SMOKING AND SOCIAL INTERACTION

PANU POUTVAARA
LARS-H. R. SIEMERS

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Abstract

We study the social interaction of non-smokers and smokers as a sequential game, incorporating insights from social psychology and experimental economics into an economic model. Social norms affect human behavior such that non-smokers do not ask smokers to stop smoking and stay with them, even though disutility from smoking exceeds utility from social interaction. Overall, smoking is unduly often accepted when accommodating smoking is the social norm. The introduction of smoking and non-smoking areas does not overcome this specific inefficiency. We conclude that smoking bans may represent a required (second-best) policy.

JEL Code: I18, D01, D11.

Keywords: smoking policy, social norms, guilt aversion, deviant behavior, social interaction.

Panu Poutvaara
Department of Economics
University of Helsinki
Arkadiankatu 7
00014 Helsinki
Finland
panu.poutvaara@helsinki.fi

Lars-H. R. Siemers
RWI Essen
Hohenzollernstr. 1 – 3
45128 Essen
Germany
siemers@rwi-essen.de

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1 Introduction

Active smoking causes health problems and often advanced death.[1] Second-hand smoking is less but still significantly dangerous.[2] Hence, active smokers exert a dangerous, negative externality on non-smokers whenever they smoke and socially interact with non-smokers. Correspondingly, tobacco and smoking policies have become stricter in recent years in several countries in Europe and in parts of the U.S.A.[3] The major aim of these regulations is to prevent involuntary passive smoking.

Passive smoking typically occurs in situations in which smokers and non-smokers socially interact, for instance at work, in pubs or in restaurants. We often observe the behavior that non-smokers hesitate to complain and agonize smoking, although they—including the potential utility gain from being together—would prefer not being trapped in interaction with smokers who smoke in their presence. This may appear paradoxical. However, it is fully in line with the revealed preferences once taking into account social norms. We analyze the social interaction between smokers and non-smokers as a sequential game. Beside the utility of smoking and the disutility of second-hand smoke, individuals care about behaving in line with social norms. Our model explains the observed behavior of hesitating to complain by a weak level of strategic bargaining power, determined by social norms. Social norms cause that non-smokers and smokers are often trapped in social interaction so that smoking is unduly often accepted—inefficiency arises. Therefore, in our scenario, a social norm is harmful to welfare. We show that the introduction of non-smoking areas is not sufficient to cope with this specific inefficiency. Strict smoking bans are only a second-best policy, but appear to be required in areas where smokers and non-smokers socially interact. Therefore, our findings provide support for the strict smoking

[1]Smoking is a documented risk factor, e.g. for cancer. The risk is increased when alcohol is consumed additionally (Chowdhury and Rayford, 2001; DKFZ, 2005a; Li, 2001; Partanen *et al.*, 1997; Schuller *et al.*, 2002; Silverman *et al.*, 1995).

[2]DKFZ (2002), IARC (2004), or Gruber (2001: 203-204). Smoking-related illness was identified to be the leading preventable cause of death in the United States (McGinnis and Foege, 1993: 14).

[3]The World Health Organization (WHO) even follows a policy on non-recruitment of smokers (`http://www.who.int/employment/recruitment/en/index.html`).

policies followed by several countries in recent years.

Theoretical research on smoking so far has focussed on addictive behavior (Spinnewyn, 1981; Becker and Murphy, 1988; Chaloupka, 1991; Orphanides and Zervos, 1995, 1998; Becker and Mulligan, 1997; O'Donoghue and Rabin, 1999; Suranovic *et al.*, 1999; Laux, 2000; Gruber and Köszegi, 2001). Gruber (2001) provides an excellent review of the theoretical work and the evidence on tobacco regulation. The behavior of smokers is, among other things, influenced by social and psychological aspects. For instance, advices of members of the smoker's family influence the smoking behavior (Hammar and Carlsson, 2005), and smoking regulations can help smokers as a self-control device (Gruber and Mullainathan, 2002). In Bernheim and Rangel (2004), behavior can be triggered by environmental cues that can set individuals in a "preference mode", in which an addictive substance is always consumed, irrespective of underlying preferences.

Our paper is also related to the research on social conformity and customs (Akerlof, 1980; Bernheim, 1994). Similar to these models, we extend the standard model, in which utility is derived directly from consumption, to indirect social determinants. In contrast to Bernheim, in whose model individuals additionally care about status, we include the will to behave in line with social norms and customs, which is related to Akerlof's idea of a code of behavior. Moreover, our paper is related to the article of Charness and Dufwenberg (2006) on "guilt aversion," in which individuals suffer utility losses when they do not meet the expectations of other individuals. The guilt-aversion mechanism is closely related to Hammar and Carlsson (2005), above. Related to Charness and Dufwenberg, Miettinen (2006) suggests an approach where agents feel bad about breaching social norms. While Charness and Dufwenberg (2006) and Miettinen (2006) identify cases in which social norms allow reaching a superior outcome, we highlight that social norms of politeness may also result in inefficiency and call for policy intervention in form of smoking bans. An interesting discussion of social norms is provided by Elster (1989).

2 Insights from social psychology

In social psychology, a major research field investigates the impact of social norms on the behavior of individuals (e.g. Aronson et al., 2004; Zimbardo and Gerrig, 1999). Social influence arises from confrontation with opinions or evaluations of the majority of society or of the own group, which constitute social norms (van Avermaet, 2002: 412). Social psychologists distinguish two channels via which social impacts may work: (a) normative aspects that cause adopting norms of other people for being respected, and (b) informative aspects that are followed to behave "correctly" (Zimbardo and Gerrig, 1999: 412). Erb and Bohner (2002) emphasize that many different experiments have proved that individuals as members of a social group often show a behavior of conformity. Levine (1989) found that individuals expect negative evaluations when they do not behave conformable to social norms, and that deviance is sanctioned. According to Turner (1991), missing consensus generates uncertainty, and thus causes subjective costs. Hence, there exists a subjective strategy to reduce interpersonal conflict (Moscovici, 1985) and the will not to behave deviantly in order to maintain social stability. But the wish to be accepted by majority may often only cause *public* conformity with social norms ("compliance"), without a change of private attitude ("conversion"). Therefore, we observe the change in behavior only in social interaction (Erb and Bohner, 2002). An instance is the individual decision to wait in line. If there is already a line where other people wait, most people will probably also line up, even though they might not do so if there would be only two or three other persons that are waiting.

The idea that departures from social norms impair the individual reputation or status or entail other forms of social punishment is also a central building block in Akerlof (1980), Bernheim (1994), Charness and Dufwenberg (2006), and Miettinen (2006). We believe that such social and psychological aspects are also crucial for the behavior of smokers and non-smokers when they socially interact. We argue that individual behavior is influenced by whether an action is in line with social norms and conventions or not. This extension generates an adjustment in the distribution of bargaining power, so that people may actually behave in their own best interest when hesitating in asking for stopping smoking, though seemingly suffering a net utility loss.

