The Regulation Level of Business Hours

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Abstract

Using the model based on Inderst and Irmen (2005), we analyze retail industries with competition in business hours and prices and examine the desirable degree of business hours regulation for policy makers who have objectives to enhance the welfare. We find that the strict regulation of business hours, which business hours are regulated in all regions, enhances the welfare only when the transportation cost parameter is relatively large. This implies that, contrary to some previous studies, the deregulation is not always welfare enhancing. Although some countries have regulated business hours only in some regions, such partial regulation might worsen the welfare because a retail store located at deregulated regions charges a higher price.

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1 Introduction

Recently, different countries have different degrees of business hours regulation in retail sector. Countries such as Austria, Denmark, Finland, Norway, and Korea maintain substantial restrictions on business hours in all regions of the country. On the other hand, France and Germany regulate business hours in some regions of the country. For example, France implements International Tourist Zones (ZTIs), which ease the restrictions on business hours of retail stores located at tourist zones including Paris and outside the capital. In Germany, since 2006, business hours has been allowed some states to be extended past 8 p.m. Japan has completely deregulated business hours in all regions of the country since 2000. Different degrees of business hours regulation may have different effects on price competition among retail stores and consumer welfare. This raises a question: what's the desirable degree of business hours regulation for policy makers?

To address this issue, this paper examines the desirable regulatory policy in terms of the welfare. We set up an extended version of the standard Hotelling (1929) model with the two dimensional time-location space. Consumers have preferences over the location of retailers and over shopping time. Even if no retailer opens at their preferred shopping time, they cannot either advance or postpone their shopping time because time-constrained consumers suffer an infinite disutility of adjusting their shopping times.[1] There are two retailers. Each retailer locates in a different region and competes in business hours and prices. The game runs as follows. First, a policy maker decides how and to what extent to regulate business hours. Given the extent of business hours regulation, retailers simultaneously determine their closing times. Finally, after having observed the time decision, they compete in price.

Within the above framework of the model, we investigate how policy makers should design regulatory policy in retail sector. This paper considers three regulation levels. One is *the case of complete liberalization*, where retailers in all regions can decide their closing times with no restrictions on business hours. Another is *the case of partial regulation*, where a policy maker sets an upper limit of business hours only in one region. In this case, retailers in regulated and deregulated regions compete in business hours. The other is *the case of complete regulation*, where restrictions on business hours are imposed on retailers in all regions. Comparing these cases, we discuss the welfare implications of regulatory policy.

We find that the equilibrium business hours depends on the regulation level. With both complete liberalization and partial regulation of business hours, one retailer is open full-time whereas another retailer operates part-time. With complete regulation of business hours, one retailer is open to full-time up to the upper limit of business hours whereas another retailer operates part-time. In any regulation levels, the store with longer business hours charges a higher price and serves more customers, and thereby, it earns a higher profit. We also find

[1] Some theoretical papers assume that consumers are flexible about adjusting (postponing or advancing) their shopping times if retailers are closed at their preferred times although consumers suffer a disutility of adjusting their shopping times (e.g., Inderst and Irmen (2005), Shy and Stenbacka (2006, 2008), Wenzel (2011), and Flores and Wenzel (2016)).

that charged prices, demand, and profits with complete liberalization and partial regulation of business hours are higher than those with complete regulation. Only when the transportation cost parameter is relatively large, complete regulation enhances welfare. This implies that, contrary to some previous studies, the deregulation is not always welfare enhancing. Although, in reality, France and Germany have eased restrictions on business hours only for retailers located in some regions of the country, such partial regulation of business hours would worsen welfare. Therefore, policy makers might be better to set an upper limit of business hours for all retailers in all regions. The optimal upper limit of business hours with complete regulation depends on the gross surplus derived from the consumption of the retail product, the mass of day-time shoppers, and the transportation cost parameter. The larger the gross surplus (the mass of day-time shoppers), the longer the optimal upper limit of business hours. On the other hand, the larger the transportation cost parameter, the shorter the optimal upper limit of business hours.

Extending the basic model, we consider a situation in which consumers can advance their shopping if a retailer is closed at their preferred shopping time. Our findings are as follows. With complete liberalization of business hours, both retailers operate full-time. With partial regulation of business hours, one retailer is open full-time whereas another retailer operates part-time. With complete regulation of business hours, both retailers are open to full-time up to the upper limit of business hours. The price of a retailer which opens for longer is highest when business hours are partially regulated. Thus, the welfare with partial regulation of business hours is lower than that with complete liberalization and regulation of business hours. This implies that policy makers might be better to set an upper limit of business hours for all retailers in all regions if she/he consider the regulatory restrictions on the retail industry.

The existing literature on business hours has largely focused on how the deregulation of business hours affects the structure and competitiveness of the retail industry. Some empirical studies show that deregulation leads to higher prices in large retail stores, and redistribution of industry profitability from small to large retail stores (Morrison and Newman 1983; Tanguay et al. 1995).[2] Theoretically, Clemenz (1990) shows that deregulation lead to lower prices as longer business hours facilitate the comparison of prices. Recent theoretical studies find that retail prices increase when a retail store opens for longer than its competitors under deregulation (Inderst and Irmen 2005; Shy and Stenbacka 2008; Wenzel 2011; Flores and Wenzel 2016; Yamada 2019). Shy and Stenbacka (2008) and Yamada (2019) examine the effect of business hours deregulation on social welfare. They denote there is no justification for regulation of business hours. Similarly, Wenzel (2011) shows that business hours deregulation increases social welfare and consumer welfare. Contrary to these studies, Flores (2015) theoretically finds that

