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REGULATED BUSINESS HOURS, COMPETITION,
AND LABOR UNIONS

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We analyze a retail industry where shops compete in prices and opening hours. We demonstrate that stores with longer opening hours tend to charge higher prices. Then, we calculate the symmetric equilibrium in closing hours and demonstrate a market failure with opening hours shorter than the socially optimal level. Furthermore, we characterize a condition under which labor unions would set high wages that would limit opening hours below the equilibrium level. Thus, opening hours shorter than the equilibrium level would be consistent with an outcome affected by strong labor unions.

**Keywords:** Regulated Business Hours, Opening Hours, Labor Unions, Regulated Closing hours

**JEL Classification Numbers:** L81, M2, J51
1. Introduction

During the past decade issues related to shopping hour restrictions have been subject to repeated and intense debate in many European countries. Countries like Austria, Denmark, Finland, Germany and Norway still maintain substantial restrictions on shopping hours. For example, in Germany stores must close by 8 P.M. on weekdays. On Saturdays stores lock up at 1 or 2 P.M., except in city centers where shops typically serve until 4 P.M. except a number of Saturdays prior to Christmas. On Sundays there are typically no retail activities at all. Other European countries, like Sweden and United Kingdom, have taken radical steps towards a liberalization of trading hours.

In this study we analyze a differentiated retail industry where shops engage in two-stage competition with respect to opening hours and prices. We demonstrate that retailers with longer opening hours tend to charge higher prices in equilibrium. We then calculate the symmetric subgame perfect equilibrium in closing hours and demonstrate a market failure whereby competition generates retail service operation, which is shorter than the socially optimal number of opening hours. In fact, this market failure seems to constitute a robust finding insofar as it is shown to be true within the framework of a partial as well as a general equilibrium approach. Intuitively, price competition induces the retailers to cut costs and commitments to short opening hours represent an efficient instrument in this respect.

But, if subgame perfect shopping hours fall short of socially optimal opening hours, why do we then observe that liberalization of shopping hours typically result in longer, not shorter, opening hours? In light of our model it might simply mean that current regulations of shopping hours are not designed to maximize social welfare. In fact, we characterize the shopping hour regulation favored by labor unions, which are sufficiently strong in a political sense so as to influence this regulation in a crucial way. In this respect we find that a monopoly labor union would mandate opening hours that are shorter than the opening hours generated through competition if the disutility of work exceeds an explicitly characterized threshold. It should be emphasized that this conclusion is reached despite the fact that the union is modeled to fully internalize the role of workers as consumers. That is, the union
mandates shorter shopping hours even though it takes into account the discomfort caused by early closing hours to consumers (workers) who prefer late shopping hours.

The existing literature on the effects of a deregulation of shopping hours has generated ambiguous predictions. Kay and Morris (1987) present conditions under which competition in a retail market with homogeneous consumers could induce opening at times when high costs would induce price increases relative to a situation with restricted shopping hours. In light of their empirical evidence they, however, conclude that deregulation of shopping hours would in practice lead to lower costs and prices in the retail sector. Tangay, Vallee and Lanoie (1995) predict that a trade hour deregulation would shift demand from small shops towards large ones and that this shift in demand makes it possible for large shops to increase prices. In empirical tests based on Canadian data they found that the Canadian deregulation of opening hours in 1990 has generated price increases at large stores, which offer extensive shopping hours.

Also more theoretically oriented studies have presented mixed results. Clemenz (1990) shows that opening hour deregulation may lead to lower retail prices within the framework of a model with consumer search. The mechanism behind this result is that longer shopping hours facilitate more extensive search activity, which, in turn, leads to lower retail prices. In a subsequent study Clemenz (1994) investigates a homogeneous market where customers are differentiated with respect to their preferred shopping times. Within such a framework he focuses on the polar cases of monopoly and perfect competition, and he shows that a monopolist will apply shopping hours which exceed the socially optimal opening hours.

