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A Study on How General Super Markets Affect Traditional Markets Performance*

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Abstract

Purpose - In Korea, general super markets have a great impact on the market performance of traditional markets. We propose a modified two stage DEA model for evaluating the performance of traditional markets in Incheon, Korea by identifying the influence of external environmental factors including the presence of general super markets as non-discretionary variables in DEA.

Research design, data, and methodology - After obtaining bias-corrected estimates of original DEA efficiency scores using the input and output data of 49 traditional markets, we regress them on several external environmental factors by bootstrap-truncated regression.

Results - We obtain bias-corrected efficiency scores from the original DEA efficiency scores by bootstrap and among the five environmental factors, the residential population and the presence of general super markets or SSMs can be considered as the driving forces influencing bias-corrected efficiency scores, positively and negatively, respectively.

Conclusions - When DEA efficiency scores tend to be overestimated, we need to use a biased-corrected efficiency score by bootstrap. It is important to note that the efficiency of traditional markets can be largely influenced by external environmental factors such as the presence of general super markets or SSMs that traditional markets can not control. Therefore, it is desirable to consider such environmental factors appropriately for a reasonable performance evaluation.

Keywords: Traditional Markets, General Super Markets, Two Stage DEA, Environmental Factors, Simar and Wilson's Bootstrap.

JEL Classifications: C12, D12, L80, L81.

1. Introduction

In the meantime, traditional market support policy in Korea has been suffering from efficiency problems such as huge financial support and low performance by indiscriminate support. From 2002 to 2016, the government invested KRW 2.9 trillion of government expenditure into the installation such as arcade and parking lot, the modernization for facilities and sales events of 1,589 traditional markets nationwide(Park, 2017). Among them, the budget for the facility modernization project is 1.9 trillion won, accounting for 67.1% of the total. If the parking environment improvement project is included, the budget for supporting the facility changes from 67.1% into 73.9% of the total (Park, 2017). On the other hand, the sales in the traditional markets decreased 7%, from 21.4 to 19.9 trillion, and the average daily number of customers per store decreased from 22.4 to 21.7 between 2010 and 2013, for four years (SMBA, 2015).

These main results have been pointed out the support system problems such as the uniform improvement in shopping facilities of the traditional markets and the one-time event support, or the limit of the less sophisticated evaluation method. Therefore, this shows the necessity for differentiated funding through more objective and transparent performance evaluation.

A study on the existing performance analysis of the traditional markets can be said to require the improvement

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in the following points. First, until now, most of the traditional market support policy has been carried out uniformly across all the traditional markets as a unit. However, it is necessary to consider each traditional market as a distinct and independent decision-making unit to improve the performance of each traditional market(Jeong, 2016). Therefore, each traditional market's own efforts should be considered as an important factor in performance evaluation(Park, 2017; Choi & Suh, 2017; Nam, 2017). Second, each traditional market is exposed to the conditions of a different external environment, thus, it is difficult to control by itself. The presence of such an external environment can be also an important factor influencing market performance regardless of the efforts of the traditional market itself. The impact of competitive retailers such as general super markets on the sales and technical efficiency of traditional markets has attracted much attention (Chun & Chae, 2003; Park, 2003). Despite the importance of establishing a policy, however, many researches have been mainly based on the subjective estimation of the impact based on the questionnaire. Therefore, more robust studies based on the quantitative analysis are necessary. The performance evaluation and support strategies should be devised in accordance with the situation of each traditional market considering the external environment such as the existence of general super markets or SSMs(super supermarkets), the size of resident population and so on. As the law for the development of the distribution industry has been revised recently, those who intend to open large-scale stores are obliged to submit the commercial assessment report and the regional cooperation plan to the heads of local governments. This trend requires more rigorous analytical methodology to objectively measure the impact of large-scale stores such as general super markets on local commercial areas.

This study analyzes the effects of external environmental factors on the performance of traditional markets using data envelopment analysis(DEA). DEA is an enhanced mathematical programming approach that offers an objective method to obtain a single meaningful efficiency score for measuring the performance of traditional markets. Charnes, Cooper, and Rhodes(1978) first proposed the DEA model as an measurement tool for relative efficiency among Decision Making Units (DMUs).

In this study, we propose a modified two stage DEA model of the traditional DEA model by identifying the influence of external environmental factors including general super markets as non-discretionary variables or environmental factors in DEA. In other words, this research evaluates the relative efficiency of Korean traditional market in the first stage, and then reveals the external determinants of their performance in a comparative setting. To achieve this, the analysis is enriched by the second stage in which the DEA efficiency scores are regressed on external environmental factors of efficiency with Simar and Wilson (2007)'s bootstrap-truncated regression.

