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Liberalization of Opening Hours with Free Entry

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Tobias Wenzel*

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Abstract
This paper studies competition in prices and opening hours in a model with free entry. It is shown that under free competition a market failure arises: Entry is excessive and opening hours are under-provided. Restrictions on opening hours aggravate this failure. I analyze the impact of a liberalization of opening hours. The model predicts that in the short run prices will remain constant, but increase in the long run. Concentration in the retail sector will rise and opening hours will increase in two steps, immediately after deregulation and further over time. Finally, employment in the retail sector increases.

JEL Classification: L13, L51, L81

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1 Introduction

This paper addresses the issue of opening hours in the retail industry and its liberalization. In the public and political debate, this topic is controversial. Though there has been a substantial trend towards deregulation in recent years, the debate is still ongoing. Restrictions on business hours differ a lot among European countries. For instance, in the UK and Sweden opening hours in the retail industry are much more liberalized than in France or Norway. In Germany, opening hours were highly regulated for the last decades, but have been liberalized recently.

The focus of the present paper is on the relationship between liberalization of opening hours and concentration in the retail sector. To this aim a model of retail competition with free entry in the spirit of Salop (1979) is used. However, in contrast to his model, competition between retailers takes place in two dimensions. First, retailers compete in prices and second they compete in opening hours. The question is whether the competitive outcome is optimal or if restrictions on opening hours can improve on welfare. The model suggests that the competitive outcome without any restrictions on opening hours leads to a market failure with excessive entry into the market and under-provision of business hours. Hence, restrictions on opening hours do not help to improve on the market outcome. Even worse, regulating opening hours works in the opposite direction. By restricting opening hours even further entry is induced. Thus, restrictions on business hours are not adequate to improve welfare, but aggravate the market failure.

Analyzing the impact of a liberalization of opening hours, the model indicates that in the short run - where entry and exit in the market is not possible - prices remain constant. However, in the longer run when entry and exit is possible retail prices increase and the concentration in the retail sector increases, i.e. the number of retail stores decreases. Furthermore, the model suggests that opening hours increase in two steps. First, they increase directly after liberalization and second they go up further as some retailers leave the market. There is also a positive effect on employment from liberalization as total industry opening hours increase.

Beyond the public debate the issue of business hours (and its liberalization) has attracted considerable interest in the literature in recent years. Particularly, models are used in which the choice of opening hours acts as a strategic variable in competition. Inderst and Irmen (2005) consider a two-stage model with competition in prices and opening hours. In a model with two symmetric firms, firms can use shopping time strategically as an additional means to relax price competition by choosing asymmetric opening hours when consumers have high preferences for their ideal shopping time. Similarly, Shy and Stenbacka (2005) analyze a retail industry where competition takes place in opening hours and prices. The focus of their study is on the impact of different shopping time flexibility assumptions. They study scenarios where consumers are bi-directional, i.e. if a shop is closed at their preferred shopping time, consumers can postpone or advance their shopping. Furthermore, they explore situations where consumers are forward- or backward-oriented, i.e. they either can postpone or advance. While the two former contributions use models where consumers are distributed uniformly along the time dimension, Shy and Stenbacka (2006) analyze a setting where consumers' ideal shopping times are distributed non-uniformly. They find that a monopoly supplier chooses inefficiently short opening hours. However, in contrast to the former two contributions, they treat prices as fixed. In addition, all models mentioned above take the industry structure as given i.e. the number of active retail stores is assumed to be constant. This may be an appropriate description in the short run where no entry or exit occurs, but rather inappropriate when it comes to the long run as the industry structure can adapt due to a deregulation of opening hours.

The remainder of the paper is structured as follows: Section 2 introduces the model. Section 3 describes the equilibrium under liberalized opening hours. Section 4 compares the competitive outcome to the socially optimal one. Section 5 describes the equilibrium under regulated opening hours and analyzes the impact of the abolishment of these regulations. Finally, section 6 concludes.

2 The model

Consider a spatially differentiated retail industry where stores offer a homogenous retail product. Consumers in this market have preferences over the location of retail stores and over opening hours. To formalize this, I adopt the circular city model of Salop (1979) with a modification to incorporate opening hours[1].