[2] de Haas et al. (2020) examine empirically the drivers of the decision on whether retail stores extend their business hours by using data on the business hours of all German retail grocery stores and the distance between them. They finds that the probability that a retail store expands business hours increases if nearby competitors already are open for a long time.

business hours deregulation is not always welfare enhancing.[3] The main purpose of our study is to show the optimal degree of business hours regulation in retail industry, and thereby the justification for restrictions on business hours. For this purpose, unlike these literatures, we introduce policy makers' decision on the level of business hours restriction.[4]

This paper is organized as follows: Section 2 presents the basic structure of the model. Section 3 describes the equilibrium in three cases: case (a) complete liberalization of business hours; case (b) partial regulation of business hours; case (c) complete regulation of business hours. Section 4 considers welfare implications of business hours regulation. In this section, we derive our main result concerning the desirable business hours regulation for policy makers. Section 5 discusses an extension of the model, and Section 6 concludes the paper.

2 The Model

In this paper, we set up the model based on Inderst and Irmen (2005) with product differentiation in two dimensions: space and time.[5] To represent the first dimension, we consider that consumers are uniformly distributed on a line segment $[0,1]$. Without loss of generality, we normalize total population to 1. The location of a consumer, denoted by $x \in [0,1]$, is associated with her/his shopping-location preference. The location of retailers, store 1 and 2, is exogenous. Store 1 locates at 0 and store 2 does at 1. Let x_i be the location of store i $(i = 1,2)$. If there is no retail store at their preferred location, the consumers incur transport cost $t|x - x_i|$ to travel to a store, where $t > 0$ is the transportation cost parameter.

To present the second dimension, we consider a time line segment $[0,1]$ with piecewise uniformly distributed consumers. The location of a consumer on the time line is denoted by y which represents her/his preferred shopping time. A consumer is characterized by her/his address (x, y). Addresses are independently distributed over $[0,1] \times [0,1]$. The mass of consumers located at $y = 0$ is $K \in (1/2, 1)$ and that of consumers located at $y \in (0,1]$ is $1 - K$. Note that the number of day-time shoppers is greater than that of night-time shoppers. Consumers located at $y = 0$ prefer to go shopping during the day, and consumers located at $y \in (0,1]$ prefer to go shopping during the night because of working hours during the day. The location of store i $(i = 1,2)$ on the time line is denoted by y_i which represents the closing time of store i. The night-time shoppers can buy a product only if a store locates at their preferred shopping time $(y_i < y)$.[6] This implies that extended business hours have a market expansion effect.

Each consumer buys a product from a store that maximizes her/his indirect utility. The

[3] Flores (2015) examines whether extending business hours are effective to deter entry of potential competitors and discusses the welfare implications of such an entry deterrence behavior.

[4] Also, we introduce a market expansion effect due to extended business hours such as Flores and Wenzel (2016) and Yamada (2019).

[5] Yamada (2019) also uses an extended version of Inderst and Irmen (2005) and examines the relationship between store quality and business hours.

[6] Section 5 considers the effects of consumers' shopping time flexibility on equilibrium business hours, prices, and the welfare.

indirect utility is given by

$$U = \begin{cases} S - p_i - t|x - x_i| & \text{open at preferred time,} \\ 0 & \text{otherwise.} \end{cases}$$

S denotes the gross surplus derived from the consumption of the retail product. We assume $S \geq 4t$ to ensure that a store who opens longer sells to both day-time and night-time shoppers. p_i is the price charged by store i. Stores are constrained to charge a single price, regardless of their business hours.

Stores have constant marginal costs of serving consumers and marginal operating costs which increase with the time already open. For simplify, normalize both the marginal costs to zero. The profit of store i is denoted by $\pi_i = p_i D_i$, where D_i is the respective store's demand.

The game runs as follows. First, a policy maker, who has objective to enhance consumer welfare, decides how and to what extent to regulate business hours. Here, we consider three cases of regulation level of business hours: case (a) complete liberalization of business hours; case (b) partial regulation of business hours; case (c) complete regulation of business hours. In the case of complete liberalization, a policy maker does not set an upper limit of business hours. In the case of partial regulation, she/he sets an upper limit of business hours, $\bar{y} \in (0, 1)$, only for store 2 located at 1 in geographical line. In the case of complete regulation, she/he sets $\bar{y}$ in all stores. Second, given the extent of business hours regulation, stores simultaneously determine their closing times, y_i. Finally, after having observed the time decision, stores compete in prices.

3 Equilibrium

Here, we derive the equilibrium in three cases of regulation level of business hours. Without loss of generality, suppose as follows: in case (a), $0 \leq y_2 \leq y_1 \leq 1$; in case (b), $0 \leq y_2 \leq \bar{y} \leq y_1 \leq 1$; in case (c), $0 \leq y_2 \leq y_1 \leq \bar{y} \leq 1$. In each case, there exist three categories of consumers. First, consumer $y \in [0, y_2]$ can buy from either store. Second, consumer $y \in (y_2, y_1]$ can buy only from store 1. Second, consumer $y \in (y_1, 1]$ cannot buy from any store. Consumer $y \in [0, y_2]$ is indifferent between store 1 and 2 if

$$S - p_1 - tx = S - p_2 - t(1 - x).$$

or explicitly by

$$\bar{x} = \frac{p_2 - p_1 + t}{2t}.$$

Stores' demand functions are

$$D_1 = (K + (1 - K)y_2)\bar{x} + (1 - K)(y_1 - y_2),$$

$$D_2 = (K + (1 - K)y_2)(1 - \bar{x}),$$

where $(K + (1 - K)y_2)$ and $(1 - K)(y_1 - y_2)$ represent the mass of consumer $y \in [0, y_2]$ and $y \in (y_2, y_1]$, respectively.

