SUGISAKA MASANORI

Journal of Robotics, Networking and Artificial Life Vol. 10(4); March (2024), pp. 368–373
ISSN (Online): 2352-6386; ISSN (Print): 2405-9021
https://alife-robotics.org/jrnal.html

Research Article

The Antecedents of Michinoeki's Efficiency in Japan: A Longitudinal Study

Satoshi Ikeda[1], Tsutomu Ito[2], Seigo Matsuno[2], Makoto Sakamoto[1], Rajiv Mehta[3], Takao Ito[4]

[1]*Faculty of Engineering, University of Miyazaki, Japan*
[2]*Department of Business and Administration, Ube National College of Technology, Japan*
[3]*Martin Tuchman School of Management, New Jersey Institute of Technology, U.S.A*
[4]*Graduate School of advanced Science and Engineering, Hiroshima University, Japan*

ARTICLE INFO

Article History

Received 24 November 2023
Accepted 23 July 2024

Keywords

Michinoeki
Efficiency
DEA
Revitalization
PRC

ABSTRACT

The expansion of Michinoeki along Japanese highway systems is widely considered to be a successful socio-economic experiment, which has enhanced interstate commerce as well as spurred tourism. Although descriptive studies on Michinoeki have been conducted, a review of the literature indicates that quantitative investigations are sparse. It is pivotal to identify the determinants that contribute to the success and efficiency of Michinoeki's, which can provide insights to further augment their development, thus revitalizing the surrounding local economy. To address this gap in the literature, the present investigation drew data from the entire population of Michinoeki towards ascertaining their relative efficiency by employing the DEA model, which enables data-driven inferences as well as comparative analyses. Based on the findings of the study, managerial implications are identified and avenues for future research are forwarded.

1. Introduction

The continuous expansion of Michinoeki along Japanese highways has been widely recognized as a successful socio-economic initiative. Since its establishment in 1993 with 103 stations, the network has grown significantly to encompass over 1,193 stations today. Michinoeki serve multiple crucial functions: (1) providing parking spaces and rest areas, (2) coordinating disaster prevention efforts, (3) collaborating with local communities to foster commercial and economic development, and (4) disseminating information [1]. Japan's economy has grappled with deflation over the past three decades amidst a declining birthrate and aging population. Michinoeki have been regarded as effective measures to stimulate local commerce and economic revitalization amid these challenges. The multifunctional role of Michinoeki has proven to be essential in addressing some of Japan's pressing socio-economic issues. The parking spaces and rest areas offer significant benefits for long-distance travelers and truck drivers, ensuring safety and comfort during their journeys. Moreover, as disaster prevention hubs, Michinoeki provide crucial resources and support during emergencies, offering shelter and information to affected individuals.

In addition to these roles, the collaboration with local communities has been a cornerstone of Michinoeki's success. By promoting local products and services, these stations boost local economies and create opportunities for small businesses. The information dissemination function of Michinoeki further enhances their utility, offering travelers valuable insights into local attractions, events, and services. Despite the evident importance and multifaceted benefits of Michinoeki, empirical research specifically focusing on them remains limited. This paper aims to fill this gap by evaluating the efficiency of Michinoeki using the DEA (Data Envelopment Analysis) model, facilitating comparative performance assessments

Corresponding author E-mail: saka2000@cc.miyazaki-u.ac.jp

across different regions. By doing so, it seeks to provide a comprehensive understanding of how effectively these stations are operating and identify areas for potential improvement.

The structure of this paper is as follows: Section 2 reviews previous research, Section 3 outlines the data collection process and operationalizations, Section 4 presents the research findings, and finally, administrative implications and conclusions are discussed. This comprehensive approach aims to shed light on the operational efficiency of Michinoeki and provide insights for enhancing their contributions to local and national socio-economic landscapes.

2. Background

Previous studies on Michinoeki have primarily focused on their four main functions. For instance, Yoshida et al. examined their role during natural disasters, noting local residents' reliance on nearby Michinoeki [2]. Other research has evaluated their economic impact and sustainability. Ozuka et al. explored methods to boost the local economy around Michinoeki [3], while Ito et al. assessed their efficiency in supporting local commerce and tourism in Yamaguchi prefecture [4]. This paper aims to further contribute by evaluating the efficiency of Michinoeki across Japan and comparing performance between different prefectures.