To our knowledge, no author so far has addressed and explained the behavior of non-smokers in the social interaction with smokers. In the literature on smoking and in the smoking debate, the role of social interaction and the consequences of social norms have been completely neglected. We shed some light on this behavioral and health issue, and deduce corresponding policy implications.

3 Model

For simplicity, we consider the social interaction of one smoker, player S, and one non-smoker, player N; the players are indexed by $i = \{S, N\}$. The smoker obtains utility of $B > 0$ by smoking; potential utility losses in the case of addiction when she/he does not smoke represent saved opportunity costs and increase B. That is, variable B is the net benefit from smoking. The smoker's utility when she/he is alone and does not smoke is normalized to zero. The non-smoker, in turn, suffers a utility loss of size $E > 0$ by second-hand smoking; utility loss E (external effect) also involves the subjective perception of the danger of second-hand smoking. Moreover, both players might enjoy being together and receive utility of size $T_i > 0$, $i = \{S, N\}$, from this social interaction.

So far, our model is standard. We now additionally assume that within society, or in the narrow environment of social interaction, there exists a *social norm* or standard behavior that determines whether or not smoking is generally accepted: We hypothesize that if accommodating smoking is the social norm, then social interaction happens at a location where smoking is accepted in general, and the non-smoker has to ask the smoker not to smoke. Hence, our model has to take into account the findings of the theories on social impacts and guilt aversion: If accommodating smoking is the norm, we assume that the non-smoker will suffer a utility loss of size $A_N > 0$ from asking for not smoking; because asking for not smoking is uncommon, it potentially starts a conflict, and it may be considered as a deviant behavior that may cause a feeling of guilt. Similarly, if accommodating smoking is not standard, the smoker will have to ask for permission to smoke, which costs her/him utility of size $A_S > 0$.

3.1 When accommodating smoking is the social norm

Suppose the two players sit in a pub or restaurant, or the like. If accommodating smoking is the norm the smoker will not ask for permission to smoke and smokes whenever she/he wants to.[4] Therefore, the two play the following sequential game:

Game 1:

Stage 1 The smoker decides to stay and smoke, to stay and not to smoke, or to leave. If the smoker does not smoke both stay in the room together, if the smoker goes she/he smokes alone. In both cases the game ends.

Stage 2 If the smoker chooses to stay and smoke, the non-smoker decides whether she/he goes away, asks the smoker to stop smoking, or accepts smoking. If she/he accepts smoking, the game ends and both stay together; if the non-smoker directly goes away, the game ends as well.

Stage 3 If the non-smoker asks for stopping smoking, the smoker decides to stay and stop smoking, to stay and continue smoking, or to leave. If the smoker stops smoking, both stay together. If the smoker goes away she/he smokes alone. In both cases the game ends.

Stage 4 If the smoker continues smoking, the non-smoker decides whether to accept smoking or to go. If the non-smoker accepts they will stay together, otherwise she/he has to leave. The game ends.

The game is illustrated by the game tree in Figure 1; one can also find the payoffs P_j, $j = \{1, 2, \ldots, 8\}$, there. Notice that the possibility of going away at every stage represents an exit option. We assume that there also exists a social norm that determines that going away is considered as a rude step. Breaking it generates a (strong) feeling of guilt and therefore involves, for the one leaving, a loss of utility of L_i. In the following we assume

[4] The same holds if it is a social norm of politeness that non-smokers do not object if a smoker asks for a permission to smoke.

$L_i > A_i$, for $i = \{S, N\}$. Whenever the smoker chooses not to smoke, the non-smoker chooses to accept smoking, or one of the players goes, the game ends. We assume that both players exactly observe the actions of the other player (perfect information). We also assume that both players know each other's type and payoff function (complete information), for simplicity.[5] The social interaction between the players during the game does not take so much time that we would have to discount the payoffs correspondingly. Moreover, for simplicity, we introduce the following tie-breaking rule: if a player is indifferent between two actions, the player chooses that action that results in being together, that is, for instance, the smoker is then willing not to smoke. We solve the game by backwards-induction and obtain:[6]

Proposition 1. *Depending on parameter constellation, Game 1 possesses the following subgame-perfect Nash equilibria:*

(a) If $T_N \geq E - L_N$, the unique subgame-perfect Nash equilibrium is described by the sequence of actions[7] (smoke, accept) and payoff[8] $P_4 = (B + T_S, T_N - E)$.

(b) If $T_N < E - L_N$ and

- *(i) $B > T_S$, the unique subgame-perfect Nash equilibrium is described by the sequence of actions (smoke, go) and payoff $P_3 = (B, -L_N)$.*
- *(ii) $B \leq T_S$, there exist two subgame-perfect Nash equilibria. One equilibrium is described by the sequence of actions (smoke, ask, stop smoking) and payoff $P_6 = (T_S, T_N - A_N)$, another by (do not smoke) and $P_2 = (T_S, T_N)$.*

[5] Allowing for uncertainty would only have the consequence that we have to deal with expected payoffs, and not provide any additional insight.

[6] Note that there may exist further Nash equilibria, but the only subgame-perfect Nash equilibria are the equilibria associated with the backwards-induction outcome (Gibbons, 1992: 59).

[7] The first entry is the equilibrium choice of the smoker at stage 1, the second the of the non-smoker at stage 2, the third would be the optimal choice of the smoker at stage 3, and so on: (stage 1, stage 2, stage 3, ...).

[8] The first term in parentheses represents the payoff of the smoker and the second the payoff of the non-smoker.