Given stores' business hours decisions in each case, prices are given by

$$p_1 = \frac{t(3K + (1-K)(4y_1 - y_2))}{3(K + (1-K)y_2)},\ p_2 = \frac{t(3K + (1-K)(2y_1 + y_2))}{3(K + (1-K)y_2)}.$$

Store i chooses y_i to maximize π_i in anticipation of p_1 and p_2. Solving the problem, we derive the equilibrium business hours y_i^* and obtain the following result:

Result 1 *(i) With both complete liberalization and partial regulation of business hours, $y_1^* = 1$ and $y_2^* = 0$; (ii) with complete regulation of business hours, $y_1^* = \bar{y}$ and $y_2^* = 0$.*

The second-order conditions are given by

$$\frac{\partial^2 \pi_1}{\partial y_1^2} = \frac{16(1-K)^2 t}{9(K + (1-K)y_2)},$$

$$\frac{\partial^2 \pi_2}{\partial y_2^2} = \frac{4(1-K)^2 t(K + (1-K)y_1)^2}{9(K + (1-K)y_2)^3}.$$

These imply that there exist possible corner solutions. With complete liberalization of business hours, we obtain three possible corner solutions: (i) $y_1 = 1$ and $y_2 = 0$; (ii) $y_1 = 1$ and $y_2 = 1$; (iii) $y_1 = 0$ and $y_2 = 0$. With partial regulation of business hours, we obtain three possible corner solutions: (i) $y_1 = 1$ and $y_2 = 0$; (ii) $y_1 = 1$ and $y_2 = \bar{y}$; (iii) $y_1 = 0$ and $y_2 = 0$. In these cases, only the pair of $y_1 = 1$ and $y_2 = 0$ appears in equilibrium. With complete regulation of business hours, we obtain three possible corner solutions: (i) $y_1 = \bar{y}$ and $y_2 = 0$; (ii) $y_1 = \bar{y}$ and $y_2 = \bar{y}$; (iii) $y_1 = 0$ and $y_2 = 0$. Only the pair of $y_1 = \bar{y}$ and $y_2 = 0$ appears in equilibrium (the proof is in the appendix). Note that the equilibrium business hours in case (c) implies that under complete regulation, stores choose an asymmetric configuration of location in time. That is, in any cases, business hours are effective as an instrument to achieve differentiation.[7]

The resulting equilibrium prices and profits are shown in Table 1. Here, we obtain the following result:

Result 2 *With complete regulation of business hours, equilibrium prices and demand increases as the upper limit of business hours, $\bar{y}$, increases.*

We find that $\partial p_{ir}^* / \partial \bar{y} > 0$ and $\partial D_{ir}^* / \partial \bar{y} > 0$ $(i \in 1, 2,\ i \neq j)$, where r denotes complete regulation of business hours. This implies that business hours deregulation leads to increased prices and demand. That is, extended business hours relax price competition and increase consumers who can shop at their preferred time. The increased prices have a negative impact on consumer surplus whereas the increased demand has a positive impact.

[7]Considering consumers' shopping time flexibility, we find that stores choose a symmetric configuration of business hours. See Section 5.

Comparing the equilibria of complete liberalization, partial regulation, and complete regulation of business hours, we obtain the following result:

Result 3 *(i) In each case, store* 1 *with longer business hours charges a higher price and serves more customers, and thereby, it earns a higher profit. (ii) Charged prices, demand, and profits with complete liberalization and partial regulation of business hours are higher than those with complete regulation. (iii) The difference in price between deregulation (complete liberalization or partial regulation) of business hours or complete regulation of business hours increases in the transportation cost parameter.*

The intuition of Result 3 (i) is simple. In each case, store 1 that opens longer can monopolize night-time shoppers due to market expansion effect, leading to a higher price and demand. Whereas store 2 that operates part-time charges a lower price in order to attract day-time shoppers. Result 3 (ii) can be confirmed by the fact that $dp^*_{ir}/d\bar{y} > 0$ and $dD^*_{ir}/d\bar{y} > 0$. Result 3 (iii) can be confirmed by the fact that $d(p^*_{id} - p^*_{ir})/dt > 0$, where d denotes the deregulation (complete liberalization and partial regulation) of business hours.

Table 1: Equilibrium prices, profits, and price for linear demand.

