Quarterly Journal of Quantitative Economics(JQE) **(2025) 21(4) 163-219**

Shahid Chamran University of Ahvaz

Quarterly Journal of Quantitative Economics

Journal Homepage: www.jqe.scu.ac.ir
Print ISSN: 2008-5850
Online ISSN: 2717-4271

Comparison of technical and environmental efficiency of selected power plants and determination of Ramsey price

Khatereh Kaveh*, Ali Emami Meibodi**, Farid Asgari***, Kambiz Hozabr Kiani****

** PhD Student in Economics, Department of Economics, Faculty of Humanities, Abhar Branch, Islamic Azad University, Abhar, Iran.*
***Email**: khaterehkaveh@yahoo.com*

*** Professor of Energy Economics, Department of Energy Economics, Faculty of Economics, Allameh Tabatabai University, Tehran, Iran (Corresponding Author).*
***Email**: emami@atu.ac.ir*
0000-0002-4823-4151
***Postal Address**: Faculty of Economics, Allameh Tabatabai University, Corner of Ahmad Qusair, Shahid Beheshti St., Tehran, Iran Postal Code: 1513615411.*

**** Assistant Professor of Economics, Department of Economics, Faculty of Humanities, Abhar Branch, Islamic Azad University, Abhar, Iran.*
***Email**: asgari@abhariau.ac.ir*

***** Professor of Economics, Department of Economics, Faculty of Economics and Management, Science and Research Branch, Islamic Azad University, Tehran, Iran.*
***Email**: kianikh@yahoo.com*

ARTICLE HISTORY	JEL CLASSIFICATION	KEYWORDS
Received: 03 Desember 2021	***F30, F4, F3 ,F02***	***Capital Mobility, Trade Openness, Kof index, Home Bias***
Revision: 11 February 2022		
Acceptance: 09 June 2022		

Further Information:
The present article is taken from the dissertation of Ms. Khatereh Kaveh, with Supervisor of Ali Emami meibodi and Farid Asgari and under the advice of Kambiz Hozabr Kiani at the Islamic Azad University, Abhar Branch.

Shahid Chamran University of Ahvaz
Quarterly Journal of Quantitative Economics
(former Economic Studies)

Acknowledgments: Acknowledgments may be made to individuals or institutions that have made an important contribution.
Conflict of Interest: The authors declare no conflict of interest.
Funding: The authors received no financial support for the research, authorship, and publication of this article.

How to Cite:
Kaveh, Khatereh., Emami Meibodi, Ali,. Asgari, Farid. & Hozabr Kiani, Kambiz. (2025). Comparison of technical and environmental efficiency of selected power plants and determination of Ramsey price. *Quarterly Journal of Quantitative Economics(JQE)*, 21(4), 163-219. [in persian]
10.22055/jqe.2022.39360.2445

EXTENDED ABSTRACT

INTRODUCTION

The need to achieve high productivity and efficiency in the country's electricity industry, given the limited resources, increasing electricity demand, the strong dependence of other industries on this industry and environmental issues is vital. The best and simplest possible way to increase production, which can continuously improve the existing conditions, is the optimal use of resources and improving the efficiency and productivity of existing power generation devices. Paying attention to this issue in the electricity sector causes not only the added value of this sector but also the added value of other production and service units operating in the country, which are directly and indirectly related to the activities of this sector. A superficial look at the issues facing public sector enterprises in Iran indicates that one of the major problems of these enterprises is the pricing of goods and services. This problem has arisen because the public sector has a ready budget based on oil revenues, which fluctuates oil revenues on the one hand and the expectations and violations of the foundations of production on the other hand, has faced serious problems for public enterprises. This study has tried to investigate the technical and environmental efficiency of 20 selected thermal power plants using the output model of non-parametric data

envelopment analysis (DEA) technique. Also, using the production function and cost of selected power plants, the code price of electricity in 2018 should be calculated.

