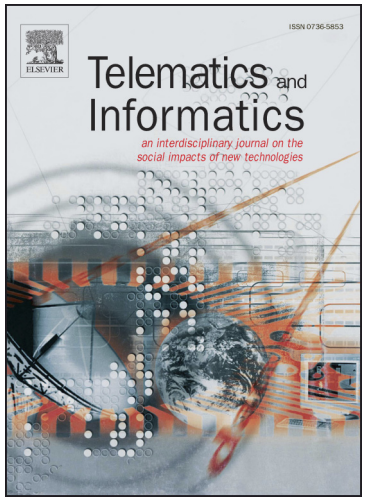


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# Efficiency comparison of digital content providers with different pricing strategies*

**Ho Seoung Na [1], Junseok Hwang [2], Jasmine Yoo Jung Hong [3], Daeho Lee [4,**],**

[1] Ph.D. Student, Technology Management, Economics, and Policy Program, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea; Email: hoseoung@snu.ac.kr

[2] Professor, Technology Management, Economics, and Policy Program, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea; Tel.: +82 2 880 8679; Email: junhwang@snu.ac.kr

[3] Ph.D. Student, Department of Interaction Science, Sungkyunkwan University, 25-2 Sungkyunwan-ro, Jongno-gu, Seoul, Republic of Korea; Email: yjasmine@skku.edu

[4] Assistant Professor, Department of Interaction Science, Sungkyunkwan University, 25-2 Sungkyunwan-ro, Jongno-gu, Seoul, Republic of Korea; Tel: +82 2 760 0683; Fax: +82-2-740-1856; Email: daeho.lee@skku.edu

** Correspondence: daeho.lee@skku.edu; Tel: +82 2 760 0683

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# Efficiency comparison of digital content providers with different pricing strategies

**Abstract**

Unlike traditional products, digital content can be offered free because the marginal cost required for additional production is close to zero. Since free digital content is offered at a lower price than that of the competitors, it is a strategy that can beat the competition. However, digital content firms use various strategies, such as the advertising sales-based strategy, freemium strategy, and membership fee-based strategy. This study categorizes Korea's digital content firms into three groups based on the pricing strategy and uses the meta-frontier analysis method in order to determine which group's production function is closer to the meta-frontier production function. In addition, Tobit regression is used to analyze whether the differences in the efficiency levels between groups are statistically significant. The results reveal that the free group has the highest efficiency, followed by the fee group and the mix group in that order.

Keywords: *digital content providers; pricing strategy; efficiency; meta-frontier;*

## 1. Introduction

The price of a product is proportional to the cost of production. According to traditional economic theories, businesses pursue profit maximization, where the price of a product is proportional to marginal cost rather than fixed cost. However, the price of digital content products, unlike traditional products, is uniquely determined. A myriad of digital content, such as information available through search engine services and Internet newspaper articles, are offered free over the Internet.

As stated in a number of literatures, including Shapiro and Varian (1999), unlike traditional products, digital content can be offered free because the marginal cost required for additional production is close to zero. Yet, although the marginal cost for digital content is almost zero, a lot of fixed cost is incurred during early production. As shown in the studies of Shapiro and Varian (1999) and Lee et al. (2006), fixed cost is reflected in the price of a product, which deviates from the traditional economic theory.

Nevertheless, another reason that digital content can be offered free is due to advertising sales. Because content providers place advertisements on the homepage that offers digital content and are thus able to gain sales from advertisers, they can offer digital content at a price lower than the actual price or for free. Gallaugher et al. (2001) and Fan et al. (2007) explain that as traditional newspapers or media firms transform their business strategy to that of the Internet, homepage advertisements become a new revenue stream, thus allowing content to be offered free. In another study, Parker and Van Alstyne (2005) showed that information goods traded in a two-sided market can also be offered at a reduced price or free to the users.

