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The Performance of Privatized Firms: Empirical Analysis for Libya

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The state of mixed results in the literature with regards to the production efficiency between state-owned and private-owned firms motivated the conduct of this study. This paper examines the technical efficiency of Libyan manufacturing firms over the 2000 to 2008 time period. The objective of the analysis is to compare the production efficiency of firms before and after privatization. Using the Data Envelopment Analysis (DEA) technique, efficiency scores are measured for each firm to determine their relative positions on the efficiency ladder. An inefficiency model is estimated to link the inefficiency of inputs or resources used to produce output to other factors such as ownership structure to justify the impact of privatization policy on efficiency. The results indicated that the average efficiency score before privatization was 49.5 percent, but the score improved to 62.3 percent after privatization. The increase of 12.8 percent indicates that on average there is only minor improvement in technical efficiency of firms after privatization. Nevertheless, this increase was not statistically significant. The results also indicated that even though there was an increase in technical efficiency scores of state (government) control and private-owned firms, again this was not statistically significant. The present results suggest that firms in Libya are not prepared for the true sense of privatization, resulting in almost all firms facing difficulties in optimizing their own resources economically. Hence, efficiency is also not a function of ownership structure in the privatization context.

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1. Introduction

In the early stage of privatization, a considerable debate raged about whether privatization leads to improved firm performance (Andrews & Dowling, 1998). In this context, numerous empirical studies focused on the ownership issue. Comparisons were made between the performance of privately owned firms and state firms. In the mid-1980s, many governments around the world reached the conclusion that state ownership was not working, and that private ownership was much more productive. As a result, there has been a global movement away from the state ownership of production and services towards private ownership and free enterprises (Gratton-Lavoie, 2000). Libya, a developing country, was no exception in this attempt. However, because of political and organizational reasons, the results of this study differ for developed and developing countries. In other words, the impact of privatization on one aspect of performance, which is production efficiency, was influenced by crisis internal to the country, rather than external.

The goal of this study is to contribute to the literature on privatization with a focus on the problems and issues in developing countries, such as Libya. This is because Libya has a unique environment for studying privatization. From the mid-1980s until early 2000, these were what had transpired in Libya. The US banned the importation of Libyan oil

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into the US since 1982 and had put strict rules on American exports to Libya. In 1986, the US forced economic sanctions against Libya which generally prevented US persons and organizations from any financial transactions involving Libya, including the export to Libya of all goods, services, or modern technology; the import of goods or services of Libyan origin, engaging in any type of contract in support of an industrial, business-related, or government project in Libya; and dealing in any possessions in which the government of Libya had any interest. The UN also imposed sanctions on Libya for suspected bombing of a US Pan American Airway airliner in Lockerbie, Scotland. During the early 2000s Libya began to make policy changes and restore diplomatic ties. This means that for a long period of time, Libya was in an isolated position without much foreign competition for its enterprises.

However there is a recent debate on privatization that there is growing evidence from developed countries that privatization alone has been insufficient to stimulate performance improvement. This also has motivated us to conduct this study to verify the impact of privatization on performance, this time for a developing country. Since the mid-1980s, three waves of privatization had taken place in Libya as economic reform programs. Even though there were three privatization attempts in Libya, efforts taken to improve performance of firms failed each time because of the constraints that existed in each phase of the privatization initiatives. And the constraints were forceful enough to warrant any improvement in performance out of the privatization attempts. Moreover, the privatization law which was issued by the General People Congress to regulate the private sector businesses was only passed in September 1992.

The first wave of privatization in Libya began in 1987 in response to the drop in oil market prices. The drop in the oil market affected the country's ability to continue with its previous policy. As a result the government adopted its first economic reform and allowed for the first time since 1977, limited private sector investment in Libya. Therefore, only small scale private sector was allowed to participate in retail trade, service and light industries as means of overcoming the inefficiency in these industries (Meliha, 1996). Moreover, most of the firms that were privatized through this system suffered from performance decline, some even continued with loss-making resulted from prior debts. Additionally their labour force was also intact and in excess. Also, at that time state intervention in the economy remained widespread. Price setting was still state controlled, and this resulted in a situation that it was difficult for firms to make profits as in a free market economy.

