MAGNITUDE AND TREND OF TECHNICAL EFFCIENCY IN THE ETHIOPIAN LEATHER INDUSTRY

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Abstract

This study aims at examining whether or not there are technical efficiency differences among leather industries owing to firm level weaknesses and proposing measures to augment gaps if there are any. Stochastic frontier production functions are estimated for two groups of firms: tanneries and leather processors for the period of 1996-1999. Mean technical efficiency of tanneries was about 83 per cent. Contrary to the widely held view, exporting tanneries were not more efficient except that they employed capital intensive technologies, which might have allowed them to produce good quality products. Large-scale firms were more efficient perhaps because of higher scale economies. Overall, technical efficiency was declining at an increasing rate in tanning industry, and shortages of raw materials, use of obsolete machineries and failure to effectively utilize the prevailing technology are the most prevalent constraints. On the other hand, there were not statically valid technical efficiency differences amongst leather processors. Econometric results attributed the malfunctioning of leather processors to external factors, which might be explained by unfair competition with illegal imports, lack of government support in terms of access to technology and market information, failure to effectively control product quality, high transaction costs associated with export trade and other similar constraints. Although, statistical tests fail to affirm the maximum likelihood estimation, an increasing trend of inefficiency is a reflection of firm level weaknesses associated with mediocre product design, use of backward machineries, weak international exposure and passive reaction to competitive products. Thus, it requires addressing the problem from both sides. Enterprises should work to address their weaknesses and accustom themselves to the changing global environment. Government should also play its supportive role in the framework of free market, in terms of creating a level ground for fair competition, extending support in availing market information, training, technologv choice and minimizing transaction costs related to its services.

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1. INTRODUCTION

Ethiopia has failed to record a meaningful change in the structure of the export sector for many years. The sector has been dominated by a handful of primary commodities, coffee being the key one. Except in some exceptional years of price shock in the world coffee market stirred mainly through excess supply by major producing countries, the share of manufacturing export has never exceeded 20% (NBE 2002). Within the manufacturing export, leather products, in their semi- and fully-processed form, constitute more than 50 per cent. Despite attempts in the food, beverage, textile, and chemical industrial groups to export their products to the international market, the dominance of the leather sub-sector still continues. With a relatively modest share in gross value of production (7.2%), persons engaged (7.3%) and fixed assets (8.6%) of all medium- and large-scale industries, the leather sub-sector was able to contribute about 73 per cent to manufacturing export in 1999/00. The export earning was about 44% of the gross value of production of the sub-sector in the same year. It is the only industrial group, which could finance its own foreign exchange demands for the purchases of imported inputs (CSA 2001).

Notwithstanding its dominant position in the midst of highly inward-oriented industrial sector, the performance of the leather sub-sector is not satisfactory given the huge livestock potential and the country's ardent demand for foreign exchange earnings. It is common knowledge that Ethiopia has a very large livestock reserve, which few countries are fortunate to be endowed with. According to Befekadu and Berhanu (2000), the country has an estimated livestock population ranging between 30-35 million Tropical Livestock Unit (TLU). Berhanu and Kibre (2002) also noted that Ethiopia held about 15.75% of the cattle and 9% of the sheep and goat herd of Africa in 1996, which confirms the claim that Ethiopia has the largest livestock population in the continent. Despite the fact that the off-take rate is comparably low in contrast to the pack, the country provides about 2 million pieces of hides and 13.6 million skins annually. Had this amount been properly utilized, it could have benefited gretly those currently operating and potential investors in the sub-sector in particular, and the country as a whole.

Low performance of the sub-sector is reflected through the number, capacity and scale of operation of leather processing industries. According to the Central Statistical Authority (2001), there were 53 medium and large-scale leather industries operating in the country in the fiscal year 1999/00 with a fixed asset worth Birr 5.1 billion. These enterprises were able to create job opportunities for only about 7034 persons and had an annual production capacity worth Birr 1.1 billion.

While sustainable operation in line with the global market requirements and reaping the benefit of export market opportunities require at the very least commanding the local market, the sub-sector is under severe pressure from imports. Befekadu *et al.* (2002) indicated that the problem has not only led many footwear industries to slow down their operation but also forced to close down not less than 20 medium- and large-scale footwear industries. Similarly, a survey result of the Central Statistical Authority (2000 & 2001) revealed that there were about 63 medium and large-scale leather industries in the 1998/99 fiscal year but this figure declined to 53 in 1999/00. As a result of this, the sub-sector was obliged to reduce its labour force by about 13 per cent between 1996/97 and 1999/00. The average rate of capacity utilization of those industries, which were able to survive in the sub-sector, was only 49 per cent in 1999/00.

Obviously, this indicates the prevalence of severe problems constraining the proper functioning of the sub-sector. These problems arise from internal as well as external factors. Externally, before upholding their competitive capabilities, firms that were either accustomed to operate in a highly protective environment or emerging infant industries were exposed to swift liberalization that they could not withstand. These industries had need of a certain learning period and technical support with respect to market search, manpower training and the like.

The other major problem was the manner in which some countries did business in the name of free trade. A study on leather industries of four African countries, Ethiopia, Nigeria, Tunisia and South Africa and China by Berhanu and Kibre (2001) revealed that Ethiopian industries have not performed any lower than successful exporters of leather products such as Tunisia and China. It was rather illicit trade in the form of dumping and the supply of sub-standard products by foreign firms that led many domestic enterprises to be out of business. This has been further accentuated by the reluctance of concerned bodies to control such drawbacks and strive to assure a healthy market environment. While this and other external constraints are beyond the sphere of firm level decisions, there are also internal problems.