3. Methods and Construct Operationalizations

3.1. *Procedure*

Information on free parking space, systems to spread information, disaster prevention facilities, local population size, number of retail establishments selling local products from 2014 to 2015 and management style were drawn from the internal databases of Michinoeki headquarters (see Table 1).

Table 1. 20 Selected Variables as Explanatory Variables in the Multiple Regression Model.

No.	Variable		No.	Variable	
x_1	Square Meters of Land Space	SMLS	x_{11}	Operating Cost	OC
x_2	Number of Standard-Sized Car Parking Lot	NSSCPL	x_{12}	Total Customers	TC
x_3	Number of Large Vehicles Parking Lot	NLVPL	x_{13}	Number of the Agriculture Products and Sales	NAPS
x_4	Square Meters of Parking Area	SMPA	x_{14}	Number of the Agriculture and Marine Products	NAP
x_5	Total Number of the Restroom	TNR	x_{15}	Local Products	NLP
x_6	Square Meters of Free Rest Place	SMFRP	x_{16}	Number of the Selling Items	NSI
x_7	Total Seats of the Free Rest Place	TSFRP)	x_{17}	Number of Original Products	NOP
x_8	Weekdays' Traffic Near the Station	WTNS	x_{18}	Number of the Registered Farmers	NRF
x_9	Holidays' Traffic Near the Station	HTNS)	x_{19}	Square Meters of the Facilities for Marine Products	SMFMP
x_{10}	Population of the City Located	PCML	x_{20}	Square Meters of Facilities Space	SMFS

Table 2. Standard Coefficients between Selected Variables and the PRC and SRRC.

	Standard Coefficients (Probability)			
	PRC（2014)	SRRC（2015)	PRC（2014)	SRRC（2015)
x_1		-0.0227(0.7142)		
x_{10}	0.0776(0.0374)	-0.0004(0.9948)	0.0771(0.0253)	0.0981(0.0031)
x_{11}	0.2783(0)	0.034(0.5951)	0.2086(0)	0.1747(0)
x_{12}	0.3982(0)	-0.0127(0.837)	0.4458(0)	0.5054(0)
x_{15}	-1.2764(0.0014)	-0.3527(0.6106)	-1.596(0)	
x_{16}	1.256(0.0016)	0.3478(0.6158)	1.6157(0)	
x_{18}	0.0791(0.0506)	-0.0064(0.9137)	0.1067(0.0043)	0.0849(0.0142)
x_{19}	0.1871(0)	0.0191(0.7569)	0.2279(0)	0.3218(0)
Intercept	0(0.729)	0(0.5323)	0(0.2775)	0(0.0038)
R^2	**0.6502**	**0.04466**	**0.699**	**0.7956**

Passengers of Register Count (PRC) and Sales Revenue of Register Count (SRRC) were considered as Efficiency—the dependent variables in the regression equation. Additionally, the 20 selected variables as explanatory variables in the multiple regression model are detailed in Table 1, which were used to develop the multiple regression model below [1].

$$y = a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 + a_6x_6 + a_7x_7 + a_8x_8 + a_9x_9 + a_{10}x_{10} + a_{11}x_{11} + a_{12}x_{12} + a_{13}x_{13} + a_{14}x_{14} + a_{15}x_{15} + a_{16}x_{16} + a_{17}x_{17} + a_{18}x_{18} + a_{19}x_{19} + a_{20}x_{20} + c. \quad (1)$$

(See Table 1 for independent variable descriptions)

Eight variables (SMLS, PCML, OC, TC, NLP, NSI, NRF, SMFMP) were selected as key determinants that were expected to have strong impact on PRC and SRRC. Standard coefficients between selected variables and PRC and SRRC are reported in Table 2.

3.1. *Operationalizations*

DEA (Data Envelopment Analysis) is a prominent method for evaluating the relative efficiency of decision-making units such as businesses. One of the basic models of DEA is the Charnes, Cooper, and Rhodes (CCR) model, in which the problem of determining the efficiency of a specific Michinoeki, denoted as j, as a decision-making unit is formulated as the following mathematical programming problem:

$$\text{maximize} \quad D_j = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \quad (2)$$

$$\text{subject to} \quad \frac{\sum_{r=1}^{s} u_r y_{rj}}{v_i x_{ij}} \le 1 \quad (j = 1,2,\dots,n)$$

$$u_r \ge 0 \quad (r = 1,2,\dots,s)$$

$$v_i \ge 0 \quad (i = 1,,2,\dots,m)$$

Here $x_{i1},\dots,x_{im}$ and $v_1,\dots,v_m$ represent the inputs to the Michinoeki i and their respective weights, while $y_{r1},\dots,y_{rs}$ and $u_1,\dots,u_s$ signify the outputs from Michinoeki r and their respective weights.

