Laboratoire
de Recherche
en Gestion
& Economie

Working Paper

Working Paper

2011-06

Retailing regulation via parking taxation

Jacques Thépot

September 2011

Université de Strasbourg
Pôle Européen de Gestion et d'Economie
61 avenue de la Forêt Noire
67085 Strasbourg Cedex
http://ifs.unistra.fr/large

Institut de Finance
de Strasbourg

Retailing regulation via parking taxation

Jacques Thépot
LARGE
Université Louis Pasteur
61, avenue de la Forêt Noire
67085 Strasbourg cédex
France
e-mail : thepot@cournot.u-strasbg.fr

September 9, 2011

Abstract

This paper explores the idea to regulate retailing industry through a tax on the store parking size. In Western economies, retailers use common resources (land use, road networks) contributing to the store accessibility that they do not pay for. This kind of free riding gives gross merchandisers and hypermakets a competitive advantage which establishes undue market power while creating, presumably, inefficiencies when social cost is taken into account. Hence the idea to tax the parking, which is a proxy measure of the accessibility resources used by the retailer. By using a standard model of horizontal differentiation, we explore the impact of parking taxation in a monopoly and in duopoly and we characterize optimal taxation policies

Keywords : spatial competition, optimal taxation, parking
JEL classification : L13, H20, H40, R10.

1. Introduction

For many decades, retailing industry is hugely expanding in Western countries [2]. Most of the cities in Europe and in North America are now surrounded by hypermarkets and hypercenters attracting each day crowds of customers. Some European countries worried about this concentration wave in retailing industry ; they decided to introduce specific regulations rules so as to control indirectly or directly the supermarket expansion. The most common way is to restrict opening hours except for shops in sparsely populated areas and retail units like bakeries, florists, kiosks, etc..for instance in Germany and Finland ; but an expansion of store hours is an indirect means for supermarkets/mass merchandisers to sustain growth, as small, general merchandise retailers are likely going to suffer (cf. [4]). An extreme case is France where in 1974 and 1996, under the pressure of shopkeepers lobbies, the government put legal restrictions on the size of new stores (*loi Royer* and *loi Raffarin*) ; exceptions to these rules are decided by local committees whose members are a mix of shopkeeper representatives, civil servants and politicians. The lack of economic guidelines and the bribe practices made such a control system quite permissive. In addition, such a regulation amounts to deter entry of potential competitors so that the incumbent retailers gained a decisive advantage. Finally, the mass merchandisers were not the last to adopt creative compliance practices to bypass the rules. As a result, this regulation system is poorly founded and inefficient. Clearly, floor space is not an exact measure of market power.

It can be argued that, in market economies, conventional antitrust policies should be sufficient to regulate retailing industry. Of course, this is true for supplier-retailer relationships and dominant positions problems. But these policies are not suitable to cope with public good issues. Clearly, in industrialized countries, mass merchandisers benefit from externalities which are underestimated or neglected by the regulator.In addition, they generate road traffic and congestion which account for negative externalities. Undoubtedly these externalities are a key factor explaining the huge development of the retailing industry and consequently their market power.

Where do these externalities come from ? Historically, it is well known that any retailing system is related to a specific transportation mode, for the suppliers as well as for the customers. At the end of the 19th century, for instance, the expansion of big department stores in London, Paris or New York is due to the technology of the lifts and elevators. Since the fifties, hypermarket growth results from the overwhelming use of individual car, the building of highway networks linking the cities, amenable both for customer cars and supplier trucks. Hence, a key factor explaining the growth of hypermarkets is undoubtedly the improvement of accessibility. Accessibility comes from public investment, it can be considered as a public good for which the retailers do not pay the full price since roads are mostly paid by the taxpayer. This free rider behavior is quite explicit when retailers choose their location. It must be said however that accessibility can not be exactly measured and that it is a public good used for a broad range of economic purposes which cannot be isolated from the shopping decisions. But the part of accessibility which is specifically used in shopping activities is strongly related to the parking size of the store, which is clearly a complementary resource of (public) accessibility. Accordingly, parking size may be considered as a tax basis to cover externalities induced by accessibility.

In this paper, we argue that retailers should be taxed on the store parking size as an indirect means to make them to pay for the use of accessibility. This paper is aimed at exploring this idea and also at discussing optimal taxation issues in the imperfect competition context of retailing. For this purpose, we use a standard model of horizontal differentiation [5], [8] where consumers of a standard basket of goods are distributed uniformly along a road represented by interval $[0, 1]$. The travel cost incurred by the customer is here the sum of a cost depending on the distance to the store, as usual, and a cost depending on accessibility. Accessibility is measured by the parking size installed by the retailer and then generates an investment/operating cost incurred by the retailer. Then accessibility operates both at the demand and the supply sides. But it also induces a social cost proportional to the parking size a part of which is paid by the retailer through a tax rate[1].

Section 2 is devoted to the monopoly case where an unique retailer is located at point 0. In this context, we prove that taxation is detrimental to the retailer but also to the consumers when they do not contribute to the remaining part of the social cost. When they do, we find a taxation rule among the consumers where the taxpayers are only those who *buy* the good ; this taxation rule is neutral in the sense that it does not affect the demand function. Optimal taxation is then studied and yields a tax rate which can be interpreted in terms of Lindahl prices. In section 3, these results are extended to the duopoly case when two identical retailers are located at points 0 and 1. Discussion is organized in terms of two key parameters : the travel cost per unit of length, which is inversely related to consumer mobility, and the unit social cost, which measures the environmental impact of accessibility. The latter is then related to the urbanization rate of the area. According to the values of these parameters, prevailing market structures (local monopolies, exclusive territories, duopoly), parking sizes and optimal taxation rates are derived. Two main results are found :

[1]Commodity taxation in vertical and horizontal differentiated duopoly are respectively analysed in [3],[6].

- Taxation generates market imperfections ; by decreasing parking sizes and retailing areas, taxation stimulates the prevalence of local monopolies and exclusive territories.
- In highly urbanized environments, *optimal* parking tax rate do not depend on the market structure. But in weakly urbanized environments, local monopolies should face a lower tax rate. In real world, this suggests that retailing regulation by taxation has to be designed consistently with the competitiveness of the sector.