Operating under similar policy, institutional and marketing environment, firms may exhibit different levels of efficiency. For instance, Taye and Francis (1998) found that exporting firms were 32% and 15% more efficient than non-exporting firms in Cote d'Ivore and Kenya, respectively. In an appraisal they made in technical efficiencies of certain firms, Battese *et al.* (2001) came out with a result that significant efficiency differences were prevailing not only amongst firms in the different regions of Bangladesh but also within a given region.

In the case of Ethiopia, similar studies have been conducted revealing that firms are operating at different levels of efficiency due to either internal or external factors. Berhanu and Kibre (2002) assessed the performance of the Ethiopian leather sector using total factor productivity indices and found that not only productivity varied among tanning and footwear industries but also tended to decline over the period of 1995-1999. The methodology employed in the paper by Berhanu and Kibre (2002) does not allow segregating the extent to which firm-specific weaknesses contributed to the total factor productivity turn-down that was reported during the period.

Estimating the extent of inefficiency attributable to firm level failures associated with organizing and optimally utilizing available inputs provides policy advice to firms themselves to address internal weaknesses before opting for external solutions. Besides making the overall environment conducive, empirical findings of this sort also trigger policy makers to examine the kind of support that they should extend to the existing firms before additional investment outlays are considered. Thus, this study aims at exploring the performance and prospect of the leather sub-sector in line with this view.

A number of factors or characteristics could be cited as possible causes for efficiency variations among different firms. In our case, some of the firms were exporting the bulk of their products while others were not. Since it is usually the case, it is possible to hypothesise that enterprises that were able to operate more efficiently than others have penetrated the international market. The other possible hypothesis is related to size. Larger firms may enjoy relatively higher scale economies and use inputs in a more productive way than smaller firms. The objective of this study is, therefore, to examine efficiency variations among leather manufacturing enterprises and in light of this assess the possible future destiny of the industry as a whole. Comparative analysis is also made between exporting and non-exporting, and relatively larger and medium-scale firms. Stochastic frontier production functions are estimated through maximum likelihood and technical efficiency ratios are derived.

Considering the fact that tanning industries and leather processors employ totally different technologies due to different modes of operation, the study uses two different panel data sets involving 10 tanneries on the one hand and 24 leather processors on the other for a period of four years (1996-1999). Accordingly, the analysis is done separately for the tanning industry and the other leather processors. Tanning industries and other leather processors do not equally perform in the export sector, and a comparative analysis between exporting and non-exporting firms is found feasible only among factories in the tanning industry. For the sake of this paper, exporting firms are defined as those tanning enterprises whose primary source of market is the rest of the world and that only sell the leftover, rejected and sub-standard products to the local market. On the other hand, non-exporting firms are defined as those enterprises which sell their entire outputs to the local market.

The source of data is the Central Statistical Authority. The data set has its own limitations. Number of tanning and leather processing industries reporting to the Authority varied from year to year. Enterprises either reported missing values, or highly exaggerated figures and sometimes they did not report at all. Increasing the number of firms to be considered compelled us to reduce the time period whereas extending the time period required compromising with the former. There was also an attempt to use some other variables that might positively or negatively explain efficiency of firms such as benefit accrued to workers, education, and composition of administrative and productive workers. However, the data management process could not allow this, due to several missing values. Thus, the findings of this study should be seen in light of these limitations.

2. MODEL SPECIFICATION AND ESTIMATION PROCEDURES

2.1. Model Specification and Estimation Procedures

On the basis of Aigner, Lovell and Scmidt (1977) and Pitt and Lee (1981), Battese and Coelli (1992) propose a stochastic frontier production function for panel data having the usual stochastic error term, exogenous to the system and firm level effects to be distributed as truncated normal random variables, assumed to systematically vary over time. The generic representation of the model is as follows.

$$\ln(Y_{it}) = X_{it}\beta + V_{it} - U_{it},\ i = 1, 2, \ldots N;\ t = 1, 2, \ldots, T; \qquad [2.1]$$

where

- Y_{it} is the output of the i-th firm at the t-th time period;
- X_{it} denotes a (1XK) vector of (transformed) input values and other associated variables;
- β is a (KX1) vector of unknown scalar parameters to be estimated;
- V_{it} are the usual random errors, measuring the positive and negative effects of exogenous shocks, assumed to be iid with $N(0, \sigma_v^2)$ independently of the U_{it}s;
- U_{it}s hold non-negative values which are assumed to account technical inefficiency in the model;

The left hand side of Equation [2.1] involves two random variables, V_{it} and U_{it}, the summation of which could be expressed as e_{it}. Thus, $\sigma^2_e = \sigma_v^2 + \sigma_u^2$ and γ = $\sigma_u^2 / \sigma_v^2 + \sigma_u^2$. Technical efficiency for i-th firm in the t-th time period is defined by,

$$TE_{it} = \exp(-U_{it}) \qquad [2.2]$$

There are mixed views about the distribution of U_{it} revolving around the issue of whether or not the values are invariant of time. Some assumed that technical inefficiency effects are time-invariant,

$$U_{it} = U_i,\ i = 1, 2 \ldots N;\ t = 1, 2 \ldots T. \qquad [2.3]$$

The assumption of constant efficiency over time presumes that weaknesses that are attributable to firms themselves are inherently persistent in their very nature and their impact is invariant with time. However, assuming firms to be time-irresponsive in their mode of organization and inputs utilization is not usually practical. Battese *et al.* (1998) defined technical inefficiency effects as a function of time. The relationship is expressed as:

$$U_{it} = \{\exp[-\eta (t-T)]\} U_i, \quad i = 1, 2 \ldots N; 1, 2 \ldots T; \qquad [2.4]$$

U_i are assumed to be iid as the generalized truncated normal random variable, N (μ, σ_u^2).