	Complete liberalization & Partial regulation case	Complete regulation case
Price	$p^*_{1d} = \frac{(4-K)t}{3K}$, $p^*_{2d} = \frac{(2+K)t}{3K}$	$p^*_{1r} = \frac{t(3K+4(1-K)\bar{y})}{3K}$, $p^*_{2r} = \frac{t(3K+2(1-K)\bar{y})}{3K}$
Profit	$\pi^*_{1d} = \frac{(4-K)^2 t}{18K}$, $\pi^*_{2d} = \frac{(2+K)^2 t}{18K}$	$\pi^*_{1r} = \frac{t(3K+4(1-K)\bar{y})^2}{18K}$, $\pi^*_{2r} = \frac{t(3K+2(1-K)\bar{y})^2}{18K}$
Demand	$D^*_{1d} = \frac{4-K}{6}$, $D^*_{2d} = \frac{2+K}{6}$	$D^*_{1r} = \frac{3K+4(1-K)\bar{y}}{6}$, $D^*_{2r} = \frac{3K+2(1-K)\bar{y}}{6}$

4 Welfare Implications

This section discusses the desirable regulatory policy in terms of consumer welfare.[8] With complete regulation of business hours (case (c)), consumer welfare is defined by

$$CW = (K + (1-K)\bar{y}) \int_0^{\bar{x}} (S - p_1 - tm)dm + K \int_{\bar{x}}^1 (S - p_2 - t(1-m))dm.$$

With complete liberalization and partial regulation of business hours (case (a) and (b)), consumer welfare is defined by

$$CW = \int_0^{\bar{x}} (S - p_1 - tm)dm + K \int_{\bar{x}}^1 (S - p_2 - t(1-m))dm.$$

[8] Although we abstain from discussing total welfare, we find that complete regulation of business hours enhances total welfare when the transportation cost parameter t is relatively large. This is similar to the condition which complete regulation enhances consumer welfare.

Note that consumer welfare in case (a) is equal to that in case (b) because the equilibrium value is equal in both cases.

Comparing consumer welfare in case (c) with consumer welfare in case (a) and (b), we have the following result:

Result 4 *(i) Consumer welfare with complete regulation of business hours is greater than that with the deregulation (complete liberalization and partial regulation of business hours) if* $\frac{12K(2-5K+2(1-K)\bar{y})S}{28-5K(12+17K)+4(1-K)\bar{y}(7-8K+7(1-K)\bar{y})} < t < \frac{S}{4}$, *(ii) consumer welfare with the deregulation (complete liberalization and partial regulation of business hours) is greater than that with complete regulation of business hours if* $t < \frac{12K(2-5K+2(1-K)\bar{y})S}{28-5K(12+17K)+4(1-K)\bar{y}(7-8K+7(1-K)\bar{y})}$.

This implies that the deregulation is not always welfare enhancing. If the transportation cost parameter t is relatively large, complete regulation of business hours is welfare enhancing. The intuition is simple: the larger the transportation cost parameter t, the more consumers suffer disutility under deregulation (complete liberalization and partial regulation of business hours). In addition, the larger t, the higher the price under deregulation than the price under regulation. That is, with the deregulation, such negative effects on consumers dominate the positive effect of increased demand due to extended business hours. Therefore, a policy maker should choose complete regulation and set an upper limit of business hours in both stores in terms of consumer welfare when t is relatively large. In reality, some policy makers regulate business hours only in some regions of the country. For example, France has eased restrictions on business hours only for retail stores located in tourist areas. However, such partial regulation of business hours would worsen consumer welfare.

Some previous studies show that business hours deregulation is always welfare enhancing. Shy and Stenbacka (2008) and Yamada (2019) show that the deregulation increases social welfare. Wenzel (2011) also shows that the deregulation increases both social welfare and consumer welfare. In contrast, we show the justification for strict restrictions on business hours, as Flores (2015) shows. Here, we examine the optimal upper limit of business hours under the complete regulation when t is relatively large. A policy maker chooses $\bar{y}$ to maximize consumer welfare in case (c). Solving the maximization problem, we obtain the following result:

Result 5 *(i) With complete regulation of business hours, a policy maker should set the upper limit of business hours at* $\bar{y}^* = \frac{K(12S+2t-\sqrt{144S^2-708St+2461t^2})}{42(1-K)t}$ *in terms of consumer welfare. (ii) As the gross surplus S increases, the optimal upper limit for the policy maker $\bar{y}^*$ is extended. (iii) As the transportation cost t increases, the optimal upper limit for the policy maker $\bar{y}^*$ is shortened. (iv) As the mass of day-time shoppers K increases, the optimal upper limit for the policy maker $\bar{y}^*$ is extended.*

The intuition of Result 5 (*ii*) is simple: the extended $\bar{y}$ relaxes price competition, leading to the negative effect on consumers. However, the larger S, the more such negative effect are mitigated. Therefore, a policy maker has incentives to extend $\bar{y}$ when S is large. The intuition of Result

5 (ii) is as follows: the extended $\bar{y}$ increases consumers who can shop. However, the larger t, the more consumers suffer disutility. Therefore, when t is large, a policy maker has incentives to shorten $\bar{y}$ in order to decrease consumers who suffer disutility. The intuition of Result 5 (iv) comes from the fact that, by extending $\bar{y}^*$, more night-time shoppers can shop at store 1, yielding the increased consumer welfare.

5 Extension

Extending the basic model, we consider a situation in which consumers can advance their shopping if a store is closed at their preferred shopping time. The indirect utility is given by

$$U = S - p_i - t|x - x_i| - \tau(y, y_i),$$

where

$$\tau(y, y_i) = \begin{cases} \tau & \text{if } \; y_i < y, \\ 0 & \text{if } \; y \leq y_i. \end{cases}$$

Each consumer incurs additional inconvenience costs $\tau > 0$ for shifting (advancing) the shopping if a store is closed at her/his preferred shopping time. Suppose now $S > 2t + \frac{1}{9}\tau$ to ensure that a store who opens longer sells to both day-time and night-time shoppers.