2. Literature Review

2.1. DEA with Environmental Factors

A powerful technique to evaluate the relative technical efficiency of DMUs is DEA which was initiated by Charnes et al.(1978) and extended by Banker et al.(1984). This Linear Programming based approach is a data-oriented method to measure the relative technical efficiency of DMUs with multiple inputs and outputs. In the last three decades, DEA has been widely applied in areas that range from assessment of public sectors such as hospitals and health-care systems, schools, and universities to private sectors such as banks and financial institutions.

The foregoing traditional DEA model of Charnes et al. (1978) assumed that all inputs can be controllable by the DMUs. Such inputs are called discretionary inputs. However, in many real applications, DMUs may perform in different environments where some inputs are not controllable by the DMUs and cannot be directly influenced by the DMUs. These inputs are called “environmental (or non-discretionary) inputs.” For example, a supermarket located a short distance from a traditional market may have an enormous impact on the performance of the traditional market but an environmental factor that the traditional market can not control. This effect should be considered in the performance assessment of the traditional market.

External environmental factors are generally not controllable internally in traditional markets. Therefore, these factors cannot be treated as input in traditional DEA. In order to overcome this problem, Banker and Morey(1986) took the approach of comparing a specific company with other companies in a poor environment when it is possible to order a specific environmental factor. In the case of Chanes, Cooper, and Rhodes(1981), when sub-sampling according to a specific environmental factor is possible, DEA is performed for each sub-sample, and the projection points on the efficient frontier are compared. However, both of the above methods have a limitation that only one environment variable should exist.

The recent two-stage method involves solving a DEA problem in the first-stage analysis, involving only the traditional inputs and outputs(Coelli et al., 2005). In the second stage, the efficiency scores from the first stage are regressed upon the environmental factors. One disadvantage of the two-stage method is that DEA efficiency estimates used in the first stage are serially correlated, leading to biased inference. To obtain unbiased beta coefficients and valid confidence intervals, we follow the bootstrap procedure of Simar and Wilson(2007). It involves obtaining efficiency estimates in the first step and then regressing them on environmental factors with the use of a bootstrap-truncated regression. This empirical strategy shares similarities with previous studies, namely Ray(1991), Kirjavainen and Loikkanen(1998), and Bradley, Johnes, and Millington(2001).

2.2. Performance assessment of retail stores using DEA

While there are a lot of studies on performance assessment of retail stores using DEA, the studies seems to have placed more emphasis on supermarket chains. Many of those studies have focused either on the performance of individual stores in same chain(Xavier, Moutinho, & Moreira, 2015; Lau, 2013; Barros & Alves, 2004) or the performance comparison between different chains(Athanassopoulos & Ballantine, 1995). Xavier et al.(2015) estimated the retailing efficiency in a 26-store women clothing retail chain and decomposed it in several measures in order to contribute to the performance improvement of this retail service firm as well as to compare the technical efficiency of the different DMUs. Lau(2013) studied the feasibility of using DEA model to measure technical efficiency and rationalize a distribution channel as an alternative approach to the traditional method of optimizing delivery schedules through LP(linear programming), which can be very complex and require a lot of data. Barros and Alves(2004) estimated a total change of productivity of a Portuguese retail store chain and decomposed it into technically efficient change and technological change with data envelopment analysis. Athanassopoulos and Ballantine(1995) used DEA to study a lot of issues concerning the evaluation of corporate performance, which includes an assessment of sales' technical efficiency, the effects of scale economies, benchmarking of each firm's performance and the relationship between the grocery industry in the UK.

From a dynamic perspective, panel data studies stand out. Barros(2006) uses the output-oriented DEA method to study the efficiency of 22 Portuguese hypermarket and supermarket stores. He continuously used a bootstrapped Tobit regression to strengthen the analysis. Sellers-Rubio and Mas-Ruiz(2006) also used an DEA model to study a Spanish grocery retail chain having complemented their study with correlations. Perrigot and Barros(2008) use an output-oriented DEA model to evaluate the efficiency of 11 French general retail chains complementing the analysis with a two stage bootstrapped Tobit regression. Moreno(2010) uses an input-oriented DEA method to study 1,323 non-specialized retail stores from six European countries using a two stage model, in which first, the stores belonging to different countries are compared against each other store and second, best strategies are used to improve efficiency throughout the whole sample.

In the case of traditional markets, each of them is not a member of retail chain such as supermarket but an independent business unit. Unlike the supermarket chain, the performance evaluation of these traditional markets is made by the central government as a central evaluator. Bogetoft (1997) argues that DEA is well suited to these government-led performance evaluations for the following reasons. First, it requires very little technological information a priori. Secondly, it allows a flexible, non-parametric modeling of multiple-input multiple-output production processes in contrast to the stylized processes typically considered in the incentive and regulation literature.