The random variable U_i can be considered as technical inefficiency effects for i-th firm in the last period of the panel. Technical inefficiency effects of the firm for earlier periods are assumed to be the product of technical inefficiency effect of the last period and the value of the exponential function, exp [$-\eta$ (t-T)]. If the parameter η has a value more than zero, then $-\eta$ (t-T) would be greater than zero and the exponential function provides a value not less than one. In such cases, technical inefficiency effects in earlier periods would outweigh the situation during the last period of the panel, $U_{it} > U_i$. If the value of $\eta = 0$, technical inefficiency effects of i-th firm do not vary over time, $U_{it} = U_i$ and if $\eta < 0$, then $U_{it} < U_i$ [Ibid. 1998], implying technical efficiency declines over time.

The production technology representing medium and large-scale leather industries during the period 1996/97–1998/99 could be either Cob-Douglass or translog stochastic frontier production function as represented in Equations [2.5] and [2.6] respectively.

$$y_{it} = \beta_0 + \sum_{j=1}^{3} \beta_j x_{jit} + v_{it} - u_{it}, \qquad [2.5]$$

$$y_{it} = \beta_0 + \sum_{j=1}^{3} \beta_j x_{jit} + \sum_{J<k}^{3} \sum_{j<k=1}^{2} \beta_{jk} x_{jit} x_{kit} + v_{it} - u_{it}, \qquad [2.6]$$

where i= 1,2, ..., N, representing identity of firms (in our case N=10 for tanneries or 24 for shoe and other leather product processors), t = 1, 2, 3 or 4, representing the time period and j = 1, 2, 3, identifying explanatory variables. Variables, y_{it} and x_{jit} denote log of output and factor inputs respectively.

Assuming time variant technical inefficiency effect, U_{it}s are non-negative random variables as defined in Equation [2.4] and the probability distributions of both v_{it} and μ_{it} are as described above βs, η, μ, σ^2, σ_v^2 and σ_u^2 are parameters to be estimated.

2.1. Definition of Variables

1. **Gross Value of Production (Y_{it}):** The output of a certain enterprise could be measured either in gross value of production or in terms of value added. Both measures have their own strengths and weaknesses. Production is the result of the interplay of raw materials, fixed assets and other basic industrial costs and it is relatively less affected by measurement errors when calculated at the firm level. Thus, considering gross value of production as measure of output and a dependent variable is found to be more reasonable.

2. **Industrial Cost (X_{1it}):** Industrial cost includes raw materials, fuels, electricity and other supplies consumed and industrial services rendered by the firm.

3. **Wages and Salaries (X_{2it}):** Labour is a heterogeneous input not only in terms of biological make- up but also education, work experience and other similar attributes. Wages and salaries are presumed to better consider such differences and better represent the extent of labour input use.

4. **Fixed capital (X_{3it}):** It represents those assets of enterprises with a productive life of one year or more. It shows the net book value at the beginning of the reference year plus new capital expenditure minus the value of sold and disposed machineries and equipment and depreciation during the reference year.

3. EMPIRICAL RESULTS

3.1. Descriptive Statistics Results

3.1.1. Tanning Industries

The average firm level annual production, industrial cost and wages were Birr 45,425,390, Birr 31,394,530 and Birr 2,429,550, respectively, for selected tanneries. In these industries, the average employed fixed capital was about Birr 9,963,869. Despite having similar machineries and equipment, there was a very wide difference in the level of production and the volume of variable and fixed inputs employed in tanneries.

Relatively, a considerable number of tanneries (67.5%) were exporting their products. Contrary to the customary thinking, there was no tangible evidence in terms of central and scatter variability measures that exporting firms were any better in scale of operation and productive use of resources. Table 2 below shows that neither labour nor capital was more productive in exporting firms compared to inward-oriented industries.

