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DEVEVLOPING LINKAGES BETWEEN EXPORT GUARANTEES AND TECHNICAL EFFICIENCY OF INDIAN FIRMS

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Abstract
The study examines the technical efficiency of Indian small manufacturing firms and their specific determinants utilising firm-level data for 2007-08 and 2017-18. The focus is on simultaneous expenditure on insurance premium and export earnings by firms on their technical efficiency. Results from a stochastic frontier production function and technical inefficiency effects model reveal that Indian firms on an average had widening technical efficiencies for the years. The results also indicate that factors such as firm size, firm age, type of firm ownership, technological imports, expenditure on R&D and export guarantees contribute to the technical efficiency. In fact, top 25 percent of firms in 2017-18 relied more on exports with higher expenditure on marketing & advertising and expenditure on export guarantees. This, thus warrants further improvement in technical efficiency through easier access to financial services, access to skilled labour, training of the workforce and entrepreneurs, encouraging foreign investment for operational synergies and export incentives for easier and risk-free penetration in the world market.

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I. Introduction

Exports being a major component of a nation's growth and driver of economic development is accompanied with risk and uncertainty both at the local and international. A number of international risks like financial crisis, currency risks, political risks and economic risks are prevalent in the field of exports and affect them adversely (Amiti and Weinstein, 2011). In order to promote exports and provide covers in the form of guarantees, most of the countries have their official Export Credit Agencies (ECAs). These ECAs provide a number of export guarantees to mitigate risks arising due to economic and political reasons. In India, one such institution set up by Government of India in 1957 is ECGC Limited. The organisation aims to promote exports from the country by providing credit risk insurance and related services for exports. ECGC generally insures losses arising out of certain Commercial and Political risks, and doing so it provides the exporters with an opinion on the credit worthiness of overseas buyers, helps exporters to get export finance easily, etc.

Firms contribute to the social and economic development of nations and contribute significantly towards generating employment, business opportunities and developing linkages (Audretsch et al., 2009; Doern, 2009; Harvie, 2007; Hussain et al., 2009). Firms in India face major challenge in terms of available infrastructure, technology adoption, credit gap and realising payments. Government interventions have tended to be fairly supply-side oriented and unable to effectively respond to demands of the market. Firms require financial assistance due to inability in accessing trade credit, discount to buyers, high cost of production, lack of awareness and inclination of availing credit guarantees, high interest rates and collaterals. ECAs and export guarantees aim at motivating firms to enhance their performance by providing covers for default in payment against exports. Thus, the present paper aims to identify the determinants of efficiency for firms in Indian manufacturing sector and analyses influence of export guarantees on the efficiency level of exporting firms. The paper compares efficiency differences of manufacturing firms' performance between 2007 and 2017 by considering the cross-section version of the stochastic frontier model. This comparison will assist in examining the impact of export guarantees on exports of firms.

II. Export Guarantees and Efficiency: Theoretical and Empirical Framework

The purpose of export guarantees is primarily to reduce the loss of firms arising due to non-payment of exports undertaken (Craig et al 2008). It has been seen that export guarantees are effective with respect to covering high risks and low collaterals (Green 2003). It has also been suggested to consider externalities while designing export guarantees as they may lead to subsidies and thus impact the sustainability of the guarantees (Levitsky 1997, Honohan 2008). Performance of firms can be assessed through numerous various approaches like employment generation, output growth, exporting and financial performance (Bartlett, 2004; Chen et al., 2007; Kimura and Kiyota, 2007; Liedholm, 2002; Park et al., 2009; Tambunan, 2008). Efficiency whether allocative, indicating reduction in cost or minimum use of inputs for maximum output or technical, indicating maximum output from given technology and inputs and thus operating on the production efficiency frontier (Arunsawadiwong, 2007; Coelli et al., 2005; Herrero and Pascoe, 2002; Murillo-Zamorano, 2004).

Export credit guarantees are considered as a reduction in both fixed and variable trade costs, which would imply an increase both at the extensive and the intensive margins of international trade in standard new trade theory models with heterogeneous firms (Melitz, 2003). Credit Constraints reduce firm-level exports, limit export product variety, and increase product churning for countries with less developed financial markets as well as heterogeneity in financial constraints helps to explain the selection of firms into exporters and non-exporters (Bellone et al., 2010; Manova, 2008). The role of Export Guarantees and their relationship with exports has not been adequately explored but it is seen that it is primarily the political risk which impacts international trade covered by these export guarantees (Moser et al., 2008; Egger and Url, 2006).