METHODOLOGY

Since the purpose of this study is to compare the technical and environmental efficiency of selected thermal power plants between 2010-2018 and to determine the ramsey price of the country, it was not possible to separate the statistics of production management companies by power plants. Therefore, restrictions on access to the labor force statistics of all thermal power plants in the country, limited the statistical population. Due to statistical limitations and the lack of some data required for this study, it was only possible to study 20 thermal power plants definitively. There are parametric and non-parametric methods to measure the necessary indicators in this regard. In this study, the technical efficiency and bio-efficiency of each selected thermal power plant have been measured using the output-driven model of the non-parametric data envelopment analysis technique (DEA) and assuming variable efficiency on a scale. This method is used when the institutes need more than two factors for producing their output. The input of this study include the variables of labor force, installed capacity and fuel consumption. Fuel inputs include gas oil, furnace oil and natural gas. Also, carbon dioxide and sulfur dioxide were included in the model as undesirable outputs.

FINDINGS

The results of applying the data envelopment analysis method in determining the technical efficiency show that the average technical efficiency of the studied power plants was between 71.9% and 87.8%. The study of the average environmental efficiency of these power plants during this period shows that this efficiency has been between 71 and 83.8%. So, without the need for more production factors, it is possible to increase production by 12.29-29% and, in addition to being established on the efficiency frontier, it is also possible to produce at an optimal scale. The study of the average environmental efficiency of these power plants during this period shows that this efficiency has been between 71 and 83.8%. Therefore, without the need for more production factors, production can be increased by an average of 16.29-29%. In addition to being established on the efficiency frontier, it also enabled production on an optimal scale.

Shahid Chamran University of Ahvaz
Quarterly Journal of Quantitative Economics
(former Economic Studies)

Table1. Comparison of average technical efficiency and environmental efficiency of selected power plants in 1389-1397
Source: research result

Technical Efficiency		Environmental		Year
Managerial Efficiency	Technical Efficiency	Managerial Efficiency	Technical Efficiency	
0.917	0.829	0.945	0.839	Average 1389
0.920	0.822	0.840	0.719	Average 1390
0.889	0.799	0.886	0.796	Average 1391
0.987	0.822	0.904	0.825	Average 1392
0.903	0.838	0.840	0.771	Average 1393
0.895	0.773	87/7	77/6	Average 1394
0.851	0.710	0.913	0.827	Average 1395
0.869	0.771	0.932	0.854	Average 1396
0.881	0.797	0.949	0.878	Average 1397

CONCLUSION

During the period under review (2010-2018), Rey power plant has always had the lowest technical and environmental efficiency. The inefficiency of this power plant has been due to managerial and scale inefficiencies both. The results show that technical efficiency in 2011 and environmental efficiency in 2016 per year have decreased simultaneously for various reasons such as managerial inefficiency or scale inefficiency or both. The amount of carbon dioxide emissions in 2013 was higher than other years under review, which was due to the reduction of natural gas consumption. Also, the amount of sulfur dioxide emissions during the years 2011-2013 due to high consumption of fuel oil and gas oil was more than other years that this method of fuel consumption has reduced the bio-efficiency of power plants in 2013. The same results confirm that based on the three defined scenarios, the coded prices in different scenarios are estimated at 982, 827 and 780 Rials, respectively. According to the results, it can be said that pricing based on final cost has left the industry with a deficit, and based on this, Ramsey pricing can be a pricing method in this field.

Reference

Aigner, D. J., & Chu, S.-f. (1968). On estimating the industry production function. *The American Economic Review*, *58*(4), 826-839 .

Ardabili Miyanaji, P., & Borimnezhad, V. (2017). Evaluation of Agricultural Bank Branches Performance Using Data Envelopment Analysis: Case Study of Alborz Province. *Agricultural Economics Research*, *8*(32), 19-38. doi:20.1001.1.20086407.1395.8.32.2.8

Asatryan, Z., & Barbu, M. (2009). Changes in the structure of German airport charges. In *GAP Working Paper, Berlin*.

Baumol, W. J & ,.Bradford, D. F. (1970). Optimal departures from marginal cost pricing. *The American Economic Review, 60*(3), 265-283 .