2. Retailing monopoly and parking taxation

Let us consider a store with a parking of size a. We assume that variable a is a proxy measure of all factors under the control of the retailer facilitating access to the customers, contributing for instance to "one-stop shopping"[2].

Let us consider a "market", namely a set of consumers likely to buy one unit of a standard basket of goods, uniformly distributed on interval $[0, 1]$; in interval $[y, y + dy]$ there are Ndy consumers, so that N stands for the potential size of the market. We assume all the consumers have the same valuation of the good, w. The retailer, is located at point 0, charges a price p. Let t the travel cost per unit of length of the consumers, with $w \leq t$. We assume that any consumer incurs a (perceived) fixed cost of transport $G(a)$ to join the store ; this cost negatively depends on the store access, i.e. on the parking size, namely, $G' \leq 0$. Travel cost for consumer located at point y is $G(a) + ty$. He/she will buy the good if :

$$p + G(a) + ty \leq w,$$

Then the surplus (indirect utility) gained by consumer y is $[w - (p + G(a) + ty)]^+$. The *retail area* is defined by the set $[0, u]$ of consumers who buy the good, with $u = (w - p - G(a))/t$, so that the demand to the retailer is :

$$D(p, a) = N (w - p - G(a))/t, \tag{2.1}$$

and the aggregate surplus is given by :

$$S(p, a) = \frac{1}{2} N \frac{(w - p - G(a))^2}{t}. \tag{2.2}$$

[2] When $a = 0$,we consider that the store still works with on-street parking and walking customers

2.1. Monopoly pricing and parking size

Let $c < p$ the purchase and delivery cost of a standard basket of goods sold by the retailer. Let $C(a)$ the building/operating cost of the parking. Parking is actually a true technology encompassing various operations including space arrangement (cf.[1]), maintenance, security and shopping cards management. We postulate that parking technology faces decreasing returns to scale, i.e. $C' > 0$ et $C'' \geq 0$,since dedicated resources are needed when the parking size becomes large. Accordingly the profit of the retailer can be written as :

$$P = (p - c)\, D(p, a) - C(a) \tag{2.3}$$

In the following, we postulate that fixed travel cost is linear, i.e. $G(a) = \sigma - ga$. Parameter $g \geq 0$ measures the efficiency of the parking system. Then :

$$D(p, a)) = N\,(v - p + ga)\,/t \tag{2.4}$$

with $v = w - \sigma$ is termed the *(net) reservation price* for the good, with $v > c$. We assume that the parking cost is a quadratic function, $C = \alpha a^2/2$. Hence :

$$P\,(p, a) = (p - c)\, N\,(v - p + ga)\,/t - \alpha a^2/2), \tag{2.5}$$

and the consumer surplus becomes given by (2.2) is $S(p, a) = \dfrac{N\,(v - p + ga)^2}{2t}$ .Then maximizing P with respect to a, p yields optimal price, parking size and quantity given by :

$$\begin{aligned} p_m &= \frac{\alpha t\,(c + v) - Ng^2 c}{2\alpha t - Ng^2}, \\ a_m &= Ng\frac{v - c}{2\alpha t - Ng^2}, \\ q_m &= N\alpha\frac{v - c}{2\alpha t - Ng^2}. \end{aligned}$$

We assume that the efficiency of the parking system is no too high, namely :

$$g \leq \sqrt{2\alpha t/N}. \tag{2.6}$$

Then $p_m \geq c$, $a_m \geq 0$ and $q_m \geq 0$. The optimal profit and surplus is $P_m = \dfrac{N\alpha\,(v - c)^2}{2\,(2\alpha t - Ng^2)}$ and $S_m = \dfrac{1}{2}\dfrac{N\alpha^2 t\,(v - c)^2}{(2\alpha t - Ng^2)^2}$. Of course, when $g = 0$, the classical formulas are found with monopoly price $p_0 = (c + v)/2 \leq p_m$ and the profit and surplus $P_0 = \frac{N(v-c)^2}{4t}$, $S_0 = \frac{N(v-c)^2}{8t}$, with the parking size equal to zero.

Proposition 2.1. *Under condition (2.6), in creasing the efficiency of the parking system leads to increasing the price, the parking size, the individual surplus and the profit.i.e.*

$$\frac{\partial p_m}{\partial g} \geq 0, \frac{\partial a_m}{\partial g} \geq 0, \frac{\partial P_m}{\partial g} \geq 0, \frac{\partial S_m}{\partial g} \geq 0. \tag{2.7}$$

Proof. Immediate ■

Thus any effort to improve the efficiency of the parking is Pareto-improving for the consumers and the retailer. The price increase is more than compensated by the increase of the parking size.

2.2. Second best pricing and parking sizing

It is easy to prove that the socially optimal price and parking size which maximize the social welfare $W = S + P$ is $p = c$, $a = \dfrac{Ng(v-c)}{\alpha t - Ng^2}$,for which the profit is negative. Accordingly, we have to consider the second best optimum, defined as solution of the following program :

$$\begin{cases} \max\limits_{p,a} S \\ P = 0 \end{cases} \tag{2.8}$$

Standard computations give price and parking size values given by : $p_{sb} = c + \dfrac{Ng^2(v-c)}{2\alpha t - Ng^2}$, $a_{sb} = \dfrac{2Ng(v-c)}{2\alpha t - Ng^2}$, with $a_{sb} > a_m$and $p_{sb} \leq p_m$ if $g \leq \sqrt{t\alpha/N}$,if not. It is then socially desirable to have larger parking. The price is lower than in the monopoly case except for strongly efficient parking (i.e. for $\sqrt{\alpha t/N} \leq g \leq \sqrt{2\alpha t/N}$) where the price is higher.