The second wave of privatization which began in 1992 was still in response to the drop in the oil market prices in early 1990s and the poor financial performance of many public sector firms in terms of low productivity. The government proceeded with another economic reform program. However this time, the government introduced the concept of joint-stock company, which allowed private companies to open foreign currency accounts and to import equipment (Vanderwalle, 1998). This concept was actually to share the burden of public sec tor firms with the private sector. Unfortunately, for the second wave of privatization, the performance of some of the privatized firms had declined, and their productivity was similar to, if not worse than, the situation before privatization. Some privatized firms suffered from expensive spare parts and also had difficulty obtaining them because of procedures that were imposed on the private sector. Furthermore, during the 1999-2001 period most of the public industrial projects were overstaffed, equipped with old machinery and suffered from lack of stable management. Most of the firms were loss makers as they were suffering from high inventories.

The third wave of privatization began in 2003 and this was a large scale privatization program. It was described as a program of broadening the ownership base through encouraging residents to own the public firms to avoid concentrated ownership. The program was also aimed to make the country eligible for World Trade Organization (WTO) membership. The government also chose this program, called the Wealth Distribution Program (WDP) as a way to maximize social welfare, launched to distribute part of the oil wealth to the population. The distribution was in the form of both cash and shares in the public firms to improve the standard of living of the residents. The WDP program was actually to create people's capitalism or the program aimed to restructure the economy towards building popular capitalism through spreading share ownership in firms more widely. It is also aimed to transfer the role of the state from the owner to encourager of economic activities. This resulted in the setting up of people's committee responsible to manage the organizations in Libya. Each employee in different departments or management in the Libyan company could be a member of the people's committee which included the head of the company. Thus, the top of the hierarchical structure could be managed by employees to contribute at decision making. This process might lead to making wrong decisions because most employees did not have good and adequate educational qualifications or period of experience. Therefore, public organizations then were more focused in providing basic goods and services to the citizens rather than focusing on maximizing profits. Hence, performance in terms of production efficiency would falter.

Therefore, the privatization process in Libya was more of changing ownership or sharing ownership via deregulation of the markets for the purpose of rescuing troubled public or state firms, and also to make the country eligible for WTO membership, that is, the government was attempting to develop international links via the WTO; hence its polices at encouraging workers and managers to engage in private sector activities. In other words, privatization initiatives were not the real sense of privatization to stimulate competition for improved performance of firms. So this is expected to explain why the results of this study differ for developed and developing countries.

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This study specifically examines the effect of privatization on technical efficiency of Libyan manufacturing firms. This study contributes to the literature on privatization because it adds new empirical evidence about Libya, questioning whether the privatization programs have helped to improve the production technical efficiency of firms. The remainder of the paper is structured as follows. Section 2 sets out to review the literature for relevant past studies, and how this study relates to previous works in this field. Section 3 presents the research methodology employed. Section 4 explains the research findings, while section 5 concludes the study.

2. Literature Review

The public choice, agency and property rights theories outlined theoretical grounds that might explain efficiency gains that could arise from privatization. Even though these theories have been under criticism, they represent the economic rationale behind efficiency improvement that privately owned enterprises will nurture. Nevertheless, past studies showed mixed results on the effect of privatization on efficiency (Megginson et al., 1994, Omran, 2004). Some studies reported that the performance of firms increased after privatization. In contrast, Cabeza and Gomez (2007), Bachiller (2009) and Akram (2009) revealed insignificant improvements after privatization policy. Generally, most empirical studies do not subscribe to either of these extreme positions. Rather, most

studies reported mixed results as to the effect of privatization. As well, there appears to be limited attention paid to ownership structure and its effect on successful privatization.

However, supportive evidences on improved technical efficiency obtained from privatizing state owned enterprises are limited among the developing nations (Ephraim, 2001). Although the results from comparative studies on privatization and state or public owned firms are few, they supported the view that privatized firms are more efficient than state owned firms in achieving higher efficiency in competitive environments. For instance, the work by Fare, Grosskopf, and Logan (1985) compared 30 public and 123 private electric utilities operating in the US in 1970. They measured overall efficiency in terms of cost-minimizing effects. Overall efficiency measures were disaggregated into overall technical efficiency and allocative (or price) efficiency. The overall technical efficiency was further disaggregated into pure technical efficiency, congestion and scale efficiency. Fare, Grosskopf, and Logan (1985) found that publicly and privately owned utilities were not significantly different in terms of the overall allocative and overall technical efficiency measures. They also found that publicly owned utilities have better ratings in terms of pure technical efficiency but are worse than privately owned utilities in terms of congestion and scale efficiency. The major source of inefficiency is due to the lack of allocative (price) efficiency. The authors concluded that on average the publicly owned are overall slightly more efficient than the privately owned electric utilities.