Emami meibodi, A., Amadeh, H., & Amini, F. (2017). Evaluation of Technical and Environmental Efficiency of Selected Thermal Power Plants of Iran. *Quarterly Journal of Energy Policy and Planning Research, 3*(3), 33-67. Retrieved from http://epprjournal.ir/article-1-255-fa.html

fazeli, e., vafaei, f., & jamshidi navid, b. (2015). Investigation on efficacy of the hospitals affiliated to Ilam University of Medical Sciences by DEA method. *journal of ilam university of medical sciences, 23*(1), 89-97. Retrieved from http://sjimu.medilam.ac.ir/article-1-2095-fa.html

Hakimov, R., & Mueller, J. (2014). Marginal costs estimation and market power of German airports. *Research in Transportation Economics, 45*, 42-48 .

Henderson, J. M., & Quandt, R. E. (1971). Microeconomic theory: A mathematical approach .

Hosseinpoor, A., & ghorbanpour, a. (2023). Provide a model based on the dimensions of circular economy, clean production and the fourth generation industrial revolution to improve the sustainable productivity of manufacturing industries. *Quarterly Journal of Quantitative Economics (JQE), 20*(2), 165-185. doi:10.22055/jqe.2022.39085.2433 [In persian]

Laffont, J.-J & ,.Tirole, J. (2000). Global price caps and the regulation of access. *Brazilian Review of Econometrics, 20*(1), 115-146 .

Martín-Cejas, R. R. (1997). Airport pricing systems in Europe and an application of Ramsey pricing to Spanish airports. *Transportation Research Part E: Logistics and Transportation Review, 33*(4), 321-327 .

Mishra, V. (2019). Measuring Technical Efficiency in Healthcare Service: A Case Study .

Morrison, S. A. (1982). The structure of landing fees at uncongested airports: An application of Ramsey pricing. *Journal of Transport Economics and Policy*, 151-159 .

Pourebadollahan Covich, M., Fallahi, F., Heydari, K., & Kiani, P. (2017). Efficiency Correction of Iran's Electricity Distribution Companies by Environmental Factors: An Application of Two-stage (DEA and Tobit) Analysis. *Iranian Energy Economics, 6*(23), 59-88. doi:10.22054/jiee.2017.8026

Saglam, Ü. (2018). *The Efficiency Assessment of Renewable Energy Sources with Data Envelopment Analysis.* Paper presented at the 2018 Annual Meeting of the Decision Sciences Institute Proceedings, Chicago IL.

Sarıca, K. (2017). Parametric vs. non-parametric efficiency assessment: Case of power plants in Turkey .

Shafiei Nikabadi, M., Shahroudi, K., Oveysiomran, A., & Khosravi, M. R. (2018). Inputs and Outputs Selection of Data Envelopment Analysis to Evaluate the Performance of Regional Electricity Companies in Iran by Neural Network. *Industrial Management Studies, 16*(51), 181-206. doi:10.22054/jims.2018.15618.1551

Shepherd, W. G. (1992). Ramsey pricing: Its uses and limits. *Utilities Policy, 2*(4), 296-298 .

Sojoodi, S., Dastmalchi, L., & Neshat, H. (2020). Efficiency Ranking of Iranian Power Plants Using Super Efficiency Method. *Quarterly Journal of Applied Theories of Economics, 7*(2), 223-254. doi/۱۰/۲۲۰۳۴:ecoj.2020.11290

Suri, A. R., Garshasbi, A. R., & Oryani, B. (2007). Comparative comparison of the efficiency of Iranian commercial banks using DEA and SFA methods. *8*(2), 33-60. Retrieved from https://www.sid.ir/fa/journal/ViewPaper.aspx?ID=165785

Wilson, R. B. (1993). *Nonlinear pricing*: Oxford University Press on Demand.

Xie, B.-C., Chen, Y.-F., Gao, J., & Zhang, S. (2021). Dynamic environmental efficiency analysis of China's power generation enterprises: a game cross-Malmquist index approach. *Environmental Science and Pollution Research, 28*(2), 1697-1711 .

Yang, T., Chen, W., Zhou, K., & Ren, M. (2018). Regional energy efficiency evaluation in China: A super efficiency slack-based measure model with undesirable outputs. *Journal of cleaner production, 198*, 859-866 .