Is the Ethiopian Leather Industry on the Right Track? An Empirical Investigation[1]

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Abstract

This study aimed at examining the existence of technical efficiency differences among tanneries and leather processing firms using stochastic frontier production function models. The study considered 10 tanneries and 24 leather processing firms for the period 1996 to 1999. Mean technical efficiency of tanneries was about 83 percent for the entire period, albeit showing a declining trend. Among tanneries, larger firms were found to be more efficient because of the advantage of scale economies. Contrary to the widely held view, exporting tanneries were not as efficient as inward oriented ones except that they were using capital intensive and relatively modern technologies which might have allowed them producing good quality products for their target markets. Although, leather processing industries were operating far below their designed capacity, the empirical evidence externalized the causes for their poor performance. The Translog production function estimated through OLS was found to better characterize their production technology implying that there was not statistically significant technical efficiency difference amongst them. External constraints might include unfair competition with illegal imports, lack of easier access to finance, and limited government support in light of the fiercely competitive global trade and the infant nature of the sector. Albeit, statistical tests do not affirm it, an increasing trend of inefficiency has been observed in leather processing industries. This is perhaps a reflection of firm level weaknesses associated with mediocre product design, use of backward machines, limited international exposure and passive reaction to competitive products. Thus, both tanneries and leather processing industries ought to firmly work in addressing their weaknesses and accustom themselves with the challenges of the changing global environment. Government should also play its supportive role in terms of ensuring a fairly competitive domestic market, providing market and technology related information, supporting trainings, and minimizing transaction costs related to the provision of its services.

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1. Introduction

Ethiopia counted many years without recording a meaningful change in the structure of the export sector. The sector has been dominated by a handful of primary commodities, coffee being the key. 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 been exceeded more than 20 percent [NBE, 2002]. Within the manufacturing export, leather products, in their semi and fully processed form, constitute more than 50 percent. Although, there are attempts in the food, beverage, textile, and chemical industrial groups, the dominance of the leather sub-sector still continues. With a relatively modest share in gross value of production (7.2 percent), persons engaged (7.3 percent) and fixed assets (8.6 percent) of all medium and large scale industries, the leather sub-sector was able to contribute about 73 percent of manufacturing export in 1999/00. The export earning was about 44 percent 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]3.

Notwithstanding its dominant position in the midst of highly inward oriented industrial sector, the performance of leather sub-sector is not satisfactory given the huge livestock potential and the country's ardent demand for foreign exchange earnings. It is a 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 Unit4 (TLU). Berhanu and Kibre (2002) also noted that Ethiopia held about 15.75 percent of the cattle and 9 percent 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 or actual utilization rate is comparably low in contrast to the pack or the potential, the country provides about 2 million pieces of hides and 13.6 million skins annually. Had this amount been properly utilized, leave alone the potential; it could have been a great opportunity for those currently operating and potential investors in the sub-sector in particular and the country in general.

[3] For instance, in 2002/03, tanneries and leather processing industries were able to fully cover their own and contribute about 21 percent of the total foreign exchange requirements of the manufacturing sector to acquire imported inputs.

[4] Tropical Livestock Unit (TLU) is a standardized measure of the number of live animals of all sorts using a conversion factor of 250 Kg as one TLU.

Low performance of the sub-sector is reflected through the fewer number, low level of capacity utilization and small-scale operation of leather processing industries. According to 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 of Birr 5.1 billion. These enterprises were able to create job opportunities only for about 7034 persons and had an annual production capacity worth of Birr 1.1 billion.

While sustainable operation in line with the global market requirements and reaping the benefit of export market opportunities requires at the very least commanding the local market, the 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 foot wear industries. Similarly, survey result of 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 sector was obliged to reduce about 13 percent of workers within 1996/97 to 1999/00. The average rate of capacity utilization of those industries, which were able to survive in the sub sector, was only 49 percent in 1999/00.

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

The other major problem is the manner that some countries do 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 been 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 out of business. This has been further accentuated due to limited capacity and efficiency of concerned bodies to control such drawbacks and strive assuring a healthy market environment. While this and other external constraints are beyond the sphere of firm level decisions, there are internal problems.

Operating under similar policy, institutional and marketing environment, firms may exhibit different levels of efficiency. For instance, Taye and Teal (1998) found that exporting firms were 32 percent and 15 percent more efficient than non-exporting firms in Cote d'Ivore and Kenya respectively. Battese et al (2001) estimated technical efficiencies of firms and came out with a result that significant efficiency difference was 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 conditions. 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. Neither the paper had the intention nor would the methodology employed allow segregating the extent to which firm specific weaknesses contributed for the total factor productivity turn down 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 for firms themselves to address their internal weaknesses before opting for external solutions. Besides, making the overall environment conducive, empirical findings of this sort also initiates 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 variation among different firms. In our case, some of the firms were exporting their products while others were not. Since it is usually the case, it is possible to hypothesize that those enterprises that were able to operate more efficiently than otherwise have penetrated the international market. The other possible hypothesis emerges with relation to size. Large firms may enjoy relatively higher scale economies and use inputs in a more productive way than the case in small scale firms. The objective of this study is, therefore, to examine efficiency variation 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 compared among firms. 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).

