Differentials at Firm Level Productive Capacity Realization in Bangladesh Food Manufacturing: An Empirical Analysis

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Abstract

This paper empirically estimates the firm-specific *PCR* indices using the stochastic frontier production function and analyses a number of variables explaining realization rates across firms and over time. The stochastic frontier production function is used to estimate capacity output and thereby *PCR*. Using the Firm level panel data from Bangladesh food manufacturing the results show that capacity realization rates widely vary across firms and over time. The average rate of realization is about 65% implying that most of the firms are producing away from their frontier. This paper also identifies several firm-specific and policy-related variables explaining capacity realization. The results show that firm size (*SZE*) and outward orientation (*OPN*) have positive while capital intensity (*CNSTY*), market structure (*MSTRE*) and effective rate of assistance (*ERA*) have negative impact on realization rates. Strikingly, both policy-related variables are statistically insignificant. Sensitivity analysis using the 'extreme bound analysis' also confirms the fragility (insignificance) of these two variables. Excessive support to firms and piecemeal liberalization reform may be attributed to these results. Thus, further reform of the domestic and trade policies are suggested to ensure competition and competitiveness of the manufacturing sector and of the country.

Keywords: Stochastic frontier production function, Productive capacity realization, Capital intensity, Effective rate of assistance, Outward orientation

JEL Classification: D24; L11; L25; L66

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Introduction

Improvement in productive capacity realization (*PCR*) [1] of firm is the key to sustained economic growth. The growth of the food processing sector is particularly important to Bangladesh as this is one of the important industries in terms of its contribution to total manufacturing production and employment. For example, food processing runs second only to textiles in terms of value of output and employment, accounting 25 per cent of total industrial output and 16 per cent of total manufacturing employment in 2002/03 (BBS 2004). Several empirical studies (Islam 1981; Kalirajan and Salim 1997) show that manufacturing firms had worked with high degrees of unrealized productive capacity due to excessive controls of the protective regimes in the 1960s to mid 1980s. It is expected that recent liberalization programs have encouraged firms to eliminate excess capacity and to improve productivity growth. For this reason, this investigation of the *PCR* of Bangladesh manufacturing firms and its determinants is of important policy relevance. This paper measures the *PCR* indices with more recent available data and analyses the factors explaining the capacity realization rates using firm level panel data. However, the main focus of this paper lies on the latter objective.

The rest of the paper is organized as follows. Section 2 presents the concept and measurement of *PCR* followed by a critical review of the existing literature on the differentials of capacity realization. Section 4 provides data sources and an analysis on the empirical estimates of *PCR* followed by an analytical framework based heavily upon the theoretical and empirical studies in the Industrial Organization (IO) literature. Variations in the rates of capacity realization across firms and through time are then explained using several factors, whose expected and effective impact is discussed at some length in section 6, along with the detailed sensitivity analysis. A summary and conclusions are given in the final section.

Concept and Measurement of Productive Capacity Realization

Theoretical models of firm dynamics have formalized the concept of capacity realization and discussed its importance for projecting potential output and resource allocation. As a result, a body of research evolved in order to measure capacity realization and productivity growth of economic decision making units (EDMU). Capacity realization is defined as the ratio of the actual to some measure of capacity output (*i.e. y/y**). Capacity output may be the engineering variable that is technically determined (Johansen 1959) or cryptic. Following Klein's arguments, it might be the firms' desired output that is 'the production flow associated with the input of fully utilized manpower, capital and the relevant factors of production' (1960: 275). This is, in one sense, firms' potential or maximum possible output that could have been produced from the existing bundle of input and technology. The firm obtains its potential output when it uses the best techniques available from the given technology. This potential output may or may not be realized by a firm.

Alternative methodologies have been developed for measuring capacity output and thereby *PCR* in the literature. The limitations of conventional approaches for measuring *PCR* have been well documented and need not be repeated here (Färe *et al* 1989; Segerson and Squires 1990; Gréboval 1999). The econometric approach to *PCR* has spread rapidly in the last decade (Berndt and Hesse 1986; Nelson 1989; Morrison 1988 among others). Though these analyses follow the neoclassical theory of either production or cost function in empirical research, usually these functions are estimated by allowing them to pass through the mean of the data set which provides average output, rather than the theoretically determined maximum possible output or the minimum cost. So the indexes of *PCR* are over-estimated for some observations and under-estimated for others.

The framework developed here is based on Klein's definition of capacity output, but applies the stochastic frontier production function approach. Capacity is measured here from observed inputs and output based on the 'best practice' performance of firms. Not all firms can produce the theoretically maximum output all the time due to the adverse effects of various institutional and organizational factors. This then leads to variations in the level of potential outputs.

The stochastic frontier production function is defined as

$$y_{it} = f(x_{it})\exp(v_{it} - u_{it}) \qquad (1)$$

where y_{it} refers to output and x_{it} are factor inputs and u_{it}s are non-negative random variables representing specific productive characteristics (unrealized production capacity in this case) of the *i*th firm in *t*th period and v_{it}s are random disturbance terms which are assumed to be independently and identically distributed as $N(0, \sigma_v^2)$. Due to the presence of the random variables, v_{it}s the above specification represents a stochastic frontier. Further, v_{it}s are expected to capture the influence of factors outside the control of firms that cause the actual output of firms to vary around some mean level. Firms fully realize their potential output (*i.e.* produce at the production frontier) in the *t*th period if and only if u_{it}s equal zero. This specification implies that firms cannot produce more than a theoretically possible level of output. The greater the value of u_{it} the further the firm will be from the production frontier and the less will be firm's observed output. That means the higher the rate of under-utilization of productive capacity the less will be firm's observed output.

The productive capacity realization (*PCR*) in the *i*th firm in the *t*th period is defined as

$$PCR_{it} = \frac{y_{it}}{y^*_{it}} \tag{2}$$

where y_{it} is observed or realized output level and y^*_{it} is the maximum possible output evaluated at inputs x_{it}. Given the stochastic frontier production function (1), the *PCR* of the *i*th firm in the *t*th period can be expressed as

$$PCR_{it} = exp(-u_{it}) = \frac{y_{it}}{f(x_{it})exp(v_{it})} = \frac{y_{it}}{y^*_{it}} \tag{3}$$

An interesting feature of this definition of *PCR* is that capacity realization is evaluated at the stochastic frontier. In the stochastic frontier model, the random variation of output is captured by v_{it} is excluded from the *PCR* index whereas it is included in other deterministic efficiency approaches (e.g. Data Envelopment Analysis) and thereby contaminated traditional capacity utilization indices. The maximum likelihood method is used to estimate the unknown parameters of the production function and the likelihood function is expressed in terms of variance parameters, *i.e.* $\sigma^2 = \sigma^2_v + \sigma^2_u$ and $\gamma = \sigma^2_u / \sigma^2$. The parameter γ has interesting significance in the stochastic frontier model and it has the value between 0 and 1. If this parameter turns out to be zero or close to zero then this means that the random variable u_{it} and the full frontier model has little explanatory power over the realization rate of individual firm in the sample. Conversely, if the parameter is close to 1, then the residual is dominated by the random variable u_{it}, which implies that the frontier model has strong explanatory power.

