A Study on the Relative Efficiency of Retail Industry in Korea*

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This paper investigates the relative efficiency of Korea's 111 retail firms during 2006-2010 using the Data Envelopment Analysis(DEA) method and Malmquist Productivity Analysis. From the empirical analysis, the results of the DEA provide that the overall efficiency for the retail industry is 0.5942, revealing that retail companies have yet to demonstrate efficient performance. Upon taking a closer look into sub-categories of industries, convenience stores had the comparatively highest average efficiency score of 0.7833 followed by other retail sales via mail order houses(0.7483) and electronic commerce via the internet(0.6424). Supermarkets, department stores, and retail sales in other non-specialized large stores exhibited comparatively low DEA efficiency scores. The explanation for these results seems to be that large-scale stores such as department stores and supermarkets tend to require higher fixed assets, which causes an excess of input.

JEL Classification: C81, D21, D22 [1)2)3)]

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I. Introduction

Korea's retail sector represents a large and growing portion of the overall economy; in 2010 it accounted for 8.5 percent of the GDP, and an even larger percentage of the overall employment at 15 percent.[1)] Korea's retail industry, which had previously been dominated by small-scale businesses, began to diversify and include larger and more modern establishments such as multi-store retail chains, and experienced a substantial structural change since the opening of the distribution market in 1996. The 1997 financial crisis damaged the retail sector in general, along with all other economic sectors, and stifled growth of the industry. In the process, modernization of retail industry has advanced, which has served to increase the efficiency and productivity of retail industry and benefit consumers. But during that process, small and medium-sized retailers have declined. Nevertheless, retail industry shows positive

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1) Bank of Korea(2011), Statistics Korea(2011).

growth thanks to chain retailers operated by large companies while independent retailers and traditional retail networks are giving way rapidly to large discount chain stores. In particular, large retailers have strengthened their power through grocery retailing.

Grocery product purchases have increased as modern grocery retailers such as hypermarkets and supermarkets have enhanced their grocery offers by adding diverse categories of products. In addition, consumers have shown a tendency to purchase fewer non-grocery products at modern grocery retailers due to the expansion of mixed retailers as well as non-store-based channels such as internet retailing, home shopping and direct selling. Consumers are now more familiar with convenient shopping methods and delivery services such as internet or home shopping. So it is expected that non-store retailing will continue to grow while store-based retailing will show weaker performances as independent retailers are expected to decline.

The relative productivity of Korea's retail industry was 0.42 in 1998 and has increased to 0.57 in 2010. However, it is still at a low level compared to other industries such as the manufacturing industry(1.81) and overall service industry(0.85).[2] Small and medium-sized retailers function positively in terms of employment and vitalization of the local economy, making it hard to pursue large firms-centered upsizing and organizing unilaterally in retail industry. The support of small and medium-sized retailers may conflict with productivity improvement in the retail industry. Nevertheless, both issues must be considered in establishing policy for strengthening competitiveness of the retail industry.

In order to strengthen the competitiveness of Korea's retail industry, retail firms need to be operated more efficiently in an organized manner as to increase productivity. The main purpose of this study is to explore the relative efficiency of Korea's retail firms and to decompose the efficiency change over time. Data Envelopment Analysis(DEA) method is used with financial data collected from 111 retailing companies from the years 2006 to 2010. Some policy implications for strengthening competitiveness of the retail industry are also suggested.

II. Literature Review

Data envelopment analysis(DEA) is a linear nonparametric method in operations research and economics to empirically evaluate the efficiency of multiple decision-making units(DMUs). A DMU is generally regarded as the entity responsible for converting inputs into outputs. For the purpose of DEA to compare relative efficiency, a group of DMUs is used to evaluate each other with each DMU having a certain degree of managerial freedom in decision making. DMUs may include various entities with different size such as department stores and supermarkets. Many studies use DEA to compare relative efficiency of companies or organizations

2) "Relative productivity" can be defined as the labor productivity level of a specific industry compared to that of total industry. If the relative productivity of industry A equals to 1, it means that A industry's labor productivity is the same as the labor productivity of the total industry(Kim, Kim, and Kim 2011).

with different sizes in a specific industry category classified by the Korea Standard Industrial Classification(KSIC).[3)]

DEA was initially developed as one methodology for assessing the comparative efficiencies of organizational units by Farrell(1957) on the concept of technical efficiency. Charnes, Cooper and Rhodes(1978) expanded the single-input, single-output model to the concept of multiple_inputs, multiple-outputs in order to assess the relative efficiency of a homogeneous group of operating DMUs. They developed a mathematical model, commonly known as the CCR model which does not have to setup any assumptions or weights beforehand.

