Time inconsistencies, paternalism, and drug consumption: a theory of "good" distortions.

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Abstract

"Whisky is a bad thing, especially bad whisky." Winston Churchill.

This paper studies a simple model of paternalistic pricing, in which one agent (the "mother") may modify the choices made by an other agent (the "son"), by changing his budget set, either through prices or income. When preferences of both agents differ, changes in the price system faced by the son will distort his behavior; this distorsion is valued positively by the mother.

This model first applies to time inconsistent preferences, where mother and son represent two instances of the same individual at different times. A second application is to merit goods, when the mother is interpreted as an informed government, and the son as a misinformed agent. The mother (today's self) may optimally decide to restrict the son's (tomorrow's self) choice space by increasing some prices, which become a commitment device. Such a "demand for taxation" may exist when both disagreement between the two selves and price elasticity of demand are large enough.

The theory is then illustrated by the case of a heavilly taxed good: tobacco. Many surveys indicate that a significant proportion of smokers actually favor an increase in cigarette taxes. This "demand for taxation" can be interpreted as a way to correct the negative external effect to oneself, where price is used as a self-disciplining device for an individual who anticipates his changing preferences. Under standard estimates for the elasticity of demand, the analysis shows that the current level of tobacco tax would be optimal (from this single commitment perspective) if smokers weight present events four times more than future events, revealing a very high "salience" parameter. Still from this comittment perspective, prohibition of a good is justified only when the elasticity of demand is *large* enough (in absolute terms), which may be more the case for heroin than for cocain.

JEL :

1 Introduction

Many public health interventions take the form of price policies: some goods are subsidized (e.g., preventive care) wheras others are taxed (e.g., tobacco products) or even prohibited (some other drugs).

Indeed, tobacco appears to be one of the most healvilly taxed commodities (Viscusi, 1994). A standard justification for such heavy taxes relies on the negative external effects to others, though this argument has been challenged on different grounds. Most negative external effects of smoking are borne by household members; if the decision unit is the household, these costs are not "external" but may be one element of an internal bargaigning process[1]. Other external costs include socialized health expenditures, but early deaths of smokers also reduce Social Security payments and nursing home costs; the global balance is not clear, and may indeed be positive[2]

Apart from this usual suspect for taxation (negative external effects on others), many authors have also challenged the rationality assumptions underlying the economic approach to tobacco taxes. When individuals underestimate the true probabilities of adverse events, price distorsions may be used to attain ex post efficient allocations (Sandmo, 1983), especially when information policies aimed at manipulating preferences (through probability weights) are too costly to implement (Holly et al., 1999)[3]. A second failure of rationality may come from "excessive" discounting of future events, especially by children. Protecting children from a future, poorly expected (US. Department of Health and Human Services, 1994) addiction to nicotine, may indeed be one of the strongest arguments in favor of high tobacco taxes. If the costs to him/herself in the future are not fully internalized by the smoker

[1] As noted by Chaloupka and Warner (2000), this argument may poorly apply to the health impacts of pregnant mothers smoking to their children, which may be considerable (Environmental Protection Agency, 1992.)

[2] Most studies attempt to estimate the *total* private and social costs associated to smoking, and do not estimate the social value of a *marginal* change in taxes; Leu and Shaub (1983) and Viscusi (1995) find a net social benefit of smoking. However, according to Chaloupka and Warner (2000), the balance changes sign when the external costs of smoking pregnant women are taken into account.

[3] However, it is not clear that smokers actually *underestimate* the negative effects of smoking on their own health. Viscusi (1992) reports that smokers preceive the total smoking mortality risk to be around 0.47 (non smokers estimate it at 0.57), whereas the epidemiological literature estimates of this risk range from 0.16 to 0.36.

(especially the younger one), then there is a negative externality on oneself (Schelling, 1984).

