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Should small-scale online retailers diversify distribution channels into offline channels? Focused on the clothing and fashion industry

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ABSTRACT

Distribution channels have changed rapidly with the advent of online channels, and many companies built an omni-channel by adding online channels to their existing offline channels. However, mall enterprises face difficulties in broadening their distribution channel due to budget constraints, and therefore, most of them still use only one channel, offline or online. To increase their revenue, small-scale enterprises need to decide which will be more efficient, using only one channel or using online and offline channels together. This paper uses stochastic frontier analysis to estimate the technical efficiencies of small-scale enterprises selling clothing or fashion items. In addition, this paper categorizes the enterprises into two groups, those that sell their products only though the online channel and those that use both online and offline channels (omni-channel companies), and compares the efficiencies of the two groups using a meta-frontier analysis. In the results, the omni-channel group is superior to the pure online channel group by 17% in terms of technology gap ratio. These results indicate that the value of offering customers a choice of channel affects the efficiency of a company's earnings, and that the company's channel choice increases the efficiency of resource allocation.

1. Introduction

A distribution channel represents a significant and cohesive relationship among all independent companies responsible for distributing a product to a particular market and the market distributors surrounding it (Corey, 1976). It also refers to a collection of interdependent organizations that participate in that process (El-Ansary and Stern, 1972).

From a traditional point of view, a distribution channel is an aggregate that builds and manages vertical links from manufacturers to consumers. In the industrial society of the early 19th century, as the industrial revolution enabled mass production, the original distributors were not separated from the manufacturer. In late industrial society, the manufacturer was responsible only for the production function, and the distributor was in charge of the distribution function. In 20th century industrialized markets, the distribution industry, which supports the distribution needs of the manufacturing industry, continued until the 1960s, but unification and internationalization increased the status of the distribution industry, which found a balance between manufacturing and distribution. Since around 1980, the distribution industry has been spreading various types of offline distribution businesses, including hyper market, category killer, and super supermarket,[1] based on the strong bargaining power of large retailers.

The distribution industry has matured and store expansion has slowed since the 1990s, requiring distributors to expand the range of possible distribution channels in the consumer market (Schoenbachler and Gordon, 2002). As e-commerce has become more active as the Internet has evolved, retailers have turned to multi-channel or omni-channel strategies that discard single-channel approaches such as traditional retail and catalog methods. Ponsford (2000) typified three distribution channels; the traditional offline sales channels (brick-and-mortar), online single-channel (click-and-click), and traditional offline channels with an online shopping channel (click-and-mortar).

In spite of its various advantages, the online distribution channel cannot communicate the physical presence of a product. Therefore, online distribution channels, which also face problems such as insufficient after-sales services, consumer distrust of electronic payment systems, and privacy risks, have not completely replaced offline distribution channels (Hammond et al., 1998).

In recent years, the omni-channel strategy has been gaining popularity among distributors. In other words, companies that have been selling products through online channels have secured offline

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[1] A super supermarket refers a large-size supermarket operated by a large enterprise.

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distribution channels to counter the reverse showrooming phenomenon. These omni-channel phenomena, called online to offline, are particularly active in China and South Korea. Indeed, recent studies analyzing consumers' shopping patterns have shown that consumers are supplementing the shortcomings of online distribution channels by using offline stores together with online distribution channels. Kearney (2014) conducted a survey of 2500 shoppers in the United States to analyze which channels consumers use for each shopping phase of product discovery, purchase, payment, receipt, and return. They found that two-thirds of shoppers used both offline and online channels.

However, even if offering goods through the omni-channel provides additional satisfaction to consumers, companies must take into account that they incur additional costs with that strategy. The possibility that offering additional distribution channels could reduce sales through existing distribution channels is also a concern. Forman et al. (2009) analyzed book sales data and demonstrated that offline channels adversely affect online sales performance, and Zentner (2008) analyzed CD sales data and found that online channel activation negatively affects offline sales performance.

Companies must combine distribution channels and allocate resources efficiently to satisfy customers and maximize profits. Therefore, identifying the characteristics of the distribution channel that consumers prefer and comparing them with the utility and cost of that channel will be a prerequisite for generating synergy and expanding profits (Montoya-Weiss et al., 2003).

In this study, we analyze small-scale enterprises because most large corporations already have their own omni-channels or can easily broaden their distribution channels, whereas about 78% of Korean small-scale online enterprises do not yet have an offline channel (Small and Medium Business Institute, 2014). Recently, large-scale online channels in South Korea have helped small-scale enterprises to expand their distribution channels. Therefore, we divide small-scale enterprises into two groups, those that sell products only through online distribution channels and those that have offline stores along with online distribution channels. We gathered financial data from both groups through questionnaires. By analyzing the technical efficiency of the two groups using stochastic frontier analysis (SFA) and comparing the efficiency of the two groups through meta-frontier analysis (MFA), we consider whether the omni-channel strategy could be more effective than the single-channel strategy for small-scale enterprises.