To the best of our knowledge, the literature survey reveals that there is yet no published paper specifically analyzing Korean traditional market efficiency considering the impact of environmental factors. Moreover, we find no study that incorporates a DEA and bootstrap procedure in Korean context.

3. Methodology

A fundamental assumption in DEA is that if a specific DMU can be producing Y units of the output with X units of input, then other DMUs or a combination of the other DMUs also should be able to do the same. Such combined DMUs do not necessarily exist, and we refer to them as virtual DMUs. The key to DEA analysis then is to find the “best” virtual DMU for each real DMU(Cook & Zhu, 2008). If the virtual DMU shows better performance than the original DMU by either making more outputs with the same input levels, or making the same output levels with lower amounts of inputs, then the original DMU is inefficient.

Suppose now that there are n traditional markets (DMUs) and each traditional market uses m inputs to produce s products. Let x_{ij}(i=1, 2, ...,) and y_{rj}(r=1,2,..., s) be ith input and rth output of DMU_j(j=1,2,...,n), respectively. We want to see how a particular traditional market DMU_0 can increase the output or decrease the input compared to its best virtual traditional market. In this case, the virtual traditional markets we are interested in should use less input and produce more output than DMU_0, so we can express it as the following formula.

$$\sum_{j=1}^{n}\lambda_j x_{ij} \le x_{i0}, \qquad i=1,\cdots,m$$

$$\sum_{j=1}^{n}\lambda_j y_{rj} \ge y_{r0}, \qquad r=1,\cdots,s$$

$$\sum_{j=1}^{n}\lambda_j = 1$$

$$\lambda_j \ge 0, \qquad j=1,\cdots,n$$

The left hand sides in the equation (1) are the convex combination of the given inputs and outputs of all DMUs and the right hand side shows the inputs and outputs of the specific DMU, DMU_0. The input-oriented DEA model determines how much the current input level can be minimized in the given output level. Therefore, the DEA model can be derived as follows.

$$\theta^* = Min\ \theta$$

$$s.t.\ \sum_{j=1}^{n}\lambda_j x_{ij} \le \theta x_{i0}, \quad i=1,\cdots,m$$

$$\sum_{j=1}^{n}\lambda_j y_{rj} \ \ge\ y_{r0}, \quad r=1,\cdots,s$$

$$\sum_{j=1}^{n}\lambda_j = 1$$

$$\lambda_j \ \ge\ 0, \quad j=1,\cdots,n$$

In the above model (2), the decision variables are the weights $\lambda_j(j=1,...,n)$ and θ, where θ is the DEA efficiency index. Since θ = 1 is a feasible solution, the optimal solution θ^* must be always less than or equal to 1. If θ^*=1, then, the current input level can not be reduced proportionately, so the current input level of DMU_0 is efficient. In other words, since the same output can be produced with less inputs, the input level of DMU_0 is inefficient.

In this paper, we will modify the above traditional DEA model in the two stage method using bootstrap for a more reasonable evaluation in traditional markets.

3.1. First stage: Bootstrapped DEA for bias-corrected estimator of θ

Nonparametric DEA estimator θ obtained by model (2) is based on a finite sample from observed production set. Because we are minimizing over a smaller set than real production set, the estimated efficiency scores may be larger than the real efficiency scores. The result is that DEA estimate is upward biased(Bogetoft & Otto, 2011). The identification in many cases on DMUs is falsely efficient or too optimistic efficiency scores, that is called a lack of discrimination(Podinovski & Thanassoulis, 2007). Such an efficiency estimation may not serve the purpose of the evaluation. To eliminate the bias, we first estimated the bias, and then obtained a bias-corrected estimate. We can estimate the bias as

$$bias \ = \ E(\hat{\theta}) - \theta.$$

Unfortunately, we do not know the distribution of θ, so we cannot calculate $E(\hat{\theta})$. This is where the bootstrap enters in(Simar & Wilson, 1998). When θ^b and $\overline{\theta^*}$ are a bootstrap replica b estimate and the bootstrap estimate of θ, respectively, the bootstrap estimate of the bias is

$$bias^* \ = \ \frac{1}{B}\sum_{b=1}^{B}\theta^b - \hat{\theta} \ = \ \overline{\theta^*} - \hat{\theta}.$$

A bias-corrected estimator of θ, $\breve{\theta}$ is then

$$\breve{\theta} \ = \ \hat{\theta} - bias^* = \hat{\theta} - \overline{\theta^*} + \hat{\theta} \ = \ 2\hat{\theta} - \overline{\theta^*}.$$

Simar and Wilson (1998) described a bootstrap method to get this bias-corrected efficiency scores. Practically to obtain them, we utilize Wilson's FEAR 2.01 R package, which is freely available online.

