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Unintended Demand Diversion to Online Shopping: The Mandatory Supermarket Closing Day Regulation in South Korea*

Jong Jae Lee**

Abstract

The Distribution Industry Development Act in South Korea requires supermarkets to take two self-enforced days of closing every month to divert the demand from supermarkets to traditional markets nearby. This paper studies when and how this demand diversion occurs in a modified Hotelling model that includes an online shop. We show that the intended demand diversion does not occur, but traditional bazaar shops benefit indirectly from the policy because an unintended demand diversion from online shops occurs. Moreover, we show that a relatively larger market share of online shops to supermarkets predicts a larger demand diversion to the traditional bazaar.

KRF Classification : B030200, B030904
Keywords : Supermarket Shutdown Policy, Traditional Market Protection, Online Shopping, Retail Competition, Hotelling Model

Ⅰ. Introduction

In 2012, the Distribution Industry Development Act (amended in

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** Assistant Professor, Department of Economics, The Catholic University of Korea, e-mail: piuslee83@catholic.ac.kr

2011, article 12-2) came into force, restricting the business hours of supermarkets (including large-scale supermarkets, hypermarkets, and big discount store chains) in Korea. This so-called *Supermarket Shutdown Policy* (henceforth, SSP) mandates supermarkets to temporarily close their business for two days a month on holiday, say the second and fourth Sunday of every month, and limits the operating hours from midnight to 10am.[1] This policy was introduced to protect small retailers (and competition) by diverting the demand, at least temporarily on the closing days, from supermarkets to traditional markets nearby.

The effectiveness of the SSP has been disputed in recent years. The critics argue that the law was legislated when a few people did grocery shopping online, and therefore failed to reflect growing competition from online retailers. The mandatory shutdown of supermarkets might lead to the unintended demand diversion to online businesses without helping the small retailers in the traditional markets. This criticism lies behind the pending amendment to the Distribution Industry Development Act that makes exceptions for mail-order businesses (such as providing early morning deliveries) within supermarkets.[2] In addition, the city governments of Daegu and Cheongju have transitioned from Sunday closure to weekdays, thereby signaling a move toward revoking the law.[3] Also, the Seoul Metropolitan Council passed a motion seeking the same transition to weekdays.[4] The survey by the Korea Chamber of Commerce and

1) Byun, H. J. (2022, July 25). "Debate reopens on 10 year-old supermarket shutdown rules," *The Korea Herald*.
2) Lee J. H. et al. (2022, December 29). "Korea, big-box retailers seek to ease rule on store operating hours," *Maeil Business News Korea*.
3) Woo, S. K. and Lee, H. Y. (2022, December 20). "Daegu relaxes major supermarket chain's weekend closure mandate," *Maeil Business News Korea*; Yoo, S. H. (2023, April 23). "Cheongju, followed by Daegu, revised its regulation on the store closure day," *Etoday*.
4) Kim, M. J. (2024, April 26). "City council passed ordinance that allows supermarkets in Seoul to be closed on weekdays instead of weekends," *THEPR*.

Industry in 2023 June corroborates the unintended demand diversion to online retailers: almost 50% of respondents bought through other shopping channels (such as online or smaller discount stores) when supermarkets were closed, 33.5% of consumers said they just waited until supermarket reopened, and only 16.5% of them responded that they used traditional markets. In addition, around 70% of the respondents agreed that the regulation in supermarkets should be relaxed.[5)]

In this paper, our aim is to theoretically investigate whether and how the presence of online retail businesses impinges on the intended demand diversion from the supermarkets to the traditional markets. To the best of our knowledge, no theoretical construct or framework has been provided for the SSP. To this end, we provide a simple stylized theoretical framework that adapts the celebrated Hotelling model to allow for an online shop. However, we should not like to claim that our model accommodates and thus extends the existing models that include an online shop to the Hotelling model, such as Lijesen (2013), Colombo and Matsushima (2020), and Guo and Lai (2024) to name a few. Our aim lies not in developing a new model but in providing theoretical predictions and evaluations regarding the SSP. For sharper theoretical results, we simplify rather than extend the existing models by including the common elements into ours. Yet, our model departs from the existing models in two ways. First, unlike the existing models that assume two symmetric brick-and-mortar firms, we consider asymmetry for such firms. We assume that one firm is a small retailer in the traditional market and therefore has a competitive disadvantage over the other firm which represents a supermarket. This reflects that small retailers and businesses in the traditional bazaar are often perceived as more inconvenient to

