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Deregulation of Shopping Hours: The Impact on Independent Retailers and Chain Stores

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Abstract
This paper studies shopping hour decisions by retail chains and independent competitors. We use a Salop-type model where retailers compete in prices and shopping hours. Our results depend significantly on efficiency differences between retail chain and independent retailer. If the efficiency difference is small, the independent retailer may choose longer shopping hours than the retail chain and may gain from deregulation at the expense of the retail chain. The opposite result emerges when the efficiency difference is large. Then, the retail chain may benefit whereas the independent retailer loses from deregulation.

Keywords: Business hours, retailing, deregulation
JEL-Classification: L13, L51, L81

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I Introduction

In many European countries, shopping hours are regulated by the state. However, the degree of regulation varies to a large extent. For instance, in the UK, Sweden, and recently also in Germany, shopping hours are much more deregulated than in France or Norway. Even though the trend goes towards less regulation, the issue is still discussed controversially.

There is a particular controversy about how deregulation impacts on competition between large retail chains and smaller, independent competitors. Smaller retailers fear that they may be harmed by a deregulation of shopping hours. The reason is that small retailers might not be able to match long shopping hours at chain stores. This disadvantage in shopping hours could then lead to a drop in demand as more customers make use of the larger shopping time flexibility offered by chains. Via this chain of reasoning, independent retailers may lose profits. If these effects are strong enough, deregulation of shopping hours could even lead to the exit of independent retailers. It is the aim of the present study to develop a theoretical model of retail market competition between retail chains and independent retailers. We use this model to evaluate the impact of shopping hours deregulation on retail chains and independent retailers.

For this purpose the following stylized model is analyzed. There are two firms in a retail market. One firm is a retail chain that operates multiple stores, the other firm is an independent retailer that operates a single store. Those two firms compete in a spatially differentiated market.[1] Competition is modeled in two stages. First, retailers can choose their business hours. Second, they compete in prices. We use this model to analyze the choice of shopping hours under deregulation, where shopping hours can be chosen without constraints. This outcome is compared to the one under regulated shopping hours.

[1]This structure aims to reflect settings where a chain operates several stores in a close geographic area, for instance, in a city. The grocery market in Germany constitutes a suitable example. Here, it can be observed that chains own stores close to each other. Further examples can be found, for instance, in Pal and Sarkar (2002).

Our results suggest that the impact of deregulation depends on efficiency differences between the retail chain and the independent retailer. Typically, one would assume that retail chains have lower operating costs—either due to more buyer power, more efficient organizational structures, or economies of scale. We find that the independent retailer never chooses shorter shopping hours than the retail chain when these efficiency differences are sufficiently small. Under certain circumstances the independent retailer may even choose longer shopping hours. The situation reverses when the retail chain is much more efficient than the independent retailer. We study the impact of deregulation on profits of the chain and the independent retailer. We obtain a simple condition to evaluate this impact. If deregulation leads to longer shopping hours in both firms, both retailers lose in terms of profits. If deregulation leads to asymmetric shopping hours, the retailer that chooses longer shopping hours gains and the retailer that chooses shorter shopping hours is harmed by deregulation. Hence, whether deregulation favors retail chains or independent retailer depends to a large extent on cost efficiency differences between the two competitors. If the cost difference is sufficiently small, deregulation might favor the independent retailer, while with a large efficiency difference, deregulation might favor the chain and harm the independent retailer. Overall, the problem for smaller retailers does not arise through the deregulation of shopping hours per se, but it originates only in combination with lower efficiency. We also study the impact of deregulation on consumer surplus and welfare. We show that welfare and consumer surplus increase unambiguously due to deregulation. Thus, from this point of view, the model delivers no reasons for regulating shopping hours.

Competition over business hours between large and small retailers is also studied by Morrison and Newman (1983), Tanguay et al. (1995) and Inderst and Irmen (2005). Morrison and Newman (1983) and Tanguay et al. (1995) associate small stores with high prices and low access costs, and large stores with low prices and high access costs. Longer opening hours decrease access costs. In their setup deregulation then leads to a redistribution of sales from small to large stores. However, they assume a rather simplified setup. Neither, prices (in

Morrison and Newman (1983)), access costs (via location), nor opening hours are determined endogenously. In an extension to their symmetric base model, Inderst and Irmen (2005) consider competition between large and small retailers. The advantage of their approach is that the choice of opening hours is endogenous. However, they simply associate shop size with cost advantage. These papers find that deregulation benefits large stores. Contrary to these papers, we consider competition between an independent store and a chain owning several shops. In this setting the independent store tends to act more competitively. If the cost difference between the chain and the independent retailer is not too large, the independent store might choose longer opening hours and gain from deregulation.

From a modeling perspective, the paper builds on papers that view the choice of opening hours as a strategic variable in competition. De Meza (1984) and Ferris (1990) develop models—based on Salop (1979)—that relate shopping hours with transportation costs. Longer shopping hours tend to decrease transportation costs. Subsequent authors propose models that introduce explicitly the benefit of long shopping hours in the consumer's utility function. Inderst and Irmen (2005) consider a model with competition in prices and opening hours to analyze the impact of shopping hours deregulation. In a model with two symmetric firms, firms can use shopping time as an additional instrument to relax price competition by choosing asymmetric opening hours. Similarly, Shy and Stenbacka (2008) 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 the shop is closed at the preferred shopping time consumers can postpone or advance their shopping. Moreover, they explore situations where consumers are forward- or backward-oriented, i.e. consumers either can postpone or advance their shopping. While the former two contributions use models where consumers are distributed uniformly along the time dimension, Shy and Stenbacka (2006) analyze a setup where consumers' ideal shopping times are distributed non-uniformly. Finally, Wenzel (2009) studies the impact of deregulation on concentration in the retail sector. He finds that deregulation of opening hours tends to increase concentration in the retail sector. In contrast to the existing literature, the present study analyzes competition in shopping hours in an asymmetric industry where a retail chain and an independent retailer compete. We derive equilibrium shopping hours as well as the welfare impacts of a deregulation.

The paper proceeds as follows: Section II describes the model setup. Section III analyzes the price game. The equilibrium shopping hours are derived in Section IV. Section V describes the impact of a deregulation on profits and welfare. Finally, Section VI concludes.