Differentials at Firm Level Capacity Realization: A Critical Review

All producers are not equally efficient in production, because access to information, structural rigidities (for example, infrastructure failure, seasonality of raw materials etc.) and time lags to learn technology, differential incentive systems, and organizational factors (such as *X*-efficiency and human capital related variables) all affect firms' ability in production. Mueller pointed out that '.....the role of non-physical inputs, especially information and knowledge, which influence the firm's ability to use its available technology set fully' (1974 :731). Given these factors, few firms achieve maximum feasible output from their available inputs and existing technology.

There are two classic views on the explanation of productive capacity under-realization of production agents. One of these argues that capacity under-realization is a long-run problem in which the patterns of productive capacity realization depend on non-price factors affecting managerial decisions such as economies of scale, oligopolitistic market structure, cyclical demand for output and insufficient supply of complementary inputs. Winston (1971) developed a model of capacity utilization in line with this argument. The other view is that capacity under-utilization is a short-run phenomenon and its determinants depend on the profitability of increasing capacity realization of production units. This view claims that increases in profitability lead to higher capacity realization. However, this analysis does not include non-price elements (such as the market structure and the size of the market) as explanatory variables of capacity realization. The underlying assumption is that firms choose their capacity realization rate to maximize profit. However, testing these models empirically has proven to be quite difficult.

Recent theoretical works in the IO literature offer two other views on the differences in observed capacity realization of firms. Firms may build excess capacity for both strategic and non-strategic reasons. Profit-maximizing firms may hold non-strategic excess capacity in markets where demand is cyclical or stochastic, where plants are inherently lumpy or subject to economies of scale, or where imported inputs are allotted on the basis of built-in production capacity. The latter reason was and still is more common in developing countries, particularly countries which adopted, or still follow an import substituting industrial strategy. Empirical evidence for the above explanations is quite sparse. Leibenstein (1966) emphasized the importance of organizational factors, while Lecraw (1978) indicated the importance of technology-related factors, such as capital intensity and scale of operation, as being responsible for differential performance of firms. Along these lines, Schydlowsky (1973) suggested six possible reasons why capacity utilization of production units varies substantially: factor intensities, relative factor prices and, particularly, the cost differential between labor shifts (i.e. the shift premium) economies of scale, the elasticity of substitution between inputs, the elasticity of demand and the availability of working capital.

Caves and Barton (1990) argued that the differential performance of firms in terms of realization of productive capacity could be analyzed through the well-known structure-conduct-performance (S-C-P) theory of industrial economics. Neoclassical S-C-P is related to market structure, such as the degree of seller concentration, growth of demand and so on. However, the more recently developed 'endogenous growth' theory emphasizes the role of human capital on firm's productivity performance. The crucial role of human capital in the production process is two-fold: first, management skills strongly influence the firm's ability to produce the maximum possible output by realizing existing production capacity. The realization rate increases through the implementation of many specific activities, such as maintenance, design and modification, and quality control. Second, there is an important feedback effect to the firm's endowments of human capital from efforts to productivity improvements in response to external stimuli. For example, successful implementation of worker training programs may, by increasing human capital endowment, augment the ability of a firm to undertake further improvements.

The impact of firm-specific characteristics, such as age and size of firms, market structure and policy related variables, such as concentration and effective rate of protection (ERP) on a firm's (or industry's) performance in terms of profitability, have been widely tested in the IO literature. However, relatively few studies have been carried out to test these hypotheses taking capacity realization as firms' (or industries') performance. The principal finding that emerges from these studies is that, in most cases, capital intensity, market structure, openness, import content in production, and scale of operation are important variables in determining capacity realization. However, the analyses on the effects of the policy related variables on *PCR* have become very important in the wake of deregulation and liberalization. Since more than two decades of policy reform and the availability of firm level data Bangladesh food manufacturing could be a suitable case study to identify several firm-specific and policy related variables influencing the inter-firm differences in capacity realization.

Data and the Empirical Measurement of PCR

This study uses firm level data from the *Master tape* of the Census of Manufacturing Industries (CMI) conduced by the Bangladesh Bureau of Statistics (BBS). BBS conducts the similar census every year for the Government. Private researchers, academic and scholars have limited access to the more recent firm level information. This study uses the CMI data for the period 1992-1994 and 1997-1999 [2]. Food processing is one of the vital sectors of the national economy of Bangladesh in terms of employment, contribution to GDP and foreign exchange earnings. Therefore, this study uses 4-digit firm-level panel data from the Bangladesh food manufacturing industries.

Table 1: Summary Statistics of the Selected Variables

Variables	Year	Minimum	Maximum	Mean	Std. Dev.
Value-Added (million TK.)	1992	1.27	265.52	36.71	34.94
	1993	1.63	331.24	38.96	35.55
	1994	1.47	365.82	43.11	48.66
	1997	2.16	389.72	49.57	52.12
	1998	2.98	441.65	52.55	50.23
	1999	3.11	477.53	63.34	55.17
Labor (‘00’ persons)	1992	0.40	8.31	1.58	3.45
	1993	0.55	8.67	1.80	3.71
	1994	0.65	9.10	2.04	3.60
	1997	0.60	9.50	2.10	3.75
	1998	0.63	9.80	2.15	3.66
	1999	0.70	10.20	2.45	3.62
Capital (million TK.)	1992	1.10	50.01	10.43	12.51
	1993	1.75	65.42	13.11	12.65
	1994	1.90	85.94	17.32	10.88
	1997	1.92	88.45	22.42	15.33
	1998	2.25	103.67	25.77	12.77
	1999	2.67	127.10	30.22	12.01
Materials (million TK.)	1992	0.41	25.14	2.50	3.44
	1993	0.63	30.55	3.32	3.32
	1994	0.64	37.42	4.58	3.80
	1997	0.71	44.78	6.01	4.22
	1998	0.74	50.34	6.94	3.50
	1999	0.80	67.93	8.52	4.01

Source: Census of Manufacturing Industry (CMI) (Master Tape, Current Production). Bangladesh Bureau of Statistics (BBS), Ministry of Planning, Dhaka, Bangladesh.
Note: All variables are measured in ‘million’ Taka except labor, which is measured in ‘100’ persons. Official exchange rate is US$1=52.70 Taka in 1999.