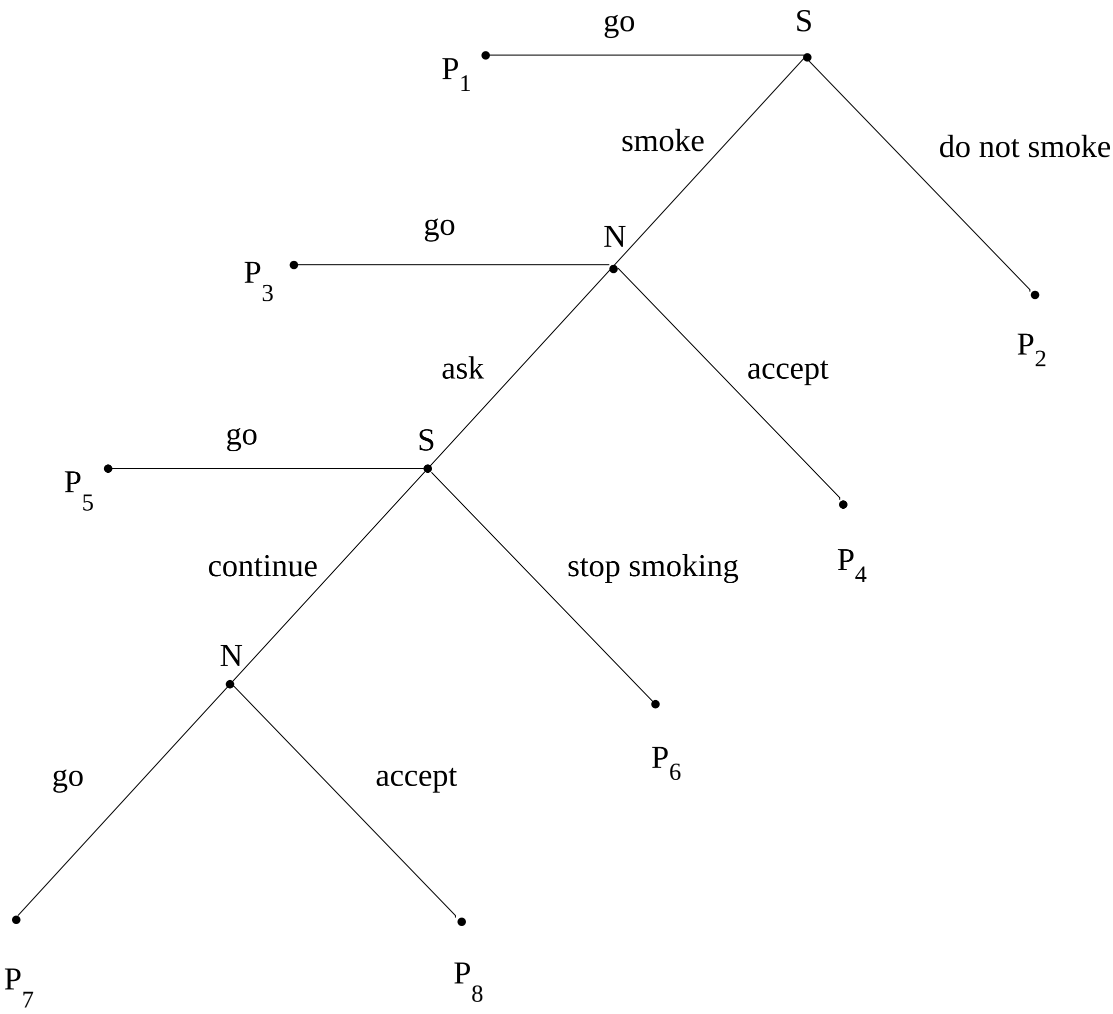

Figure 1: Game tree of Game 1 where accommodating smoking is the social norm and payoffs are given by $P_1 = (B - L_S, 0)$, $P_2 = (T_S, T_N)$, $P_3 = (B, -L_N)$, $P_4 = (B + T_S, T_N - E)$, $P_5 = (B - L_S, -A_N)$, $P_6 = (T_S, T_N - A_N)$, $P_7 = (B, -A_N - L_N)$, and $P_8 = (B + T_S, T_N - A_N - E)$.

Proof: See appendix.

In case (a), the non-smoker's preferences are such that she/he prefers being together suffering second-hand smoke to leaving and being without the smoker: if the non-smoker values the smoker's company plus the costs of being "impolite" by leaving higher than the danger of second-hand smoking, E, the outcome will always be that the smoker smokes and the non-smoker accepts this. The smoker knows that the non-smoker's threat of leaving would not be credible, and hence the smoker will not stop smoking if asked for, which the non-smoker knows, in turn: there is no point in asking the smoker to stop smoking. Thus $T_N + L_N \geq E$ is a necessary and sufficient condition for smoking being accepted.

However, in the contrary case, the non-smoker's threat of leaving is credible. Now the smoker must consider whether she/he prefers being together with the non-smoker renouncing smoking (case $(b)(ii)$) or smoking alone (case $(b)(i)$). If the smoker prefers the latter alternative ($B > T_S$) she/he will smoke at stage 1 knowing that the non-smoker will immediately go. The smoker will not go at stage 1, because then she/he would behave impolitely, and the non-smoker will not ask the smoker to stop smoking because she/he knows that she/he will have to leave, anyway. If the smoker prefers being together with the non-smoker, it is clear that knowing that the non-smoker might leave, the smoker decides not to smoke. However, because the smoker knows that the non-smoker prefers asking her/him to stop smoking—compared to directly going away—(case $(b)(ii)$), the smoker might also prefer that the non-smoker first asks for stopping smoking before she/he stops smoking.

Notice that the smoker will never go away, since the norm "allows" to smoke, while non-smokers might have to leave the pub (case $(b)(i)$) or suffer smoking. Part (a) of the proposition tells us that a non-smoker will accept smoking even though her/his subjective perception of the danger of second-hand smoking, expressed by E, is higher than her/his utility from being together, i.e. $T_N < E$. This seemingly paradoxical behavior occurs because smoking is not considered as impolite and asking for stopping smoking involves social costs due to the social norm. The social norm thus reduces the non-smoker's bargaining power in our game, and the non-smoker hesitates to ask.[9] Normally we would argue that the non-smoker should just leave if $T_N < E$. But going away is a step that is considered as impolite, whereby the non-smoker hesitates to leave. The smoker, in turn, has no reason to regard her/his behavior as impolite, because she/he acts in line with the social norm. Without the social norm that accommodating smoking is standard, asking for stopping smoking would not involve any costs ($A_N = 0$): condition $T_N - A_N \geq -L_N$ was

[9] Our concept of bargaining power is similar to the *Best Alternative To a Negotiated Agreement* (BATNA) (cf. e.g. Korobkin, 2004; Spangler, 2003; Breslin and Rubin, 1991; Fisher *et al.*, 1992): the smoker can stay and smoke, the non-smoker can only go away.

more often fulfilled, so that the smoker would more often decide not to smoke. Moreover, without the social norm that going away is impolite—that is, when $L_N = 0$—smoking would be less often accepted, since condition $T_N \geq E - L_N$ was less often fulfilled; especially the behavior that non-smokers accept smoking though their perception is $T_N < E$ would not occur.

3.2 When accommodating smoking is not the social norm

If accommodating smoking is not the social norm, then it is the smoker who has to ask whether she/he may smoke. The two players then play the following three-stage game:

Game 2:

Stage 1 The smoker decides whether to ask for the non-smoker's approval to smoke. If the smoker goes away or does not ask permission to smoke the game will end. In the first case, the smoker smokes without the non-smoker, in the latter they stay together.

Stage 2 If the smoker asks for permission to smoke, the non-smoker decides whether or not to allow smoking. If the non-smoker allows the smoker to smoke, the game ends and both stay together with the smoker smoking. Moreover, the non-smoker has the option to go away, in which case the game ends.

Stage 3 If the non-smoker does not want the smoker to smoke, the smoker decides whether she/he stays or goes. The game ends.

The game is illustrated by the game tree in Figure 2; one can also find the payoff vectors P_j, $j = \{1, 2, \ldots, 6\}$, there. We obtain:

Proposition 2. *Depending on parameter constellation, Game 2 possesses the following subgame-perfect Nash equilibria:*

(a) If $B - L_S \leq T_S$, there exists a unique subgame-perfect Nash equilibrium with the sequence of actions (do not smoke) and payoff vector $P_2 = (T_S, T_N)$.