II Model setup

The model setup draws on Inderst and Irmen (2005) and Shy and Stenbacka (2008), but extends their work to asymmetric firm types. Consider a spatially differentiated retail industry in the spirit of Salop (1979). Consumers in this market have preferences over the location of retail stores and over opening hours. There are two firms. The first firm is an independent retailer operating a single store whereas the second firm is a retail chain operating two stores. These stores are located exogenously on a circle of circumference one. Similar extensions with one firm owning several stores on the Salop circle are provided by, for example, Levy and Reitzes (1992) and Giraud-Heraud et al. (2003).[2]

Consumers

Consumers are uniformly distributed on a circle of circumference one, representing the spatial dimension ('spatial circle'). The location of a consumer, denoted by θ, is interpreted as his most preferred shopping location. If there is no store at his preferred location, the consumer

[2]Levy and Reitzes (1992) study the impact of mergers on the Salop circle. In Giraud-Heraud et al. (2003), competition between one multi-store firm and several single-store firms is studied. In contrast to the present model, firms in these papers compete only in prices. Gal-Or and Dukes (2006) study the impact of mergers in media markets. In their setup, media firms compete in prices and advertising ratios.

has to incur some costs to travel to the next store. Additionally, each consumer has a preferred shopping time (t). Time is modeled as a unit circle ('time circle'). If a store is closed at the preferred shopping time, consumers can either postpone or advance their shopping. According to the terminology of Shy and Stenbacka (2008), consumers are bidirectional. Consumers are assumed to be uniformly distributed on the 'time circle'.[3] Hence, consumers can be characterized by the tuple (θ, t). Both attributes are distributed independently, and the mass of consumers is normalized to one.

A consumer (θ, t) derives the following utility from buying at a store i, located at x_i. The utility depends on whether the store is open or closed at the consumer's preferred shopping time:

$$U = \begin{cases} R - p_i - \lambda|\theta - x_i| & \text{open at preferred time} \\ R - p_i - \lambda|\theta - x_i| - \tau \cdot \min|t - t_c, t_o - t| & \text{closed at preferred time,} \end{cases} \tag{1}$$

where R represents the gross valuation from buying the retail good. We assume that R is high enough such that no consumer abstains from buying. From gross utility, the price p_i and transportation costs are deducted. Transportation costs are linear with a rate of λ. If the store is closed at the consumer's preferred shopping time, additional inconvenience costs for shifting the shopping are deducted. Consumers can advance or postpone their shopping. Optimally, this decision is done by minimizing $|t - t_c, t_o - t|$, where t_o (t_c) denotes the opening (closing) time of the store. The parameter τ represents consumers' willingness to deviate from their preferred shopping time. The higher τ, the less people like to adjust their shopping time.

[3] Shy and Stenbacka (2008) also discuss different densities of day-time and night-time consumers. They show that this does not affect the main results.

Retailers

Two firms operate in the retail market. The independent retailer owns a single store and the retail chain owns two stores. So, in total there are three stores in the market. Firms' stores are located equidistantly on the spatial circle. The independent retailer is positioned at zero. The stores of the chain are then positioned at $\frac{1}{3}$ and $\frac{2}{3}$.[4]

Firms can decide on the price of their product and on the length of opening hours. Following Inderst and Irmen (2005) and Shy and Stenbacka (2008), the choice of opening hours is a discrete one: a store can either choose part-time shopping hours or full-time shopping hours. The time period $t \in [0, \frac{1}{2}]$ represents day-time, and the period between $t \in [\frac{1}{2}, 1]$ represents the night-time. We assume that the opening time of each store is $t_o = 0$. If a store is open part-time, the closing time is $t_c = \frac{1}{2}$, and if a store is open full-time, the closing time is $t_c = 1$. Thus, we interpret part-time as being open during day-time and full-time as being open day and night. We make the additional assumption that the retail chain is bound to choose uniform opening hours for all its stores.[5]

Firms have the following cost structure: For opening during day-time, firms have to pay a fixed cost of f_d which is normalized to zero. For opening full-time, an additional cost of $f_n = f > 0$ has to be paid for the night-time. There is a unit cost for the production of the retail good. We assume that the retail chain has a cost advantage over the independent retailer. This cost advantage may reflect economies of scale, a more efficient organizational structure or more buyer power on the part of the retail chain. The independent retailer has a unit cost of c while the cost of the retail chain is normalized to zero. Thus, c denotes the

[4]The particular setting—one independent store and two stores owned by one chain— is not decisive for our results. One can generalize the model to the case with a chain owning an arbitrary number of stores. The calculations are available from the author upon request. In principle it is also possible to consider more complex settings, for instance, competition between one independent store and two chains each owning two stores. This would not change the main implications of the present paper as long as stores owned by chains are adjacent.

[5]This assumption is made for convenience. The main results of the paper do also hold when allowing the retail chain to choose non-uniform shopping hours for its stores, that is, when the chain stores may have different shopping hours. The derivation of this case is relegated to Appendix D.

efficiency advantage enjoyed by the retail chain.[6]

Competition between the retailers follows a two-stage game: In the first stage, firms decide on shopping hours. In the second stage, firms decide on the price of the retail good.[7] Thus, we seek for a subgame-perfect equilibrium.

The following assumption is imposed on parameter values:

Assumption 1 $\lambda > \max\{\frac{15}{32}\tau + \frac{3}{4}c, \frac{15}{16}\tau - \frac{3}{2}c\}$.

This assumption ensures that differentiation along the spatial dimension is dominant: For any time preference t, each retailer attracts a positive mass of consumers in equilibrium. The assumption is made for technical convenience. A similar restriction is made in Shy and Stenbacka (2008).[8]

III Price competition

We start our analysis with the second stage of the game, that is, retailers' price choice for given opening hours. As each retailer has two choices of opening hours, we have to consider four different cases: i) both retail firms are open full-time, ii) both retail firms are open part-time, iii) the retail chain is open full-time, the independent retailer is open part-time, and iv) the independent retailer is open full-time, the retail chain is open part-time.

[6] Apart from differences in the cost structure, one could also argue that retail chains offer more variety which benefits consumers. The present model can easily be adapted to account for this without changing the main results. More variety at the chain introduces an aspect of vertical differentiation and leads to a competitive advantage for the chain. This would lead to similar results as we obtain from the cost difference considered in this paper.