Consumer $y \in [0, y_2]$ is indifferent between buying at store 1 and buying at store 2 if $S - p_1 - tx = S - p_2 - t(1 - x)$. The location of such indifferent consumers is given by $\bar{x}_\alpha = (p_2 - p_1 + t)/2t$. Consumer $y \in (y_2, y_1]$ is indifferent between buying at store 1 and buying at store 2 if $S - p_1 - tx = S - p_2 - t(1 - x) - \tau$. The location of such indifferent consumers is given by $\bar{x}_\beta = (p_2 - p_1 + t + \tau)/2t$. Consumer $y \in (y_1, 1]$ is indifferent between buying at store 1 and not buying at all if $S - p_1 - tx - \tau = 0$. The location of such indifferent consumers is given by $\bar{x}_\gamma = (S - p_1 - \tau)/t$. Stores' demand functions are given by

$$D_1 = (K + (1 - K)y_2)\bar{x}_\alpha + (1 - K)(y_1 - y_2)\bar{x}_\beta + (1 - K)(1 - y_1)\bar{x}_\gamma,$$

$$D_2 = (K + (1 - K)y_2)(1 - \bar{x}_\alpha) + (1 - K)(y_1 - y_2)(1 - \bar{x}_\beta).$$

Now we have the following result regarding the equilibrium business hours. The proof is given in the appendix.

Result 6 *(i) With complete liberalization of business hours, $y_1^{**} = 1$ and $y_2^{**} = 1$; (ii) with partial regulation of business hours, $y_1^{**} = 1$ and $y_2^{**} = 0$; (iii) with complete regulation of business hours, $y_1^{**} = \bar{y}$ and $y_2^{**} = \bar{y}$.*

Note that Result 6 (i) and (iii) imply that stores choose a symmetric configuration of location in time with complete liberalization and regulation of business hours. The intuition is simple: shortened business hours would decrease demand as consumers incur additional inconvenience costs τ for shifting the shopping. Thus, both stores have incentives to acquire customers due to extended business hours. The intuition of Result 6 (ii) is as follows: Store 1 extends business hours in order to attract night-time shoppers distributed on the time line $y \in (0, 1]$. On the other hand, in anticipation of such store 1's action, store 2 shortens business hours in order to target day-time shoppers.

We then obtain the following result:

Result 7 *(i) With complete liberalization of business hours, store* 1 *with longer business hours charges lower prices and acquires more customers, but earns lower profits; (ii) with partial regulation of business hours, store* 1 *with longer business hours charges higher prices and acquires more customers and profits; (iii) with complete regulation of business hours, the price, demand, and profit of store* 1 *are equal to those of store* 2*; (iv) the price of store* 1 *is highest when business hours are partially regulated.*

The intuition of Result 7 (i) is simple: with complete liberalization of business hours, store 1 charges lower prices in order to attract consumers $y \in (y_1, 1]$. The intuition of Result 7 (ii) and (iv) is as follows: with partial regulation of business hours, store 1 that opens longer charges higher prices as it can monopolize night-time shoppers. Therefore, the price of store 1 in the case of partial regulation of business hours is higher than that of store 1 with other cases (complete liberalization and regulation of business hours). Result 7 (iii) is the well-known result and can be confirmed by the fact that the demand of store 1 is equal to that of store 2.

For simplify, assuming $K = 2/3$, we obtain the following result:

Result 8 *Consumer welfare with partial regulation of business hours is lower than that with complete liberalization and regulation of business hours only if* $\frac{8}{27}\tau < t \leq \frac{6}{19}\tau$ *and* $2t + \frac{1}{9}\tau < S < -\frac{5}{9}t + \tau$.

The intuition can be confirmed by Result 7 (iv). We also find that the highest consumer welfare is in the case of complete liberalization of business hours, as some previous studies show. France implements the policy which restricts on business hours of stores located at tourist zones. However, such partial regulation policy would worsen consumer welfare. This implies that policy makers might be better to set an upper limit of business hours for retailers in all regions of the country if she/he has objectives for the regulatory restrictions on the retail industry.

6 Conclusion

This paper analyzes retail industries with competition in business hours and prices and examines the effect of regulation of business hours on consumer welfare.

Countries vary in the degree of regulation of business hours. Using an extended version of the standard Hotelling (1929) model with the two dimensional time-location space, we investigate how and to what extent policy makers should regulate business hours in terms of consumer welfare. This paper considers three levels of business hours regulation. One is the case of complete liberalization, where there are no regulations on business hours. Another is the case of partial regulation, where a policy maker sets an upper limit of business hours only for one store. The other is the case of complete regulation, where she/he sets an upper limit of business hours for all stores.

We find that consumer welfare with complete regulation of business hours is greater than that with complete liberalization and partial regulation of business hours only when the transportation cost parameter is relatively large. This implies that, contrary to some previous studies, the deregulation (complete liberalization and partial regulation of business hours) is not always welfare enhancing. Although France and Germany have regulated business hours only in some regions of the country, such partial regulation might worsen consumer welfare because a retail store located at deregulated areas charges a higher price.