Evans (2008) describes three innovative changes of online advertising that makes it distinct from traditional advertising: 1) the placement of targeted ads through collection of user information, 2) the creation of effective market parameters for advertising deals, and 3) the emergence of specialized advertising platform firms, such as Google and advertising.com. Furthermore, Lin et al. (2012) assert that the influence of advertising on Internet content providers is a critical factor in the success of online business. Since free digital content is offered at a lower price than that of the competitors, it is a strategy that can beat the competition. In addition, when a lot of consumers are secured through this strategy,

advertising revenue also increases.

However, despite such advantages, digital content firms in reality use various strategies, such as the advertising sales-based strategy, freemium strategy, and membership fee-based strategy. For example, in 2015, among Google's total sales of $74,989M, $67,390M was from advertising sales, constituting 89.9% of the total sales; among Facebook's sales of $17,928M, $17,079M was from advertising sales, constituting 95.3% of the total sales. On the other hand, Netflix's sales reached $613.4M solely from membership fees. According to Korea Mobile Internet Business Association (2015), the sales structure of the entire mobile content firms in Korea is as follows: paid-for sales of $2,068M (40.0%), advertising sales of $1,025M (19.8%), and in-app purchase sales of $2,079M (40.2%).

Such differing views regarding the optimal pricing strategy of digital content firms can be seen in existing studies. Fan et al. (2007) propose for media firms offering content over the Internet that paid-for sales is appropriate when the product quality is high and the user's network cost is low, whereas free strategy based on advertisement is suitable when the user's network cost is high. In another study, Prasad et al. (2003) suggest different optimal strategies for content firms depending on the context: pure pay-per-view strategy for high-income users, who are willing to pay the advertising avoidance fee, and free strategy based on advertisement for high advertising sales with low-quality content. Lin et al. (2012) assert that a mixed strategy of paid and free content is most favorable for content firms in a monopoly position, and in a duopoly state, only one firm is able to employ the mixed strategy.

Therefore, the present study categorizes Korea's digital content firms into three groups based on the pricing strategy ('fee' group that offers content at a certain price, 'free' group that offers content for free, and 'mix' group that offers both paid and free content) and uses the stochastic frontier analysis (SFA) method to estimate the efficiency of each group. Although the SFA method provides the efficiency value within each group, it is unable to compare the efficiencies across different groups. Thus, the meta-frontier analysis (MFA) method is used to compare the efficiencies across different groups. In addition, Tobit regression is used to analyze whether the differences in the efficiency levels between groups are statistically significant. The present study provides implications regarding the optimal pricing strategy for digital content firms.

## 2. Methodology

To measure the efficiency value of online content firms with different pricing strategies, the present study first applies the SFA method to obtain the efficiencies of the three groups. Then the suggested MFA method is used to compare the efficiencies of the three groups of firms that engage in production activities under a different production function.

### 2.1 SFA (Stochastic Frontier Analysis)

SFA indicates the relationship between input and output with a production function. It uses the frontier production function, the maximum output from a given input, to estimate the technical efficiency. Technical efficiency (TE) of a firm refers to how the technology level of a given firm stands relative to the technical efficiency standard represented in the form of a frontier production function. Here, as the distance between a firm's technology level and the frontier production function increases, the given firm's efficiency level decreases.

To reflect the change in efficiency over time, the following equation (1) based on the SFA model suggested by Battese and Coelli (1995) is used to estimate efficiency:

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

where $Y_{it}$ is the output of firm $i$ in period $t$; $x_{it}$ is an input vector of firm $i$ in period $t$; $f(\cdot)$ is the production function; $\beta$ is the parameter of the production function; $V_{it}$ is independent from $U_{it}$ and is a random error that follows a distribution of $N(0, \sigma_v^2)$; $U_{it}$ is a non-negative random variable that represents the technical efficiency of firm $i$ in period $t$. If $V_{it}$ is a typical random error of a regression, $U_{it}$ is the firm's inefficiency. To denote a fixed inefficiency, $U_{it}$ is not negative, and it is assumed in the present paper that $U_{it}$ follows a half-normal distribution.

