

## Performance Rating of Privatized and Non-Privatized Firms

### Using Data Envelopment Analysis Technique

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#### Abstract

This paper examined the technical efficiency of Libyan manufacturing firms over the 2000 to 2008 time period. The study used the Data Envelopment Analysis (DEA) technique to analyze production efficiency of firms before and after privatization. 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 there were no evidences to suggest that there are differences in efficiency levels of firms before and after privatization policy, and efficiency is a function of ownership structure.

**Keywords:** Libya, Data Envelopment Analysis, technical efficiency, ownership, privatization

#### 1. Introduction

One of the most significant economic phenomena of recent years has been the privatization of state-owned enterprises all over the world. While there are several possible reasons why privatization may be undertaken (Yarrow 1986), the main driver of this trend has been the search for an increase in efficiency of the firms involved (Megginson et al., 1994).

Libya, like many developing countries, has tried to implement a privatization strategy to overcome the problems of the public enterprise sector such as lack of incentives (e.g., competition) and control mechanisms (e.g., communications/reporting systems). The most important goal is to increase the efficiency of Libyan firms to facilitate the role of the private sector to stimulate economic growth and therefore able to increase the prosperity of the whole community (Moneer, 2005). Moreover, many researchers argue that more empirical research are needed to address the effect of privatization on performance efficiency, and factors affecting the privatization-efficiency relationship like political, transitional effects of privatization on efficiency, to name a few (Megginson and Netter, 2001, Loc et al., 2006). Most empirical studies analyzed the linkage between privatization and efficiency in developed countries. The results reported from these empirical studies may not hold true for developing countries, for reasons mainly due to political and organizational.

This study appears to be the first of its kind in offering a critical evaluation of the privatization policy in Libya in relation to firm performance. The focus on Libya is of interest for several reasons: firstly, the Libyan government has been willing to develop international links through the World Trade Organization (WTO), and its recent policies at encouraging workers and managers to engage in private sector activities; and secondly, the Libyan experience could provide new insights on the effectiveness of privatization and factors that contribute to its success. As there has been lack of empirical studies done for the North African continent, this paper attempts to measure the effect of privatization on one aspect of performance, which is efficiency, in a developing Arab country. Hence, this study specifically examines the effect of privatization on technical efficiency of the Libyan manufacturing sector.

## 2. Literature Review

Past studies have shown mixed results on the effect of privatization on efficiency (Megginson et al., 1994, Omran, 2004). Some reported that the performance of firms increases after privatization. In contrast, (Cabeza & Gomez, 2007, Bachiller, 2009, Akram, 2009) showed insignificant improvements after privatization. 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 is little attention paid to ownership structure and its effect on successful privatization.

(Chao--Chung 2006) measured the efficiency change at Chaughwa Telecom Company (CHT) in Taiwan pre and post-privatization using the Data Envelopment Analysis (DEA) technique. He used input-orientation modeling approach according to variable constant returns to scale (CRS) and return to scale (VRS) assumptions. He found that CHT's partial privatization has enhanced its own production efficiency significantly. However, the performance of the company pre-and post-privatization is inefficiency because the technical efficiency scores were less than one, computed with the CCR-DEA and BCC-DEA. (Okten and Arin 2006) tested the effects of privatization on productive and allocative (market) 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. The results on allocative efficiency, however, are dependent on changes in the competitive environment. While all plants seem to improve labor productivity through work force reductions, plants privatized to foreign buyers also increase their capital and investment significantly. Meanwhile, (Maiti 2007) examined some aspects of productivity and technical efficiency of Indian industrial firms at the microeconomic level, particularly textile industry, as a case study. He used the Translog Stochastic Frontier production function as a technique to estimate technical efficiency (TE) of firms. He found that the average TE varies between 68 percent and 84 percent across the period of study, and that individual TE varies with firm-specific characteristics such as size and age. Additionally, public sector firms are found to be relatively less efficient. As well, the researcher did not find evidence that older firms tend to be more efficient. This position being so despite postulated advantages of being more established, such as an older firm may have easier access to finance, smoothly functioning buyer-supplier linkages, and more experience; and counter arguments, such as young firms may have assets of later generations and a fresher workforce .Next, (Bachiller 2009) analyzed the efficiency gains achieved by five strategic Spanish firms privatized during the 1990s, which enjoy monopoly status in sectors like energy, telecommunications and air transport. The study compared the efficiency of these firms before and after privatization, applied the Data Envelopment Analysis (DEA) technique and Tobit analysis to analyze efficiency changes and to determine the effect of the ownership and board structure on technical efficiency respectively. 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. Therefore, the privatization process in Spain has not been appropriate to improve the performance. This means that privatization does not lead to improvements on efficiency as the agency and public choice theories asserted.