The CMI covers all public and privately owned enterprises with 10 or more employees. However, it provides information on a different number of firms in the same industry for different years because of either the entrance (exit) of new firms or both. This study takes 92 firms with over 25 employees after removing the firms showing inconsistencies. The gross value-added and three other variables labor (l), capital (k), and materials (m) inputs -are taken for estimating a production function. The details of the construction of these variables are given in the appendix and the summary statistics are presented in Table 1.

Model Specification and the Estimates of PCR

The reliability of realization rate estimates hinge crucially on the specification of the model. The Cobb-Douglas functional form has been extensively used in stochastic frontier production function analysis as this affords maximum flexibility in dealing with data imperfections (Tybout 1990). Although it is argued that the Translog production function is a more general type of production function, it may not provide efficient estimates, because collinearity among the explanatory variables cannot be avoided. It is therefore not surprising that recent surveys of empirical applications of frontier production functions by Kumbhakar and Lovell (2000) revealed that the Cobb-Douglas technology specifications still dominate. Nevertheless, the Translog and the Cobb-Douglas specifications for annual (value added) data are sequentially tested by using the generalized likelihood ratio (LR) test as an important decision-making tool when theoretical considerations do not suggest correct functional specifications. Statistical results support the Cobb-Douglas functional form in this case. [3]

Accordingly the following production function is specified in estimating potential output and thereby *PCR*:

$$y_{it} = \alpha + \beta_1 k_{it} + \beta_2 l_{it} + \beta_3 m_{it} + \psi t - u_{it} + v_{it} \qquad (4)$$

where $i = 1, 2, \cdots, 92$ (firms) and $t = 1992-1994 \ and 1997\text{-}1999$. The variables y_{it}, k_{it}, l_{it} and m_{it} represent, respectively, the logarithm of output (value added), inputs of capital, labor, and materials in the *i*th firms and *t*th period of time. Variable t is added here to measure Hicks-neutral technical change. Before estimating the model we checked whether there was correlation between the individual effects (*i.e.* unrealized capacity) and productive factors (*i.e.* explanatory variables) and for possible endogeneity of the explanatory variables in the production function. For example, one can expect that labour input may be simultaneously determined with output. However, Hausman tests ruled out correlation between the individual effects and the explanatory variables and the endogeneity of productive factors.

A computer program *LIMDEP version 8.0* developed by Greene (2002) is used here in order to estimate the production function. The estimation is carried out on the data of a complete panel of 92 firms from 10 sectors of the food manufacturing for the periods

1992-1994 and 1997-1999. The maximum likelihood estimates of the model (Equation 4) are presented in Table 2. As can be observed from Table 2, most of the parameter coefficients are statistically significant and they all have correct signs. Output elasticities with respect to capital and material inputs are comparable while the elasticity with respect to labour is much larger indicating the increasing labour by one unit lead to a greater increase in output compared to a one unit increase in capital or materials. The sum of the coefficients of the three core factors labour, capital and materials is 0.90 suggesting that food manufacturing is likely to exhibit decreasing returns to scale. The coefficient of time variable (*t*) is 0.02 indicating an annual 2% technical progress. The value of γ is 0.872 which indicates that the variation in residuals is mostly explained by variation in firm-specific realization of production capacity. Thus, unrealized production capacity is the dominant source of random errors.

Table 2: The Maximum Likelihood Estimates of the Stochastic Frontier Production Function

Variables	Parameters	Coefficients	t-ratios
INTERCEPT	α	0.07	2.37
Ln(capital)	β_1	0.25	9.62*
Ln(Labor)	β_2	0.38	11.57*
Ln (materials)	β_3	0.27	4.33**
Time	ψ	0.02	3.01**
$\sigma^2 = \sigma_v^2 + \sigma_u^2$	σ^2	0.494	3.64**
$\gamma = \sigma_u^2 / \sigma^2$	γ	0.872	12.15*
Log-likelihood Function		-86.347	

Note: The asterisks ** and * denote 5% and 1% significance levels respectively.

Table 3 reports the *PCR* indices. It can be observed from this table that *PCR* rates vary across firms and over time. Fish & seafood has the highest average realization rates (over 70%) followed by Grain milling (70%) and rice milling (69%). A possible explanation is that the recent liberalization might have affected the highly export-oriented sector, fish & seafood while domestic deregulation might induce domestic resource based sectors such as grain and rice milling sector to realize higher production capacity. The worst performer in terms *PCR* is the sugar factories (45%). Besides organizational factors (these are mostly large firms) the long gestation period and seasonality of raw materials supply and poor infrastructure might prevent them achieving full production capacity. Sugar factories are mostly public sector firms and enjoy a seller's market. Also, there is no 'exit threat' or bankruptcy law for such enterprises. In fact, Khan and Hossain (1989) and Ahmad (1993) argued that financial constraints of these firms are 'soft'. Both phenomena lead to underutilization of existing productive capacity in these enterprises. Overall, *PCR* indices oscillate around 65% in the Bangladesh food manufacturing sector. This means that on average food manufacturing firms produce (realize) about 65% of what they could produce with given resources and technology. In other words, they could increase production by about 35% if they were realized full production capacity. That means most firms are producing far away from frontier indicating substantial unrealized production capacity remains at firm level in this industry.

Table 3: Productive Capacity Realization in Food Processing Industries,

Sectors	Minimum	Maximum	Mean	Std. Deviation
Dairy products (3112)	0.521	0.725	0.623	
Fish and sea foods (3114)	0.687	0.744	0.703	
Hydrogenated veg. oil (3115)	0.581	0.701	0.672	
Edible oil (3116)	0.512	0.625	0.552	
Grain milling (3118)	0.650	0.754	0.700	
Rice milling (3119)	0.493	0.718	0.691	
Bakery products (3122)	0.520	0.764	0.647	
Sugar factories (3123)	0.389	0.522	0.454	
Tea and coffee processing (3126)	0.458	0.786	0.639	
Tea and coffee blending (3127)	0.562	0.705	0.675	
Total	0.389	0.786	0.647	

Source: Calculated from CMI data (Master Tape, Current Production). Note: Numbers in the parentheses are industrial codes from Bangladesh Standard Industrial Classification (BSIC) which is consistent with the International Standard Industrial Classification (ISIC).