Table 1: Descriptive Statistics Results on Tanning Industries ('000 Birr)

Indicators	Output (Y_{it})	Industrial Cost (X_{1it})	Wages and Salaries (X_{2it})	Fixed Capital (X_{3it})
Mean	45425.39	31394.53	2429.55	9963.869
Max	133015	91271	7921	76652.05
Min	4199	1193	201	1401.653
Stdev	35206.65	24470.41	2417.694	15312.95

Table 2: Exporting and Non-exporting Tanneries: Comparative Descriptive Statistics Results ('000 Birr except the ratios)

Exporting Tannery Industries							
Indicators	Y_{it}	X_{1it}	X_{2it}	X_{3it}	Y_{it} / X_{2it}	Y_{it} / X_{3it}	X_{3it} / X_{2it}
Mean	44540.1	31872.7	2430.5	11195.9	18.32562	3.97824	4.606465
Max	133015	87246	7921	76652.05	16.7927	1.73531	9.677067
Min	6393	5080	231	1401.653	27.67532	4.56104	6.067762
Stdev	33541.0	23073.3	2496.321	17194.31	13.43617	1.95070	6.887862
Non-Exporting Tannery Industries							
Indicators	Y_{it}	X_{1it}	X_{2it}	X_{3it}	Y_{it} / X_{2it}	Y_{it} / X_{3it}	X_{3it} / X_{2it}
Mean	48474.6	29747.6	2426.333	5720.074	19.97855	8.47447	2.357497
Max	128536	91271	6033	10555.88	21.30549	12.1767	1.749691
Min	4199	1193	201	2489.018	20.89055	1.68701	12.38317
Stdev	42548.4	30311.7	2264.283	2882.835	18.79111	14.7592	1.273178

As can be observed from Table 3, the value of output produced by one Birr worth of labour input has declined on average in both exporting and non-exporting firms though the rate was relatively higher in the latter case. Evidenced from capital labour ratio, exporting firms were relatively capital-intensive and capital productivity was declining over time without any improvement in labour productivity. In the case of non-exporting firms, capital productivity was increasing though not commensurate enough to compensate for the decline in output per one-Birr worth of labour.

The other probable cause for efficiency variation may be the size of enterprises and the consequential level of scale economies that they could possibly exploit. Apparently, there has not been any rule of thumb to level a firm into a certain scale. For the sake of this analysis, firms engaging 200 persons and more are considered large while others are labelled to be medium. According to this classification, equal numbers of tanneries are categorized in the two scales by chance. Table 4 below demonstrates that mean value of production and inputs significantly vary between large- and medium-scale tanneries.

Table 3: Partial Productivity Trends of Tanneries

Indicators	1996	1997	1998	1999	Growth
			Exporting Firms		
Y_k/X_{2k}	17.53059	22.897	22.56393	12.70946	-0.16127
Y_k/X_{3k}	11.38162	6.470776	3.351514	2.399486	-0.43676
			Non-Exporting Firms		
Y_k/X_{2k}	29.81688	15.45216	12.87596	10.29976	-0.28285
Y_k/X_{3k}	7.055577	11.91835	9.934936	7.951523	0.10772

Table 4: Large and Medium Scale Tanneries: Descriptive Statistics ('000 Birr except the ratios)

Indicators	Y_k	X_{1k}	X_{2k}	X_{3k}	Y_k / X_{2k}	Y_k / X_{3k}	X_{3k} / X_{2k}
			Large-scale Tanneries				
Mean	65386.85	43566.5	4167.1	13113.7	16.9044	9.32247	5.46254
Max	133015	91271	7921	76652.1	52.0223	15.5867	68.2565
Min	17815	8744	1123	2489.02	7.82046	0.76216	0.84625
Stdev	38179.75	26601.6	2351.06	20867.5	9.67596	4.70384	14.9130
			Medium-scale Firms				
Mean	25463.9	19883.9	702	6829.78	50.7174	5.23673	10.6158
Max	57210	50162	1194	17513.1	156.336	12.3276	22.2823
Min	4199	1193	201	1401.65	5.08970	0.52550	1.73258
Stdev	15738.4	13939.0	348.634	4984.75	43.2129	3.27812	5.83046

Medium-scale industries are relatively capital intensive, even though the average value of fixed assets employed was less than 50% of their large-scale counterparts. Perhaps due to this factor, large-scale industries were more productive in the use of their capital resource where as labour productivity was considerably high in medium-scale tanneries. Of the total number of large-scale enterprises, about 75% were exporters, while only 41 per cent of medium-scale industries were able to penetrate the international market.

3.1.2. Leather Processing Industries

The situation of shoe and other leather product processors was more erratic compared to what was the case in tanneries during the study period. More often than not, a firm reported to operate in a certain year might not proceed in its operation in the subsequent one or two years. Accordingly, establishments, which managed to operate in successive years without interruption, were relatively very few compared to the total number of firms found in the list of the Central Statistical Authority at any given time.

Table 5: Descriptive Results of Shoe and Other Leather Industries ('000 Birr)

Indicators	Y_{it}	X_{1it}	X_{2it}	X_{3it}
Mean	5764.58	3420.646	669.667	2330.31
Maximum	63044	38447	5503	14053.42
Minimum	137	74	10	20.44
Stdev	10701.9	6441.938	1501.43	2537.059

The average firm level annual production, industrial cost, and wage bill paid were Birr 5,764,583, Birr 3,420,646, and Birr 669,667, respectively. These industries, on the average, employed Birr 2,330,310 worth of fixed assets. There was, however, a significant disparity in the scale of operation and the amount of inputs utilized among these establishments[1].