2.3. Social cost and parking taxation

The previous results hold since the social cost of accessibility is not taken into consideration. The social cost eventually includes negative externalities on the environment generated by the road traffic around the store. We assume that the social cost is proportional to the parking size, of the form θa, with $\theta > 0$. It is convenient to interpret unit cost θ *as a measure of the urbanization rate of the area.* The social cost is shared among the parties. A part is paid by the retailer through a tax on a at rate $s \leq \theta$. The after tax profit is $\Pi = P - sa$. The remaining part, $(\theta - s)\,a$, is covered by the consumers.

2.3.1. Taxation rules for the consumers

How could the remaining part $(\theta - s)\,a$ be charged among the consumers ? This can be done through individual taxation policies implemented by a regulator ; however these polices can induce distortions on the demand and modify the retail area of the store. In our context, four taxation policies may be considered by combining the following features :

(i) the basis of taxation, consumers vs buyers,

(ii) the uniformity in terms of location.

Three policies deserve consideration :

1. *Uniform taxation, consumer based* : Each consumer in the economy - buyer or not - is taxed an amount equal to $(\theta - s)\,a/N$; this case deals with a net global surplus function $\Sigma = S - (\theta - s)\,a$ and the retail area remains equal to $(v + ga - p)\,/t$; the demand is then unaffected by the social cost.

2. *Uniform taxation, buyer based.* This is the case where a toll l is paid at the entrance of the parking. Toll l is defined by $N\int_0^{\frac{v-p+ga-l}{t}} l dy = (\theta - s)\,a$,namely $l = \frac{1}{2}\left((v + ga - p) - \sqrt{\left((v + ga - p)^2 - 4\,(\theta - s)\,at/N\right)}\right)$. And then the retail area is $\left(\sqrt{\left((v + ga - p)^2 - 4\,(\theta - s)\,at/N\right)} + (v + ga - p)\right)/2t$,which depends on unit social cost θ. Obviously, it converges to the neutral case when $N \to \infty$.

3. *Non-uniform taxation, buyer based.* Only the customers are taxed. The tax payed by the individual located at distance y is assumed to be a linear and decreasing function of y on the form $f - hy$; the farther the customer is located, the less he is taxed. Accordingly, the retail area is then $\frac{v-p+ga-f}{t-h}$. Coefficients f and h are determined by conditions ensuring that (i) the sum of the contributions equals the social cost $(\theta - s)\,a$, (ii) the pivotal customer, who is indifferent between buying and not buying, is not taxed so as to avoid threshold effects. Both conditions amount to solve the system :
$$\begin{cases} N\int_0^{\frac{v-p+ga-f}{t-h}} (f - hy)\,dy - (\theta - s)\,a = 0, \\ f - h\left(\frac{v-p+ga-f}{t-h}\right) = 0. \end{cases} \tag{2.9}$$
Solving system (2.9) yield :
$$h = \frac{2\,(\theta - s)\,at^2}{N\,(v + ga - p)^2},\ f = \frac{2\,(\theta - s)\,t}{N\,(v + ga - p)}.$$

It can be checked that the retail area is still equal to $(v + ga - p)/t$ and then demand is unaffected by the social cost so that, as in policy 1, a net global surplus function $\Sigma = S - (\theta - s) a$ can be unambiguously considered.

Policies 1 and 3 are neutral in terms of consumer preferences as the demand function is not distorted by the social cost while policy 2 is not. In the following, we assume that only policies 1 and 3 are used by the regulator. Notice that, for policy 3, the regulator needs a full information on the location of the consumers.

2.3.2. Monopoly pricing under parking taxation

Solving program $\max_{p,a\geq 0} \Pi$, for any value of the tax rate, yields the monopoly solution given by the following proposition. Let :

$$\hat{s} = \frac{Ng(v-c)}{2t}.$$

Proposition 2.2. *for $s \leq \hat{s}$, the monopoly solution is given by :*

- *The price and parking size are :* $p^*(s) = \dfrac{\alpha t (c+v) - Ng^2 c - gst}{2\alpha t - Ng^2}$, $a^*(s) = a = \dfrac{Ng(v-c) - 2st}{2\alpha t - Ng^2}$.
- *The quantity sold is* $q^*(s) = N\frac{\alpha(v-c)-gs}{2\alpha t - Ng^2}$.
- *The profit is* $P^*(s) = P = \frac{1}{2}\frac{N\alpha(v-c)^2 - 2s^2 t}{2\alpha t - Ng^2}$.
- *The consumer surplus is given by* $S^*(s) = S = \frac{1}{2}\dfrac{Nt(gs - \alpha(v-c))^2}{(2\alpha t - Ng^2)^2}$.

For $s > s$, one has :

- $p^* = p_0$,
- $a^* = 0$.

Proof. immediate ■

Corollary 2.3. • *The price and the parking size are decreasing functions of rate s.*

- *The demand is decreasing.*
- *The surplus and the profit are decreasing,*
- *The net profit* $\Pi^*(s) = P^*(s) - sa^*$ *is decreasing and the net surplus* $\Sigma^*(s) = S^*(s) - (\theta - s)\,a^*$ *is increasing*

Proof. immediate ■

Hence taxing the parking size of the retailer reduces the parking size of the store but decreases the price charged by the retailer in order to attract more consumers. Because of the monopoly power exerted by the retailer, the tax is not neutral from the customer point of view : the parking reduction induces a shrinking of the retail area since the inframarginal customers will be deterred from shopping at the store. To dampen this phenomenon, the retailer has to decrease his price but this is insufficient, in terms of individual surplus, to offset the parking size decrease.