In another study, (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 the DEA and Stochastic Frontier Analysis (SFA) techniques to compute efficiency estimates, and the empirical results are discussed in terms of management perspective and mathematical analysis. From the management perspective, he suggests that airports should focus more on investment than human resources. In addition, the study found that inefficiency effects associated with the production functions of airports increased over the investigated period. From the perspective of mathematical analysis, the researcher determined that the deviations from the efficient frontiers of production functions are largely attributed to technical inefficiency. Finally, the empirical results also indicated that employing the discretion to adjust the scale size of the production function appears to improve efficiency.

### 3. 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 for 21 Libyan manufacturing firms over the period 2000-2008 was used to measure the technical efficiency pre-and post privatization. All the companies 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 for financial data was the source of data for the firms after privatization. To evaluate technical efficiency, the input values employed in this study are labor, capital and total assets. Labor is the annual total number of employees of the firm. The capital cost of each firm is calculated as value of depreciation plus a risk free rate of return on capital employed. The real rate of return is 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 are sales and net income. Sales are the total value of the sales. Net income is calculated as sales minus the expenses, interest expense and taxes.

#### 3.1 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:

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

If a firm produces 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 & Fieldhouse 1962). The aim of this technique is to define a frontier of most efficient decision making units (DMUs) and then to measure how far from the frontiers are the less efficient units. The relative efficiency can be measured as:

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

By using usual notations, this efficiency measure can be written

$$\text{Efficiency unit } j = \frac{u_1 y_{1j} + u_2 y_{2j} + \dots}{v_1 x_{1j} + v_2 x_{2j} + \dots} \quad (3)$$

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 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. They recognized 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 shows the most favorable light in comparison to the other units. The DEA technique overcomes this problem, where units can be properly 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 So that it can obtain an efficiency rating due to its ability minimize inputs.

Assume there are  $K$  inputs and  $M$  outputs for each  $N$  firm. For the firms 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. For each firm, can measure all outputs over inputs in the form of ratios as  $\frac{u \cdot y_i}{v \cdot x_i}$

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:

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

Subject to

$$- y_i + Y\lambda \geq 0 \quad (4)$$

$$\theta x_i - X\lambda \geq 0$$

$$\lambda \geq 0$$

Where  $\theta$  is a scalar and  $\lambda$  is a  $N \times 1$  vector of constant.

The objective of the linear program is to find an optimal set of weights denoted by  $\lambda$  that satisfy the  $K \times i$  constraints and give an efficiency score denoted by  $0 \leq \theta_k \leq 1$ . 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) is used to solve the following Slack model:

$$s_i^- = \theta^* x_{i0} - \sum_{j=1}^n \lambda_j x_{ij} \quad i = 1, 2, \dots, m$$

$$s_r^+ = \sum_{j=1}^n \lambda_j y_{rj} - y_{r0} \quad r = 1, 2, \dots, s \quad (5)$$

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<sub>0</sub> efficient we should decrease its inputs ( $X_0$ ) to  $X_0^*$  which is the optimal input to make DMU<sub>0</sub> efficient and its output ( $Y_0$ ) also should increase to  $Y_0^*$ :

#### 4. Findings

This paper first examines the most efficient year ( $s$ ) and uses 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.