2.1 Consumers

Consumers are uniformly distributed on a circle of circumference one, representing the spatial dimension. The location of a consumer, denoted by x, is interpreted as his most preferred shopping location. If there is no store at his preferred location, the consumer has to incur some costs to travel to the next store. Consumers also value longer opening hours as this increases their flexibility of deciding when to go shopping. Consumers are assumed to be homogenous in their valuation for opening hours[2].

Consumers have the following utility if buying from store i:

$$U = V - t(dist_i) + \theta h_i - p_i \tag{1}$$

where $dist_i$ denotes the absolute distance to the retail store, and the parameter t is the associated measure of transportation costs. The variable h_i denotes the length of opening hours of the retailer's store while the parameter θ measures the benefit a consumer derives from an additional opening

[1]The extension used here is similar to variants used to study advertising in media markets. Examples are Dukes (2004), Crampes et al. (2005) or Choi (2006). They introduce a variable reflecting nuisance of consumers due to advertising that affects consumers negatively and generates revenues, while I introduce a variable that reflects the length of opening hours that affects consumers positively, but entails a cost to the firm.

[2]In the models by Inderst and Irmen (2005), Shy and Stenbacka (2005, 2006) consumers differ in location/taste and in their ideal shopping time while the model used here assumes that all consumers have identical preferences for longer opening hours. The introduction of two differing consumer groups - one group values longer opening hours highly, one group does not value longer opening hours at all - would not change the qualitative results of the model.

hour. Hence, this is the benefit consumers derive from increased opening hours due to more flexibility. The price, p_i, that the consumer is charged is deducted from utility. The gross utility from consuming the retail product - given by V - is assumed to be high enough such that each consumer buys. Furthermore, it is assumed that each consumer buys a single unit of the homogenous retail product[3]. The total mass of consumers is normalized to one.

2.2 Retail stores

There are n retail stores, indexed by i, located equidistantly on the circle of circumference one[4]. Without loss of generality store one is located at zero (one). The remaining stores are then located at $\frac{1}{n}, \frac{2}{n}, ... \frac{n-1}{n}$.

All retail stores face identical, constant marginal costs for production of the retail good. For simplicity, these costs of production are normalized to zero. Stores also face costs for their opening hours: These costs are assumed to amount to $\frac{g}{2}h_i^2$. Hence, marginal costs of extending the opening time increases with the time already open. The economic rationale behind this assumption is that stores may have a higher wage bill when extending their business hours (e.g. overtime compensation, late night surcharges). Additionally, firms have to pay fixed costs of f for entering the market.

Competition between retail stores follows a two-stage game: In the first stage potential entrants can simultaneously enter the market or stay out. To enter the market a fixed payment of f has to be incurred. In the second stage, those retailers who entered the market decide on price and opening hours. These two decisions are made simultaneously by all active retailers. The time structure imposed here reflects the fact that the entry decision is a long-term decision and that prices and opening hours can be changed relatively fast[5]. Respecting the time structure, I look for a subgame-perfect

[3] I assume that the quantity consumed does not depend on the length of opening hours. Empirical evidence for this assumption is given in Skuterud (2005) for the case of deregulating Sunday opening hours in Canada.

[4] This paper does not consider the issue of location, and hence stores' locations are treated as exogenous. For further reading see Economides (1993).

[5] Alternatively, one could use a three stage game with entry in the first stage, choice of

equilibrium by applying backward induction.

3 Equilibrium

This section derives the equilibrium.

3.1 Static equilibrium

In a first step I look for equilibrium prices and opening hours given a fixed number of stores in the retail market. I interpret the outcome as a short-run equilibrium.