Using three variables (SMLS, NRF, SMFMP) as input, and PRA as output of equation (1), the efficiencies of 554 stations in 2014, and 561 stations in 2015, out of a total of 1,107 stations, are calculated due to a lack of data. The results of the efficiencies of 561 Michinoeki across ten areas in 2015 are illustrated in Fig. 1.

4. Empirical Results and Explanation

Fig. 1 shows that the efficiency of Chugoku, Chubu, Hokkaido, Tohoku, and Okinawa is higher than that of Hokuriku, Kinki, Shikoku, and Kyushu. The mean and coefficient of variation of Michinoeki efficiency are depicted in Fig. 2 and Fig. 3, respectively.

Increased efficiency and lower coefficient of variation scores exhibit higher performance. In Okinawa, the efficiency in 2015 is higher than in other areas as is its coefficient of variation. These findings suggest that this area could be considered as one of the best performers when compared to the other ten areas.

Fig. 4 depicts high efficiency and low coefficient of variation, indicating that the Chubu Michinoeki is the most optimal while the Michinoeki in Shikoku, Hokkaido, Hokuriku, and Okinawa also exhibit positive performance. Michinoeki in Okinawa and Hokuriku exhibit inconsistent efficiency performance levels as 2015 is higher than in 2014. The results are stable for Michinoeki located in Kyushu, Kanto, Chugoku, Tohoku, and Kinki as they exhibit lower levels of efficiency, indicating the potential for enhancing performance in these regions.

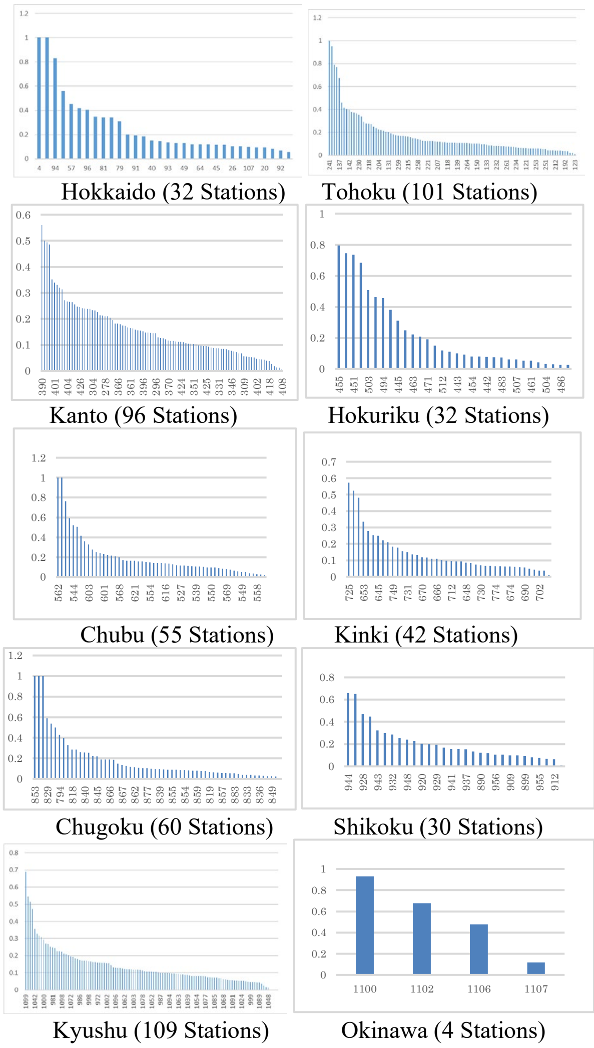

Fig. 1 Michinoeki' Efficiency of 10 Areas (2015, 561 Stations)

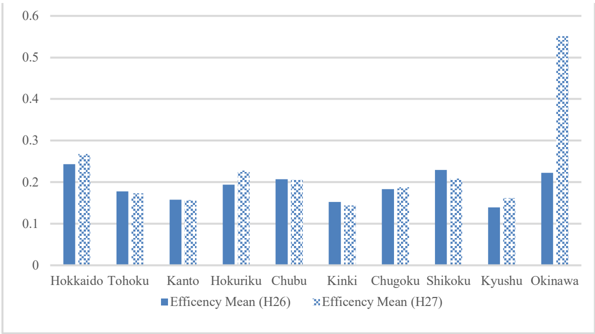

Fig. 2. Mean Value of Michinoeki' Efficiency in 10 Areas.

