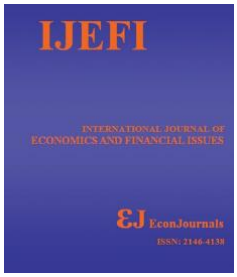

**International Journal of Economics and Financial Issues**

ISSN: 2146-4138

available at http: www.econjournals.com

**International Journal of Economics and Financial Issues, 2025, 15(6), 294-298.**

# Benchmarking the Financial Efficiency of Public Corporations in Mexico

**Jose Humberto Ablanedo-Rosas*, Allen J. Cutcher, Michael S. Garcia, William Conwell**

The University of Texas at El Paso, USA. *Email: jablanedorosas2@utep.edu

**Received:** 22 May 2025 **Accepted:** 21 September 2025 **DOI:** https://doi.org/10.32479/ijefi.21099

**ABSTRACT**

This research introduces a non-parametric approach, based on financial ratios, to assess the financial performance of public organizations. The approach utilizes financial ratios as outputs in an output-only Data Envelopment Analysis (DEA) model. The output-oriented DEA method estimates relative financial efficiency scores that are used to estimate efficiency densities via a kernel distribution with a normal optimal smoothing parameter. A kernel test of hypothesis is then used to perform financial performance comparisons between companies to assess the statistical significance of their performance differences. The proposed approach is tested when evaluating the financial efficiency of eight public Mexican corporations from 2018 to 2023. Hence, multiple heterogeneous financial ratios are combined into a single measure of efficiency, which allows ranking of the corporations' performance based on their financial ratios. Results confirm the usefulness of the proposed approach and provide valuable data-driven insights for decision makers.

**Keywords:** Financial Ratios, Data Envelopment Analysis, Public Companies, Kernel Distribution
**JEL Classifications:** C14, C67, L25

## 1. INTRODUCTION

International trade between regional partners has begun a paradigm shift away from globalization. Supply Chains are now being redirected from offshoring to nearshoring. Now more than ever, Mexico has growing importance as it trades with the United States, Mexico, and Canada trade bloc (USMC). Mexico's commercial partners have concerns about its corporations' financial health as they impact trade and economic stability. Historically, evaluating a corporation's financial health has been addressed through the analysis of financial ratios, which have proven to be efficient predictors of a corporation's financial state. This research paper expands on work initiated by Fernandez-Castro and Smith (1994) and recommends an approach for testing the statistical significance of financial performance differences between public corporations. A sample of eight Mexican public corporations is utilized to test the usefulness of this approach. Six relevant financial ratios were obtained for the period 2018-2023. Decision makers can use this financial performance evaluation approach to distinguish top performers and identify meaningful benchmarking opportunities.

## 2. LITERATURE REVIEW

The financial performance of public corporations has been extensively studied from different perspectives. This literature review focuses on recent research aligned with the use of financial ratios and non-parametric approaches such as DEA.

The use of financial ratios in DEA models presents a few challenges, such as difficulty in estimating output target values (Ablanedo-Rosas et al., 2010) and the presence of negative financial ratios (Mahla et al., 2020). Recently, Wanke et al. (2023) incorporated the case of undesirable financial output ratios in a DEA model under weak disposability. Furthermore, they implemented an Auto Regressive Moving Average model to project efficiency scores five years ahead. Rivera et al. (2022) presented a recent case in a Latin American country where they studied the financial impact of

the novel COVID-19 pandemic on Peruvian public corporations. They utilized financial ratios and a Malmquist Index Productivity to estimate the financial performance of corporations and inferred improvement opportunities. These research projects do not use hypothesis testing to validate the significance of their efficiency inferences, which is a major contribution of the research described in this paper.

The use of financial ratios and DEA has been prolific in studying banking institutions (Ngo and Le, 2019). Cedolin and Genevois (2019) studied the performance efficiency of ATMs, where they implemented a DEA approach as a substitute for the traditional use of financial ratios. The main focus was to assist banks in increasing the efficiency of their ATM systems. They attained good results; however, they recommended testing the robustness of the different approaches that can be utilized, which can be achieved by following the kernel test method proposed in this research. Horváthová and Mokrišová (2020), and similarly, Nurcan and Deniz Köksal (2021) used financial ratios, a logistic regression model, and DEA to estimate the financial success or failure of public firms in Turkey. Logistic regression was utilized to confirm the results generated by DEA, but no statistical significance between the two approaches was estimated.