5) Lee, S. A. and Cho, J. W. (2023, August 1). "Retailers joined the administration in opposing Sunday closures," *Korea JoongAng Daily*.

customers than supermarkets. Second, we focus on the demand diversion induced by the SSP. No existing model of competition between online and offline retailers zeros in on this aspect in the framework of the Hotelling model.

Our main result is that for a low level of the relative online-to-offline shopping cost, the intended demand diversion from supermarkets to traditional markets does not occur. The mandatory closure of supermarkets diverts all of its customers towards an online shop. Nevertheless, the traditional bazaar shop benefits from the policy. An unintended demand diversion occurs from online shops. The underlying intuition goes as follows. The SSP reduces competition and raises overall product prices. In particular, the online retailer's price increases more than the traditional bazaar shop's because the demand diversion from supermarkets makes the demand less elastic for the online shop. The relatively higher price at the online shop leads some customers to switch to the traditional bazaar if located nearby.

Moreover, we show that the relative competitive advantage between online retailers and supermarkets predicts how much demand diversion will occur to traditional markets relative to online retailers (Theorem 1). Specifically, a larger market share of the online shop relative to the supermarket predicts a larger demand diversion will occur to the traditional bazaar than to the online shop. This is a novel prediction that has never been tested empirically in the existing body of literature on the effect of the SSP (Choi and Jeong, 2016; Kim, 2012; Lee and Kwon, 2014; Lee et al., 2018; Shin, 2012; Shin, 2014; Suh and Jo, 2019). In addition, our results emphasize the importance of the relative online-to-offline shopping cost in predicting both (i) the relative market share of online shops to supermarkets and (ii) the volume and the direction of demand diversion from supermarkets.

Lastly, this paper also contributes to the emprically literature on the

effect of the SSP in two aspects. First, the existing body of literature fails to account for the presence of online retailers when studying the effect of the SSP (Choi and Jeong, 2016; Kim, 2012; Lee and Kwon, 2014; Lee et al., 2018; Shin, 2012; Shin, 2014; Suh and Jo, 2019). Moreover, the empirical studies fail to distinguish the two related but distinct questions, (i) whether the demand diversion occurred as intended, and (ii) whether the SSP benefits the small retailers in traditional markets. We believe that our theoretical results and distinction between (i) and (ii) above help understanding the empirical results that point different directions

The rest of this paper is organized as follows: Section 2 describes our model, and Section 3 presents our theoretical findings with a particular focus on the demand diversion and we conclude in Section 4.

Ⅱ. Model

We consider an environment in which three firms O, S, and T compete in prices for a continuum of consumers located uniformly on a unit interval $[0,1]$. Each consumer has a unit demand and the same reservation value $v>0$ for all products. Each firm $j=O,S,T$ produces a single product with no production cost and charges price p_j. As in the Hotelling model, firms charge prices simultaneously.

Firms differ from each other in two aspects. First, firms S and T are physically located at the ends of the unit interval. To buy from either firm, consumer $x\in[0,1]$ must incur a traveling cost $t>0$ per distance. On the other hand, firm O has no physical location and consumer x needs to pay a fixed delivery cost $F>0$. In this sense, the first two firms, S and T are *brick-and-mortar* firms whereas firm O is an *online* shop. Second, firm T has a competitive disadvantage