Given the symmetric structure of the model, I seek for an equilibrium in which all stores charge the same price and have identical opening hours. I therefore consider the decision to be made by a representative store i. Take for instance the retail store located at x=0. Competition in this model is local and takes place between store i and its two neighboring stores, (i-1) and (i+1). Starting with the store (i+1), there is a consumer who is indifferent between buying from the shop located at x=0 and the shop located at $\frac{1}{n}$. This marginal consumer - when firm i charges p_i and opens h_i while the remaining (n-1) retailers charge p and have opening hours of h - is implicitly given by

$$V - tx_m + \theta h_i - p_i = V - t\left(\frac{1}{n} - x_m\right) + \theta h - p \tag{2}$$

or explicitly by

$$x_m = \frac{p - p_i + \theta(h_i - h) + \frac{t}{n}}{2t} \tag{3}$$

Similarly, the retail shop faces a competitor located at $\frac{n-1}{n}$. The situation is symmetric, hence demand is given by $2x_m$:

opening hours in the second stage and price competition in the last stage. However, this time structure does not change the qualitative results.

$$D_i = \frac{p - p_i + \theta(h_i - h) + \frac{t}{n}}{t} \tag{4}$$

Demand depends positively on competitor's price and negatively on the own price. Longer own opening hours increase demand, and extended business hours at competitors' stores reduce demand.

With the cost structure imposed, profits of the representative store are as follows:

$$\Pi_i = \left[\frac{p - p_i + \theta(h_i - h) + \frac{t}{n}}{t}\right] p_i - \frac{g}{2} h_i^2 - f \tag{5}$$

Retail stores decide simultaneously on prices and opening hours. The first-order conditions for the representative firm i are given by:

$$\frac{\partial \Pi_i}{\partial p_i} = -\frac{1}{t} p_i + \frac{p - p_i + \theta(h_i - h) + \frac{t}{n}}{t} = 0 \tag{6}$$

$$\frac{\partial \Pi_i}{\partial h_i} = p_i \frac{\theta}{t} - g h_i = 0 \tag{7}$$

The equilibrium with all retailers charging identical prices and having identical opening hours is then given by:

$$p^* = \frac{t}{n} \tag{8}$$

$$h^* = \frac{\theta}{gn} \tag{9}$$

Result 1 *The short-run equilibrium price increases in t and decreases in n. The short-run equilibrium level of opening hours increases in θ and decreases in n and g.*

The equilibrium exhibits the expected properties of the equilibrium price. The price does not differ from the same model without opening hours as described in Tirole (1988). Price depends positively on the degree of product differentiation (as perceived by consumers) and negatively on the number of competitors in the market. The comparative static properties with respect to the equilibrium opening hours are more interesting. As might be expected opening hours depend positively on consumers valuation for increased shopping time flexibility and negatively on the costs for opening hours. Main result, however, is that opening hours depend negatively on the number of retail stores operating in the market. The reason for this result lies in the fact that a larger number of stores reduces the price and hence reduces the benefit of attracting more customers via extended opening hours.

3.2 Equilibrium with entry

The analysis above has derived opening hours and prices when the number of stores in the market is fixed exogenously. In the long run, however, the number of store need not be fixed but may adapt. Hence, in a second step, the number of retail stores is now derived.

It is assumed that to enter the market an investment of f has to be made. Stores enter the market as long as they can earn positive profits. The number of these stores is denoted by n^c. Considering the prices and opening hours in the second stage (equation 8 and 9), then n^c satisfies the zero profit condition:

$$\frac{t}{(n^c)^2} - \frac{g}{2}\left[\frac{\theta}{n^c g}\right]^2 - f = 0 \tag{10}$$

Solving for n^c explicitly gives the equilibrium number of retail stores in the market[6]:

$$n^c = \frac{\sqrt{2tg - \theta^2}}{\sqrt{2fg}} \tag{11}$$

The associated price and opening hours are then:

[6] Literally, the number of retail stores has to be an integer. However, this integer problem is neglected here, and the number of stores is treated as continuous.

$$p^c = \frac{t}{n^c} = \frac{t\sqrt{2fg}}{\sqrt{2tg - \theta^2}} \tag{12}$$

$$h^c = \frac{\theta}{gn^c} = \frac{\theta\sqrt{2fg}}{g\sqrt{2tg - \theta^2}} \tag{13}$$

The equilibrium under free entry is hence characterized by equations 11, 12, 13. Note that the term $(2tg - \theta^2)$ has to be positive to allow for a positive number of stores in equilibrium, an assumption that I will make from here on.