From equation (1), the technical efficiency of firm $i$ in period $t$, $TE_{it}$, is given as follows:

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

Generally, the Cobb-Douglas function or the translog function is most widely used as the production function of SFA. However, the Cobb-Douglas function has the tendency of oversimplification, as it considers output variables only as a log-linear combination of input variables. Therefore, the translog function, more specifically the random effects time-varying production model, is used in the present study. When assuming the use of the translog production function, equation (1) can be expressed as equation (3) shown below:

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

where $x_{1it}$ is the amount of capital (K) of an $i_{\text{th}}$ firm in period $t$; $x_{2it}$ is the amount of cost (M) of an $i$th firm in period $t$; and $x_{3it}$ is the number of employees of an $i$th firm in period $t$ that received a salary (L). The present study uses total asset as K, the cost of revenue as M, and the number of employees as L. Furthermore, the net sales value is used as output Y.

### 2.2 Meta-Frontier Analysis

The traditional SFA is unable to compare the technical efficiencies across different groups of firms with different technologies. Consequently, the meta-frontier production function that encompasses the production functions of the different groups is used (Battese & Rao, 2002). Initially, the meta-frontier analysis was largely applied to the agricultural sector. However, as of 2016, it has been applied to various areas, such as telecommunications, broadcasting, online content, as well as the information technology (IT) industry (e.g. see Hong et al. (2011), Yang et al. (2013), Lee et al. (2015), Kim et al. (2016), Lee et al. (2016)). The meta-frontier production function model proposed by Battese et al. (2004) is defined as follows:

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

where $j$ denotes each group, and the different pricing groups are represented as follows: firm that offers paid content $(j = 1)$, firm that offers free content $(j = 2)$, and firm that offers both paid and free content $(j = 3)$. $\beta^*$ is the unknown vector variable of the meta-frontier function that satisfies the equation (4). From equation (4), the meta-frontier production function graph is always located above each group's production frontier function graph during all periods. That is, the meta-frontier production function envelopes the frontier function of each group with identical technologies. For simplification, when function $f(\cdot)$ in equation (1) is assumed to be in the form of $e^{x_{it}\beta_{(j)}}$, equation (1) can be transformed as follows:

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

When both sides of equation (5) are divided by $e^{x_{it}\beta^* + V_{it(j)}}$, equation (6) is derived as follows:

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

The first part of the right-hand side of equation (6), $e^{-U_{it(j)}}$, refers to the technical efficiency (TE) of group $j$. The second part is the Technical Gap Ratio (TGR) or Meta-Technology Ratio (MTR), which denotes the ratio of group $j$'s frontier function to the meta-frontier function. The meta-frontier technical efficiency, TE*, is the product of TE and TGR and can be expressed as follows:

$$TE^*_{it} = \frac{Y_{it}}{e^{x_{it}\beta^* + V_{it(j)}}} = TE_{it} \times TGR_{it} \tag{7}$$

There are two methods to calculate the parameters of the meta-frontier production function: linear programming (LP) and quadratic programming (QP). LP minimizes the sum of the absolute value of deviations, whereas QP minimizes the sum of squared deviations. According to Battese et al. (2004), LP and QP are defined as follows:

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

$$\text{QP: } \min_{\beta^*} \sum_{t=1}^{T} \sum_{i=1}^{N} \left(x_{it}\beta^* - x_{it}\hat{\beta}_{(j)}\right)^2, x_{it}\beta^* \geq x_{it}\hat{\beta}_{(j)} \quad (9)$$

## 3. Analysis Result and Discussion

### 3.1 Data

Based on Koiso-Kanttila's (2004) conceptualization of digital content as "bit-based objects distributed through electronic channels" (p. 46), Rowley (2008) provides examples of digital content, such as "online news, electronic journals, e-books, virtual pets, online health advice, databases, online directories, mobile micro movies, games, music downloads, and software package updates" (p. 521-522). Among the abovementioned categories of digital content, the present study analyzes firms that offer digital content to general users over the Web. Accordingly, e-learning, multimedia (audio and video type), online news, information offering, and Internet portals are included in the digital content classification. The present study uses data collected from the KISVALUE database provided by Nice Investors Service. The KISVALUE database provides information, such as portfolio, financial statement, credit rate, and stock price, of firms in Korea that are listed or undergoing external audits. The sample consisted of 25 paid-content firms, 9 free content firms, and 16 freemium content firms, totaling 50 firms. Various information, such as the firm's net sales, total asset, cost of revenue, and number of employees, was collected during the period from 2000 to 2014. Table 1 shows the descriptive statistics of the collected information.