In contrast to the studies mentioned above, in the present study we investigate the welfare implications of imperfect competition within the framework of a two-stage model where firms commit to opening hours in the long run, and are engaged in price competition in the short run. Thus, our model concentrates on treating shopping hours as strategic instruments. Such a focus we share with the recent study by Inderst and Irmen (2001). Inderst and Irmen demonstrate the incentives of firms to use opening hours as an instrument to achieve product differentiation, for the purpose of increasing their market power. Clearly,
if different shops apply differentiated closing hours, competition will be weakened at each point in time. We obtain similar results for configurations with differentiated opening hours. However, precisely for the purpose of eliminating this case for differentiation, we focus on symmetric configurations. In fact, we show that there is a uniquely determined symmetric subgame perfect equilibrium, and we explicitly characterize the associated closing hour. This subgame perfect equilibrium is compared with the socially optimal (symmetric) closing hour.

In addition, and in distinction from Inderst and Irmen (2001), we extend our basic model to a general equilibrium framework, which incorporates a labor market. This extension is necessary to analyze welfare distortions associated with different regimes for how shopping hours are determined.

The present study is organized as follows. Section 2 develops a model of a retail industry with two shops competing in two strategies: Closing hours and prices. Section 3 analyzes how shops’ pricing decisions are affected by the lengths of shopping hours. Section 4 solves for the equilibrium and socially optimal opening hours, in a partial-equilibrium framework. Section 5 introduces a labor market and solves for the equilibrium and socially-optimal opening hours in a general-equilibrium framework. Section 6 analyzes a labor union in control of shopping hours. Section 7 offers concluding comments.

2. The Model

Consider a duopolistic retail industry with two shops, indexed by \( i = A, B \), selling a homogeneous product to heterogeneous shoppers. Let \( p_A \) denote the price charged by shop \( A \), and \( p_B \) the price charged by \( B \). In line with the Hotelling model of product differentiation, firm \( A \) is located at the left end of the unit interval, whereas firm \( B \) is located at the right end of the interval.

Time is indexed continuously on the interval \([0, T]\). The most obvious interpretation of \( T \) is that of hours per day. Thus, \( T = 24 \) means that stores cannot be opened more than 24 hours each day. Let \( t_i \) denote the closing time of store \( i \), where \( 0 \leq t_i \leq T \), and \( i = A, B \).
2.1 Shoppers

Shoppers are differentiated in two dimensions: (i) Preferred shopping time and, (ii) location relative to stores’ location. Each point in time \( t \) \((0 \leq t \leq T)\) represents an ideal shopping time for a continuum of potential shoppers who are further differentiated according to their location relative to stores. Thus, for every ideal shopping time \( t \), potential Shoppers are indexed by \( x \) with uniform density on the unit interval with a mass of \( n \) consumers per location and shopping time. Shoppers of type \( x \) close to 0 reside nearby shop \( A \), and shoppers of type \( x \) close to 1 reside nearby store \( B \). Altogether, the mass of shoppers is \( n \times T \). Figure 1 illustrates how shoppers are distributed in the two-dimensional time-location space.

![Figure 1: The distribution of shoppers across locations and ideal shopping time.](image)

The utility of a consumer indexed by the pair \((t, x)\) (where \( t \in [0, T] \) and \( x \in [0, 1] \)), is

\[
U_{x,t} \overset{\text{def}}{=} \begin{cases} 
\beta - p_A - \lambda x & \text{shopping at } A; \text{ store } A \text{ is open} \\
\beta - p_A - \lambda x - \tau |t - t_A| & \text{shopping at } A; \text{ store } A \text{ is closed} \\
\beta - p_B - \lambda (1 - x) & \text{shopping at } B; \text{ store } B \text{ is open} \\
\beta - p_B - \lambda (1 - x) - \tau |t - t_B| & \text{shopping at } B; \text{ store } B \text{ is closed}
\end{cases}
\]

The parameter \( \beta \) measures a consumer’s basic utility derived from the consumption of the retail service. The parameter \( \lambda > 0 \), which we refer to as the location parameter, formally measures the transportation cost per unit of distance. This parameter captures the disutility an individual experiences from traveling to the store. The parameter \( \tau > 0 \), which we refer to as the value-of-time parameter, measures the per-unit-of-time disutility an individual
experiences when he has to adjust the shopping time because the store is closed the at the ideal time for this consumer.

