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Comparison of Media Company Performance Efficiency Based on the Search Engine's Method of Providing News Content (External Links vs. Internal Links)

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Abstract: The conflict between the search engine and the news media industries has become a fierce dispute. News media companies produce news content and receive advertising and subscription fees, however, search engines that select and place content that they did not create themselves do not pay copyright fees, depending on the situation. We focused on search engines that use two hyperlink methods (external links vs. internal links) to deliver news content to consumers and analyzed how the two hyperlink methods affect the technical efficiency of media companies. Still, there have been few empirical studies on the performance efficiency of news media companies depending on how search engines provide news content. Analyzing by meta-frontier production function, the result shows when news services are provided through internal links, media companies are strongly constrained under the influence of search engines regardless of the companies' size, financial status, and reputation. However, if a media company can provide a suitable user interface and high-quality content to consumers, the external link strategy can be competitive with the internal link strategy. The result of this study can be a starting point for resolving conflicts between search engines and the media industry.

Keywords: search engine; hyperlink; external link; internal link; news media; technical efficiency



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1. Introduction

The media industry is wary of search engines that have emerged as a new power [1]. Conflicts with content providers are also increasing because search engines do not produce content but gain profits by mediating content to users [2]. Early search engines started as directory services that categorized vast amounts of information along with search services [3]. After that, the role of providing content such as news, games, and entertainment has been gradually strengthened by taking advantage of high accessibility and low diffusion cost [4]. As such, the search engine, which has expanded its scope, from directory services, search, and e-mail, to various contents, entertainment, communication, and commerce, is called a web portal [5]. As search engines have editorial rights to selectively publish news content and change titles [6], the influence of search engines on the media industry has increased, and web portals, including search engines, are recognized as a huge media [7].

Because the method of publishing content by search engines affects content consumption, the media industry's interest in this method is very high [8,9]. Journalism through internet services grew with the development of information technology [10], and search engines were referred to as gateways as well as gatekeepers [11]. The media industry is wary of the fact that search engines have gained excessive market power [12]. As it becomes important to appear higher on search engine results pages (SERPs) displayed in response to

a user's query, the discussion of search engine optimization (SEO) and hyperlink methods is steadily progressing [13].

Unlike existing news media companies that publish news content within their web pages, search engines provide content from various sources via hyperlinks [14]. Hyperlinks are divided into an internal link method that allows users to view news content while staying within the interface of a search engine, and an external link method that connects directly to a web page of a media company that provides news content [15,16]. Internal links are used by many search engines and portals because they have the advantages of short loading time, simple advertisement placement, and high user convenience through a unified interface [17]. Currently, Yahoo Japan, Daum of Korea, Yandex of Russia and Facebook News provide news content through internal links. In particular, Google, the world's largest search engine, mainly uses external links, and uses internal links only in its mobile app 'Google News'. There are also search engines that use both external links and internal links. Korea's Naver and China's Baidu provide news services using a mix of external links and internal links. The external link method is evaluated to have relatively lower user convenience compared to the internal links method [18]. Instead, the external link method connects news consumers directly to the web page of the media company, enabling various agenda settings. This method has the positive function of facilitating competition among media companies while alleviating the power concentration of search engines and portals [18]. In addition, in the case of the external link method, data of users can be utilized by each news media company as well as a search engine.

Methods such as content placement and hyperlinks affect the user's content consumption process [19]. In particular, the internal links method re-mediate news content to users and the search engine sets the public agenda as a gatekeeper [20], which has a greater impact on users' opinions than individual news media [21]. In addition, since all users can leave comments within the internal links of a search engine, the influence of user interaction is superior to that of individual news media [16]. On the other hand, there is criticism that the internal link method has a negative impact on the media industry due to the mass production of entertainment-oriented soft news and the risk of manipulation of user comments [22]. For this reason, some argue that the news service of the search engine should be converted to an external links method [23]. In Korea, as large-scale political comment manipulation was revealed in the news content of internal links in 2018, many news media are arguing that the news service of search engines should be changed to external links. However, according to Neys and Jansz [22], the external link method cannot solve all the problems because it has a disadvantage in that excessive advertisements and stimulating news increase to improve profitability. Google, which has been using the external link method for a long time, is also not free from conflicts over the distribution of advertising revenue with news media in each country [24]. Search engines effectively provide important information, and news media companies are wary of the search engines becoming a new power group, so in the current situation, conflict between search engines and companies is inevitable [25].