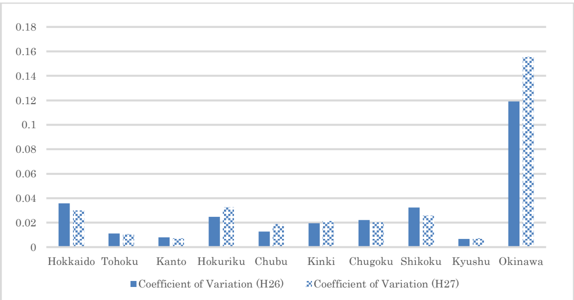

Fig. 3. Coefficient of Variation of Michinoeki' in 10 Areas.

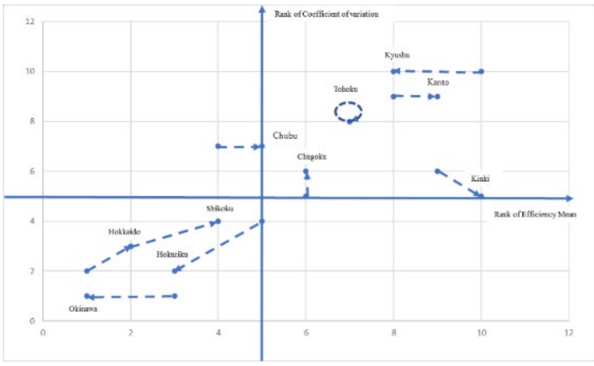

Fig. 4. Transition of Michinoeki' Rank of 10 Areas in 2014 and 2015.

Lastly, the linkage between efficiency and registered passenger count (PRC) and sales register count (SRRC) in 2014 and 2015 are plotted as follows: The horizontal axis represents efficiency, and the vertical axis depicts passengers and sales revenues in Fig. 5, Fig. 7 and Fig. 6, Fig. 8, respectively.

Higher efficiency was associated with smaller numbers of passengers or sales revenue of register count in Siranuikoitoi (No.1) and Kamiyuubetuonsen (No.2) in Hokkaido, Murayama (No.3) and Tuchiyu (No.4) in Touhoku, Fujikawarakuza (No. 5) in Chubu—as revealed in Fig. 5 and Fig. 6, Oribenosato (No. 4) in Chubu, and Suparakan and Tekhara (No. 7) in Chugoku in Fig. 7 and 8. Thus, it is possible to infer that effective management systems are established in these Michinoekis. In contrast, the hypothesis of a higher number of passengers or sales revenue of register count, is associated with lower efficiency in Abucho (No. 210), Chugoku, Shinshuhiraya (No.241), Chubu, Kawamata (No.445), Tohoku—as shown in Fig. 5. Moreover, Mizubenosatoooyama (No. 442) in Kyushu, Toyohiradonngurimura (No. 455) in Chugoku—as revealed in Fig. 6, and Mikamo (No. 218) and Nishikata (No. 249), and Tohoku, Kamisekikaikyo (No. 444) in Chugoku—as depicted in Fig. 7. These findings suggest that additional effort is required to improve their efficiency.

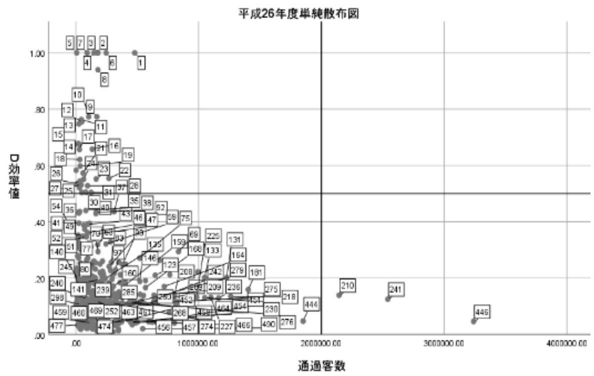

Fig. 5. Relationship between Efficiency and Passengers of Register Count (PRC) in 2014.