Next, Dewenter and Malatesta (2001) compared state owned firms and privatized firms and concluded that state-owned firms are less profitable than privatized firms and use more leverage than private firms. Boardman et al. (2002) found that privatization improved the technical financial performance of companies in Canada. Similar finding was reported by Omran (2004) who evaluated the financial and operating performance of privatized Egyptian state owned firms. A study by Lien and Peng (2001) investigated production efficiency in OECD countries from 1980 to 1995 and found that increase in technical efficiency improves firm's production scale. The study concluded that competitiveness in telecommunication firms contributed immensely to enhanced technical efficiency. Chao-Chung (2006) measured the efficiency change at Chaughwa Telecom Company (CHT) in Taiwan before and after privatization using the Data Envelopment Analysis (or DEA) technique. He found that CHT's partial privatization has enhanced its own production efficiency significantly. Okten and Arin (2006) tested the effects of privatization on productive and allocative efficiency using a rich panel data set of 22 privatized cement plants in Turkey for the period 1983–99. They found that ownership effects are sufficient to achieve improvements in labor productivity. Meanwhile, Maiti (2007) examined some aspects of productivity and technical efficiency of Indian industrial firms at the microeconomic level, particularly the textile industry, as a case study. However, he used the Translog Stochastic Frontier production function (or SFA) to estimate the technical efficiency of firms. He found that publicly owned firms are relatively less efficient. As well, the researcher did not find evidence that older firms tend to be more efficient. In another study, Bachiller (2009) analyzed the efficiency gains achieved by five strategic Spanish firms privatized during the 1990s. The study compared the efficiency of these firms before and after privatization via the DEA technique. The results showed that the improvements are not related to privatization, and the driving idea behind privatization policies that private ownership results in greater efficiency was not confirmed for the Spanish companies.

Bhandari (2007) examined the efficiency of Indian industrial firms at the microeconomic level using the SFA technique, specifically the firms in the textile industry. The results indicated that publicly owned firms were relatively less efficient. Last but not least, Yang (2010) investigated the efficiency levels and discussed the managerial implications of 12 international airports in the Asia–Pacific region based on data collected for the period 1998–2006. The study applied both DEA and SFA techniques to compute the efficiency estimates. He found that inefficiency effects associated with the production functions of airports increased over the investigated period. From the perspective of mathematical analysis, the author determined that the deviations from the efficient frontiers of production functions are largely attributed to technical inefficiency.

3. The Methodology and Model

The objective of this study is to test whether Libyan manufacturing firms perform better after privatization. To achieve this objective, the secondary data of 21 Libyan manufacturing firms over the period 2000-2008 was used to measure technical efficiency levels before and after privatization. All the firms were privatized in 2004. Information about the firms was obtained from Libyan National Authority in relation to ownership and investment. The National Authority for the ownership and investment information and the Ministry of Industry were the source of data for firms prior to privatization, and the annual reports containing financial data was the source of data for the firms after privatization. This paper focused on manufacturing sector firms that existed as early as the first wave of the privatization program. Therefore, firms from the manufacturing sector comprised the largest number involved in the privatization programs. This condition meets the study's requirement of 3 years before and 3 years after privatization to determine the change in the performance of the firms, pre and post privatization. The possibility to obtain the data was bright as there were numerous firms in the manufacturing sector, particularly with regards to before the privatization period. 32 firms were actually privatized from the manufacturing sector. Eleven firms were omitted from the sample because of the difficulties in obtaining data, especially after privatization.

To evaluate the technical efficiency measures, three input measures were used for this study. They were labor, capital and total assets. The proxy for labor input was the annual total number of employees of the firm. The capital cost of each firm was calculated as value of depreciation plus a risk free rate of return on capital employed. The real rate of return was to reflect the opportunity cost of holding the asset in the business. Total assets are the value of the assets. Meanwhile, the output measures used were sales and net income. The sales figure came from the total value of the sales. Net income was calculated as sales minus the expenses, interest expense and taxes.

