positive impacts on profitability and productivity of industrial upgrading in terms of the usage of expensive machinery and vertical integration and industrial agglomeration.

The findings of this paper lend support to the view that the East Asian pattern of export-oriented industrialization still holds great promise as a way of promoting the industrialization of low-income countries, even without active government interventions. As Roberts and Tybout (1996) and Aw, Chen and Roberts (2001) demonstrated for other developing countries, there is great diversity in profitability and productivity among firms even in a growing industry, and frequent entries and exits 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 a case in point. Since Bangladesh

does not have any physical and institutional advantages in promoting industries over other LDCs, there is no reason why the pattern and mechanism of development of the knitwear industry in Bangladesh cannot be replicated in other LDCs in the near future.

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Table 1
Average Monthly Wage (Rates) of Sample Firms

(Tk./Month)

	Experience	less than 1 year		1-5 years		6 years and above		All		
	Sex	Male	Female	Male	Female	Male	Female	Male	Female	Both
Administration Section	Managerial/ Executive	4,000	15,000	9,661	7,500	13,695	9,423	12,415	9,210	12293
	Other Officer	3,688	-	5,139	5,673	8,669	15,000	7,131	8,005	7142
Knitting Section (Knitted Fabrics)	Engineer	-	-	6,962	-	8,295	8,000	8,153	8,000	8152
	Supervisor	-	-	4,053	-	4,923	5,000	4,632	5,000	4633
	Operator	1,583	-	3,349	-	3,343	4,000	3,334	4,000	3334
	Helper	1,512	1,500	1,518	-	1,919	2,000	1,600	1,625	1600
Knitting Section (Knitted Goods)	Engineer	4,000	-	-	-	9,286	-	8,625	-	8625
	Supervisor	4,500	-	4,914	4,000	5,346	4,941	5,151	4,800	5085
	Operator	2,500	2,500	4,515	3,271	7,053	3,603	5,269	3,454	4979
	Helper	1,026	1,015	1,386	1,166	-	-	1,311	1,110	1213
Sewing Section	Engineer	4,875	-	4,789	5,000	7,764	-	7,203	5,000	7190
	Supervisor	-	2,000	3,405	4,684	4,270	4,907	3,974	4,738	4015
	Operator	1,686	1,600	3,008	3,053	3,394	2,995	3,218	3,015	3153
	Helper	1,051	1,160	1,122	1,178	1,333	1,256	1,136	1,183	1158
Other Production Sections	Engineer	-	-	9,538	-	26,222	-	22,985	-	22985
	Supervisor	3,000	-	3,691	4,500	4,915	4,250	4,541	4,400	4539
	Operator	-	1,527	2,911	2,339	3,823	2,500	3,325	2,243	3114
	Helper	1,536	1,390	1,443	1,283	1,900	1,450	1,514	1,303	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 averages are the conditional mean among firms which employ persons of each combination of features such as section, designation, sex, and experience.

Table 2
Average Earnings by Mode and Sector of Employment and Poverty Status in Rural Bangladesh in 1999/2000

(Tk./Month)

Status	Farm		Non-Farm		
	Self-employed	Casual Wage Labor	Casual Wage Labor	Self-employed	Salaried Wage Labor
Extremely Poor	411	754	1,013	962	1,403
Moderately Poor	644	898	1,248	1,640	1,785
Moderately 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 daily rates, quoted in the *Household Income and Expenditure Survey 2000* (BBS, 2003), are multiplied by a factor of 25 to derive monthly earnings.
Source: Osmani *et al*. (2003, Table IV.2, p. 40).