Table 6: Large and Medium Scale Leather Processors: Descriptive Statistics ('000 Birr except the ratios)

Indicators	Y_{it}	X_{1it}	X_{2it}	X_{3it}	Y_{it} / X_{2it}	Y_{it} / X_{3it}	X_{3it} / X_{2it}
			Large-scale Industries				
Mean	24876.8	14711.9	3561.88	2758.236	8.52065	14.82357	2.781221
Max	63044	38447	5503	5007.163	18.3414	58.82216	13.02459
Min	3059	1841	341	8.520651	2.84031	0.688749	0.196439
Stdev	15463.1	9450.60	1879.97	1400.504	4.35599	15.79843	4.400924
			Medium-scale Industries				
Mean	1942.15	1162.39	91.225	2244.725	37.3897	2.612038	37.97958
Max	7524	6428	430	14053.42	413.9	30.02644	312.8092
Min	137	74	10	20.44	3.16177	0.129435	0.335082
Stdev	1884.46	1399.75	82.4337	2706.173	56.6589	4.711847	48.69887

The scale of operation of those enterprises engaging 200 persons and more was large as it could be demonstrated in terms of gross value of production and inputs

[1] In this industrial group, not only the percentage share of exporting firms was low (3 out of 24 enterprises); they were not able to keep up their sales in a continuous basis. Thus, comparison of exporting and non-exporting firms could not be feasible.

use. As it was the case in tanneries, medium-scale industries were relatively capital-intensive. Regardless of being medium-sized, these enterprises employed machineries and equipment of almost a comparable value with large scale industries. As a result of this, labour was found significantly productive in these industries, contrary to capital. Partial measures may not entail a conclusive indication whether large- or medium-scale shoe and other leather processors were more efficient in the use of their factors of production.

4. ECONOMETRIC RESULTS

4.1. Functional Form Selection

Stochastic frontier Cobb-Douglas and Translog production functions are estimated through Coelli (1994) OLS and Maximum Likelihood Error Component Frontier estimation procedures and a likelihood ratio test is carried out to identify the underlined production technology that might better explain the operation of enterprises. The results of the log likelihood ratio test are presented in Table 7 below[2].

Table 7: Functional Form and Estimation Procedure Selection Tests

Type of Industrial	Log-likelihood ratio		χ^2_{cal}	$\chi^2_{(r),\,0.95}$
	Case 1 : Functional Form			
	Cobb Douglas (H_0)	**Translog (H_1)**		
Tanneries	-7.08	-4.2	5.76	12.59
Shoe and Other leather industries	-30.96	-18.99	23.94	12.59*
	Case2: Estimation Procedure			
	OLS	**MLE**		
Tanneries	-10.46	-0.7078	6.66	5.99*
Shoe and Leather Industries	-20.00	-18.99	2.01	5.99

In Case 1, the study tests whether Cobb-Douglas or Translog better represents the underlying production function of the industrial group. In Case 2, whether there is tangible inefficiency among firms during the period or not will be examined. The null hypothesis for Case 1 is Ho= β11=β22= β33= β12...=0 and the alternative hypothesis is, H1=β11≠β22≠β33≠β12...≠0. For Case 2, Ho = μ= γ =0, implying there is no significant inefficiency among firms and the operation of the industry would be better characterized by the average production function. The alternative hypothesis is,

[2] The log likelihood ratio test is based on a comparison of two maximum-likelihood estimators, generated by maximizing the constrained and the unconstrained likelihood functions. The statistics is asymptotically equal to; χ^2_{cal} = -2{log [L(Y; β^c)]-log [L- Y; β^u]}.

$H1 = \mu \neq \gamma \neq 0$. We accept Ho if $\chi 2$ cal < $\chi 2(r)$, 0.95, where (r) is the number of restrictions and the reverse could be the case for the alternative (Gourieroux 2000).

According to the test, Cobb-Douglas stochastic frontier production specification is found to better represent the underlying state of art in tanneries whereas translog functional form better characterizes the operation of shoe and other leather product processors. On the other hand, the test demonstrated that there was statistically valid technical efficiency difference among tanning industries. Shoe and other leather processing industries were operating more or less on a similar level of technical efficiency. The forthcoming analysis on tanning industries would, therefore, proceed on the basis of the selected functional and estimation procedure. With respect to leather processors, despite the fact that OLS better estimates the underlying production function, the η coefficient being statically significant is a source of motivation for investigating whether the trend in technical inefficiency, though not meaningful in the very short term, has been worsening or not.

4.2. Tanning Industries

As far as the focus of the study is on analysing technical efficiency differences among firms owing to firm specific factors, production function coefficients of the model are of secondary importance. Besides, the Battese and Coelli (1992) estimation procedure is such that it does not provide overall significant tests, such as the values for F-test and coefficient of determination for the OLS estimates. Nevertheless, OLS and Maximum likelihood estimates are presented together in Table 8 below, and the former provide the average responses of firms' output to a unit change in each of the inputs.

All explanatory variables came up with a priori expected sign, except that the coefficient for fixed capital variable is found to be insignificant. In a capital scarce country, one may not find it theoretically sound to observe a result of this sort. However, the extent of fixed capital use is highly influenced by the amount of variable inputs employed. The majority of the firms were operating far below their technical capacity and reported values of production might not go proportional to their capacity. On the other hand, a one per cent change in labour and industrial cost could result in a 0.12% and 0.67% change in output respectively. Ignoring the insignificant coefficient for fixed capital, the summation of elasticity values for the two factors of production revealed that tanneries were operating in diminishing returns to scale. This goes in line with the technical efficiency figures to be seen in the forthcoming section.