Various research papers on the efficiency of public organizations such as schools, banks, hospitals, shops, and businesses have been published using DEA method. This model allows input-reducing and output-increasing orientations and assumes constant returns to scale. Banker, Charnes, and Cooper(1984) developed a new formulation of DEA, commonly known as the BCC model, which enables to compute efficiency under the assumption of variable returns to scale while CCR model assumes constant returns to scale.

The DEA-based Malmquist Productivity Index (MPI) measures productivity change over time. The Malmquist productivity index is defined on benchmark technology satisfying constant returns to scale, which can be distinguished from best practice technology allowing for variable returns to scale. Another type of efficiency analysis frequently used is stochastic frontier analysis(SFA), which is a parameterized model. The stochastic frontier model is used in a large literature of studies of production, cost, revenue, profit and other models of goal attainment.[4)]

Ⅲ. Empirical Method

1. Efficiency Measures and Data Envelopment Analysis

Efficiency can be defined as the ratio of a weighted sum of outputs to a weighted sum of inputs. A higher ratio of measured output to measured input factors can be directly interpreted as higher efficiency. There are a number of methodologies which can be used for unit evaluation of efficiency including output-to-input ratio approach, regression, cost function, and total factor productivity indexes. Non-parametric approaches like DEA have the benefit of not assuming a particular functional form/shape for the frontier; however, they do not provide a general relationship relating output and input. The DMUs usually use a set of resources, referred to as input indices, and transform them into a set of outcomes, referred to as output indices. The DEA efficiency assessment model uses envelope line technology to replace the general economics of individual production function. DEA successfully divides them into two categories: efficient and inefficient DMUs. For the category of inefficient DMUs, the efficiency score is derived from comparisons involving performances

3) See Park(2008) for detailed list of literature using DEA for specific industry.
4) References by category of industry and by analysis method, either DEA or SFA, are well listed in Kim, Choi and Lee(2007).

of different sets of efficient DMUs.

DEA has been credited for not requiring a complete specification for the functional form of the production frontier nor for the distribution of inefficient deviations from the frontier. Rather, DEA requires general production and distribution assumptions only. The main advantage to this method is its ability to accommodate a multiplicity of inputs and outputs. It is also useful because it takes into consideration returns to scale in calculating efficiency, allowing for the concept of increasing or decreasing efficiency based on size and output levels. Other advantages of the DEA based efficiency evaluation method include utilization of both output and input observations, accommodation of both controllable and uncontrollable factors, computation of a single index of productivity, and development of a relative measure of performance for each DMU using the best performers as the bases. Moreover, unlike total factor productivity indexes, DEA gives each of the observations its own set of weights which make the analysis more appropriate.

A drawback of the DEA method is that model specification and inclusion/exclusion of variables can affect the results. DEA model requires general production assumptions, but if those assumptions are too weak, inefficiency levels may be systematically underestimated in small samples. In addition, erroneous assumptions may cause inconsistency with some bias over the frontier leading to overestimation of efficiency. So it may lead to derivation of too many DMUs to be considered efficient. Furthermore, if only one efficient DMU can be chosen due to budget constraints, that places a limit of being incapable of ranking groups. Therefore, the ability to alter, test and select production assumptions is essential in conducting DEA-based research.