Factors Explaining PCR Indices

PCR indices obtained from the production frontier approach have a very limited utility for policy and management purposes if empirical studies do not investigate the factors affecting these realization rates. Realization rates of manufacturing firms are not only affected by the firm specific attributes but also by the country's domestic and international (trade & exchange rate) policies. The latter has become very important in the wake of deregulation and liberalization. The summary statistics of these variables appear in Table 4. Drawing on theoretical and empirical studies summarized earlier, this section outlines a range of hypotheses that pertain to inter-firm differences in capacity realization.

Table 4: Factors Explaining Productive Capacity Realization

Variables	1992	1993	1994	1997	1998	1999
Farm Size (*SZE*)	0.024	0.028	0.025	0.032	0.035	0.037
Capital Intensity (*CINSTY)*	25.10	27.40	27.52	28.68	30.10	35.72
Prpn. of professnal. worker (*PNWT*)	0.32	0.30	0.27	0.31	0.28	0.25
Market Structure (*MSTRE*)	0.58	0.63	0.65	0.65	0.68	0.67
Effective rate of assistance (*ERA*)	0.232	0.181	0.163	0.154	0.155	0.142
Openness (*OPN*)	0.20	0.25	0.27	0.30	0.32	0.35

Note: Variables construction details are given in Appendix. Mean values of all variables are presented in the table. In addition to these variables two dummies for private and joint venture firms (*DPVT* and *DJNT*) are also used. Source: Same as Table 1

Economists argue that firm size (*SZE*) reflects the existence of scale economies. Larger firms have better access to foreign technology, a greater ability to bear risk and greater advantages from R&D. The larger the firm size, the lower the unit cost (because of scale economies and externalities in production). As a result, capacity realization increases with firm size, so a positive relation is expected between these two variables. However, Pilat (1995) argued that firm size can give little information about the effect of scale economies on capacity realization and even if firm size does give an indication that it would be biased towards low capacity realization, because large firms may have coordination problem, worse labor relation and may suffer more strikes than small firms. Moreover, small firms adopt technology that is more appropriate, are more flexible in responding to changes in technology, product lines and markets, foster more competitive factor and product markets, and thus, are able to realize a higher rate of productive capacity. In Bangladesh, previous industrial policies encouraged firms to increase production capacity in order to fulfill the planned targets without emphasizing efficiency and higher capacity realization in production. By influencing government administration, large firms were able to accumulate subsidized imported inputs and machinery disregarding full utilization of plant capacity. In a comparable economic environment in Pakistan Pasha and Qureshi (1984) found a negative association between size of firm and capacity realization. Therefore a negative relationship is expected between firm size and capacity realization in Bangladesh.

Firm's age (*AGE*) is an important determinant of productive capacity realization, because equipment and machinery used by older firms do not embody the most recent technological advances, whereas younger firms are able to adopt the most efficient technologies available at the time of their establishment. However, there is a contrary hypothesis, that *AGE* captures the learning by doing phenomenon in a firm. The longer a firm is in production, the greater is the management experience and the fewer are labor bottlenecks and thus, older firms may have higher capacity realization. Empirical findings in earlier studies are mixed. However, this variable is not included in the second stage as the time trend (*t*) is already included in the first stage analysis.

Many authors argued that ownership (*DPVT*) of firm is also an important factor in determining capacity realization. In addition to public and private firms, there are joint ventures between private and public firms or foreign participation with either public or private firms or both. In the literature, it is hypothesized that public sector firms have greater access to import licenses, credit and technology, and so operate at a high level of capacity realization. The 'property right school', however, argues that managers within public firms tend to look after their self-interest rather than profit maximization. Since property rights are non-transferable in the case of public enterprises, the 'owners' (that is the public at large) have no incentive to pressure the managers of these enterprises to realize high level of production capacity, so public enterprises perform less efficiently than private enterprises. However, the empirical evidence actually provides weak support for this hypothesis. Bardhan (1992) argued that whether a firm is public or privately owned is less important. As long as its financial constraint is 'hard', there is no reason that this firm performs poorly.

Joint venture (*DJNT*) firms are assumed to realize high production capacity for at least two reasons. First, they have good management experience and good organizational structure; second, they encourage research and development. Garnicott (1984) demonstrates that foreign participation facilitates access to the latest and best practice technology and offers a positive impact on research and development. However, because of structural rigidities, joint venture firms may fail to cope simultaneously with domestic and foreign markets and so firms cannot operate at a high level of capacity realization. Economic theory, therefore, gives little guidance about the relationship between ownership and capacity realization of firm. Therefore it remains an empirical issue.

Capital intensity (*CINSTY*) has been shown to be an important variable in determining capacity realization. It is hypothesized that firms with higher capital intensity are likely to operate at higher realization rates, because they cannot afford the rental cost of unused capital. In other words, more capital-intensive plants have a greater incentive to economize on cost of capital through a high rate of capacity realization. However, if the cost of capital becomes relatively cheap due to subsidized credit or low interest rates, then firms may accumulate more capital than is required for production and are likely to operate at a lower rate of capacity realization, so a negative relationship could be expected between these two variables. Using Thai manufacturing data Lecraw (1978) found a positive association between these two variables while Srinivasan (1992) found negative in India. During the 1970s and 1980s, industries in Bangladesh enjoyed various types of concessions and incentives such as tax holidays, accelerated depreciation allowances and exemption of reinvested income from both corporation and personal income taxes. Heavy protection was also given to industries in the form of subsidized inputs and machinery through import licensing, making capital relatively cheap. Thus, distorted factor prices and import licensing rules encouraged capital-intensive techniques and over-expansion of industrial capacity. Capacity realization remained low in most of the large industries, particularly in import substituting capital-intensive industries, so a negative relationship is hypothesized between capital intensity and rate of realization.

In the production process, the proportion of white-collar (professional) workers to total employment (*PNWT*) includes managerial administration, labor relations, R&D and engineering personnel who contribute to effective acquisition and combination of productive resources. It reflects the average education level in the industry. Therefore, with a higher proportion of highly educated labor would also be more receptive to new approaches to production and management, leading to a positive association between the share of non-production employees and the rate of *PCR*. However, this view is opposed in an OECD study (1986) in that an increase in the proportion of ‘white-collar’ or managerial staff imposes a certain rigidity in the production process, thereby retarding rapid adjustment to variations in demand. There is also a view that increasing bureaucratization of the production process may reflect ‘feather bedding’ and the development of *X*-inefficiencies within the context of protected and regulated industries. Economic theory is indeterminate in postulating the relationship between this variable and the rate of *PCR*. In Bangladesh, a large proportion of industrial enterprises are in public sector, with excessive employment and excessive wage and fringe benefits for employees. Bangladesh does not have a social security system, so employment in clerical and administrative activities has been used as one way of helping people to improve their quality of living. Therefore, a negative relationship between *PNWT* and *PCR* is expected.