Table 1. Descriptive Statistics

| Variables | Group of Content firms by pricing | | |
|---|---|---|---|
| (Unit) | Fee | Free | Mix |

| | | | | |
|---|---|---|---|---|
| No. of Firms | | 25 | 9 | 16 |
| No. of Observations | | 234 | 66 | 194 |
| Y: Net Sales (KRW) | Min | 1,457,313 | 1,604,909 | 1,071,630 |
| | Max | 220,464,782,000 | 162,261,056,000 | 1,637,164,959,000 |
| | Average | 20,014,570,609 | 27,022,824,672 | 97,302,057,241 |
| | S.D. | 28,542,722,303 | 47,049,722,323 | 260,463,125,044 |
| K: Total Asset (KRW) | Min | 676,317 | 1,141,466 | 1,056,246 |
| | Max | 158,886,722,000 | 203,444,588,000 | 2,755,830,752,000 |
| | Average | 21,124,367,704 | 23,780,083,525 | 142,426,395,443 |
| | S.D. | 27,368,203,040 | 42,881,962,850 | 430,618,000,703 |
| M: Cost of Revenue (KRW) | Min | 193,797 | 562,735 | 574,538 |
| | Max | 198,297,943,000 | 25,840,945,000 | 925,265,388,000 |
| | Average | 12,880,544,023 | 5,375,132,662 | 47,086,126,145 |
| | S.D. | 25,422,905,462 | 7,148,873,939 | 121,474,216,309 |
| L: No. of Employees (Persons) | Min | 2 | 3 | 1 |
| | Max | 1,285 | 818 | 3,259 |
| | Average | 111 | 249 | 327 |
| | S.D. | 161 | 268 | 554 |

### 3.2 Analysis Result

The production function for each firm was estimated through the *FRONTIER 4.1* program, and the meta-frontier production function was calculated using *MATLAB*. As mentioned in the introduction section, the present study categorized online content firms into three groups (fee, free, and mix) based on the pricing scheme. Table 2 below depicts the estimates of the production functions for all three groups using SFA. The coefficient of the meta-frontier production function calculated through the MFA based on the estimation results is displayed on the two far right columns.

Table 2. Estimation results of group and metafrontier production functions.

| Variables | Fee Group | | Free Group | | Mix Group | | Metafrontier | |
|---|---|---|---|---|---|---|---|---|
| | Estimated | S.E. | Estimated | S.E. | Estimated | S.E. | LP | QP |

| | Coefficient | | Coefficient | | Coefficient | | | |
|---|---|---|---|---|---|---|---|---|
| Constant | 0.006 | 1.421 | 10.238*** | 1.971 | -0.951 | 2.171 | 10.238 | 10.238 |
| $lnx_1$ | 1.024* | 0.584 | 0.353 | 0.469 | 0.813 | 0.546 | 0.725 | 0.865 |
| $lnx_2$ | 0.901 | 0.697 | 0.867** | 0.439 | 0.644 | 0.482 | -0.143 | -0.391 |
| $lnx_3$ | 0.073 | 0.691 | -0.851* | 0.449 | 0.271 | 0.351 | 0.130 | 0.361 |
| $(lnx_1)^2$ | -0.022 | 0.029 | -0.022 | 0.052 | -0.037* | 0.021 | -0.004 | -0.009 |
| $(lnx_2)^2$ | -0.172*** | 0.043 | -0.178** | 0.091 | 0.026 | 0.037 | 0.056 | 0.032 |
| $(lnx_3)^2$ | -0.211*** | 0.047 | -0.130 | 0.088 | 0.068* | 0.035 | 0.044 | 0.009 |
| $(lnx_1)(lnx_2)$ | -0.275*** | 0.064 | 0.058 | 0.112 | 0.149*** | 0.053 | -0.086 | -0.062 |
| $(lnx_2)(lnx_3)$ | 0.384*** | 0.081 | 0.334* | 0.178 | -0.088 | 0.067 | -0.073 | -0.012 |
| $(lnx_3)(lnx_1)$ | 0.246*** | 0.063 | -0.067 | 0.130 | -0.168*** | 0.048 | 0.058 | 0.027 |

Note: *, **, and *** denotes $p < 0.1$, $p < 0.05$, and $p < 0.01$ respectively.