### 2.2 Shops

Shop $A$ is located at point 0 and shop $B$ at point 1. The shoppers are uniformly distributed on the unit interval between the stores with a uniform density of $n$ shoppers per location for each unit of time, $t \in [0, T]$.

Each shop competes with two strategic instruments: The price, $p_i$, and its closing hour, $t_i$, ($t_i \leq T$, for $i = A, B$). We assume that both stores open at $t = 0$.\(^1\) Our analysis is based on the following assumptions.

**Assumption 1**

(a) *Shops must irreversibly commit to closing hours, $t_A$ and $t_B$.*

(b) *Shops must commit to single prices, $p_A$ and $p_B$ before trade begins. In addition, prices cannot vary during shopping hours.*

Assumption 1(a) is straightforward since committing to preannounced closing hours is absolutely essential for building basic reputation among potential shoppers. Assumption 1(b) is based on the observation that stores tend to keep prices constant throughout their opening hours, despite the fact that their market power intensifies after competing stores close.

With no loss of generality, suppose that store $B$ has (weakly) longer opening hours than store $A$. Formally, let $0 \leq t_A \leq t_B \leq T$. Shops’ opening hours are illustrated in Figure 2.

![Figure 2: Shops’ opening hours.](image)

\(^{1}\)In other words, we focus our analysis on closing times by assuming both stores open at the same time, which is normalized to zero. Clearly, our study could focus on competition on the opening hour instead of the closing hour.
2.3 Timing

The competition between the stores takes place within the framework of a two-stage interaction:

Stage I: Stores A and B commit to their closing hours \((t_A, t_B)\), simultaneously.

Stage II: Stores take closing hours as given, and simultaneously set their prices \(p_A\) and \(p_B\).

Stages I and II are completed before the clock turns \(t = 0\) when both stores open.

2.4 Shoppers’ allocation among stores

Assume that stores A and B charge retail prices \(p_A\) and \(p_B\), and that these stores apply closing hours \(0 \leq t_A \leq t_B \leq T\). Initially we consider a consumer whose ideal shopping time belongs to the interval where both shops are open. From (1) we can then conclude that the equation

\[
\beta - p_A - \lambda x = \beta - p_B - \lambda(1 - x)
\]

implicitly determines the location of a consumer who is indifferent between shopping at A and B. Hence, the location of this consumer is given by

\[
\hat{x} = \frac{1}{2} + \frac{p_B - p_A}{2\lambda}, \quad t \in [0, \min\{t_A, t_B\}].
\]

(2)

Clearly, the ideal time \(t\) does not appear in (2) since both stores are open, and therefore only location and prices affect shoppers’ decisions on where to shop. Thus, in this time interval (both shops are open) all shoppers indexed on \([0, \hat{x}]\) prefer shopping at A whereas all shoppers indexed on \((\hat{x}, 1]\) prefer shopping at B.

Now consider a consumer whose ideal shopping time falls when A is closed while B is open (the second interval in Figure 2). From the utility function (1), such a consumer is indifferent between shopping at A and B if the equation

\[
\beta - p_A - \lambda y - \tau(t - t_A) = \beta - p_B - \lambda(1 - y)
\]

holds. Hence, the location of the indifferent consumer is given by

\[
\hat{y}(t) = \frac{1}{2} + \frac{p_B - p_A - \tau(t - t_A)}{2\lambda}, \quad t_A \leq t \leq t_B.
\]

(3)

The shopper with the “latest” ideal shopping time that would advance his purchase in order
to shop from \( A \) is denoted by \( \hat{t} \) and found from (3) by setting \( \hat{y} = 0 \). Hence,

\[
\hat{t} = t_A + \frac{\lambda + p_B - p_A}{\tau}.
\] (4)