3.2. Second stage: Truncated regression for external environmental factors

The two-stage method involves solving a DEA problem in the first-stage analysis, involving only the traditional inputs and outputs. In the second stage, the efficiency from the first stage are regressed on the external environmental factors. The second stage involves truncated regression analysis, due to the limited range of the efficiency scores (between 0 and 1) and some lumpiness in the estimated values(due to several values of 1 for the most efficient traditional markets). The second stage explains the efficiency score differences as a function of external environmental factors, such as the location of traditional markets and the existence of general super markets, and other variables that are not inputs in the production process. One disadvantage of the two stage DEA method is that DEA efficiency estimates used in the first stage are serially correlated, leading to biased inference. To obtain unbiased regression coefficients and valid confidence intervals, we use the bootstrap procedure of Simar and Wilson(2007). It involves obtaining efficiency estimates in the first step and then regressing the efficiency estimates on environmental factors with the use of a bootstrap-truncated regression. By checking the robustness of them, we perform the following two stage method by utilizing double bootstrapping. In the first stage, we obtain bias-corrected efficiency scores by bootstrapping original efficiency scores, and then in the second stage we regress these bias-corrected efficiency scores, instead of original efficiency scores, on environmental factors by utilizing the bootstrap-truncated regression. The bootstrap-truncated regression procedure can be briefly summarized in the following steps:

Step 1: Obtain bias-corrected estimator $\breve{\theta}_i(i=1,...,n)$ at the first stage

Step 2: Fitting $\breve{\theta}_i = \beta' z_i + \epsilon_i$ using truncated regression to obtain estimates $\hat{\beta}$ and $\hat{\sigma_\epsilon}$

Step 3: Loop over the next three steps B times (b=1,...,B)

(1) Draw ϵ_i^b from N(0, $\hat{\sigma}_\epsilon$) with right-truncation at $(1-\hat{\beta}' z_i)$ for i=1,...,n

(2) compute $\theta_i^b = \hat{\beta}' z_i + \epsilon_i^b$ for I=1,...,n

(3) Estimate $\hat{\beta}^b$ and $\hat{\sigma}_\epsilon^b$ by truncated regression using the artificial efficiency scores θ_i^b as dependent variable

Step 4: Construct standard errors for $\hat{\beta}$ and $\hat{\sigma}_\epsilon$ (and confidence intervals for β and σ_ϵ) from simulated distribution of $\hat{\beta}^b$ and $\hat{\sigma}_\epsilon^b$

In the present analysis, we used B = 1,000 replicates. The above bootstrap-truncated regression is implemented by using 'simarwilson' Stata module which implements the procedure proposed by Simar and Wilson(2007).

4. Data and Descriptive Statistics of the Variables

The research data used for the study are 49 traditional markets in Incheon, which were surveyed by the small enterprise and market service(SEMAS) in 2013. The surveyed items are divided into 4 major categories; general status of the market like the number of stores, market activities such as co-marketing, market environment such as resident population, and market performance such as sales and visitor numbers.

The factors affecting the performance of traditional markets can be divided into both internal and environmental market factors. The internal market factors are divided into the following five categories. In other words, it can be divided into marketing activity, market infrastructure, public relation facility, customer convenience facility, and market condition inspection.

The marketing activity categories include 14 activities such as sweepstake events, regular sales, special sales, flyer advertisements, market festivals or events, coupons, specialties sale market, joint purchase, market news, store brochure, homepage, internet shopping mall, shipping space, and shipping means. Each marketing activity was assigned a value of 1 and 0, respectively, depending on whether the activity is carried out or held in each market. By summing over all the 14 activity values, the value from 0 to 14 was assigned to each market in the marketing activity category. The market infrastructure category was examined from 10 items(fire fighting facilities, broadcasting facilities, communal restrooms, restrooms for the disabled, outdoor street lights, drainage facilities, joint warehouse, gas facilities, arcade, and CCTV). In the category, the value from 0 to 10 can be assigned to each market in the same way as the marketing activity category. In a similar way, 5 items(event plaza, acoustics/sculpture, TV billboard, LED billboard, market guide map) for the public relations facility category and 13 items (customer support center, playroom, call center, cafeteria, feeding room, storage room, private parking lot, bicycle depository, cultural classroom, cart, alien information center, sports facility, small library) for the customer convenience facility category were measured. The market condition inspection category shows the hygiene and inspection status of each area inside the market according to 8 items (common toilet, market entrance and passage, individual store, drainage facility, parking convenience, customer line (shop display line), price indication, origin indication). Each item was rated as a 5 point Likert scale from very poor to very good. The scores for 8 items were averaged for each market.