Result 2 *With free entry the number of retail stores decreases with f and θ, and increases with t and g. The price increases with f and θ, and decreases with g. The impact of t on the price is ambiguous. Opening hours increase with f and θ, and decrease with t and g.*

Proof. By differentiating equations 11, 12 and 13 with respect to the variable of interest. Derivatives are given in appendix A.

		Exogenous Variables			
		t	f	θ	g
Endogenous Variables	n^c	+	-	-	+
	p^c	?	+	+	-
	h^c	-	+	+	-

Table 1: Comparative statics results

Table 1 summarizes the comparative statics results. The impact of f and t on the number of stores is as expected. Higher fixed costs of entry reduce the number of firms and higher transportation costs as measured by t increases the number of retailers that enter. More interesting are the comparative statics results on the number of retailers with respect to the costs and benefits of opening hours. Higher costs for extending opening hours g lead to more stores, and a higher valuation for shopping time flexibility decreases the number of stores. The reasoning behind these results is the following: As in equilibrium all stores have identical opening hours, no additional demand is attracted by longer opening hours. However, stores face the costs of opening. From the perspective in the first stage, these costs work like additional fixed costs on entry. Thus, factors that lead to longer (shorter) opening hours work like an increase (decrease) in costs of entry. Hence, a higher valuation for shopping time flexibility, leading to longer opening hours, leads to a smaller number of stores. The opposite holds for the costs of extending opening hours. This effect is an example of Sutton's endogenous sunk costs (Sutton, 1991).

The price increases with the fixed costs f and valuation for shopping time flexibility θ as these variables reduce the number of retail stores. Higher costs of extended business hours increases the number of stores and thus leads to a decrease in the price. The comparative statics property of the transportation cost parameter on the price is ambiguous. There are two effects at work, a direct one and an indirect one. The direct effect is that for a given number of retail stores a higher t leads to higher prices (see equation 8). The indirect effect works via the number of stores. A higher t leads to more stores, and more stores lead to increased competition, and hence lower prices. For $tg - \theta^2 > 0$, the direct effect dominates. However, for $tg - \theta^2 < 0$, the indirect effect is the larger one.

The comparative statics results concerning the length of opening hours are intuitive. Costs of entry and consumers' preferences for extended opening hours let shops expand their business hours as both tend to reduce the number of stores. The reverse holds for the transportation costs and the costs for extending business hours. Both factors induce more stores to enter and thus, have a negative impact on the length of opening hours chosen by the retailers.

4 Welfare analysis

Does competition with entry and exit provide the socially optimal outcome? This section determines the socially optimal number of retail stores and their business hours. Social welfare is here defined as the sum of consumer utility (as given by equation 1) and profits of the retail industry (equation 5). As prices are mere transfers between consumers and retailers they are irrelevant for welfare. Thus social welfare comprises four parts: The transportation costs of consumers, the benefit of extended opening hours, the costs due to opening hours, and the fixed costs of entry.

$$W = V - 2n \int_0^{\frac{1}{2n}} tx \; dx + \theta h - nf - n\frac{g}{2}h^2 \tag{14}$$

Welfare is maximized with respect to h and n. This gives the following first-order conditions:

$$h^s = \frac{\theta}{gn^s} \tag{15}$$

$$\frac{t}{4(n^s)^2} = f + \frac{g}{2}(h^s)^2 \tag{16}$$

These two equations describe the social optimum. Inspecting the first-order condition with respect to h it can be noticed that the opening hours chosen in the competitive market are optimal if the number of active firms is the optimal one (compare equation 15 with 9). If the number of stores is too high (too low), opening hours are too short (long) in the market outcome compared to the social optimum.