Finally, shoppers whose ideal shopping time happens to be when both shops are closed \( (t > t_B) \), and are indifferent between shopping at \( A \) and \( B \) are found by substituting \( t = t_B \) into (3). Hence,

\[
\hat{z} = \hat{y}(t_B) = \frac{1}{2} + \frac{p_B - p_A - \tau(t_B - t_A)}{2\lambda}, \quad \text{for } t > t_B.
\] (5)

Figure 3 displays the allocation of shoppers between the stores. Figure 3 is drawn under the assumption that store \( A \) sells at a lower price than store \( B \) \((p_A < p_B)\) implying that store \( A \) has a larger market share than \( B \) among all shoppers whose ideal shopping time belongs to the time interval when both stores are open. Figure 3 illustrates how shop \( B \) to an increasing extent attracts customers with an ideal time belonging to \([t_A, t_B]\), when shop \( A \) is closed while \( B \) is still open. In Figure 3 this is captured by the feature that \( \hat{y}(t) \), which is analytically characterized by (3), is monotonically decreasing on the time interval \([t_A, t_B]\). When both stores are closed the curve (3) then settles at a lower rate given by \( \hat{z} \) in (5). Finally, Figure 3 reveals that after store \( B \) closes \((t > t_B)\) market shares remain

![Figure 3: Shoppers’ allocation between stores. Note: Areas should be multiplied by \( n \) to obtain actual number of shoppers.](image)

7
constant since both $A$-shoppers and $B$-shoppers maintain the same difference between their ideal shopping time and the time when store $B$ closes, $t_B$.

In view of Figure 3, (2) and (5), the number of consumers shopping at store $A$ is

$$q_A = n \left[ t_A \hat{x} + \frac{(\hat{x} - \hat{z})(t_B - t_A)}{2} + (T - t_B)\hat{z} \right]$$

$$= \frac{n}{4\lambda} \left[ 2T [p_B - p_A + \lambda - \tau(t_B - t_A)] + \tau(t_A + t_B)(t_B - t_A) \right].$$

Therefore, the number of consumers shopping at store $B$ is

$$q_B = nT - q_A = \frac{n}{4\lambda} \left[ 2T [p_A - p_B + \lambda + \tau(t_B - t_A)] - \tau(t_A + t_B)(t_B - t_A) \right].$$

3. Equilibrium Prices and Profit Levels Under Given Closing Hours

This section solves and analyzes equilibrium prices and profit levels assuming that store hours are predetermined as displayed in Figures 2 and 3 (corresponding to Stage II of the game described in Section 2.3). Let $\sigma > 0$ be the parameter measuring how many worker-hours are needed to keep a store open for one additional hour. Also let $w$ denote the hourly wage rate. In this section, we treat $w$ as exogenously given. However, in Section 5 we introduce a labor market and derive $w$ endogenously in a general-equilibrium model.

For given $t_A$ and $t_B$, (6) and (7) imply that the profit levels of the shops are given by

$$\pi_A(p_A, p_B) = p_A \frac{n}{4\lambda} \left[ 2T [p_B - p_A + \lambda - \tau(t_B - t_A)] + \tau(t_A + t_B)(t_B - t_A) \right] - w\sigma t_A;$$

$$\pi_B(p_A, p_B) = p_B \frac{n}{4\lambda} \left[ 2T [p_A - p_B + \lambda + \tau(t_B - t_A)] - \tau(t_A + t_B)(t_B - t_A) \right] - w\sigma t_B.$$  

It is straightforward to establish that each profit function $\pi_i$ is strictly concave with respect to $p_i$. Thus, maximizing $\pi_A$ with respect to $p_A$, and $\pi_B$ with respect to $p_B$, and solving the system of equations determined by the two best-response functions yield

$$p_A(t_A, t_B) = \frac{2T[3\lambda - \tau(t_B - t_A)] + \tau(t_A + t_B)(t_B - t_A)}{6T};$$

$$p_B(t_A, t_B) = \frac{2T[3\lambda + \tau(t_B - t_A)] - \tau(t_A + t_B)(t_B - t_A)}{6T}. $$