This research studies the financial performance of Mexican public corporations. Similar scenarios have been explored before. Mohammadian and Rezaee (2020) utilized financial ratios and the Hicks-Moorsteen productivity index to investigate the performance of public pharmaceutical companies in Tehran. They determined the optimal values of input consumption and output production, but no hypothesis testing was conducted.

A noticeable exception to statistical testing is the research of Exenberger and Kavčáková (2020) where the Mann Whitney U test and the Li test were implemented. However, they were implemented to identify statistically significant financial indicators to evaluate the financial health of companies. A second exception is the study of Horváthová and Mokrišová (2020), who conducted statistical tests to compare firms' financial performance estimated by a logit model and DEA. In conclusion, the literature review confirms the lack of a methodology to estimate the statistical significance of differences when performing financial efficiency comparisons between pairs of organizations. This research fills that gap and proposes a non-parametric methodology based on a kernel distribution to assess the aforementioned statistical significance.

## 3. OUTPUT ORIENTED DATA ENVELOPMENT ANALYSIS

Charnes et al. (1978) introduced the constant returns to scale DEA model, which assumes a linear relationship between inputs and outputs. Six years later, this basic DEA model was expanded, and the variable returns to scale assumption variant of the basic DEA model was introduced by Banker et al. (1984). As a non-parametric approach, DEA makes no assumptions about data distribution. Decision Making Units (DMUs) are the units of analysis and each DMU consumes inputs to generate outputs. Hence, DEA operates as a production function where resources are consumed to "produce" an outcome. The ratio between a weighted combination of outputs and a weighted combination of inputs defines the DMU's relative efficiency. This relative efficiency can be used to guide benchmarking efforts and, by definition, ranges within the interval [0,1]. An efficient DMU attains an efficiency score of "1", while any score less than one corresponds to an inefficient DMU. DEA has been applied in all types of scenarios. For example, container ports (Ablanedo-Rosas et al., 2010), elementary schools (Morgan et al., 2010), countries (Abdelfattah et al., 2011), computational algorithms (Ablanedo-Rosas and Rego, 2018), small food/drink producers (Kedžo and Lukač, 2021), banks (Wanke et al., 2023; Ravanos and Karagiannis, 2024), hotels (Ablanedo-Rosas et al., 2023), and movie theaters (Ablanedo-Rosas et al., 2024), among others.

Fernandez-Castro and Smith (1994) proposed an output oriented model to assess the financial efficiency of corporations. The model uses outputs only and considers different financial ratios as outputs. Al-Shammari and Salimi (1998) used the model to estimate the efficiency of Jordanian banks, while Halkos and Salamouris (2004; 2007) studied Greek Banks. This research expands the approach by adding a kernel distribution estimation and a kernel test to determine statistical significance when comparing the financial efficiency performance between corporations. The approach is tested with Mexican public corporations in the areas of telecommunication, retailing, banking, and the airline industry.

DEA is a linear programming formulation where $n$ DMUs consume inputs to generate outputs. In this case, the formulation considers outputs only, which have been expressed as ratios. Hence, the basic framework of the DEA approach is preserved. Each $DMU_i$ ($i$=1,…,$n$) produces $q$ outputs $y_{ij}$ ($j$=1,…,$q$). Let $E_0$ be the efficiency of $DMU_i$ and $c_i$ the decision variable associated with $DMU_i$. The outputs only model is formulated as follows:

Max $E_0$

Subject to

$$\sum_{i=1}^{n} c_i = 1$$

$$\sum_{i=1}^{n} y_{ij} c_i \geq y_{i0} E_0 \qquad j = 1,\ldots,q$$

$$E_0 \geq 0,\ c_i \geq 0,\ \forall\ i$$

The linear programming formulation must be solved $n$ times, and each solution $E_i$ corresponds to the relative efficiency of $DMU_i$ ($i$ = 1,…, $n$). In the case analyzed in this research, each $DMU_i$ has six efficiency scores, one for each year in the period 2018-2023.