Solving the two equations for n and h gives the optimal number of active firms and optimal opening hours explicitly:

$$n^s = \frac{\sqrt{\frac{tg}{2} - \theta^2}}{\sqrt{2fg}} \tag{17}$$

and

$$h^s = \frac{\theta\sqrt{2fg}}{g\sqrt{\frac{tg}{2} - \theta^2}} \tag{18}$$

Comparing the equilibrium outcome with the socially optimal one, the following result can be established:

Result 3 *Compared to the social optimum, the market outcome leads to excessive entry behavior and opening hours that are too short.*

Proof. By comparing equation 11 with 17, and equation 13 with 18.

As in the original model by Salop (1979) entry is excessive. But in the present model the result of excessive entry has also an impact on the length of opening hours as it leads to under-provision of business hours (see equation 15). As the number of stores increases, opening hours are reduced. The result of under-provision of business hours is also established in models without entry (Shy and Stenbacka, 2005, 2006).

Since in the market equilibrium opening hours are already too short from a social perspective, further restrictions on opening hours are useless to correct for the market failure. However, a social planner that wants to implement optimal opening hours need not address regulations of business hours, but can tackle excessive entry, for instance by charging an additional entry cost. If entry is optimal this leads automatically to optimal opening hours.

5 Regulation of opening hours and liberalization

In this section, the retail market is studied when opening hours are regulated and how liberalization affects the number of retailers in the market, the price of the retail good and opening hours. As seen in the welfare analysis of section 4 the competitive equilibrium with free entry already exhibits under-provision of business hours. Hence, restricting opening hours can never be welfare-improving.

5.1 Equilibrium under regulation

I start by characterizing equilibrium under regulation. Consistent with the usual practice in many countries, the regulation studied here poses an upper limit on the hours a retailer can stay open. However, retailers may choose shorter opening hours. Imagine the market is now in a long-run equilibrium such that no retailer wants to leave the market and no potential entrant wants to enter. The analysis of regulated opening hours is then only interesting if the regulation is binding, i.e. retailers would like to open longer but are not allowed to. If firms would choose shorter opening hours the analysis would remain unchanged to the one in section 3. Thus I focus on the case with a binding regulation. Denoting regulated opening hours by $\overline{h}$, the condition $\overline{h} < h^c \Leftrightarrow \overline{h} < \sqrt{\frac{f\theta^2}{g(tg-\frac{\theta^2}{2})}}$ ensures that regulation is binding.

Proceeding in an analogous way as in section 3 with opening hours being fixed to $\overline{h}$ the equilibrium with free entry under regulation is then characterized by:

$$\overline{n}^c = \frac{\sqrt{t}}{\sqrt{f + \frac{g}{2}\overline{h}^2}} \tag{19}$$

$$\overline{p}^c = \frac{t}{\overline{n}^c} = \sqrt{t(f + \frac{g}{2}\overline{h}^2)} \tag{20}$$

$$\overline{h}^c = \overline{h} \tag{21}$$

Note that there is a positive relationship between the degree of regulation and the number of stores. The tighter regulation, i.e. the lower $\overline{h}$, the more stores enter the market. It shows that regulations on opening hours worsen the competitive outcome. Instead of reducing entry - as is socially desirable - it induces even more entry. However, tighter restrictions lead to lower prices.

5.2 Impact of liberalization

I now turn to the impact of a liberalization of opening hours and consider the following scenario. Before the liberalization, opening hours are regulated at a upper limit of $\overline{h}$ and the market outcome is as described in section 5.1. By liberalization this upper limit is abolished such that stores face no longer any restrictions on their choice of opening hours. I analyze short-term and long-term consequences of this liberalization on prices, opening hours, number of stores and employment.

Immediately after liberalization, price and opening hours may respond to the deregulation. The number of retail stores, however, is still at its pre-liberalization level $\overline{n}^c$. New price and opening hours are then described by the short-run equilibrium of section 3. Hence, $\hat{p} = \frac{t}{n^c}$ and $\hat{h} = \frac{\theta}{g\overline{n}^c} > \overline{h}$. A comparison with the equilibrium under regulation gives the short-run impact of deregulation:

Result 4 *In the short run after a liberalization prices remain unchanged and opening hours are longer.*

As the number of stores is unchanged, so is the price. This result is consistent with the impact of deregulation in models without entry as long as stores choose symmetric opening hours. Under asymmetric configurations - one store opens longer or stores open at different times - prices change due to deregulation (Inderst and Irmen, 2005; Shy and Stenbacka, 2005).