Methods

Technical efficiency reflects the ability of a firm to obtain maximum output from a given set of inputs (Farrell, 1957). There is an increasing concern in measuring and comparing efficiency of firms under different environments and activities. One of the simplest and easiest ways to measure efficiency is:

$$Efficiency = \frac{output}{input} \quad (1)$$

If a firm produced only one output using one input, this could be done easily. However, this method is often inadequate as firms normally produce multiple outputs by using various inputs related to different resources.

The measurement of relative efficiency which involves multiple, possibly incommensurate inputs and outputs was first addressed by Farrell (1957) and later developed by Farrell and Fieldhouse (1962). The aim of this technique is to define a frontier of most efficient decision making unit(s) (or DMU(s)) and then to measure how far from the frontiers are the less efficient units. The relative efficiency can be measured as:

$$\text{Efficiency} = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}} \qquad (2)$$

By using usual notations, this efficiency measure can be written

$$\textit{Efficiency unit } j = \frac{u_1 y_{1j} + u_2 y_{2j} + ..}{v_1 x_{1j} + v_2 x_{2j} + ..} \qquad (3)$$

where:

u_1 is the weight given to output 1
y_{1j} is the amount of output 1 from unit j
v_1 is the weight given to input 1
x_{1j} is the amount of input 1 to unit j

This measure of efficiency assumes a common set of weights to be applied across all units. This raises the problem of how much an agreed common set of weights can be applied to all units. In cases where there is only one input and one output, efficiency is often measured in terms of an output-input ratio. But, a typical DMU will have multiple inputs and outputs. Efficiency can be measured by using a weighted average of the outputs and a weighted average of inputs. When comparing efficiency between DMUs, the above measure can be most readily applied when a common set of weights for the DMUs is applicable.

However, in practice it might be difficult for the DMUs to find and agree on a common set of weights that can be used. Each DMU might have their own criteria to emphasize outputs and inputs. Hence, it might be difficult to attach values to each output and input. Charnes et al. (1978) recognized the difficulty in seeking a common weight to determine the relative efficiency measure. They recognised the importance that different units might value inputs and outputs differently, so that they can adopt different weights. They proposed that each unit should be allowed to adopt a set of weights that are favourable to them in comparison to the other units. The DEA technique overcomes this problem, where units can relatively value inputs or outputs differently, or where there is a high uncertainty or disagreement over the value of some inputs or outputs by allowing each DMU to choose its own set of appropriate weights. By doing this, the DMU can obtain an efficiency rating due to its ability to minimize inputs.

Assuming there are K inputs and M outputs for each N firm. For the firm they are represented by the column vectors x_i and y_i respectively. The $K \times N$ input matrix X and $M \times N$ output matrix Y represent the data for all N firms. Each firm can measure all outputs over inputs in the form of ratios as $\frac{u' y_i}{v' x_i}$ where u is a $M \times 1$ vector of output weights and v is a $K \times 1$ vector is input weights. As such, the following mathematical programming is used to solve the optimal weight:

$$\min_{\theta,\lambda} \quad \theta$$

subject to

$$\begin{aligned} -y_i + Y\lambda &\geq 0 \\ \theta x_i - X\lambda &\geq 0 \\ \lambda &\geq 0 \end{aligned} \qquad (4)$$

where θ is a scalar and λ is a $N \times 1$ vector of constant.

The objective of the linear program is to find an optimal set of weights denoted by λ that satisfy the *K* x *i* constraints and give an efficiency score denoted by $0 \leq \theta_k \geq 1$. The magnitude of the weights gives information about relevant benchmarks for each inefficient DMU. That is, the weights taking on positive values form the set of potential benchmarks for the inefficient DMU in question. The DEA model provides the solution as it determines the appropriate benchmarks for the inefficient DMU rather than an exogenous source such as an average.