2. Methodology

2.1. Stochastic Frontier Analysis

Stochastic Frontier Analysis (SFA) represents the relationship between inputs and output factors as a production function and estimates technological efficiency using the frontier production function, which represents the maximum output relative to input. The technical efficiency (TE) of a company indicates its relative level of technology compared to the efficiency of its frontier production function. The greater is the distance between an enterprise's technology level and its frontier production function, the less efficient it is.

In this study, we measure efficiency using the SFA model shown in Eq. (1), based on Battese, Coelli (1995), to reflect changes in efficiency over time.

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

where 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 the production function; β is a vector of parameters of the production function. V_{it} is a generic random error in regression with a distribution of $N(0, \sigma_v^2)$, and is independent of U_{it}. U_{it} is a non-negative random variable indicating the technological efficiency of firm i at time t. To show that it is always inefficient, U_{it} itself is not negative, and we assume that U_{it} follows a half-normal distribution, $N(\mu, \sigma_u^2)$. From Eq. (1), the technical efficiency TE_{it} of firm i at time t is given by Eq. (2).

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

As a production function of SFA, we use the translog function. In particular, using the random effects time-varying production model and assuming a production function of the translog form, Eq. (1) can be expressed as Eq. (3).

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

where x_{1it} represents the amount of capital (K) of the ith firm at time t, x_{2it} represents the costs (M) of the ith firm at time t, and x_{3it} represents the number of employees of the ith firm at time t. In this study, the total capital stock is used for K; other expenditures are used for M; personnel expenses are used for L, and net sales are used for the output, Y.

2.2. Meta-frontier analysis

Comparisons of technological efficiencies among groups cannot be performed using traditional SFA because the TE of a particular firm is difficult to compare with those that operate using other technologies. Therefore, we use a meta-frontier production function that includes the production functions of all groups to compare the efficiency levels of groups operating under different technical conditions (Battese and Rao, 2002). Meta-Frontier Analysis (MFA) was initially applied to agriculture, but recently has been widely used to analyze the information and communication technology industry, such as online content, telecommunications, and broadcasting (e.g., see Lee et al., 2015; Kim et al., 2016; Lee et al., 2016; Na et al., 2017).

For simplicity, Battese et al. (2004) define the meta-frontier production function model as follows:

$$Y_{it}^* = f(x_{it}, \quad \beta^*) = e^{x_{it}\beta^*}, \quad i = 1, 2, ..., N, \quad N = \sum_{i=1}^{R} N_j, \quad t = 1, \quad 2, ..., \quad T,$$

$$s.\ t. \quad x_{it}\beta^* \geq x_{it}\beta_{(j)} for\ all j = 1, 2, ..., T \tag{4}$$

In this case, j means each group; for the group with offline channels $j = 1$, and for the group without offline channels $j = 2$. β^* is an unknown variable vector of the meta-frontier function satisfying Eq. (5), and $\beta_{(j)}$ is a vector of parameters of production function of group j. From Eq. (4), the graph of the meta-frontier production function is located above the graph of the production frontier function of each group for all periods. That is, the meta-frontier production function is an envelope containing the frontier function of each group based on the same technology. For simplicity, suppose that the function f in Eq. (1) is $e^{X_{it}\beta_{(j)}}$; then Eq. (1) can be divided as follows:

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

If we divide both sides of Eq. (5) by $e^{x_{it}\beta^* + V_{it(j)}}$, then

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

In Eq. (6), $e^{-U_{it(j)}}$, the first part of the right side, is the TE of group j, and the second part is the ratio of group j's frontier function to the meta-frontier function, which is called the technical gap ratio (TGR) or the meta technology ratio (MTR). The technical efficiency of the meta-frontier function (TE^*) is represented by multiplying 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 of measuring the parameters of a meta-frontier function: linear programming (LP) and quadratic programming

Table 1
Statistics by group (unit: ten thousand KRW[a]).

Classification	Group with offline channel	Group without offline channel
Sample size	163	119
Average sales	2510.1227	13,801.0504
Average labor costs	290.6380	755.1261
Average other spending	724.5092	834.6639
Average capital	3106.6196	4621.4286

[a] As of September 6, 2018, 1 USD is 1118.50 KRW.

(QP). LP minimizes the sum of the absolute values of the deviations, and QP minimizes the sum of the squares of the deviations. In this study, we used only the LP method. According to Battese et al. (2004), LP is defined as follows:

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

3. Results

To measure the TE, we used monthly average sales, monthly average labor costs, monthly average expenditures excluding labor costs, and capital stock. To increase the objectivity of the questionnaire responses, we first used multiple-choice questions for each data item and then asked for specific values to answer the question.

Among the total 362 shopping companies, 51.3% (211) were omni-channel, while 41.7% of them used an online channel only. In this study, we excluded companies with missing data and 1-person companies who had no additional labor costs. As a result, we classified a total of 282 shopping companies according to the presence of offline stores. The basic statistics for each group are shown in Table 1.

To analyze efficiency differences by group, we first estimate the production function through the SFA methodology and measure group efficiency using the distance from the production function.