(9a) and (9b) display the equilibrium retail prices as functions of the closing hours. Hence,

$$p_A|_{t_A = t_B} = p_B|_{t_A = t_B} = \lambda, \quad \text{and} \quad \Delta p \overset{\text{def}}{=} p_B - p_A = \frac{\tau(t_B - t_A)(2T - t_A - t_B)}{3T} > 0.$$  

8
Thus, when both stores share the same opening hours, the uniform equilibrium price equals the standard Hotelling symmetric price which equals to the transportation-cost parameter, $\lambda$. We summarize our results so far with the following proposition.

**Proposition 1**

Let stores’ closing hours be given at the levels $t_A$ and $t_B$. Then,

(a) The store that closes late charges a higher price. Formally, $p_B \geq p_A$ if and only if $t_B \geq t_A$.

(b) The prices charged by both stores increase with the location (transportation-cost) parameter. Formally, $\frac{dp_i}{d\lambda} > 0$, $i = A, B$.

(c) An increase in the value of time would lower the price of the store that closes early, and increase the price of the store that closes late. Formally, $\frac{dp_A}{d\tau} < 0$ and $\frac{dp_B}{d\tau} > 0$. Therefore,

(d) An increase in shoppers’ value of time would increase the difference in stores’ prices. Formally, $\frac{d\Delta p}{d\tau} > 0$.

**Proof.** (a) Follows directly from (10). (b) follows directly from (9a) and (9b). (c) and (d) follow from (9a) and (9b) observing that

$$\frac{dp_A}{d\tau} = -\frac{dp_B}{d\tau} = -\frac{(t_B - t_A)(2T - t_A - t_B)}{6T} < 0.$$ 

Comparing parts (b) and (c) of Proposition 1 reveal that the two parameters reflecting heterogeneity among shoppers have do not affect equilibrium prices in the same way. As in the standard Hotelling model, an increase in the transportation cost parameter $\lambda$ increases both prices. Intuitively, this captures the idea that the market power of both the retailers increase in response to a higher degree of product differentiation. However, an increase in the value of time parameter $\tau$ raises one price and lowers the other.

Furthermore, parts (c) and (d) of Proposition 1 imply that a higher shoppers’ value of time places the store that closes early at a greater disadvantage compared to the store with
longer opening hours. In contrast, a higher value of time places the store that closes late at a
greater advantage due to its monopoly hours that enable charging higher prices. A further
investigation of (9a) and (9b) yields our next proposition.

**Proposition 2**

The equilibrium price of each store increases when the store extends its shopping hours, and
decreases when the competing store extends its shopping hours.

**Proof.** (9a) and (9b) imply that

\[
\frac{dp_i}{dt_i} = \frac{\tau(T - t_i)}{3T} > 0 \quad \text{and} \quad \frac{dp_j}{dt_j} = \frac{\tau(t_j - T)}{3T} < 0, \quad \text{for} \quad i, j = A, B, \quad i \neq j.
\]

Proposition 2 reveals that shop B can increase its premium over store A when it further
extends its shopping hours (while store A is closed). Similarly, store A raises its (lower)
price compared with that of B when it extends its shopping hours. These features are
consistent with the predictions of Tangay, Vallee, and Lanoie (1995) as well as Kay and

4. Closing Hours: A Partial Equilibrium Approach

In this section we investigate the effects of closing hours on stores’ profit levels. Our analysis
is conducted under the following assumption.