This envelopment form involves fewer constraints than the multiplier form $(k + M < N + 1)$, and hence is generally the preferred form to solve. In this regard, the DEA Excel Solver developed by Zhu (2003) was used to solve the following Slack model:

$$\begin{aligned} s_i^- &= \theta^* x_{i0} - \sum_{j=1}^{n} \lambda_j x_{ij} \qquad i = 1,2....m \\ s_r^+ &= \sum_{j=1}^{n} \lambda_j y_{rj} - y_{r0} \qquad r = 1,2....s \end{aligned} \qquad (5)$$

where s_i^- and s_r^+ represent input and output slacks respectively,

A DMU is efficient if and only if $\theta^* = 1$ and $s_i^- = s_r^+ = 0$ for all i and r, and a DMU is weakly efficient if $\theta^* = 1$ and $s_i^- \neq 0$ and/or $s_r^+ \neq 0$

Whenever we have mix inefficiency the input slack s_i^- shows an exceeding amount of input that cause inefficiency in comparison to the related reference set for that DMU. The output slack s_r^+ shows the shortfall amount of output that causes inefficiency. In order to make DMU_0 efficient we should decrease its inputs (X_0) to X_0^* which is the optimal input to make DMU_o efficient and its output (Y_0) also should increase to Y_0^*.

4. The Findings

This study first examined the most efficient year(s) and used that as a benchmark to judge the level of efficiency in every other year. Each year's financial results for each of the firms are considered as a separate DMU. If the DMU is technically efficient, the efficiency ratings equals 1 and the ratings will be less than 1 if the DMU is relatively inefficient.

Boussofiane et al. (1997) used both constant returns to scale (CRS) and variable returns to scale (VRS) model in UK privatization and found, except two firms (out of eleven), the results were similar irrespective of whether constant or variable returns was assumed . However, this depends if the variable returns to scale assumption is invoked. Smith (1993) demonstrates that the inappropriate use of the VRS assumption can lead to widely inflated efficiency estimates when the sample size is small, which is the present case. As a result, Boussofiane et al. (1997) attached more weight on the CRS DEA model. This study followed similar approach.

Technical Efficiency Scores of Firms

The efficiency scores three years before and three years after privatization were averaged to determine the effect of privatization on efficiency. The average technical efficiency scores of the 21 firms calculated from 2000 to 2008 before and after privatization are provided in Table 1. The change in efficiency is shown in the last column of Table 1 where positive value is indicates improvement, while a negative value indicates deterioration. The average efficiency rating before privatization was 49.5 per cent and improved to 62.3 per cent after privatization. The increase of 12.8 per cent implies that on average there is minor improvement in technical efficiency of firms after privatization.

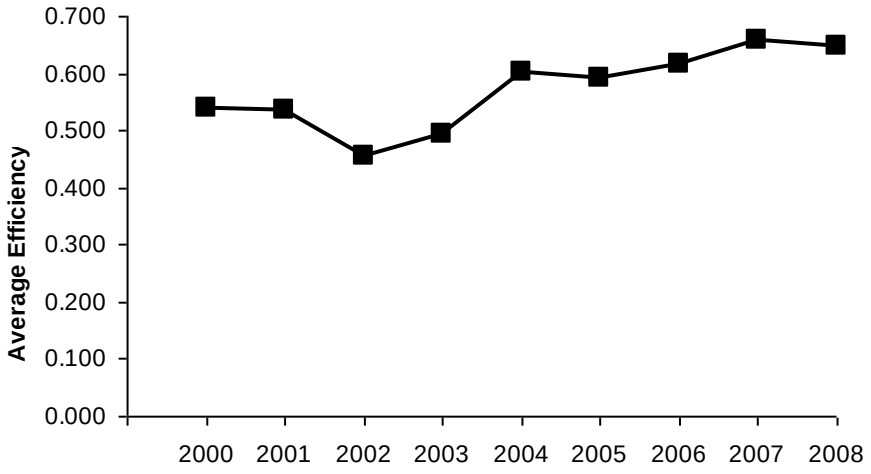
Table 1: Average Efficiency Scores of Firms