Therefore, this study focused on the conflict between search engines and news media companies, which have been in the deepest dispute for a long time within the confrontation structures between traditional companies and new technology companies. News media companies claim autonomy and adequate compensation for the use of news content, arguing that search engines dominate the web traffic and advertising market without any effort on content creation [26]. However, existing studies have focused on how gatekeepers develop specific issues into social agendas [27] or the process of dissemination and transfer of news content according to the interaction between search engines and consumers [28], which were often analyzed for search engines as news gatekeepers. Hinman [29] noted the opacity of search engines and pointed out that the public has no choice but to believe that search engines will not operate as falsified gatekeepers because they do not know exactly how they work. There has also been academic attention on the ethical issues of search engines, which have a dominant position in the media industry [30,31], including

discussions of the privacy issues related to search engine policies and practices [29,32]. Research on ethical issues and privacy in the field of search engines has been limited to seeking better access to personal information [33].

In addition, there have been studies on the empirical impact of online agendas [34] and studies to evaluate the value of broadcasting contents by focusing on the problem of profit distribution among media companies [35]. Studies on the usefulness and value evaluation of search engines were not linked to media companies and did not extend to hyperlink methods [36]. There has been no empirical study on how the performance efficiency of a news media company varies depending on the hyperlink method selected by a search engine. The method of hyperlinks used by search engines is becoming an increasingly important and controversial topic because exposure to the top pages of search results means more opportunities for content to be distributed [37].

Therefore, this study aims to examine the effect of the external link method and the internal link method on the technical efficiency of news media companies. For this purpose, we looked at the case of the search engine Naver, which uses both external and internal link methods. Naver was selected because it has the highest market share in a specific region and distributes news from various media companies using both external and internal link methods. There are 123 news media companies providing news content to Naver, of which 63 companies use external links and 60 companies deliver news content to consumers using internal links. Therefore, in this study, the technical efficiency of the two groups is compared using stochastic frontier analysis (SFA), and the meta-technology ratio of the two groups is compared using meta-frontier analysis (MFA) to examine the efficiency of news media companies according to the hyperlink method. Of course, in addition to the types of links, many factors such as the types of contents, categories, length, mood and tone can affect the technical efficiency of news media companies. However, in this study, as in other previous studies [38–40], it was assumed that the effects of other variables were averaged out, and only the effects of the types of link were examined. The results of this study are expected to provide an empirical clue to alleviating the conflict between search engines and traditional news media, which has intensified due to the gatekeeping controversy. This study can serve as prior research for multinational search engines such as Google and companies that started news services such as Facebook and Apple to negotiate copyrights with news media or measure content usage fees. In addition, it can be a basic verification case for the hyperlink methodology, which is gaining importance in social media, online shopping, video content, and financial services.

2. Literature Review

Hyperlinks enable free movement on the Internet through interconnection between all information units present on the Internet. The hyperlink service goes beyond the meaning of a technical device that simply connects web pages and extends horizontally to various areas and lower layers of content composition, acting as a key indicator to show the flow of information [19]. Therefore, comparing external links and internal links is a very important part of the research to promote search engine optimization (SEO) of all websites. Websites typically try to achieve search engine visibility through search engine optimization and paid search ads. Unlike paid search, where web pages are displayed when searching for specific keywords, SEO has high research value because it analyzes the algorithm of the search engine and enables the website to be displayed technically and organically on the top of search engine results pages [19,41]. Therefore, SEO has been studied in various fields such as image search, video search, academic search, news search, and industry-specific search engines under the subject of crawling search engines and hyperlinks [42].

SEO extensively studies how search engines work, algorithms, and search behaviors of users, as well as how search engines provide services that users prefer. Research on SEO has continued to expand as the potential customer base grows when more visitors flow into the SERP [43]. Website operators who mainly use paid search judge that SEO implementation is difficult, expensive, and does not consistently produce satisfactory results. However,

users consider the reliability of the SERP to be an important factor when selecting a web page as a search result. Users trust the content of websites displayed according to user search results more than websites displayed with paid advertisements at the top. Therefore, it is increasingly important to study SEO that can be realistically applied by websites while satisfying user needs [44].