Based on the estimated production functions, the technical efficiency (TE) of each group, TGR, and TE* can be calculated, as depicted in Table 3. The results showed that the mix group had the highest TE value (0.669), followed by fee group (0.512) and free group (0.425). However, because the comparison of the technical efficiencies of groups with different production functions is meaningless, the meta-frontier analysis was conducted. As for TGR, which compares the efficiencies of groups by measuring the distance between meta-frontier and group frontier production function, the exact opposite result was found. The free group, which showed the lowest technical efficiency, had the highest TGR value of 0.886[1]. On the other hand, the mix group, which showed the highest technical efficiency, had the lowest TGR value of 0.459. This result indicates that the free group's production function is closer to the meta-frontier production function. Even though the average TE value of free group was the lowest, this result implies that it is not because most firms in the free group were inefficient, but because some firms in the free group tried to elevate their production frontier. When the production frontier of one group was moved toward the meta-frontier by some portion of firms in the group and if there was no change on other firms in the same group in terms of production, the average TE of that group decreases. Even regarding TE*, which is the product of TE and TGR, the free group had the highest TE* value of 0.718, followed by fee group (0.560) and mix group (0.331). The free group had the highest standard deviation value in the TE results. This is probably because firms in the free group

[1] This paper mentions the LP estimates only because the LP and QP estimates are almost the same.

raise sales through advertising and are thus able to freely engage in innovative activities compared to other groups. Although the free group had the highest standard deviation and the lowest average TE value due to the high degree of freedom, the firms' freedom of innovative activities shifted the free group's production function upwards.

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

| Estimated Value | Group | Mean | St. dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| TE | Fee | 0.512 | 0.156 | 0.294 | 0.915 |
| | Free | 0.425 | 0.233 | 0.205 | 0.848 |
| | Mix | 0.669 | 0.104 | 0.473 | 0.854 |

| Estimated Value | Group | Mean | | St. dev. | | Minimum | | Maximum | |
|---|---|---|---|---|---|---|---|---|---|
| | | LP | QP | LP | QP | LP | QP | LP | QP |
| TGR | Fee | 0.658 | 0.646 | 0.050 | 0.048 | 0.576 | 0.566 | 0.720 | 0.707 |
| | Free | 0.886 | 0.850 | 0.053 | 0.053 | 0.739 | 0.710 | 0.935 | 0.913 |
| | Mix | 0.459 | 0.453 | 0.038 | 0.041 | 0.394 | 0.370 | 0.533 | 0.529 |

| Estimated Value | Group | Mean | | St. dev. | | Minimum | | Maximum | |
|---|---|---|---|---|---|---|---|---|---|
| | | LP | QP | LP | QP | LP | QP | LP | QP |
| TE* | Fee | 0.560 | 0.550 | 0.042 | 0.041 | 0.490 | 0.482 | 0.612 | 0.601 |
| | Free | 0.718 | 0.688 | 0.043 | 0.043 | 0.598 | 0.575 | 0.757 | 0.739 |
| | Mix | 0.331 | 0.327 | 0.028 | 0.030 | 0.284 | 0.266 | 0.384 | 0.381 |

To more accurately analyze the cause of the differences in the TGR values, the present study additionally conducted Tobit regression using the STATA program. In model 1, $lnK$, $lnL$, $lnM$ values were used as moderator variables in order to moderate the effect of firm size on the TGR value. To analyze the difference in TGR values across groups, mix group-based dummy variables $D\_fee$ and $D\_free$ were used. Table 4 below depicts the Tobit regression results. There was no significant effect of $lnL$ on efficiency difference, whereas $lnK$ had a positive effect and $lnM$ had a negative effect significantly. The TGR values of both the free group and fee group were statistically significantly greater than that of the mix group.