Environmental factors refer to the external environmental conditions that traditional markets can not control themselves but can affect the performance of traditional markets. In other words, the size of the resident population located around the traditional market, the increase/decrease of the floating population, the number of the commercial facilities, the number of the transportation facilities, the presence of the general super market or SSM. The size of resident population was measured by the number of resident population from the administrative region(Dong) where the traditional market was located. The rate of increase or decrease of the floating population was evaluated as a 5-point Likert scale from rapid decrease to rapid increase compared with the previous year. The number of commercial facilities was measured by the number of 4 items (government offices, schools, tourist attractions/historical sites, apartments/multi-family villas) located in the region and the number of transportation facilities was measured by 3 items(bus stop, subway, bus terminal).

In addition, the value of 1 and 0 were given by checking whether general super markets or SSMs(super supermarket) existed within a radius of 2 km from the traditional market. In particular, it has been insisted by traditional markets that the presence of general super markets or SSMs has a significant negative impact on the performance of traditional markets.

Finally, the market performance of traditional markets were measured by two output variables: the daily average number of customers and the daily average sales per store.

<Table 1> summarizes the input and output variables used in DEA. Marketing activities actually implemented by market are shown to be an average of 2.2 out of 14 activities, showing very low marketing diversity level. Among the marketing activities, the most popular activities in the traditional markets were sweepstake events and market festivals or events, while specialties sale market and internet shopping mall were rarely implemented. It was found that each traditional market had an average of 7 out of 10 infrastructures surveyed. On the other hand, the average number of facilities related to public relations and customer convenience is 1.3 and 2.4 respectively, which is relatively low compared to the infrastructure. In the market condition

inspection, the average score was 3.2 points out of 5 points. In the market performance, on average, 24.4 people visit stores per day, resulting in the sales of 357,000 won.

<Table 1> Variables used in the first stage DEA

Variable	Variable Description	Mean	Stand. Dev.	Med.	Min.	Max.
Input Variables						
matot	marketing activity	2.2	2.3	1	0	10
fatot	market infrastructure	7.0	2.0	8	2	9
protot	public relations facility	1.3	1.1	1	0	5
convtot	customer convenience facility	2.4	2.1	2	0	8
checktot	market condition inspection (1=very bad ~ 5=very good)	3.2	0.7	3.3	0.9	4.6
Output Variables						
cusjum	daily average number of customers per store	24.4	12.8	22.6	4.1	54.1
salesjum	daily average sales per store (10,000 won)	35.7	29.3	29.2	6.3	169.9

<Table 2> summarizes the measured results of external environmental factors for traditional markets in Incheon. Around 39,000 people were living in each traditional market of Incheon, and it was surveyed that general super markets or SSMs were located around 28 traditional markets (57%). In addition, there were 5.5 commercial facilities and 1.8 transportation facilities around each traditional market.

<Table 2> Environmental variables used in the second stage truncated regression

Var.	Variable description	Mean	Stand. Dev.	Med.	Min.	Max.
Pop	resident population (ten thousand)	3.9	2.9	3.0	0.4	13.8
Flow	floating population (1=rapid increase~5=rapid decrease)	2.4	0.8	2	1	4
Mart	presence of general super markets or SSMs (yes=1, no=0)	0.6	0.5	1	0	1
Facility	number of the commercial facilities	5.5	2.7	6	0	13
Traffic	number of the transportation facilities	1.8	0.7	2	1	4

5. Empirical Analysis on Efficiency Performance

5.1. First step DEA results

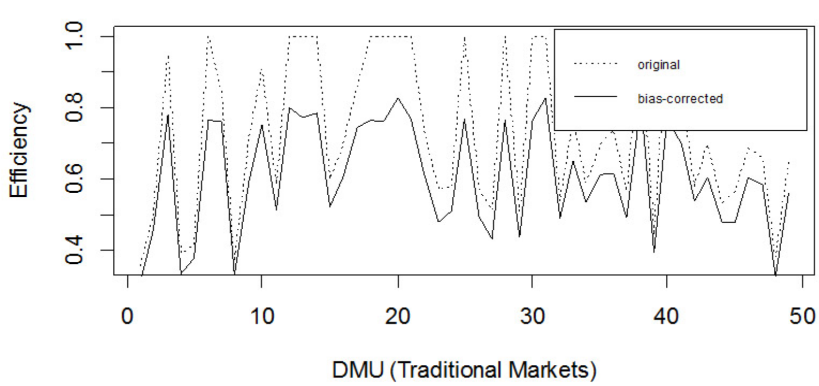
We run an input-oriented efficiency model. Our basic specification considers two outputs and five inputs. As inputs we consider marketing activities, market infrastructure, public relations facilities, customer convenience facilities, and market condition inspections. The set of outputs include daily average number of customers per store and daily average sales per store as described in the previous section.

