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SMOKING BANS AS A RESPONSE TO CONSTRAINED TAX POLICY

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ABSTRACT

This paper presents a model which explains why governments, wishing to reduce smoking, may ban smoking in the workplace in addition to using high taxes. Individuals wish to smoke evenly and hence dislike variance in cigarette consumption. The government has two possible policies - increasing the price (imposing a tax) or limiting when the cigarettes can be consumed (imposing a ban on smoking in the workplace). The effectiveness of the tax policy is limited because the smoker can buy illegal but untaxed cigarettes on the "black market." A ban is costly as it creates variance in cigarette consumption which the smoker dislikes. We show that the optimal policy is a combination policy of "tax plus ban."

Key words: smoking, cigarette, ban, government policy

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brain. Traditional studies of addiction stress long-term addiction in which, once a smoker has established a steady level of nicotine to the brain, it is very hard to lower this level and to quit. But there is also short-term addiction in which the smoker finds it very hard to lower his consumption during a period of the day. We focus on the individual's wish to maintain a steady level of nicotine within the day. Our modeling innovation is to model this wish by a utility on smoking in the workplace. Like the tax policy, the ban on smoking in the workplace cannot eliminate smoking: the smoker still smokes cigarettes at home. As discussed earlier, the ban is costly in the sense that it creates variance for the smoker which lowers his utility. Although imposing a ban is costly, we show that a ban is a component of the optimal policy or that the best policy is a combination policy of “tax plus ban.”

In our model the government is paternalistic. It wants to limit smoking because smokers systematically underestimate the ill-effects of smoking on their health. We noted in the opening sentence that governments use three broad policies to discourage smoking, viz. a price policy of high taxes, a quantity policy of banning smoking in the workplace and in public places, and informational policies such as requiring health warnings on tobacco packages and limiting advertizing by tobacco companies. Although the rationale for policy is that the government has better information than the individual on the expected long-run cost of smoking, we focus on the interplay between the price and quantity policies. We do not focus on the informational policies. We do this because the psychology and behavioral economics literatures suggest that individuals have difficulty making correct and consistent decisions when events are uncertain and occur in the future.[2] These difficulties are likely to carry over into the process by which the individual uses new information to update his perception of the expected long-run risk of smoking, or an individuals’ perception and hence behavior is likely to be insensitive to any new information provided by the government.[3]

As noted above, in our model the government wants to limit smoking because smokers underestimate the ill-effects of smoking on their health. Other reasons why a paternalistic government might want to limit smoking are that smokers suffer from time inconsistency

(Gruber and Koszegi (2004)), or that there is a projection bias (O’Donohue and Rabin (2001)) or that smokers are exposed to the wrong type of cue (Bernheim and Rangell (2004)). An efficiency reason to limit smoking is the externality created by “second-hand” smoke. Introducing these

Period 2 is c_2 and in Period 3 is c_3. In the absence of smoking, the individual's health is H; smoking causes ill-health or sickness S with probability Pr or his expected health is H - Pr S. Summarizing, the individual's true utility depends on x, c_1, c_2, c_3, and on his expected health H - Pr S. We assume the individual's true utility has specific form as

$$x + v(c_1, c_2, c_3) + H - Pr\,S. \tag{1}$$

The individual's income is denoted M and the consumer price (which may include a tax) of a cigarette is denoted q. The individual potentially receives a lump-sum transfer B from the government. Budget balance for the smoker implies that his consumption of the numeraire is:

$$x = \qquad\qquad . \tag{2}$$

The parameters a' and b' are positive. Noting that the mean can be written as

$mean(c_1, c_2, c_3) = ⅓(c_1 + c_2 + c_3)$ and the variance can be written as

$variance(c_1 , c_2 , c_3) = (2/9) (c_1^2 + c_2^2 + c_3^2 - c_1c_2 - c_1c_3 - c_2c_3)$, we write $a' = 3a$ and $b' = (9/2)b$,

and individual i's direct utility achieved from smoking is:

$$v(\qquad . \tag{3}$$

ma

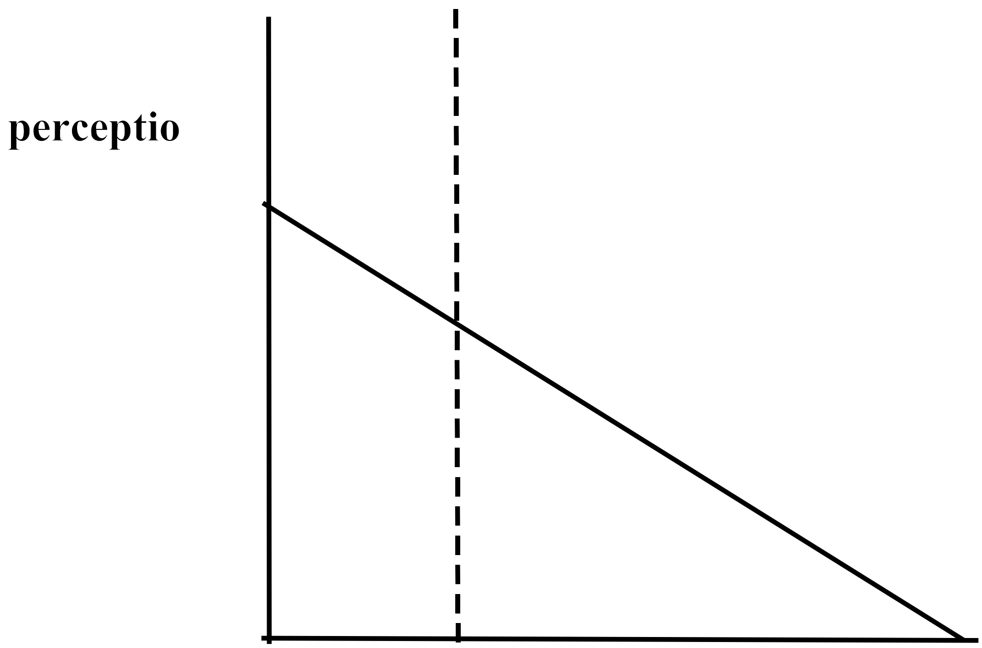
[redacted] a sufficiently low perception of the negative effect [redacted]

[redacted] *is the perception parameter of the* [redacted] *ing taxed cigarettes.*

[redacted] s (9):

[redacted] (10)

[redacted]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3. SMOKING BAN IN WORKPLACE

This section considers the policy *(q, B)* or the government levies a cigarette tax and bans smoking in Period 2. With no smoking allowed in the workplace, the individual maximizes his perceived utility (Equation (7)) with the additional restriction that $c_2 = 0$, or:[7]

$$\max_{c_1 \geq 0,\, c_3 \geq 0} \; M + R(q, B) - q(c_1 + c_3) + a(\qquad .$$

his first cigarette, increasing his smoking from $c_1 = c_2 = c_3 = 0$ by a marginal cigarette (arbitrarily assumed to be smoked in Period 1). Recognizing that the left-hand side of Equation (8) is the perceived marginal utility if there is no ban,

$$\frac{\partial u^P}{\partial c_1} \Big|_{c_1 = c_2 = c_3 = 0} = a - q - \theta^i \alpha.$$

Similarly, the left-hand side of Equation (13) is the perceived marginal utility if there is a workplace ban,

$$\frac{\partial u^P}{\partial c_1} \Big|_{c_2 = 0,\, c_1 = c_3 = 0} = a - q - \theta^i \alpha \ .$$

perceived health cost and increases the variance cost of a marginal increase in c_1 or c_3. If the

$c_1 + c_3$.

PROOF: see Appendix B.

Utility has consumer surplus form and social welfare is utilitarian. In consequence social welfare is unchanged if, instead of tax revenue being returned as a uniform lump-sum transfer, the tax revenue paid by a smoker is returned to the smoker as an individual-specific lump-sum transfer. With this construction, the ban reduces the cigarettes smoked by each smoker but leaves the resources consumed by each individual unchanged. Lemma 1 is proved by showing that, with the tax being returned in this way, the ban increases the utility - as calculated by the government - of *each* smoker. This is formalized in the Corollary.

COROLLARY: If the tax revenue paid by a smoker is returned to the smoker as an individualistic lump-sum transfer, a ban on smoking in the workplace increases the true utility of each smoker.

4. TAX ONLY

Government welfare is highest when individuals do not smoke and hence, to discourage smoking, the government may impose a tax on cigarettes. In this section, we assume that the government only uses a tax and does not use a smoking ban, or the policy is *(q,ű)* . From Equation (10), if an individual i is choosing between not smoking and buying taxed cigarettes at consumer price q, he chooses not to smoke if

$$\theta^i \geq \theta_1(q, \varphi) = \frac{\quad}{\quad} .$$

or if

$$q \geq a - \underline{\theta}\alpha .$$

Hence, if the individual's choice is only between not smoking and buying taxed cigarettes, the government can achieve its objective of stopping smoking by imposing a sufficiently high tax. However, a high tax favors the development of a "black market" in which individuals can buy untaxed but illegal cigarettes. This section explores the individual's choice in the presence of parallel markets for legal taxed and illegal untaxed cigarettes.

For the smoker, the advantage of buying on the illegal market is the lower price. However, participation in an illegal activity imposes a utility cost. This cost may be a psychological cost or the expected cost of being apprehended by law-enforcement and punished. We assume that the utility cost of buying illegal cigarettes is the fixed cost *F*.[10] The smoker chooses the illegal market if the benefit of the lower price exceeds *F*. The benefit of the lower price increases with the cigarettes smoked, or the smokers buying on the illegal market have low perception parameters d^i .[11]

Formally, consider a smoker *i* choosing between buying legal taxed cigarettes and illegal untaxed cigarettes. If the individual buys legal cigarettes, the consumer price is *q* and, using Equation (9b) in Equation (7), his perceived utility is:

$$M + R - q3\frac{a - q - \theta^i\alpha}{6\theta^i\beta} + a3\frac{a - q - \theta^i\alpha}{6\theta^i\beta} + H - \theta^i\left(\alpha\left(\qquad\right)\right). \quad (15)$$