In model 2, we put content genre information as dummy variables in the Tobit model because the pricing strategy largely depends on the genre of the content as mentioned in the introduction section. Four variables, *D_info*, *D_media*, *D_portal*, and *D_elearn*, which indicate content group providing various information, online video streaming group, online portal group, and e-learning group respectively, were used as dummy variables, and newspaper group providing news through online website was used as the baseline group. The results of moderator variables ($lnL$, $lnK$, and $lnM$) and group dummy variables ($D\_fee$ and $D\_free$) in model 2 were similar to those of model 1. For content genre dummy variables, only the TGR of media group providing online video streaming service was significantly smaller than that of newspaper group, and there was no significant difference among other groups.

Table 4. Estimation results of the Tobit model.

| | *Model 1* | | | *Model 2* | | |
|---|---|---|---|---|---|---|
| Variables | Coef. | (S. E.) | $t$ –Value | Coef. | (S. E.) | $t$ –Value |
| $lnK$ | 0.042*** | 0.007 | 6.07 | 0.073*** | 0.008 | 9.41 |
| $lnL$ | 0.004 | 0.007 | 0.56 | -0.003 | 0.008 | -0.38 |
| $lnM$ | –0.040*** | 0.007 | –5.93 | -0.074*** | 0.007 | -10.05 |
| $D\_fee$ | 0.195*** | 0.014 | 14.09 | 0.201*** | 0.020 | 10.21 |
| $D\_free$ | 0.409*** | 0.020 | 20.17 | 0.431*** | 0.022 | 19.20 |
| *D_info* | | | | -0.028 | 0.023 | -1.24 |
| *D_media* | | | | -0.88*** | 0.027 | -3.28 |
| *D_portal* | | | | -0.038 | 0.028 | -1.36 |
| *D_elearn* | | | | 0.004 | 0.034 | 0.13 |
| *Constant* | 0.351*** | 0.049 | 7.16 | 0.452*** | 0.070 | 6.49 |

Note: *** indicates statistically significant at the 1% level

*D_fee* and *D_free*: dummy variables indicating fee and free group respectively

*D_info, D_media, D_portal, D_elearn*: dummy variables indicating content group providing various information, online video streaming group, online portal group, and e-learning group respectively

### 3.3 Discussion

Based on the analysis results, it can be concluded that the traditional business

strategy, which consists of content production cost, sales, and the collection of profit based on the difference between the two, is no longer effective in the digital content market. This is in the same vein as the research results of Gallaugher et al. (2001) and Fan et al. (2007), who describe a phenomenon that can emerge when traditional mass media such as newspapers and broadcast transform to a business conducted over the Internet.

Gallaugher et al. (2001) state that a greater number of online newspapers will adopt the free strategy supported by online advertisement with two reasonings: The first reasoning is that because online advertisements have fewer restrictions than printed newspapers, earning revenue from online advertisement and offering free online news are effective, and the second reasoning is that since users have become accustomed to free content, if similar content charges a fee, users will not select paid content. In another study, Fan et al. (2007) explain that it has become easier for users to download or watch media programs over the Internet, so the perception of media firms is eventually changing from traditional broadcast businesses to content delivery firms.

Furthermore, based on the MFA analysis, the meta-frontier efficiency value of the mix group was lower than that of the fee group. According to Lin et al. (2012), the mixed strategy of paid and free content is optimal only when the content provider is in a monopoly position. Moreover, Sprenger et al. (2016) suggest that when the users' willingness to pay is different, where a business is targeting general customers in lieu of a specific audience, the mixed strategy is effective. However, in cases where the competitor's content or service is offered free, consumers will be unwilling to purchase paid content (Sprenger et al., 2016). As shown in Table 1, because firms that use the mixed strategy are in competition with other firms that offer similar content, they are unable to be in a monopoly position, where the mixed strategy is optimal. Furthermore, content offered by firms that adopt the mixed strategy is often similar to those provided by firms that use paid or free strategy. Hence, it can be analyzed that the meta-frontier efficiency value of the mix group was rather lower because it lacks a definite differentiating factor in competing against firms that offer similar content for free, as described by Sprenger et al. (2016).