No.	Firm	Average efficiency before	Average efficiency after	Change in efficiency (before-after)
1	Misurata Textile Firm	0.471	0.932	0.461
2	Benghazi Textile Firm	0.485	0.640	0.154
3	Janzur Textile Firm	0.365	0.323	-0.042
4	Bani Walid Textile Firm	0.447	0.734	0.287
5	Janzur firm for Bandages and Cotton	0.429	0.627	0.198
6	Derna firm for Textile and Cloths	0.227	0.526	0.299
7	Misurata Furniture Firm	0.275	0.335	0.060
8	Benghazi Furniture Firm	0.366	0.803	0.437
9	Derna Furniture Firm	0.580	0.555	-0.025
10	Al-Sawni Furniture Firm	0.397	0.587	0.191
11	Arab Firm for Drinks Industry	0.905	0.928	0.023
12	Zamzam Firm for Soft Drinks	0.946	0.759	-0.187
13	Abo-Atni Firm for Soft Drinks	0.503	0.995	0.492
14	Bengashear Firm for Drinking Water Industry	0.517	0.558	0.041
15	Misurata Biscuit and Cake Firm	0.561	0.384	-0.177
16	Tripoli Biscuit and Cake Firm	0.394	0.618	0.223
17	Al-Mahari Firm for Food Industries	0.495	0.449	-0.046
18	Al-Mansorah Firm for Food Industries	0.643	0.931	0.287
19	Al-Mamorah Firm for Food Industries	0.431	0.378	-0.053
20	Cooperation Firm for Food Industries	0.309	0.336	0.027
21	Al-Bida Furniture Firm	0.648	0.682	0.035
	Average Efficiency	0.495	0.623	0.128

Figure 1 depicts technical efficiency scores for four years before privatization and four years after privatization. The figure shows that, except for three periods, technical efficiency increased annually. Initially, technical efficiency reduced slightly, but thereafter it was increasing annually specifically after a sharp decline in technical efficiency in 2001, 2002 and 2003. We could say that efficiency was much affected during the sanction period, imposed on Libya over the years 1992-2003. The graph shows an upward trend meaning that technical efficiency was increasing year by year indicating that technical efficiency improved after privatization. The highest technical efficiency score was achieved in 2007 at 65.9 per cent, while the worst score was 45.5 per cent achieved in 2002.

Figure 1: Technical Efficiency Scores of All Firms

Year	All Firms
2000	0.538
2001	0.535
2002	0.455
2003	0.495
2004	0.603
2005	0.593
2006	0.618
2007	0.659
2008	0.647



To test whether the increase was statistically significant, the Mann-Whitney U test was applied. The Mann-Whitney U test is a non-parametric counterpart of the t-test that is used to compare means. As the study used the non-parametric analysis, the Mann-Whitney U test is appropriate for this study. As shown in Table 2, overall the difference in efficiency before and after privatization was 0.128, a change that is in the positive direction. However, in the Mann-Whitney U test, the p-value was 0.08, which was more than 0.05 (i.e., at 95 per cent confidence level). Thus, there was no significant difference in the average efficiency measures before and after privatization. This means that the increase in technical efficiency of 12.8 per cent after privatization was not significant.

Table 2: Results of Mann-Whitney U Test of All Firms (Technical Efficiency)

Average Efficiency	Mean before privatization	Mean after privatization	Mean Increase/ Decrease	p-value
All firms	0.495	0.623	0.128	0.080

Note: This table shows the mean technical efficiency scores and Mann-Whitney U test results before and after privatization of all firms.

Technical Efficiency by Ownership Structure

In this section, technical efficiency of the fully privatized firms and firms with state government control are examined separately. The efficiency scores before and after privatization was averaged to determine the effect of privatization on efficiency. This section aims to examine if ownership structure had any influence in determining the level of technical efficiency.

Technical Efficiency Scores of State Owned Firms

The average technical efficiency scores of the 7 state owned firms 3 years before and 3 years after privatization, are provided in Table 3. The change in efficiency is shown in the last column of Table 3. Though change values are positive, 5 firms out of 7 showed positive performance meaning that 57.1 per cent of firms have improved technical efficiency after privatization. The average efficiency rating before privatization was 49.6 per cent and improved to 59.2 per cent after privatization. Janzur Textile Firm, in

particular, had the lowest efficiency score before and after privatization of 0.36 and 0.32 respectively. Zamzam Firm for Soft Drinks scored the highest efficiency score before privatization (0.94) and Benghazi Furniture Firm scored the highest efficiency score after privatization (0.80). This indicates that all firms were operating inefficiently pre-and post privatization, which means that all the firms faced difficulties in using their own resources efficiently.