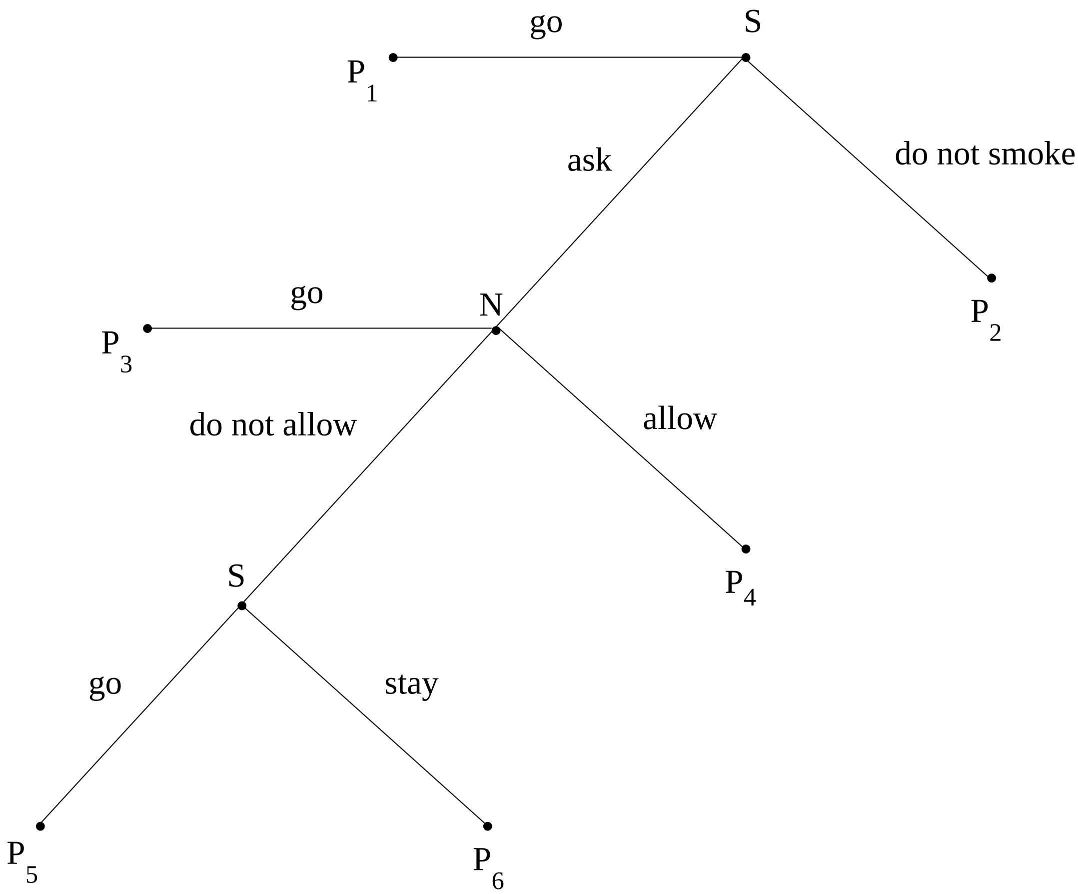

Figure 2: Game tree of Game 2 where accommodating smoking is not the social norm and payoffs are given by $P_1 = (B - L_S, 0)$, $P_2 = (T_S, T_N)$, $P_3 = (B - A_S, -L_N)$, $P_4 = (B + T_S - A_S, T_N - E)$, $P_5 = (B - A_S - L_S, 0)$, and $P_6 = (T_S - A_S, T_N)$.

(b) If $B - L_S > T_S$ *and*

- *(i)* $T_N < E$*, the unique subgame-perfect Nash equilibrium is described by the sequence of actions (go) and payoff vector* $P_1 = (B - L_S, 0)$*;*
- *(ii)* $T_N \geq E$*, the unique subgame-perfect Nash equilibrium is described by the sequence of actions (ask, allow) and payoff vector* $P_4 = (B + T_S - A_S, T_N - E)$*.*

Proof: See appendix.

Three outcomes are possible in the equilibrium: the smoker directly decides not to smoke, directly decides to leave, or asks whether she/he may smoke and the non-smoker allows it. If $T_S \geq B - L_S$ the smoker prefers being together without smoking, compared to the situation where she/he goes away to smoke. Since the non-smoker knows this, the non-smoker will not allow the smoker to smoke, because the threat that the smoker will leave is not credible. Knowing this, in turn, there is no point for asking for being allowed to smoke. Hence, this condition is a necessary and sufficient condition for the outcome "do not smoke". If, to the contrary, $B - L_S > T_S$ holds, the smoker's threat of leaving is credible. Therefore, the non-smoker must reflect whether she/he rather wants to be together with the smoker suffering the smoke than being alone. Knowing the non-smoker's consideration in this regard, the smoker will directly go away when the non-smoker prefers being alone instead of suffering the smoke (case $(b)(i)$); there is no reason for asking for permission, since the request will be refused anyway. However, if $T_N \geq E$, the smoker knows that the non-smoker will not reject her/his request, so that she/he will ask whether she/he may smoke and receive permission to do so (case $(b)(ii)$).

We obtain the reversed image of the case where accommodating smoking is the norm: the non-smoker will never go away, since the social norm of not accommodating smoking strengthens the non-smoker's bargaining power. With $L_S = 0$ inequality $B - L_S \leq T_S$ was fulfilled less often, so that the smoker would smoke more often. Again, since people want to avoid behaving in a way that by the majority of people is considered as impolite (i.e. is against the social norm), now it can happen that the smoker does not smoke even if $B > T_S$, that is, when she/he rather would prefer to smoke instead of not smoking in companion with the non-smoker. One might say that this case is comparable to that where accommodating smoking is the norm. However, smokers produce a dangerous externality, non-smokers do not. Therefore, the two cases differ qualitatively.

4 Policy implications

Second-hand smoke is an instance of a negative externality. Would both players cooperate, the efficient outcome of their private negotiation is deduced from maximizing the sum of both players' payoffs (following the concept of utilitarianism). In this scenario both players have to choose one out of three options: 'being together with smoke,' 'being together without smoke,' or 'not being together and the smoker smokes.' We obtain:

Proposition 3. *If both players cooperate and maximize the sum of their payoffs, the optimal payoffs are given by:*

$$P^* = \begin{cases} (T_S, T_N) & \text{if} \quad E > B \quad \text{and} \quad T_S + T_N > B; \\ (B + T_S, T_N - E) & \text{if} \quad E < B \quad \text{and} \quad E < T_S + T_N; \\ (B, 0) & \text{otherwise.} \end{cases} \tag{1}$$

Proof: See appendix.