[7] We do not allow firms to charge different prices during day and night-time. Thus, intertemporal price discrimination is not studied.

[8] Similar assumptions are typically employed in models of multi-dimensional product differentiation to ensure that equilibrium values can be calculated in closed form. See, for instance, Irmen and Thisse (1998) or Janssen et al. (2005).

Case 1: Symmetric opening hours

When retailers have symmetric opening hours, the analysis is identical regardless whether stores are open full-time or part-time. To see this, we start by deriving the marginal consumer between the independent shop, located at zero, and the chain store located at $\frac{1}{3}$. From equation (1), this consumer is implicitly given by $R - p_s - \lambda\theta_m = R - p_1 - \lambda(\frac{1}{3} - \theta_m)$ when both stores are open at a consumer's preferred shopping time and by $R - p_s - \lambda\theta_m - \tau \cdot \min|t - \frac{1}{2}, 1 - t| = R - p_1 - \lambda(\frac{1}{3} - \theta_m) - \tau \cdot \min|t - \frac{1}{2}, 1 - t|$ when both stores are closed at the preferred shopping time. The price charged is p_s for the independent retailer and p_1 (p_2) for the chain store 1 (2). Then, with symmetric shopping hours, the marginal consumer is independent of his preferred shopping time t, given by:

$$\theta_m = \frac{1}{6} + \frac{p_1 - p_s}{2\lambda}. \tag{2}$$

Similarly, one can derive the marginal consumer between the independent store and chain store 2 located at $\frac{2}{3}$. Demand at the independent retailer then is:

$$D_s = \frac{1}{3} + \frac{p_1 + p_2 - 2p_s}{2\lambda}. \tag{3}$$

Analogously, one can derive demand at the stores owned by the retail chain. The profit of the independent retailer is:

$$\Pi_s = (p_s - c)\left[\frac{1}{3} + \frac{p_1 + p_2 - 2p_s}{2\lambda}\right]. \tag{4}$$

The profit of the chain is the sum of the individual profits of the two stores:

$$\Pi_c = p_1\left[\frac{1}{3} + \frac{p_s + p_2 - 2p_1}{2\lambda}\right] + p_2\left[\frac{1}{3} + \frac{p_s + p_1 - 2p_2}{2\lambda}\right]. \tag{5}$$

Both firms choose prices as to maximize their profits. Equilibrium prices are given by:

$$p_s^* = \frac{4}{9}\lambda + \frac{2}{3}c, \tag{6}$$

and

$$p_1^* = p_2^* = p_c^* = \frac{5}{9}\lambda + \frac{1}{3}c. \tag{7}$$

Either retailer may charge a higher price. Suppose first that there are no cost differences between the chain and the independent retailer, that is, $c = 0$. As a consequence, the price charged by the chain is higher than the price charged by the independent retailer. The reason is that the chain internalizes the impact of a price increase at one store on the profitability at the other store. Second, efficiency differences, that is $c > 0$, lead to relatively higher prices at the independent retailer. When this difference is sufficiently large, the retail chain may charge a lower price.

Equilibrium profits amount to:

$$\Pi_s^* = \left(\frac{4}{9}\lambda - \frac{1}{3}c\right)^2 \frac{1}{\lambda}, \tag{8}$$

$$\Pi_c^* = \left(\frac{5}{9}\lambda + \frac{1}{3}c\right)^2 \frac{1}{\lambda}. \tag{9}$$

Provided that both retail firms open full-time, costs for the extended opening hours have to be subtracted. These costs are f for the independent retailer, and $2f$ for the retail chain. The profit earned by the chain is always higher than the one earned by independent retailers. In addition, a higher cost difference increases profits of the chain and reduces profits of the independent retailer.[9]

[9]Note that prices and profits are higher at all stores compared to an industry structure with three independent retailers. Thus, in this model there is a rationale to form a chain. This effect is reinforced by cost efficiencies (measured by lower unit costs or lower fixed costs). In more general settings this is also shown in Giraud-Heraud et al. (2003) and Levy and Reitzes (1992).

Case 2: Retail chain is open full-time; independent retailer is open part-time

Now we turn to the first asymmetric case. Stores operated by the chain are open full-time and the independent retailer is open part-time. Again, we determine the marginal consumer. For those consumers preferring to shop during day-time ($t \in [0, \frac{1}{2}]$), the situation is the same as before as both firms are open during the day. Only for those consumers preferring to shop at night ($t \in (\frac{1}{2}, 1)$), the decision may change. They can either buy at the chain store at their preferred time or postpone / advance their shopping and travel to the independent retailer. The marginal consumer between the independent retailer and chain store 1 is implicitly given by $R - p_s - \lambda\theta_m - \tau \cdot min[t - \frac{1}{2}, 1 - t] = R - p_1 - \lambda(\frac{1}{3} - \theta_m)$. Optimally, consumers with $t \in (\frac{1}{2}, \frac{3}{4})$ advance their shopping and those with $t \in (\frac{3}{4}, 1)$ postpone their shopping until the next day.

Summarizing, the marginal consumers—illustrated by Figure 1—being dependent on the preferred shopping time is given by:

$$\theta_m = \begin{cases} \frac{1}{6} + \frac{p_1 - p_s}{2\lambda} & \text{for } t \in [0, \frac{1}{2}] \\ \frac{1}{6} + \frac{p_1 - p_s}{2\lambda} - \frac{\tau}{2\lambda}[t - \frac{1}{2}] & \text{for } t \in (\frac{1}{2}, \frac{3}{4}] \\ \frac{1}{6} + \frac{p_1 - p_s}{2\lambda} - \frac{\tau}{2\lambda}[1 - t] & \text{for } t \in (\frac{3}{4}, 1). \end{cases} \tag{10}$$

In light of figure 1, Assumption 1 ensures that $1 > \theta_m > 0$.