Efforts for search engine optimization began in the mid-1990s with the webmaster, a website administrator. SEO in the early stage remained at a basic level before the field was subdivided, such as a web crawler crawling a web page and extracting links from that page to other pages [45]. The algorithms of search engines continued to develop to select the content according to relevance and to determine the order arrangement of the exposure of web pages and the search results [46]. After that, as website operating companies gradually recognized the value of the SERP, resource allocation for SEO continued [47]. As a result of resource allocation for SEO, unnecessary traffic was reduced, the inflow of potential consumers increased, and it was confirmed that the real profit of the company improved [48]. Therefore, search engines such as Google conduct research, conferences, and seminars for SEO, and provide information and guidelines for SEO publicly.

Research on SEO in academia and business is focused on demonstrating the effectiveness of online marketing by paying attention to short-term performance indicators. Malaga [49] said that the ranking of web pages at the top of the SERP is a key role of SEO. Rubel et al. [50] emphasized that search engine marketing should be considered first when a for-profit company builds a web page, and it is important to establish a strategy to induce visitors to web pages from SERPs. The main studies related to search engines have been focused on how to improve the usefulness of the search engine, strengthen the marketing competitiveness of web pages, or increase consumer convenience [36]. In addition to research on SEO, discussions on ethical issues and privacy protection of search engines have also been conducted in the direction of maximizing search engine efficiency [33]. It was also emphasized that search engines artificially intervene in the content and media sectors to enforce editorial rights to enhance consumer experience and convenience [47]. Based on this, there have been many comprehensive attempts to evaluate the usefulness and value of search engines. Geoghegan [51] provides five measures to compare search engine usability. He compares several major search engines by the look of the input window and result list, relevance of results, speed of result list calculation, and the performance of results based on a natural question. Lewandowski [52,53] proposed a quality framework for a search engine, which consists of search engine usability, quality of the results, quality of search features, and index quality.

However, as mentioned above, despite the heightened conflict between search engines and news media companies, there are not many studies of the effect on the performance efficiency of news media companies by paying attention to the hyperlink method of the search engine. Research related to hyperlinks has been focused on analyzing social phenomena in each region using the amount, direction, and concentration of hyperlinks. The fact that the offline social network structure is being projected online has also been studied from various angles through hyperlink analysis [54]. There have also been studies that classified content into subjects such as politics, economy, religion, and culture, and looked at which fields were at the center of the network or were most exclusive and isolated through the number and concentration of hyperlinks [55]. There was also a study analyzing the direction and amount of hyperlink flow to determine which structure or form of media spreads news content well [56,57].

There have also been studies on hyperlink characteristics that affect content usage motivation and content comprehension by paying attention to the user's point of view. Wise et al. [58] reported that the motivation to use the content is enhanced only when a certain amount of news content is provided to the user through an appropriate hyperlink on the web page. There was also a study showing that the level of users' content perception and comprehension was affected by the degree of information and interest of hyperlink phrases [19]. However, research on the media industry and news content was lacking, and

the fact that SEO and hyperlink research was conducted focusing on the needs of online companies represented by e-commerce is a limitation of existing research. Although there have been many studies on hyperlinks for SEO, online marketing, and online commerce, it is necessary to separately consider how the performance efficiency of news media companies varies depending on the hyperlink method used by the search engine.

3. Methodology

3.1. SFA (Stochastic Frontier Analysis)

SFA expresses the relationship between input and output factors as a production function, and technical efficiency is estimated through the frontier production function, which represents the maximum output versus input. The TE (technical efficiency) of a company indicates where the company's technology level is relative to the efficiency technology level expressed in the form of a frontier production function. The farther the company's technology level is from the frontier production function, the lower the efficiency of the company. The production frontier can be estimated through non-parametric and parametric methods. In this study, the parametric method estimates the production frontier using stochastic frontier analysis. Also, in this study, FRONTIER Version 4.1 provided by Coelli is used for estimation.