Appendix

Proof of Result 1

Here, we prove Result 1, which characterizes the business hours equilibrium. First, consider the complete liberalization of business hours. For the pattern (i) $y_1 = 1$ and $y_2 = 0$, suppose that store 1 deviates to $y_1 = 0$ from $y_1 = 1$ given $y_2 = 0$. The deviation profit of store 1 is given by $\pi_1^\kappa = Kt/2$. Comparing the profit before deviation π_{1d}^* with π_1^κ, π_{1d}^* is greater than π_1^κ. Thus, store 1 has no incentives to deviate to $y_1 = 0$ from $y_1 = 1$. Then, suppose that store 2 deviates to $y_2 = 1$ from $y_2 = 0$ given $y_1 = 1$. The deviation profit of store 2 is given by $\pi_2^\kappa = t/2$. Comparing the profit before deviation π_{2d}^* with π_2^κ, π_{2d}^* is greater than π_2^κ, so that store 2 also has no incentives to deviate to $y_2 = 1$ from $y_2 = 0$. Thus, the pair of $y_1 = 1$ and $y_2 = 0$ appears in equilibrium. For the pattern (ii) $y_1 = 1$ and $y_2 = 1$, suppose that store 2 deviates to $y_2 = 0$ from $y_2 = 1$ given $y_1 = 1$. The deviation profit of store 2 is given by $\pi_2^\kappa = (2 + K)^2 t/18K$. Comparing the profit before deviation π_{2d}^* with π_2^κ, π_{2d}^* is smaller than π_2^κ, so that store 2 has incentives to deviate to $y_2 = 0$ from $y_2 = 1$. Thus, the pair of $y_1 = 1$ and $y_2 = 1$ does not appear in equilibrium. For the pattern (iii) $y_1 = 0$ and $y_2 = 0$, suppose that store 1 deviates to $y_1 = 1$ from $y_1 = 0$ given $y_2 = 0$. The deviation profit of store 1 is given by $\pi_1^\kappa = (4 - K)^2 t/18K$. Comparing the profit before deviation π_{1d}^* with π_1^κ, π_{1d}^* is smaller than π_1^κ, so that store 1 has incentives to deviate to $y_1 = 1$ from $y_1 = 0$. Thus, the pair of $y_1 = 0$ and $y_2 = 0$ does not appear in equilibrium.

Second, consider the partial regulation of business hours. For the pattern (i) $y_1 = 1$ and $y_2 = 0$, suppose that store 1 deviates to $y_1 = 0$ from $y_1 = 1$ given $y_2 = 0$. The deviation profit of store 1 is given by $\pi_1^\kappa = Kt/2$. Comparing π_{1d}^* with π_1^κ, π_{1d}^* is greater than π_1^κ. Thus, store 1 has no incentives to deviate to $y_1 = 0$ from $y_1 = 1$. Then, suppose that store 2 deviates to $y_2 = \bar{y}$ from $y_2 = 0$ given $y_1 = 1$. The deviation profit of store 2 is given by $\pi_2^\kappa = (2 + K + (1 - K)\bar{y})^2 t/18(K + (1 - K)\bar{y})$. Comparing π_{2d}^* with π_2^κ, π_{2d}^* is greater than

π_2^κ, so that store 2 also has no incentives to deviate to $y_2 = \bar{y}$ from $y_2 = 0$. Thus, the pair of $y_1 = 1$ and $y_2 = 0$ appears in equilibrium. For the pattern (ii) $y_1 = 1$ and $y_2 = \bar{y}$, suppose that store 2 deviates to $y_2 = 0$ from $y_2 = \bar{y}$ given $y_1 = 1$. The deviation profit of store 2 is given by $\pi_2^\kappa = (2 + K)^2 t/18K$. Comparing π_{2d}^* with π_2^κ, π_{2d}^* is smaller than π_2^κ, so that store 2 has incentives to deviate to $y_2 = 0$ from $y_2 = \bar{y}$. Thus, the pair of $y_1 = 1$ and $y_2 = \bar{y}$ does not appear in equilibrium. For the pattern (iii) $y_1 = 0$ and $y_2 = 0$, suppose that store 1 deviates to $y_1 = 1$ from $y_1 = 0$ given $y_2 = 0$. The deviation profit of store 1 is given by $\pi_1^\kappa = (4 - K)^2 t/18K$. Comparing π_{1d}^* with π_1^κ, π_{1d}^* is smaller than π_1^κ, so that store 1 has incentives to deviate to $y_1 = 1$ from $y_1 = 0$. Thus, the pair of $y_1 = 0$ and $y_2 = 0$ does not appear in equilibrium.

Finally, consider the complete regulation of business hours. For the pattern (i) $y_1 = \bar{y}$ and $y_2 = 0$, suppose that store 1 deviates to $y_1 = 0$ from $y_1 = \bar{y}$ given $y_2 = 0$. The deviation profit of store 1 is given by $\pi_1^\kappa = Kt/2$. Comparing π_{1r}^* with π_1^κ, π_{1r}^* is greater than π_1^κ. Thus, store 1 has no incentives to deviate to $y_1 = 0$ from $y_1 = \bar{y}$. Then, suppose that store 2 deviates to $y_2 = \bar{y}$ from $y_2 = 0$ given $y_1 = \bar{y}$. The deviation profit of store 2 is given by $\pi_2^\kappa = (K + (1 - K)\bar{y})t/2$. Comparing π_{2r}^* with π_2^κ, π_{2r}^* is greater than π_2^κ. Thus, store 2 also has no incentives to deviate to $y_2 = \bar{y}$ from $y_2 = 0$. The pair of $y_1 = \bar{y}$ and $y_2 = 0$ appears in equilibrium. For the pattern (ii) $y_1 = \bar{y}$ and $y_2 = \bar{y}$, suppose that store 2 deviates to $y_2 = 0$ from $y_2 = \bar{y}$ given $y_1 = \bar{y}$. The deviation profit of store 2 is given by $\pi_2^\kappa = (3K + 2(1 - K)\bar{y})^2 t/18K$. Comparing π_{2r}^* with π_2^κ, π_{2r}^* is smaller than π_2^κ, so that store 2 has incentives to deviate to $y_2 = 0$ from $y_2 = \bar{y}$. The pair of $y_1 = \bar{y}$ and $y_2 = \bar{y}$ does not appear in equilibrium. For the pattern (iii) $y_1 = 0$ and $y_2 = 0$, suppose that store 1 deviates to $y_1 = \bar{y}$ from $y_1 = 0$ given $y_2 = 0$. The deviation profit of store 1 is given by $\pi_1^\kappa = (3K + 4(1 - K)\bar{y})^2 t/18K$. Comparing π_{1r}^* with π_1^κ, π_{1r}^* is smaller than π_1^κ, so that store 1 has incentives to deviate to $y_1 = \bar{y}$ from $y_1 = 0$. Thus, the pair of $y_1 = 0$ and $y_2 = 0$ does not appear in equilibrium.

