

A Study on the Productivity Measurement and Effect Factors of Management Evaluation in Public Firms with a Focus on the Port Authorities

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Abstract : In this study, we first measured the malmquist productivity index by DEA among the Korean public firms. Second, there are 12 public corporations whose productivity (MPI) has decreased compared to 2014. This is mainly because of a decrease in productivity, as well as a decrease in the technical efficiency change index (TECI), impacted by the internal environment, and the increase in productivity because of an increase in the technology change index (TCI) impacted by the external environment. Finally, the analysis of the impact on the management assessment scores showed that the productivity (MPI), scale efficiency (CRS), size of sales, operating profitability, and total capital investment efficiency are significantly related (+), except for the asset turnover, which is a static financial ratio. Meanwhile, the management evaluation scores between the high-productivity public corporations and low-performing public corporations were significantly discriminating. Thus, it is confirmed that the nation's state-run companies must manage their MPIs in a time series to score high in management evaluation.

Key words : public firm, port authority, management performance evaluation, data envelopment analysis, malmquist productivity index, panel multiple regression method, panel probit analysis, panel logit regression analysis

1. Introduction

Korea's Public Firms are in charge of key national industries and major infrastructure, which has a significant impact on the national economy. Unlike private companies, however, the company lacks responsibility as an ownerless company. Although the management evaluation system was introduced by the enactment of the Government Investment Management Framework Act in 1984, it was not organized as a performance management tool for public firms due to incomplete evaluation organization and manpower composition, evaluation procedure, evaluation index system, and incentive system(Park, S.H., 2006). Under the Act on the operation of Public Institutions enacted in 2007, the government classified public institutions established and operated under the government's investment, investment, or government financial support as public firms, quasi-government organizations, and other public agencies, and sought to change the system of management of public firms. In other words, the government intended to induce public firms to innovate their management and improve productivity based on specific performance indicators.(Kim, J.K, 2001).

As such, the management evaluation system of public firm has continuously improved since 1984, but the

diversity of the purpose of establishment and environmental characteristics has not been fully reflected in the management evaluation index. In particular, port authorities with relatively few years or sizes are increasingly exposed to problems that are considered disadvantageous. Lee and Ahn(2013). Therefore, In this study, the Malmquist Productivity Index (MPI) by data envelopment analysis was first measured in Korea's public firms. MPIs can measure productivity changes over time through longitudinal and transverse area analysis of outputs for different inputs. This is because the reasons for the change in the productivity of the public firm can be explained separately from the changes in technology and efficiency. Second, the impact relationship between productivity and major financial ratios (profitability, financial stability, liquidity, efficiency, and productivity) was identified to derive measures to improve the productivity of public firms. This paper is aimed at enhancing the profitability and global competitiveness of Korean public firms, including port authorities.

2. Theoretical Background

Efficiency is generally expressed as output/input, and the greater the value of the ratio, the more efficient it is.

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firm efficiency can be classified as Technical Efficiency (TE) and Distribution Efficiency (AE). Technical efficiency breaks down into the product of pure technical efficiency and scale efficiency. The efficiency of scale is a measure of whether a company's production scale is optimal across the firm(Farrell, 1959). This is assessed by defining it as a revenue constant(CRS) for size from the operational perspective of the entity. DEA is a nonparametric methodology that uses inputs and outputs to measure firm efficiency through a DMU (Decision Making Unit) efficiency and productivity analysis. The Malmquist Productivity Index (MPI) used in this study was defined by Caves, Christensen and Diewert in 1982. Unlike the analysis method of cross-sectional area of DEA, it measures the change in productivity over time through longitudinal and cross-sectional area analysis, and explains the cause of change in productivity by utilizing technological change and efficiency change.

$$M_0(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)} \times \left[\frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^{t+1}, y^{t+1})} \times \frac{D_0^t(x^t, y^t)}{D_0^{t+1}(x^t, y^t)} \right]^{\frac{1}{2}} = \text{TECI} \times \text{TCI}$$

A value of 1 or more indicates an improvement in productivity, while a value of 1 or less indicates a stagnation and a decline in productivity. Technical Efficiency Change Index(TECI) refers to an index that indicates the extent to which efficiency changes contributed to technological productivity changes. TECI consists of a purely technical production change(PECI) and a scale technical production change(SECI) that increases or decreases the index under the influence of the internal environment. Technical Change Index(TCI) indicates the degree of change in productivity due to changes in technology, which means advances in technology when the index is greater than 1, and backward when less than 1. The TCI is affected by the external environment.