In <Table 3>, we present the summary of two efficiency estimates: original efficiency scores and bias-corrected scores. The mean value of the original efficiency scores is 0.73 (73%), the highest efficiency score is 1 (100%) and the lowest efficiency score is 0.36 (36%). 17 of the 48 traditional markets (29%) in our data are 100% efficient, obtaining efficiency scores equalling 1. To eliminate the bias and improve the discrimination of DEA, we first estimate the bias and obtain a bias-corrected estimate. Bias-corrected efficiency scores obtained by bootstrap method are presented. Their mean value is 0.61 (61%), the highest efficiency score is 0.83 (83%) and the lowest efficiency score is 0.31 (31%). Since we are assuming an input- oriented approach, the traditional market would have to decrease its input by the factor (1-DEA score)×100% in order to reach the frontier. Therefore, the efficiency score of 0.61 indicates that, when examining the traditional markets analyzed here, their input could be saved by as much as 39%, keeping their output stable.

<Table 3> Comparison of two efficiency scores

Efficiency Scores	Mean	Standard deviation	Med.	Min.	Max.
original	0.72662	0.21798	0.69604	0.35763	1
bias-corrected	0.60522	0.15589	0.60259	0.31182	0.82649

As shown in <Figure 1>, the bias-corrected scores for all the traditional markets are shown to be reduced from the original scores indicating lower efficiency in relation to the original ones. The vertical difference between the two graphs represents the magnitude of the bias for each DMU.



<Figure 1> Efficiency scores of DMUs

5.2. Second step bootstrap regression results

To examine the determinants of efficiency, a Tobit Model could be, regressing the efficiency scores of the first step by different contextual variables. This method is used in the second stage of DEA analysis i.e., when the relationship between exogenous factors and DEA scores is assessed. The Tobit is chosen in view of the truncation of the efficiency scores between 0 and 1. However, it is recognized in the DEA literature that the efficient estimates obtained in the first DEA stage are correlated with the independent variables used in the second regression stage, so that the second stage efficiency scores estimates will be seriously inconsistent and biased (Simar & Wilson, 2007). Therefore, Simar and Wilson(2007), Yu and Ramanathan (2008), and Perrigot and Barros(2008) suggested that a bootstrap procedure should be employed to overcome this problem. The bootstrap is a computer-based statistical method for assigning measures of accuracy and validation to statistical estimates.

At this stage, DEA scores are linked through a parametric model with additional variables, describing resident population, floating population, presence of general super markets or SSMs, number of the commercial facilities, number of the transportation facilities. The second stage model to be estimated takes on the following form:

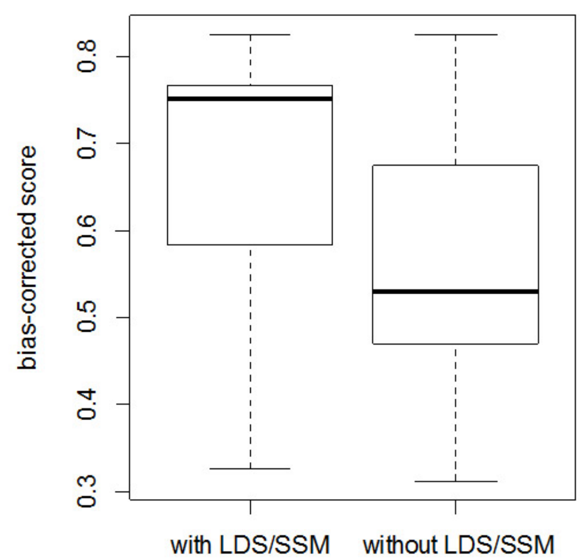
$$\theta_i = \beta_0 + \beta_1 Pop_i + \beta_2 Flow_i + \beta_3 Mart_i + \beta_4 Facility_i + \beta_5 Traffic_i + \epsilon_i$$

where θ_i is a bias-corrected score of traditional market i and Pop_i, $Flow_i$, $Mart_i$ $Facility_i$ $Traffic_i$ indicate resident population, floating population, presence of general super markets or SSMs, number of the commercial facilities, number of the transportation facilities of traditional market i, respectively. We obtain 1,000 replications for each parameter estimate $\hat{\beta}_i$ of the marginal effect of these environmental variables. Last, we construct bootstrap-based 95% confidence intervals for each parameter estimate.