2.3.3. Optimal parking taxation

The regulator has to decide the tax rate s which maximizes the net social welfare $\Omega^*(s) = P^*(s) + S^*(s) - \theta a^*(s)$. In this subsection, we assume that the social cost is low, namely :

$$\Omega = P + S - \theta a \tag{2.10}$$

$$\frac{\partial \Omega}{\partial s} \tag{2.11}$$

, Solution is :

$$\left\{ s = \frac{-4\theta\alpha t + 2\theta N g^2 + \alpha N g v - \alpha N g c}{-4\alpha t + 3N g^2} \right\} \tag{2.12}$$

$$\theta \leq \frac{3}{4} N g \frac{v - c}{t}. \tag{2.13}$$

Let $s^{**} = \arg\max \Omega^*(s)$. Straightforward computations give :

$$s^{**} = \frac{2\theta\left(2\alpha t - N g^2\right) - N g \alpha (v - c)}{4\alpha t - 3N g^2} \leq \theta. \tag{2.14}$$

$$s^{**} = 0 \Rightarrow t = \frac{1}{4} N g \frac{2g\theta + \alpha v - \alpha c}{\theta\alpha} \tag{2.15}$$

Under condition (2.13), $s^{**} \leq \hat{s}$. It follows that the price, parking size and quantity are given by :

$$p^{**} = \frac{2\alpha t (c + v) - 3N g^2 c - 2t\theta g}{4\alpha t - 3N g^2}, \tag{2.16}$$

$$a^{**} = \frac{3Ng(v-c) - 4t\theta}{4\alpha t - 3Ng^2}. \tag{2.17}$$

These values of price and parking size can be directly achieved by the social planner, provided that the monopoly power of the retailer is preserved. The latter is captured by relation :

$$(p-c)\frac{\partial D}{\partial p} + D(p) = 0, \tag{2.18}$$

which defines price p as a function of a:

$$p = h(a) = \frac{1}{2}v + \frac{1}{2}ga + \frac{1}{2}c. \tag{2.19}$$

Let us consider that the regulator seeks to maximize the net social welfare under monopoly pricing condition (2.18). For this purpose, using relation (2.19), let us express all the variables as functions of a : $\tilde{S}(a) = S(h(a), a)$, $\tilde{P}(a) = P(h(a), a)$, $\tilde{\Omega}(a) = \tilde{S}(a) + \tilde{P}(a) - \theta a$. Then the program of the regulator is :

$$\max_a \tilde{\Omega}(a). \tag{2.20}$$

It can be proved that the solution of program (2.20) is a^{**}. In other words, optimal tax rate s^{**} leads to the socially best value of the parking size of the store (and the price) preserving the price-maker behavior of the retailer.

2.3.4. Interpretation in terms of Lindahl prices under imperfect competition

Rates s^{**} and $(\theta - s^{**})$ can be interpreted as Lindhal prices [7] of the parking size conceived as a public good, ensuring the achievement of the social optimum a^{**}(cf. Appendix 1) . This is made in a decentralized way, from the point of view of both the consumers and the retailer. parking size a^{**} is the solution of both programs

$$\max_a \left[\tilde{P}(a) - s^{**}a\right], \tag{2.21}$$

$$\max_a \left[\tilde{S}(a) - (\theta - s^{**})a\right]. \tag{2.22}$$

In program (2.21), the tax rate is exactly chosen so that the optimal parking size from the point of view of the retailer coincides with the socially optimal size. In the similar way, program (2.22) can be interpreted as follows : let us imagine that a public agency, in charge of the only interests of the consumers/taxpayers, is responsible for building the parking incurring a cost of $(\theta - s^{**})a$. This agency would fix the parking size exactly at the socially desirable level.

3. Retailing duopoly competition and parking taxation

Let us assume that the market is served by a spatially differentiated duopoly of identical retailers. Retailer 1 is located at point 0 and retailer 2 at point 1. Let p_i, a_i the price and the parking size of firm i. D_i stands for the demand to firm i. With a tax rate s,the after tax profit of firm i is $\Pi_i = (p_i - c)\, D_i - \alpha a_i^2/2 - s a_i$. Let S_i the surplus gained by the consumers of firm i. The social cost is $\theta\,(a_1 + a_2)$. As in the monopoly case, we assume that the regulator has to fix the tax rate on the parking sizes. We will discuss the impact of taxation in terms of mobility and urbanization rate.

3.1. Parking taxation

First of all, let us assume that tax rate s is fixed ; it is identical for both retailers who are involved in a spatial duopoly where each of them has to fix the parking size and the price. The analysis is restricted to symmetric equilibria of the duopoly. The Nash conditions are derived in Appendix 2. According to the values of travel cost t, three types of market structures may arise :

- **High consumer mobility**, for $t \leq 2\left[v - c + g\frac{(gN-2s)}{2\alpha}\right]/3$, the retailers are involved in a *differentiated duopoly* competition. All the customers buy the good, the market shares are $1/2, 1/2$. The parking sizes depend on the tax rate but the price does not..
- **Medium consumer mobility:**for $2\left[v - c + \frac{g(gN-2\theta)}{2\alpha}\right]/3 < t \leq v - c + \frac{g(gN-2\theta)}{2\alpha}$, the retailers act on an *exclusive territory* basis on half of the market : this means that the median customer, located at point $1/2$ is exactly indifferent between the three following alternatives : to buy to retailer 1, to buy to retailer 2, not to buy. The price and the parking size depends on the tax rate.
- **Low consumer mobility :** for $v - c + g\frac{(gN-2s)}{2\alpha} \leq t < \frac{1}{2}\frac{v-c}{s}gN$. The retailers are *local monopolies*, they implement parking ($a_i > 0$). There is no full coverage of the market. Customers located around the middle do not buy. The price and the parking sizes depend on the tax rate.
- **Very low consumer mobility,** for$\frac{1}{2}\frac{v-c}{s}gN \leq t$, the retailers are *local monopolies*, they do not implement parking ($a_i = 0$). The price does not depend on the tax rate.

