BGPE
Bavarian Graduate Program in Economics

BGPE Discussion Paper

No. 55

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June 2008

ISSN 1863-5733

Editor: Prof. Regina T. Riphahn, Ph.D.
Friedrich-Alexander-University Erlangen-Nuremberg

B G P E Discussion Paper Series

The Strategic Effects of Smoking Bans

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April 21, 2008

Abstract

We analyse the welfare effects of a publicly imposed smoking ban in privately owned places like bars. In an economy where households have heterogenous (positive and negative) attitudes towards smoking bans, bars can use the smoking regime choice as a strategic variable. In doing so, bars may endogenously implement a product differentiation. Focusing on the possibility to separate markets, we derive the Nash equilibrium of the decentral economy in a setting in which duopoly bars compete in capacity and choose the smoking regime. We show how the smoking regime choice is a function of the heterogeneity of households. Moreover, we show that the social planer implements the smoking regime obtained in the decentral economy. As such, imposing smoking bans is welfare decreasing in an economy in which bar landlords chose to allow smoking.

Keywords: Smoking Ban, Endogenous Product Differentiation
JEL: L13, I18, D61

1 Introduction

A large fraction of EU memberstates already has or is planning to implement bans on smoking in bars and restaurants, see EU Commission (2007) .[1] These

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[1]Many other OECD countries such as the US or Canada have also implemented bans on smoking in public places, especially bars and pubs.

bans are more or less strict, ranging from the obligation to have a separate non-smoker room to the complete ban of the consumption of tobacco products in pubs. According to a recent poll (Eurobarometer, 2006) more than 60% of all Europeans are in favor of smoking bans in pubs; more than 70% would like to see smoking banned from restaurants.

The exposure to active and passive smoking is a major hazard to health. Smoking increases the risk for lung cancer, stroke and other pulmonary diseases. In fact, the relative risk associated with passive smoking is highest in pubs (see Jarvis, 2001, and EU Comission, 2007). Decreasing the health risks of (especially second-hand) smoking is one of the main arguments which is put forward by the advocates of a smoking ban. The economic effects, positive as well as normative, are less clear.

The primary fear of landlords is that they will experience a large decline in customers in case of a smoking ban. Most of the existing papers which analyse the economic effects of smoking bans, see e.g. the meta-analysis in Scollo et al. (2003) or, more recently, Adams and Cotti (2007), actually focus on the effects on output and employment in the hospitality industry. The consensus view of these studies is that the effect of a smoking ban on bar output/employment is by and large mildly positive.

The analysis mainly highlight the positive economic effects of smoking bans. Despite their importance, we believe that the normative question deserves some closer scrutiny. After all, the widely spread view that smokers exert negative externalities on non-smokers is at least debateable. Arguing along the lines of the Coase Theorem, Boyes and Marlow (1996) empirically substantiate that privately owned businesses for the most part internalize the externalities exerted from smoking customers on non-smokers. In assessing the welfare effects of smoking bans, we add to their analysis the following observation. Although households know about the risk of (passive) smoking and although the majority would like to see smoking banned from pubs, there has been no decentral (market based) solution to this problem. Before public smoking bans have been implemented, the choice of the smoking regime has been a strategic variable of pub landlords. Most of them have chosen to allow smoking. This begs the question whether their choice reflects an optimal situation or whether we have some sort of market failure which justifies the implementation of a public smoking ban.

To analyse this question theoretically, we apply a very stylised model in which households derive utility from going out and consume pub services. Households are heterogenous with respect to their attitude towards smoking bans. A fraction of households (the “non-smokers”) gains from the introduction of a smoking ban in that their utility from going out increases. For the remaining fraction of households (the “smokers”), a smoking ban decreases their (marginal) utility (and vice versa).