Figure 1 about here

The situation is symmetric with respect to the marginal consumer located between the independent retailer and chain store 2. Demand for the independent retailer is calculated by integrating over t:

$$D_s = \frac{1}{3} + \frac{p_1 + p_2 - 2p_s}{2\lambda} - \frac{1}{16}\frac{\tau}{\lambda}. \tag{11}$$

Similarly, one can derive demand for the stores owned by the retail chain. Note, however, that the marginal consumer between these two stores is unchanged compared to case 1 as both chain stores have identical opening hours. Demand at store 1 and 2 is then given by:

$$\begin{aligned} D_1 &= \frac{1}{3} + \frac{p_s + p_2 - 2p_1}{2\lambda} + \frac{1}{32}\frac{\tau}{\lambda}, \\ D_2 &= \frac{1}{3} + \frac{p_s + p_1 - 2p_2}{2\lambda} + \frac{1}{32}\frac{\tau}{\lambda}. \end{aligned} \tag{12}$$

The profits of the respective retailers amount to:

$$\Pi_s = (p_s - c)\left[\frac{1}{3} + \frac{p_1 + p_2 - 2p_s}{2\lambda} - \frac{1}{16}\frac{\tau}{\lambda}\right], \tag{13}$$

and

$$\Pi_c = p_1\left[\frac{1}{3} + \frac{p_s + p_2 - 2p_1}{2\lambda} + \frac{1}{32}\frac{\tau}{\lambda}\right] + p_2\left[\frac{1}{3} + \frac{p_s + p_1 - 2p_2}{2\lambda} + \frac{1}{32}\frac{\tau}{\lambda}\right] - 2f. \tag{14}$$

In equilibrium, retailers set the following prices:

$$p_s^* = \frac{4}{9}\lambda + \frac{2}{3}c - \frac{\tau}{48}, \tag{15}$$

and

$$p_1^* = p_2^* = p_c^* = \frac{5}{9}\lambda + \frac{1}{3}c + \frac{\tau}{48}. \tag{16}$$

The difference in opening hours is reflected in prices. Compared to the symmetric case, the chain increases its prices by $\frac{\tau}{48}$ while the independent retailer reduces its price by the same amount. The reason is that the chain store has a larger market power over consumers preferring to shop at night and thus finds it profitable to increase prices. The price difference rises in τ, that is, in consumers' disutility associated with shopping at a time different from the most convenient one. It can also be shown that the market share of the retail chain is larger compared to a situation with symmetric opening hours.[10]

Profits are:

$$\Pi_s^* = \left(\frac{4}{9}\lambda - \frac{1}{3}c - \frac{1}{48}\tau\right)^2 \frac{1}{\lambda}, \tag{17}$$

and

$$\Pi_c^* = \left(\frac{5}{9}\lambda + \frac{1}{3}c + \frac{1}{48}\tau\right)^2 \frac{1}{\lambda} - 2f. \tag{18}$$

Compared to case 1, profits (net of fixed costs) of the chain increase while those of the independent retailer decrease.

Case 3: Independent retailer is open full-time; retail chain is open part-time

Now, we assume that the independent retailer chooses full-time and the retail chain part-time. The marginal consumer is presented in Figure 2. As the analysis is similar to case 2, we only report equilibrium prices and profits given by:

$$p_s^* = \frac{4}{9}\lambda + \frac{2}{3}c + \frac{\tau}{48}, \tag{19}$$

and

$$p_1^* = p_2^* = p_c^* = \frac{5}{9}\lambda + \frac{1}{3}c - \frac{\tau}{48}. \tag{20}$$

Profits are now:

$$\Pi_s^* = \left(\frac{4}{9}\lambda - \frac{1}{3}c + \frac{1}{48}\tau\right)^2 \frac{1}{\lambda} - f, \tag{21}$$

and

$$\Pi_c^* = \left(\frac{5}{9}\lambda + \frac{1}{3}c - \frac{1}{48}\tau\right)^2 \frac{1}{\lambda}. \tag{22}$$

[10] Shy and Stenbacka (2008) also show that the store with shorter shopping hours has a larger market share during day-time compared to the situation with symmetric shopping hours. This is due to the lower price charged by this store.

The results are reversed compared to case 2. Reflecting asymmetric shopping hours, the independent retailer increases its price while the chain has to reduce the price.

Figure 2 about here

IV Shopping hours

Given the analysis of the price game in the preceding section, we are now in the position to analyze firms' choice of shopping hours. Firms—being aware of the subsequent price competition—choose their shopping hours simultaneously. Figure 3 displays the reduced form of the game taking into account the outcomes of the price subgames.

Figure 3 about here

Retail chain and independent retailer are equally efficient: $c = 0$

It is instructive to start the analysis with the case where the retail chain and the independent retailer are equally efficient.

We define the following critical levels of costs for extending shopping hours to full-time: $f_a = \frac{\tau}{48}(\frac{8}{9} + \frac{1}{48}\frac{\tau}{\lambda})$ and $f_b = \frac{\tau}{48}(\frac{5}{9} - \frac{1}{96}\frac{\tau}{\lambda})$, where $f_a > f_b$. The following result, which is derived in Appendix A, can then be established:[11]

Result 1 *Provided that the retail chain and the independent retailer are equally efficient, the independent retailer does not choose shorter shopping hours than the retail chain.*

In more detail: If costs for extending shopping hours are high ($f > f_a$), both retailers choose part-time. For intermediate costs ($f_a \geq f > f_b$), the independent retailer chooses full-time

[11] We assume that a firm being indifferent between part-time and full-time chooses full-time.

and the retail chain chooses part-time. Finally, when costs are low ($f \leq f_b$), both retailers choose full-time.

Depending on the costs for extending opening hours (f), three different equilibria can emerge—two symmetric equilibria and one asymmetric equilibrium. If the costs for extending business hours are either high or low, a symmetric outcome arises. For high costs, both firms are closed during night-time, and for low costs, both firms are open during night-time. The interesting result occurs for an intermediate level of costs. In this case the independent retailer chooses longer opening hours than the retail chain.[12] The intuition behind the equilibrium structure is the following: The independent retailer can gain more from extending opening hours than its competitor. By extending opening hours, the independent retailer attracts customers from both neighboring stores—both owned by the retail chain. Conversely, the retail chain can only gain customers from one store, but has to pay the costs twice, that is, once for each affiliated store. Thus, while internalization among chain stores induces the chain, on the one hand, to increase the price, it decreases, on the other hand, the incentives to compete in shopping hours.