Proof of Result 6

We prove Result 6, which characterizes the business hours equilibrium by extending the basic model. First, consider the complete liberalization of business hours. For the pattern (i) $y_1 = 1$ and $y_2 = 0$, suppose that store 2 deviates to $y_2 = 1$ from $y_2 = 0$ given $y_1 = 1$. The deviation profit of store 2 is given by $\pi_2^\kappa = t/2$. Comparing the profit before deviation $\pi_2^{**} = (9t-\tau)^2/162t$ with π_2^κ, π_2^{**} is smaller than π_2^κ. Thus, store 2 has incentives to deviate to $y_2 = 1$ from $y_2 = 0$, so that the pair of $y_1 = 1$ and $y_2 = 0$ does not appear in equilibrium. For the pattern (ii) $y_1 = 1$ and $y_2 = 1$, suppose that store 1 deviates to $y_1 = 0$ from $y_1 = 1$ given $y_2 = 1$. The deviation profit of store 1 is given by $\pi_1^\kappa = (4S + 6t - 5\tau)^2/294t$. Comparing the profit before deviation $\pi_1^{**} = t/2$ with π_1^κ, π_1^{**} is greater than π_1^κ. Thus, store 1 has no incentives to deviate to $y_1 = 0$ from $y_1 = 1$. Then, suppose that store 2 deviates to $y_2 = 0$ from $y_2 = 1$ given $y_1 = 1$. The deviation profit of store 2 is given by $\pi_2^\kappa = (9t-\tau)^2/162t$. Comparing the profit before deviation $\pi_2^{**} = t/2$ with π_2^κ, π_2^{**} is greater than π_2^κ, so that store 2 has no incentives to deviate to $y_2 = 0$ from $y_2 = 1$. Thus, the pair of $y_1 = 1$ and $y_2 = 1$ appear in equilibrium. For the pattern (iii)

$y_1 = 0$ and $y_2 = 0$, suppose that store 1 deviates to $y_1 = 1$ from $y_1 = 0$ given $y_2 = 0$. The deviation profit of store 1 is given by $\pi_1^\kappa = (9t+\tau)^2/162t$. Comparing the profit before deviation $\pi_1^{**} = 2(2S + 3t - 2\tau)^2/147t$ with π_1^κ, π_1^{**} is smaller than π_1^κ. Thus, store 1 has incentives to deviate to $y_1 = 1$ from $y_1 = 0$. Then, suppose that store 2 deviates to $y_2 = 1$ from $y_2 = 0$ given $y_1 = 0$. The deviation profit of store 2 is given by $\pi_2^\kappa = (2S + 10t + \tau)^2/588t$. Comparing the profit before deviation $\pi_2^{**} = (S + 5t - \tau)^2/147t$ with π_2^κ, π_2^{**} is smaller than π_2^κ, so that store 2 also has incentives to deviate to $y_2 = 1$ from $y_2 = 0$. Thus, the pair of $y_1 = 0$ and $y_2 = 0$ does not appear in equilibrium.

Second, consider the partial regulation of business hours. For the pattern (i) $y_1 = 1$ and $y_2 = 0$, suppose that store 1 deviates to $y_1 = 0$ from $y_1 = 1$ given $y_2 = 0$. The deviation profit of store 1 is given by $\pi_1^\kappa = 2(2S + 3t - 2\tau)^2/147t$. Comparing $\pi_1^{**} = (9t + \tau)^2/162t$ with π_1^κ, π_1^{**} is greater than π_1^κ. Thus, store 1 has no incentives to deviate to $y_1 = 0$ from $y_1 = 1$. Then, suppose that store 2 deviates to $y_2 = \bar{y}$ from $y_2 = 0$ given $y_1 = 1$. The deviation profit of store 2 is given by $\pi_2^\kappa = (S + 5t - \tau)^2/147t$. Comparing $\pi_2^{**} = (9t - \tau)^2/162t$ with π_2^κ, π_2^{**} is greater than π_2^κ, so that store 2 also has no incentives to deviate to $y_2 = \bar{y}$ from $y_2 = 0$. Thus, the pair of $y_1 = 1$ and $y_2 = 0$ appears in equilibrium. For the pattern (ii) $y_1 = 1$ and $y_2 = \bar{y}$, suppose that store 2 deviates to $y_2 = 0$ from $y_2 = \bar{y}$ given $y_1 = 1$. The deviation profit of store 2 is given by $\pi_2^\kappa = (9t + \tau)^2/162t$. Comparing $\pi_2^{**} = (9t - \tau + \tau\bar{y})^2/162t$ with π_2^κ, π_2^{**} is smaller than π_2^κ. Thus, store 2 has incentives to deviate to $y_2 = 0$ from $y_2 = \bar{y}$. The pair of $y_1 = 1$ and $y_2 = \bar{y}$ does not appear in equilibrium. For the pattern (iii) $y_1 = 0$ and $y_2 = 0$, suppose that store 1 deviates to $y_1 = 1$ from $y_1 = 0$ given $y_2 = 0$. The deviation profit of store 1 is given by $\pi_1^\kappa = (9t + \tau)^2/162t$. Comparing $\pi_1^{**} = 2(2S + 3t - 2\tau)^2/147t$ with π_1^κ, π_1^{**} is smaller than π_1^κ. Thus, store 1 has incentives to deviate to $y_1 = 1$ from $y_1 = 0$. Then, suppose that store 2 deviates to $y_2 = \bar{y}$ from $y_2 = 0$ given $y_1 = 0$. The deviation profit of store 2 is given by $\pi_2^\kappa = (2S + 10t - 2\tau + 3\tau\bar{y})^2/588t$. Comparing $\pi_2^{**} = (S + 5t - \tau)^2/147t$ with π_2^κ, π_2^{**} is smaller than π_2^κ, so that store 2 also has no incentives to deviate to $y_2 = \bar{y}$ from $y_2 = 0$. Thus, the pair of $y_1 = 0$ and $y_2 = 0$ does not appear in equilibrium.