According to Battese and Coelli [59], a stochastic production frontier model is assumed as shown in Equation (1) below to reflect the change in efficiency over time.

$$Y_{it} = f(x_{it}, \beta) e^{V_{it} - U_{it}}, i = 1, 2, \dots, N, t = 1, 2, \dots, T \quad (1)$$

Y_{it} is the output of firm i at time t , x_{it} is the input vector of firm i at time t , f is a production function, β is a vector comprising parameters of the production function, V_{it} is independent of U_{it} and is a random error with a distribution of $(0, \sigma_v^2)$, and U_{it} is a non-negative random variable representing the technical efficiency of company i at time t . V_{it} is the general random error of the regression equation, and U_{it} is the company's inefficiency. In order to always show inefficiency, U_{it} itself is not negative, and it is assumed that U_{it} follows a half-normal distribution in this paper. In this study, data from 2013 to 2020 were used, and T is 8. From Equation (1), the technical efficiency TE_{it} of company i at time t is given as Equation (2) below.

$$TE_{it} = e^{-U_{it}} = \frac{Y_{it}}{f(x_{it}, \beta) e^{V_{it}}}, i = 1, 2, \dots, N, t = 1, 2, \dots, T \quad (2)$$

In general, the translog function and the Cobb–Douglas function are most widely used as the production functions of SFA. The Cobb–Douglas function tends to be oversimplified because it sees the output variable as a linear combination of only the input variables. In this study, the translog function is used. In particular, we use a random effects time-varying production model. Assuming the translog form of the production function, Equation (1) can be expressed as Equation (3) below.

$$\ln Y_{it} = \beta_0 + \sum_{m=1}^3 \beta_m \ln x_{mit} + \sum_{m=1}^3 \sum_{k \geq m}^3 \beta_{mk} \ln x_{mit} \ln x_{kit} + V_{it} - U_{it} \quad (3)$$

In this case, x_{1it} represents the size of capital (K) of the i -th company at time t , x_{2it} represents the size of the cost (M) of the i -th company at time t , and x_{3it} represents the labor (L) of the i -th company at time t . In this study, K is the total asset, L is the total labor cost, and M is the selling general and administrative expense. Also, net sales is used for output Y .

3.2. MFA (Meta-Frontier Analysis)

Since it is difficult to directly compare the technological efficiency of a specific company with those operating with other technologies, the comparison of the technological efficiency

between groups cannot be performed using traditional SFA. Therefore, in order to compare the efficiency levels of different groups operating under different technical conditions, we use the meta-frontier production function that wraps the production function of all groups [59]. Created by Battese, Rao, and O'Donnell [60,61], the meta-frontier production function model is defined by the formula below.

$$Y_{it}^* = f(x_{it}, \beta^*) = e^{x_{it}\beta^*}, i = 1, 2, \dots, N, N = \sum_{j=1}^R N_j, t = 1, 2, \dots, T, \text{ s.t. } x_{it}\beta^* \geq x_{it}\beta_{(j)} \text{ for all } j \quad (4)$$

In this case, $\beta_{(j)}$ is a vector composed of the parameters of the production function of the j -th group, and β^* is an unknown variable vector of the meta-frontier function that satisfies the following equation. As shown in Equation (4) above, the graph of the meta-frontier production function is placed above the graph of the production frontier function of each group for all periods. The meta-frontier production function becomes an encircling form of the frontier function of each group based on the same technology. To simplify, if the function f of Equation (1) is $e^{x_{it}\beta_{(j)}}$, Equation (1) can be divided as follows.

$$Y_{it} = e^{-U_{it(j)}} \times \frac{e^{x_{it}\beta_{(j)}}}{e^{x_{it}\beta^*}} \times e^{x_{it}\beta^* + V_{it(j)}} \quad (5)$$

When both sides of Equation (5) are divided by $e^{x_{it}\beta^* + V_{it(j)}}$, the following Equation (6) is derived.

$$\frac{Y_{it}}{e^{x_{it}\beta^* + V_{it(j)}}} = e^{-U_{it(j)}} \times \frac{e^{x_{it}\beta_{(j)}}}{e^{x_{it}\beta^*}} \quad (6)$$