3. Management status analysis

3.1 Comparison of Size between PA and Public firm

In 2018, the number of public firms is 35 (Public firm I =15, Public firmII=20). The number of public firms is 30 from 2014 to 2016, the period during which MPIs are

measured. Consequently, the number of firms subject to research was limited to 30 units. And the four Port Authority are busan, incheon, yeosu-gwangyang and ulsan port authority. The average total number of employees at the four PA increased 8.8% annually to 188 in 2018, compared with 104 in 2011. During the seven years, the average employees of the four PA was 146, which is only 3.9% for market-type(Public firm I: Pub. I) and 4.4% for semi-market-type(Public firmII: Pub.II) public firms.

Table 1 Contrast of Average staff and Asset between PA and Public firm

Year	Average staff(person)			Average Asset(billion won)		
	PA	Public Co. I	Public Co. II	PA	Public Co. I	Public Co. II
mean	146	3,782	3,315	2,731	25,036	18,045
2011	104	3,286	3,023	2,630	21,210	16,979
2012	117	3,410	3,103	2,643	22,664	17,672
2013	136	3,559	3,134	2,693	24,208	18,312
2014	150	3,728	3,258	2,749	25,492	18,340
2015	153	3,817	3,287	2,774	26,131	17,722
2016	159	4,005	3,361	2,791	26,550	18,121
2017	174	4,156	3,523	2,793	26,783	18,415
2018	188	4,297	3,827	2,898	27,288	18,800
CAGR	8.8%	3.9%	3.4%	1.4%	3.7%	1.5%
Contrast ratio		3.9%	4.4%		10.9%	15.1%

The average total assets of the four PA increased 1.4% annually to 2.898 billion won in 2018, compared with 2.724 trillion won in 2011. During the seven-year period, the average assets of the four port Authoritys stood at 2.731 billion won, accounting for only 10.9% of market-type public firms and 15.1% of quasi-market-type public firms.

Table 2 Contrast of Average Capital and Sales between PA and Public firm

(unit: billion won)

Year	Average Capital			Average Sales		
	PA	Public Co. I	Public Co. II	PA	Public Co. I	Public Co. II
mean	1,968	9,637	5,827	150	9,238	3,011
2011	1,916	8,807	5,258	104	8,402	2,682
2012	1,915	8,733	5,324	123	9,748	2,791
2013	1,938	8,833	5,485	131	9,843	2,807
2014	1,966	9,201	5,762	154	9,955	3,048
2015	1,997	10,066	5,621	183	9,025	3,326
2016	1,998	10,635	5,975	169	8,717	3,245
2017	2,018	10,542	6,371	171	8,796	3,267
2018	2,024	10,289	6,820	171	9,416	2,924
CAGR	0.8	2.2	3.8	7.4	1.6	1.2
Contrast ratio		20.4	33.8		1.6	5.0

The average capital of the four PA reached 2,034 billion won in 2018, up 0.8% annually from 1,916 billion won in 2011. During the seven-year period, the average capital of the four port Authorities stood at 1,968 billion won, accounting for only 20.4% of market-type public firms and 33.8% of quasi-market-type public firms.

The average sales of the four PA reached 171 billion won in 2018, up 7.4% annually from 104 billion won in 2011. During the seven-year period, the average sales of the four port Authorities stood at 150 billion won, accounting for only 1.6% of market-type public firms and 5.0% of quasi-market-type public firms.

3.2 Comparison of Financial rate between PA and Public firm

The average debt ratio of the four PA reached 36.7% in 2018, up 1.4% annually from 33.2% in 2011. During the seven-year period, the average debt ratio of the four PA stood at 34.5%, accounting for only 23.4% of market-type public firms and 43.8 % of quasi-market-type public firms.

The average current ratio of the four PA reached 188.9% in 2018, up 4.2% annually from 141.2% in 2011. During the seven-year period, the average sales of the four port Authorities stood at 142.2%, accounting for 125.7% % of market-type public firms and 57.1% of quasi-market-type public firms.