Market structure (*MSTRE*) is generally seen as a potentially important variable in determining the level of capacity realization. The usual practice is to employ a proxy for market structure using a firms' concentration ratio. In the standard IO paradigm, a high concentration ratio is expected to diminish competitive rivalry among firms with the likelihood of under-utilization of production capacity. Chamberlin (1938) pioneered the analysis of the relationship between market structure and capacity realization. His well-known explanations for the existence of excess capacity in industries are based on monopolistic competition. Due to the absence of competition among sellers, few firms undertake independent experiments to seek better ways of carrying out production activities. Scherer (1996) contended that concentration does not lead to greater R&D intensity, and so leads to a decrease in capacity realization. Again, concentration may inhibit the information flow across firms within an industry and thus permit inefficient production units to survive. All these arguments suggest that, *ceteris paribus*, rates of capacity realization decrease with a greater concentration of producers.

However, another line of argument suggests that high concentration brings about greater innovation and technological change, which may be sufficient to offset the adverse monopoly effects of high concentration. Again, concentrated industries suffer from less uncertainty of demand than other firms and can plan better for high utilization of production capacity. These arguments suggest a positive relationship between industry concentration and the rate of *PCR*. Bangladesh possesses an oligopolistic market structure in the industrial sector, created by the policy regimes pursued during the seventies to early eighties. Foreign competition was eliminated through trade restrictions, and domestic competition was hindered through a system of industrial licensing and various fiscal and financial privileges directed to specific groups of entrepreneurs. In his recent study Salim (1999) showed that the concentration ratio declined in some industries, such as jute, garments, fish and seafood industries, perhaps due to the removal of the investment ceiling and import licenses as part of economic reforms. Still the market structure in Bangladesh manufacturing remains concentrated.

Given the oligopolistic market structure, our *a priori* expectation is a negative relationship between market structure and capacity realization.

The openness variable (*OPN*) has been used mostly in aggregate analysis. Many earlier studies have documented a positive association between exports and economic growth at an aggregate (national) level in many developing countries (Feder 1982, Yanikkaya 2003 and others). Findlay (1985) demonstrated that export-orientation *per se* is not 'necessarily growth-inducing'; the missing link is found in such real determinants of growth as capital formation, capacity utilization and technological progress which are so vital for the dynamic internal economic transformation of these economies. Some industry (firm) level studies also lend support to a positive relationship between openness and performance. Export-oriented firms (industries) are expected to realize higher production capacity than non-exporting firms for two reasons: first, firms with high export proportions are likely to be subject to more external competition than firms producing mainly for local consumption. This competition may cause a 'cold-shower' effect on domestic managers. To stay in business, a firm competing in the world market might be forced to realize a higher production capacity than one selling only in a sheltered domestic market. There is an implicit 'challenge-response' mechanism induced by competition, forcing domestic industries to adopt new technologies, to reduce 'X-inefficiency', and generally to reduce costs whatever possible. Second, a firm selling in more than one market has an advantage over a firm selling in a single market, particularly when it comes to coping with unexpected demand problems.

However, neoclassical theory suggests that capacity realization is exogenous and therefore is unaffected by trade openness. It may be argued, in line with the 'new' growth theories that trade policies affect capacity realization and technological progress, which in turn, lead to long-run growth. In these models, openness to trade provides access to imported inputs, which embody new technology and increase the effective size of the market facing producers, raising the demand for output and leading to higher utilization of technology (Grossman and Helpman 1990). High export intensity may signal the achievement of economies of scale. It may be argued that exporting may involve relatively greater risks and consequently firms may attempt to export only if the return is higher than on domestic sales. This suggests that firms will exploit avenues to reduce costs and this is possible by realizing a higher rate of production capacity. Most industries in Bangladesh are import substituting except jute, leather and tea. However, following the economic reforms in the early eighties, some export-oriented sub-sectors within various industries were developed such as ready-made garments, fish and sea food and electronics. Manufacturing exports as a percentage of total exports of the country steadily increased since 1982. From all the above arguments, *a priori*, a positive relationship between export-orientation and the capacity realization of firm is presumed.

Trade and domestic regulatory incentive policies *(ERA)* play a critical role in determining capacity realization of manufacturing firms. In general, tariff protection and other industry regulatory or assistance measures are thought to lessen the competitiveness of industry, because all of these assistance measures protect domestic industries from foreign competition. These policies also create price distortions and have indirect costs, which increase exponentially with the magnitude of price distortions. By limiting competition with foreign products, all sorts of protection become counter-productive. Therefore, protection is expected to have an adverse impact on firm-specific capacity realization. However, in line with the so called 'infant industry argument', it can be argued that protection helps to realize higher production capacity. The low rates of protection may promote best practice techniques and thereby improve capacity realization through the reduction of risk provided by protective barriers. This is similar to the argument of Schumpeter (1942) that a reduction in competitive pressure or an increase in market power may reduce the risk and stimulate the rate of *PCR* of a firm. The above arguments for and against protection lead to the conclusion that economic theory is indeterminate concerning the nature of the relationship between the *ERA* and *PCR* of firm (or industry).

Protection and regulation have historically been an important feature of Bangladesh industry. Following independence in 1971, Bangladesh pursued inward looking policies with the emphasis on a leading role for the public sector in economic activities. A series of measures, such as quantitative restrictions (*QRs*), highly differentiated tariff rates (0 to 400%), and various licensing procedures along with an overvalued exchange rate and huge subsidization programs were put in place to protect domestic industries from competition. These policies created bottlenecks by preventing speedy availability of inputs for the production process and by holding up the import of necessary spare parts and critical equipment, which affect firms' capacity realization. However, since the early 1980s, *QRs* were replaced by tariffs, tariffs rates were reduced (average tariff rate is less than 40% as of 2002) and rationalized and licensing systems were removed so that the economy become substantially open and outward looking, which have influenced the production environment of firms. Therefore, a positive association between *ERA* and *PCR* in Bangladesh manufacturing is expected.

Thus, a number of explanatory variables have been considered in explaining the variation of firm level capacity realization both in developed and developing countries. However, no single variable was statistically significant in all studies. Most variables had ambiguous effects (different signs) and therefore, generated contradictory interpretations. The weak results of these studies may be due to the poor quality of data, or to the omission of information in estimating independent variables or the dependent variable, or both.