This study used the CCR model to measure the DMUs' operating efficiency. CCR model is most commonly used in DEA method and assuming constant returns to scale. The theoretical description is as follows:[5)]

Suppose n DMUs and each DMU k $(k=1,\cdots,n)$ produces r types of output y_{rk} $(r=1,\cdots,s\ ;\ k=1,\cdots,n)$ >0 using the m types of input factors x_{ik} $(i=1,\cdots,m\ ;\ k=1,\cdots,n)$ >0. Then the efficiency value of DMU k from the input based CCR model can be analyzed as follows:

$$Max \quad \frac{\Sigma_{r=1}^{s} u_{rk} y_{rk}}{\Sigma_{i=1}^{m} v_{ik} x_{ik}} \tag{1}$$

$$s.t.$$

$$\frac{\Sigma_{r=1}^{s} u_{rk} y_{rj}}{\Sigma_{i=1}^{m} v_{ik} x_{ij}} \leq 1,\ where\ j=1,...,n$$

$$u_{rk},\ v_{ik} \geq \epsilon,\ where\ r=1,...s,\ \text{and}\ i=1,...m.$$

where

u_{rk}: the weight assigned to the r th output of DMU k

v_{ik}: the weight assigned to the i th input of DMU k

y_{rk}: amount of the r th output for DMU k

x_{ik}: amount of the i th input for DMU k

m : total number of input factors

s : total number of output variables

ϵ: Non-Archimedean Quantity, which is arbitrary small positive values

5) Kim and Kim(2010)

The fractional linear program (1) can be written as a linear program with $s+m$ variables and $n+s+m+1$ constraints. The problem is then formulated as:[6)]

$$Max \quad \theta_k = \sum_{r=1}^{s} u_{ry} y_{rk} \tag{2}$$

$$s.t.$$

$$\Sigma_{i=1}^{m} v_{ik} x_{ik} = 1$$

$$\Sigma_{i=1}^{m} u_{rk} y_{rj} - \Sigma_{i=1}^{m} v_{ik} x_{ij} \le 0$$

$$u_{rk},\ v_{ik} \ge \epsilon$$

where, θ_k: efficiency value of DMU k.

$j=1,...,n;\ r=1,...,s;$ and $i=1,...,m$

The optimal value θ_k^* indicates the efficiency score of DMU k. If $\theta_k^*=1$, DMU k is being operated efficiently and if $\theta_k^* \neq 1$, DMU k is not efficient. If $\theta_k^* \neq 1$, DMU k may increase its efficiency score by reducing the amount of input or increasing the amount of output, as it is not being operated efficiently. In other words, the efficiency score can be improved by adjusting the variance of the input and output variables.

For more introductory explanation of the DEA method, techniques, and references, see Park(2008).

2. Malmquist Productivity Index(MPI) methodology[7)]

The DEA-based Malmquist productivity index can be decomposed into two components: one measuring the technical change and the other measuring the frontier shift.

The Malmquist Productivity Index(MPI) is defined as:

$$M^t = \frac{D^t(x^{t+1}, y^{t+1})}{D^t(x^t, y^t)},\ M^{t+1} = \frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^{t+1}(x^t, y^t)} \tag{3}$$

where $D^t(x^t, y^t)$ is an output distance function using input x^t to produce output y^t which is technically feasible in period t and $D^t(x^{t+1}, y^{t+1})$ indicates an output distance function with x^{t+1} and y^{t+1}.

Using the benchmark technology in two time period t and $t+1$, the Malmquist productivity index, which measures the productivity change of a particular DMU_k in time t and $t+1$, can be written as the geometric mean of the two:

$$M(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\frac{D^t(x^{t+1}, y^{t+1})}{D^t(x^t, y^t)} \times \frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^{t+1}(x^t, y^t)} \right]^{\frac{1}{2}} \tag{4}$$

It can be seen that the above measure actually is the geometric mean of two Malmquist productivity indexes. M > 1 indicates productivity gain; M < 1 indicates productivity loss; M = 1 means no change in productivity from time t to $t+1$. In other words, if the Malmquist index on the basis of minimization of production factors is less than one, it indicates productivity decrease. If on the basis of maximization of production factors the Malmquist index or any of its elements is less than one, it signifies worsening productivity, while if the index is bigger than one, it indicates improvement in productivity.