Given this demand structure, we derive the equilibrium chosen by two duopoly bars which compete in Cournot fashion for customers and offer an identical bar service. As such, the bars are perfect substitutes as long as both choose the same “smoking regime”. The duopoly landlords, however, have discretion over the choice of whether to allow smoking or not. Thus a smoking ban is an endogenous (and hence strategic) means of differentiating the bar service.[2] The Nash equilibrium of the smoking regime choice depends on the fraction of ”non-smokers” relativ to ”smokers”.

In order to analyse the welfare effects of a public smoking ban, we derive aggregate welfare (given that firms are allowed to choose capacity) and investigate which smoking regime the planer would implement. We find that the planer's choice coincides with the decentral solution. This implies that in a situation in which we observe the smoking regime (as we did in the majority of OECD countries), a public smoking ban unambiguously decreases welfare.

We organize our argument as follows. Section 2 presents the model. We first derive the decentral equilibrium (section 3) and then contrast the outcome with the social planer solution (section 4). Section 5 concludes.

2 The Model

2.1 Households

Consider an economy which is inhabited by a mass of one households. To keep things as simple as possible, we assume that every household k goes out and consumes a fix amount of pub services (drinks, food etc.). Moreover, we assume consumers to be heterogenous with respect to their attitude towards smoking (or smoking bans) in pubs. Some of the households dislike smoking bans whereas others like them or are indifferent. We could argue that this (dis)taste for smoking bans is an expression for the preference for (non)smoking. With this, we assume a utility function which generates the

[2] This is closely akin to Mussa and Rosen's (1978) notion of pricing quality-differentiated goods of the same generic type when customers attach different valuations to specific attributes of the good.

following marginal willingness to pay (for the pub service).[3]

$$q + (2\theta - 1)c_k, \tag{2.1}$$

where q denotes the marginal utility gain from consuming the (fixed amount) of pub service; θ indicates whether the pub allows smoking ($\theta = 1$) or not ($\theta = 0$) and c_k denotes the additional marginal (dis)utility derived from the smoking regime (depending on the type of household).

We assume the (non)smoking indicator c_k to be uniformly distributed over households, where we denote the lower bound of the distribution by $-A$ and the upper bound by B.[4] Thus, the household with $c_k = A$ is the one that values smoking in the pub most whereas at the same time (which is due to symmetry reasons) it is also the one who dislikes a smoking ban most.

Using the marginal willingness to pay and assuming a price p that a household has to pay for the consumption of bar services, we can derive the demand function. That is, the number of customers in the case of smoking bans ($\theta = 0$) is

$$n = \frac{q - p + A}{A + B}, \tag{2.2}$$

while in the situation in which $\theta = 1$, i.e. pubs allow smoking,

$$n = \frac{q - p + B}{A + B}. \tag{2.3}$$

Note that the only difference between the demand functions in the two smoking regimes is that they shift upwards (or downwards) depending on the attitudes towards smoking at the boundary points of the distribution, i.e. depending on the number of "smokers" and "non-smokers". The slope of the demand function remains unchanged.[5] This property is especially important for the pricing strategy of bars.

[3] This modelling is inspired by Katz and Shapiro (1985) .

[4] We could alternatively assume some other functional form for the distribution of the (non)smoking indicator. However, the uniform distribution generates linear demand functions which are easy to handle plus the additional insight from more general functional forms would not be too large.

[5] This is due to the assumption of the uniform distribution of the attitudes towards smoking. Different distributional assumptions may also yield different slopes of the demand curves in the different regimes.

2.2 Firms/Pubs

The (fixed) bar service which is consumed by the households is supplied by two bars. We assume these bars to make two choices. At the first stage they choose which smoking regime to implement (i.e. whether to allow or forbid smoking). At the second stage, the bars make a capacity choice and choose how many customers/households they are going to serve. Note that the choice concerning the smoking regime at the first stage is crucial for the strategic environment that both pubs face. If both choose the same regime, they end up in Cournot competition whereas when each bar chooses a different regime, both bar can act as “monopolists”. The monopoly behaviour, however, is restricted to a part of households.