**Assumption 2**

The transportation cost and/or the value of time parameters should exceed a threshold level
given by

\[
\lambda \cdot \tau > \frac{3\sigma^2 w^2}{T n^2}.
\]

Of course, an alternative interpretation for Assumption 2 would be that either the shoppers’
density and/or that the potential length of shopping hours are sufficiently large.\(^2\)

\(^2\)Assumption 2 extends the standard Hotelling assumption in which sufficient consumer heterogeneity is
required for a Nash-Bertrand equilibrium to exist. Here, heterogeneity also means a higher value of time.
Substituting (9a) and (9b) into (8a) and (8b) yields

\[
\pi_A(t_A, t_B) = \frac{n}{72T\lambda} \left\{ 2T[3\lambda - \tau(t_B - t_A)] + \tau(t_A + t_B)(t_B - t_A) \right\}^2 - w\sigma t_A \quad (11a)
\]

\[
\pi_B(t_A, t_B) = \frac{n}{72T\lambda} \left\{ 2T[3\lambda + \tau(t_B - t_A)] - \tau(t_A + t_B)(t_B - t_A) \right\}^2 - w\sigma t_B. \quad (11b)
\]

In a subgame perfect equilibrium of the game described in Section 2.3, in the first stage each shop \( i \) chooses its closing hour, \( t_i \), to maximize \( \pi_i(t_A, t_B) \), taking the closing hour of the competing store as given. The following proposition provides a testable prediction how closing hours are determined. The proof of the proposition is given in Appendix A.

**Proposition 3**

There is exists only one symmetric equilibrium where both stores close at the same. The uniform closing hour is given by

\[
\bar{t} = T - \frac{3\sigma w}{n\tau}. \quad (12)
\]

Thus, the symmetric equilibrium shopping hours decline in the retailers' hourly wage bill, \( w\sigma \), increase in the value of the time parameter, \( \tau \), and the shoppers' density \( n \). Perhaps the most important prediction of Proposition 3 is that stores will be open most of the time (i.e., almost \( T \) hours) in heavily-populated markets (large \( n \)), and/or in markets where shoppers have a high value of time. In contrast, high-wage countries tend to have shorter business hours. This prediction is consistent with the observation that 24-hours supermarkets and gas stations are found more frequently in the United States than in Europe.

We now turn to the question whether the unregulated market generates too short or too long shopping hours from a social viewpoint. In order to answer this question, we define the economy’s social loss function as the sum of aggregate consumers’ disutility due to shopping at non-ideal time, and the total wage bill paid during opening hours. Formally, the social planner chooses a uniform closing time \( t^* \) that solves

\[
\min_{t^*} L(t^*; \sigma, \tau, n, T) \overset{\text{def}}{=} n\tau \int_{t^*}^{T} (t - t^*) \, dt - 2w\sigma t^* = \frac{n\tau[T^2 - 2Tt^* + (t^*)^2]}{2} - 2w\sigma t^*. \quad (13)
\]

It can be easily verified that this social-loss function (13) is proportional to the (negative) sum of all shoppers’ utility (1) and stores’ profits (11a) and (11b), evaluated at a common
closing time $t^\ast$.

It can be easily verified that the loss function (13) is strictly convex in $t^\ast$. Hence, the unique solution to (13) is

$$t^\ast = T - \frac{2\sigma w}{n\tau}.$$  \hspace{1cm} (14)

Comparing (14) with (12), we can now draw the following important conclusion.

**Proposition 4**

*Stores limit their opening hours below the socially-desired level. Formally, $\bar{t} < t^\ast$.*

The reason for the market failure described in Proposition 4 is that intensive price competition stemming from attracting shoppers to physically walk (or drive) to the nearest store generates incentives for cost cutting. This cost cutting is accomplished by limiting the shopping hours. Note that this distortion, manifested by the difference $\bar{t} - t^\ast$, is enhanced with an increase in the wage rate, $w$, and is eliminated only when $w = 0$.

5. **Closing Hours: A General Equilibrium Approach**

Our analysis, so far, was based on the assumption that the market ongoing wage rate, $w$, is exogenously given. Moreover, the “partial-equilibrium” interpretation of the social-welfare function (13) is that the cost of labor is a real cost to the economy, either because this labor is not employed elsewhere, or because labor is foreign.