over the others. Specifically, shopping at firm T costs consumers additional cost of $a \in (0,t)$. We assume that $a < t$ in order to exclude the case in which firm T ceases to operate regardless of whether or not SSP is in effect. One might consider firm T to be a shop in *the traditional bazaar or farmers' market* and firm S *a grocery store or a supermarket*. The additional cost of shopping at the traditional bazaar (firm T) might reflect ageing and decrepit infrastructure, small parking lots, a low acceptance rate of credit cards, or combinations of these (Iyer and Kuksov, 2012; Kim and Kim, 2012; Kang and Chun, 2015). To sum up, consumer x's payoff depends on which firm to buy from as follows:

$$u_S(x) = v - tx - p_S, \; u_T(x) = v - t(1-x) - p_T - a,$$
$$u_O = v - F - p_O. \tag{1}$$

For later use, we define a measure of the relative online-to-offline shopping cost (provided that the product prices are identical) by

$$\theta = \frac{2F}{2t+a}. \tag{2}$$

To understand why θ measures the relative cost of online shopping, note that $(2t+a)/2$ captures the average of the maximum possible costs when shopping offline. Specifically, given the same product price, a consumer's maximum possible cost when buying from firm T is $a+t$ (when a consumer is located at $x=0$). Likewise, the maximum possible cost of buying from firm S is t (when the consumer is located at $x=1$). Therefore, the average maximum cost of offline shopping is $(2t+a)/2$, and θ is merely the number that divides the online shopping cost F by this offline cost $(2t+a)/2$.

As it is usual in the standard Hotelling model, we identify the

marginal consumers who are indifferent between two purchasing options. Let x_{SO} be the marginal consumer who is indifferent between S and O and let x_{OT} be the marginal consumer who is indifferent between O and T. These two consumers exist because the payoffs $u_S(x)$ and $u_T(x)$ are monotone in x, whereas u_O is constant (See Figure 1). Specifically, x_{SO} and x_{OT} are computed as follows:

$$u_S(x_{SO}) = u_O(x_{SO}) \Leftrightarrow x_{SO} = \frac{F - p_S + p_O}{t},$$
$$u_T(x_{OT}) = u_O(x_{OT}) \Leftrightarrow x_{OT} = \frac{t - F - p_O + p_T + a}{t}. \quad (3)$$

Therefore, the demand for each firm is computed as

$$q_S = x_{SO} = \frac{F + p_O - p_S}{t}, \quad q_T = 1 - x_{OT} = \frac{F + p_O - p_T - a}{t},$$
$$q_O = x_{OT} - x_{SO} = \frac{p_S + p_T - 2p_O - 2F + t + a}{t}. \quad (4)$$

Because we investigate how the presence of an online shop impinges on the intended effect of the SSP, we focus on the case in which the online shop (firm O) is active, $q_O > 0$ or equivalently $x_{SO} < x_{OT}$, guaranteed by the following assumption.

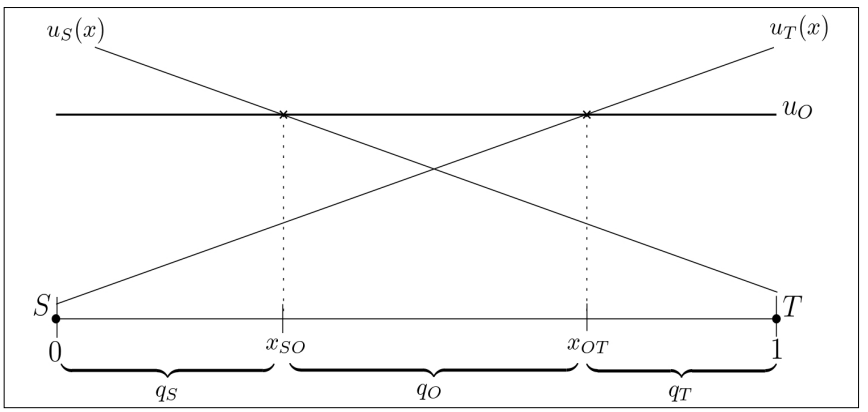
Assumption 1. The relative cost of online shopping satisfies $\theta < 1$.