Interestingly enough, many surveys report that a significant proportion of smokers actually *favor* an increase in cigarette taxes, as shown in Table 1[4]:

Share of population favoring an increase in cigarette taxes

Survey	Year	Smokers	Nonsmokers
Roper	1970	20	46
Roper	1972	13	44
Roper	1974	14	42
Roper	1976	12	45
Roper	1978	16	50
Gallup	1978	45	57
Gallup	1981	23	59
Harvey and Shubat	1987	75	80

Table 1: Trends in public opinion about cigarette taxes
Source: US Surgeon General Report, 1989

Such a "demand for taxation" may only be justified by temporal inconsistencies of choices due to changing preferences. Some individuals wish to "tie their hands," and restrict their consumption tomorrow. A high price then serves as a disciplining, self-comittment, device.

An "inconsistent" individual has different preferences when taking his consumption decisions and when evaluating this choice. Clearly, situations in which one thinks "I know I shouldn't be eating this extra piece of cake," have been experienced by many; the Churchill quote gives an other example of such disrepancies between the self that actually consumes, and the self that judges this behavior[5].

[4] I thank Ken Warner and Ronald Davis for providing me these figures. People were asked if they favored an increase in federal and state taxes on cigarettes. The Gallup 1978 survey asked "Do you think that the present 8 cents/ pack federal tax on cigarettes should be increased?" The Harvey and Shubat 1987 survey asked "Would you favor an increase in the tax on tobacco products if the money from the increase went to Medicare?"

[5] Exogenously changing preferences were introduced by Allais (1947), who stressed out the difficulties in welfare calculations when agents regret earlier decisions. Changing preferences that may lead to intertemporally inconsistent choices have given rise to a large litterature, beginning with Strotz (1956). See in particuliar Hammond (1976), and Laibson (1997) for a recent survey.

When an agent perfectly acknowledges the fact that his preferences will change, a key question is whether or not there exists some commitment device, such that the agent's choices will remain temporally consistent[6]. A famous example is given by Elster (1979): Ulysses asks the sailors to tie him up to the mast, so that he will be able to listen to the sirens without having the opportunity to leave the boat, an opportunity he would surely regret afterwards. One key feature in this story is that Ulysses could *reduce his choice space*. Thanks to the sailors and the ropes, the price to leave the boat and rush to the sirens became infinite.

Similarly, taxes that affect demerit goods also reduce the choice space, and may be seen as a commitment device for intertemporally inconsistent individuals.

The present paper investigates the close link between merit goods and changing preferences, and asks if the current level of tobacco price is "optimal" from this single comittment perspective. More precisely, what would be the degree of temporal inconsistency of preferences for the observed level of taxes on tobacco or drugs to be optimal? (apart from market failures arguments).

Section 2 introduces a very simple model, in which two selves may disagree about the relative values of some goods. This model may be interpreted as a two-period hyperblic discounting model in which price may be used as a commitment device by individuals who acknowledge their inconsistency. Other interpretations include standard merit-demerit good models (Sandmo, 1983; Besley, 1988) in which taxes induce choices distortions that may actually improve welfare. A simple rule determines the optimal level of tax (or the demand for taxation). We show that this optimal level is strictly positive if the degree of disagreement and the price elasticity of demand for the good are large enough (even though preferences are inconsistent, the optimal tax rate may be zero).

Section 3 illustrates the theory in the case of two heavilly taxed goods: tobacco and illegal drugs. Under standard estimates for the elasticity of demand, we show that the current level of taxes on tobacco would be optimal (from this single "commitment" perspective) if the marginal utility changes,

[6] Carillo and Mariotti (2000) revisit this issue in a dynamic context with information imperfections; agents can commit themselves by strategically deciding to remain uninformed about the true quality of a good, an information they may regret afterwards.

when seen from one point of view or the other, in a ratio of one to four. Put differently, the additional weight given to future costs and benefits with respect to present ones must be of one fourth. Given current estimates of long term demand elasticity for hard drugs, prohibition increases ex ante welfare only when future costs are taken into account with a psychological discount factor of less than 0.1.

2 The model

2.1 Preferences and disagreement

In an intertemporal choice framework, changing preferences between the selves at different times may lead to the inconsistency of optimal consumption plans (Strotz (1956)), thus leaving some room for regret (REF). A "rationally inconsistent" individual perfectly forecasts his change of preferences. Hammond (1976). The question is: to what degree does this rational forecast limit the intertemporal inconsistency problem?. Very broadly, the answer depends on the availability of some commitment device the individual may use to "tie his hands."