The results (for $s \leq gN/2$) are summarized in table 3.1.

range of t	price	parking size
$t \leq 2\left[v - c + g\frac{(gN-2s)}{2\alpha}\right]/3,$	$c+t$	$\frac{gN-2s}{2\alpha}$
$2\left[v - c + \frac{g(gN-2s)}{2\alpha}\right]/3 < t \leq v - c + \frac{g(gN-2s)}{2\alpha}$	$v - t/2 + g\frac{gN-2s}{2\alpha}$	$\frac{gN-2s}{2\alpha}$
$v - c + g\frac{(gN-2s)}{2\alpha} \leq t < \frac{1}{2}\frac{v-c}{s}gN$	$\frac{\alpha t(c+v)-Ng^2c-gst}{2\alpha t-Ng^2}$	$\frac{Ng(v-c)-2st}{2\alpha t-Ng^2}$
$\frac{1}{2}\frac{v-c}{s}gN \leq t$	$\frac{v+c}{2}$	0

Table 3.1: Mobility and taxation

As expected, the higher is the travel cost t,the less competitive is the retailing industry. In this context, taxation results in two related effects :

1. Taxation decreases the parking sizes in any situation and then hurts the consumers, as in the monopoly case. For medium and low consumer mobility, this is compensated by a price decrease which restores a part of the consumer surplus loss. *For high and very low consumer mobility, parking tax does not affect the price.*

2. More importantly, taxation has an impact on the market structure : table 1 indicates that the threshold values determining the various cases shift to the left when rate s increases. Hence, there are values of travel cost t for which duopolists become exclusive territory retailers, and exclusive territory retailers become local monopolies. Accordingly, *taxation generates market imperfection* : Reducing the parking sizes through taxation strengthens local market power of the retailers.

3.2. Optimal taxation

Of course, at the global level, taxation is made to cover social cost. The above mentioned effects interact in determining the optimal tax rate. Let us examine now what it happens when tax rate is chosen so as to maximize the social welfare. Computations are derived in Appendix 3. Three situations may arise according to the unit social cost value.

3.2.1. Low urbanization, $\theta \leq 3Ng/4$

Table (3.2) indicates the optimal value of tax rate and the related parking sizes according to cost t. Let $\tilde{t} = v - c + \frac{g(gN-2\theta)}{2\alpha}$,the value at which local monopoly prevails. $\tilde{t}$ will be termed *the turning point* of the industry.

range of t	tax rate	parking sizes
$t < 2\left[v - c + \frac{g(gN-2\theta)}{2\alpha}\right]/3$	$\min(\theta, gN/2)$	$\frac{gN-2\theta}{2\alpha}$
$2\left[v - c + \frac{g(gN-2\theta)}{2\alpha}\right]/3 < t \leq v - c + \frac{g(gN-2\theta)}{2\alpha}$	$\min(\theta, gN/2)$	$\frac{gN-2\theta}{2\alpha}$
$v - c + \frac{g(gN-2\theta)}{2\alpha} \leq t < v - c + \frac{g(3Ng-4\theta)}{4\alpha}$	$\frac{2\alpha(v-c-t)+g^2N}{2g}$	$\frac{c+t-v}{g}$
$v - c + \frac{g(3Ng-4\theta)}{4\alpha} \leq t < 3gN\frac{v-c}{4\theta}$	$\frac{2\theta\left(2\alpha t-Ng^2\right)-Ng\alpha(v-c)}{4\alpha t-3Ng^2}$	$\frac{3Ng(v-c)-4t\theta}{4\alpha t-3Ng^2}$
$t \geq 3gN\frac{v-c}{4\theta}$	$\frac{2\theta}{3}$	0

Table 3.2: Tax rate for low urbanization

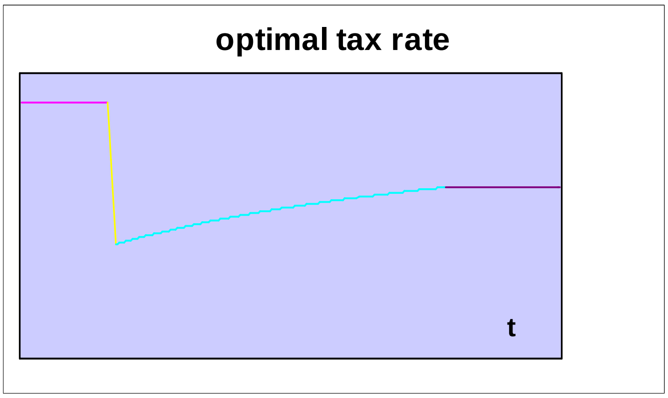

Figure 3.1:

Evolution of the optimal tax rate in terms of travel cost is given in figure(3.1). These results indicate that the optimal tax rate globally decreases with consumer mobility. Except at the turning point where the tax rate suddenly jumps. Anyway tax is lower in the local monopoly case than in the duopoly.

In terms of policy implication, consumer mobility is not really observed. Only market structure matters. These results clearly imply that *the tax rate has to be differently designed according to the market structure : in weakly urbanized environments, the local monopolies are less taxed as they do not cover all the market* (cf. figure 3.1) Accordingly, optimal parking sizes have a peak at the competitiveness point (cf. figure 3.2). Taxation is reduced so as not to shrink to much the retailing areas of the firms. As a result, *optimal tax rate does not vary monotonically with consumer mobility and, consequently, with the competitiveness of the economy.*

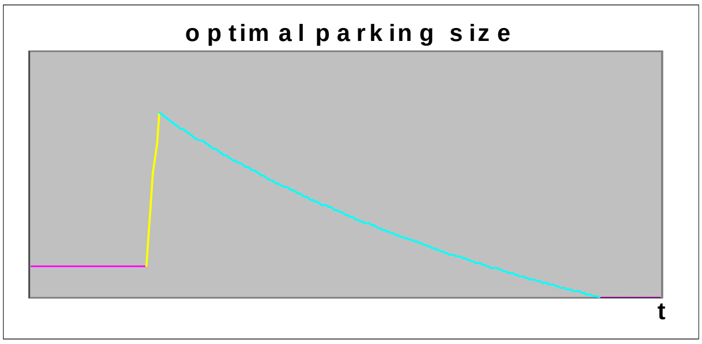

Figure 3.2:

3.2.2. High urbanization $\theta \geq 3N/4g$

In high urbanized environments, the optimal tax is equal to $gN/2$, for any value of t,i.e. for any market structure prevailing in the retailing sector. The unit social cost is too high to sustain a differentiated tax treatment between duopoly, exclusive territories retailers and local monopolies. As a result, the parking sizes are equal to zero. *Optimal taxation amounts to eliminate all the the social cost generated by the retailers and tax rate is independent on the market structure.*

4. Concluding remarks

In this paper, we investigated the possibility to regulate retailing industry through a tax on the store parking. The argument supporting this idea is that retailers in modern economies use common resources contributing to the accessibility they do not pay for. These resources are especially scarce in highly urbanized areas. This gives gross merchandisers and hypermakets a competitive advantage which establishes undue market power while creating, presumably, inefficiencies when social cost is taken into account. We presented a formal treatment of this argument ; by using a standard model of horizontal differentiation, we explored the impact of taxation in a monopoly and in duopoly and we characterized optimal taxation policies. Some extensions can le mentioned : in the model, the social cost is assumed to be a linear while, in the real world, a convex form could better fit the environmental impact of retailing industry. Similarly, taxation is also assumed to be linear ; using a non linear scheme could incite the retailers to share parking resources, as they do in shopping centers. Finally, we have to keep in mind that retailing industry face economies of scale which explain the gigantism tendency observed in this sector. The question is to to know whether these economies of scale could come from free-rider behaviors on neglected public resources.This is a crucial issue for regulation.