We can decompose the Malmquist index to the Technical Efficiency Change Index(TECI), which measures technical efficiency change, and the Technical Change Index(TCI), which measures the geometric mean of the magnitudes of technical

6) For more detail, see Cooper et al.(2006)

7) Park(2008)

change along rays through (x^t, y^t) and (x^{t+1}, y^{t+1}) :

$$TECI = \frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^t(x^t, y^t)} \quad (5)$$

$$TCI = \left[\frac{D^t(x^{t+1}, y^{t+1})}{D^{t+1}(x^{t+1}, y^{t+1})} \times \frac{D^t(x^t, y^t)}{D^{t+1}(x^t, y^t)} \right]^{\frac{1}{2}} \quad (6)$$

Then, we can briefly determine the Malmquist Productivity Index change in a successive period of time as the multiplication of TECI and TCI.

$$M(x^{t+1}, y^{t+1}, x^t, y^t) = TECI \times TCI \quad (7)$$

We can further decompose productivity changes to include scale efficiency components. The Technical Efficiency Change Index(TECI) can be divided into the Pure Efficiency Change Index(PECI), which measures technical efficiency change on the best practice technologies, and the Scale Efficiency Change Index(SECI), which measures the change in scale efficiency from period t to period $t+1$. Therefore, MPI can be divided into three components of PECI, SECI, and TCI.

$$MPI = PECI \times SECI \times TCI \quad (8)$$

In an industry, occasionally companies face similar productivity decreases over a specific period of time. For example, by evaluating productivity elements, it could be observed that lack of technological advancements and necessary investments led to the productivity decrease for one company, while for another company, a decline in the size of activities and the limitation of the productivity scale were to blame, and for a third company the inefficiency of managers led to the decrease, holding the corporation's manager responsible. Therefore, the above technique demonstrates that equal decline in productivity does not indicate a common reason but the possibility of a specific explanation for each company.[8)]

Ⅳ. Data

In the DEA model, the performance determinants were used as input variables while the performance indicators were used as the output variables. The selection of correct elements is very important because efficiency score is different depending on the input and output elements. We selected input and output factors upon reviewing the input and output variables used in other studies. For efficiency measurement of a retail company, we employ the conceptual definition of the input/output factors. In this article, we used the wage as a labor variable, the current asset and fixed asset (or non-current asset) as capital variables, and operating and management costs as the other cost variables. The capital section is measured by the net value of fixed assets, which includes land, buildings, and machines. Operational expenses are included to grasp efficiency by operation degree. The total sales amount and operating income are chosen as output factors. The sales amount can show the present share of the company and the long-term development degree.

Object companies for data collection were limited to companies that continuously kept external audit company conditions over the years 2006-2010 to facilitate collecting the financial affairs information

8) Mohammadi and Ranaei(2011)

<Table 1> *Summary of Descriptive Statistics of Variables for DEA Analysis* (in million Won)

Factor			2006	2007	2008	2009	2010	Total
Input	Wage	Mean	21,672	26,853	29,203	30,449	34,155	28,466
		Max.	457,497	521,620	590,543	636,882	725,604	586,429
		Min.	228	256	250	176	180	218
		Std.Dev.	61,804	73,133	82,640	91,430	101,838	82,169
	Operating and Management Costs	Mean	90,647	111,760	124,192	135,488	155,671	123,552
		Max.	1,922,968	2,166,568	2,450,580	2,698,995	3,033,530	2,454,528
		Min.	448	490	509	656	634	548
		Std.Dev.	252,986	294,784	330,360	375,553	423,104	335,358
	Variable Asset	Mean	87,900	82,590	92,926	104,103	133,854	100,274
		Max.	3,465,106	2,153,288	1,940,403	2,032,998	2,599,159	2,438,191
		Min.	352	600	606	540	192	458
		Std.Dev.	337,331	226,321	219,410	238,140	315,315	267,303
	Fixed Asset	Mean	322,049	359,174	414,480	493,124	557,003	429,166
		Max.	8,407,208	9,789,066	11,363,280	16,625,359	18,623,012	12,961,585
		Min.	18	398	547	1,445	1,240	730
		Std.Dev.	1,088,296	1,232,709	1,441,746	1,868,650	2,187,718	1,563,824
Output	Sales	Mean	337,837	411,098	454,797	492,575	574,082	454,078
		Max.	9,055,880	9,768,132	10,509,251	11,535,281	13,516,928	10,877,094
		Min.	562	764	1,437	1,437	1,381	1,116
		Std.Dev.	1,172,191	1,300,702	1,404,096	1,561,684	1,784,198	1,444,574
	Operating Profit	Mean	25,921	27,239	29,541	34,980	42,487	32,034
		Max.	749,372	765,773	839,955	919,306	1,148,382	884,558
		Min.	-25,269	-64,899	-159,183	-30,534	-34,849	-62,947
		Std.Dev.	99,798	104,301	111,958	124,125	148,902	117,817