The value of the intercept term in the MLE estimation is higher than its OLS counterparts implying that the most efficient firm was operating over and above the average firms during the period. This indicates the existence of efficiency difference among the different tanneries. However, γ being statistically insignificant implies that the share of firm level inefficiency from the total output variation attributable to both internal and external factors was not that much significant. Tanning industries have been operating at about two-third of their capacity (CSA 2001) and the impacts of external factors have their own significant contribution. These external factors may be related to government policies and regulations, the supply of electricity, water and other auxiliary inputs and infrastructural facilities. Limited access to capital for operation as well as extension and rehabilitation activities is also a constraint.

Table 8: Cobb Douglas Production Function Estimates

Coefficients	OLS		MLE	
	Coefficients	**t-ratio**	**Coefficients**	**t-ratio**
B_0	2.403932	3.70728*	2.741695	3.13104*
X_1	0.675247	9.75457*	0.650895	9.03383*
X_2	0.123498	2.0494*	0.117528	2.01183*
X_3	0.042875	0.629834	0.558556	0.68235
σ^2	0.109759	-	0.1023438	1.8725*
$\gamma = \sigma_u^2 / \sigma_v^2 + \sigma_u^2$.	-	-	0.256968	0.985593
μ	-	-	0.321995	1.46997*
M	-	-	0.321995	1.46997*
η	-	-	-0.775502	-2.57117*
Log likelihood function	-10.461	-	-7.077976	

* Significant at 5%.

Above all, shortage of hides and skins due to low level of domestic livestock production, considerably high human consumption for traditional clothing, furnishing and handicrafts, low off-take rate and low recovery rate (damage) arising from the process of flaying and preservation is a very serious problem. Moreover, the main source of raw materials being farmers, the hides usually come from older draft animals which have suffered from diseases and they contained branding and scratches. The long marketing chain started primarily from the rural farmer to rural markets, small dealers and agents, urban traders and shed owners, big traders in the central market, Addis Ababa and finally to tanneries also causes an escalating input cost and quality corrosion. Even though the Ministry of Agriculture is delegated to implement national standards on raw hides and skins owing to its proximity to the source, it did not establish a tangible mechanism to carry out this activity [UNCTAD 2000]. Smuggling of livestock to neighbouring countries has also greatly prevented the sub-sector from realizing its potential. About 23 per cent of all medium and large-scale industries attributed raw materials shortage as their major constraint [CSA 2001].

Equally important is the negative and statistically significant coefficient of η that reveals the existence of technical inefficiency among tanning industries, which was rising over time during the period. In 1996, the average technical efficiency deviation of firms from the most efficient enterprise was only 3.3%. The variation came to be apparent as time went on. In 1999, a 28 per cent average deviation was observed and the trend became very alarming.

Table 9: Technical Efficiency Trend in Tanning Industry

Period	Mean Efficiency	Rate of Growth in %
1996	0.967	-
1997	0.931	-3.79
1998	0.857	-7.95
1999	0.719	-16.06

During the four-year period, the average technical efficiency of tanneries in general was about 87 per cent. Thus, the influences of external factors being constant, identifying and accordingly alleviating firm specific constraints could have compensated the 13 per cent shortfall in output. This was not, however, the case for all firms. The most inefficient firm was lagging behind by about 37%, thus demanding an extra effort. Most tanneries have been operating with old and obsolete equipment, with little rehabilitation and expansion activities. They suffer from lack of proper management to institute waste disposal mechanisms and ensure a conducive working environment and quality of products. They also failed to study ways of improving mode of operations in light of new technological developments and improve their competitiveness.

Table 10: Efficiency Variation between Groups of Tanneries

		Market Orientation		Scale	
Indicator	All Tanneries	Exporting	Non-Exporting	Large	Medium
Mean	0.868	0.848	0.939	0.881	0.851
Max	0.980	0.977	0.980	0.980	0.970
Min	0.631	0.631	0.792	0.686	0.631
Stdev	0.1021	0.1036	0.057	0.090	0.109

Penetration to the international market requires either a special privilege from importing countries or producing goods with the required quality and competitive price. Ironically, consistent with descriptive statistics results, econometric findings also reveal that exporting firms were found rather less efficient compared to those which were either unable or totally gave up looking for the international market. However, they have been able to sustain supplying their products to the international market in the absence of subsidies. Possible explanations for the paradox are the following.

Roughly approximated through fixed capital wage ratio, exporting firms employed relatively modern machineries. This might have allowed them processing hides and skins that could qualify to international market standards. Once they were able to establish market access through various mechanisms including participation in trade fairs, use of internet, buyer contacts, etc, they could continue benefiting from the market due to the natural superiority of Ethiopian leather. According to UNCTAD (2000), "the Ethiopian highland sheepskins, estimated to comprise 70% of the total sheepskin production, have international reputations for their unique natural substance of fineness, thickness, flexibility, strength and compactness of texture. They are very suitable for the production of high quality leather dress gowns, sports gloves and garments".

Whatever the degree of competition abroad, the alternative market might not be attractive for exporting firms. The kind of technologies and the level of processing are oriented to manufacture high-grade leather, whose effective demand may be very low in the local market. Export-oriented leather product processors, which could have been a good market for exporting tanneries, are very few and they may not have the capacity to constantly use superior quality tanned leather for the production of exportable articles.