For simplicity, we assume that the (variable) cost of producing the bar service is zero.

3 Decentral Equilibrium

We derive for the equilibrium smoking regime and output choice of the two bars by backward induction. Hence, we firstly solve for the equilibrium bar capacity given the smoking regime choice and secondly for the smoking regime.

3.1 Capacity Choice

$\theta_i = \theta_j = 0$. In the regime in which both firms forbid smoking, the profit of firm i reads

$$\Pi_i = pn_i = (A + q - (n_i + n_j)(A + B))n_i, \tag{3.1}$$

where we took advantage of the fact that the bars produce a homogenous good, at least as long as the smoking regime is the same, and that $n = n_i + n_j$. With this, the reaction curves are given by

$$n_i = \frac{A + q}{2(A + B)} - 0.5n_j. \tag{3.2}$$

Equilibrium capacity and equilibrium profits are symmetric between the duopolists,

$$n_i = \frac{1}{3}\frac{A+q}{A+B} \tag{3.3}$$

$$\Pi_i(\theta_i = \theta_j = 0) = \frac{1}{9}\frac{(A+q)^2}{A+B}. \tag{3.4}$$

$\theta_i = \theta_j = 1$. The profit function in the smoking regime is

$$\Pi_i = pn_i = (B + q - (n_i + n_j)(A+B))n_i, \tag{3.5}$$

which yields reaction curves of the form

$$n_i = \frac{B+q}{2(A+B)} - 0.5n_j. \tag{3.6}$$

Equilibrium capacity and profits in this case are given by:

$$n_i = \frac{1}{3}\frac{B+q}{A+B}, \tag{3.7}$$

$$\Pi_i(\theta_i = \theta_j = 1) = \frac{1}{9}\frac{(B+q)^2}{A+B}. \tag{3.8}$$

Note that the equilibrium profit under this regime is larger than the profit in the smoker regime if $B > A$, hence if the maximum additional utility of a smoker is larger than the maximum additional disutility.

$\theta_i = 0$, $\theta_j = 1$. In this situation both bars do not engage in oligopolistic competition, but both can act as monopolists (on their part of the demand curve). As such, the price of bar services need not to be the same since arbitrage is not possible. Both bars sell different products (i.e. varieties of the same generic type).

The profit function of firm i is

$$\Pi_i = p_i n_i = (A + q - n_i(A+B))n_i. \tag{3.9}$$

Although the non-smoking regime bar is monopolist, it has to take into account that implicitly its market size (the demand function) is affected by the capacity and price regime choice of the other bar. Thus, the bar has to take the implicit quantity restriction $n_i + n_j \leq 1$ into account. Thus, depending on the rival bar choice it is restricted in its optimization. The first-order-conditions for the problem of the bar read:

$$(A + q - n_i(A + B)) - n_i(A + B) - \lambda_i = 0 \quad (3.10)$$

$$\lambda_i(n_i + n_j - 1) = 0, \quad (3.11)$$

where λ denotes the Lagrange multiplier. With this we can distinguish two situations. With a non-binding restriction, we find the “usual” monopoly result with $n_i = 0.5\frac{A+q}{A+B}$. In the binding case it is obvious that the bar will only serve its residual demand.

The maximization problem of bar j is analogous to that of bar i. The profit function reads

$$\Pi_j = p_j n_j = (B + q - n_j(A + B))n_j. \quad (3.12)$$

The first order conditions for bar j are:

$$(B + q - n_j(A + B)) - n_j(A + B) - \lambda_j = 0, \quad (3.13)$$

$$\lambda_j(n_i + n_j - 1) = 0, \quad (3.14)$$

which again imply that either the bar acts as a monopolist with $n_j = 0.5\frac{B+q}{A+B}$ or serves the residual demand.