## 4. EMPIRICAL ANALYSIS

This research utilizes data envelopment analysis and financial ratios to benchmark eight public corporations in Mexico during

the period 2018-2023. The method is based on a DEA approach where only outputs are considered. Several financial ratios describe a company's financial performance. This research adopts the same financial ratios discussed in Ablanedo-Rosas et al. (2010): return on equity (ROE), total asset turnover (TAT), accounts receivable turnover (ART), inventory turnover (IT), current ratio (CR), and quick ratio (QR).

Table 1 shows the average of the financial ratios during the 2018-2023 period for each company. The 'Return on equity' column suggests that all the companies except BCCL and AC have a good return on equity ratio (>10%), which implies profitable companies. The 'Total asset turnover' column shows Walmex, GRBM, GRUMAB, and CMZO with total asset turnover ratios greater than one, signaling that these companies efficiently used their assets to generate sales or revenues.

Walmex was by far the best company collecting its accounts receivable, while GRBM, AC, and AMXB effectively managed their inventories with a turnover greater than 10. All companies but GRBM and AMXB have good liquidity (CR > 1). OMAB, CMZO, and BCCL showed solvency as well (QR > 1), which places them in a good position to pay their liabilities. This heterogeneous set of characteristics makes it difficult to differentiate financially efficient performers. Hence, DEA is used as a tool to estimate companies' financial efficiency. The outputs only model utilized by Ablanedo-Rosas et al. (2010) is implemented next.

**Table 1: Average financial ratios for the period 2018-2023**

| Company | ROE | TAT | ART | IT | CR | QR |
|---|---|---|---|---|---|---|
| Walmex | 0.2383 | 2.0052 | 348.6232 | 7.6024 | 1.0353 | 0.3226 |
| GRBM | 0.1700 | 1.1170 | 1.0213 | 14.0752 | 0.7259 | 0.5844 |
| OMAB | 0.3413 | 0.4825 | 10.1496 | 0.1062 | 2.1468 | 1.4973 |
| GRUMAB | 0.2136 | 1.2917 | 10.3068 | 4.4136 | 1.8576 | 0.8591 |
| CMZO | 0.4294 | 1.1804 | 11.9293 | 6.7861 | 2.9271 | 2.4123 |
| BCCL | 0.0902 | 0.4480 | 3.7193 | 1.4231 | 3.9018 | 2.2204 |
| AC | 0.0856 | 0.7468 | 19.8271 | 11.2467 | 1.4266 | 0.9978 |
| AMXB | 0.1020 | 0.2666 | 5.6499 | 14.1978 | 0.7056 | 0.4392 |

The efficiency scores are presented in Table 2. A simple inspection of the scores suggests that Walmex is a top performer with the highest frequency of scores "one", followed by CMZO. Alternatively, GRUMAB and AC look like low performers with no "one" scores at all. However, the range of efficiency variation is small, and the immediate question that arises is whether the slight differences in efficiency scores are statistically significant. Estimating the efficiency distribution helps perform a robust comparison between companies' performance. A kernel distribution, with a normal optimal smoothing parameter, is utilized to obtain the efficiency distributions, and the results are depicted in Figure 1.

Figure 1 depicts additional details of financial performance during the period of study. For example, Walmex and GRUMAB clearly show unimodal behavior, while BCCL and OMAB show multimodal behavior. In terms of performance, BCCL shows an apparent lower performance than the rest of the companies. Hence, it is worthwhile to assess the significance of efficiency differences.

Pairs of companies are used to conduct a kernel hypothesis test, with 28 different pair combinations. The null hypothesis is that the efficiency distributions are equal. Figure 2 shows a kernel test for the first pair, Walmex-CMZO. The null hypothesis is that Walmex's efficiency distribution equals CMZO's efficiency distribution. The shaded area is the confidence interval. The P-value of the kernel test is 0.03, so the test rejects the null hypothesis at the 0.05 significance level, and the efficiency distributions are statistically different.