Table 3 Contrast of Debt ratio and Current ratio between PA and Public firm

Year	Debt ratio(%)			Current ratio(%)		
	PA	Public Co. I	Public Co. II	PA	Public Co. I	Public Co. II
mean	34.5	147.7	78.8	142.2	113.2	248.9
2011	33.2	121.7	87.8	141.2	128.7	215.0
2012	33.8	128.4	104.2	120.4	105.1	205.2
2013	34.1	144.3	86.7	80.6	115.2	216.9
2014	35.4	152.9	81.0	213.5	136.0	261.8
2015	35.5	144.4	74.5	120.9	104.5	239.0
2016	35.7	101.3	71.7	146.5	114.3	282.2
2017	33.7	132.9	65.6	109.5	93.6	290.1
2018	36.7	262.0	59.1	188.9	103.3	281.4
CAGR	1.4	11.6	-5.5	4.2	-3.1	3.9
Contrast ratio		23.4	43.8		125.7	57.1

The average OI/sale ratio of the four PA reached 29.4% in 2018, up 6.7% annually from 18.7% in 2011. During the seven-year period, the average OI/sale ratio of the four PA stood at 28.7%, accounting for 330.1% of market-type public firms and 289.4 % of quasi-market-type public firms.

The average BTI/sale ratio of the four PA reached 23.2% in 2018, up 16.4 % annually from 8% in 2011. During the

seven-year period, the average BTI/sale ratio of the four port Authorities stood at 19.3%, accounting for 620.9% of market-type public firms and 317% of quasi-market-type public firms.

Table 4 Contrast of OI/sale and BTI/sale between PA and Public firm

Year	OI/sale(%)			BTI/sale(%)		
	PA	Public Co. I	Public Co. II	PA	Public Co. I	Public Co. II
mean	28.7	8.7	9.9	19.3	-3.1	6.1
2011	18.7	14.4	5.0	8.0	9.7	3.5
2012	22.2	11.9	7.3	4.1	6.9	-0.4
2013	26.2	12.9	7.6	13.5	8.4	10.7
2014	32.7	8.5	13.2	21.9	2.0	9.0
2015	32.6	-10.1	11.7	34.0	-45.9	1.5
2016	33.8	12.5	12.3	23.3	-7.8	8.0
2017	30.4	12.6	11.3	24.2	4.9	8.5
2018	29.4	5.9	10.2	23.2	-3.7	7.9
CAGR	6.7	-12.1	10.8	16.4	-187.0	12.5
Contrast ratio		330.1	289.4		620.9	317.0

* OI/Sale ; Operating Income/sale profitability. BTI/sale ; Before Tax Income/sale profitability.

The average turnover of total asset(Sale/TA) ratio of the four PA reached 0.9% in 2018, up 4.7% annually from 5% in 2011. During the seven-year period, the average turnover of total asset ratio of the four PA stood at 6.3%, accounting for 15.7% of market-type public firms and 12.7% of quasi-market-type public firms.

Table 5 Contrast of Sale/TA and VAD/TA between PA and Public firm

Year	Sale/TA(%)			VAD/TA(%)		
	PA	Public Co. I	Public Co. II	PA	Public Co. I	Public Co. II
mean	6.3	40.1	49.7	6.1	9.9	22.5
2011	5.0	49.5	52.4	0.0	0.0	0.0
2012	5.8	53.4	46.9	2.6	10.0	19.2
2013	5.9	46.5	48.3	5.2	9.5	19.9
2014	6.4	39.7	50.0	6.0	9.5	23.7
2015	6.9	33.4	52.1	6.8	5.8	25.2
2016	6.7	30.6	50.8	6.6	12.7	24.1
2017	6.9	32.4	49.6	6.6	12.1	23.3
2018	6.9	35.5	47.6	6.7	8.3	20.7
CAGR	4.7	-4.6	-1.4	20.5	3.8	3.9
Contrast ratio		15.7	12.7		61.2	27

* Sale/TA ; turnover of total asset ratio, VAD/TA ; the average total capital investment efficiency

The average VAD/TA ratio of the four PA reached 6.7% in 2018, up 20.5% annually from 0% in 2011. During the seven-year period, the average VAD/TA ratio of the four port Authorities stood at 6.1%, accounting for 61.2% of

market-type public firms and 27% of quasi-market-type public firms.