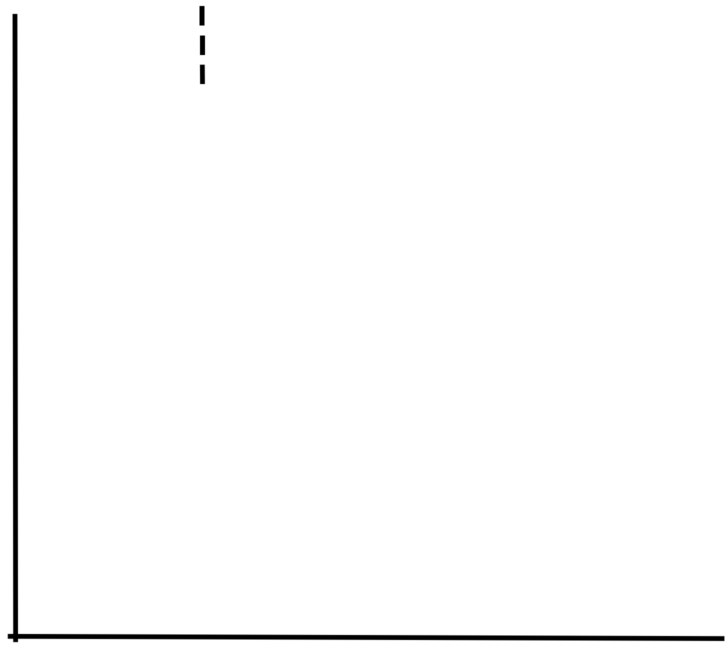
perceived utility[12] :

$$\max_{c}$$

$$\theta_2(q\,,\varphi) \;=\; \frac{(a-p)^2 - (a-q)^2}{2\alpha(q-p) + 4\beta}\ . \tag{18}$$

above $\hat{q}$ the value of d^i which makes the smoker indifferent between not smoking and smoking is $d_2(q$

Similarly, if he buys illegal untaxed cigarettes, he buys *2(a-p-ďŬ)/(4ďб+b)* cigarettes to achieve perceived utility



social welfare function implies that social welfare can be calculated “as if” any tax paid by a

LEMMA 2: If legal taxed and illegal untaxed cigarettes are available, a ban on smoking in the workplace increases social welfare, or $W(q, B) > W(q, ű)$ *with q $ p.*

PROOF: See Appendix D.

Lemma 2 extends Lemma 1 to the full model with parallel markets. By establishing that, at any *q*: *q $ p*, , the ban increases social welfare, Lemma 2 establishes that a ban on smoking in the workplace is part of the optimal policy.

Now consider whether, in the presence of a ban, it is always desirable to impose a strictly positive tax rate or $q > p$. As noted at the end of Section 4, imposing a sufficiently small tax rate pushes no smoker into buying illegal untaxed cigarettes. But such a tax reduces participation and reduces the cigarettes smoked by every smoker; both of these effects increase social welfare. This is formalized in Lemma 3 below.

LEMMA 3: $\frac{dW(q, B)}{dq} \Big|_{q = p} > 0$

PROOF:

PROOF: $\max\limits_{q:q>p}$

it increases the variance of the consumption stream. Both of these impacts - the former being beneficial and the latter being detrimental - are included in the government's welfare function. The paper shows that the former effect outweighs the latter effect in the government's calculus so that the ban is always a useful tool. By showing that the best policy is "tax plus ban", we hope to add to the literature on smoking policy and mor generally to add to the "price *v.* quantity" debate on how to best control some socially undesirable activities.

APPENDIX A: RESTRICTION ON M

When calculating the individual's choice of cigarettes, we do not include the constraint that the individual's income is at least as large as his expenditure on cigarettes. This is valid if the smoker's cigarette consumption, as expressed in Equation (9b), is affordable, or

$$q \; 3 \; \underline{\hspace{4em}} \qquad\qquad ;$$

$$M \geq \max_{q : q \geq p} \frac{(a-q)q - \underline{\theta}\alpha q}{2\underline{\theta}\beta}.$$

The right-hand side is maximized when

$$\frac{d}{dq}\frac{(a-q)q - \underline{\theta}\alpha q}{2\underline{\theta}\beta} = \frac{a - 2q - \underline{\theta}\alpha}{2\underline{\theta}\beta} = 0.$$

d^i under policy P. Using Equation (12), social welfare under policy P is

$$W(P) \;=\; \int_{\underline{\theta}}^{\bar{\theta}} \left(M + R(P) + H + G(\theta^i;P) \right) f(\theta^i)\, d\theta^i . \tag{B.2}$$

Denote the total tax paid by a smoker with perception parameter d^i as $r(d^i; P)$,

$$r(\theta^i; P) \qquad . \tag{B.3}$$

APPENDIX C: RESTRICTION ON F

We now establish the restriction on the fixed cost *F* such that $d_2(\hat{q}, \H{u}) > \underline{d}$. $\hat{q}$ solves $d_2(q, \H{u}) = d_1(q, \H{u})$, or

$$\frac{(a -}{}$$