In Equation (6) above, $e^{-U_{it(j)}}$ on the right side is the technical efficiency of group j . The statement $\frac{e^{x_{it}\beta_{(j)}}}{e^{x_{it}\beta^*}}$ is the ratio of the j group frontier function to the meta-frontier function, that is called MTR (meta-technology ratio) or TGR (technical gap ratio). TE^* , which represents the technical efficiency of the meta-frontier function, is a value obtained by multiplying TE and MTR , and can be expressed as follows.

$$TE_{it}^* = \frac{Y_{it}}{e^{x_{it}\beta^* + V_{it(j)}}} = TE_{it} \times MTR_{it} \quad (7)$$

There are two methods to measure the parameters of meta-frontier functions: quadratic programming (QP) and linear programming (LP). QP is a method of minimizing the sum of squares of deviations, and LP is a method of minimizing the sum of absolute values of deviations. According to Battese, Rao and O'Donnell [60,61], QP and LP are defined as Equations (8) and (9) below.

$$QP: \min_{\beta^*} L \equiv \sum_{t=1}^T \sum_{i=1}^N (x_{it}\beta^* - x_{it}\hat{\beta}_{(j)})^2, x_{it}\beta^* \geq x_{it}\hat{\beta}_{(j)} \quad (8)$$

$$LP: \min_{\beta^*} L \equiv \sum_{t=1}^T \sum_{i=1}^N |x_{it}\beta^* - x_{it}\hat{\beta}_{(j)}|, x_{it}\beta^* \geq x_{it}\hat{\beta}_{(j)} \quad (9)$$

QP and LP find a β^* that minimizes L . Here, L is defined as in the right part of Equations (8) and (9). In this study, using Matlab R2020b, the parameters of the meta-frontier function were measured through the above QP and LP.

4. Estimation Results

In this study, we focused on media companies that publish news content on the search engine Naver. We collected data from 63 media companies that provide news content with the external link method and 60 media companies that provide news content with the

internal link method. The source of the data is KISLINE, a corporate information service operated by Nice Rating Information. KISLINE is Korea's leading corporate information service that allows users to view corporate financial data. To compare two groups of production efficiency, financial information from 2013 to 2020 of a total of 123 companies was used. Among various financial information, we select several input variables for comparing production efficiency. The input variables are total assets, cost of sales, and labor costs, and the output variable is sales. Table 1 below shows sample statistics on input and output variables of the companies used in this study.

Table 1. Sample statistics.

	External Links	Internal Links
Revenue	42,816,719,009.009	69,907,377,822.2997
(Standard Deviation)	(154,272,331,365.156)	(163,570,830,182.209)
Total Asset	44,685,966,418.9189	100,480,211,045.993
(Standard Deviation)	(305,725,470,939.046)	(197,841,629,900.742)
Total Cost of Sales	14,363,353,306.3063	31,625,542,355.4007
(Standard Deviation)	(62,303,023,103.1901)	(107,567,506,640.0230)
Total Wage	3,526,651,310.8108	7,133,729,564.4599
(Standard Deviation)	(10,605,526,263.9267)	(15,679,361,371.4579)
Number of firms	63	60
Numbers of Observations	222	287

Unit: KRW (From 'Revenue' to 'Total Wage'). Note: 1 USD = 1399 KRW (4 September 2022, Ministry of Economy and Finance, Republic of Korea).

As can be seen from Table 1 above, the total assets, cost of sales, and labor costs of media companies that provided news through internal links are generally higher than those that use external links. As a result, the sales volume of the internal link method is also larger. Table 2 below shows the estimation results of the frontier production function of the external links group and the internal links group estimated using Frontier 4.1. In addition, it shows the β^* value of the meta-frontier production function calculated using the LP and QP methods.

Table 2. Estimation results of group and meta-frontier production functions.

	External Links	Internal Links	Meta-Frontier	
	Estimate (t-Value)	Estimate (t-Value)	LP	QP
Constant	7.8800 *** (7.9329)	4.9212 * (1.9257)	8.527865	2.321221
$\ln x_1$	−8.3936 *** (−9.9765)	−0.6238 (−0.7143)	−7.29096	−4.23376
$\ln x_2$	0.8574 (1.0575)	2.2875 *** (7.0512)	1.492447	1.682885
$\ln x_3$	6.6566 *** (8.1108)	−1.5367 * (−1.7420)	4.8524	3.009739
$(\ln x_1)^2$	2.0083 *** (4.0657)	−0.4737 *** (−3.2088)	2.443998	1.433955
$(\ln x_2)^2$	−0.0670 (−0.3118)	−0.0447 (−1.2368)	0.061414	0.075224
$(\ln x_3)^2$	1.7391 *** (3.3376)	−0.6738 *** (−2.7980)	1.903512	1.209849
$\ln x_1 * \ln x_2$	0.7445 (1.3961)	−0.3822 *** (−3.6890)	0.172138	0.119306

Table 2. Cont.