This assumption holds unless online shopping costs are prohibitively high potentially due to limited internet access and long delivery time. Therefore, this assumption is likely to occur because the last decade has seen a dramatic growth in e-commerce driven by better internet quality and supply chain innovation.

The profit maximization problem and the optimal pricing rule for each firm are

$$\max_{p_S} \pi_S = p_S\left[\frac{F+p_O-p_S}{t}\right], \quad p_S = \frac{F+p_O}{2},$$
$$\max_{p_T} \pi_T = p_T\left[\frac{F+p_O-p_T-a}{t}\right], \quad p_T = \frac{F+p_O-a}{2},$$
$$\max_{p_O} \pi_O = p_O\left[\frac{p_S+p_T-2p_O-2F+t+a}{t}\right],$$
$$p_O = \frac{p_S+p_T-2F+t+a}{4}. \tag{5}$$

〈Figure 1〉 The choice-dependent payoffs of consumer x and the market segmentation



Remark 1. The two bricks-and-mortar firms, S and T, are not in direct competition with each other. The optimal pricing rule of each firm relies on the other's price only through the online shop's product price. The two brick-and-mortar retailers are in direct competition with the online counterpart. This captures the conventional wisdom that e-commerce presents a united front against the brick-and-mortar retailers.

Supermarket Shutdown Policy (SSP) When the supermarket (firm S)

is mandatorily closed, firms T and O compete with each other. The profit maximization problem of firm T is the same as before SSP, so does its optimal pricing rule. However, the profit maximization problem and the optimal pricing rule of firm O change under SSP because the demand is now defined as

$$q_O^{SSP} = x_{OT}. \tag{6}$$

Therefore, we state the profit maximization problem and the optimal pricing rule of firm O as follows:

$$\max_{p_O} \pi_O = p_O\left[\frac{t-F-p_O+p_T+a}{t}\right], \quad p_O = \frac{t-F+p_T+a}{2}. \tag{7}$$

Ⅲ. The Effect of Supermarket Shutdown Policy

In this section, we examine the effect of SSP. To this end, we begin by solving for an equilibrium with and without SSP, respectively. Then, we examine the demand diversion induced by the SSP and we close this section by computing the social welfare loss of the SSP.

1. Equilibrium

We first consider the pre-SSP case. By solving the optimal pricing rules of firms S, T, and O in the previous section, we obtain the following equilibrium.

Proposition 1 (Equilibrium under no SSP). *Suppose that the supermarket shutdown policy does not exist. Then, a unique Nash equilibrium leads to the following outcomes:*

(1) *Prices:* $p_S^* = \frac{2t+4F+a}{12}$, $p_T^* = \frac{2t+4F-5a}{12}$,

and $p_O^* = \frac{2t+a-2F}{6}$.

(2) *Demands:* $q_S^* = \frac{2t+4F+a}{12t}$, $q_T^* = \frac{2t+4F-5a}{12t}$,

and $q_O^* = \frac{2t+a-2F}{3t}$.

(3) *Profits:* $\pi_S^* = \frac{(2t+4F+a)^2}{144t}$, $\pi_T^* = \frac{(2t+4F-5a)^2}{144t}$,

and $\pi_O^* = \frac{(2t+a-2F)^2}{18t}$.

Note that the indifferent consumers that define the demand for each firm are

$$x_{SO}^* = \frac{2t+4F+a}{12t}, \quad x_{OT}^* = \frac{10t-4F+5a}{12t} \tag{8}$$

where $x_{SO}^* < x_{OT}^*$ by Assumption 1.

The equilibrium price and demand of firm T (traditional bazaar) are lower than those of S (supermarket). The traditional bazaar's cheaper products and lower market share are consistent with the common wisdom and the abundant empirical evidences. On the other hand, whether firm S (supermarket) or firm O (online shop) performs better in the market depends on the relative online shopping cost θ.