<Table 2> *Retail Industry Classification and Number of Firms*

Group	Class	Subclass	No. of Firms
Retail Sales in Non-Specialized Stores	Retail Sales in Non-Specialized Large Stores(≥3,000㎡)	Department Stores	29
		Retail Sales in Other Non-Specialized Large Stores	29
	Retail Sales in Non-Specialized Stores with Food or Beverages Predominating(<3,000㎡)	Supermarkets(165㎡~3,000㎡)	13
		Convenience Stores	5
		Retail Sales in Other Non-Specialized Stores with Food or Beverages Predominating(<165㎡)	2
Non-Store Retailers	Retail Sales via Mail Order Houses	Electronic Commerce via Internet(OnlineRetailing)	23
		Other Retail Sales via Mail Order Houses(Homeshopping,CatalogRetail)	6
	Other Non-Store Retail Sales	Vending Machine Operation	2
		Retail Sales of Contract-Delivery	1
		Door to Door Retailing of Merchandise	1

Note: The subclass categories' English names are from the Korean National Statistical Office.(http://kostat.go.kr)

of input and output variables.

We collected financial data for 111 such retailing companies. Table 1 presents the summary of the descriptive statistics.

For our research, we defined the retail industry and classified the types of businesses based on Korea Standard Industry Code (Rev. 9). The KSIC has five levels: Sector, Division, Group, Class and Subclass.

We obtained our data from KisValue Database of Korea Information Service, which provides corporate information such as industry profiles, finances, and annual company reports.[9] Table 2 shows the information on retail industry classification according to KSIC.

V. Result

1. DEA Efficiency

In our research, we analyzed the relative efficiency of 111 retail companies in Korea using 2 DEA based models, the DEA-CCR model and the Malmquist productivity index model.

Efficiency, which discloses the performance for retailing industry, is derived from the relationships between input and output. The results show that the overall efficiency for the retailing industry is 0.5942, rendering it difficult to assess that the retail companies have shown efficient performance. The maximum value of DMU efficiency score is 1 and the minimum is 0.0378 showing great difference gap between companies. Table 3 presents the overall DMU analysis results over the years of 2006-2010.

Table 4 shows the comparative DEA efficiency score for the 111 retail companies categorized by the type of business. Convenient stores result in the comparatively highest average efficiency score of 0.7833 followed by other retail sales via mail order houses(0.7483) and electronic commerce via internet(0.6424). On the contrary, supermarkets show the comparatively lowest DEA efficiency score

<Table 3> DEA Analysis Results for Retail Companies in Korea from 2006-2010

	2006	2007	2008	2009	2010	Total
Efficiency(Mean)	0.6103	0.6006	0.5868	0.6000	0.5732	0.5942
Max.	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Min.	0.0558	0.0718	0.0808	0.0412	0.0378	0.0378
No. of DMUs	111	111	111	111	111	111