In addition, from the fact that the strategy that generates sales through advertisements and offers free content has a high efficiency from a metafrontier perspective, it can be

inferred that consumers have a favorable attitude toward online advertisements that lower the cost of content. As explained by Evans (2008), advertising over the Internet consists of an innovative factor that makes it different from traditional advertising, and there are many favorable results regarding user attitudes on Internet advertisements. In a 1996 survey, Schlosser et al. (1999) derived results that Internet users generally have a positive attitude toward online advertisements. More than half of the respondents stated that Internet advertisements are informative, and that they are confident in their purchasing decisions, indicating their trust in Internet advertisements (Schlosser et al., 1999). Calisir (2003) states that young consumers have a perception that website as an advertising media is excellent for precipitating for action, is the most reliable source, provides two-way communication and is not irritating. Furthermore, it can lead to more outstanding results than traditional advertising media, such as TV and radio (Calisir, 2003). In another study, Dehghani et al. (2016) conducted a 2015 survey on 378 university students and analyzed that the entertainment effect and customization of YouTube advertisements have a significant effect on the user's purchase intention, and especially customization plays an important role in advertisement value.

Accordingly, as online advertising that began with a simple banner advertisement (Briggs & Hollis, 1997; Bruner, 2005) improves continuously, it offers utility that exceeds the advertising avoidance cost of online content users. However, as can be seen in the results of studies on the negative effect of Internet advertisements and the reasons for avoiding them (Cho & Cheon, 2004) and factors of using advertising avoidance software (Gill et al., 2013), it is necessary to consistently ponder over an online advertising method that is not harmful to the users at an appropriate level.

## 4. Conclusion

Unlike the traditional offline products, digital content products can be offered free because the marginal cost is close to 0, and advertising revenue can be raised based on secured consumers. However, there is some dissent among researchers regarding the optimal pricing strategy for digital content providers. In fact, firms in reality use various pricing policies. The present study categorized the digital content firms into three groups based on the pricing

strategy and estimated each group's efficiency value using SFA. The estimation results showed that the mix group that uses both free and fee strategies had the highest average efficiency value, whereas the group that uses free strategy had the lowest average efficiency value. The limitation of traditional efficiency measurement methods is that it is unable to compare the efficiencies of groups that use different production functions. Therefore, TGR and TE* values were estimated using MFA. The comparison of efficiency values of three groups based on the meta-frontier production function showed opposite results. The TGR and TE* values of the free group were the highest, whereas the TGR and TE* values of the mix group, which had the highest TE value, were the lowest.

Lowering the product's price to 0 will lead to price competitiveness among competitors, thus securing more consumers in the initial market. When more consumers are secured, it will be more advantageous regarding word-of-mouth effect and product diffusion. Especially because IT products, including digital content, have a higher network effect than other products, it is highly probable that the firm that secures more consumers will maintain its competitiveness. It is most likely for this reason that the firms using the zero pricing strategy had a higher meta-frontier efficiency compared to the other groups. An interesting point is that the meta-frontier efficiency value of the mix group was lower than that of the fee group.

One of the limitations of the present study is that it only analyzed firms that are listed or undergoing external audits, which have grown beyond a certain size. Because many firms that offer new content and services over the Internet have started as small firms, analysis on the efficiency of such firms will also derive meaningful research results. Nevertheless, albeit the limitation, the fact that the efficiencies of digital content providers with different pricing strategies were compared using MFA has great implications for the digital content industry, which will become increasingly important in the future.

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Highlights

- This paper categorizes digital content firms based on the pricing strategy
- It compares the efficiency of firms using meta-frontier analysis method
- The free group has the highest efficiency, followed by the fee group