4. Research Methodology and Analysis

4.1 Research Model and Variables

In this paper, First, the efficiency index(CRS) of public firms in Korea was derived by the DEA-BCC model. Second, the productivity index(MPI) was derived in accordance with the calculation DEA model of the Malmquist to measure the productivity, taking into account the time series of the Korea Port Authority and the Korean public firms. Second, the significant relationship between Malmquist Productivity Index(MPI)·CRS and the management evaluation results(total scores) was measured. Third, the significant relationship between key financial rates(size) and the management evaluation results(scores) was measured. Therefore, the following research models were constructed to achieve this purpose.

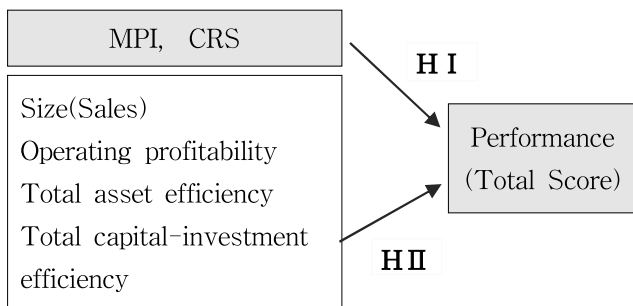


Fig. 1 Research model

4.1.1 Dependent variables(performance)

The performance measurements of public firm as defined in this study were measured by the overall management evaluation score. The measurement method uses the inspection (released data in Alio) scored by the public firm for five years from 2014 to 2017.

4.1.2 Independent variables

The first type are MPI and CRS derived by the DEA-BCC model with Malmquist. The second type are key financial ratios and size. The key financial ratios are operating profitability(operating profit/sales), total capital investment efficiency and turnover on total asset. These variables are also measured using calculated figures by obtaining data on the financial statements of public firm (data disclosed in Alios) for seven years from 2014 to 2018.

4.2 Research Hypothesis and analysis method

Hypothesis I was established as follows by testing the relevance of seven evaluation items to their management performance.

[H I] MPI and CRS will affect public-firm’s performance.

[H I -1] MPI will affect public-firm’s performance.

[H I -2] CRS will affect public-firm’s performance.

Hypothesis II was established as follows by testing the relevance of financial rates and size to management performance to assessing adequacy.

[HII] Size · financial rate will affect public-firm’s performance.

[HII -1] Size(sales) will affect performance.

[HII -2] Investment efficiency of total capital will affect performance.

[HII -3] Turnover of total asset will affect performance.

4.3 Analysis procedure and method

In this study, prior studies were referenced to derive the Scale Efficiency(CRS) and Malmquist Productivity Index (MPI) by the optimal DEA analysis model. In addition, the MPI is calculated from the time series data for five years, so there are input and output variables restrictions. Consequently, the inputs from the optimal DEA analysis model are the total assets and the total number of employees, and the outputs are the total operating profit and overall scores obtained as a result of the management evaluation. In addition, the following analysis procedures were performed. First, research hypotheses were tested by Panel Multivariate Regression in relation to the impact of the scale efficiency index(CRS), productivity index(MPI), financial ratio and sales volume on the overall score of the management evaluation derived from the DEA model.

$$Y_i = \alpha + \beta_1 MPI_i + \beta_2 CRS_i + \sum_{\tau=1}^3 \beta_{\tau} X_{\tau i} + \varepsilon_i$$

Y_i = overall score (i = 30 Public Firms, 2014-2018 years)

MPI_i = DEA Malmquist productivity index

CRS_i = DEA Size efficiency index, i = panel items

X_i = operating profitability, total capital investment efficiency and turnover on total asset, sales), ε_i = error.

Second, the overall score between public corporations whose MPIs are derived from the DEA model are greater than 1 and those whose productivity is less than 1 were

tested and the ability to distinguish the above independent variables was tested. Analysis methods are Panel Probit Resistance and Panel Logit Resistance.

$$MP_i = \alpha + \beta_1 Y_i + \beta_2 CRS_i + \sum_{\tau=1}^3 \beta_{\tau} X_{\tau} + \varepsilon_i$$

MPI = Productivity classification of public Firms(1= MPI>1, 0= MPI<1) 2014 year(1=13, 0=17), 2015 year(1=12, 0=18), 2016 year(1=4, 0=26), 2017 year(1=17, 0=13), 2018 year(1=9, 0=21).

4.4 Statistics of Variables

The average MPI of 30 public firm over the five years from 2014 to 2018 is 0.96(min is 0.65 and max is 1.31). The average total score of 30 public firm over the five years from 2014 to 2018 is 77(the min score is 64 and the max score is 85.4).