The source of data is 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, highly exaggerated figures or at times they could even become totally out of sight in the data set. In the case of tanneries, the problem is not very much serious. We got only one firm which failed to provide a complete date for four consecutive years. However, in the case of leather processing industries, the total number of firms at end of 1999 were 32 and 24 of them (about 67%) had a four year complete data. As a result, we took those observations that have four years complete data. There was also an attempt to use some other variables that may 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, findings of this study should be seen in light of these limitations.

2. Model specification and definition of variables

2.1. Model specification

On the basis of Aigner, Lovell and Schmidt (1977), Pitt and Lee (1981) and Battese and Coelli (1992) propose a stochastic frontier production function for panel data having the usual stochastic error term, which is 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.

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

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, σ_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,

$$TE_{it} = \exp(-U_{it})^5 \qquad \textbf{(2)}$$

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,

$$U_{it} = U_i,\ i = 1, 2\ldots N;\ t = 1, 2\ldots T. \qquad \textbf{(3)}$$

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 and et al (1998) defined technical inefficiency effects as a function of time. The relationship is expressed as:

$$U_{it} = \{\exp[-\eta\ (t-T)]\}U_{i},\ i = 1, 2\ldots N; 1, 2\ldots T; \qquad \textbf{(4)}$$

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

[5] This is a measure of the extent to which a certain firm operates below the frontier drawn by the mot efficient firm among the sample firms given similar working conditions and nature of input use. Alike measures such as designed capacity of machinery, the model does not set internationally accepted technically attainable maximum level of output to make an inter country comparison possible.

periods are assumed to be the product of technical inefficiency effect of the last period and the value of the exponential function, exp [-η (t-T)]. If the parameter η has a value more than zero, then -η (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 what could the situation be during the last period of the panel, $U_{it} > U_{i.}$ If the value of η= 0, technical inefficiency effects of i[th] firm do not vary over time, $U_{it} = U_i$ and if η< 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 equation (2.5) and (2.6) respectively.

$$y_{it} = \beta_0 + \sum_{j=1}^{3} \beta_j x_{jit} + v_{it} - u_{it}, \qquad \textbf{(5)}$$

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

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.

2.2. Definition of variables

1. **Gross value of production (Y_{it}):** 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 strength 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 more reasonable. One needs to be cautious that the price of products could vary from one factory to the other due mainly to quality differences. This is mainly seen in the exporting and non-exporting firms. Thus, this paper takes different value of production among factories for similar quantity of output assuming that prices could capture quality differences.

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 in education, work experience and other similar attributes. Though not fully take into account, wages and salaries are presumed to 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

Descriptive statistics results

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.

Table 3.1: 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
Minimum	4199	1193	201	1401.653
Standard deviation	35206.65	24470.41	2417.694	15312.95

Relatively, a considerable number of tanneries (67.5 percent) were exporting their products. Contrary to the customary thinking, it was found 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 3.2 below revealed that neither labour nor capital was more productive in exporting firms compared to inward-oriented industries.

Table 3.2: Comparative descriptive statistics for exporting and non-exporting tanneries ('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	18.33	3.98	4.61
Max	133015	87246	7921	76652.2	16.79	1.74	9.68
Min	6393	5080	231	1401.6	27.68	4.56	6.07
Standard Deviation	33541.0	23073.3	2496.3	17194.3	13.44	1.95	6.89
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	2426.3	5720.1	19.98	8.47	2.36
Max	128536	91271	6033	10555.9	21.31	12.18	1.75
Min	4199	1193	201	2489.0	20.89	1.69	12.38
Standard Deviation	42548.4	30311.7	2264.3	2882.8	18.79	14.76	1.27

As it could be observed from Table 3.3, 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 the decline in output per one-Birr worth of labour.

Table 3.3: Partial productivity trends of tanneries

Indicators	**1996**	**1997**	**1998**	**1999**	**Growth**
Exporting Firms					
Y_{it}/X_{2it}	17.5	22.9	22.6	12.7	-0.16
Y_{it}/X_{3it}	11.4	6.5	3.4	2.4	-0.446
Non-Exporting Firms					
Y_{it}/X_{2it}	29.8	15.5	12.9	10.3	-0.28
Y_{it}/X_{3it}	7.1	11.9	9.9	8.0	0.11

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, numbers of tanneries categorized into the two scales are similar. Table 3.4 below demonstrated that mean value of production and inputs significantly varied between large and medium scale tanneries.