Finally, consider the complete regulation of business hours. For the pattern (i) $y_1 = \bar{y}$ and $y_2 = 0$, suppose that store 2 deviates to $y_2 = \bar{y}$ from $y_2 = 0$ given $y_1 = \bar{y}$. The deviation profit of store 2 is given by $\pi_2^\kappa = (2 + \bar{y})(2S + 10t - 2\tau - (2S + t - 2\tau)\bar{y})^2/6t(5\bar{y} - 14)^2$. Comparing $\pi_2^{**} = ((2 + \bar{y})(-2S - 10t + (2S + t)\bar{y}) + \tau(4 - (5\bar{y} - 4)\bar{y}))^2/6t(2 + \bar{y})(5\bar{y} - 14)^2$ with π_2^κ, π_2^{**} is smaller than π_2^κ, so that store 2 has incentives to deviate to $y_2 = \bar{y}$ from $y_2 = 0$. Thus, the pair of $y_1 = \bar{y}$ and $y_2 = 0$ does not appear in equilibrium. For the pattern (ii) $y_1 = \bar{y}$ and $y_2 = \bar{y}$, suppose that store 1 deviates to $y_1 = 0$ from $y_1 = \bar{y}$ given $y_2 = \bar{y}$. The deviation profit of store 1 is given by $\pi_1^\kappa = (4S + 6t - \tau(4 + \bar{y}))^2/294t$. Comparing $\pi_1^{**} = (4 - \bar{y})(4S + 6t - 4\tau - (4S - 3t - 4\tau)\bar{y})^2/6t(5\bar{y} - 14)^2$ with π_1^κ, π_1^{**} is greater than π_1^κ. Thus, store 1 has no incentives to deviate to $y_1 = 0$ from $y_1 = \bar{y}$. Then, suppose that store 2 deviates to $y_2 = 0$ from $y_2 = \bar{y}$ given $y_1 = \bar{y}$. The deviation profit of store 2 is given by $\pi_2^\kappa = ((2 + \bar{y})(-2S - 10t + (2S + t)\bar{y}) + \tau(4 - (5\bar{y} - 4)\bar{y}))^2/6t(2 + \bar{y})(5\bar{y} - 14)^2$. Comparing

$\pi_2^{**} = (2+\bar{y})(2S+10t-2\tau-(2S+t-2\tau)\bar{y})^2/6t(5\bar{y}-14)^2$ with π_2^{κ}, π_2^{**} is greater than π_2^{κ}, so that store 2 also has no incentives to deviate to $y_2 = 0$ from $y_2 = \bar{y}$. Thus, the pair of $y_1 = \bar{y}$ and $y_2 = \bar{y}$ appears in equilibrium. For the pattern (iii) $y_1 = 0$ and $y_2 = 0$, suppose that store 1 deviates to $y_1 = \bar{y}$ from $y_1 = 0$ given $y_2 = 0$. The deviation profit of store 1 is given by $\pi_1^{\kappa} = (4-\bar{y})(4S+6t-4\tau-(4S-3t-5\tau)\bar{y})^2/6t(5\bar{y}-14)^2$. Comparing $\pi_1^{**} = 2(2S+3t-2\tau)^2/147t$ with π_1^{κ}, π_1^{**} is smaller than π_1^{κ}. Thus, store 1 has incentives to deviate to $y_1 = \bar{y}$ from $y_1 = 0$. Then, suppose that store 2 deviates to $y_2 = \bar{y}$ from $y_2 = 0$ given $y_1 = 0$. The deviation profit of store 2 is given by $\pi_2^{\kappa} = (2S+10t-2\tau+3\tau\bar{y})^2/588t$. Comparing $\pi_2^{**} = (S+5t-\tau)^2/147t$ with π_2^{κ}, π_2^{**} is smaller than π_2^{κ}, so that store 2 also has no incentives to deviate $y_2 = \bar{y}$ from $y_2 = 0$. Thus, the pair of $y_1 = 0$ and $y_2 = 0$ does not appear in equilibrium.

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