Besides their own weaknesses, inefficient operation of exporting firms could be attributed to problems related to export facilitation. A study on Sub-Saharan African countries revealed that in addition to policy-related constraints, transport costs exerted a severe negative impact on external trade performance. "Freight rates for African exports often are considerably higher than on similar goods originating in other countries, and these charges generally conceal very high rates of effective protection for processed goods, a point that significantly reduces incentives for new investment in export-oriented production activities" (World Bank 1995). The condition in Ethiopia could not be any different, if not worse.

Inefficiencies are observed in relation to external trade movements. Long delays of vehicles carrying exportable and imported goods, mainly due to time-consuming and lengthy processes result in high transaction costs. Reduction of these costs could substantially benefit the sector in particular and the country in general (TFEDC 2001). Through this process, exporters could supply their products with competitive prices and import principal and auxiliary inputs at cheaper prices. In this effect, the application of improved logistics management system such as Electronic Data Interchange (EDI) scheme allows to effectively coordinate the activities of transport service providers, custom offices, insurance companies, port service providers and exporters. This is a practically proven mechanism, which has brought about a significant reduction in transaction costs, and facilitated trade relations in many countries (World Bank 1992).

It has also been observed that technical efficiency varies, to some extent, with firm size. Those establishments that engaged 200 and more persons were relatively more efficient compared to medium ones. This may be due to better opportunities to exploit economies of scale and minimize unit cost of production in large-scale industries. Large firms are also likely to have well-organized management systems, market research units, better technical personnel and quality control sections.

4.3. Leather Processing Industries

From Table 11 below, one may observe that except few, including the intercept term, coefficients of factors of production, their squares and cross products are found statistically significant at 5% and 10%. Unlike the case of Cobb-Douglas specification, elasticities of factor inputs are not constant and easily explained[3].

Table 11: Translog Production Function Estimates

	OLS		MLE	
Coefficients	**Coefficients**	**t-ratio**	**Coefficients**	**t-ratio**
β_0	-1.830817	-1.2582	-1.777742	-1.80768*
X_1	0.9945053	3.20557*	1.000555	1.444629**
X_2	0.4588151	1.80012*	0.487280	0.683805
X_3	0.4263999	2.09824*	0.402057	1.631284**
$(X_1)^2$	0.9005223	2.80295*	0.107196	1.825239*
$(X_2)^2$	0.0424758	1.74916**	0.05958	2.126716*
$(X_3)^2$	0.0314722	1.87055*	0037486	1.93068*
$(X_{1t}{*}X_{2t})$	-0.1202342	-2.71211*	-0.153627	-2.79126*
$(X_{1t}{*}X_{3t})$	-0.1308514	-4.01417*	-0.143813	-4.24689*
$(X_{2t}{*}X_{3t})$	0.22604089	0.561654	-0.029678	0.557109
σ^2	0.09915169	----	0.0918087	6.305468*
$\gamma = \sigma_u^2/\sigma_v^2+\sigma_u^2$	--	---	0.0449567	1.208066
M	--	---	0.128490	1.773774*
η	--	---	-0.345856	-1.953943*
Log likelihood function	-20.005045	---	-18.99187	---

* Significant at 5%. ** Significant at 10%.

As demonstrated above, OLS better estimates the kind of production function representing the operation of shoe and other leather product processors. Under capacity utilization, financial loss and entire bankruptcy of firms in this sub-sector is largely explained by external factors than internal firm level weaknesses. Through

[3] For instance, elasticity of labour (e_L) = $d\ln(Y)/d\ln(X_2) = \beta_{22} + (\ln X_2) + \beta_{12}(\ln X_1) + \beta_{13}(\ln X_3)$. Thus, elasticities of output with respect to changes in labour depend on the level of labour input, fixed capital and industrial cost which vary along each firm. Under conditions of perfect competition, elasticities of output with respect to each input are assumed to be equal to the shares of expenditure on the respective factor inputs in total output. This could not be practical at least in the Ethiopian situation where markets are highly distorted by illegal operation, information asymmetry and other physical institutional factors. The negative coefficients for cross products indicate the possibility of factor substitution.

illicit trade in the form of dumping, contraband and under-invoicing, the domestic market has been flooded mainly with imitation and synthetic products that substitute locally manufactured genuine leather products including shoes, garments and other articles. This may be observed clearly along the streets of Addis Ababa and in almost all urban centres of the country. Lack of technical support with respect to technology choice, access to finance and market information put these enterprises in a disadvantageous position compared to competing East Asian firms.

The Government has established an institute to provide training on leather processing but the effect has not been yet meaningfully observed in terms of unit cost and quality improvements. The Quality Standard Authority of Ethiopia is responsible to implement standards and help institute ISO 9000, an integrated management system that could ensure quality and thus competitiveness of leather products in a sustainable manner. Even though new developments might have taken place recently, very few enterprises knew about the existence of this Authority in 2000 while UNCTAD was conducting a study. Regarding the widespread contraband trade, government bodies are accountable for their, among others, uncoordinated and less effective control. Among others, the Quality Standard Authority of Ethiopia could have seriously inspected the quality of legal and illegal imports that have unfairly driven out many local firms. While it requires time to comment as to its sustainable operation, currently the Government through the Ministry of Revenues has taken measures to manage contraband trade before it becomes out of control.