Table 3
Profits-capital ratio of export-oriented knitwear industry

Sample	Min.	Max.	Median	Mean	Std Dev.	Sample
All	-7.098	37.954	0.673	1.570	3.729	229(55)
Positive value added	-1.843	37.954	0.744	1.820	3.660	216(42)
Positive rent	-7.098	16.328	0.668	1.422	3.067	159(40)
Positive interest	-4.721	37.954	0.746	1.673	4.269	101(21)
Knitting fabrics only (a)	-1.953	1.385	-0.009	-0.010	0.834	13(7)
Making garments only (b)	-1.500	15.702	0.099	1.819	3.922	29(12)
Dyeing fabrics only (c)	0.271	1.278	0.662	0.737	0.508	3(0)
(a) and (b) only	-7.098	37.954	0.827	1.758	4.189	142(29)
(a) and (c) only	-0.147	0.610	0.010	0.158	0.399	3(1)
(b) and (c) only	-1.843	0.890	0.246	-0.018	1.107	5(2)
(a), (b), and (c)	-1.344	11.510	0.790	1.648	2.445	35(4)

Note: Figures in parentheses are the number of firms with negative profits.

Table 4

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 $\exp\left[-E\left(\varepsilon_{Ei}|u_i\right)\right]$. Figures in parentheses are standard errors. Estimates with ***, ** and * asterisks are significantly different from zero at 1%, 5% and 10% error probability levels, respectively.

Table 5A

Proximate Determinants of Profits-capital Ratio
(Firms engaged in knitting fabrics, making garments or both)

Intercept	-30.174*** (10.814)	-30.286*** (10.716)
Production		
Knitting fabrics only (=1)	-0.452 (0.942)	-0.431 (1.047)
Making knitwear only (=1)	1.554* (0.796)	1.441* (0.825)
Subcontracting in knitting fabrics (=1)	3.908** (1.767)	4.004** (1.849)
Subcontracting in making garments (=1)	2.246 (1.695)	2.536 (1.903)
Output (log)	1.755*** (0.551)	1.807*** (0.581)
Status		
Limited company (=1)	-1.377 (0.976)	-1.266 (0.894)
BGMEA member (=1)	0.620 (0.795)	0.420 (0.707)
Joint Venture (=1)	0.729 (0.632)	0.878 (0.596)
Factory rented (=1)	-	-0.937 (0.953)
Years since establishment	-0.064 (0.131)	-0.084 (0.131)
Location		
Outside Narayanganj (=1)	-1.130* (0.643)	-0.993 (0.656)
Savar and Gazipur (=1)	-0.482 (1.101)	-0.845 (1.235)
EPZ(=Foreign-owned) (=1)	-4.701*** (1.526)	-4.370*** (1.577)
BSCIC industrial area (=1)	0.604 (1.174)	0.592 (1.147)
Management		
Age	0.053 (0.046)	0.051 (0.045)
Education: HSC (=1)	0.601 (0.644)	0.641 (0.646)
Education: BA (=1)	0.630 (0.918)	0.766 (0.991)
Education: MA or higher (=1)	0.942 (0.768)	1.015 (0.797)
Experience: Same firm	0.102 (0.144)	0.131 (0.139)
Experience: Knitwear	-0.044 (0.071)	-0.053 (0.077)
Experience: Textile and garments	-0.076 (0.048)	-0.082* (0.049)
Sample size	**177**	**177**
R^2	**0.280**	**0.288**
Adjusted R^2	**0.188**	**0.192**
Hausman Test of Endogeneity		
Coefficient of Output (log)	-0.621 (0.554)	0.575 (0.542)
Coefficient of Residual of log Output	1.387 (1.016)	1.524 (1.057)

Notes: Figures in parentheses are White heteroskedasticity-consistent robust standard errors. Estimates with ***, ** and * asterisks are significantly different from zero at 1%, 5% and 10% error probability levels, respectively.

Table 5B

Proximate Determinants of Profits-capital Ratio
(Firms engaged in knitting fabrics, or both knitting fabrics and making garments)