Credit guarantees affect exports and may have a significant impact on exports thus affecting efficiency and productivity of firms (Chor and Manova, 2011; Heiland and Yalcin, 2015; Felbermayr et al., 2012; Badinger and Url, 2013; Magnus, et al, 2018). efficiency of firms may enhance exports by the theory of learning by exporting or engaging highly productive firms in exports (Bigsten and Soderbom 2006; Wagner, 2007 and 2012; Martins and Yang, 2009; Melitz, 2003; Melitz, & Ottaviano, 2008). Though it is not necessary that guarantees may enhance productivity, efficiency and thus exports as certain small firms though highly productive may have high costs of trade primarily due to lack of access to external finance (Berman and Héricourt, 2010, Forlani, 2014, Muûls, 2015, Minetti and Zhu, 2011). Export guarantees may require collaterals which may not be favourable for firms with low productivity and with liquidity constraints (OECD, 2013, USITC, 2010, Manova, 2013; Riding et al., 2012, Beck and Demirguc-Kunt, 2006, Carpenter and Petersen, 2002).

Thus, considering the empirical and theoretical evidence, export guarantees assist in covering market failures and risks by mitigating financial constraints and promoting international trade. In case of India, the studies are scarce in terms of examining the impact of guarantees on exports and thus the present paper is an attempt towards examining the impact of guarantees for promoting international competitiveness and exports.

III. Methodology and Variables

The analysis involves export credit guarantee cover and participation in export in enhancing efficiency of firms. A firm's performance can be mapped through its technical and allocative efficiencies, by employing stochastic frontier analysis. In this paper, a two-stage approach is adopted. In the first stage, firm technical efficiency scores are estimated for the sample of firms using a stochastic frontier analysis (SFA) a parametric approach (Alvarez and Crespi, 2003; Battese and Coelli, 1992; Kumbhakar and Lovell, 2000). In the second stage the estimated technical efficiency scores are regressed against hypothesised explanatory variables (Admassie and Matambalya, 2002; Alvarez and Crespi, 2003; Coelli et al., 2005; Battese and Coelli, 1992;

Battese and Coelli, 1995; Amornkitvikai and Harvie, 2011; Kim, 2003; Kumbhakar and Lovell, 2000).

For the estimation of the model, a software package, FRONTIER 4.1 developed by Coelli (1996) commonly used in the estimation of stochastic production frontiers and cost functions in the literature is used in this study. This software provides maximum likelihood estimates of a wide variety of panel data, time-varying and invariant efficiencies; cost and production functions; half-normal and truncated normal distributions; and functional forms having a dependent variable in logged or original units. However, this program cannot estimate exponential or gamma distributions, and estimate systems of equations[1].

A three-input factor and one output Cobb–Douglas production function in logarithmic form utilising cross-sectional data can be expressed as follows:

$$\ln Y_i = \beta_0 + \beta_1 \ln(K_i) + \beta_2 \ln(L_i) + \beta_3 \ln(Mi) + (V_i - U_i) \qquad \ldots\ldots.(1)$$

$i = 1,\ldots,N$,

where:

Y_i = output value of firm i,

K_i = the net value of fixed assets of firm i,

L_i = the total number of employees of firm i,

M_i = the material inputs of firm i,

V_i = a random error term for firm i, and is assumed to be an independently and identically distributed normal random variable with zero mean and variance Vi: iidN$(0,\sigma_V^2)$ independently distributed of U, and,

U_i = a non-negative random variable for firm i, accounting for technical inefficiency in the production function and is assumed to be independently distributed such that Ui is defined by the truncation of the normal distribution with mean μ_1 and variance σ_u^2.

Vi and Ui are also assumed to be independently distributed for all firms ($i = 1, 2,\ldots, N$) (Battese and Coelli, 1995; Coelli, 1996a; Coelli et al., 2005; Tran et al., 2008). If u_i is equal to zero the firm is defined as being totally technically efficient and is at its maximum output level given the inputs used.

If u_i is greater than zero the firm is defined as being technically inefficient (Coelli, 1996a; Kumbhakar and Lovell, 2000; Tran et al., 2008). Here, the subscript i refers to firms, β_0 represents the intercept term, β_1, β_2 and β_3 represent the coefficient estimates of capital, labour and material inputs. The variables are selected based on existing theories and are considered as possible causes of inefficiency of the production units under examination.