In the optimum, the non-smoker only has to suffer second-hand smoke (second line of (1)) if the group as a whole benefits from smoking and from being together more than it loses from the externality of second-hand smoke. If the group benefits from being together more than from smoking and the damage from smoking is higher than its benefits, it is optimal to stay together without smoking. Finally, if for the group as a whole being together neither compensates for the damage of smoking nor bears more utility than smoking, it is optimal to go separate ways, so that the smoker can smoke without aggrieving the non-smoker. Comparing these conditions of social optimum with these of the private game, it becomes clear that the private outcome cannot guarantee socially optimal outcomes.

Obviously, only good friends will do so and achieve the efficient cooperative solution. With (sufficiently) selfish individuals a game is played and the corresponding private arrangements may produce inefficient outcomes. Thus government intervention may be justified. In most countries accommodating smoking at least has been the norm, and in a lot of countries or situations it still is. As a consequence, social interaction would often be accompanied by smoking unduly often. To contain the problem of excessive smoking, politicians have introduced smoking bans at many places all over the world.[10] However, a theoretical scrutiny of alternative instruments is missing.

[10] Australia, Cuba, England, Estonia, Finland, France, Ireland, Italy, Latvia, the Netherlands, Macedonia, Malta, New Zealand, Norway, Scotland, South Africa, Spain, Sweden, Switzerland (Kanton Tessin), Tanzania, Thailand, several states and cities in the United States (e.g. California, New York, Montana and Washington), Wales.

4.1 The introduction of smoking and non-smoking areas

In the context of smoking policy the introduction of separated smoking and non-smoking areas is often discussed. It is argued that the establishment of smoking and no-smoking areas is sufficient to overcome the problem of second-hand smoke. However, this is ultimately not the case. To demonstrate this, we simply reinterpret the games already analyzed in Section 3.

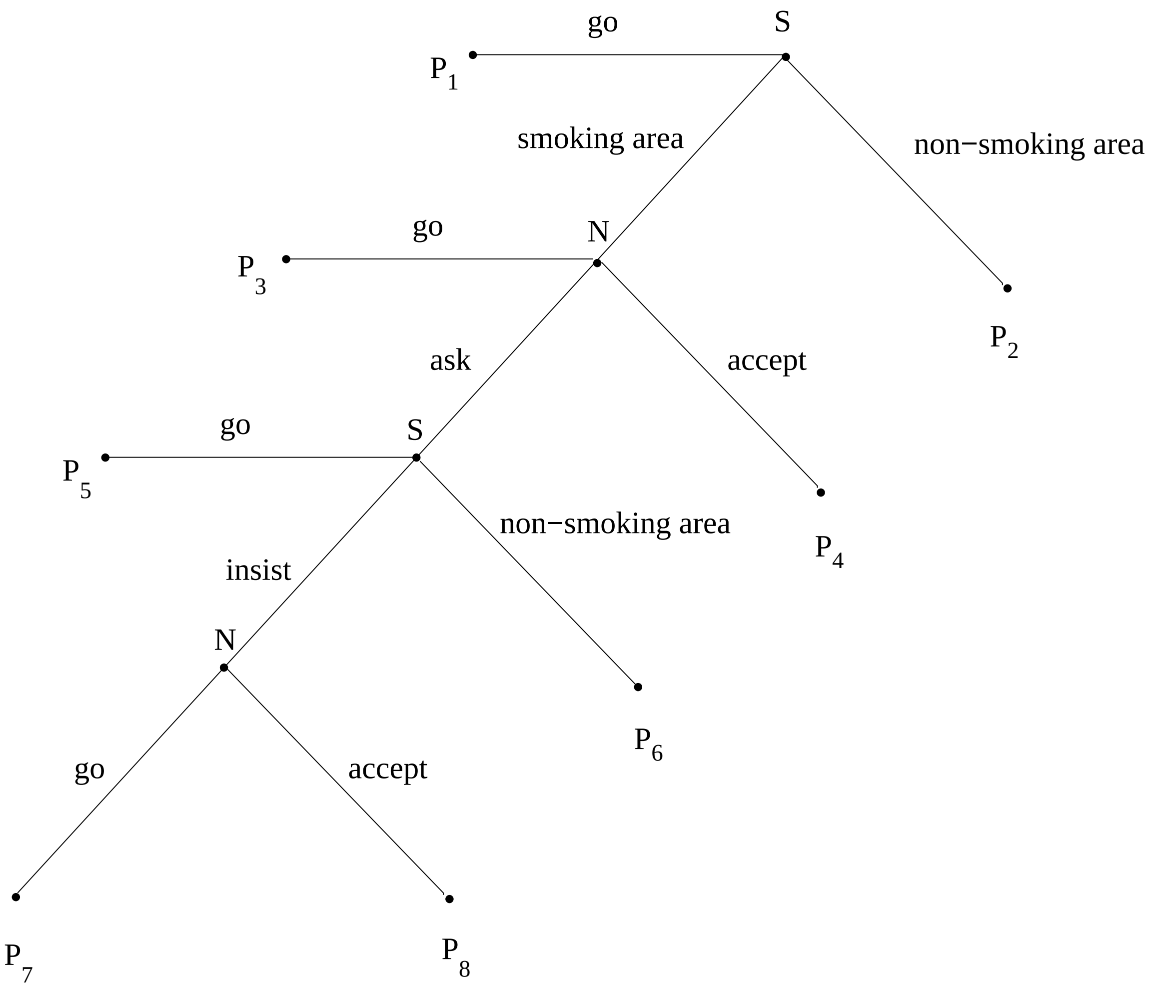

Figure 3: Game tree of Game 1 with relabeled actions when there exist smoking and non-smoking areas; payoffs are again given by $P_1 = (B - L_S, 0)$, $P_2 = (T_S, T_N)$, $P_3 = (B, -L_N)$, $P_4 = (B + T_S, T_N - E)$, $P_5 = (B - L_S, -A_N)$, $P_6 = (T_S, T_N - A_N)$, $P_7 = (B, -A_N - L_N)$, and $P_8 = (B + T_S, T_N - A_N - E)$.

Imagine there are indeed separated smoking and non-smoking areas. The smoker and non-smoker are together and have to decide where to go. If accommodating smoking is the norm, at stage 1 of the game, the smoker can go away, opt for the non-smoking area or for the smoking area. If the smoker goes away or opts for the non-smoking area the game ends. However, if the smoker opts for the smoking area, the non-smoker can go away, accept going to the smoking area, or ask for going to the non-smoking area. If the non-smoker accepts or goes away the game ends, but if the non-smoker asks for going to the non-smoking area, the smoker at stage 3 can go away, accept going to the non-smoking area, or insist on going to the smoking area. If the smoker really insists on going to the smoking area, the non-smoker could accept going to the smoking area, or can go away. Therefore, both players play the same game as analyzed in Section 3, the only difference is that the actions are relabeled (see Figure 3). Analogously, one can reinterpret Game 2. It directly follows that the establishment of smoking and non-smoking areas is *not* sufficient to overcome the identified problem of social norms in the social interaction of the smoker and non-smoker. The introduction of the two areas simply doesn't change the fact that accommodating smoking is or is not the social norm. If demanding going to the non-smoking area is not in line with the norm, it represents a deviant behavior and causes a feeling of guilt which involves costs A_N. The power of the social norm is likely to be weakened by official anti-smoking policy, so that the cost A_N and L_N are lower, but the bias in the distribution of bargaining power remains. Overall, the bargaining power of non-smokers would be strengthened by the introduction of non-smoking areas, but inefficiency may persist as long as the social norm favors smokers.