When time is passing after deregulation entry and exit becomes possible, and hence, the number of active retailers may change in response to the liberalization. The long-run equilibrium is described by equations 11, 12, and 13 in section 3. Comparison with the equilibrium under regulation gives the long-run impact of liberalization:

Result 5 *In the long run after a liberalization the number of retailers decreases, the price increases, and opening hours increase compared to the pre-deregulation level and to the level immediately after deregulation.*

Proof. Given in appendix B.

Prior to deregulation the market is in a free-entry equilibrium and hence stores have zero profits. As seen above, in the short run after deregulation retailers extend opening hours, but prices remain at the previous level. Thus, revenues are unchanged, but costs are higher than before the deregulation. This leads to negative profits, and some retail stores leave the market. Hence, a long-run consequence of liberalization is a smaller number of retailers in the market, or put differently a higher concentration in the retail sector. This increase in concentration leads to higher prices for the retail good, but also to a further increase in the length of opening hours. The result of higher prices due to liberalization is in contrast to Clemenz (1990). In a model with consumer search he shows that liberalization of opening hours decreases prices as longer opening hours facilitate search activities. In the present paper the mechanism behind higher prices lies in a higher concentration in the retail sector.

Finally, I consider employment effects due to liberalization. Does liberalization lead to more employment? As a measure of employment I take the total number of opening hours in the industry. I find that liberalization has a positive effect on total opening hours. Under regulation, total industry opening hours amount to $\overline{H} = \overline{n}^c \overline{h}$. Opening hours after liberalization amount to $H = \overline{n}^c \hat{h} = n^c h^c = \frac{\theta}{g}$. Note that total industry opening hours are equal in the short and in the long run after liberalization. The reason is that as some retailers leave the market - leading ceteris paribus to a decrease in total opening hours - opening hours increase at the remaining stores. These two effects cancel each other such that industry opening hours remain unchanged.

Comparing industry opening hours before and after liberalization leads to the following result:

Result 6 *Liberalization leads to higher total industry opening hours.*

Proof. Given in appendix C.

If total industry opening hours can be interpreted as a measure of employment, liberalization of opening hours leads to more employment in the retail industry. This result is consistent with empirical evidence. For example, Skuterud (2005) finds a positive employment effect due to deregulation of opening hours on Sundays in Canada. In his study, he estimates 8 to 12% more employment in the retail sector. Burda and Weil (2005) find evidence for the US that restrictions on opening hours reduce employment inside and outside the retail sector. They argue that this decrease is mainly a decrease in part-time employment.

Summarizing, liberalization leads to increased concentration in the retail sector, higher prices, and opening hours that increase in two steps, immediately after liberalization and over time as some stores exit the market. Employment in the retail market is higher under liberalized opening hours than under regulation. As already pointed out, welfare is higher under deregulation than under restricted opening hours. In fact, as shown in section 4 the competitive equilibrium exhibits excessive entry and under-provision of opening hours. Instead of correcting this market failure, restrictions on opening hours aggravate the market failure by inducing even more entry and even shorter opening hours.

6 Conclusion

This paper uses a model with free entry in a differentiated oligopoly. In the model, retailers compete in prices and opening hours. It is shown that competitive markets lead to opening hours that are too short compared to the socially optimal level. In contrast, entry in the market is excessive. Regulations on opening hours do not attenuate the market failure, but worsen the outcome. Studying the impact of a liberalization of shopping hours the paper shows that the impact in the longer run differs from the short-run effect. While in the short run prices remain constant, in the long run they increase. This is due to the fact that after liberalization retail market concentration rises and thus competition is relaxed. Opening hours increases in two steps: First, they increase directly after the deregulation. Secondly, they increase further over time as some retailers leave the market. In accordance with empirical evidence the model used here predicts that employment in the retail industry should rise.

A Comparative Statics of equilibrium with entry

I give the details of the comparative statics as given in result 2. The equilibrium values of n, p, and h are given by equations 11, 12, 13.