The following explanatory variables are emphasised in this study for the sample of Indian firms: firm age (learning by doing hypothesis), firm ownership type (domestic or foreign), export intensity, ECGC capturing variable, R&D intensity, expenditure on marketing &

[1] More information about this software can be obtained from; http://tarjomefa.com/wpcontent/uploads/2017/07/7209-English-TarjomeFa.pdf

advertising, expenditure on outsource of manufacturing jobs, expenditure on royalty & technical know-how and firm size (market share).

Hence, potential firm specific-factors that could influence technical efficiency can be modelled in an inefficiency functional form as follows,

$$\mu_i = \delta_0 + \delta_1 Age_i + \delta_2 Ownership_i + \delta_3 ExpM\_A_i + \delta_4 ExpOutsrce\_jobs_i + \delta_5 ExpRoyalty_i + \delta_6 ExpR\&D_i + \delta_7 ExportD_i + \delta_8 DXECG_i + + \delta_9 Size_i \qquad \ldots\ldots.(2)$$

Table 1 gives the definition of different variables and their expected signs.

Table-1 Description of Variables

S.No	Explanatory Variables	Description	Expected Signs
1.	Size	Share of i'th firms' sales to median sales in an industry	+
2.	Export Dummy ($ExportD_i$)	1- firms exporting 0- firms not exporting	+
3.	Interaction of export dummy and other insurance premium variable ($DXECG_i$)	1- firm's undertaking both exports and spending on other insurance premium. 0- firm's participation in either of the activities or none of the activities.	+
4.	Age_i	1- firms incorporation after 1991 (new firms) 0- firms incorporation before 1991 (old firms)	+/-
5.	$Ownership_i$	1- Foreign Promoter 0- Indian Promoter	+
6.	Intensity of expenditure on Advertising and Marketing ($ExpM\_A_i$)	Expenditure on advertising and marketing as a % of net sales	+
7.	Intensity of expenditure on outsourced manufacturing jobs ($ExpOutsrce\_jobs_i$)	Expenditure on outsourced manufacturing jobs as a % of net sales	+
8.	Disembodied technology imports intensity ($ExpRoyalty_i$)	Royalties and technical fees paid as a proportion of firm's net sales	+
9.	Intensity of expenditure on R&D ($ExpR\&D_i$)	Ratio of R&D expenditure to net sales	+

The coefficients of the stochastic frontier production function and technical inefficiency effects model are estimated utilising the maximum likelihood method. The maximum likelihood function is defined in terms of the variance parameters as follows (Battese and Corra, 1977; Coelli et al., 2005):

$$\sigma^2 \equiv \sigma_v^2 + \sigma_u^2 \quad \text{and } \gamma \equiv \sigma_u^2/\sigma^2 \qquad \ldots\ldots.(3)$$

where:

σ_v^2 = a random error variance;

σ_u^2 = a technical inefficiency effects variance.

γ represents the share of technical inefficiency in the overall residual variance. If the value of γ is close to zero deviations from the frontier are largely attributable to noise, whereas a value close to unity indicates that deviations from the frontier are largely attributable to technical inefficiency (Coelli et al., 2005; Tran et al., 2008).

The empirical estimation uses firm-level data taken from the Prowess IQ, online corporate database (Centre of Monitoring Indian Economy) for the years 2007-08 and 2017-18. The sample covers all listed Indian firms on Prowess (taken 3556 in 2007-08 and 3430 in 2017-18). A consideration for small firms has been made in terms of the market share in the paper. The focus has been to restrict the firm size greater than 2.

Next, to capture the impact of ECGC variable on export performance of firms, we narrowed down on one variable, “other insurance premium” as it proxied the involvement of firms in undertaking of ECGC policy. At 4-digit National Industrial Classification 2008 (NIC-2008), the total number of Indian manufacturing Firms included in the years 2007-08 and 2017-18 are 3556 and 3646, respectively. Almost 50% of the firms got deleted because of the misreporting of major variable of interest; other insurance premium. The construction of variables in the frontier production function (stage-1) and the inefficiency model (stage-2) are explained below.

1. Output (Y): It is the production value, which consists of total sales in the year and the change in stocks of finished and semi-finished goods.