In the Appendix, we show, too, that one yields qualitatively the same result if the non-smoker moves first (see Lemma 1). Therefore, the establishment of non-smoking and smoking areas is not a tool that solves our problem.[11]

[11]However, designated smoking areas might solve the problem of passive smoking of non-smokers, who are not interacting with smokers.

4.2 Are smoking bans really required?

In many countries it has been decided to enact more or less strict smoking bans in the last couple of years (cf. footnote 10). Smoking bans, however, involve the drawback that they even do not allow smoking when it is efficient. All the efficient outcomes in our model that involve smoking would be excluded. Hence, bans may only represent a second-best solution. The private outcomes, however, rely on the *subjectively* perceived negative effect of second-hand smoke, E, and many individuals presumably still underestimate the hazard of second-hand smoke.[12] The objective, real damage of smoking is probably significantly higher, so that it is unclear how often a socially optimal outcome arises from private action. Be that as it may, a presumably second-best smoking ban should represent only a last resort.

The alternative classical tools are Pigouvian taxes or subsidies, the creation of markets and establishing property rights so that a Coasean solution takes place (Cropper and Oates 1992). The Pigouvian subsidy involves well-known problems, since they generate bad incentives. Taxes, in turn, are widespread and are found to reduce smoking (e.g. Chaloupka, 1991; Hammar and Carlsson, 2005). However, they do not influence the decision of the remaining smokers whether they start smoking in interaction with a non-smoker.[13] Hence they do not solve our problem; in fact, accepting smoking would have to be taxed, or starting smoking in companion of non-smokers, which is not feasible. The Coasean solution, in turn, may also fail to obtain because of the psychological transaction costs associated with asking an individual to refrain from smoking, addressed in this paper. Therefore, external effects in the area of consumption, like the instance of second-hand

[12]There is no doubt that smoking is significantly dangerous for passive smokers (Chowdhury and Rayford, 2001; DKFZ, 2005a, 2002; Gruber, 2001; IARC, 2004; Li, 2001; Partanen *et al.*, 1997; Schuller *et al.*, 2002; Silverman *et al.*, 1995). Passive smoking is linked to higher rates of cancer and heart disease in non-smokers (Evans *et al.*, 1999: 728). It can also cause other health problems like asthma. The number of early deaths caused by second-hand smoke in Germany, for instance, is estimated to amount to 3300 per year (DKFZ, 2005b).

[13]It is open whether excise taxes have a significant effect on the decision to start or quit smoking (Hammar and Carlsson, 2005).

smoke, may have to be solved by bans:[14] limited smoking bans in closed spaces where people socially interact ought to be introduced.[15] An open issue in reference to smoking bans, however, is whether they will be accepted and enforced in practice.

5 Conclusion

The paper is twofold. In the first part, we incorporate insights of social psychology and experimental economics on guilt aversion into a game-theoretic model. We highlight the crucial role of social norms in determining the behavior of smokers and non-smokers in social interaction. Asking for something that is not in line with social norms represents deviant behavior and may cause a feeling of guilt, as experiments in social psychology and economics have proved. If accommodating smoking is the norm, non-smokers will hesitate to ask smokers to stop smoking, since asking is not customary and thus involves utility losses. Additionally, going away is considered as rude and causes a feeling of guilt. Extending the standard model correspondingly, we explain why non-smokers may, in social interaction with smokers, accept smoking even though they would, overall, actually prefer not to be trapped in social interaction with a smoker who smokes. Contrarily, if tolerating smoking is not the social norm, the smoker hesitates to ask whether she/he may smoke. Thus social norms and the will to behave politely determine and distort the distribution of bargaining power among smokers and non-smokers when they socially interact. This

[14] Sohmen (1976, p. 270) emphasizes that solving external effects in consumption is much more difficult than in production, since there prevail traditional patterns of behavior that prevent solutions based on compensations in the Coasean sense. Schelling (1980, pp. 32-33) also emphasizes that an important limitation of solving conflicts via bargaining is absence of a custom of bidding to pay for a particular right. Beyond that, if compensations would actually be paid, everybody would feign externalities involving activities to receive some.

[15] Coase emphasized the reciprocal nature of externalities, namely that avoiding the harm of the non-smoker necessarily inflicts harm to the smoker (Coase, 1960: 2). The question to be decided is: 'Is the value of non-smoker protection and the freedom to live in healthy conditions higher than the loss of utility and freedom on the side of the smokers?' It is likely that a ban generates a Kaldor-Hicks and Scitovsky improvement, since the benefit of non-smoker protection includes the value of a good health and life.

generates, in both cases, a social inefficiency. Since inefficiently much smoking involves inefficiently high risk of health damage and of death, while inefficiently low incidence of smoking solely involves decreased pleasure from smoking, the former case appears more severe. A typical instance for the problem is the case of teenagers in schools.[16] A child would rarely ask smoking classmates to stop smoking because the social costs of doing so—namely being considered as very "uncool"—are significantly high.

In the second part, we embed our results in a smoking policy debate. We show that the introduction of smoking and non-smoking areas does not suffice to overcome the distortion of bargaining power generated by social norms. Without a well-founded welfare analysis, enriched by empirical facts, we cannot provide definite policy implications from within our model. However, we argue that social norms produce transaction cost and render Coasean bargaining inefficient, so that all methods but smoking bans turn out to be inadequate.[17] Accordingly, we suggest smoking bans in all closed spaces where smokers and non-smokers socially interact, for instance in restaurants, pubs, bars and cafés—though bans represent only a second-best instrument. Our model especially suggests introducing smoking bans at places where the identified social transaction costs caused by social norms are substantially high, for instance, at schools where the social pressure among teenagers is massive. Hence our analysis supports corresponding policies already implemented all over the world. In addition, models of limited self-control and weak will (O'Donoghue and Rabin, 1999; Suranovic *et al.*, 1999) suggest that smoking bans support many smokers who want to give up smoking anyway. This conclusion is especially in line with the results of Gruber and Mullainathan (2002) who find that taxation of cigarettes—i.e. restricted access to tobacco—makes smokers happier as the tax provides a valuable self-control device. Finally, in the model of Bernheim and Rangel (2004: 1580), a restriction of public consumption of goods like tobacco—for instance a smoking ban—reduces people's exposure to cues that can cause addictive behavior by mistaken decisions.