(Bousofiane *et al.* 1997) used both constant returns to scale (CRS) and variable returns to scale (VRS) model in U.K privatization and found except two firms (out of eleven) the results were similar irrespective of whether constant or variable returns were assumed. However, this depends on if the variable returns to scale assumption is invoked. (Smith, 1993) demonstrates that the inappropriate use of this assumption can lead to widely inflated efficiency estimates when the sample size is small-which, is the present case. As a result (Bousofiane *et al.* 1997) attached more weight on CRS model. This paper follows the above approach. An efficiency assessment for each of the 21 firms is undertaken assuming constant returns to scale. The efficiency ratings can be carried out assuming variable returns to scale. However, this study considers only the former.

##### 4.1 Technical Efficiency of the Full Sample

The efficiency values three years before and three years after privatization were averaged to determine the effect of privatization on efficiency. The average technical efficiency scores for the 21 companies 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 indicates improvement, while a negative value indicates deterioration. The average efficiency rating before privatization was 49.5 percent and improved to 62.3 percent after privatization. The increase of 12.8 percent implies that on average there is minor improvement in technical efficiency of firms after privatization.

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 by the sanction imposed on Libya over the period 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 percent, while the worst score was 45.5 percent achieved in 2002.

To test whether the increase is statistically significant, the Mann-Whitney U test is applied. As shown in Table 2, overall the difference in efficiency before and after privatization was 0.128, a change in the positive direction. However, in Mann-Whitney U test, the p-value is 0.08, which is more than 0.05. Thus, there is no significant difference in the average efficiency values before and after privatization. This means that the increase in technical efficiency of 12.8 percent after privatization is not significant.

#### 4.2 Technical Efficiency by Ownership Structure

In this section, technical efficiency for the fully privatized firms and firms with state government control are studied separately. The efficiency values before and after privatization were averaged to determine the effect of privatization on efficiency. This section aims to examine if ownership type has any influence in determining the level of technical efficiency.

#### 4.3 Technical Efficiency of State-Owned Firms

The average technical efficiency for the 7 state controlled 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 1.3. Though change values are positive, 5 firms out of 7 show positive performance meaning that 57.1 percent of firms have improved technical efficiency after privatization. The average efficiency rating before privatization was 49.6 percent and improved to 59.2 percent after privatization. Janzur Textile Company scored the lowest efficiency score before and after privatization 0,36 and 0,32 respectively. Zamzam company for soft drinks scored the highest efficiency score before privatization (0,94) and Benghazi Furniture Company scored the highest efficiency score after privatization (0,80). This indicates that all firms are operating inefficiently pre-and post privatization, and all the firms face difficulties to use their own resources efficiently.

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

#### 4.4 Technical Efficiency of Private Firms

The average technical efficiency for 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 are positive, the efficiency rating prior to privatization was 49.1 percent and increased to 64.5 after privatization, indicating increase in technical efficiency of 15.3 percent. A closer observation explains that out of 14 firms, only 3 firms, Derna Furniture Company , Misurata Biscuit and Cake Company and Al-Mahari company for Food Industries show a decline in technical efficiency, meaning that 78.5 percent of firms show increase in technical efficiency. However, these results indicated that these firms have slacks in not using the resources efficiently to produce the same level of outputs.

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



Figure 2 shows technical efficiency scores of two types of ownership structure (firms with state government control and full privatized firms). Comparing the results of the two groups, the highest technical efficiency score 69.5 percent was obtained by the fully privatized firms in 2007 while the lowest 43.3 percent by the fully privatized firms in 2002. The technical efficiency levels were unstable over the period of study particularly before privatization. The efficiency of fully privatized firms increased slightly after privatization particularly in 2008. In terms of firms with state government control the efficiency increased after privatization, but it was unstable in two years in 2006 and 2007. Figure 2 shows that the fully privatized firms were more efficient than the firms with state government control after privatization, but the overall results indicated that the increase for both groups was not statistically significant. This result was not consistent with the theory. This may be due to inability for greater autonomy and exposure to competitive markets that would create a stronger sense of responsibility and greater commitment among firms to cut waste and improve performance.