2. Capital (K): Capital Stock is calculated by considering the depreciation of Gross Fixed Assets (GFA), we calculate the capital stock by perpetual inventory method.

3. Labour (L): Number of firms in each firm are calculated by considering Prowess data on compensation to the employee and average wage from the ASI data.

4. Raw materials (RM): The raw material input includes all expenditure on intermediate inputs and energy consumed in the process of production for all the firms.

The construction of variables for the inefficiency model (2) is explained below.

1. Size: One of the most important determinants of the innovative activities being the size of the firm. We have taken the share of firm in total industry sales. Because of the existence of scale economies (Cohen & Levinthal, 1989), the large firms are able to spread the fixed capital over large sales volume due to the availability of greater financial resources. But small firms have greater flexibility in adjusting inputs in their production, resulting in less costly adjustments to business environment and economic shocks. Thus a priori, the impact of ECGC cover on exports of firms increasing their efficiency will be more if firm has more resources and is willing to take more risks in the form of higher exports. We assume a positive relation between firm size and technical efficiency.

2. Exports: Firm's extent of interaction with the foreign buyers and foreign markets and the consequent learning from them is represented by its value of export. Many empirical studies have found that exporting has a positive association with technical efficiency (Granér and Isaksson, 2009; Kim, 2003; Rankin, 2001). Here, the export dummy has been taken. We assume a positive relation between exports and technical efficiency of firms.

3. Interaction of exports dummy and ECGC proxy variable: The main variable of interest is Other insurance premium. Insurance means protection against future contingent losses. In business parlance, it is a contract in which the insured party makes a periodic payment to another party, known as an insurer, with the agreement that the insurer will compensate for or bear the insured's losses, or a part thereof. This contract between the two parties is called as insurance policy. Now, to compensate for losses when importer fails to repay exporters, the role of ECGC comes into picture. And while all those firms which simultaneously export and pay premium for the risk of trade loss, is what is captured by the interaction dummy here. A priori we postulate that technical efficiency should increase if firms take ECGC cover leading to increase in exports.

4. Technology imports: In developing countries, the major source of technology transfer is through import of technology. It is taken as royalties, licensing, and technical fees paid by domestic firms for using the technology of foreign firms. Based on the results of the previous studies, Agarwal and Goldar (1999), Driffield and Kambhampati (2003), Parameswaran (2002) and Keshari (2012), we postulate a positive relationship between technology imports and technical efficiency.

6. Ownership: The studies about the innovative activities of MNCs reveal that most of their innovative activities are carried out in their home countries (Cantwell, 1989, cited in Gustavsson & Poldhal, 2003). This may have access to efficiency enhancing technology and skills from their corresponding MNCs. This, thus could lead to higher level of efficiency for FDI affiliated firms in relation to domestic firms in the industry. We use foreign promoters' share[2] to capture the effect of foreign equity participation.

7. Research & Development expenditure Intensity: Firm's efforts to develop, adapt and absorb new technology is measured by its R&D intensity. As most of these activities are efficiency enhancing, the higher R&D expenditures is experienced to lead to higher TE, Driffield and Kambhampati (200)3; Wu et al. (2007); Keshari (2012). Therefore, a positive relationship is expected between TE and R&D.

8. Age: Age of the firm is included in the inefficiency model to control for the effect of experience of the firm on technical inefficiency. Thus, age is expected to have a favourable impact on TE. On the contrary, if a firm's age reflects the plant vintage and/or rigidity in outlook or inflexibility towards the changing market conditions, it is expected to have negative influence on TE. Thus, the relationship between age and TE cannot be predicted on a priori basis.

9. Marketing and advertising intensity: Advertising and marketing are important for creating product differentiation by promoting corporate image, brand equity and customer loyalty. Hence, higher expenditure on marketing and advertising may lead to higher sales, giving efficiency advantage to a firm.

[2] We define foreign firms as those having foreign promoters' share ≥ 10%. This is consistent with the definition of foreign firms as given by the Reserve Bank of India.

10. Outsourced manufacturing jobs: Outsourcing defined as the practice of having certain job functions done by another individual/enterprise, instead of getting it done internally, captures all those expenses incurred by a company for getting their manufacturing requirements done from outside parties. The key objective for outsourcing is cost saving. Apart from that, outsourcing also helps a company optimise its labour resources and use it efficiently, while offloading certain non-core processes to outside parties. Outsourcing also helps bring aboard expertise without having to spend on recruitment and training of workforce. Thus, we assume a positive relation between technical efficiency and outsourced jobs.