Table 6 Statistics of MPI and variables
(Sale and Total asset unit: billion won)

2018 Year	meam	sd	min	max
MPI	0.96	0.14	0.65	1.31
TECI	1.03	0.53	0.02	3.43
TCI	0.85	0.09	0.72	1.05
PECI	1.22	0.84	0.01	3.79
SECI	1.01	0.36	0.16	2.26
CRS	0.48	0.36	0.01	1.00
x1	0.08	0.26	-0.68	0.74
x2	0.16	0.21	-0.26	1.04
x3	0.42	0.52	0.05	2.90
sale	5,953	11,597	86	60,628
Total Asset	22,761	44,585	221	185,249
Y	77.0	5.1	64.0	85.4

* Y; overall score, X₁ ; operating profitability, X₂ ; total capital investment efficiency X₃ ; turnover on total asset

4.4 Correlation Analysis Result between Score and MPI and Related Variables

Table 7 Correlation Analysis Results of Score·MPI

Correlation	Score	MPI	CRS	Sale	x1	x2	
MPI	corr	.231	1				
	P	.004					
CRS	corr	.185	-.003	1			
	P	.024	.968				
Sale	corr	.045	-.005	-.271	1		
	P	.584	.952	.001			
x1	corr	.306	-.045	.371	.014	1	
	P	.000	.582	.000	.870		
x2	corr	.372	.079	.349	-.126	.207	1
	P	.000	.336	.000	.124	.011	
x3	corr	.125	-.064	.032	.044	-.038	.260
	P	.126	.439	.699	.595	.645	.001

Table 7 is the result of analysis of Pearson correlation between management evaluation scores of Korean public

corporations and management efficiency(CRS) and productivity(MPI) and related variables. There is a strong correlation between management evaluation scores and productivity(MPI) and management efficiency(CRS).

4.5 DEA Malmquist Productivity Analysis Results

The number of state-owned firms with increased technical efficiency change index(>1) affected by the internal environment increased slightly from 14 in 2014 to 16 in 2016, but decreased to 7 in 2017 and 11 in 2018. On the other hand, the number of Public Firms that declined (<1) decreased from 11 to six in 2016, but increased to 17 in 2017 and 12 in 2018, indicating that productivity has deteriorated significantly. Meanwhile, the number of public corporations affected by the external environment increased (>1) from 24 in 2014 to 6 in 2016 and recovered to 14 in 2017. However, the number dropped significantly to two again in 2018. On the other hand, the number of reduced public corporations (<1) increased significantly from six in 2014 to 28 in 2018, indicating that internal environmental factors played a greater role in the productivity of public corporations than external factors. As a result, the number of Public Firms with increased productivity is nine and the number of Public Firms with a drop in productivity is far higher at 21, worsening the total output of Public Firms.

Table 7 MPI Analysis Result by DEA Model

Item	Year	2014	2015	2016	2017	2018
MPI	Index<1	17	18	26	13	21
	Index=1	0	0	0	0	0
	Index>1	13	12	4	17	9
TECI	Index<1	11	9	6	17	12
	Index=1	5	6	7	6	7
	Index>1	14	15	17	7	11
PECI	Index<1	13	10	7	12	8
	Index=1	7	8	9	10	11
	Index>1	10	12	14	8	11
SECI	Index<1	13	13	7	14	9
	Index=1	5	6	7	6	7
	Index>1	12	11	16	10	14
TCI	Index<1	6	7	24	9	28
	Index=1	0	0	0	7	0
	Index>1	24	23	6	14	2

4.6 Panel Regression Analysis results

The panel analysis results between the management evaluation items and the overall score(Y) by the OLS, OLS dum, fixed effect and random effect models are shown in Table 8. The four panel regression models have very high R²(determination coefficient) of 0.2815 0.4356, 0.1857. 0.1612 respectively, indicating that the models are suitable. Among them, the R² of OLS dum is the best analysis model with

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0.4356. Productivity(MPI) is a significant positive($p<0.05$) influence relationship that is strong in scoring the management evaluation of a public firm, so [H I-1] is adopted. However, [H I-2] is also acceptable, although the scale efficiency(CRS) shows a somewhat weak positive influence($p<0.1$) on the management evaluation scores of public firms. Total capital productivity, the scale of sales and the financial ratio, shows a significant positive impact relationship ($p<0.01$) on management evaluation scores, so [H II-1] and [H II-2] were adopted. However, [H II-3] was rejected because the total asset turnover, a measure of asset efficiency as a financial ratio, does not have an impact on management assessment scores.