References

[1] Cassady, R. & J.E. Kobza, A probabilistic approach to evaluate strategies for selecting a parking space, *Transportation Science* (1998), 32, 1, 30-42

[2] Corstjens, J. et M. Corstjens, *Store Wars, (1995),*Wiley.

[3] Cremer, H. & J. Thisse, Commodity taxation in a differentiated oligopoly, *International Economic Review* (1994) 35, 613-633.

[4] Grünhagen, M. & R. Mittelstaedt, The impact of store hours and redistributive income effects in the retail industry : some projections for Germany, *working paper,Clemson University (2000).*

[5] Hotelling,H., Stability in competition, *Economic Journal* (1929), 39, 41-57

[6] Lambertini, L., Optimal fiscal regime in a spatial duopoly, *Journal of Urban Economics,*(1997), 41, 407-420.

[7] Lindahl, E., Just taxation - a positive solution, in T. Musgrave & A. Peacock (eds), *Classics in the Theory of Public Finance*, (1967) New-York : St Martin Press, 168-176

[8] Tirole, J., 1988, *The theory of industrial organization*, (1988), MIT Press

Appendix 1: Lindhal prices and taxation

Lindhal prices are used to determine public good taxation. The parking size can be considered as a public good. In section 2, we defined :

- the profit of the retailer, $\tilde{P}(a)$,
- the consumer surplus, $\tilde{S}(a)$,
- the social cost, θa.

The socially optimal parking size is $a^{**} = \arg\max\left[\tilde{P}(a) + \tilde{S}(a) - \theta a\right]$, .so that

$$\tilde{P}'(a^{**}) + \tilde{S}'(a^{**}) = \theta$$

This "allocation" of the public good can be achieved in a decentralized way, when the retailer and the consumer face public good prices m_1 and m_2 ; independently, both maximize their utilities defined by

$$\begin{aligned}\tilde{\Pi}(a_1) &= \tilde{P}(a_1) - m_1 a_1, \\ \tilde{\Sigma}(a_2) &= \tilde{S}(a_2) - m_2 a_2.\end{aligned}$$

Of course, $a^{**} = \arg\max \tilde{\Pi}(a_1) = \arg\max \tilde{\Sigma}(a_2)$ if $m_1 = s^{**}$ and $m_2 = \theta - s^{**}$.

APPENDIX 2 :DUOPOLY SPATIAL COMPETITION UNDER TAXATION

The duopolists have to choose the prices and the parking sizes for a given tax rate s. Let$[0, u_1]$ and $[u_2, 1]$ the market respectively served by firm 1 and 2, so that $D_1 = Nu_1$, $D_2 = N(1-u_2)$. The switching point is $\hat{u}$ such that $v + ga_1 - p_1 - tu = v + ga_2 - p_2 - t(1-u)$, namely :

$$\hat{u} = \frac{p_2 - p_1 - g(a_1 - a_2) + t}{2t}. \tag{.1}$$

For the sake of symmetry, we will only consider the situation of firm 1. Clearly, the following conditions have to be fulfilled :(i) the consumer of firm 1 located at u_1 must lie at the left-hand side of the switching point ; (ii) he has to get a positive surplus from buying to firm 1, hence the conditions :

$$u_1 \leq (p_2 - p_1 + g(a_1 - a_2) + t)/2t, \tag{.2}$$

$$u_1 \leq (v + ga_1 - p_1)/t. \tag{.3}$$

Then duopolist 1 faces the following optimization program

$$\begin{aligned}&\max_{p_1, a_1, u_1} N(p_1 - c)u_1 - \alpha a_1^2/2 - sa_1 \\ &u_1 \leq (p_2 - p_1 + g(a_1 - a_2) + t)/2t \\ &u_1 \leq (v + ga_1 - p_1)/t. \\ &a_1 \geq 0.\end{aligned}$$

The Lagrangian can be written as : $L = N(p_1 - c)u_1 - \alpha a_1^2/2 - sa_1 + \lambda((p_2 - p_1 + g(a_1 - a_2) + t)/2t - u_1)$
$+\xi((v + ga_1 - p_1)/t - u_1) + \eta a_1$. Necessary optimality conditions can be written ;

$$Nu_1 - \lambda/2t - \xi/t = 0, \tag{.4}$$

$$N(p_1 - c) - \lambda - \xi = 0, \tag{.5}$$

$$-\alpha a_1 - s + g\lambda/2t + g\xi/t + \eta = 0. \tag{.6}$$

$$\begin{aligned}\lambda\left[\left(p_2-p_1+g\left(a_1-a_2\right)+t\right)/2t-u_1\right] &= 0, \\ \xi\left[\left(v+ga_1-p_1\right)/t-u_1\right] &= 0, \\ \eta a_1 &= 0.\end{aligned} \tag{.7}$$

$$\lambda \geq 0, \xi \geq 0, \eta \geq 0. \tag{.8}$$

Let us assume firstly that the tax rate is not too high, i.e. :

$$s \leq Ng/2 \tag{.9}$$

Using symmetry arguments, we consider that, at the equilibrium, $p_2 = p_1$, $a_2 = a_1$. Hence the following regimes can be distinguished :