<Table 4> DEA Analysis Results for Retail Industry by Category of Business

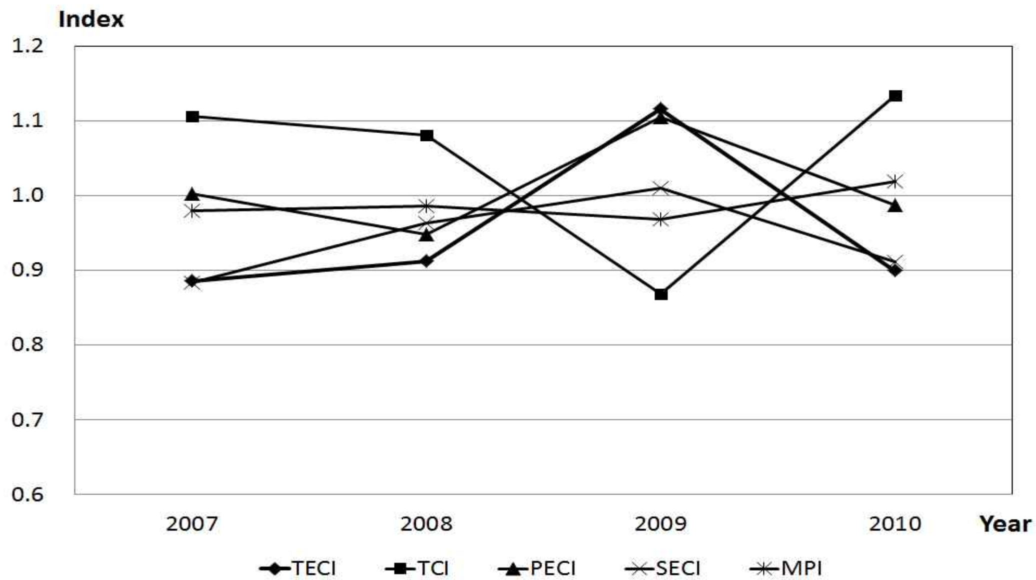
Classification	DMUs	2006	2007	2008	2009	2010	Average
Department Stores	29	0.5894	0.5768	0.5387	0.5187	0.5464	0.5540
Supermarkets	13	0.5161	0.5164	0.5200	0.5419	0.4934	0.5176
Retail Sales in Other Non-Specialized Large Stores	29	0.5187	0.5323	0.5332	0.5950	0.5998	0.5558
Convenience Stores	5	0.7887	0.8213	0.7908	0.8623	0.6532	0.7833
Retail Sales in Other Non-Specialized Stores with Food or Beverages Predominating	2	0.6095	0.4796	0.7767	0.7942	0.8686	0.7057
Electronic Commerce Via Internet	23	0.7499	0.6999	0.6418	0.6038	0.5167	0.6424
Other Retail Sales via Mail Order Houses	6	0.7316	0.7058	0.7160	0.7665	0.8218	0.7483
Others	4	0.5259	0.5967	0.6801	0.7190	0.5373	0.6118

Note: The ‘Others’ category includes retail sales of contract-delivery, door to door retailing of merchandise, and vending machine operation.

9) http://www.kisvalue.com

<Table 5> Results of the Malmquist Productivity Index Analysis

	TECI (b×c)	TCI (a)	PECI (b)	SECI (c)	MPI (a×b×c)
2007	0.8858	1.1054	1.0025	0.8836	0.9792
2008	0.9119	1.0802	0.9472	0.9628	0.9851
2009	1.1155	0.8683	1.1051	1.0094	0.9686
2010	0.8993	1.1334	0.9866	0.9114	1.0192
Geometric Means	0.9488	1.0412	1.0087	0.9406	0.9878



<Figure 1> Productivity Change over Time

of 0.5176 following department stores(0.5540) and retail sales in other non-specialized large stores(0.5558). The reason behind these results seems to be that large-scale stores such as department stores and supermarkets require higher fixed assets, which causes an excess of input.

2. Malmquist Productivity Index

We provide an extension to the DEA-based Malmquist approach. The Malmquist productivity index approach not only reveals patterns of productivity change and presents new interpretations along with the managerial implications of each Malmquist component, but also identifies the strategy shifts of individual DMUs based upon isoquant changes.

Through analysis of the two Malmquist components, we present Malmquist indices (productivity growth) decomposed into technical efficiency change and technological change for the 111 retail companies. The average MPI index of the retail companies in Korea is less than 1, which indicates decreasing productivity from 2007 to 2009. The overall productivity in the 111 retail companies has decreased by 1.2% annually from 2006 to 2010. The

<Table 6> *Average Productivity Index by Business Category(2006-2010)*

Classification	DMUs	TECI (b×c)	TCI (a)	PECI (b)	SECI (c)	MPI (a×b×c)
Department Stores	29	0.9547	1.0263	0.9766	0.9792	0.9792
Supermarkets	13	0.9405	1.0622	1.0558	0.8953	0.9998
Retail Sales in Other Non-Specialized Large Stores	29	1.0017	1.0376	1.0211	0.9859	1.0383
Convenience Stores	5	0.9262	1.0517	0.9930	0.9316	0.9747
Retail Sales in Other Non-Specialized Stores with Food or Beverages Predominating	2	0.9670	1.0310	0.9562	1.0109	0.9952
Electronic Commerce via Internet	23	0.9059	1.0548	1.0222	0.8946	0.9547
Other Retail Sales via Mail Order Houses	6	1.0919	1.0556	1.0377	1.0379	1.1520
Others	4	0.9333	1.0247	1.1880	0.8003	0.9532
Mean	111	0.9488	1.0412	1.0087	0.9406	0.9879