Descriptive Statistics

Table-2 provides the summary statistics of the key indicators included in our empirical analysis. A comparison in the mean values of indicators mainly comprising of net sales, no. of labours, material input and others among firms show that from 2007-08, in 2017-18 the expenditure on these indicators increased. But other expenditure variables like marketing & advertising, outsourcing, insurance premium and expenditure on royalty decreased on an average in 2017-18. Bifurcating these variables according to firm ownership; firms with foreign ownership have on an average higher net sale, material input, spend more on technology imports and R&D intensity. Also, these firms have greater export intensity and certainly capture more market as determined by their size for both the years. The foreign-owned firms on an average didn’t spend much on marketing expenses and outsourcing of manufacturing jobs. This is mainly because these firms are already well-established in the market unlike the domestic firms. However, it is the domestic firms which rely more on insurance cover and have greater number of firms that are both exporting and using insurance cover on exports. Although in 2017-18, the expenditure on DXECG decreased on an average, the number domestic firms doing exports and undertaking insurance cover also declined; this signifies that domestic firms in their approach are willing to take more risks with increase in export intensity.

Table 2: Expenditure Intensity across Firms (Mean)

S.No	Indicators	2007-08			2017-18		
		All	Domestic	Foreign	All	Domestic	Foreign
1	No. of labours (L)	4	2.3	3	4	4	5
2	Net sales (in million)	754	750	993	1664	1670	1330
3	Material Inputs (in million)	5	5.08	5.5	6	5.78	5.8
4	Mkt & advert exp/net sales (ExpM_A)	0.13	0.13	0.09	0.006	0.007	0.001
5	Outsource jobs/ net sales (ExpOutsrce_jobs)	0.54	0.55	0.12	0.03	0.09	0.05
6	Disembodied technology imports intensity (ExpRoyalty)	0.08	0.08	0.043	0.009	0.009	0.013
7	R&D/net sales (ExpR&D)	0.001	0.001	0.008	0.002	0.002	0.007
8	DXECG (in million)	935.5	945	390	802	807	437
9	Age group- 0, Before 1991 1, After 1991	0-1679, 1-1877	0-1633 1-1862	0-46, 1-15	0-1255, 1-2175	0-1212, 1-2167	0-43, 1-8
10	No. of firms doing exports and using other insurance premium (DXECG)	1644	1600	44	1436	1408	28
11	Export Intensity	0.331	0.105	0.146	0.10	0.10	0.13
12	Size (Market share)	0.99	0.99	1.14	1.03	1.02	1.52

IV. Empirical results

Hypotheses test results

Table 3 presents results for hypotheses tests for manufacturing firms in the period 2007-08 and 2017-18. The first null hypothesis (H_0) testing for the absence of technical inefficiency in the model is rejected at the 1% level of significance for both the years as specified by Eqs. (1) and (2). The second null hypothesis (H_0), that technical inefficiency effects are not stochastic, is also rejected at the 1% level of significance, implying that the technical inefficiency effects model is applicable for manufacturing firms for both the years.

Table 3: Hypothesis tests of the stochastic frontier model and technical inefficiency effects

Years	**2007-08**	**2017-18**
	All Firms	All Firms
(1) Null Hypothesis No technical inefficiency effects (H_0: $\gamma = \delta_0 = \delta_1 = \cdots = \delta_9 = 0$)		
LR statistics	242.14	107.57
Critical value* 27		
Decision	Reject H_0	Reject H_0
(2) Null hypothesis No stochastic inefficiency (H_0: $\gamma = 0$)		
t-ratio	5.9*	1.7***
Decision	Reject H_0	Reject H_0

* For both 2007 and 2017, micro, small and medium-sized enterprises have 13 explanatory variables. All critical values of the test statistic are presented at the 1% level of significance and obtained from a chi-square distribution obtained from Table 1 of Kodde and Palm (1986). * & *** indicate level of significance at 1% & 10% level.