- **Regime (a)** $\xi = 0, \lambda > 0, \eta = 0,\ u_1 = 1/2, \lambda = N\left(p_1 - c\right)$.Condition (.4) gives $N/2 - N\left(p_1-c\right)/2t - \xi/t = 0$.Then $p_1 = p_2 = t + c, a_1 = a_2 = \dfrac{gN-2s}{2\alpha} \geq 0$ This regime is optimal if condition (.3) is satisfied, namely for values of $s \in [0, \theta]$ such that :

$$t/2 \leq \left(v + g\left(\frac{gN-2s}{2\alpha}\right) - t - c\right) \tag{.10}$$

, Solution is : $\left\{t \leq -\frac{1}{3}\frac{-2v\alpha-g^2N+2gs+2c\alpha}{\alpha}\right\}$, No solution found., Solution is :

$$\left\{s \leq -\frac{1}{2}\frac{3t\alpha-2v\alpha-g^2N+2c\alpha}{g}\right\} \tag{.11}$$

, Solution is :

$$\left\{s = -\frac{1}{2}\frac{3t\alpha-2v\alpha-g^2N+2c\alpha}{g}\right\} \tag{.12}$$

$$s \leq Ng/2 + \frac{1}{2}\frac{\alpha\left(2v-3t-2c\right)}{g}. \tag{.13}$$

with

$$t \leq 2\left[v - c + g\frac{gN}{2\alpha}\right]/3 \tag{.14}$$

We have $S_1 = S_2 = N\int_0^{1/2}\left(v - p_1 + ga_1 - ty\right)dy = N\dfrac{4v\alpha - 5t\alpha - 4c\alpha + 2g^2N - 4gs}{8\alpha}$ and $\Pi_1 = \Pi_2 = \frac{1}{2}Nt - \frac{1}{8}\left(gN - 2s\right)\frac{Ng+2s}{\alpha}$. When $s \geq Ng/2$, neither firm invests in parking size. Four similar regimes are found with $a_1 = a_2 = 0$, where g and s are put to zero in the above formulas.

- **Regime (b)** $\xi > 0, \lambda > 0, \eta = 0$, $u_1 = 1/2$. Multipliers $\xi$and λ are solution of system {(.4),(.5)}, namely $\xi = N(c + t - p_1), \lambda = N(2p_1 - 2c - t)$. Price $p_1$is determined by relation $1/2 = (v + ga_1 - p_1)/t$,i.e. $p_1 = v - \frac{1}{2}t + ga_1$.Relation (.6) yields $a_1 = a_2 = \frac{gN-2s}{2\alpha}$ and then $p_1 = p_2 = v - t/2 + g\frac{gN-2s}{2\alpha}$. This regime is optimal if $\xi > 0$ and $\lambda \geq 0$, or

$$Ng/2 + \frac{1}{2}\frac{\alpha(2v - 3t - 2c)}{g} < s \leq Ng/2 + \frac{\alpha(v - t - c)}{g} \tag{.15}$$

with

$$\begin{aligned} Ng/2 + \frac{\alpha(v - t - c)}{g} &\geq 0 && (.16) \\ Ng/2 + \frac{1}{2}\frac{\alpha(2v - 3t - 2c)}{g} &\leq \theta && (.17) \end{aligned}$$

We have $S_1 = S_2 = N\int_0^{1/2}(v - p_1 + ga_1 - ty)\,dy = Nt/8$,and $\Pi_1 = \Pi_2 = (p_1 - c)N/2 - \alpha a_1^2/2 - sa_1 = \frac{2N\alpha(2v-t-2c)+(2s-Ng)^2}{8\alpha}$.

- **Regime (c)** $\xi > 0, \lambda = 0, \eta = 0$. Variables ξ and u_1 are solution of system {(.4),(.5)}, namely $\xi = N(p_1 - c)$, $u_1 = \frac{p_1-c}{t}$. Hence $p_1 = \frac{1}{2}c + \frac{1}{2}v + \frac{1}{2}ga_1$ and, of course, $a_1 = a_2 = a^*(s) = \dfrac{Ng(v - c) - 2st}{2\alpha t - Ng^2}$, $p_1 = p_2 = p^*(s)$. This regime is optimal for $\frac{p_1-c}{t} \leq (v + ga_1 - p_1)/t$, $\xi > 0$ and $a_1 \geq 0$. According to relations (2.6) and (.9), these conditions are satisfied if

$$\frac{1}{2}(v - c)g\frac{N}{t} \geq s \geq Ng/2 + \frac{\alpha(v - t - c)}{g} \tag{.18}$$

:

We have $S_1 = S_2 = S^*(s) = \frac{1}{2}\dfrac{Nt(\alpha c - \alpha v + gs)^2}{(2\alpha t - Ng^2)^2}$, $\Pi_1 = \Pi_2 = \Pi^*(s) = \frac{1}{2}\dfrac{\alpha N(v - c)^2 + 2s(st - Ng(v - c))}{2\alpha t - Ng^2}$.

- **Regime (d)** $\xi > 0, \lambda = 0, \eta > 0$. We have $a_1 = a_2 = 0$, $p_1 = p_2 = (c + v)/2, \xi = N(v - c)/2$. This regime holds at the equilibrium for :

$$\frac{1}{2}(v - c)g\frac{N}{t} \leq s \tag{.19}$$

We have $S_1 = S_2 = S_0 = \frac{N(v-c)^2}{8t}, \Pi_1 = \Pi_2 = P_0 = \frac{N(v-c)^2}{4t}$.

APPENDIX 3 : OPTIMAL TAXATION

Let us consider successively the four regimes so as to determine the optimal value of tax rate $s \in [0, \theta]$ which maximizes $\Omega = P_1 + P_2 + S_1 + S_2 - \theta (a_1 + a_2)$.