We also compute the meta-frontier production function on the estimated production function and compare the efficiencies of the groups. Table 2 shows the group production functions estimated by SFA and the meta-frontier production function derived using the LP method. In order to estimate the group production function and to calculate TE of each group, this paper used *Frontier version 4.1* software provided by Coelli. In addition, *Matlab 7.1* was used to solve the LP problem in calculating meta-frontier production function.

The TE, TGR, and TE* of each group were estimated from the estimated SFA production function and meta-frontier production function. The results are summarized in Table 3.

The analysis shows that the TE of the companies without offline stores is 47.91%, which is higher than the TE of 46.79% for companies with offline stores. However, that efficiency difference is very low, only 1.12%. However, it is impossible to compare TE results from groups using different production functions as mentioned in Section 1.

In case of the TGR index, which compares group efficiency using the distance between the meta-frontier and the group frontier, was 57.59% for companies with an offline store and only 40.25% for companies without an offline channel. For TE *, which can be obtained by multiplying TE and TGR, TE * (26.29%) of companies with an offline store is higher than TE * (18.91%) of companies without an offline store.

Table 3
Technical efficiency and TGR.

Group	Mean	St. dev.	Minimum	Maximum
TE				
Group with offline	0.4679	0.2226	0.0009	0.8562
Group without offline	0.4791	0.1633	0.0041	0.8052
TGR				
Group with offline	0.5759	0.2093	0.0860	1.0000
Group without offline	0.4025	0.2400	0.0022	1.0000
TE*				
Group with offline	0.2629	0.1507	0.0001	0.8055
Group without offline	0.1891	0.1284	0.0002	0.6592

4. Conclusion

In this study, we analyzed the efficiency difference between companies using pure online distribution channels and those using online distribution channels in combination with offline stores. First, we estimated the production function using the SFA methodology, measuring group efficiency as the distance from the production function. Then, we calculated the meta-frontier production function, which encompasses the estimated production functions, and compared the efficiencies of the two groups.

We estimated the TE, TGR, and TE* and found that the TE of the pure online channel and omni-channel groups was 47.9% and 46.8%, respectively. However, the omni-channel group was superior to the pure online channel group by 17% in the TGR index, which compares group efficiency using the meta-frontier and group frontier distance.

On the TGR indicator side, the omni-channel strategy is clearly superior to using pure online channels because satisfying consumer needs drives performance efficiency. As described above, the omni-channel strategy has a comparative advantage over a single channel because consumers can supplement the disadvantages of an online distribution channel by using an offline store. Consumers value the opportunity for channel selection and tend to prefer omni-channel at each stage of information seeking, acquisition, comparison, and purchasing. Because a company's goal is to satisfy customers and maximize profits, efficiently allocating resources and combining existing distribution channels can be performed in parallel. Single-channel companies face constant risk from market conditions and other variables.

Table 2
Group production function and meta-frontier production function estimate.

	Group with offline channel		Group without offline channel		Meta-frontier
	Estimates	*t*-value	Estimates	*t*-value	LP
Constant	4.6085	1.6226	0.4376	0.3299	0.0332
$\ln x_1$	0.4230	0.6074	− 0.1888	− 0.2434	0.5098
$\ln x_2$	− 0.4932	− 0.9275	1.2992*	1.7101	0.7854
$\ln x_3$	0.4847	1.2266	0.2140	0.4128	0.4856
$(\ln x_1)^2$	0.1133	1.4284	0.1834**	2.1779	0.3214
$(\ln x_2)^2$	0.1069*	1.9095	0.0624	0.9821	0.1351
$(\ln x_3)^2$	0.0413	1.3648	0.1352***	2.6513	0.0854
$\ln x_1 \times \ln x_2$	− 0.0282	− 0.2824	− 0.0449	− 0.3394	− 0.3163
$\ln x_2 \times \ln x_3$	− 0.0591	− 1.0808	− 0.1973**	− 2.2755	− 0.0911
$\ln x_3 \times \ln x_1$	− 0.1333	− 1.5204	− 0.1388	− 1.3875	− 0.1803

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

On the other hand, omni-channel companies can protect customer satisfaction and corporate profits by adjusting their resource allocation to different channels as situations change.

These results are consistent with the study of Nicholson et al. (2002), which emphasizes the complementary properties of channels. Consumers want to use multiple media in the purchase process and value online channel opportunities. This study is also consistent with that of Montoya-Weiss et al. (2003), which states that resources can be distributed through a combination of channels to maximize customer satisfaction and corporate profits.

Unlike previous research, this study derives the difference in efficiency between online channel and omni-channel companies using the meta-frontier production function, which is meaningful because we targeted small companies and focused on the clothing and fashion industry. However, small companies have no obligation to submit to regular external audits, which makes it difficult to accurately calculate their sales, labor costs, capital stock, cost of sales, and selling and administrative expenses. Therefore, we used the survey method, but the credibility of the resulting data is inferior to that of certified audit data. To compensate for those limitations, we repeated the same questions in both multiple-choice and supplementary forms. However, the reliability of the most essential data remains insufficient. It is important for small-scale enterprises to build up omni-channels with the support of large companies. Small-scale enterprises that build omni-channel capability can increase profitability and the speed of company growth with high efficiency.

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