Estimation results for input elasticities, gamma parameters and technical efficiency (first stage)

The maximum likelihood estimates (MLE) of the parameters of the stochastic frontier and technical inefficiency effects models (Eqs. (1) and (2)) are estimated simultaneously using the computer program Frontier Version 4.1 developed by Coelli (1996b). The estimation technique is a three-step procedure. In step 1, the ordinary least squares (OLS) is applied to obtain unbiased estimates of the parameters of the production function. Step two involves taking the OLS estimates to be used as starting values to estimate the final maximum likelihood model. Where the value of the likelihood function is estimated through a grid-search of γ between 0 and 1 given the values of the βs derived by OLS. Finally, an iterative Davidon–Fletcher–Powell algorithm is used to calculate the final parameter estimates, taking the values of the β's from the OLS and the value of γ from the intermediate step as starting values. The estimated results are reported in Table-4 along with an estimate of average technical efficiency.

Table-4 presents the results for the manufacturing firms in 2007-8 and 2017-18. For 2007-08, capital (β_1), labour (β_2) and raw material (β_3) inputs have positive coefficients and are significant at 1%. The firms relied more on material inputs as its elasticity is higher out of all the inputs. Labour input had the least elasticity for these firms in the same year. With this, these firms operated at nearly constant returns to scale (0.85). In the year 2017-18, the production was still operating at constant returns to scale (0.93). Again, the firms relied more on material inputs, but the elasticity of labour input rose in this period with positive and significant value at 1% level, indicating the effectiveness of labour employed. Further, the inefficiency parameter (γ) firms in 2007-08 were 0.18 which is significant at 1% level, indicating a moderate degree of technical inefficiency in production. However, the technical inefficiency was much lower at 0.05 and significant at 1% in 2017-18. Thus, the firms utilized their given resources in a productive way in 2017-18 as they achieved better technical efficiencies.

Technical efficiency estimates of Indian manufacturing Firms

Figure-1 represents the frequency plot showing the maximum number of firms attaining 60% efficiency in 2007-08 and 93% in 2017-18. Indicating towards higher efficiency in utilization of resources in 2017-18. The graph for the year 2007-08 also shows a cluster of firms attaining technical efficiency greater than 68%. But average technical efficiency as listed in Table-5 for year 2007-08 is 70%. Out of which, foreign firms in comparison to domestic firms exhibit higher average technical efficiency. Similarly, the graph showing frequency plot for the year 2017-18 also shows a cluster of firms attaining technical efficiency greater than 95%. And in comparison, to 2007-08, in 2017-18 the average technical efficiency is 94%. The average technical efficiency for foreign firms and domestic firms were 96% and 94%, respectively. However, the difference between the mean efficiencies for foreign and domestic firms was lower this year. This is mainly because of an increase in capacity and its efficient utilization.

Figure-1 Efficiency Frequency of all the firms

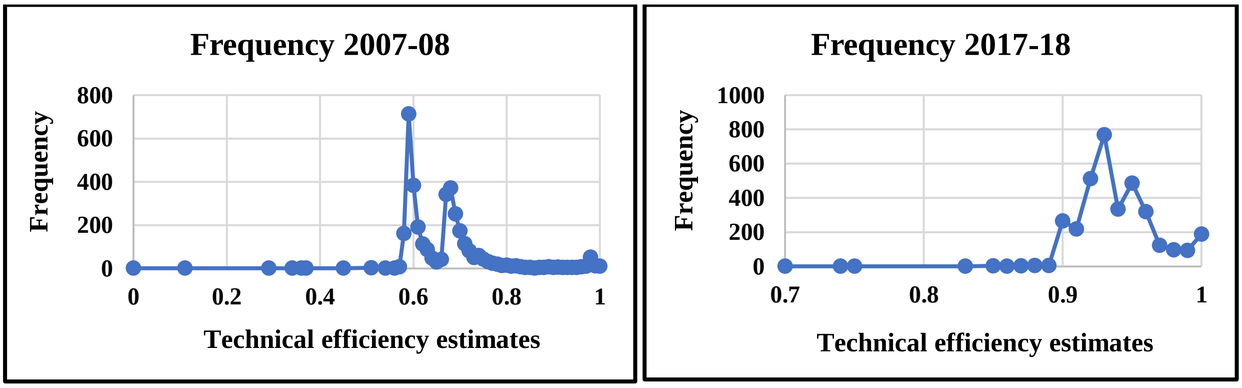

Table 4: MLE for parameters of the stochastic frontier model and technical inefficiency effects model