Corollary 1. *Under no SSP, firm S (supermarket) has a larger market share than firm O (online shop), $q_S > q_O$ if $\theta > 1/2$. Moreover, the product price of firm S is higher than that of firm O, $p_S > p_O$, if $\theta > 1/4$.*

Now, consider the case in which the SSP is in effect. Solving the optimal pricing rules of firms T and O (now with the one under SSP)

yields the following equilibrium.

Proposition 2 (Equilibrium under SSP) *Under SSP, a unique Nash equilibrium yields the following outcomes:*

(1) Prices: $p_T^{**} = \frac{t+F-a}{3}$ *and* $p_O^{**} = \frac{2t-F+a}{3}$.

(2) Demands: $q_T^{**} = \frac{t+F-a}{3t}$ *and* $q_O^{**} = \frac{2t-F+a}{3t}$.

(3) Profits: $\pi_T^{**} = \frac{(t+F-a)^2}{9t}$ *and* $\pi_O^{**} = \frac{(2t-F+a)^2}{9t}$.

The indifferent consumer that define the demand for each firm is

$$x_{OT}^{**} = \frac{2t-F+a}{3t}. \tag{9}$$

Remark 2. The prices increase due to less competition. Specifically, they increase by

$$p_O^{**} - p_O^{*} = \frac{2t+a}{6},\ p_T^{**} - p_T^{*} = \frac{2t+a}{12}.$$

These changes in price do not depend on F (the online shopping cost). Facing no competition near the left endpoint of the Hotelling line, firm O charges a higher price. Then, the strategic complementarity leads firm T to raise its product price. Note that the online shopping cost plays no role in this process. Moreover, the price charged by firm O increases more. Even under the SSP, firm O enjoys more demand, charges a higher price, and earns more profit than firm T does.

2. Demand Diversion

Proposition 2 implies that the demand that used to be for firm S before SSP, $q_S^* = \frac{2t+4F+a}{12t}$, is diverted to the other two firms T and O. Specifically, the demand diversion to firm T is

$$\Delta q_T := q_T^{**} - q_T^* = \frac{t+F-a}{3t} - \frac{2t+4F-5a}{12t} = \frac{2t+a}{12t}, \tag{10}$$

and to firm O is

$$\Delta q_O := q_O^{**} - q_O^* = \frac{2t-F+a}{3t} - \frac{2t-2F+a}{3t} = \frac{F}{3t}. \tag{11}$$

Note that $q_S^* = \Delta q_T + \Delta q_O$. Because we focus on how much demand is diverted to firm T as intended by the SSP, we define the demand diversion ratio of T to O as

$$Div(t,a,F) := \frac{\Delta q_T}{\Delta q_O} = \frac{2t+a}{4F} = \frac{1}{2\theta}. \tag{12}$$

By Assumption 1, $Div(t,a,F) > 1/2$.

Lemma 1 (Comparative statics of the demand diversion) *The demand diversion ratio $Div(t,a,F) = 1/(2\theta)$ decreases in the relative online-to-offline shopping cost θ. That is, it satisfies the following:*

(1) $Div(t,a,F)$ increases in a and decreases in F.

(2) $Div(t,a,F)$ increases in t.

The inverse relationship between $Div(t,a,F)$ and θ seems counter-intuitive. *When the online shopping becomes more expensive relatively to the offline shopping, the less demand would go to the*

brick-and-mortal shops in the traditional bazaar. To understand the intuition behind this result, note that the traditional bazaar (firm T) faces less severe competition after the SSP is introduced, which makes the effect of a, t, or F less consequential. For example, the effect of a on the demand for firm T decreases (in absolute values),

$$\left| \frac{\partial q_T^{**}}{\partial a} \right| = 1/3 < 5/12 = \left| \frac{\partial q_T^{*}}{\partial a} \right|. \quad (13)$$

In other words, the effect of a higher a harms the traditional bazaar (firm T) more in competition with the supermarket (firm S). Because the demand for T decreases less under SSP for the same increment in a than under no SSP, the changes in the demand Δq_T increases in a. The same logic applies to the case of F when it comes to the demand for firm O. The effect of a lower F benefits the online shop (firm O) more in competition with the supermarket. The changes in the demand for O, Δq_O increases in F.