The equilibrium in the case in which both firms have opposing smoking regimes depends on the common marginal utility of households from consuming pub services. If $q \leqslant 0.5(A+B)$ every bar can act as a monopolist. In the opposite case, the equilibrium capacity of every bar (and hence its profit) is indetermined. In this situation equilibrium output of firm i and j are:

$$n_i \in [0.5\frac{A + q}{A + B}; 1 - 0.5\frac{B + q}{A + B}] \quad (3.15)$$

$$n_j \in [0.5\frac{B + q}{A + B}; 1 - 0.5\frac{A + q}{A + B}] \quad (3.16)$$

Figure 1 depicts the equilibrium for situations in which we observe an ”interior” solution (the dotted lines), i.e. both bars can act as monopolists and for which there is a range of equilibria.

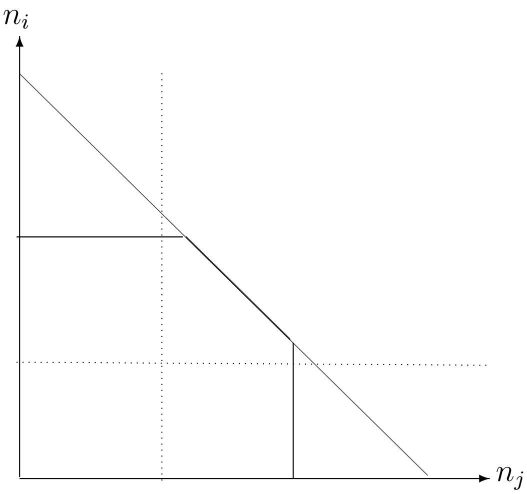

Figure 1: Reaction Curves in the case of $\theta_i \neq \theta_j$

3.2 Smoking Regime

At the first stage of the game, both bars choose simultaneously which smoking regime they are going to implement, anticipating the outcome of the capacity game at the second stage. To solve for the optimal regime choice, we hence have to compare profits in the different situations. When choosing the smoking regime, firm i faces the trade-off between choosing the same regime as firm j and engaging in cournot competition or becoming a monopolist. However, being the monopolist is obviously only advantageous if the market is sufficiently large.

Consider the regime choice of firm i (obviously the regime choice is symmetric for firm j). If firm j has chosen to forbid smoking ($\theta_j = 0$), firm i will also choose to forbid smoking if $\frac{A}{q} > 0.5 + 1.5\frac{B}{q}$. In this case the value of non-smoking (in utility units of going out) is larger than the value of smoking. Thus, being the monopolist in a small market is less attractive than engaging in Cournot competition in the larger non-smoking market.

Note, however, that the opposite is not necessarily true. This is due to the fact that firm i may not realise the monopoly profit since the (aggregate) market is too small, i.e. the households are too homogenous. With enough heterogeneity, however ($A + B > 2q$, which we assume to hold), the firm will implement the smoking regime if $\frac{A}{q} < 0.5 + 1.5\frac{B}{q}$.

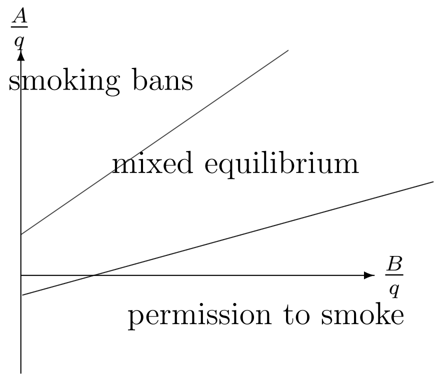

Figure 2: A taxonomy of equilibria

Similar reasoning applies to the situation in which firm j has chosen to allow smoking. In this situation firm i will also choose the smoking regime if $\frac{A}{q} < \frac{2}{3}\frac{B}{q} - \frac{1}{3}$. In this case, the value of non-smoking among households is large. Considering again the situation in which heterogeneity is large, firm i will choose a smoking ban if $\frac{A}{q} > \frac{2}{3}\frac{B}{q} - \frac{1}{3}$.