## 5. Conclusion

This paper analyzed the technical efficiency of 21 Libyan manufacturing firms before and after privatization using the input-oriented Data Envelopment Analysis (DEA) technique. DEA is a linear programming technique used to get the technical efficiency scores of the decision making units or firms. The findings showed that in terms of overall performance, there was little improvement in technical efficiency of all firms after privatization. This improvement of 12.8 percent was not significant in terms of ownership. The firms were divided into different ownership types. In the first group, firms with state government control showed an improvement in technical efficiency of 9.6 percent after privatization; however, this increase was not significant. Meanwhile, the fully privatized firms showed an improvement of 15.3 percent in technical efficiency after privatization and this improvement was also not significant. These results were not consistent with the theory associated with performance and ownership. This may possibly be due to inability for greater autonomy and exposure to competitive markets. These two characteristics actually would create a strong sense of responsibility and great commitment among firms to reduce waste and improve performance. The results indicated that all the firms were operating inefficiently during pre-and post privatization period, and all the firms were experiencing difficulties in using their own resources efficiently that is, the resources were not used in an optimal and economical manner.

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Table 1. Average Efficiency Ratings (CRS) of All Firms (pooled years)



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

Table 1 illustrates the changes in technical efficiency before and after privatization for all firms. The results indicated that there is improvement in the technical efficiency after privatization, but the improvement is 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 companies      | 0.495                     | 0.623                    | 0.128                   | 0.080   |

Table 2 shows the mean technical efficiency results and Mann-Whitney U Test for before and after privatization for all firms.

Table 3 Average Efficiency Ratings (CRS) of State-Owned Firms

| No | Firm | Ave efficiency | Average efficiency | Change in efficiency |
|----|------|----------------|--------------------|----------------------|
|----|------|----------------|--------------------|----------------------|

|   |  | before | after | (before-after) |
|---|--|--------|-------|----------------|
| 1 | Janzur Textile Company                         | 0.365  | 0.323 | -0.042         |
| 2 | Bani Walid Textile Company                     | 0.447  | 0.734 | 0.287          |
| 3 | Benghazi Furniture Company                     | 0.366  | 0.803 | 0.437          |
| 4 | Al-Sawni Furniture Company                     | 0.397  | 0.587 | 0.191          |
| 5 | Zamzam company for Soft Drinks                 | 0.946  | 0.759 | -0.187         |
| 6 | Bengashear company for Drinking Water Industry | 0.517  | 0.558 | 0.041          |
| 7 | Al-Mamorah Company for Food Industries         | 0.431  | 0.378 | -0.053         |
|   | Average  | 0.496  | 0.592 | 0.096          |

Table 3 demonstrates the differences in the performance pre-and post privatization for State-Owned Firms. The average efficiency rating before privatization was 49.6 percent and improved to 59.2 percent after privatization. This indicates that all firms are operating inefficiently pre-and post privatization, and all the firms face difficulties to use their own resources efficiently.

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   |

Table 4 shows the mean technical efficiency score and Mann-Whitney U test results for state-owned firms, before and after privatization.

Table 5. Average Efficiency Ratings (CRS) of Full Privatized Firms

| No. | Company                                | Ave efficiency before | Ave efficiency after | Change in efficiency (before-after) |
|-----|--|-----------------------|----------------------|-------------------------------------|
| 1   | Misurata Textile Company               | 0.471                 | 0.932                | 0.461                               |
| 2   | Benghazi Textile Company               | 0.485                 | 0.640                | 0.154                               |
| 3   | Janzur company for Bandages and Cotton | 0.429                 | 0.627                | 0.198                               |
| 4   | Derna company for Textile and Cloths   | 0.227                 | 0.526                | 0.299                               |
| 5   | Misurata Furniture Company             | 0.275                 | 0.335                | 0.060                               |
| 6   | Derna Furniture Company                | 0.580                 | 0.555                | -0.025                              |
| 7   | Arab company for Drinks Industry       | 0.905                 | 0.928                | 0.023                               |
| 8   | Abo-Atni company for Soft Drinks       | 0.503                 | 0.995                | 0.492                               |
| 9   | Misurata Biscuit and Cake Company      | 0.561                 | 0.384                | -0.177                              |
| 10  | Tripoli Biscuit and Cake Company       | 0.394                 | 0.618                | 0.223                               |

|    |   |       |       |        |
|----|---|-------|-------|--------|
| 11 | Al-Mahari company for Food Industries   | 0.495 | 0.449 | -0.046 |
| 12 | Al-Mansorah Company for Food Industries | 0.643 | 0.931 | 0.287  |
| 13 | Cooperation Company for Food Industries | 0.309 | 0.336 | 0.027  |
| 14 | Al-Bida furniture company               | 0.648 | 0.682 | 0.035  |
|    | Average                                 | 0.491 | 0.645 | 0.153  |