[16] In many schools, for instance in Germany, smoking still is or has been allowed in smoking areas.

[17] Coase (1960: 15-19) himself stated that his theorem fails if transaction cost is too high. See also Schweizer (1988).

Our paper opens many avenues to future research. An interesting question to investigate is which effect the extension of the model to more than one smoker and one non-smoker would have? The bargaining power of a group may increase in its number of members, but starting a conflict by asking smokers not to smoke becomes more costly when a non-smoker has to ask more than one smoker. Additionally, the non-smoker asking smokers to stop smoking might disturb other non-smokers by starting a conflict when the group of non-smokers consists of heterogeneous members. Another extension is to analyze repeated games where players could play dynamic strategies like trigger strategies. Smokers, e.g., could initially follow the strategy to continue with smoking more often, to strengthen their bargaining power.

Moreover, future research could elaborate under which environment which social norm prevails and how strong such norms are. Related, an interesting aspect to investigate is why smoking in the public in some time period has been generally accepted and in others not. Future research could also address the question whether there exists a potential trade-off between public and private smoking. On the one hand, it is possible that smokers who are not allowed to smoke publicly so often anymore will smoke more often at home, so that their children will suffer more second-hand smoke than before. On the other hand, O'Donoghue and Rabin (1999), Suranovic *et al.* (1999), and Bernheim and Rangel (2004) suggest that there will be less smokers and less smoking of smokers in general, once a ban has been established.

Appendix

A Proofs

Proof of Proposition 1. Consider the game tree depicted in Figure 1 and the payoffs P_j, $j = \{1, 2, \ldots, 8\}$, there. Beginning at **stage four**, the non-smoker's optimum choice is "go", if $-L_N > T_N - E$. If $T_N \geq E - L_N$, the non-smoker accepts the smoking of the smoker.

At **stage three**, the smoker compares payoff vector P_8 with P_5 and P_6, if $T_N \geq E - L_N$; otherwise, $T_N < E - L_N$, the smoker has to select from the alternatives P_7, P_5 and P_6. In the case where $T_N \geq E - L_N$, the smoker strictly prefers payoff vector P_8 to P_5 or to P_6, and therefore chooses to continue with smoking. However, if $T_N < E - L_N$ and the smoker has to select from payoff vectors P_7, P_5 and P_6, the smoker will choose "stop smoking", if $B \leq T_S$. In contrast, if $B > T_S$ the smoker will choose "continue".

Turning to **stage two**, the non-smoker has to consider several constellations. If $T_N \geq E - L_N$ the non-smoker's effective set of possible outcomes to consider is P_3, P_4 and P_8. Since $T_N \geq E - L_N$, "accept" is the dominant strategy in this subgame, so that the outcome is described by P_4. However, if $T_N < E - L_N$ things become more complex. If it additionally holds that $B > T_S$, then the non-smoker has effectively to consider P_3, P_4 and P_7. The non-smoker always prefers P_3 compared to P_7. Because of $E - L_N > T_N$ the non-smoker also prefers P_3 compared to P_4, and therefore plays "go". In contrast, if additionally to $T_N < E - L_N$ it holds that $B \leq T_S$, then the non-smoker has to compare outcomes P_3, P_4 and P_6. Due to $T_N - E < -L_N$ outcome P_3 dominates outcome P_4. Comparing P_3 and P_6, the non-smoker plays "ask" and we arrive at outcome P_6, because $T_N - A_N \geq -L_N$ always holds.

Eventually we have to find the subgame-perfect strategies at **stage one**. If $T_N \geq E - L_N$ the smoker must compare P_1, P_2 and P_4. One can easily prove that the subgame-perfect equilibrium is described by (smoke, accept) and payoff vector P_4. If $T_N < E - L_N$, however, we have to consider two cases. If it additionally holds that $B > T_S$, the smoker compares her/his payoffs in P_1, P_2 and P_3. Since $B > T_S$, "do not smoke" is no option, and "go" is also no option. Thus the smoker smokes and we end in the terminal node with payoff P_3. In contrast, if we consider scenario $T_N < E - L_N$ combined with the constellation $B \leq T_S$, the smoker effectively compares payoffs P_1, P_2 and P_6. Outcome P_1 is strictly dominated by P_2 and P_6. Between payoff vector P_2 and P_6, in turn, the smoker is indifferent, and we obtain two subgame-perfect equilibria, (do not smoke) and (smoke, ask, stop smoking).

□

Proof of Proposition 2. Consider Figure 2 and the corresponding payoff vectors P_j, $j = \{1, 2, \ldots, 6\}$, of the end nodes. Beginning at the **last stage** the smoker chooses "go" whenever $B - L_S > T_S$ holds, and "stay", otherwise.

At **stage two**, in turn, the non-smoker will play "allow" if $B - L_S > T_S$ and additionally $T_N \geq E$ holds. If $B - L_S > T_S$ holds together with $T_N < E$, in contrast, the non-smoker chooses "do not allow". If $B - L_S \leq T_S$ holds, the non-smoker definitely decides to select "do not allow".

Eventually at **stage one**, the smoker compares P_1, P_2, and P_4, if the parameter constellation is such that $B - L_S > T_S$ and $T_N \geq E$. Because of $L_S > A_S$, we know that $T_S + B - A_S > B - L_S$, so that we can drop option P_1. If it now holds that $B - A_S \geq 0$, the smoker plays "ask", and we arrive at the end node with payoff P_4.[18] If $B - L_S > T_S$, $T_N \geq E$ but $B - A_S < 0$ the smoker will choose "do not smoke" and payoffs are given by P_2. If we now turn to the constellation $B - L_S > T_S$ and $T_N < E$, the smoker considers P_1, P_2, and P_5. We can directly exclude P_5 and P_2, so that the smoker will play "go" right at the beginning of the game. Finally, if $B - L_S \leq T_S$, the smoker must compare P_1, P_2, and P_6. We immediately see that the smoker will decide to play "do not smoke", and the outcome is described by P_2.

□

[18]We assume that the smoker prefers being together and smoking to being together without smoking. Therefore, the smoker chooses "ask" also when $B - A_S = 0$.

Proof of Proposition 3. We have to select the maximizing option from the following three sum of payoffs:

- $T_S + T_N$ (both together without smoke)
- $T_S + T_N + B - E$ (both together with smoke)
- B (both separated)

The optimum alternative is found by comparing the three options with each other, given the parameter constellation. It is easy to prove that the ranking of the alternatives depends on $E \gtreqless B$, $B \gtreqless T_S + T_N$, and $E \gtreqless T_S + T_N$. As there are three alternatives that have to be compared pairwise, there are $2^3 = 8$ permutations. If $E > B$ and $T_S + T_N > B$ the optimum is that both come together without smoking, irrespective of whether $E \gtreqless T_S + T_N$, which covers two permutations. If $B > E$ and $T_S + T_N > E$ the optimum is that both come together and the smoker smokes, irrespective of whether $B \gtreqless T_S + T_N$, which covers further two permutations. Moreover, if $B > T_S + T_N$ and $E > T_S + T_N$ the optimum is that both stay separated, so that the smoker can smoke alone, which again covers further two permutations. Two permutations remain to analyze, namely, (i) $E > B$, $B > T_S + T_N$, and $T_S + T_N > E$, and (ii) $B > E$, $T_S + T_N < E$, and $B < T_S + T_N$. Both constellations are inconsistent and cannot exist; from (i) $E > B > T_S + T_N$, for instance, it directly follows that $T_S + T_N \overset{!}{<} E$.