Table 3.4: Descriptive statistics for large and medium scale tanneries ('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 tanneries							
Mean	65386.9	43566.5	4167.1	13113.7	16.9	9.3	5.5
Max	133015	91271	7921	76652.1	52.0	15.6	68.3
Min	17815	8744	1123	2489.02	7.8	0.76	0.8
Standard Deviation	38179.8	26601.6	2351.06	20867.5	9.7	4.7	14.9
Medium scale firms							
Mean	25463.9	19883.9	702	6829.8	50.7	5.2	10.6
Max	57210	50162	1194	17513.1	156.3	12.3	22.3
Min	4199	1193	201	1401.7	5.1	0.53	1.7
Standard Deviation	15738.4	13939.0	348.6	4984.8	43.2	3.28	5.8

Medium scale industries are relatively capital intensive, even though the average value of fixed assets employed was less than 50 percent 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 percent were exporters, while only 41 percent 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. 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 Central Statistical Authority at any given time.

Table 3.5: Descriptive results of shoe and other leather industries ('000 Birr)

Indicators	Y_{it}	X_{1it}	X_{2it}	X_{3it}
Mean	5764.58	3420.646	669.7	2330.3
Maximum	63044	38447	5503	14053.4
Minimum	137	74	10	20.4
Standard Deviation	10701.9	6441.9	1501.4	2537.1

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 were, 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[6].

Table 3.6: Large and medium scale shoe and other 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	3561.9	2758.2	8.5	14.8	2.78
Max	63044	38447	5503	5007.2	18.3	58.8	13.02
Min	3059	1841	341	8.5	2.8	0.69	0.196
Standard Deviation	15463.1	9450.60	1879.97	1400.5	4.4	15.8	4.4
Medium scale industries							
Mean	1942.15	1162.39	91.2	2244.7	37.4	2.6	37.98
Max	7524	6428	430	14053.4	413.9	30.0	312.8
Min	137	74	10	20.4	3.2	0.13	0.34
Standard Deviation	1884.46	1399.75	82.5	2706.2	56.7	4.71	48.7

6 In this industrial group, exporting firms were very few (3 out of 24 enterprises), and even these firms were not able to keep up their sales in a continuous basis. Thus, comparison of exporting and non-exporting firms could not be feasible.

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 use. As it was the case in tanneries, medium scale industries were relatively capital intensive. Regardless of being medium size, these enterprises employed machineries and equipment that worth 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.

3.2. Econometric results

3.2.1. 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 3.7 below[7].

Table 3.7: Functional form and estimation procedure selection tests

Type of Industrial	Log-likelihood ratio Case 1 : Functional Form			
	Cobb Douglas (H_o)	Translog (H_1)	χ^2_{cal}	$\chi^2_{(r), 0.95}$
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

[7] 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; $\chi^2_{cal} = -2\{\log [L(Y; \beta^c)] - \log [L- Y; \beta^u]\}$.

In Case 1, a test is made to investigate whether Cobb-Douglas or Translog better represents the underlining production function of the industrial group. In Case 2, whether or not there is tangible inefficiency among firms during the period is examined. The null hypothesis for Case 1 is H_o=β11=β22=β33=β12…=0 and the alternative hypothesis is, H_1=β11≠β22≠β33≠β12…≠0. For Case 2, $H_o = \mu = \gamma = 0$, implying there is no significant inefficiency difference among firms and the operation of the industry would be better characterized by OLS. The alternative hypothesis is, $H_{1=}\mu \neq \gamma \neq 0$. We accept H_o 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 where as Translog functional form better characterizes the operation of shoe and other leather product processors. On the other side, 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 statistically significant is a source of motivation for investigating whether the trend in technical inefficiency, though not meaningful in the very short run, has been worsening or not.

3.2.2. Tanning industries

As far as the focus of the study is mainly on analyzing 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 3.8 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. Majority of the firms were operating far below their technical capacity, reported values of production might not go proportional to their capacity. On the other side, a one percent change in labour and industrial cost could result a 0.12 percent and 0.67 percent change in output. 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.

Table 3.8: 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 percent.

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 by 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.

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 rural farmers, the hides usually come from older draft animals and therefore suffer from diseases, 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 for 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 threatened the sub-sector from realizing its potential. About 23 percent 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 percent. The variation came to be apparent at time went on. In 1999, a 28 percent average deviation was observed and the trend became very alarming.

Table 3.9: Technical efficiency trend in tanning industry

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

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

Table 3.10: Efficiency variation between groups of tanneries

Indicator	All Tanneries	Market Orientation		Scale	
		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
Standard Deviation	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 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 for the international market standards and accordingly get relatively higher prices as compared to what the local market could offer. Once they meet basic international standards and establish market access through various mechanisms including participation in trade fairs, use of internet, buyer contacts, etc, exporting firms have continued to benefit from the market due to natural superiority of Ethiopian leather. According to UNCTAD (2000), “the Ethiopian highland sheepskins estimated to comprise 70 percent 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 in number and they may not have the capacity to constantly use superior quality tanned leather for the production of exportable articles.