In the next step we study the impact of τ, consumers' willingness to deviate from the preferred shopping time, and λ, the transportation cost parameter, on an asymmetric choice of shopping hours:

Result 2 *i) An increase in τ increases the range of f for which an equilibrium with asymmetric shopping hours exists. ii) An increase in λ decreases the range of f for which an equilibrium with asymmetric shopping hours exists.*

Proof. By noting that i) $\frac{\partial(f_a - f_b)}{\partial\tau} > 0$ and ii) $\frac{\partial(f_a - f_b)}{\partial\lambda} < 0$.

[12] The structure of equilibrium shopping hours is similar the one in the symmetric model by Shy and Stenbacka (2008). For large and small costs of extending opening hours the resulting opening hours are symmetric. For intermediate values, the outcome is asymmetric with one store choosing longer opening hours than the competitor.

When consumers have a stronger dislike to deviate from their preferred shopping time (larger τ), the range of costs for extending shopping hours for which the independent retailer chooses longer shopping hours than the retail chain increases. A rise in τ raises for both firms the incentive to extend shopping hours, however, this effect is stronger for the independent retailer. An increase in λ has the opposite effect. A larger λ, that is, low price competition among retailers, reduces the parameter range for which an equilibrium with asymmetric shopping hours exists. The reason is that as transportation costs rise, it is harder to attract customers via longer shopping hours. This effect is more pronounced for the independent retailer as he tries to attract customers from two neighboring chain stores.

The general case: $c \geq 0$

Now we turn to the general case where the retail chain enjoys lower production costs than the independent retailer. This is probably a more realistic case. Analyzing this case, we can present the following result:[13]

Result 3 *i) For a small efficiency advantage ($c < \frac{3}{9}\lambda - \frac{1}{32}\tau$), the independent retailer does not choose shorter shopping hours than the retail chain. ii) For an intermediate efficiency advantage ($\frac{3}{9}\lambda - \frac{1}{32}\tau \leq c \leq \frac{3}{9}\lambda + \frac{1}{32}\tau$), either retailer may choose longer shopping hours. iii) For a large efficiency advantage ($c > \frac{3}{9}\lambda + \frac{1}{32}\tau$), the retail chain does not choose shorter shopping hours than the independent retailer.*

Result 3 shows that the efficiency difference between the retail chain and the independent retailer is a decisive factor in determining equilibrium shopping hours. When the efficiency advantage is small, the independent retailer does not choose shorter opening hours than the retail chain. However, whenever the efficiency advantage is relatively large, the retail chain does not choose shorter shopping hours than the independent retailer. For an intermediate

[13]The derivation of this result can be found in Appendix B.

efficiency advantage, both outcomes are possible, so that both types of stores may have longer business hours. In this case, the equilibrium may not be unique.

The general structure of equilibrium shopping hours is identical to the case $c = 0$. For high (low) costs of extending shopping hours, both retailers choose part-time (full-time) shopping hours. For intermediate costs the outcome is asymmetric with one retailer choosing part-time and one full-time. The critical fixed costs of operation can be found in Appendix B.

It follows from Result 3 that the larger the cost difference between chain and independent retailer, the larger is the parameter range of f for which an equilibrium with longer shopping hours at the chain store exists. Loosely speaking, the larger the cost advantage of the chain, the more likely the chain will offer longer shopping hours. The reasoning behind this result is the following. The larger the cost difference, the larger is the the chain's advantage in the pricing stage. The chain can more easily attract additional customers which raises the incentives for the chain to extend shopping hours. We summarize this reasoning in the following result:

Result 4 *The larger the efficiency advantage of the retail chain, the larger is the range of f for which the retail chain chooses longer shopping hours than the independent retailer.*

Our results differ from Inderst and Irmen (2005). In their model, large retailers are associated with lower marginal costs of production which gives them an advantage in choosing longer opening hours. Thus, in their study large retailers are more likely to offer longer opening hours. In our model it is also possible that the independent retailer chooses longer shopping hours.

V Impact of deregulation

This section examines the effect of deregulation on profits, total welfare and consumer surplus.

We assume that under regulation stores are allowed to open during day-time but are prohibited to open during night-time. Hence, the outcome under regulation is described by case 1 with shops closed at night (Section III). When shopping hours are deregulated, retail firms are free to open at night as well. The results are presented in Section IV. In our analysis we only focus on cases where deregulation matters.[14]

Impact on firm profitability

By comparing profits in both situations, we can determine the impact of deregulation on firms' profits:

Result 5 *i) If deregulation leads both retailers to choose full-time, both retailers lose profits. ii) If deregulation leads to asymmetric shopping hours, the retailer choosing longer shopping hours gains at the expense of the retailer choosing shorter shopping hours.*

If deregulation leads to symmetric shopping hours with both retailers choosing to open full-time, both retail firms lose in terms of profits. The reason is that both stores extend their opening hours, thus prices and market shares remain unchanged, but operating costs are higher. Hence, profits decrease. This is an example of the classic prisoners' dilemma.[15] Thus, both retail firms are affected in the same way by deregulation. However, the impact is asymmetric if deregulation leads to asymmetric shopping hours. Then, the retailer choosing

[14] When costs for extending shopping hours are prohibitively high, deregulation does not matter. The outcome is identical under regulated and deregulated shopping hours, and hence not very interesting.

[15] In Shy and Stenbacka (2008) a similar result emerges. They conclude that retailers have an incentive to collude on short shopping hours.

full-time benefits and the retailer that chooses part-time suffers from deregulation. Compared to pre-deregulation, the retailer that chooses full-time shopping hours can increase prices and market share but he also has to bear the costs for additional business hours. The impact on profits, however, is positive. The retailer with part-time shopping hours has to decrease prices and loses market share so that profits of this retailer decrease.

In Result 4 we have shown that a large efficiency advantage increases the parameter range for an outcome with longer shopping hours at the chain store. In combination with Result 5, we obtain:

Result 6 *i) The retail chain might benefit from deregulation, if the efficiency advantage is sufficiently large. ii) The independent retailer might benefit from deregulation, if the efficiency advantage is sufficiently small.*

It is noteworthy that our results differ from the existing literature. In Morrison and Newman (1983) and Tanguay et al. (1995) large retailers benefit from deregulation at the expense of smaller competitors. The reason is that in their models deregulation leads to a shift of demand towards large retailers as the locational disadvantage is mitigated. In our model, we show that the impact of deregulation depends fundamentally on the efficiency difference between the chain and the independent retailer. If the efficiency advantage is sufficiently small, the independent retailer may as well gain from deregulation.