Note: The ‘Others’ category includes retail sales of contract-delivery, door to door retailing of merchandise, and vending machine operation.

MPI index in 2010 is 1.0192 indicating a 1.9% productivity increase, compared to 2009. The reduced productivity is due to decrease in TECI in 2007 and 2008 and decrease in TCI in 2009. Despite the decrease in TECI, the increase in TCI in 2010 led to an increase in productivity in 2010. Figure 1 shows the productivity change measured by MPI over time.

Table 6 shows the MPI analysis results by type of business for the 111 companies.[10] The sub-category industries that show productivity increases from 2006 to 2010 are other retail sales via mail order houses(15.2%), retail sales in other non-specialized large stores(3.8%). The remaining sub-category industries show decreases in productivity. Electronic commerce via internet, for example, shows a 4.5% decrease in productivity compared to the results in 2006.

Ⅵ. Conclusion and Implications

In summary, the results of the DEA method show that the overall efficiency for the retailing industry is 0.5942, revealing that retail companies have yet to demonstrate efficient performance. Upon taking a closer look into sub-categories of industries, convenient stores had the comparatively highest average efficiency score of 0.7833 followed by other retail sales via mail order houses(0.7483) and electronic commerce via internet(0.6424). Supermarkets, department stores, and retail sales in other non-specialized large stores exhibited comparatively low DEA efficiency scores. The explanation for these results seems to be that large-scale stores such as department stores and supermarkets require higher fixed assets, which causes an excess of input. The results of the Malmquist productivity index analysis show that overall productivity of 111 retail companies decreased by 1.2% annually from 2006 to 2010. The sub-category industries that showed productivity increase from 2006 to 2010 are other retail sales via mail order houses(15.2%), and retail sales in other non-specialized large stores(3.8%).

Through these analysis results, we can draw some implications for our retail industry as follows:

10) The time trends results by retail industry classification is provided upon request since it is difficult to present all the decomposed MPI index over time period in one table.

First, retail companies in Korea had decreased productivity performance while still experiencing much technological improvement. In particular, relatively small supermarkets show low scale efficiency change index(SECI), while large sized retail companies can improve their scale economies. Therefore, small and mid-sized retail companies need to improve their management efficiency for overall efficiency improvement in the retail industry. Small and medium sized retail companies may need to organize themselves in order to achieve scale economies.

Second, while inefficiency of input has generally existed in the retail industry, the degree of excessive input is decreasing and the efficiency of the retail industry is improving. Consequently, such inefficiency in input will continue to improve. In these circumstances, retail companies are required to improve efficiency of the overall retail industry, expand in size, specialize in retailing, and control amount of input.

Third, Korea’s retail industry has experienced a large extent structural change since the distribution market opened in 1996. Consumers are now more familiar with convenient shopping methods and delivery services. Thus, it is expected that internet retailing or home shopping will be the key drivers in the retail industry in Korea. Therefore, these businesses should prepare to react to any expected future changes in the retail industry. Regarding Efficiency improvement in these categories of business is important to improve overall retail business efficiency in Korea and may be the key points for retail industrial growth. Therefore, new investments and other policy measures to improve efficiency in these businesses for the future are important.

Because the efficiency drawn in this research is relative efficiency, it is difficult to make a direct comparison among companies. The analysis of the efficiency of retail companies in this article was limited to financial data because of the problems of data accuracy and data collection. As a result, many small sized (or family owned) retail businesses were excluded as their efficiency could not be analyzed by its size. Therefore, research that uses the non-financial index to reflect identifiable marks of retail industry and analyzes the administration efficiency of individual retail company is necessary. We leave the study of the efficiency analysis of small businesses for future research by developing an instrumental variable method to measure the efficiency of small sized businesses. We also leave the study of the comparison with other DEA models and stochastic frontier models for further study. A BCC model, for example, assumes variable returns to scale and can provide a decomposition of CCR efficiency into technical and scale components. A stochastic frontier models can also be alternative analysis for measuring DMU’s efficiency.