	External Links	Internal Links	Meta-Frontier	
	Estimate (t-Value)	Estimate (t-Value)	LP	QP
ln x_2 *	−0.6328	0.2641 *	−0.40439	−0.41082
ln x_3	(−0.8573)	(1.8826)		
ln x_3 *	−3.6687 ***	1.3540 ***	−4.05277	−2.38309
ln x_1	(−4.3971)	(3.5107)		

Note: * $p < 0.1$, *** $p < 0.01$.

Table 3 below shows the average, standard deviation, minimum and maximum values of TE, MTR, and TE* calculated using frontier production functions and meta-frontier production functions.

Table 3. SFA estimates of technical efficiencies and meta-technology ratios.

		External Links	Internal Links
TE	average	0.6782	0.7226
	stdev	0.1317	0.0973
	min	0.3938	0.4883
	max	0.9805	0.9758
MTR_LP	average	0.9279	0.8776
	stdev	0.0780	0.1402
	min	0.5269	0.0105
	max	1.0000	1.0000
MTR_QP	average	0.8696	0.8290
	stdev	0.0581	0.1164
	min	0.6097	0.0907
	max	1.0000	1.0000
TE*_LP	average	0.6268	0.6309
	stdev	0.1215	0.1200
	min	0.2075	0.0093
	max	0.9388	0.8963
TE*_QP	average	0.5892	0.5969
	stdev	0.1191	0.1070
	min	0.2401	0.0806
	max	0.9437	0.8459

As a result of the analysis, the TE value showed that the efficiency of the internal links group (0.7226) was higher than that of the external links group (0.6782). However, in the case of two groups using different production technologies, the MTR values and the TE* values should be compared rather than basing the comparison on the TE values. In the case of TE*, the difference between the external links group (0.6268) and the internal links group (0.6309) was very small in terms of LP. In other words, whether providing news articles within a search engine or providing news articles by connecting users to their website, the meta-frontier efficiency was similar. However, the MTR of the external links group (0.9279) was much higher than the MTR of the internal links group (0.8776), and the result was completely opposite to that of the TE.

A high TE value means that a firms' production is near the group production function. The internal link method has the advantage of improving user convenience because it provides users with a uniform format of news articles, but has the disadvantage of being difficult to differentiate the content delivery environment. For this reason, the TE value of the internal links group is very high, which is consistent with the study result of Lee and Hwang [62]. On the other hand, in the case of the external links group, when a user clicks on a news link, the user goes to the website of the media company and receives the news in a unique environment created by the company. Since the news posting environment of media companies is very diverse, the standard deviation of the external links group was 0.1317, which was higher than 0.0973 of the internal links group, which is analyzed as a factor that made the TE of the external links group low. On the other hand, the fact that the MTR of the external links group is larger than the MTR of the internal links group means that the production function of the external links group is closer to the meta-frontier production function than that of the internal links group. Unlike the media companies in the internal links group, the companies in the external links group have to publish the news in their own format, so they have been striving for news placement that increases consumer convenience along with proper advertisement placement, which has increased the MTR of the external links group.

5. Discussion

After the spread of the internet, information showed a tendency of unlimited abundance and lost the economic principle of scarcity. Efforts by companies to create exchange value by enhancing the competitiveness of information have been strengthened [63]. While such competition weakened the status of news content and traditional media, it led to platform competition where consumer convenience and delivery power are important, that is, the evolution of an attention economy [64]. In the online environment, media has changed from a push model of supplying news content to consumers to a pull model that allows consumers to be drawn to news content [65], and search engines such as Google, Baidu, and Naver are leading this change. As a result, the power of traditional media companies that produce content has been declining for a long time, and the competitiveness of search engines and social media capable of collecting, arranging, and converting content has strengthened.