<Table 4> The Second stage with bootstrap

Variable	Estimated coefficient (bias-corrected)	Stand. error	z	p>|z|	95% Conf. Interval	
					lower	upper
Pop	0.019516(***)	0.007368	2.65	0.008	0.0056	0.0351
Flow	-0.01341	0.026659	-0.50	0.615	-0.0683	0.0380
Mart	-0.12526(***)	0.041786	-3.00	0.003	-0.2049	-0.0433
Facility	0.004208	0.008129	0.52	0.605	-0.0112	0.0206
Traffic	0.027423	0.029127	0.94	0.346	-0.0247	0.0881
constant	0.561226(***)	0.100098	5.61	0.000	0.3568	0.7472

<Table 3> gives the results of the second stage truncated regression. The bootstrapped coefficients, standard errors and p-values, 95% confidence intervals are reported. The wald χ^2 test for model fitness for five degrees of freedom is 14.72 with a p-value of 0.012. The model appears to fit the data well. The model reveals that efficiency scores are statistically significant with two variables pop and mart, positively and negatively, respectively. Thus, the Bootstrapped procedure shows that the residence population and the presence or absence of general super market or SSM can be considered as the driving forces influencing efficiency of traditional markets in Korea. In other words, if there is a general super market or SSM around a traditional market, the efficiency of the traditional market is reduced by about 0.125 compared with the case without a general super market or SSM. On the other hand, as the number of residents in the surrounding area increases by 10,000, the efficiency increases by about 0.02. In <Figure 2>, the empirical box plot indicates that traditional markets without general super market or SSM are more efficient than traditional markets with general super market or SSM. The average efficiency of traditional markets with general super markets nearby and those without general super markets are 0.57 and 0.73, respectively, which this difference is statistically significant(df = 65.61, p-value = 0.05).



<Figure 2> Efficiency scores difference

6. Discussion and Conclusions

The support policy for the traditional market in Korea has been a uniform support method focused on facility investment. As a result, it did not show any remarkable achievement compared to huge financial support. Despite the importance of establishing a policy, many researches have been mainly based on the subjective estimation of the impact based on the questionnaire. Therefore, the need for differentiated support methods based on more rigorous performance evaluation for each traditional market has been raised. In this study, we used DEA method to evaluate the performance of traditional markets in Incheon. We considered marketing activities, market infrastructure, public relations facilities, customer convenience facilities, and market condition inspections as inputs. The set of outputs include daily average number of customers per store and daily average sales per store.

In this paper, we modify the traditional DEA model using the two stage method for a more reasonable evaluation of the traditional markets. In the first stage, As shown in <Table 1> we calculate the bias-corrected estimator of efficiency scores using bootstrap from original ones. In the second stage, the relationship between environment factors and the bias-corrected scores is assessed. In other words, the DEA efficiency scores from the first stage are regressed on the external environmental factors ,the residential population, the floating population, the presence of general super markets or SSMs, the number of the commercial facilities, and the number of the transportation facilities of traditional market. Among the five environmental factors, the residential population and the presence of general super markets or SSMs were statistically significant in <Table 4>. The greater the residential population around the traditional market, the higher the efficiency of traditional market. More interestingly, in the presence of general super markets or SSMs, the efficiency was lower than if they were not present. This means that the presence of general super markets or SSMs is one of the environmental factors that give the greatest impact on the efficiency or performance of traditional markets.

The potential explanation of the relationship between the presence of general super markets or SSMs and traditional markets efficiency is the main focus of this paper. The empirical analysis suggests two messages: (1) the presence of general super markets or SSMs can have a potential (negative) effect on traditional markets performances, and (2) therefore it is desirable to consider various environmental factors appropriately for a reasonable performance evaluation of traditional markets.

Our study suggests the following implications. First, efficiency scores tend to be overestimated in case of evaluating traditional market performance based on efficiency by DEA. In this case, we need to utilize a biased-corrected efficiency scores by bootstrap. Second, it is important to note that the performance of traditional markets can be largely influenced by external environmental factors that traditional markets cannot control. Therefore it is desirable to consider this environmental factor appropriately for a reasonable performance evaluation.

It should be noted that the results of this paper are based on the factors included in the DEA models and the available data. Hence, the limitations of the study can be defined with respect to the data set. First, the data used in this study are limited to Incheon area in Korea. Therefore, more nationwide data is needed to derive more general results. Second, two output variables(the daily average number of customers and the daily average sales per store) surveyed by a public institute(SEMAS) are used in this study. But these variables have limitations in that they can not be accurately measured due to the characteristics of traditional markets. Further research must be devoted to collect more accurate and nationwide data for more reliable research. However, the preliminary findings presented here claim for some major policy implications and for a wider reflection about the potential importance for the presence of general super markets or SSMs in the Korean performance evaluation setting.