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REFERENCES

Bank of Korea (2011), *National Account.*

Charnes, Abraham, William W. Cooper, and Edwardo L. Rhodes (1978), Measuring the Efficiency of Decision Making Units, *European Journal of Operational Research,* 2(6), 429-444.

Cooper, William W., Lawrence M. Seiford, Kaoru Tone (2006), *Introduction to Data Envelopement Analysis and Its Uses,* Springer.

Farrell, Michael (1957), "The Measurement of Productivity Efficiency," *Journal of the Royal Statistical Society,* Series A(General), 120(3), 253-290.

Kim, Chun-Kon, Suk-Kyung Kim, and Hun-Koo Ha (2010), *Efficiency Analysis and Policy Suggestions for Strengthening Competitiveness of Korean Logistics Industry,* Research Report, 2010-578, Korea Institute for Industrial Economics and Trade(KIET).

Kim, Suk-Kyung, Chun-Kon Kim and Ki-Hwan Kim (2011), *Structural Change Analysis and Policy Suggestions for Strengthening Competitiveness of Korean Retail Industry,* Research Report, 2011-602, Korea Institute for Industrial Economics and Trade(KIET).

Kim, Seongho, Tae-Sung Choi and Dongwon Lee (2007), *Efficiency Analysis − theory and its applications,* Seoul Economy and Business Management press.

KISVALUE, http://www.kisvalue.com/

Mohammadi, Ali, and Habibollah Ranaei (2011), "The Application of DEA based Malmquist Productivity Index in Organizational Performance Analysis," *International Research Journal of Finance and Economics*, 62, 68-76.

Park, Man-Hee (2008), *Efficiency and Productivity Analysis,* Korean Studies Information(KSI).

Statistics Korea (2011), *Economically Active Population Survey.*

한국 소매유통기업의 상대적 효율성에 대한 연구*

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초 록

본 논문은 2006-2010년간 한국의 111개 소매유통기업에 대해 자료포락분석(Data Envelopment Analysis: DEA) 및 맘퀴스트 생산성 분석(Malmquist Productivity Analysis)을 이용하여 상대적인 효율성을 연구하였다. 자료포락분석을 이용한 실증분석 결과에 따르면, 분석 대상 국내 유통기업 전체에 대한 효율성 값(이하 기간 평균)으로 0.5942로 일반적인 효율성 판단 기준인 0.5를 약간 상회하는 것으로 나타나, 우리나라 소매 유통기업들이 평균적으로 크게 효율적이라고 판단하기 어려운 것으로 보인다. 소매유통기업을 세부 업종별로 나누어 효율성을 산정한 결과, 편의점의 전체 효율성 값이 0.7833으로 나타나 다른 업종에 비해 상대적으로 효율적인 것으로 나타났다. 그 다음은 통신 판매업(0.7483)과 전자상거래업(0.6424)이 효율적인 것으로 나타났다. 반면에 슈퍼마켓(0.5176), 백화점(0.5540), 기타 대형 종합소매업(0.5558)은 상대적 효율성 값이 낮게 나타났다. 백화점, 기타 대형 종합소매업, 슈퍼마켓 등 대형 판매시설이 필요한 업종의 경우 다른 업종에 비해 고정자산의 과다투입이 상대적으로 큰 것으로 나타났으며, 이러한 요인이 상대적 효율성 값에 영향을 준 것으로 보인다. 한편, 맘퀴스트 생산성 분석결과는 유통기업들의 전반적인 생산성이 2006-2010년 동안 연평균 1.2% 감소한 것으로 나타났다. 또한, 국내 유통기업의 경우 기술진보를 통한 생산성 향상은 꾸준히 이루어지고 있으나, 규모의 경제를 통한 생산성 제고 노력이 미흡한 것으로 나타났다.

주제어 : 소매유통기업, 기업데이터, 자료포락분석, 효율성, 맘퀴스트 생산성 분석.

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