The mast, the ropes, and the sailors, provided such commitment device when Ulysses decided to listen to the Sirens (Elster). More generally, any commitment device implies some restriction of the choice space: the drug addict, when sober, may throw away all her remaining heroin doses. But an alternative way to restrict the choice space is to increase the price of the good tomorrow (indeed, destroying the good would be a way to increase its price to infinity, if a market for the good did not exist). Therefore, rationally inconsistent individuals may decide optimally, from their ex ante perspective, to increase the price they will later face.

Under rational addiction theory (Becker, Grossman, Murphy), decentralized allocation is Pareto-efficient without taxes. This is true even in a model with some forme of uncertainty; Orphanides-Zervos (1998) develop a model in which agents differ in their susceptibility to develop a strong consumption habit, and may learn their susceptibility only by consuming the good. There is some room for regret, but in some sense even regret is perfectly forecasted: agents know ex ante the true probability that they may regret their choice in the future. Again, individual decisions are ex ante optimal, and rational

addiction does not justify taxes on drugs, from an efficiency point of view.

In contrast, a situation in which government intervention may enhance welfare is when agents fail to correctly evaluate the probability distribution of future events (Sandmo, 1983). In that case, an appropriate tax and transfer mechanism may be needed to implement Pareto efficient allocations. This is a first case of merit (or demerit) good, as introduced by Musgrave (1956), for which the government is assumed to know better than the agents what is good for their own welfare. This assumption may justify paternalistic policies, such as taxing or even prohibiting demerit goods, and subsidizing or free access to merit goods. In fact, this may be the strongest argument in favor of taxing or even prohibiting consumption of some habit-forming goods, such as heroin or tobacco.

We formalise this argument in the following way. Let two "agents", whom may or may not be two instances of the same individual, be denoted as "the mother", and "the son". The son chooses his consumption bundle given his budget set, and the mother can influence the son's budget set prior to the son's consumption decision.

The son rationally chooses a bundle of L commodities (in a choice set $X \subset I\!R^L_+$) according to his own preferences, represented by a utility function u^s, and his budget set $B(p,y) = \{x \in X, px \leq y\}$, where the son faces price p and income y. The son's preferences are assumed strictly convex, continuous, and monotonous. We assume by convention (after some appropriate redifinition of commodities, i.e. leisure time instead of labor time) that the son's preferences are monotonically increasing. This implies that all commodities are standard "goods": there is no "bad" in the son's bundle. The son's marshallian demand is denoted $x^s(p,y)$.

The mother determines the son's budget set according to her own preferences, represented by a utility function u^m. These preferences may differ from her son's very radically. For example, even though the son values smoking marijuana, his mother may attribute a negative marginal utility to that activity. Therefore, if we could assume by convention that the son's preferences are non-decreasing, we may no longer make this assumption on the mother's preferences. Less radically, the mother may think that her son enjoys too much some activities (playing video games, going out with his friends,...) or too little some other activities (studying, going out with her friends,...), without disagreeing on the sign of the marginal utility. In the case of individual inconsistency, one may wish to drink a glass of wine a day, but not a

whole bottle. We also denote by $x^m(p,y)$ the marshallian demand function under the mother's preferences.

We assume that the mother perfectly knows her son's preferences. In particuliar, when mother and son are two instances of the same individual, this means that the individual is "rationally inconsistent," in the sense that he perfectly forecasts his changing preferences.

The mother's problem is the following:

$$\max_{(p,y)} u^m(x^s(p,y)).$$

When the mother and the son have identical preferences, obviously they do not disagree: there is no inconsistency problem, and no need for a commitment strategy. Therefore, the intuition is that the degree of disagreement between the two selves will strongly impact the optimal price policy. The following definition gives a precise content to this notion of "degree of disagreement".