As a result of the analysis of this study, it was found that the technical efficiency value of the group providing news content using the internal link method was larger than the value in the group providing news content using the external link method. This means that the performance of news media companies that provide news content through internal links is closer to the group production function than the performance of companies that use external links. It cannot be concluded that the technical efficiency of media companies using the internal link method is greater or better than the technical efficiency of media companies using the external link method. On the other hand, the production function of the external links group appeared closer to the meta-frontier production function than that of the internal links group. It can be said that the technical efficiency of the external links group is superior to that of the internal links group in terms of MTR.

The results of this study can be a starting point for practically examining the clues of the conflict between search engines and the media industry. The automated algorithms of search engines appear objective and neutral, but like other media companies, the operator's subjectivity is involved, and editorial judgment occurs [48]. As a representative example, it has been pointed out that Google's algorithm is not value-neutral and has a certain bias [66]. Therefore, media companies criticize the business method of search engines that want to have editorial rights without producing content. This is because the rights and policies of search engines have a profound effect on media companies and consumers [67]. For example, a search engine's popularity-based ranking algorithm may reinforce or sustain existing power structures [66]. Therefore, this paper is meaningful in that it first examines

the difference in performance efficiency of news media companies based on the hyperlink policy of the search engine, which is one of the key issues in the field.

The result that the performance efficiency of news media companies using the internal link method is closer to the group production function than in the case of external links has several implications. When news services are provided through internal links within the format established by search engines, media companies have similar performance efficiencies regardless of company size, performance, and reputation. Therefore, it is difficult for news media companies to escape from the search engines' influence and their format within the internal link method regardless of their status as major and minor companies. As the dominance of search engine policies has increased, news media companies have come under their influence, and the two industries are still in a relationship of fundamental tensions, conflicts, and disputes. In addition, since minor news media companies show similar performance efficiencies as top-tier companies within the internal link method, the external links environment may be rather disadvantageous. Major media companies are not friendly to the search-engine-led media environment due to concerns about the increasing influence of search engines through internal links and the narrowing of the performance gap with small and medium-sized media companies.

On the other hand, it should also be noted that the production function of the external links group appeared closer to the meta-frontier production function than the internal links group. In the case of news content provided by internal links, the features of a refined interface and excellent user experience are highlighted. This is the competitiveness of search engines based on long-accumulated technical expertise, so it is not easy for most media companies to follow in a short time. However, if the news media industry settles on the search-engine-led status, it will have no choice but to maintain minimal performance efficiency. In the case of major media companies, the performance gap with minor companies is in danger of narrowing due to the internal link method of search engines. In addition, it will be difficult for major media companies to fully recover the influence they had in the past, and they will continue to be exposed to the current situation of disputes with search engines. Also, it was found that the external link method greatly widens the performance efficiency gap between media companies instead of improving the performance efficiency of the news media industry. Basically, external links will give major media companies a short-term opportunity. Even for small and medium-sized media companies, if they can secure a good interface and provide high-quality content to consumers based on technological superiority, the external links method is a more advantageous environment.

As such, depending on which hyperlink method a search engine uses, it can have a significant impact on the news media industry. In the short term, it is advantageous for small and medium-sized news media companies to improve their performance efficiency by relying on the environment of internal links provided by search engines. However, ultimately, in order to get out of the current conflict structure, media companies need to adapt to the environment of external links by reinforcing technology and content competitiveness. Recently, search engines are trying to change the interface, such as using two hyperlink methods, and news media companies can improve their mid- to long-term competitiveness while adapting to the new environment.

News consumers tend to process information according to the principle of least effort [3]. That is, they try to find the optimal balance between the search effort they put in and the efficiency of the results. Search engines provide customized news content to consumers through algorithmic technology and satisfy consumers' motives for media use, 'acquisition of information', and 'interest' [68]. Search engines have focused on technically placing news content to maximize user traffic concentration [6]. The technological gap between search engines and the news media industry has caused a transfer of power and capital, and the search engine hyperlink method is at the center of the controversy because it determines performance indicators such as user traffic. The discussion on hyperlinks is expanding in various fields such as social media, online shopping, video platforms, and

fintech services, and is not limited to news media. What these industries have in common is that the search function has become important to enhance service competitiveness in each field. In other words, since many types of platforms are fulfilling the role of search engines in their respective fields, it is expected that this study will be applied to each field and serve as a starting point for finding a balance between platforms and content producers.