**Table 2: Efficiency scores for the period 2018–2023**

| Year | Walmex | GRBM | OMAB | GRUMAB | CMZO | BCCL | AC | AMXB |
|---|---|---|---|---|---|---|---|---|
| 2018 | 1.0000 | 0.9392 | 0.9172 | 0.7217 | 1.0000 | 1.0000 | 0.8666 | 0.8938 |
| 2019 | 0.9775 | 1.0000 | 1.0000 | 0.7975 | 0.9213 | 0.8142 | 0.8664 | 0.8890 |
| 2020 | 0.9975 | 0.9831 | 0.2965 | 0.7884 | 0.9542 | 0.6828 | 0.8612 | 0.7746 |
| 2021 | 1.0000 | 0.9172 | 0.6476 | 0.7851 | 1.0000 | 0.6098 | 0.8618 | 1.0000 |
| 2022 | 1.0000 | 1.0000 | 0.8349 | 0.8304 | 0.9146 | 0.5436 | 0.8370 | 0.8381 |
| 2023 | 1.0000 | 0.2965 | 1.0000 | 0.8444 | 1.0000 | 0.6215 | 0.7858 | 0.8022 |

**Figure 1:** Kernel estimation of efficiency distributions

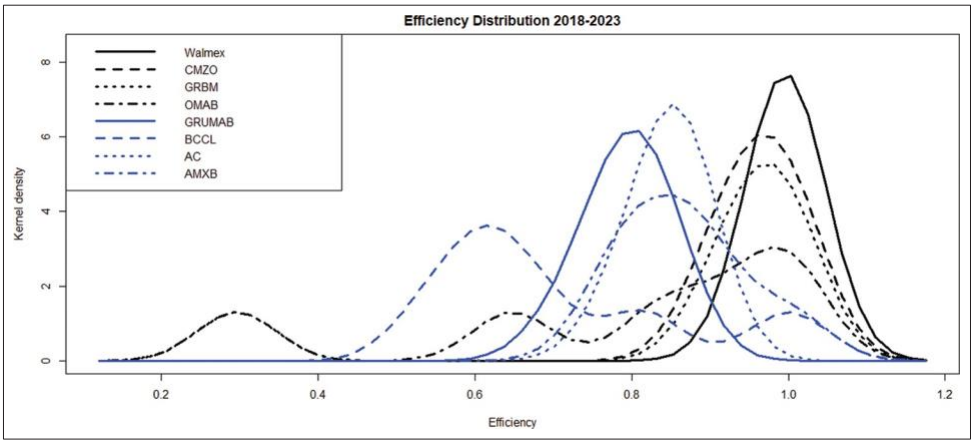

**Figure 2:** Kernel hypothesis test for pair Walmex-CMZO

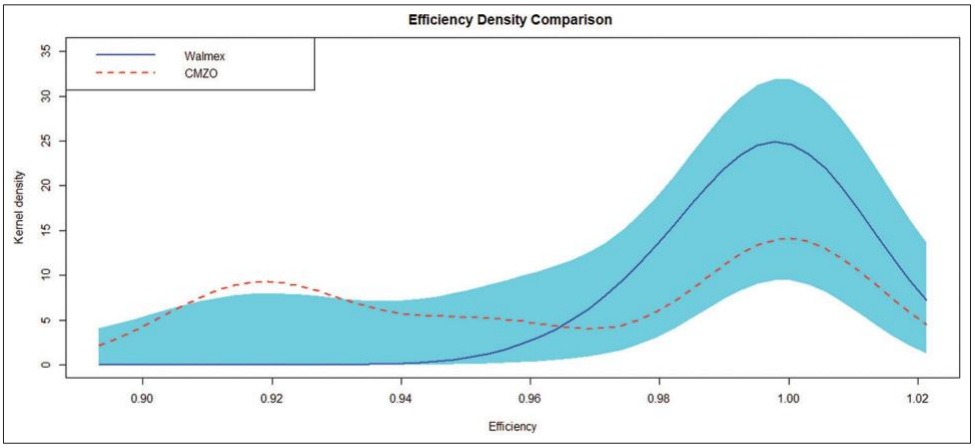


**Table 3: Efficiency scores comparisons for the period 2018-2023**

| Company | CMZO | GRBM | OMAB | GRUMAB | BCCL | AC | AMXB |
|---|---|---|---|---|---|---|---|
| Walmex | 0.03 | 0.04 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 |
| CMZO | | **0.93*** | **0.11*** | 0.00 | 0.01 | 0.00 | 0.01 |
| GRBM | | | **0.41*** | 0.00 | 0.02 | 0.00 | 0.03 |
| OMAB | | | | 0.02 | **0.11*** | 0.01 | **0.24*** |
| GRUMAB | | | | | 0.01 | 0.02 | **0.17*** |
| BCCL | | | | | | 0.00 | 0.01 |
| AC | | | | | | | **0.26*** |

* p-values ≥ 0.10 indicated in bold font

Table 3 shows the P-values for all comparison pairs. There are 7 out of 28 cases (25%) where the test failed to reject the null hypothesis. Hence, the kernel tests suggest that GRBM-CMZO, OMAB-CMZO, OMAB-GRBM, BCCL-OMAB, AMXB-OMAB, AMXB-GRUMAB, and AMXB-AC have similar efficiency distributions.

The P-values, from Table 3, reveal just one corporation whose financial performance is statistically different from the rest of them, Walmex, which is also the corporation with the largest number of efficient scores (Table 2). Hence, Walmex is the most appropriate candidate for benchmarking for best practice purposes. Similarly, the two corporations with no efficient score at all are GRUMAB and AC (Table 2). Table 3 shows that GRUMAB and AC have 6 out of 7 comparisons with P-value <0.05, which suggests that their low financial efficiency is significantly different from the rest of the corporations. Hence, GRUMAB and AC are in need of improving their financial performance. A recommended course of action is to benchmark best practices against identified top performers.