Besides their own weakness, 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 different, if not worse.

Inefficiencies are observed in relation to external trade movements. Long delays of vehicles and of exportable and imported goods, mainly due to time-consuming and lengthy processes result 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 facilitating 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 efficient compared to medium ones. This might arise due to better opportunities to exploit economies of scale and minimize unit cost of production in large-scale industries. With size, large firms are likely also to have well-organized management system, market research units, better technical personnel and quality control sections.

3.2.3. Leather processing industries

From Table 3.11 below, it could be observed that except few including the intercept term, coefficients of factors of production, their squares and cross products are found statistically significant at 5 percent and 10 percent. Unlike the case of Cobb-Douglas specification, elasticises of factor inputs are not constant and easily explained[8].

[8] For instance, elasticity of labour (e_L) = $dln(Y)/dln(X_2) = \beta_{22} + (lnX_2) + \beta_{12}(ln\ X_1) + \beta_{13}(lnX_3)$. Thus, elasticises of output with respect to changes in labour depends on the level of labour input, fixed capital

Table 3.11: Translog production function estimates

Coefficients	OLS		MLE	
	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 percent.

As it was 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 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 could 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.

and industrial cost which vary along each firm. Under conditions of perfect competition, elasticises 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

Government has established an institute to train 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 instituting 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 take place recently, very few enterprises knew the existence of this Authority while UNCTAD was conducting a study in the year 2000. For the wide spread contraband trade, government bodies are accountable for their, among others, uncoordinated and less effective control. Among others, Quality Standard Authority of Ethiopia could have seriously inspected the quality of legally and illegal imports that have unfairly derived out local firms. While it requires time to comment as to its sustainable operation, currently Government through Ministry of Revenue 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 percent. The mean technical efficiency was about 92 percent, which was only 8 percent 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 3.12: 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
Standard Deviation	0.030	0.028	0.031

The coefficient of η is negative and statistically significant at 5 percent. This indicates that technical efficiency of firms tended to decline over time. In 1996, the average technical efficiency was about 95 percent. This has declined at an increasing rate and reached to 88 percent, demonstrating how firms has been loosing 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 3.13: Mean technical efficiency over time

Year	Technical Efficiency	Growth Rate in Percent
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 back ward machineries, failure to use modern communication facilities, weak reaction in response to competitive products and weak international exposure are firm level, so to say, 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 exasperatedly weaken their fragile competitiveness and financial position.

4. Conclusion

Leather industry accounts the bulk of manufacturing export earnings. However, the performance of the industry has not been adequate given the huge livestock resources of the country. Leather processing industries in particular are under severe threat even in the domestic market owing to both external factors and firm level weaknesses. The objective of this study was to examine whether or not there was technical efficiency difference among leather industries in general, exporting and non-exporting, and large and medium scale industries in particular. The total numbers of tanneries and leather processing industries considered in the study were 10 tanneries and 24 leather processor. A stochastic frontier Cobb-Douglas and Translog production functions were estimated separately for these two groups of industries for the period 1996-1999. OLS and Maximum Likelihood Error Component Frontier estimation procedures of Coelli (1994) were applied to generate technical efficiency values.

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

Translog production function, estimated through OLS, is selected to better portray the operation of leather processors. This indicates the non-existence of statistically valid technical efficiency differences amongst selected leather processing industries. Nevertheless, the sub-sector has been performing significantly below capacity. 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 the areas of 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 loosing ground to withstand the competition with foreign firms due to their internal problems. Some of these problems might include poor product design, use of backward machineries, weak international exposure and weak reaction to competitive products.

High transaction costs of export trade resulting from transportation delays, weak information flow and coordination among exporters and service providing agencies including customs administration, insurance and transport operators seriously affect the competitiveness status of tanneries in the external market. Besides their internal weaknesses, the inability of concerned bodies to control quality standards of similar imported products and ensuring fairly competitive market environment make the survival of leather processing industries at stake.

Thus, both government and enterprises are required to work hard in their respective areas to address these constraints. In the period of globalization, once the country has gone long distance with the liberalization derive, there may not be a room to unleash the gear. Thus, enterprises should accustom themselves with the changing environment and search ways to address 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 government has wake-up, and tries to rescue the industrial sector in general and the leather industry in particular. It is a commendable move that should be pursued in a well-integrated and coordinated manner. In addition, facilitating external trade by way of establishing electronically driven information system that facilitate 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 to bring about sustainable improvement and development to the sector and the country at large.

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