Impact on welfare

Besides the impact on retail profitability, we also study the consequences of deregulation on total welfare and consumer surplus. There are several factors that have to be taken into account. These are

- consumers' benefits of increased shopping hours,

- costs of extending shopping hours,
- production costs of the retail good,
- aggregate transportation costs.

The impact of the first two factors on welfare is unambiguous. If deregulation leads to increased shopping hours at any of the stores, there are less inconvenience costs for shifting away from the preferred shopping time. However, there are fixed costs associated with this increased shopping time. The impact of deregulation on production efficiency depends on whether deregulation leads to longer shopping hours at the chain or at the independent retailer. If shopping hours after deregulation are longer at the chain store, production efficiency increases as the number of consumer buying from the chain store, which produces at lower costs, increases. The converse holds for longer shopping hours at the independent retailer. Production efficiency remains unchanged if shopping hours are symmetric after deregulation. The impact of transportation costs is ambiguous. Relegating derivations to Appendix C, the welfare impact of deregulation can be summarized as follows:

Result 7 *Deregulation increases total welfare and consumer surplus.*

Deregulation is always beneficial for total welfare and consumer surplus. This result even holds when deregulation leads to longer shopping hours at the independent retailer, where production efficiency decreases. The positive effects of deregulation outweigh the negative effects. The result is important for the policy debate on deregulation of shopping hours. No matter which type of retailer gains or loses, deregulation is positive for total welfare as well as for consumer surplus. The findings in this paper suggest that there is no need for regulating shopping hours. Thus, the paper extends the welfare conclusion from Shy and Stenbacka (2008). They show that in a model with symmetric retailers that deregulation never leads to an over-provision of shopping hours. Note, however, that in contrast to the present paper their analysis is restricted to the comparison of symmetric outcomes.

VI Conclusion

This paper studies competition between a retail chain and an independent retailer with respect to their choice of business hours. Building on Salop (1979), the retail chain is modeled as a firm owning several stores while the independent firm owns a single store. We study the impact of deregulation on retail profitability, consumer surplus and welfare. Our results depend crucially on efficiency differences between the two types of retailers. If the efficiency advantage of the retail chain is rather small the independent retailer may benefit from deregulation at the expense of the retail chain. Results are reversed when retail chains enjoy large efficiency advantages. Then, deregulation favors the retail chain and harms independent retailers. Concerning the impact of deregulation on welfare we show that total welfare and consumer surplus increase unambiguously.

A Derivation of result 1

a) Retail chain

Given that the independent retailer chooses part-time, the retail chain chooses full-time if $f \leq f_1 = \frac{\tau}{48}(\frac{5}{9} + \frac{1}{96}\frac{\tau}{\lambda})$. Given that the independent retailer chooses full-time, the retail chain chooses full-time if $f \leq f_2 = \frac{\tau}{48}(\frac{5}{9} - \frac{1}{96}\frac{\tau}{\lambda}) = f_b$. Note that $f_1 > f_2 = f_b$.

b) Independent retailer

Given that the retail chain chooses part-time, the independent retailer chooses full-time if $f \leq f_3 = \frac{\tau}{48}(\frac{8}{9} + \frac{1}{48}\frac{\tau}{\lambda}) = f_a$. Given that the retail chain chooses full-time, the independent retailer chooses full-time if $f \leq f_4 = \frac{\tau}{48}(\frac{8}{9} - \frac{1}{48}\frac{\tau}{\lambda})$. Note that $f_3 = f_a > f_4$.

c) Equilibrium

Under assumption 1, we have $f_a = f_3 > f_4 > f_1 > f_2 = f_b$. Hence, for $f > f_3 = f_a$, both firms choose part-time. For $f_2 = f_b < f \leq f_3 = f_a$, the independent retailer chooses full-time, and the retail chain chooses part-time. For, $f \leq f_2 = f_b$, both firms choose full-time.

B Derivation of result 3

a) Retail chain

Given that the independent retailer chooses part-time, the retail chain chooses full-time if $f \leq \bar{f}_1 = \frac{\tau}{48}(\frac{5}{9} + \frac{1}{96}\frac{\tau}{\lambda} + \frac{1}{3}\frac{c}{\lambda})$. Given that the independent retailer chooses full-time, the retail chain chooses full-time if $f \leq \bar{f}_2 = \frac{\tau}{48}(\frac{5}{9} - \frac{1}{96}\frac{\tau}{\lambda} + \frac{1}{3}\frac{c}{\lambda})$. Note that $\bar{f}_1 > \bar{f}_2$.

b) Independent retailer

Given that the retail chain chooses part-time, the independent retailer chooses full-time if $f \leq \bar{f}_3 = \frac{\tau}{48}(\frac{8}{9} + \frac{1}{48}\frac{\tau}{\lambda} - \frac{2}{3}\frac{c}{\lambda})$. Given that the retail chain chooses full-time, the independent retailer chooses full-time if $f \leq \bar{f}_4 = \frac{\tau}{48}(\frac{8}{9} - \frac{1}{48}\frac{\tau}{\lambda} - \frac{2}{3}\frac{c}{\lambda})$. Note that $\bar{f}_3 > \bar{f}_4$.

c) Equilibrium

When the efficiency advantage is small ($c < \frac{3}{9}\lambda - \frac{1}{32}\tau$), we have $\bar{f}_3 > \bar{f}_4 > \bar{f}_1 > \bar{f}_2$, and hence the same equilibrium configuration as in the base model. Hence, for $f > \bar{f}_3$, both firm choose part-time. For $\bar{f}_2 < f \leq \bar{f}_3$, the independent retailer chooses full-time, and the retail chain chooses part-time. For, $f \leq \bar{f}_2$, both firms choose full-time.