- **Regime(a).**

  The optimal taxation is given as the solution of the program :

$$\begin{aligned} & \max \Omega & (.20) \\ s & \leq Ng/2 + \frac{1}{2} \frac{\alpha (2v - 3t - 2c)}{g} & (.21) \\ 0 & \leq s \leq \theta, & (.22) \end{aligned}$$

  The welfare $\Omega = \frac{1}{2} (Ng - 2\theta) \frac{Ng-2s}{\alpha} + \frac{1}{4} N (4v - 4c - t)$ is a linear function of s with a coefficient $(2\theta - gN)$ Then the solution si easy to found :

  1. If $\theta \leq Ng/2$,the maximum is reached for $s = 0$. Hence $a_1 = a_2 = \frac{gN}{2\alpha}$,
  2. If $\theta \geq Ng/2$, the maximum is reached for $s = \min(\theta, Ng/2 + \frac{1}{2} \frac{\alpha(2v-3t-2c)}{g})$, i.e.
     - If $t \leq 2 \left[v - c + g \frac{(gN - 2\theta)}{2\alpha} \right] /3$, $s = \theta$, $a_1 = a_2 = \frac{gN-2\theta}{2\alpha}$
     - If not, $s = Ng/2 + \frac{1}{2} \frac{\alpha(2v-3t-2c)}{g}$

  In all the cases the price is $c + t$.

- **Regime (b)** :

  The optimal taxation is given as the solution of the program :

$$\begin{aligned} & \max \Omega & (.23) \\ Ng/2 + \frac{1}{2} \frac{\alpha (2v - 3t - 2c)}{g} & < s \leq Ng/2 + \frac{\alpha (v - t - c)}{g} & (.24) \\ 0 & \leq s \leq \theta, & (.25) \end{aligned}$$

$$\Omega = \frac{1}{4} \frac{N\alpha (4v - 4c - t) + (Ng - 2s)(Ng - 2s - 4\theta)}{\alpha} \quad (.26)$$

$$\frac{\partial \Omega}{\partial s} \quad (.27)$$

$$s = Ng/2 + \frac{\alpha (v - t - c)}{g} \quad (.28)$$

$$-\frac{Ng - 2s - 2\theta}{\alpha} \quad (.29)$$

$: 2\dfrac{-\alpha t+\alpha v-\alpha c+\theta g}{g\alpha} : \dfrac{2\alpha v-3\alpha t-2\alpha c+2\theta g}{g\alpha}$

Then welfare Ω is a convex function of s; it is maximized on the boundaries of th feasible set $\left[\max(0, Ng/2+\frac{1}{2}\frac{\alpha(2v-3t-2c)}{g}, \min(\theta, Ng/2+\frac{\alpha(v-t-c)}{g}\right]$. Four cases have to be distinguished

– $0 \leq Ng/2+\frac{1}{2}\frac{\alpha(2v-3t-2c)}{g} \Leftrightarrow t \leq 2\left[v-c+g\frac{gN}{2\alpha}\right]/3$, and $\theta \leq Ng/2+\frac{\alpha(v-t-c)}{g} \Leftrightarrow t \leq v-c+\frac{g(gN-2\theta)}{2\alpha}$

The candidates for the optimum is $\Omega(Ng/2+\frac{1}{2}\frac{\alpha(2v-3t-2c)}{g})$ and $\Omega(\theta)$:

Sraightforward computations prove that $\Omega(\theta) \lesseqqgtr \Omega(0) \Leftrightarrow \theta \lesseqqgtr Ng/3$. Then the maximum welfare is reached (i) if $\theta \leq Ng/3$; for $s=0$ and $a_1=a_2=\frac{gN}{2\alpha}$, (ii) if not, for $s=\theta$ and $a_1=a_2=\frac{gN-2\theta}{2\alpha}$. This regime is used for $2\left[v-c+g\frac{gN}{2\alpha}\right]/3 < t \leq v-c+g\frac{gN}{2\alpha}$, if $\theta \leq Ng/3$), for $2\left[v-c+g\frac{(gN-2\theta)}{2\alpha}\right]/3 < t \leq v-c+g\frac{(gN-2\theta)}{2\alpha}$if not.

- **Regime (c)**

  Each duopolist is in a local monopoly situation. Hence the tax rate is s^{**},given by (2.14). Conditions (**??**) lead to : $v-c+\frac{g(3Ng-4\theta)}{4\alpha} < t \leq 3gN\frac{v-c}{4\theta}$.This regime exists if $\theta \leq \frac{3}{4}gN$.

$$v-c+\frac{g\left(3Ng-4\theta\right)}{4\alpha}=v-c+g\frac{gN}{2\alpha} \tag{.30}$$

  , Solution is : $\left\{\theta=\frac{1}{4}Ng\right\}$

$$v-c+\frac{g\left(3Ng-4\theta\right)}{4\alpha} \geq v-c+g\frac{(gN-2\theta)}{2\alpha} \tag{.31}$$

  , No solution found.

- **Regime (d)**

  This regime holds with $a_1=a_2=0$; it is then optimal for any value of the tax rate greater or equal to $\frac{2}{3}\theta$.

When $\theta \leq \frac{3}{4}gN$, an intermediary regime b' between regime b and c appears for $v-c+\frac{g(gN-2\theta)}{2\alpha} \leq t < v-c+\frac{g(3Ng-4\theta)}{4\alpha}$. Optimal tax rate is fixed such that $t=v-c+g\frac{(gN-2s)}{2\alpha}$,, so as to stick at the upper bound of regime b, namely $s=\frac{1}{2}\frac{2v\alpha-2c\alpha-2\alpha t+Ng^2}{g}$, $a_1=a_2=\frac{gN-2s}{2\alpha}$ =: $\frac{t-v+c}{g}$: and $p_1=p_2=v-t/2+g\frac{gN-2s}{2\alpha}=\frac{1}{2}t+c$

To summarize,

1. Regime a holds with $s = \min(\theta, gN/2)$
2. For $\theta \leq 3gN/4$, regime b' and c exist.
3. For $\theta \geq 3gN/4$,regime b' and c do not exist, and $a_1 = a_2 = 0$,for any value of cost t.

Working Papers

Laboratoire de Recherche en Gestion & Economie

http://ifs.u-strasbg.fr/large/publications/publications.htm

Université de Strasbourg
Pôle Européen de Gestion et d'Economie
61 avenue de la Forêt Noire
67085 Strasbourg Cedex

http://ifs.unistra.fr/large