The competition outcome between the online shop and the supermarket before SSP predicts how much demand diversion will occur to the traditional bazaar from the supermarket.

Theoerem 1. *The demand diversion ratio of firm T to firm O, $Div(t,a,F)$, satisfies the following:*

(1) The more demand goes to the traditional bazaar T ($Div(t,a,F) > 1$) if and only if $\theta < 1/2$ (the online shop O had a larger market share than the supermarket S before SSP).

(2) The demand diversion to the traditional bazaar T cannot be as twice as that to the online shop ($Div(t,a,F) < 2$) if and only if $\theta > 1/4$ (the price at the online shop is lower than that at the supermarket S before SSP).

Lastly, we examine when and how the intended demand diversion from the supermarket (firm S) to the traditional market (firm T) fails to realize due to the presence of the online shop (firm O). To this end, note that the demand diversion directly from firm S to firm T can be defined as

$$Div_{S\to T} := \max\{0,\ x^{*}_{SO} - x^{**}_{OT}\}. \tag{14}$$

If $x^{**}_{OT} > x^{*}_{SO}$, there exists no demand diversion directly from firm S to firm T. No customer of firm S switches to firm T. Otherwise, if $x^{*}_{SO} > x^{**}_{OT}$, customers of firm S who are located on $[x^{*}_{SO},\ x^{**}_{OT}]$ buy from firm T.

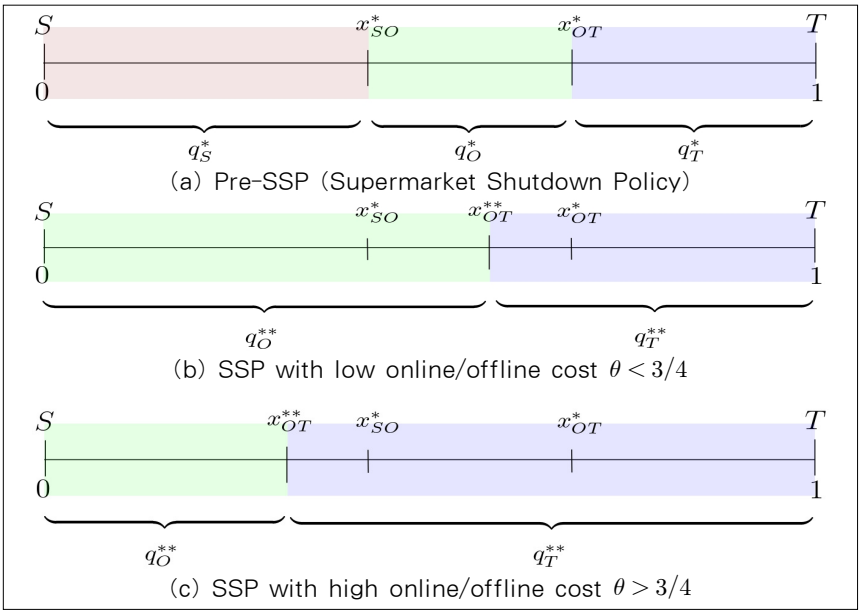
Theorem 2 (Sources of the demand diversion) *The intended diversion from firm S to T, $Div_{S\to T}$ satisfies the following:*

(a) If $\theta < 3/4$, then $Div_{S\to T} = 0$ and the demand diversion to firm T, Δq_T all comes from firm O's pre-SSP demand.

(b) If $\theta > 3/4$, then $Div_{S\to T} > 0$ and Δq_T consists of the whole pre-SSP demand of firm O and a part of the demand that used to be for firm S.

When the online shopping cost is relatively lower than the offline cost $\theta < 3/4$ as in (a), the mandatory closure of the supermarket (firm S) diverts all of its customers towards the online shop (firm O). These customers are less sensitive to the price charged by firm O because they are located far away from the traditional markets (firm T). Recognizing this, firm O raises the price of its product. However, a higher price of firm O's product diverts its original customers towards firm T, particularly those located near firm T.