Intercept	-31.121** (13.908)	-28.184** (12.006)
Production		
Knitting fabrics only (=1)	-0.860 (1.172)	-0.716 (1.143)
Making knitwear only (=1)		
Subcontracting in knitting fabrics (=1)	4.796* (2.532)	5.357* (2.748)
Subcontracting in making garments (=1)	2.425 (1.620)	2.677 (1.837)
Output (log)	1.831** (0.739)	1.956** (0.795)
Status		
Limited company (=1)	-1.755 (1.149)	-1.480 (0.990)
BGMEA member (=1)	0.665 (0.784)	0.424 (0.729)
Joint Venture (=1)	0.663 (0.683)	1.052* (0.622)
Factory rented (=1)	-	-1.341 (1.039)
Years since establishment	0.041 (0.326)	-0.038 (0.292)
Location		
Outside Narayanganj (=1)	-0.473 (0.765)	-0.177 (0.822)
Savar and Gazipur (=1)	-1.126 (1.303)	-1.567 (1.371)
EPZ(=Foreign-owned) (=1)		
BSCIC industrial area (=1)	0.766 (1.361)	0.740 (1.307)
Management		
Age	0.041(0.326)	0.046 (0.048)
Education: HSC (=1)	0.306 (0.811)	0.203 (0.839)
Education: BA (=1)	0.292 (0.834)	0.371 (0.821)
Education: MA or higher (=1)	0.946 (0.743)	0.905 (0.718)
Experience: Same firm	-0.011 (0.355)	0.082 (0.313)
Experience: Knitwear	-0.024 (0.072)	-0.047 (0.081)
Experience: Textile and garments	-0.088* (0.048)	-0.093* (0.050)
Prices		
Price of circular knitting machine (log)	-	-0.309 (0.265)
Sample size	**152**	**152**
R^2	**0.264**	**0.287**
Adjusted R^2	**0.165**	**0.178**
Hausman Test of Endogeneity		
Coefficient of Output (log)	-0.299(1.128)	-0.267(1.139)
Coefficient of Residual of log Output	2.370 (1.735)	2.444 (1.679)

Notes: See Table 5A.

Table 5C

Proximate Determinants of Profits-capital Ratio
(Firms engaged in making garments or both knitting fabrics and making garments)

Intercept	-33.374*** (11.810)	-32.049 (23.476)
Production		
Knitting fabrics only (=1)		
Making knitwear only (=1)	1.637** (0.813)	1.543* (0.923)
Subcontracting in knitting fabrics (=1)	3.930* (2.181)	3.621* (2.026)
Subcontracting in making garments (=1)	2.698 (1.852)	3.019 (2.029)
Output (log)	1.932*** (0.598)	1.977*** (0.621)
Status		
Limited company (=1)	-1.415 (1.033)	-1.320 (0.962)
BGMEA member (=1)	0.462 (0.802)	0.280 (0.720)
Joint Venture (=1)	0.688 (0.675)	0.845 (0.636)
Factory rented (=1)	-	-0.966 (1.016)
Years since establishment	-0.035 (0.147)	-0.063 (0.178)
Location		
Outside Narayanganj (=1)	-1.244* (0.689)	-1.124 (0.701)
Savar and Gazipur (=1)	-0.625 (1.050)	-1.087 (1.270)
EPZ(=Foreign-owned) (=1)	-4.909*** (1.515)	-4.436** (1.810)
BSCIC industrial area (=1)	0.595 (1.250)	0.548 (1.161)
Management		
Age	0.060 (0.051)	0.056 (0.050)
Education: HSC (=1)	0.757 (0.670)	0.810 (0.719)
Education: BA (=1)	0.564 (0.969)	0.666 (1.058)
Education: MA or higher (=1)	1.005 (0.848)	1.028 (0.905)
Experience: Same firm	0.061 (0.160)	0.092 (0.182)
Experience: Knitwear	-0.043 (0.072)	-0.051 (0.082)
Experience: Textile and garments	-0.084* (0.048)	-0.091* (0.050)
Prices		
Price of sewing machine (log)	-	-0.107 (1.459)
Sample size	**164**	**164**
R^2	**0.285**	**0.293**
Adjusted R^2	**0.191**	**0.189**
Hausman Test of Endogeneity		
Coefficient of Output (log)	0.374(0.705)	0.0.351(0.696)
Coefficient of Residual of log Output	1.893 (1.273)	1.990 (1.281)

Notes: See Table 5A.