□

B Smoking and non-smoking areas: when the non-smoker moves first

When there are separated smoking and no smoking areas and the non-smoker moves first, the following game is played (see Figure 4):

Game 3:

Stage 1 The non-smoker decides whether to propose going to the smoking area or to the non-smoking area, or to go directly away. If she/he proposes going to the smoking area both stay there together and the game ends. If the non-smoker decides to leave instead, the smoker smokes alone and the game ends.

Stage 2 If the non-smoker has chosen to propose to go to the non-smoking area, the smoker decides whether she/he goes away, accepts going to the non-smoking area, or to veto the non-smoker's proposal. If she/he accepts going to the non-smoking area, the game ends and both stay together; if the smoker goes away, she/he smokes alone and the game ends as well.

Stage 3 If the smoker vetoes going to the non-smoking area, the non-smoker has to decide whether to join the smoker and to go to the smoking area or not. If he/she joins, both stay together at the smoking area and the smoker smokes. If the non-smoker decides not to join she/he has to leave and the smoker goes to the smoking area and smokes alone. In both cases the game ends.

We obtain:

Lemma 1. *Depending on parameter constellation, Game 3 possesses the following subgame perfect Nash equilibria:*

(a) If $T_N - E \geq -L_N$, the unique subgame-perfect Nash equilibrium is described by the sequence of actions (smoking area) and payoff $P_2 = (B + T_S, T_N - E)$.

(b) If $T_N - E < -L_N$ and

(i) $B > T_S$, the unique subgame-perfect Nash equilibrium is described by the sequence of actions (go) and payoff $P_1 = (B, -L_N)$.

(ii) $B \leq T_S$, the unique subgame-perfect Nash equilibrium is described by the sequence of actions (non-smoking area, accept) and payoff $P_4 = (T_S, T_N)$.

Proof of Lemma 1. Beginning at stage 3, the non-smoker will accept going to the smoking area if $-L_N \leq T_N - E$ and leaves when $-L_N > T_N - E$. At stage 2 the smoker, in turn, will clearly play “veto” if $T_N - E \geq -L_N$. However, if $T_N - E < -L_N$ she/he compares $B - L_S$, B and T_S. Therefore, the smoker will accept going to the non-smoking location if $B \leq T_S$, but will play “veto” otherwise. Arriving at stage 1, the non-smoker has to compare $T_N - A_N - E$, $-L_N$, and $T_N - E$, if $T_N - E \geq -L_N$. Hence, she/he plays “going to the smoking area”. In contrast, if $T_N - E < -L_N$ holds, her/his decision depends on inequality $B \gtreqless T_S$. If $B > T_S$, she/he plays “go”, and “go to the smoking area” else.

□

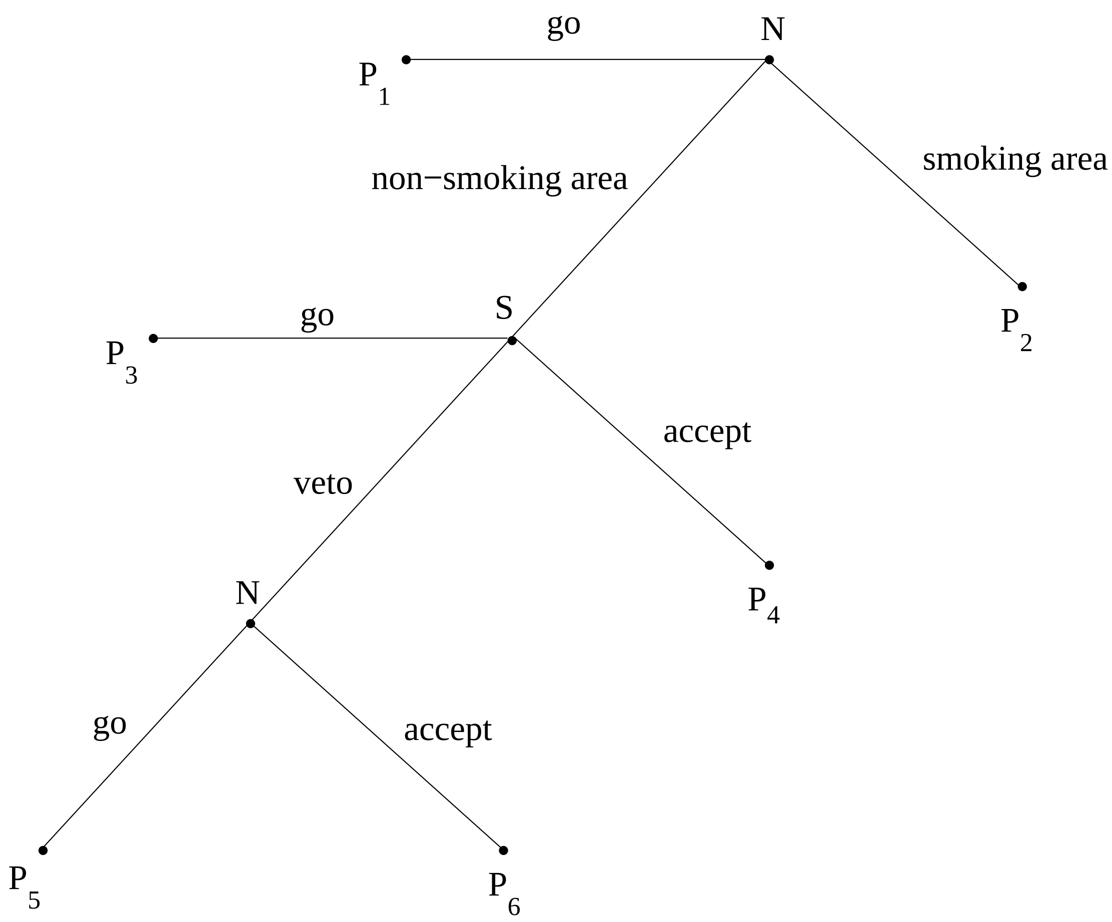

Figure 4: Game tree of game where there exist smoking and non-smoking areas and the non-smoker moves first; payoffs are given by $P_1 = (B, -L_N)$, $P_2 = (B + T_S, T_N - E)$, $P_3 = (B-L_S, -A_N)$, $P_4 = (T_S, T_N)$, $P_5 = (B, -A_N-L_N)$, and $P_6 = (B+T_S, T_N-A_N-E)$.

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