6. Conclusions

This study focused on the conflict between search engines and news media companies, which are in a very deep dispute due to the confrontational situation between new technology companies and traditional companies. To find out how the hyperlink method of the search engine affects the technical efficiency of news media companies, we looked at the case of the search engine Naver, which uses both external links and internal links. As a result of analyzing the performance efficiency of media companies distributing news content through Naver, it was found that the TE value of the internal links group (0.7226) was higher than that of the external links group (0.6782), whereas in the case of MTR, the external links group (0.9279) was higher than the internal links group (0.8776). When news services are provided through internal links, media companies are strongly constrained under the influence of search engines and have relatively similar performance efficiencies regardless of size, financial status, and reputation. Media companies whose existing power is reduced will inevitably experience conflicts or disputes with search engines.

The fact that the external links group's production function is closer to the meta-frontier production function means that the external link method is more advantageous if it is a media company that can provide a suitable interface and high-quality content to consumers. However, it is difficult for most media companies to keep up with the technological superiority and user-friendly environment of search engines in a short period of time. In order to escape from the current inefficient conflict structure, media companies need to adapt to the environment of external links by reinforcing technology, content competitiveness, and user convenience. Following the study focusing on the hyperlink method, it is necessary to measure various factors that affect the performance of media companies and to establish the correct standards for content value evaluation. In addition, recognizing that media companies will have different strategies because they have different sizes, performance, financial situations, human compositions, and interests, it will also be necessary for a search engine to provide various distribution options to media companies as content providers.

Search engines and news media companies have been in conflict for a long time. Controversy has continued in several areas, such as the dispute over copyright fees between Google and media companies, and the improvement of the hyperlink method after Naver's political comment scandal, and a study on the value estimation of content [69,70] are still ongoing. It was difficult to find content value calculation results that both sides could agree with, and most of them suffered legal disputes or search engines withdrew from the market. These disputes are still spreading in each region because there is a lack of academic research on both sides to support each other. Even when search engines changed their hyperlink methods, they were often unilateral, and news media companies expressed their objections to search engine policies without clear and objective evidence. In Korea, where the news comment manipulation incident led to a major political scandal, politicians and many media companies pressured search engines to use the external link method. However, when Naver, the largest search engine in Korea, gave its affiliated media companies the option of a hyperlink method, very few media companies chose external links. The reason for the request to change the hyperlink method was unclear and it was not known how it would affect the performance of the media company. Therefore, Naver operates the external link method in a separate space while also running the internal links method.

Essentially, the structure of this confrontation and conflict is a matter of the transfer of power from traditional industries to emerging tech companies and the distribution of profits. This conflict structure extends not only to search engines and news media companies, but

also to e-commerce platforms and online sales companies, fintech companies and traditional financial companies, video and music platforms and content producers, and app stores and app producers. Some of these conflicts have been resolved in a short period of time due to an imbalance in power, while others have not yet fully risen to the surface. This study focused on the confrontation between search engines and news media companies, which is still in fierce confrontation and needs a starting point for resolution. The results of this study are expected to be a starting point for resolving the hyperlink dispute, which is the core of the conflict between search engines and news media companies. Based on this, if in-depth research on content value estimation is conducted in the future, the conflict structure can be significantly alleviated. Since the hyperlink method affects the direction of traffic, additional research should be conducted on whether the distribution of search engine profits is appropriate based on such traffic flow and whether media companies are properly receiving copyright fees.

Also, this study has a limitation in that it is difficult to be comprehensively applied to disputes between various platforms and content producers because the analysis was focused on the performance of media companies without considering conditions other than the hyperlink method. Furthermore, it is expected to develop into research that establishes objective indicators for estimating the value of content and applying them to estimating the value of news content and non-news content. Finally, it is expected that it will be applied to a study examining the structural role and utility value of the search function, which is expanding in online shopping, video platforms, and fintech services, paying attention to the movement pattern of traffic resulting from hyperlinks.

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