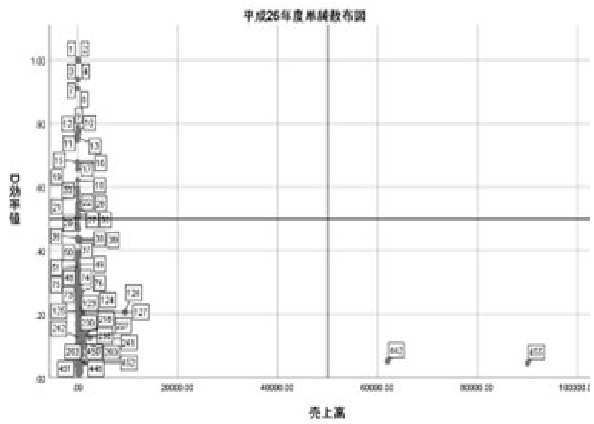

Fig. 6. Relationship between Efficiency and Sales Revenue of Register Count (SRRC) in 2014.

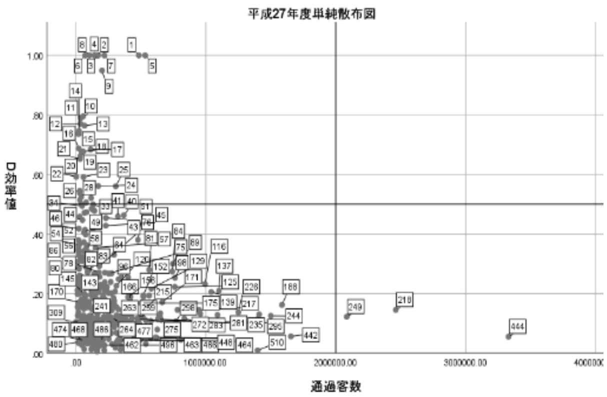

Fig. 7. Relationship between Efficiency and Passengers of Register Count (PRC) in 2015.

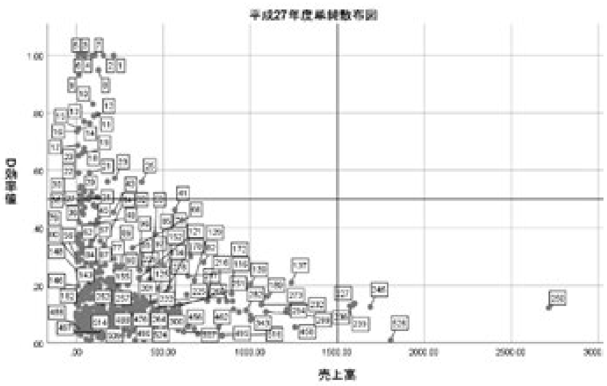

Fig. 8. Relationship between Efficiency and Sales Revenue of Register Count (SRRC) in 2015.

5. Conclusion

Several determinants were used to predict their impact on the efficiency of all Michinoeki in 2014 and 2015. Thus, this study partially bridged the gap in the current literature. However, a drawback of this paper is that analyzing the transition of Michinoeki only using two year's data is insufficient. Thus, in future research studies, additional factors, such as NLP and NSI, should be tested as antecedents of efficiency using longitudinal data.

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Authors Introduction

Dr. Satoshi Ikeda

He received Ph.D. at Hiroshima University. He is Associate Professor, Faculty of Engineering, University of Miyazaki.

Dr. Tsutomu Ito

He received Ph.D. at Hiroshima University. He is Associate Professor, of Business Administration at National Institute of Technology, Ube College, Japan

Dr. Seigo Matsuno

He received Ph.D. at Kyushu University. He is Professor of Business Administration at National Institute of Technology, Ube College, Japan.

Dr. Makoto Sakamoto

He received Ph.D. at Yamaguchi University. He is Professor, Faculty of Engineering, University of Miyazaki

Dr. Rajiv Mehta

He received Ph.D. at Drexel University. He is Professor of Marketing, Martin Tuchman School of Management, New Jersey Institute of Technology, USA.

Dr. Takao Ito

He received at Ph.D. at Kyoto University. He is Professor of Management of Technology (MOT), Graduate School of Engineering at Hiroshima University