Table 6

Proximate Determinants of Productivity
(Firms engaged in knitting fabrics, making garments or both)

Dependent variable	TFPI	TFPI	TFP2	TFP2	Solow	Solow
Method	OLS	2SLS	OLS	2SLS	OLS	2SLS
Intercept	-14.876***	-7.068**	-16.075***	-15.166***	-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: HSC	0.058	0.181	0.062	0.077	0.176	0.305
	(0.210)	(0.263)	(0.205)	(0.209)	(0.236)	(0.257)
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 garments	-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
Adjusted R^2	0.596	0.469	0.667	0.665	0.574	0.429
Hausman Test of Endogeneity: Coefficient on						
(Log) Output	-	0.359**	-	0.842***	-	0.290*
		(0.161)		(0.142)		(0.156)
Residual: (log) Output	-	0.536***	-	0.062	-	0.562***
		(0.173)		(0.152)		(0.173)
Hansen *J*-Test [$\chi^2_{(6)}$]	-	3.347	-	1.322	-	3.179
		[0.764]		[0.970]		[0.786]

Note: Figures in parentheses are White heteroskedasticity consistent robust standard errors; those in brackets are *p*- value. Estimates with ***, ** and * asterisks are significantly different from zero at 1%, 5% and 10% error probability levels, respectively.

Appendix 1. Data

A1.1. Sampling method

The data used in this paper were collected for a research project conducted jointly by the Institute of Developing Economies (IDE), Japan, and the Bangladesh Institute of Development Studies (BIDS) during July-October 2001. The Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA) fully cooperated in the project. Part of the 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 textiles and wearing apparel to the United States following the imposition by the United States of import ceilings to Bangladesh by commodity, otherwise known as "quotas". Any knitwear producing firms need to belong to either association or both to attain visas for the American 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 membership of both associations, the upper bound of the number of export-oriented knitwear producing firms in Bangladesh was 1,186 in 2001.

The survey aimed to cover all BKMEA member firms whose factories were located in the Dhaka Division, which is one of five geographical divisions in Bangladesh. The Dhaka Division covers main districts where export-oriented garment production is flourishing, such as the Dhaka, Narayanganj and Gazipur Districts. A caveat is that firms operating in Chittagong, which is the second greatest garment producing division, were not covered because of the need for the efficient allocation of research resources. However, as Table A1 shows, BKMEA members are concentrated in the Narayanganj District, with only a small number of members in Chittagong. 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 573 BKMEA member firms located in the Dhaka Division. It turned out that 16 firms had been closed down out of the original 573. In the end, we collected 251 questionnaires. However, we could not help but drop 19 of them due to inconsistencies in the reporting given by the questionnaire respondents. In the end, 232 questionnaires remained 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 2 displays the geographical distribution of the sample firms in the data set. The combination of the shares of the sample firms in Narayanganj and Dhaka are roughly comparable among 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 considered in detail 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. The main topics are sources of capital, variety of products, age of firms since establishment, scale of operation, characteristics of management, and structure of employment.

Sources of capital

First, even though export-oriented garment production was first launched by South Korean FDI ventures (Rhee, 1990), foreign firms currently present a relatively low profile in the garment industry in Bangladesh. This is partly because the export-oriented garment business was somehow regarded to be in a state of "excess competition" for visas to export to the United States, so that it was hard for new foreign entrants to secure visas, even though the export-oriented garment business was growing rapidly. In other words, an increase in local capital sufficed for rapid growth of the industry. Thus, immediately after the MFA phase-out was completed in January 1, 2005, some influential foreign investors in India and the Middle East made public 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 to the low profile of FDIs and joint ventures. Their share of sample firms is less than 2% of the 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 for foreign owned firms to refuse to be interviewed by us, as was also generally the case with large scale firms and those located in the EPZs. These companies appeared to be more cautious in disclosing any information about 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 the application of physical and chemical treatments. The sample firms engage in a combination of these four activities. Table A5 shows that more than half of the 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, in that over half of the sample firms were established within a period of less than five years preceding the date of the interview. Firms operating for longer than ten years amount to only slightly more than 10% of the sample.