With the market large enough, these two inequalities divide the parameter space such that we can derive unique Nash equilibria for the smoking regime choice. If $\frac{A}{q} > 0.5 + 1.5\frac{B}{q} > \frac{2}{3}\frac{B}{q} - \frac{1}{3}$ holds, firm i will impose a smoking ban independent of the smoking regime choice of the other bar. Hence, in a situation in which the additional value of a smoking ban for the household who values smoking bans most is large, both bars will choose to forbid smoking.

The opposite is true if $\frac{A}{q} < \frac{2}{3}\frac{B}{q} - \frac{1}{3} < 0.5 + 1.5\frac{B}{q}$. In this case the additional value of smoking bans is very low. Thus, the number of households who prefer smoking is large and so is the market for smoking. Both bars will choose to allow smoking.

Eventually, there are intermediate ranges of $\frac{A}{q}$ for which one bar implements a smoking regime whereas the other chooses to ban smoking. Which bar chooses which strategy is, however, indetermined (due to the mixed strategy equilibrium).

Figure 2 depicts the division of the parameter space for which the three different equilibria hold. Obviously, it is important by which factor the marginal utility of the individual who (dis)likes smoking the most, increases (decreases). This is due to the fact that implicitly the size of the market (the number of households that who are willing to go out) is determined by the parameter of the distribution of preferences. A large maximum additional utility of non-smoking implies a large fraction of household who prefer non-smoking bars over smoking bars and vice versa. As such, implementing a (non-)smoking regime generates a large demand. As long as the market is large enough, acting as duopolist is more attractive than monopolistically serving the "niche" demand.

4 Central Equilibrium

The public policy in most OECD countries over the last five years or so has aimed at implementing smoking bans for pubs and restaurants. Before these smoking bans came into effect, we have observed situations in which smoking was allowed in basically all pubs and bars (at least in Europe) although bar owners could have implemented smoking bans themselves. In light of the model, we conclude that households in these economies only gain a low maximum marginal utility from a privately imposed smoking ban (at least compared to its marginal "costs").[6]

Given this reasoning, two interesting question arise. First, what are the welfare effects of smoking bans if parameters are such that the decentral equilibrium gives rise to smoking regimes? Second (and more important), what is the optimal policy that a social planer should implement?

Aggregate welfare in the economy consist of the utility of consumers who participate in the market, go out and consume pub services. Additionally, the profit of the firms have to be taken into account. In the situation in which $\theta_i = \theta_j = 0$, welfare is hence given by

$$W(\theta_i = \theta_j = 0) = \underbrace{(A - 1/3(A+q))2/3\frac{A+q}{A+B}}_{\text{Consumer Surplus}} + \underbrace{\frac{2}{9}\frac{(A+q)^2}{A+B}}_{\text{Aggregate Profit}}, \qquad (4.1)$$

[6]Since we are not aware of large scale protests by household for a public smoking ban in pubs, we think it is save to conclude that bar owners have been anticipated the preference distribution correctly.

whereas when both bars choose the smoking regime, welfare is

$$W(\theta_i = \theta_j = 1) = \underbrace{(B - 1/3(B+q))2/3\frac{B+q}{A+B}}_{\text{Consumer Surplus}} + \underbrace{\frac{2}{9}\frac{(B+q)^2}{A+B}}_{\text{Aggregate Profit}} . \tag{4.2}$$

Eventually, in the situation of a mixed smoking regime, welfare is given by:

$$\begin{aligned} W(\theta_i = 0, \theta_j = 1) = \\ \underbrace{(A+q-1/2(A+q))1/2\frac{A+q}{A+B} + (B+q-1/2(B+q))1/2\frac{B+q}{A+B}}_{\text{Consumer Surplus}} \\ + \underbrace{1/4\frac{(A+q)^2}{A+B} + 1/4\frac{(B+q)^2}{A+B}}_{\text{Aggregate Profit}} . \end{aligned} \tag{4.3}$$