Factors Explaining Firm Level Productive Capacity Realization

Drawing on the earlier theoretical and empirical studies discussed above the following equation is specified. Accordingly, this model facilitates comparison of the results with those reported in previous studies.

$$PCR_{it} = f\left(\overset{?}{SZE}_{it}, \overset{?}{CINSTY}_{it}, \overset{?}{PNWT}_{it}, \overset{?}{MSTRE}_{jt}, \overset{?}{ERA}_{jt}, \overset{+}{OPN}_{jt}, \overset{+}{DPVT}, \overset{+}{DJNT}\right) + w_{it} \qquad (5)$$

where *PCR* stands for firm-specific production capacity realization indices, *SZE* for size of firm, *CINSTY* for capital intensity, *PNWT* for the proportion of non-production workers to total workers, *MSTRE* for market structure (four-firm concentration ratio, CR_4), *ERA* for effective rate of assistance, *OPN* for openness of firm, *DPVT* for dummy variable for private firm (takes value 1 when the firm is private or zero otherwise), *DJNT* for joint venture firms (takes value 1 for a joint venture firm or zero otherwise) and w_{it} for white noise error term. Subscripts *i* refer to firms, *j* refers to sectors, and *t* refers to years. The summary statistics of variables used in this study appear in Table 4.

Since *PCR* varies between zero to one it is necessary to use a nonlinear specification of the functional form, such as the logistic or exponential specification. [4] This study uses the latter functional form that is: $PCR_{it} = e^{H_{it}\beta + \lambda_i + w_{it}}$ where *H* are the variables explaining *PCR* defined as above, λ_i are individual effects and wit is stochastic disturbance term with usual properties. Using logarithm it turns out to be

$$ln\,PCR_{it} = \beta\, ln(H_{it}) + \lambda_i + w_{it} \qquad (6)$$

The estimated results of the above model (6) are presented in Table 5. The results are generally consistent with *a priori* expectations except *SZE* and *PNWT* as outlined above. The results show that the firm-size matters for productive performance. Although economic theory gives little guidance about the relationship between *SZE* and *PCR*, the industrial structure and institutional systems in Bangladesh provide some expectations of a negative relationship as explained earlier. That means the bigger the firm size the lower is the rate of productive capacity realization. But the results show that variable *SZE* has positive influence on capacity realization. The variable is statistically significant at one percent level. Not only that the size of the coefficient of this variable (0.161) is relatively big. It may be argued that big firms took advantage of licensing and other protective measures by influencing policy regimes that might help to acquire scale economies.

Table 5: Determinants of Productive Capacity Realization

Variables	Coefficients	Standard errors
INTERCEPT	0.154*	0.03713
SZE	0.161**	0.01248
CINSTY	-0.127	0.04731
PNWT	0.075*	0.02175
MSTRE	-0.153*	0.04761
ERA	-0.038	0.02415
OPN	0.052	0.02503
DPVT	0.046	0.04315
DJNT	0.037	0.02834
R^2	0.43	
No. of firms	92	
Sample Size	552	

Note: At the outset Hausman test is used to test whether the regressors are simultaneously determined. The results (χ^2=27.71) reject the null of simultaneity. The asterisks **, and * indicate significance at 1 and 5 per cent level, respectively.

Capital intensity (*CINSTY*) as expected influences *PCR* negatively but its coefficient is not statistically significant. These results appear to be consistent with the country's trade and industrial policy regimes. Enterprises were supplied with foreign equipment and machinery at subsidized rates and that encouraged firms to build excess capacity without regard for its full utilization. The variable *PNWT* (proportion of non-production workers to total work force) is positively related with *PCR* and statistically significant. One explanation of this positive association of *PNWT* with *PCR* may be that all sub-sectors of food processing industries, except for sugar products, are at an early stage of development, so that increases in non-production workers in these industries are due to expansion and demand pressure from home and abroad following the policy reforms.

More white-collar people were needed to obtain higher *PCR*, with modern technology. Since increases in non-production workers imply development of human capital, a positive impact of *PNWT* on capacity realization is expected.

The negative sign of the market structure (*MSTRE*) variable supports the hypothesis that the higher the concentration ratio or degree of monopoly in an industry the lower is capacity realization. This variable is statistically significant, which suggests that the (monopolistic and oligopolistic) market structure did not change even after the implementation of economic policy reforms. This is supported by the views of many policy-makers and international donor agencies who believe that economic policy reforms in Bangladesh are half-hearted (Mahmud 2002). The positive sign of the openness variable (*OPN*) implies that the more open firms (or sectors) have better rates of capacity realization. This result also attributed to the recent economic reforms that might helped firms become more open and face international competition. However, the coefficient is not statistically significant.

The influence of *ERA* on capacity realization is not clear. It seems to have exerted a significant negative influence on capacity realization even after the policy reforms. Before the reforms, most of the enterprises in the food-processing sector, except for sugar products were new, and *ERA* provided insulation for these firms from external influences and thus helped to realize higher production capacity, at least in the short run. But, when *ERA* is continued over a longer period, it has the potential to produce a negative effect on *PCR* which is found in this study. However, the coefficient of this variable is very small (0.038). The economic reforms have included removal of protective measures which allow uncompetitive firms to survive such as quantitative restrictions, reduction of tariffs and increasing assistance (subsidies, tax holidays, tax exemptions, etc.). Some firms survive only because of such protection and assistance and not through the efficient utilization of their capacity. Therefore, the negative correlation between *ERA* and *PCR* is not unexpected.

The two ownership dummies exerted an insignificant influence, although their coefficients have the expected positive signs in all models. Since these variables are not statistically significant, it may be argued that rate of capacity realization is independent of the locus of ownership. Such an outcome might be the result of the failure of liberalization to promote competition because of the replacement of the public sector monopoly by private sector monopolies. In fact, the privatization process in Bangladesh has been judged as grossly mismanaged (Sobhan 1990). However, these results are not certain because these variables might capture other aspects of firms' heterogeneity more than just ownership. In this context, it may be argued that efficiency gains hinge on the structure of the manufacturing sector and overall economic environment of the economy rather than just on the change of ownership. This is in agreement with Hemming and Monsoor who concluded that '..... if privatization involves no more than a transfer of activities from the public to the private sector, it may yield only limited gains' (1988:15). The overall fit of regression is restricted. R^2 value is 43 per cent respectively in three different models which implies that a large proportion of inter firm variation in capacity realization remains unexplained. This implies that other important variables, which may have an important influence on *PCR*, are omitted from these regressions. Had it been possible to include other excluded variables these results would have been more robust.