In this section we take the opposite extreme approach and introduce a labor market into the model where the market wage rate, $w$, is endogenously determined. For this purpose, we extend the utility function (1). Assuming full employment, let $\ell$ denote the per-capita hours of labor demanded and a representative individual. Then, the utility of a shopper indexed by $(x, t)$ is given by

$$V_{x,t} \overset{def}{=} U_{x,t} + w\ell - \mu \ell^2.$$  \hspace{1cm} (15)

The first term of (15) is the utility from consumption given by (1). The second term constitutes an individual’s labor income, and the last term (with the exogenously-given parameter, $\mu$) measures an individual’s disutility from work.
Maximizing (15) with respect to $\ell$ yields that each individual supplies $\ell^s = w/(2\mu)$ hours of labor. Thus, full employment implies that aggregate labor supply is $L^s = (nT w)/(2\mu)$. On the other side of this labor market, the total labor demanded by both stores is $L^d = 2\sigma \bar{t}$, where $\bar{t}$ is given in (12). Therefore, equilibrium in the labor market is determined by

$$L^d = 2\sigma \left( T - \frac{3\sigma w}{n\tau} \right) = \frac{nT w}{2\mu} = L^s.$$ 

Hence, the equilibrium wage rate and closing hours are given by

$$w^e = \frac{4T\mu n\sigma \tau}{Tn^2\tau + 12\mu \sigma^2} \quad \text{and} \quad t^e = \frac{T^2n^2\tau}{Tn^2\tau + 12\mu \sigma^2}. \quad (16)$$

Our general equilibrium results are summarized in the following proposition.

**Proposition 5**

*In a general-equilibrium setup, the equilibrium market wage rate increases (and the opening hours decrease) with an increase in the parameters affecting the disutility from working, $\mu$, and the amount of labor required for the operation of a store, $\sigma$.***

We conclude this section by analyzing the socially-optimal closing hours under general equilibrium. The aggregate social loss in this economy is the sum of aggregate disutility from working and aggregate loss of time from shopping at non-ideal time. Formally, the social planner chooses a uniform closing hour $t^s$ to solve

$$\min_{t^*} L(t^*; w, \sigma, n, \tau, T) \overset{\text{def}}{=} (nT)\mu \ell^2 + n\tau \int_{t^*}^{T} (t - t^*) \, dt, \quad \text{where} \quad \ell = \frac{2\sigma t^s}{nT}. \quad (17)$$

is the per-capita demand for labor. Therefore, under general equilibrium, the socially-optimal uniform closing hours are

$$t^* = \frac{T^2n^2\tau}{Tn^2\tau + 8\mu \sigma^2} > t^e. \quad (18)$$

which is the equilibrium closing hours given in (16). Hence, (18) confirms Proposition 4 for the general equilibrium case demonstrating that stores limit shopping hours below the socially optimal level.
6. Labor Unions and Closing Hours

We observe that countries with strongly regulated shopping hours also tend to have strong labor unions. In fact, in European countries labor unions often insist on limiting shopping hours.

Labor unions who maximize aggregate shoppers’ utilities face a tradeoff between high wages (and hence limited opening hours) and high shopping costs associated with many consumers having to shop too early relative to their ideal shopping time. In this section we investigate precisely this tradeoff.

Suppose that the labor union maximizes aggregate consumer utilities thereby not taking into consideration the profit made by stores. Also, suppose that the labor union is politically strong, so it can fully influence the regulator’s decisions regarding opening hours.