Table 3: Average Efficiency Scores of State Owned Firms

No.	Firm	Ave efficiency Before	Average efficiency after	Change in efficiency (before-after)
1	Janzur Textile Firm	0.365	0.323	-0.042
2	Bani Walid Textile Firm	0.447	0.734	0.287
3	Benghazi Furniture Firm	0.366	0.803	0.437
4	Al-Sawni Furniture Firm	0.397	0.587	0.191
5	Zamzam Firm for Soft Drinks	0.946	0.759	-0.187
6	Bengashear Firm for Drinking Water Industry	0.517	0.558	0.041
7	Al-Mamorah Firm for Food Industries	0.431	0.378	-0.053
	Average Efficiency	0.496	0.592	0.096

The results of the Mann-Whitney U test for differences in efficiency scores before and after privatization for state owned firms are provided in Table 4. The p-value of the test was 0.383, which was more than 0.05. Thus, there was no significant difference in the average efficiency scores before and after privatization meaning that the increase of 9.36 per cent in technical efficiency was not significant.

Table 4: Results of Mann-Whitney U Test of State Owned Firms

Average Efficiency	Mean before Privatization	Mean after privatization	Mean Increase/ Decrease	p-value
State owned firms	0.496	0.592	0.096	0.383

Note: This table shows the mean technical efficiency scores and Mann-Whitney U test results for state owned firms, before and after privatization.

Technical Efficiency Scores of Privatized Firms

The average technical efficiency scores of the 14 fully privatized firms 3 years before and 3 years after privatization are provided in Table 5. The change in efficiency is shown in the last column of Table 5. Though most of the change values were positive, the efficiency scores prior to privatization was 49.1 per cent and increased to 64.5 per cent after privatization, indicating an increase in technical efficiency of 15.3 per cent. A closer examination explains that out of 14 firms, only 3 firms, that is, Derna Furniture firm, Misurata Biscuit and Cake firm and Al-Mahari firm for Food Industries show a decline in technical efficiency, meaning that 78.5 per cent of firms showed increase in technical efficiency. However, these results indicated that these firms had slacks in not using their resources efficiently to produce the same level of outputs.

The findings show that the average technical efficiency score was 0.49 before privatization where 6 firms were operating above the average and 8 were operating below it. This means that 42.9 per cent of the firms operating above the average and 57.1 per cent of the firms operating below it. As well, the findings show that none of the firms scored full efficiency (i.e., TE = 1.00). On the other hand, the average technical

efficiency score was 0.64 after privatization indicating that 5 firms (35.7 per cent of the firms) were operating above the average and 9 firms (64.4 per cent of the firms) were operating below the average. However, none of the firms scored full efficiency (TE = 1.00) after privatization. Based on the statistical tests, none of the changes were significant at the 95 per cent confidence level.

Table 5: Average Efficiency Scores of Privatized Firms

No.	Firm	Ave efficiency before	Ave efficiency after	Change in efficiency (before-after)
1	Misurata Textile Firm	0.471	0.932	0.461
2	Benghazi Textile Firm	0.485	0.640	0.154
3	Janzur Firm for Bandages and Cotton	0.429	0.627	0.198
4	Derna Firm for Textile and Cloths	0.227	0.526	0.299
5	Misurata Furniture Firm	0.275	0.335	0.060
6	Derna Furniture Firm	0.580	0.555	-0.025
7	Arab Firm for Drinks Industry	0.905	0.928	0.023
8	Abo-Atni Firm for Soft Drinks	0.503	0.995	0.492
9	Misurata Biscuit and Cake Firm	0.561	0.384	-0.177
10	Tripoli Biscuit and Cake Firm	0.394	0.618	0.223
11	Al-Mahari Firm for Food Industries	0.495	0.449	-0.046
12	Al-Mansorah Firm for Food Industries	0.643	0.931	0.287
13	Cooperation Firm for Food Industries	0.309	0.336	0.027
14	Al-Bida Furniture Firm	0.648	0.682	0.035
	Average Efficiency	0.491	0.645	0.153

The results of the Mann-Whitney U test for differences in efficiency scores before and after privatization of fully privatized firms are provided in Table 6. The p-value of the test was 0.178, which was more than 0.05. Thus, there was no significant difference in the average efficiency scores, meaning that the increase of 15.3 per cent in technical efficiency was not significant.