Robustness and Sensitivity Analysis

How robust are the inferences drawn above can be checked by undertaking sensitivity analysis. Leamer (1983) introduced a simple and systematic way to test the robustness of the coefficients in the extreme bound analysis (EBA). This paper follows the variant of the EBA suggested by Levine and Renelt (1992). This test involves estimation of the regression of the following form:

$$PCR_{it} = \alpha_j + \beta_{zj} Z + \beta_{fj} f + \beta_{xj} X_j + \varepsilon \qquad (7)$$

where *PCR* is productive capacity realization rate, *Z* is independent variable of interest, *f* is the set of free variables that always appears in the regressions and $X_j \in \xi$ is a set of up to three variables taken from the pool χ of *N* remaining 'doubtful' independent variables. EBA consists of estimating regression (7) for all possible *M* combinations of $X_j \in \xi$ from the *N* doubtful regressors. For each model *j*, there is an estimate β_{zj}, and a standard deviation, σ_{zj}. According to Levine and Renelt (1992) the lower extreme bound is found from β_{zj} - σ_{zj} and the upper extreme is found to be $\beta_{zj}+\sigma_{zj}$. If the lower and upper bounds so obtained remains in the positive (or negative) domain, the variable Z can be considered as robust. If not, it is fragile, as its sign depends on alterations in the set of explanatory variables.

The results from the extreme bound analysis are presented in Table 6. The first column corresponds to the *H* variables, while the last one reports the final diagnosis of variables. If the coefficient is fragile, the number between brackets indicates the number of additional variables necessary to provoke a sign reversal, and the implicated variables given in italic form in the penultimate column.

Table 6: Extreme Bound Analysis (EBA)

Variables	Type	β	Stand error	R^2	Extrm. bound	Additional variables	Robust/ Fragile
SZE	base	0.125	0.013	0.32			R
	highest	0.153	0.014	0.34	0.179	CINSTY, ERA, OPN	
	lowest	0.081	0.012	0.31	0.047	*MSTRE*, PNWT	
CINSTY	base	-0.092	0.084	0.43			F(1)
	highest	-0.067	0.079	0.46	0.056	*SZE*, ERA, OPN	
	lowest	-0.051	0.076	0.39	-0.261	MSTRE, PNWT	
PNWT	base	0.276	0.026	0.40			R
	highest	0.345	0.025	0.37	0.158	CINSTY, *ERA*, OPN	
	lowest	0.277	0.032	0.34	0.037	MSTRE, SZE	
MSTRE	base	-0.045	0.018	0.33			R
	highest	-0.154	0.024	0.29	-0.052	CINSTY, ERA, OPN	
	lowest	-0.077	0.025	0.27	-0.185	*SZE*, PNWT	
ERA	base	-0.212	0.042	0.44			F(1)
	highest	-0.527	0.040	0.42	0.024	CINSTY, *OPN*	
	lowest	-0.246	0.046	0.38	-0.175	MSTRE, *SZE*, PNWT	
OPN	base	0.145	0.074	0.32			F(1)
	highest	0.128	0.067	0.29	0.054	CINSTY, ERA, *SZE*	
	lowest	0.054	0.075	0.26	-0.189	*MSTREE*, PNWT	

Note: R: robust/ F: fragile, with the number between brackets representing the number of additional variables necessary to provoke sign reversal (the implicated variables are in italic in the penultimate column).

Most of the variables appear to have robust correlation with PCR_{it}. However, the robustness of *SZE* and *MSTRE* does not seem firmly established, as the lower bound is particularly close to zero. In case of *SZE*, the explanation can be found from the strong correlation with one of the other regressors. From the Appendix Table 1 it can be seen that the partial correlation between *SZE* and *CNSTY* is 0.729. The positive sign of *SZE* implies the general dynamism of firms over time. The larger the firm the higher is its accumulated capital per labor. However, the variable *CNSTY* has negative coefficient indicating that, when a firm's acquire more machinery and equipment per labor, there is less likelihood of achieving full capacity realization. Although *SZE* and *CNSTY* are two important variables, reflecting the reality appear to be working opposite in realizing production capacity. In case of *MSTRE* variable half-hearted market reforms are held responsible. Many policy-makers and academics of the country are of the view that market structure in Bangladesh remains oligopolistic if not monopolistic even after the implementation of economic reform. Moreover, many people argued that the market structure variable proxied by the four-firm concentration ratio is extremely susceptible to misrepresentation, partly because it essentially captures only some of the myriad of forces that combine together to influence the level of competition in any particular sector.

Most of the firms in Bangladesh food manufacturing except fish & seafood and tea processing & blending are import competing rather than export oriented. This industry is still in the development stage. Using largely local raw material this sector is geared mainly to meet the domestic needs. Moreover, most of the firms are sheltered by the government policies. Therefore, the fragility of *OPN* and *ERA* are not a surprise at all. Again, the coefficients of *OPN* and *ERA* variables are not statistically significant and the size of the coefficients of these variables are very small (0.038 and 0.052) as it observed from Table 5. The fragility of variables *CINSTY* is not unexpected as it is strongly correlated with *SZE*. However, in view of this potential multicollinearity among explanatory variables and the interaction between firm-specific and sectoral variables and policy variables, the above inferences can be considered with caution.

Several variables are identified above some of which help and some other hinder firms realizing production capacity. These variables are not the sole determinants of capacity realization. Firms may not simply realize full capacity for strategic reasons. With increased exposure to global markets in the wake of liberalization reform firms in Bangladesh food manufacturing need more time to adjust with international competition. Even though exports are only a small element of Bangladesh's product demand, they exert an important marginal influence on capacity realization. However, since export demands are generally more volatile than domestic demands firms have to be strategic in capacity realization to adjust in volatile global markets.

Summary and Conclusions

This paper empirically estimates the firm-specific *PCR* indices using the stochastic frontier production function and analyses a number of variables explaining realization rates across firms and over time. While some of these variables are firm-specific characteristics such as size and ownership, others are policy-oriented variables such as openness and effective rate of assistance. The objective is to identify influential variables which might be manipulated by government policy to improve the rate of *PCR*. The empirical results show that there is wide variation in *PCR* across firms and over time. The average rate of rate *PCR* is approximately 65 percent indicating that there remains ample scope to improve realization rate through the various government policy interventions. The results from the second stage analysis show that all variables are not statistically significant. However, there are some important indicators for policy purposes. One is that initiatives are required to be industry specific to target accurately those influential variables which can improve productivity performance in terms of capacity realization. For example, firm size (*SZE*) has significant positive impact on capacity realization of firms. That is larger firms have the advantage of scale economies. The policy implication is obviously that nurturing the competitiveness of large firms irrespective of sectors in the food manufacturing will tend to improve the rate of capacity realization. A striking finding is the insignificance of variables related to the current trade and industrial policy reforms. This implies that policy reform to remove impediments to the competitive process may have had little impact to date on productive capacity realization. This may be attributed to piecemeal and partial nature of policy reforms. Therefore, further reforms with judicious dismantling of the existing tariff structure and lavish assistance policies of firms are suggested in order to enhance competition and competitiveness that ensure efficiency of production agents. Greater emphasis on export promotion would accelerate improved resource allocation performance and increase realization of production capacity in the industrial sector.