Years	2007-08		2017-18	
Variables	**All Firms**		**All Firms**	
No. Of Observations	**3556**		**3430**	
	coefficient	**t-ratio**	**coefficient**	**t-ratio**
STOCHASTIC FRONTIER MODEL				
Constant	2.126	32.72*	1.56	34.42*
Capital	0.165	14.19*	0.05	5.36*
Labour	0.067	10.35*	0.23	28.30*
Raw Material incl. Power & Fuel	0.620	77.62*	0.65	83.67*
TECHNICAL INEFFICIENCY EFFECTS MODEL				
Constant	0.528	10.551*	0.10	5.49*
Age group	0.003	0.143	-0.02	-1.64***
Ownership	-0.658	-10.722*	-0.06	-1.03
Mkt & Advertising/net sales	0.006	1.281	-1.18	-4.17*
Outsourcing jobs/net sales	0.013	2.971*	0.02	0.84
Disembodied technology imports intensity	-0.056	-2.226**	-0.04	-0.55
R&D intensity	-0.168	-2.727*	0.04	0.04
Export Dummy	-0.132	-6.126*	-0.03	-2.07**
DXECG	-0.001	-2.601*	-0.001	-2.22**
Size	-0.049	-13.727*	-0.02	-10.49*
sigma-squared	0.445	35.576*	0.26	40.39
gamma	0.18	5.985*	0.05	1.70***
LR Test	242.14		107.57	
Log-likelihood function	-3611.08		-2578.59	
Returns to scale	0.85		0.93	

Source: CMIE Data base – ProwessIQ. *, ** and *** indicate that the coefficients are statistically significant at 1%, 5% and 10%, respectively.

Table-5: Average technical efficiency of Indian manufacturing Firms

Years	2007-08	2017-18
	The average technical efficiency	The average technical efficiency
All firms	0.70	0.94
Foreign	0.74	0.96
Domestic	0.68	0.94

Estimation results from the technical inefficiency effects model (second stage)

Table- 4 also summarises the estimated results from the technical inefficiency effects model. Negative coefficient signs indicate technical efficiency.

Factors contributing to technical inefficiency

The SFA analysis in this paper has been robustly performed with the choice of firm-specific variables. In comparison to the year 2007-08, more firm-specific variables in year 2017-18 for all firms significantly impact technical efficiency. Considering the age of firms, the firms incorporated after 1991 are associated with higher technical efficiency than those firms which were incorporated before 1991 for firms in the 2017-18 period. In 2007-08, it was the other way round. Thus, with time, the learning of the new firms increased their technical efficiency. In the case of ownership, the foreign firms although being few, positively impacted technical efficiency but were not significant in 2017-18.

Among the expenditure variables, expenditure on marketing & advertising positively and significantly impacted technical efficiency in 2017-18. The variables measuring the content of technology generation such as R&D intensity and expenditure on disembodied technology in the form of royalty payments positively and significantly impacted technical efficiency in 2007-08 in comparison to 2017-18.

The exporting firms had positive and significant technical efficiency and when these firms simultaneously spent on other insurance premium (a proxy for ECGC cover), their technical efficiency significantly improved both in 2007-08 and 2017-18. Thus, this interaction of ECGC cover and firms undertaking exports implies that firms are dependent on insurance coverage in the form of different policies provided by ECGC to increase their technical efficiency.

With the above analyses focusing on the determinants of technical efficiency, the next section provides a comparison between the top and bottom 25% of the firms in their efficiency performance through the factors which are necessary or lacking in that performance.

Comparison of top 25% and bottom 25% efficient firms

In this paper, we have chosen all those firms which spent on other insurance premium variable in 2007-08 and 2017-18. The total number of firms in 2007-08 was 3556 and 3430 in 2017-18. In table-6, we have taken the top and bottom 25% of the highest and least efficient number of firms for comparison among the determinants affecting technical efficiency.

Howbeit, the comparison of mean values of some of the key variables for the top 25% and bottom 25% of firms in terms of technical efficiency for year 2007-08, suggests that the top efficient firms were older (incorporated before 1991), had domestic ownership, less expenditure was made on marketing & advertising, outsourcing of jobs or on royalty payments. These firms were export-oriented, spent more on insurance premium, while having greater net sales along with capturing more market share measured in terms of size. On the other hand, the bottom 25% of the technically efficient were newer firms, less export-oriented and relied more on expenditure on marketing and advertising, outsourcing of jobs and paid highly for royalty and technical know-how. And these firms spend quite less on insurance cover.