* $p<.1$; ** $p<.05$; *** $p<.01$, N=149.

The results of the management evaluation determine the measured productivity (MPI) as significant ($p<0.05$). It is judged that productivity measured in time series has an important impact on the management evaluation of Korean public corporations.

5. Summary and Conclusion

The analysis results of this study are summarized as follows.

First, the results of comparing the size and major financial ratios between the port Authority and general public firms are as follows. From 2014 to 2017, the average number of executives and employees at the four port Authorities stood at 146, or 3.9% of the average 3,782 employees at public firms. The average total assets are 2.731 billion won for the four port Authorities, compared with 25.036 billion won for the public I, 10.9% for the public firm, and 15.1% for the public II, 18.045 billion won for the country. The average sales figure is 150 billion won for the Korea port Authorities, compared with 9,238 billion won for the public firm I, 1.6% for the public firm II, and only 5.0% for the public firm II at 3,011 billion won.

However, the average debt ratio of the four port Authorities is 34.5%, compared with 147.7% for public firm I and 78.8% for public firm II, which is two to three times lower. The average operating profit of sales is 28.7%, compared with 8.7% for public firms and 9.9% for public firm II, which is three times better.

Second, there are 12 public corporations whose productivity(MPI) has decreased compared to that of 2014. This is mainly due to a decrease in productivity, mainly due to a decrease in the technical efficiency change index (TECI), which is affected by the internal environment, and the increase in productivity is due to an increase in the technology change index(TCI) affected by the external environment.

Third, there is a strong significant correlation between productivity(MPI) and management efficiency(CRS) and management evaluation scores. In detail, the Technology Change Index(TCI) by external environment does not differ between efficient public corporations and inefficient public firms, and the Technical Efficiency Change Index(TECI) by internal factors of public corporations is significantly higher for efficient public firms. This is not due to changes in net efficiency but to differences in scale efficiency, so the size

Table 8 Panel regression results for total score by MPI

Y	OLS	OLS_dum	fixed	random
MPI	.12116807***	.08617056**	.14750114***	.12932476***
CRS	.03875603	.03947009*	.06672599	.04519655*
lnsal	.01035724**	.01035924***	.08412413	.01129539**
x1	.03325737**	.03754734**	.00490372	.02793612
x2	.10191458***	.10617384***	.07526732	.09997756***
x3	.0028268	.00187757	-.20163865	.00175387
2015		.06959783***		
2016		-.01411033		
2017		.04535404***		
2018		.03982359**		
cons	.45521117***	.45995551***	-.53729231	.43207289***
R ²	.28157012	.43566259	.18576141	0.1612

* $p<.1$; ** $p<.05$; *** $p<.01$, N=149

4.7 MPI Discriminant Analysis Results

Table 9 is a multivariate regression analysis of panel probit and panel logit between the productivity(MPI) of Korean public firms and related variables. Although the Pseudo R²/ χ^2 values and significant probabilities(P) are not suitable for all three models, but the interpretation of the meaning is as follows.

Table 9 Panel Probit & Logit Results for MPI

MP	probit	xtprobit	xtlogit
Y	.03631131**	.03630037**	.05864561**
CRS	-.02262734	-.02242988	-.02272879
X1	-.21260838	-.21275319	-.33650129
X2	.19050581	.1905668	.27457553
X3	-.0952559	-.09526878	-.13695325
lnsal	-.04715601	-.04711982	-.07979214
constant	-2.4032086	-2.4029444	-3.8411334
Log likelihood	-94.5803	-94.5803	-94.6108
Pseudo R ² / χ^2	0.0360	6.70	6.48
Prob > χ^2	0.3145	0.3490	0.3712

of public corporations is proving to be an important factor in productivity.

Finally, the analysis of the impact on management assessment scores shows that productivity(MPI), scale efficiency(CRS), size of sales, operating profitability and total capital investment efficiency are significantly related (+), except for the asset turnover, which is a static financial ratio. Meanwhile, management evaluation scores between high-productivity public corporations and low-performing public corporations are found to be significantly discriminating. Therefore, it is confirmed that the nation's public firms need to manage their MPIs in a time series in order to score high in management evaluation.

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