Even though the external environment was not conducive, firms themselves were partly responsible for their failure. The intercept term reported in the OLS is lower than the case in MLE implying, with limited statistical validity, two different production functions are observed in the system; the average representing the majority and the frontier depicting the most efficient firm. Thus, the average lies underneath the frontier. This is an indication of technical efficiency variation among firms. However, the difference between the most efficient and inefficient firms during a period of four years and among 24 enterprises was only about 15%. The mean technical efficiency was about 92 per cent, which was only 8% lower than the frontier level of output. Size did not contribute for technical efficiency variation. Large and medium scale industries were operating in a comparable level of efficiency.

Table 12: Efficiency Difference Between Groups of Firms

Indicators	All Firms	Large-scale Firms	Medium-scale Firms
Mean	0.918	0.920	0.918
Max	0.966	0.956	0.966
Min	0.852	0.874	0.853
Stdev	0.030	0.028	0.031

The coefficient of η is negative and statistically significant at 5%. This indicates that technical efficiency of firms tended to decline over time. In 1996, the average technical efficiency was about 95 per cent. This has declined at an increasing rate and reached 88 per cent, demonstrating how firms have been losing ground to withstand the severe external constraints owing to deterioration of their internal managerial, technical and market searching capabilities. As a result, not only those enterprises that were able to export their products to the international market have failed to persistently do so, but also many firms became out of the domestic market in a sub-sector where the country is thought to have a comparative advantage.

Table 13: Mean Technical Efficiency Over Time

Year	Technical Efficiency	% Growth Rate
1996	0.954	-
1997	0.935	-1.9
1998	0.909	-2.71
1999	0.87	-3.78

Poor design and finishing capabilities, lack of skilled manpower, use of backward machineries, failure to use modern communication facilities, weak reaction in response to competitive products and weak international exposure are firm level constraints hindering the performance of this sub-group. According to UNCTAD (2000), none of the leather processor companies had ISO 9000 in place, implying that the attempt to fulfil international standards is very limited. These precarious conditions may bring firms into a vicious circle where the prevailing under utilization of capacities or factor inputs would further enhance unit cost of production and further weaken their fragile competitiveness and financial position.

5. CONCLUSION

The leather industry accounts for the bulk of manufacturing export earnings, although manufacturing industry does not play a vigorous role in the country's export trade. Nevertheless, the leather industry has not been performing well given the huge livestock potential of the country and leather processing industries in particular are under a severe threat even in the domestic market. This might arise both from external factors and firm level weaknesses. The objective of this study was to examine whether or not there had been technical efficiency difference among leather industries in general, exporting and non-exporting, and large and medium-scale industries in particular. A stochastic frontier Cobb-Douglas and translog production functions were estimated using 10 tanneries and 24 leather processors during 1996-1999 through Coelli (1994) OLS and Maximum Likelihood Error Component Frontier estimation procedures.

Log likelihood test revealed that Cobb-Douglas stochastic frontier production function estimated through maximum likelihood better represents the underlying production technology of tanneries. Mean technical efficiency of tanneries for the whole period was about 83 per cent. The influences of external factors being constant, addressing firm level weaknesses could allow compensating the 17 per cent production shortfall observed. Contrary to the widely held view, exporting firms were not efficient compared to inward-oriented firms. However, exporters were using capital intensive technologies, which might have allowed them producing exportable quality. Large-scale firms were more efficient compared to medium-scale industries, because of the possibility of exploiting higher scale economies. Overall, technical efficiency of tanning industries was alarmingly declining, partly due to shortages of raw materials, use of obsolete machineries, and weaknesses to productively utilize the prevailing state of the art.

Translog production function, estimated through OLS, is selected to better depict the operation of leather processors, depicting the non-existence of statically valid technical efficiency difference amongst them. Apparently, the sub-sector has been performing significantly below capacity and it is under severe problems. According to the econometric result, this could be explained largely by external factors such as unfair competition with illegal imports, lack of easier access to finance, lack of technical support in technology choice, market information and similar other areas. In spite of its statistical validity, the increasing trend of inefficiency might reflect that firms have been losing ground to withstand the competition due to their internal problems associated with product design, use of backward machineries, weak international exposure and weak reaction to competitive products.

In both industrial groups, besides firm level problems, failures to adequately discharge responsibilities by concerned bodies in terms of controlling quality standards and ensuring fair market environment greatly harm operation of enterprises. Transaction costs associated with export trade, reflected mainly in transportation delays are significantly high in Ethiopia owing to weak information flow and coordination among exporters and service providing agencies including customs administration, insurance and transport operators.

Both Government and industries need to work in their respective areas to address these constraints. In the period of globalisation, once the country has gone long distance with the liberalization drive, there may not be a room to unleash the gear. Thus, enterprises should accustom themselves with the changing environment and search for ways of addressing their weaknesses. Government can play its supportive role within the framework of free market. The intervention is required, among other things, by way of controlling illegal and unfair practices, extending technical support in availing market information, training, technology choice, and in similar other areas.

The recent interventions, both in controlling illegal trade and promoting exports, seem to indicate that the Government has started to take measures to rescue the industrial sector in general and the leather industry in particular. It is a commendable move that should be pursued with vision and well-integrated plan through a coordinated mechanism. In addition, facilitating external trade by way of establishing electronically driven information system that facilitates coordination of the services of custom, insurance, transport and all others should be considered. Efforts of enterprises, government and other stakeholders should be synchronized to address the stated constraints in order to bring about sustainable improvement and development to the sub-sector and the country at large.

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