In 2017-18, both the top and bottom 25% of efficient firms had higher technical efficiency in comparison to year 2007-08. However, the top 25% of technical efficient were newer firms (incorporated after 1991), had greater foreign control, incurred higher expenditure on marketing & advertising and royalty payments, were more export-oriented, and spend a higher amount on insurance coverage in comparison to the bottom 25% of technical efficient firms. The determinants of technical efficiency are quite different for the top 25% of efficient firms in 2017-18 and 2007-08. In 2017-18, newer firms with higher foreign ownership spend more on outsourcing manufacturing jobs while having higher net sales and share in the market.

Table 6: Comparison of top 25% and bottom 25% efficient firms: Mean value of variables

	2007-08		2017-18	
Variables	**Top 25% of firms**	**Bottom 25% of firms**	**Top 25% of firms**	**Bottom 25% of firms**
Technical efficiency	0.75	0.52	0.96	0.79
Age group Dummy	0.49	0.61	0.82	0.31
Ownership Dummy	0.05	0.00	0.06	0.00
Mkt and advert exp/net sales	0.03	0.43	0.03	0.00
Outsourced jobs/ net sales	0.02	2.12	0.09	0.24
Disembodied technology imports intensity	0.02	0.32	0.02	0.01
R&D intensity	0.00	0.00	0.00	0.00
Export Dummy	0.89	0.01	0.77	0.01
DXECG (Mn)	3517.60	0.02	3060.11	2.01
Net Sales	990.00	608.81	1854.40	1538.89
Size	2.50	0.22	2.69	0.28

Source: CMIE Database – ProwessIQ

V. Conclusion

This paper being one of the first few studies has conducted a comprehensive review of the technical efficiency performance of Indian manufacturing firms undertaking ECGC cover. Its findings are important as the manufacturing sector constituting more than 60 percent of India's total exports, remains vital to future growth and employment generation in India. In fact, many of these firms are cogs in the country's larger industrial wheel and important input suppliers to various factories. The effort of ECGC in covering the risks of exporters while these firms focus on their exports has been a pivotal point in further empowering them. In this paper, the data collected from prowess IQ takes care of ECGC cover in the form of 'other insurance premium' variable.

Descriptive statistics show that in 2017-18, firms relied on ECGC to minimise their export losses and which simultaneously led to an increase in exports starting from year 2007-08. However, the reliance of foreign firms on insurance cover was less because of their well-established pathways and risk-less trade ventures. In fact, these firms had higher technical efficiency in comparison to domestic firms for 2007-08 and 2017-18. The firms in 2017-18 achieved increasing returns to scale where newer firms relied on marketing & advertising expenses and royalty payments while doing R&D expenditure to positively increase technical efficiency in comparison to 2007-08. The main variable of interest, the interaction of exports and expenditure on insurance cover by firms positively and significantly improved technical efficiency.

The literature on technical efficiency examines the issue of whether trade and technology & knowledge created by firms enhance productivity but considering the export credit as one of the determinants in capturing technical efficiency of Indian firms, in general is not documented in the literature. The comparison of mean values of some of the key variables for the top 25% and bottom 25% of firms in terms of technical efficiency for years 2007-08 and 2017-18, exhibits that majorly the top 25% of technical efficient firms are export-oriented, incorporated after 1991, rely on disembodied technology and thus spend on other insurance variable. Also, for these firms, technology adoption is a priority.

This, thus points as to how the production among firms should be based on innovation, knowledge and skill-intensive activities for R&D intensity and technological variables to significantly and positively impact technical efficiency. Firm size, longevity, and experience in certain sectors will not guarantee future success in the contemporary economic environment if adaptability and flexibility to rapidly changing market circumstances are not taken care of. Policies should be developed to encourage foreign direct investment in firms in well-targeted sub-manufacturing sectors along with an increase in export activity.

To date, Government policy measures have largely failed to address the issue of improving technical efficiency and competitiveness. In the current times with global uncertainty in demand, a vast majority of firms operating below their capacity are strapped for cash and weighed by logistic challenges. However, on the availability of financial resources like Atmanirbhar Bharat Package, a hope can be raised on enhancing capabilities and capacity.

Also, further research addressing the growing disparity or convergence between technical efficiency and the impact of undertaking ECGC cover by firms in India and other key regions in emerging markets is important to be carried out. Government and state ownership should be carefully reviewed, while cooperative ownership should be encouraged in well-identified activities in the rural sector.

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