When the efficiency advantage is large ($c > \frac{3}{9}\lambda + \frac{1}{32}\tau$), we have $\bar{f}_1 > \bar{f}_2 > \bar{f}_3 > \bar{f}_4$. The situation is reversed compared to above. Hence, for $f > \bar{f}_1$, both firm choose part-time. For $\bar{f}_4 < f \leq \bar{f}_1$, the independent retailer chooses part-time, and the retail chain chooses full-time. For, $f \leq \bar{f}_4$, both firms choose full-time.

When the efficiency advantage is intermediate ($\frac{3}{9}\lambda - \frac{1}{32}\tau < c < \frac{3}{9}\lambda + \frac{1}{32}\tau$), we have to distinguish two cases: a) $\frac{3}{9}\lambda - \frac{1}{32}\tau < c < \frac{3}{9}\lambda - \frac{1}{96}\tau$ and b) $\frac{3}{9}\lambda - \frac{1}{96}\tau < c < \frac{3}{9}\lambda + \frac{1}{32}\tau$. In case a), we have $\bar{f}_3 > \bar{f}_1 > \bar{f}_4 > \bar{f}_2$. For $f > \bar{f}_3$, both firms choose part-time. For $\bar{f}_1 < f \leq \bar{f}_3$, the independent retailer chooses full-time and the retail chain part-time. For $\bar{f}_4 < f < \bar{f}_1$, there are two asymmetric equilibria with one store choosing full-time and the other part-time. For $\bar{f}_2 < f \leq \bar{f}_4$ the independent retailer chooses full-time and the retail chain part-time. For $f \leq \bar{f}_2$, both stores are open full-time. Thus, either store can have longer opening hours, however, the parameter space is larger where an equilibrium exists in which the independent retailer has longer opening hours. In case b), we have $\bar{f}_1 > \bar{f}_3 > \bar{f}_2 > \bar{f}_4$. For $f > \bar{f}_1$, both firms are open part-time. For $\bar{f}_3 < f \leq \bar{f}_1$, the retail chain chooses full-time and the independent retailer part-time. For $\bar{f}_2 < f < \bar{f}_3$, there are two asymmetric equilibria with one store choosing full-time and the other part-time. For $\bar{f}_4 < f \leq \bar{f}_2$, the retail chain is open full-time and the independent retailer part-time. For $f \leq \bar{f}_4$, both stores are open full-time. Again, either store can have longer opening hours. However, the parameter region for which the retail chain chooses longer opening hours is larger.

C Derivation of result 7

Total welfare consists of the following components: the loss of utility due to consumer shopping who deviate from their preferred shopping time (D), aggregate transportation costs (T), production costs (P) and costs for shopping hours (F). Total welfare in the four different cases is:

case 1a (both retailers are open part-time):

$$W_{1a} = V - \underbrace{\frac{\tau}{16}}_{D} - \underbrace{\frac{29\lambda^2 - 12\lambda c + 18c^2}{324\lambda}}_{T} - \underbrace{\left(\frac{4}{9} - \frac{c}{3\lambda}\right)c}_{P}. \tag{A1}$$

case 1b (both retailers are open full-time):

$$W_{1b} = V - \underbrace{\frac{29\lambda^2 - 12\lambda c + 18c^2}{324\lambda}}_{T} - \underbrace{\left(\frac{4}{9} - \frac{c}{3\lambda}\right)c}_{P} - \underbrace{3f}_{F}. \tag{A2}$$

case 2:

$$W_2 = V - \underbrace{\frac{\tau(32\lambda - 9\tau - 24c)}{1152\lambda}}_{D} - \underbrace{\frac{232\lambda^2 - 6\lambda\tau + 9\tau^2 + 18\tau c - 96\lambda c + 144c^2}{2592\lambda}}_{T} - \underbrace{\frac{(64\lambda - 3\tau - 48c)c}{1152\lambda}}_{P} - \underbrace{2f}_{F}. \tag{A3}$$

case 3:

$$W_3 = V - \underbrace{\frac{\tau(40\lambda - 9\tau - 24c)}{1152\lambda}}_{D} - \underbrace{\frac{232\lambda^2 + 6\lambda\tau + 9\tau^2 - 18\tau c - 96\lambda c + 144c^2}{2592\lambda}}_{T} - \underbrace{\frac{(64\lambda + 3\tau - 48c)c}{1152\lambda}}_{P} - \underbrace{2f}_{F}. \tag{A4}$$

Then it can be shown that $W_{1b} > W_{1a}$ whenever deregulation leads to case 1b, $W_2 > W_{1a}$ whenever deregulation leads to case 2, and $W_3 > W_{1a}$ whenever deregulation leads to case 3. Consumer surplus can be calculated by subtracting firms' profits from total welfare. Along the same line it can be shown that consumer surplus always increases by deregulation.

D Non-uniform shopping hours

In the base model in the text we have assumed that the retail chain is bound to choose uniform shopping hours at its stores. Here we provide the results if this assumption is relaxed, that is, the retail chain is allowed to choose different shopping hours at its two stores. Compared to our base model, this adds two additional subgames to analyze. The retail chain chooses one of its stores to open full-time and the other one to open part-time while the independent retailer chooses part-time / full-time. We focus on the case without an efficiency difference, $c = 0$.

Prices

We start by deriving equilibrium prices and profits in the subgames where the retail chain chooses asymmetric shopping hours. The outcomes of the remaining subgames have been derived in the base model in the main text.

a) Independent retailer chooses full-time

The independent retailer chooses full-time shopping hours, the retail chain chooses full-time shopping hours at store 1 and part-time at store 2. Demand is then given by:

$$D_s = \frac{1}{3} + \frac{p_1 + p_2 - 2p_s}{2\lambda} + \frac{1}{32}\frac{\tau}{\lambda}, \qquad D_1 = \frac{1}{3} + \frac{p_2 + p_s - 2p_1}{2\lambda} + \frac{1}{32}\frac{\tau}{\lambda}, \qquad D_2 = \frac{1}{3} + \frac{p_1 + p_s - 2p_2}{2\lambda} - \frac{1}{16}\frac{\tau}{\lambda}. \tag{A5}$$

Equilibrium prices are then:

$$p_s^* = \frac{4}{9}\lambda + \frac{\tau}{96}, \qquad p_1^* = \frac{5}{9}\lambda + \frac{\tau}{192}, \qquad p_2^* = \frac{5}{9}\lambda - \frac{\tau}{192}. \tag{A6}$$