The labor union chooses a uniform closing hour $t_u$ to maximize aggregate utility given by

$$W_u \equiv nT (w\ell - \mu \ell^2 + \beta - p) - n\tau \int_{t_u}^{T} (t - t_u) \, dt.$$  

(19)

Now, (10) implies that $p = \lambda$ (i.e., constant under uniform closing hours). Next, the per-capital labor demand equals $\ell = 2\sigma t_u/(nT)$. Finally, (12) implies that $w = n\tau(T - t_u)/3$. Substituting these values into (19), and maximizing with respect to $t_u$, yields the union’s mandated uniform closing hour

$$t_u = \frac{n^2T^2\tau(2\sigma + 3)}{n^2T\tau(4\sigma + 3) + 24\mu\sigma^2}.$$  

(20)

To investigate how the union affects actual closing hours we compare (20) with (16) and find that

$$t_u \leq t^e \quad \text{if and only if} \quad \mu \geq \bar{\mu}(\tau) \equiv \frac{Tn^2\tau}{6\sigma(2\sigma + 1)}.$$  

(21)

Therefore, we can state our main result.

**Proposition 6**

Unions mandate opening hours that are shorter than the equilibrium opening hours if the disutility of labor is below the threshold $\bar{\mu}$ determined by (21).
Proposition 6 provides the condition under which unions demand shorter shopping hours despite the discomfort it causes shopper which a late ideal shopping time.

The condition (21) is drawn in Figure 4. Figure 4 illustrates the tradeoff in union’s objective function (aggregate utility) between disutility from working (reflected in $\mu$), and the value of time parameter, $\tau$. A higher value of time would increase the union-mandated opening hours. In contrast, a lower labor productivity (higher value of $\sigma$) would shrink the union-mandated opening hours.

Proposition 6 demonstrates a severe market failure for the case where work causes significant disutility for the individuals. In this case, the unions cut opening hours below the equilibrium opening hours, which by Proposition 4 and (18) are also too short compared with the socially-optimal level. Note, however, that if the condition of Proposition 6 is reversed (south-eastern part of Figure 4), the unions improve social welfare by expanding opening hours, thereby reducing costs associated with shoppers’ high value of time.

7. Conclusion

In the present analysis we have characterized the subgame perfect symmetric closing hours for competing retailers engaged in price competition in the short run. The opening hours were found to be shorter than the socially optimal level. This market failure was shown to be a robust finding holding true both within a partial- and a general-equilibrium framework. Further, we characterized circumstances under which labor unions, which are modeled to
internalize the disutility caused by restrictive shopping hours, would favor shopping hours even shorter than the noncooperative equilibrium, thereby adding to the market failure generated by imperfect competition between retailers. Our analysis has focused on a retail industry with imperfect competition between the shops. Of course, if the retail industry were monopolized the retailer would exploit its increased market power to cut costs by shortening business hours at the expense of increased inconvenience for consumers. Thus, in this sense reduced competition will generate social costs not only through increased markups, but also through more extensive shopping hour reductions which increase the gap relative to the socially efficient opening hours.

Appendix A. Proof of Proposition 3

Differentiating (11a) with respect to $t_A$ yields a first-order condition given by

$$0 = \frac{d\pi_A}{dt_A} = \frac{2T^2n\tau(3\lambda - \tau(t_B - t_A) - T[6\lambda(nt_A\tau + 3\sigma w) + n\tau^2(3t_A^2 - 2t_At_B - t_B^2)] - nt_A\tau^2(t_B^2 - t_A^2)}}{18T\lambda}.$$

(22)

Substituting $\bar{t}$ from (12) for $t_B$ in (22), and then solving for $t_A$ yields

$$t_A \in \left\{ \pm \sqrt{3(8T\lambda n^2\tau + 3\sigma w^2) + 2Tn\tau + 3\sigma w} ; T - \frac{3\sigma w}{nT} \right\}.$$

Now, note that the first two terms either exceed $T$ or negative, so (12) is the unique solution.

Finally, differentiating (22) with respect to $t_A$ yields the second-order condition

$$\frac{d^2\pi_A}{dt_A^2} = \frac{n\tau \{2T^2\tau - 2T[3\lambda + \tau(3t_A - t_B)] + 3t_A^2\tau - \tau t_B^2\}}{18T\lambda} \bigg|_{t_A=t_B=\bar{t}} = \frac{3\sigma^2 w^2 - T\lambda n^2\tau}{3T\lambda n} < 0$$

by Assumption 2.
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