Comparative Statics on entry

$$\frac{\partial n^c}{\partial f} = -\frac{\sqrt{2tg-\theta^2}}{2f\sqrt{2fg}} < 0 \tag{22}$$

$$\frac{\partial n^c}{\partial t} = \frac{g}{\sqrt{2fg}\sqrt{2tg-\theta^2}} > 0 \tag{23}$$

$$\frac{\partial n^c}{\partial g} = \frac{\theta^2}{g\sqrt{2fg}\sqrt{2tg-\theta^2}} > 0 \tag{24}$$

$$\frac{\partial n^c}{\partial \theta} = -\frac{\theta}{\sqrt{2fg}\sqrt{2tg-\theta^2}} < 0 \tag{25}$$

Comparative Statics on prices

$$\frac{\partial p^c}{\partial f} = -\frac{t}{(n^c)^2}\underbrace{\frac{\partial n^c}{\partial f}}_{<0} > 0 \tag{26}$$

$$\frac{\partial p^c}{\partial t} = -\frac{t}{(n^c)^2}\underbrace{\frac{\partial n^c}{\partial t}}_{>0} + \frac{1}{(n^c)^2} = \frac{(tg-\theta^2)\sqrt{2fg}}{(2tg-\theta^2)^{\frac{3}{2}}} \gtrless 0 \Leftrightarrow (tg-\theta^2) \gtrless 0 \tag{27}$$

$$\frac{\partial p^c}{\partial g} = -\frac{t}{(n^c)^2}\underbrace{\frac{\partial n^c}{\partial g}}_{>0} < 0 \tag{28}$$

$$\frac{\partial p^c}{\partial \theta} = -\frac{t}{(n^c)^2}\underbrace{\frac{\partial n^c}{\partial \theta}}_{<0} > 0 \tag{29}$$

Comparative Statics on opening hours

$$\frac{\partial h^c}{\partial f} = -\frac{\theta}{g(n^c)^2}\underbrace{\frac{\partial n^c}{\partial f}}_{<0} > 0 \tag{30}$$

$$\frac{\partial h^c}{\partial t} = -\frac{\theta}{g(n^c)^2} \underbrace{\frac{\partial n^c}{\partial t}}_{>0} < 0 \tag{31}$$

$$\frac{\partial h^c}{\partial g} = -\frac{\theta}{g(n^c)^2} \underbrace{\frac{\partial n^c}{\partial g}}_{>0} - \frac{\theta}{g^2 n^c} < 0 \tag{32}$$

$$\frac{\partial h^c}{\partial \theta} = -\frac{\theta}{g(n^c)^2} \underbrace{\frac{\partial n^c}{\partial \theta}}_{<0} + \frac{1}{g n^c} > 0 \tag{33}$$

B Long-run impact of liberalization

Impact on the number of retailers

To show: $n^c < \overline{n}^c$

$$n^c < \overline{n}^c \Leftrightarrow \overline{h} < \sqrt{\frac{f\theta^2}{g(tg - \frac{\theta^2}{2})}} \tag{34}$$

which is true under the assumption that regulation is binding.

Impact on the price

To show: $p^c > \overline{p}^c \Leftrightarrow \frac{t}{n^c} > \frac{t}{\overline{n}^c}$. Since $n_c < \overline{n}^c$ this is true.

Impact on the opening hours

To show $h^c > \hat{h} > \overline{h}$.

i) $h^c > \hat{h} \Leftrightarrow \frac{\theta}{g n^c} > \frac{\theta}{g \overline{n}^c}$. Since $n_c < \overline{n}^c$ this is true.

ii) $\hat{h} > \overline{h}$ if regulation is binding, $\overline{h} < \sqrt{\frac{f\theta^2}{g(tg - \frac{\theta^2}{2})}}$.

Hence, $h^c > \hat{h} > \overline{h}$.

C Impact of liberalization on employment

To show: $H > \overline{H} \Leftrightarrow \overline{h} < \sqrt{\frac{f\theta^2}{g(tg-\frac{\theta^2}{2})}}$ which is true under the assumption of binding regulation.

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