## 5. CONCLUSION

The proposed approach, which combines DEA and kernel distribution, is appropriate for benchmarking the financial performance of corporations and facilitates defining the statistical significance of efficiency pairs comparison. The combination of these two non-parametric approaches provides financial performance discrimination that is otherwise difficult to achieve. Furthermore, the non-parametric nature of the mixed approach permits its implementation in diverse scenarios with other kinds of ratios. Immediate future extension of this research includes using a bootstrap DEA model and the Simar & Zelenyuk (2006) test to estimate the significance of the financial efficiency comparisons. In addition, the output target values to attain efficiency will be estimated to provide better insights to decision-makers. Another exciting opportunity is the evaluation of machine learning algorithms to boost financial performance estimation (Iparraguirre-Villanueva and Cabanillas-Carbonell, 2024).

## REFERENCES

Abdelfattah, B.M., Ablanedo-Rosas, J.H., Gemoets, L.A. (2011), Developing country efficiency assessment by means of a comprehensive model based on data envelopment analysis. International Journal of Society Systems Science, 3(1-2), 58-80.

Ablanedo-Rosas, J.H., Cortez, Y.M., Arslan, F. (2024), Measuring efficiency in the movie theater industry: A bootstrap data envelopment analysis approach. Journal of Quality Assurance in Hospitality and Tourism, 25(1), 119-152.

Ablanedo-Rosas, J.H., Gao, H., Zheng, X., Alidaee, B., Wang, H. (2010), A study of the relative efficiency of Chinese ports: A financial ratio-based data envelopment analysis approach. Expert Systems, 27(5), 349-362.

Ablanedo-Rosas, J.H., Rego, C. (2018), Assessing algorithmic performance by frontier analysis: A DEA approach. International Journal of Applied Metaheuristic Computing, 9(1), 78-94.

Ablanedo-Rosas, J.H., Rubio, I., Chen, J., Ruiz-Torres, A.J. (2023), COVID-19 impact on the operational efficiency of a downtown hotel. Anatolia, 34(2), 130-143.