Table A6. Chronological distribution of sample firms

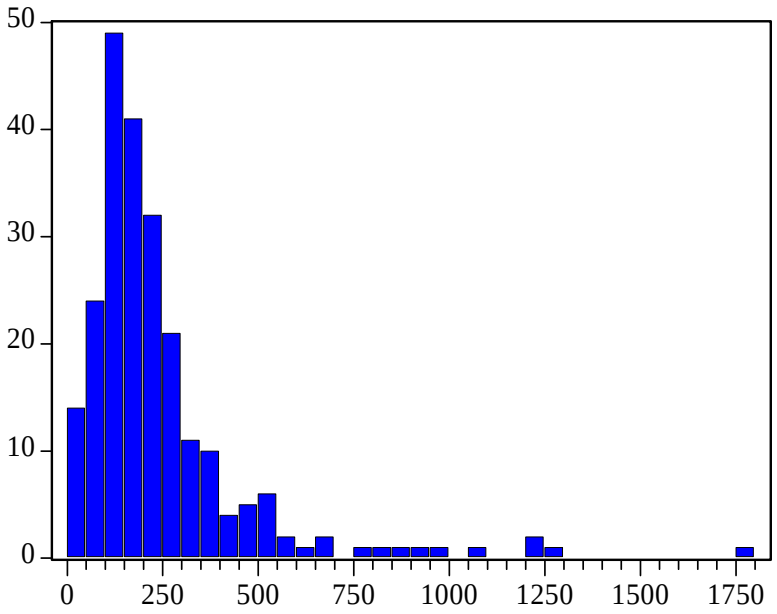
	# of firms	Share (%)
before 1976	4	1.7
1976 - 1980	0	0.0
1981 - 1985	3	1.3
1986 - 1990	19	8.2
1991 - 1995	67	28.9
1996 - 2000	133	57.3
2001	6	2.6
Total	232	100.0

Scale of operation

The scale of export-oriented garment producing firms is greater than those in other manufacturing industries partly because of the labor-intensive nature of garment manufacture. The average number of employees of the 2,891 BGMEA member firms which filed their numbers with BGMEA in 2002/03 was 399 (BGMEA, 2003). According to Little, Mazumdar and Page (1987), for developing economies, "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 (Little, Mazumdar and Page, 1987, p. 8). Compared with those standards, the scale of average export-oriented garment producers in terms of the number of workers employed is quite large. Some 96 firms out of the 2,891 BGMEA members employed 1000 employees or more, and the largest firm employed no less than 7,600 workers.

Figure A1 displays the distribution of our 232 sample firms. The average and median numbers 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.

Characteristics 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 respondents to identify the "most influential decision-maker", so as to specify the top manager, and we invited them to give the designation of the person concerned. Then, attributes of the top manager were asked for (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, and that his or her length of experience is 5.9 years in the average sample firm. Their length of experience in the knitwear industry and (using the broadest definition) in the 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, the length of experience of managers in the industry is 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 a distinctly higher degree of education than that of the average Bangladeshi. Table A8 shows that the highest qualification of top managers of half the sample firms is a university Bachelor's degree, while more than 80% of top managers attain Bachelor's degrees or higher. In other words, 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 to offer a large quantity 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[17] amounts to 67.6% (BBS, 2004). By contrast, 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, male workers outnumber female. This might well be a feature of BKMEA member firms in general.

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

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 (Knitted 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 (Knitted 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

Production of sweaters and socks is excluded from our analyses, because the machines and technologies used to make these products are distinct from those used for making the main types of knitwear. The former types of knitwear are made directly from yarn while the latter types are made from knit fabrics.

In the interests of completeness, the profits-machines ratio of the excluded types of knitwear 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 substantial.

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 re 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: $\overline{R}_p^2 = 1 - \left[(n-1)/(n-k)\right] \cdot \left(1 - R_p^2\right)$.

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	less than 1 year		1-5 years		6-9 years		10 years +		Total	
	Designation	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	less than 1 year		1-5 years		6-9 years		10 years +		Total	
	Designation	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 /__/__/__/__/__/__/