Table 5 explains the change in efficiency for fully privatized firms before and after privatization. The efficiency rating prior to privatization was 49.1 percent and increased to 64.5 after privatization. However, these results indicated that these firms have slacks in not using the resources efficiently to produce the same level of outputs.

Table 6. Results of Mann-Whitney U Test of Full Privatized Firms

| Average Efficiency         | Mean Before Privatization | Mean After privatization | Mean Increase/ Decrease | p-value |
|----------------------------|---------------------------|--------------------------|-------------------------|---------|
| Fully privatized companies | 0.491                     | 0.645                    | 0.153                   | 0.178   |

Table 6 shows the mean technical efficiency scores and results and Mann-Whitney U Test of fully privatized firms, before and after privatization

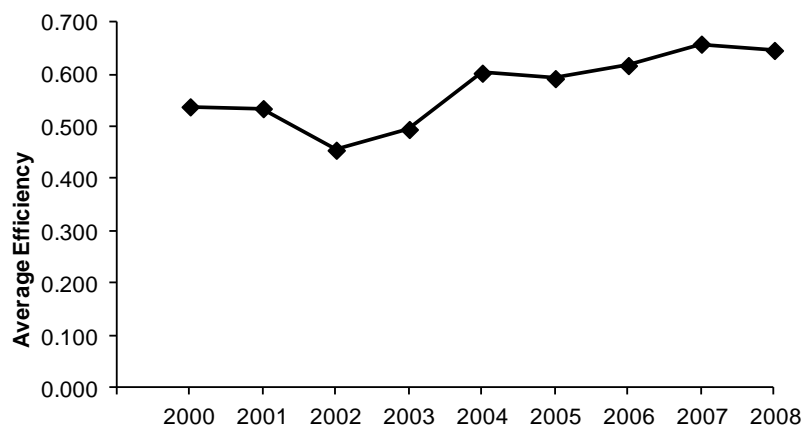


Figure 1. Technical Efficiency Scores of All Firms

Figure 1 represents technical efficiency scores before and after privatization. The figure shows that technical efficiency increased annually. Initially, technical efficiency reduced slightly. The graph shows an upward trend meaning that technical efficiency was increasing year by year indicating that technical efficiency improved after privatization.

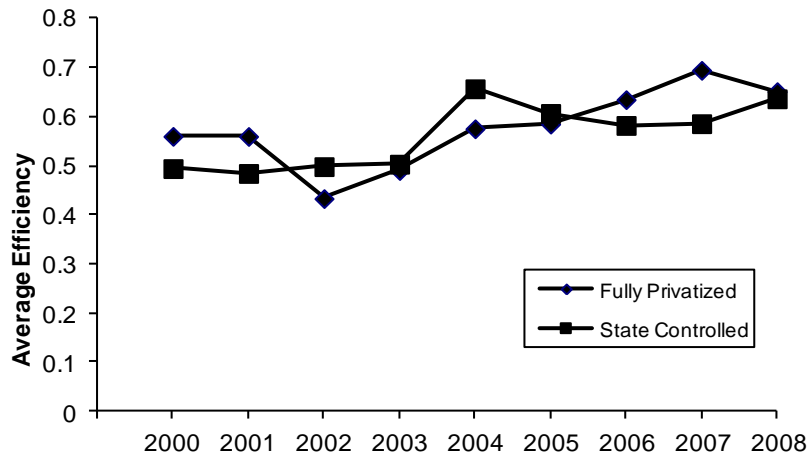


Figure 2. Technical Efficiency Scores According to Ownership Structure

Figure 2 compares the results of the two groups of ownership structure. the figure shows that the fully privatized firms are more efficient than the firms with state government control after privatization, but the overall results indicated that the increase for the both groups are not statistically significant.

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