Al-Shammari, M. Salimi, A. (1998), The operating efficiency of banks: A nonparametric methodology. Logistics Information Management, 11, 5-17.

Banker, R.D., Charnes, A., Cooper, W.W. (1984), Some models for

estimating technical and scale inefficiencies in data envelopment analysis. Management Science, 30, 1078-1092.
Cedolin, M., Genevois, M.E. (2019), District performance of the ATMs by alternative DEA techniques. In: 2019 3rd International Conference on Data Science and Business Analytics (ICDSBA). United States: IEEE, p61-64.
Charnes, A., Cooper, W.W., Rhodes, E. (1978), Measuring the efficiency of decision making units. European Journal of Operational Research, 2(6), 429-444.
Exenberger, E., Kavčáková, M. (2020), Evaluation of financial health of companies through data envelopment analysis: Selection of variables for the DEA model in R. In: Proceedings of Economics and Finance Conferences (No. 10913067). London: International Institute of Social and Economic Sciences.
Fernandez-Castro, A.S., Smith, P.C. (1994), Towards a general non-parametric model of corporate performance. OMEGA, 22, 237-249.
Halkos, G., Salamouris, D. (2004), Efficiency measurement of the Greek commercial banks with the use of financial ratios: A data envelopment analysis approach. Management Accounting Research, 15, 201-224.
Halkos, G., Salamouris, D. (2007), Efficiency Measures of the Greek Banking Sector: A Non-Parametric Approach for the Period 1997-1999. Available from: https://www.com/mpra.ub.uni/muenchen.de/2858
Horváthová, J., Mokrišová, M. (2020), Comparison of the results of a data envelopment analysis model and logit model in assessing business financial health. Information, 11(3), 160.
Iparraguirre-Villanueva, O., Cabanillas-Carbonell, M. (2024), Predicting business bankruptcy: A comparative analysis with machine learning models. Journal of Open Innovation Technology, Market and Complexity, 10(3), 100375.
Kedžo, M.G., Lukač, Z. (2021), The financial efficiency of small food and drink producers across selected European Union countries using data envelopment analysis. European Journal of Operational Research, 291(2), 586-600.
Mahla, D., Agarwal, S., Amin, G.R., Mathur, T. (2023), An inverse data envelopment analysis model to consider ratio data and preferences of decision-makers. IMA Journal of Management Mathematics, 34(3), 441-464.
Mohammadian, I., Rezaee, M.J. (2020), A new decomposition and interpretation of hicks-moorsteen productivity index for analysis of stock exchange companies: Case study on pharmaceutical industry. Socio Economic Planning Sciences, 69, 100674.
Morgan, C., Ablanedo-Rosas, J.H., Gao, H. (2010), An efficiency study of Urban public elementary schools using data envelopment analysis. International Journal of Management in Education, 4(2), 146-158.
Ngo, T., Le, T. (2019), Capital market development and bank efficiency: A cross-country analysis. International Journal of Managerial Finance, 15(4), 478-491.
Nurcan, E., Deniz Köksal, C. (2021), Determination of financial failure indicators by gray relational analysis and application of data envelopment analysis and logistic regression analysis in BIST 100 Index. Interdisciplinary Journal of Management Studies (Formerly known as Iranian Journal of Management Studies), 14(1), 163-187.
Ravanos, P., Karagiannis, G. (2024), On value efficiency analysis and cone-ratio data envelopment analysis models. Journal of Productivity Analysis, 63, 49-68.
Rivera, L.S., Origuela, N.N., Santivañez, G.Q. (2022), Analysis of the financial efficiency of companies in the industrial sector during COVID-19: Case study in Peru. In: 2022 IEEE World AI IoT Congress (AIIoT). United States: IEEE, p59-64.
Simar, L., Zelenyuk, V. (2006), On testing equality of distributions of technical efficiency scores. Econometric Reviews, 25(4), 497-522.
Wanke, P., Rojas, F., Tan, Y., Moreira, J. (2023), Temporal dependence and bank efficiency drivers in OECD: A stochastic DEA-ratio approach based on generalized auto-regressive moving averages. Expert Systems with Applications, 214, 119120.