References

Athanassopoulos, A. D., & Ballantine, J. A. (1995). Ratio and frontier analysis for assessing corporate performance: Evidence from the grocery industry in the UK. *The Journal of the Operational Research Society, 46*(4), 427-440.

Banker, R. D., & Morey, R. C. (1986). Efficiency analysis for exogenously fixed inputs and outputs. *Operations Research*, *34*(4), 513-521.

Barros, C. P., & Alves, C. (2004). An empirical analysis of productivity growth in a Portuguese retail chain using Malmquist productivity index. *Journal of Retailing and Consumer Services*, *11*(5), 269–278.

Bogetoft, P. (1997). DEA-based yardstick competition: The optimality of best practice regulation. *Annals of Operations Research*, *73*(0), 277-298.

Bogetoft, P., & Otto, L. (2011). *Benchmarking with DEA, SFA, and R*. New York, NY: Springer.

Bradley, S., Johnes, G., & Millington, J. (2001). The effect of competition on the efficiency of secondary schools in England. *European Journal of Operational Research, 135*(3), 545-68.

Charnes, A., Cooper, W. W., & Rhodes, E. L. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, *2*(6), 429-444.

Charnes, A., Cooper, W. W., & Rhodes, E. L. (1981). Evaluating program and managerial efficiency: An application of DEA to program follow through. *Management Science, 27*(6), 668-697.

Choi, D. R., & Suh, G. H. (2017). A study on the effects of small business management result by the Korean government: Focus on SEMAS. *The East*

Asian Journal of Business Management, 7(3), 33-43.

Chun, D. Y., & Chae, M. S. (2003). Small and medium-sized stores' competitive strategies, marketing capabilities, and retail performance: Competing against mass merchandisers. *Journal of Channel and Retailing*, *8*(1), 91-116.

Coelli, T. J., Rao, D. S., O'Donnell, C. J., & Battese, G. E. (2005). *An Introduction to efficiency and productivity analysis.* New York: Springer.

Cook, W. D., & Zhu, J. (2008). *Data envelopment analysis: Modeling operational processes and measuring productivity*. New York: Springer.

Jeong, D. B. (2016). A note on association for Korean markets using correspondence analysis. *Journal of Industrial Distribution & Business, 7*(3), 5-13.

Kirjavainen, T., & Loikkanen, H. A. (1998). Efficiency differences of Finnish senior secondary schools: An application of DEA and Tobit analysis. *Economics of Education Review, 17*(4), 377-94.

Lau, K. H. (2013). Measuring distribution efficiency of a retail network through data envelopment analysis. *International Journal of Production Economics*, *146*(2), 598-611.

Nam, S. J. (2017). Exploring success factors of night markets: Utilizing the diamond model. *Journal of Industrial Distribution & Business, 8*(2), 33-38.

Park, C. R. (2017). *Issues of policies for activating traditional markets*. National Assembly Research Service Publications.

Park, S. Y. (2003). A Study on the retail competitive structure when a general super market enters small cities. *Journal of Channel and Retailing, 7*(2), 21-44.

Perrigot, R., & Barros, C. P. (2008). Technical efficiency of French retailers. *Journal of Retailing and Consumer Services*, *15*(4), 296-305.

Podinovski, V. V., & Thanassoulis, E. (2007). Improving discrimination in data envelopment analysis: Some practical suggestions. *Journal of Productivity Analysis*, *28*(1), 117-126.

Ray, S. C. (1991). Resource use efficiency in public schools: A study of Connecticut data. *Management Science, 37*(12), 1620-1628.

Simar, L., & Wilson, P. E. (1998). Sensitivity Analysis of Efficiency Scores: How to Bootstrap in Nonparametric Frontier Models. *Management Science*, *44*(1), 49-61.

Simar, L., & Wilson, P. E. (2007). Estimation and Inference in Two-stage, Semi-parametric Models of Production Processes. *Journal of Econometrics, 136*(1), 31-64.

SMBA (2014). *A Basic Plan to Activate Traditional Markets and Shopping Centers*. Research Report, Small and Medium Business Administration.

Xavier, J. M., Moutinho, V. M., & Moreira, C. (2015). Efficiency and convergence analysis in a women's clothing retail store chain Evidence from Portugal. *International Journal of Retail & Distribution Management*, *43*(9), 796-814.

Yu, W., & Ramanathan, R. (2008). An Assessment of Operational Efficiencies in the UK Retail Sector. *International Journal of Retail & Distribution Management*, *36*(11), 861-882.