Table 6: Results of Mann-Whitney U Test of Fully Privatized Firms

Average Efficiency	Mean before Privatization	Mean after privatization	Mean Increase/ Decrease	p-value
Fully privatized firms	0.491	0.645	0.153	0.178

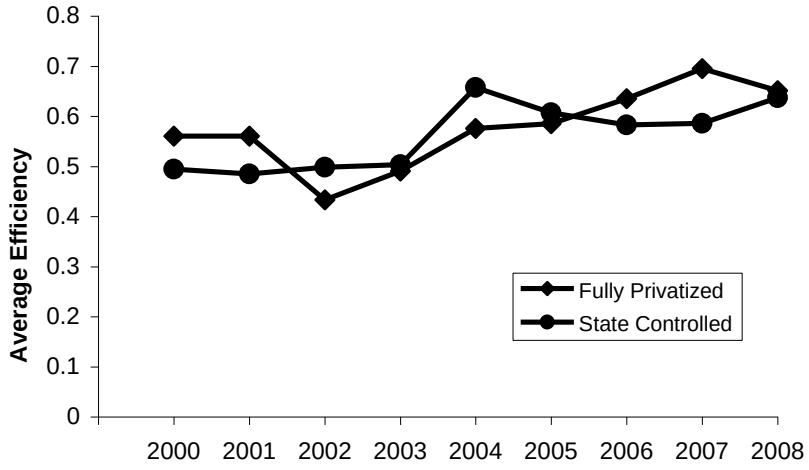
Note: This table shows the mean technical efficiency scores and results of the Mann-Whitney U test of fully privatized firms, before and after privatization.

Figure 2 shows the technical efficiency scores of two types of ownership structure (firms with state owned and full privatized firms). Comparing the results of the two groups, the highest technical efficiency score of 69.5 per cent was obtained by the fully privatized firms in 2007, while the lowest 43.3 per cent was obtained by fully privatized firms in 2002. The technical efficiency scores were unstable over the period of study, especially before privatization. The efficiency scores of fully privatized firms increased slightly after privatization, particularly in 2008. In relation to firms with state control the efficiency scores increased after privatization, but the scores were unstable in two years, that is, 2006 and 2007. The figure showed that the fully privatized firms were more efficient than firms with state control, after privatization. However, the overall results indicated that the increase for the both groups was not statistically significant. This might be due to inability for greater autonomy and exposure to competitive markets that created a

stronger sense of responsibility and greater commitment among the privatized firms to cut waste in order to improve performance. The non-significant result implies that the privatized firms are still on the learning curve.

Figure 2: Technical Efficiency Scores according to Ownership Structure

Year	Fully Privatized	State Controlled
2000	0.560	0.495
2001	0.560	0.485
2002	0.433	0.499
2003	0.491	0.504
2004	0.576	0.657
2005	0.585	0.607
2006	0.635	0.583
2007	0.695	0.586
2008	0.651	0.637



5. Summary and Conclusions

This study examined the technical efficiency scores of 21 Libyan manufacturing firms before and after privatization by using input-oriented Data Envelopment Analysis (DEA) technique. DEA is a linear programming technique used to generate technical efficiency scores of decision making units or firms. The findings showed that in terms of overall performance, there was little improvement in technical efficiency scores of all the firms after privatization. Even so, the improvement of 12.8 per cent was not significant in relation to ownership structure. The firms were divided into different ownership types. In the first group, firms with state control revealed that there was an improvement in technical efficiency of 9.6 per cent after privatization; however, this increase was not significant. Meanwhile fully privatized firms showed an improvement of 15.3 per cent in technical efficiency after privatization and likewise this improvement was not significant. This might be due to inability for greater autonomy and exposure to competitive markets. We had been made known that the primary purpose of the privatization processes in Libya was into getting the private owned firms to share the burden of the state owned firms, and to acquire WTO membership for international trading helping to generate income for the country. Hence there was no competitive pressure in order to sustain performance, implying that the fully privatized firms are still on the learning curve. Only when the local market is fully opened to foreign competition would there be a strong sense of responsibility and great commitment among firms to reduce waste and achieve optimal performance. For now, the results indicate that all the firms were operating inefficiently before and after privatization. This implies that all the firms were not planned for the privatization proper resulting in them experiencing difficulties in optimizing their own resources economically.

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