The corresponding profits in this subgame are:

$$\Pi_s^* = \frac{(128\lambda + 3\tau)^2}{82944\lambda} - f, \qquad \Pi_c^* = \frac{102400\lambda^2 - 3840\lambda\tau + 279\tau^2}{331776\lambda} - f. \tag{A7}$$

b) Independent retailer chooses part-time

The independent retailer chooses part-time shopping hours, the retail chain chooses full-time shopping hours at store 1 and part-time at store 2. Demand is then given by:

$$D_s = \frac{1}{3} + \frac{p_1 + p_2 - 2p_s}{2\lambda} - \frac{1}{32}\frac{\tau}{\lambda}, \qquad D_1 = \frac{1}{3} + \frac{p_2 + p_s - 2p_1}{2\lambda} + \frac{1}{16}\frac{\tau}{\lambda}, \qquad D_2 = \frac{1}{3} + \frac{p_1 + p_s - 2p_2}{2\lambda} - \frac{1}{32}\frac{\tau}{\lambda}. \tag{A8}$$

Equilibrium prices:

$$p_s^* = \frac{4}{9}\lambda - \frac{\tau}{96}, \qquad p_1^* = \frac{5}{9}\lambda + \frac{5\tau}{192}, \qquad p_2^* = \frac{5}{9}\lambda - \frac{\tau}{192} \tag{A9}$$

Equilibrium profits:

$$\Pi_s^* = \frac{(128\lambda - 3\tau)^2}{82944\lambda}, \qquad \Pi_c^* = \frac{102400\lambda^2 + 3840\lambda\tau + 279\tau^2}{331776\lambda} - f. \tag{A10}$$

Equilibrium

Following the derivation of Result 1 in Appendix A, equilibrium shopping hours are derived by comparing profits at the relevant stage . We define the following critical level of costs for extending shopping hours: $F_1 = \frac{\tau(1280\lambda - 93\tau)}{110592\lambda}$, $F_2 = \frac{5\tau(256\lambda+9\tau)}{110592\lambda}$, $F_3 = \frac{\tau(128\lambda+3\tau)}{6912\lambda}$, where $F_1 < F_2 < F_3$. Then, if $f \leq F_1$, the independent retailer chooses full-time and the retail chain chooses full-time for both its stores. If $F_1 < f \leq F_2$, the independent retailer chooses full-time and the retail chain chooses asymmetric shopping hours for its stores. One store is open full-time and one store is open part-time. If $F_2 < f \leq F_3$, the independent retailer chooses full-time and the retail chain chooses part-time for both its stores. Finally, if $f > F_3$, all stores are open part-time. The structure of equilibrium shopping hours parallels the outcome in the case with uniform shopping hours at the retail chain (see Result 1): The independent retail does not choose shorter shopping hours than the retail chain. However, for an intermediate range of costs there exists an equilibrium in which the retail chain chooses asymmetric shopping hours. Introducing cost asymmetries has the same impact as in the case with uniform shopping hours. It gradually increases the incentives to extend shopping hours at the chain (see Result 3). If the efficiency advantage is sufficiently large, the results reverse.

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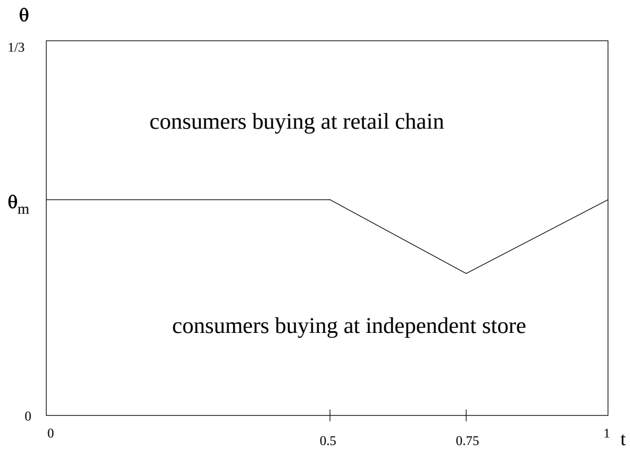

Figure 1: Case 2

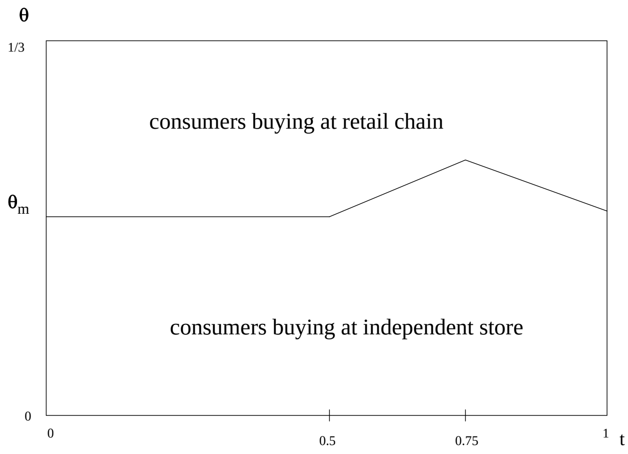

Figure 2: Case 3

		Independent retailer	
		full-time	part-time
Retail Chain	full-time	$\frac{(\frac{5}{9}\lambda+\frac{1}{3}c)^2}{\lambda}-2f, \frac{(\frac{4}{9}\lambda-\frac{1}{3}c)^2}{\lambda}-f$	$\frac{(\frac{5}{9}\lambda+\frac{1}{3}c+\frac{1}{48}\tau)^2}{\lambda}-2f, \frac{(\frac{4}{9}\lambda-\frac{1}{3}c-\frac{1}{48}\tau)^2}{\lambda}$
	part-time	$\frac{(\frac{5}{9}\lambda+\frac{1}{3}c-\frac{1}{48}\tau)^2}{\lambda}, \frac{(\frac{4}{9}\lambda-\frac{1}{3}c+\frac{1}{48}\tau)^2}{\lambda}-f$	$\frac{(\frac{5}{9}\lambda+\frac{1}{3}c)^2}{\lambda}, \frac{(\frac{4}{9}\lambda-\frac{1}{3}c)^2}{\lambda}$

Figure 3: Choice of shopping hours

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