Using these welfare measures, we are able to rank the equilibria in the economy. The ranking is, obviously, a function of the number of individuals with a positive (negative) attitude towards (non-)smoking. If $\frac{A}{q} > \frac{B}{q}$, i.e. the fraction of non-smokers is very large, $W(\theta_i = \theta_j = 0) > W(\theta_i = \theta_j = 1)$. If, however, this fraction is not large enough $\frac{A}{q} < 1.5\frac{B}{q} + 1/3$, welfare in the mixed equilibrium is larger than under the non-smoking regime. Accordingly, if $\frac{A}{q} > 2/3\frac{B}{q} - 1/3$, welfare in the mixed equilibrium exceeds that of the smoking regime. Hence, the welfare ranking of the equilibria replicates the choices in the decentral economy. As such, imposing a smoking ban in an economy that was characterised by restaurants and pubs in which smoking was (at least partly) allowed results in a welfare loss. Moreover, the social planer prefers mixed regimes in all situations in which the attitude towards smoking bans in the economy is not too heterogeneous.

5 Conclusion

This paper analyses the strategic effects of an additional characteristic of the service provided by a pub, namely whether smoking is allowed or banned. In an economy in which the (positive or negative) attitude towards smoking is uniformly distributed over households, pubs compete for the number of guests in a Cournot fashion. Additionally to choosing their optimal capacity, pubs also decide over which smoking regime to implement. We derive the

Nash equilibrium for this decision and show how the smoking regime in the economy is driven by the relation between the number of households who have a positive and a negative attitude towards smoking. If this heterogeneity is not too large, we observe a "mixed" smoking regime, i.e. a situation where one bar allows smoking while the other bar bans smoking.

Eventually, we contrast the decentral outcome with the smoking regime choice of a social planer who is only confined to choose quantities. We show that again depending on the heterogeneity in the economy, the planer would either completely ban smoking, allow smoking or opt for a mixed regime. Importantly, however, the choice of the planer coincides with the decentral choice of the duopolists. As such, implementing a smoking ban in an economy that was characterised by a smoking regime before the government intervention (as in most, if not all, OECD countries) unambiguously decreases welfare.

Highlighting the strategic incentives for bar owners in the abscence of a publicly imposed smoking ban, we have presented a very stylised model. A variety of undoubtedly important features such as externalities from smoking, network mechanisms, and framing due to various exceptions in the laws against smoking, have not been considered. Similarly, we have neglected differences in bar size, and thus a priori ignored the wisdom that small bars suffer from smoking bans, while large bars gain. Our framework can serve as point of departure to address these questions. In view of the accumulating data following the popularity of smoking bans, rigorous econometric research is feasible to test the theoretical predictions. We leave this for future research.

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	θ_i	
θ_j	0	1
0	$\Pi_i = \Pi_j = \frac{1}{9}\frac{(A+q)^2}{A+B}$	$\Pi_i \in [\frac{1}{4}\frac{(B+q)^2}{A+B};$ $\frac{qB+0.5(A-q)q-0.5B(A-q)}{A+B} - \frac{1}{4}\frac{(A+q)^2}{A+B}];$ $\Pi_j \in [\frac{1}{4}\frac{(A+q)^2}{A+B};$ $\frac{qA+0.5(B-q)q-0.5A(B-q)}{A+B} - \frac{1}{4}\frac{(B+q)^2}{A+B}]$
1	$\Pi_i \in [\frac{1}{4}\frac{(A+q)^2}{A+B};$ $\frac{qA+0.5(B-q)q-0.5A(B-q)}{A+B} - \frac{1}{4}\frac{(B+q)^2}{A+B}];$ $\Pi_j \in [\frac{1}{4}\frac{(B+q)^2}{A+B};$ $\frac{qB+0.5(A-q)q-0.5B(A-q)}{A+B} - \frac{1}{4}\frac{(A+q)^2}{A+B}]$	$\Pi_i = \Pi_j = \frac{1}{9}\frac{(B+q)^2}{A+B}$

Table 1: Payoff Matrix