Appendix

Variable Construction

Output (Value-added): This variable is the sum of gross value of output minus the value of input materials, fuel and electricity. This is then deflated by an individual firm deflator calculated from the information given by the firms about the yearly variation of in the prices of their products.

Labour: Some studies use this variable as the product of the average number of workers by the total effective hours of work (normal hours + overtime -lost hours). However, unavailability of lost-hours data precludes us to use such measure. This study uses total number of labours employed in a firm during the census period.

Capital stock: replacement value of the net capital stock. Obtained by the iterative method:

$$K_t = (1-d)K_{t-1}\frac{P_t}{P_{t-1}} + I_t$$

where *P* is the capital price index, *d* is the rate of capital depreciation and *I* is the equipment investment.

Materials: this variable is the sum of the materials and external services bought, less the variation of stocks of materials. This is then deflated by an individual firm deflator calculated from the information given by the firms about the annual variation of each component of the material prices.

Firm Size (SZE): Firm size can be measured by taking one of the attributes of firms: value added, value of shipments, sale proceeds, employment, or fixed assets. However, the measurement of firm size by using value added, value of shipments and sale proceeds is not reliable, since these variables are susceptible to price fluctuations. Price inflation or deflation alters firm size measurement. Again, the employment measure can be compromised by technological change, which alters capital to labor ratios in production (Koch 1980). None of these alternatives is particularly suitable as a unit of measurement of firm size. Hence, firm's sale as proportion of total industry sales, may not be an ideal indicator, uses in this study.

Capital Intensity (CINSTY): There are a number of alternative measures of capital intensity. The most common measure is the capital-labor ratio (K/L) where K is fixed assets and L is the total number of workers employed. The main limitation of this approach is that it ignores the quality of labor in the production process. An alternative measure of capital intensity in the literature uses a value added criterion, *i.e.* value added per employee (Lary 1968). According to Lary, if the value added per employee of a firm (or industry) is less than the average of all firms (industries) then that firm (industry) is labor intensive, while if the value added exceeds the average of all firms (industries) it is capital intensive. The severe limitations[5] of Lary's method precluded us to use in this study. Morawetz (1981) provided an alternative method in which the various categories of capital and labor are weighed with accounting prices. As the available data do not permit such a disaggregation of labor and capital, this method could not be undertaken. This study uses the capital-labor ratio, as a measure of capital intensity, which is less controversial and computationally simpler.

Market Structure (MSTRE): The best known and most frequently used measure for market structure is the *concentration ratio*. The *X*-firm (where *X* is number of firms) concentration ratio, CR_x, is defined as the share of the largest *X* firms in the industry concentrated (using whatever measure of size is thought to be appropriate and available). This is formally written as $CR_x = \sum_{i=1}^{x} P_i$ where CR_x is the measure of *X*-firm concentration ratio and P_i is the share of firm i in sales, value added, employment, or whatever measures of economic activity are chosen. Now, a value of CR_x close to zero would indicate that the largest *X* firms supply only a small share of the market while 100 per cent would indicate a single or monopoly supplier. The chief problem with this measure is the selection of *X*, the number of firms. Unfortunately, economic theory suggests nothing in this regard. This study constructs a four-firm concentration ratio using gross value of output of four-digit level selected manufacturing industries of Bangladesh, ranking by the size of fixed assets.

Effective Rate of Assistance (ERA): Effective Rate of Protection (ERP) is the conventional measure for analyzing the impact of policies on production units. Another measure recently developed in the literature is known as the Effective Rate of Assistance (ERA). The ERP accounts only for trade policies while the ERA incorporates both trade and domestic assistance policies, which directly affect the prices of factors, material inputs, products, the assistance in the form of price and quantity controls, import bans, and similar policies were also translated through appropriate methodologies into quasi-taxes and quasi-subsidies including debt default (which is assumed as a subsidy). Thus, the ERA is the relevant measure for this study. Following the methodology of the HIID's (Harvard Institute of International Development) study (1990) ERAs are estimated for this study.

Openness (OPN): In the earlier literature particularly in aggregate studies it is frequently use as the ratio of export plus import to total sales of a firm or industry as a proxy of external competition. However, we have problem here as the large part of the imports in Bangladesh are made by commercial intermediaries and foreign or local multinationals firms. Therefore, this study uses this variable as the ratio of export to total volume of sales in a particular year.

Finally, two dummy variables (DPVT, DJNT) reflecting the type of ownership are used.

Appendix Table 1: Correlation Matrix, Selected Series

Variables	SZE	CINSTY	MSTRE	OPN	ERA
SZE	1.000				
CINSTY	0.729	1.000			
MSTRE	0.223	0.073	1.000		
OPN	-0.204	0.089	0.093	1.000	
ERA	0.693	-0.100	0.085	-0.138	1.000

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Notes

[1] In the literature, the term 'capacity utilization' is used to describe the most efficient output minimizing the present values of the cost stream given stock of capital and technology (Morrison 1988 and Kang and Kwon 1993) while this study uses the term 'capacity realization' to describe maximum possible output obtainable from a given set of inputs and technology by following Klein (1960) and Färe *et al* (1989). Clearly, capacity realization is a broader concept than capacity utilization. For details please see Salim, R (1999).

[2] Since 1991, BBS started new methodology and harmonized industrial classification codes with ISIC (International Standard Industrial Classification). This is why we used here firm-level data from 1992. Moreover, 1995 and 1996 are two years of political turmoil so the CMI data are very irritable for this period. Therefore, we excluded data for these years. Finally, the year 1999 is the last year in which CMI data are available.

[3] The formal test was conducted to determine the suitable functional form under the null hypothesis is that the coefficients of the cross and squared terms in the translog function taken together are not significantly different from zero. The calculated $\chi^2_{(n,\alpha)}$ statistics are as follows:

Year	1992	1993	1994	1997	1998	1999
	1.7835	2.3412	2.3333	1.2768	1.8861	2.7651
Log Likelihood	653.3417	701.2445	678.0241	720.5632	720.8612	703.4316

[4] I am grateful to the conference participants at the University Technology Sydney, Australia who brought this issue to my knowledge.

[5] These are: first, it confuses labor productivity with capital intensity. Second, it cannot capture the quality variations or human capital issue in the presence of widespread market imperfections and excessive government intervention in an economy's factor and product markets, particularly in developing countries. Third, economies of scale of firms (or industries) are not reflected in this measure.