〈Figure 2〉 Market Segmentation (demand for S, T and O)



Suppose otherwise that the online shopping cost is relatively higher than the offline cost $\theta > 3/4$ as in (b). Then, the original customers of firm O and even some customers of firm S find the new price charged by firm O prohibitively high, thereby switching to firm T despite traveling costs.

3. Welfare

The social welfare in this model is the sum of consumers surplus because the production cost is assumed to be zero and the prices are the transfers between consumers and firms. We begin by computing the social welfare with no SSP as follows:

$$SW^* := \int_0^{x^*_{SO}} (v - tx)dx + \int_{x^*_{SO}}^{x^*_{OT}} (v - F)dx + \int_{x^*_{OT}}^{1} [v - t(1-x) - a]dx$$

$$= \frac{68t^2 - 112tF + 128ta + 80F^2 + 47a^2 - 80Fa}{144t} + \left(v - \frac{t}{2} - a\right). \qquad (15)$$

With SSP, the social welfare is computed as follows:

$$SW^{**} := \int_0^{x_{OT}^{**}} (v-F)dx + \int_{x_{OT}^{**}}^1 [v-t(1-x)-a]dx$$
$$= \frac{8t^2+5a^2-10aF-14tF+14at+5F^2}{18t} + \left(v-\frac{t}{2}-a\right). \quad (16)$$

The change in social welfare due to the SSP is therefore

$$\Delta := SW^{**} - SW^{*} = -\frac{4t^2+16at+40F^2+7a^2}{144t} < 0. \quad (17)$$

A simple intuition behind this is that the mandatory closure of the supermarket (firm S) incurs additional shopping costs for its former customers who are forced to visit the online shop or even the traditional market if the online shopping cost is relatively high. In addition, the competitive disadvantage of firm T (which we denote by a) inflicts additional damages to the former customers of firm S if they are forced to visit firm T to buy a product. However, it is not a critical parameter that determines the result, because $\Delta < 0$ still holds even when $a = 0$. Note that Δ decreases further if a or F increases because both inflict damages to consumers while benefiting none.

Ⅳ. Conclusion

This paper provides a theoretical framework to examine the demand diversion effect of the Supermarket Shutdown Policy (SSP). We show that the intended demand diversion from supermarkets to nearby traditional markets does not occur unless the relative online-to-offline shopping cost is prohibitively high, although the

traditional markets enjoy a higher demand due to the unintended demand diversion from online shops. This draws a distinction between the two questions, (i) whether or not the intended demand diversion from supermarkets to nearby traditional markets occurs and (ii) whether or not the SSP benefits the traditional markets through demand diversion. In addition, we show that the relative online-to-offline shopping cost connects the relative market share of online shops to supermarkets with the volume and the direction of demand diversion from supermarkets. The relationship between these two can be empirically tested in the future researches.

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온라인으로의 의도치 않은 수요 전환: 대형마트 의무휴업일 정책*

이 종 재**

논문초록

한국의 유통산업발전법은 수요를 *대형슈퍼마켓(혹은 대형마트)에서* 인근 전통시장으로 유도하기 위해 매달 두 번 대형마트가 자율적으로 휴업을 하도록 규정을 하고 있다. 본 논문은 온라인 상점을 포함하는 호텔링 모형에서 이러한 수요의 전환이 언제, 그리고 어떻게 발생하는지 연구하였다. 주요한 결과는 의도했던 수요의 전환은 일어나지 않지만, 의도치 않은 수요의 전환이 온라인으로부터 이루어짐으로써 전통시장은 대형마트 의무휴업제로 인한 혜택을 입는다. 또 다른 주요 결과는 온라인 유통업자의 대형마트에 대한 상대적인 시장점유율이 높을수록 대형마트 휴무일에 온라인보다 전통시장으로 더 큰 수요전환을 기대할 수 있다는 것이다.

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** 가톨릭대학교 경제학과 조교수, e-mail: piuslee83@catholic.ac.kr