Definition 1 *The mother and the son* disagree *about two commodities i and j if their marginal rates of substitution differ. The* degree of disagreement *is denoted $\delta_{ij}(x)$ and defined by:*

$$\delta_{ij}(x) = \left(\frac{MRS^m_{ij}(x)}{MRS^s_{ij}(x)} - 1 \right),$$

where $MRS^m_{ij}(x)$ (resp., $MRS^s_{ij}(x)$) denotes the marginal rate of substitution between good i and good j, evaluated at x, from the mother's (resp. the son's) perspective.

Disagreement is strong *if the two selves disagree about the* sign *of the marginal rates of substitutions, i.e., if $\delta_{ij}(x) < -1$.*

Disagreement is weak *if the two selves agree on the signs of the marginal rates of substitutions but disagree about their values, i.e., $\delta_{ij}(x) > -1$.*

In that case we say that good i is a demerit *good (relatively to good j) when the son valuates good i (relatively to good j) more than the mother, i.e. when $\delta_{ij}(x) < 0$, and a* merit good *in the other case.*

Two comments are in order. First, notice that the degree of disagreement is a local concept, and may explicitly depend on how much of each commodity is actually consumed by the son. Second, since it is defined in terms

of marginal rates of substitution, it is an intrinsic property of preference relations, independantly of their numerical representation.

2.2 Examples

Some of the models developed to study merit goods can easilly be seen as special cases of the general model proposed here. To fix the ideas, we show in turn that, not surprisingly, Besley's (1988) preference-based as well as Sandmo's (1983) information-based models of merit-demerit goods fall into that setup. More surprisingly (and maybe more interestingly), temporal inconsistencies of preferences induced by a hyperbolic discounting (Laibson, 1997) may also be seen as a simple variant of this model.

2.2.1 Public choice

The phrasing in terms of merit and demerit goods is borrowed from Musgrave (1959). Besley (1988), in a public choice context, studies the optimal pricing of a single merit or demerit good in a simple model, in which preferences are given by (the individual is the son, and the state is the mother):

$$u^m(x_1, x_2, \ldots, x_L) = u^s(\theta x_1, x_2, \ldots, x_L)$$

for some constant θ, with $\theta > 1$ in the case of a merit good and $\theta < 1$ in the case of a demerit good. In our notations, we have:

$$\left\{ \begin{array}{rcll} \delta_{ij}(x) & = & 0 & \text{if both } i, j \neq 1, \\ \delta_{1j}(x) & = & \theta - 1 & \text{for any } x \text{ and any } j \end{array} \right.$$

Section 2.5 below comes back to that case.

2.2.2 Imperfect information

Sandmo (1983) studies a model in which the social planner uses the best available information, whereas individual agents only use their own (eventually misperceived) probability. Imperfect information may justify some form of public price intervention.

Assume now that there are L states of nature; x_l denotes a monetary payment in state l (for simplicity, we assume that $x_l \in \mathbb{R}$, but the more general argument made by Sandmo follows the same line). Assume that

mother and son have the same instantaneous utility function u and differ only through their subjective probabilities about future states of nature. The son's subjective probability is $\pi = (\pi^1, \ldots, \pi^L)$, and the mother's is $P = (P^1, \ldots, P^L)$.

Under obvious notations, we have $u^m(x) = \sum_l P^l u(x_l)$, and $u^s(x) = \sum_l \pi^l u(x_l)$. Therefore, we have that $MRS^m_{ij}(x) = \frac{P^i}{P^j}\frac{u'(x_i)}{u'(x_j)}$ and $MRS^s_{ij}(x) = \frac{\pi^i}{\pi^j}\frac{u'(x_i)}{u'(x_j)}$, and:

$$\delta_{ij}(x) = \left(\frac{P^i}{P^j}\frac{\pi^j}{\pi^i} - 1\right).$$

By construction, the degree of disagreement is always larger than -1. Disagreement is weak, and good i is a merit good with respect to good j whenever the relative likelihood of state i (w.r.t. state j) is higher for the mother than for the son.

2.2.3 Changing tastes

Hammond (1976) introduces a simple model with two goods : consumption in period 0, and consumption in period 1. At time 0, the agent would prefer a moderate use of the good (e.g., tobacco): she would like to be able to decide to consume the good only in period 0, and quit in period 1. But she also anticipates that if she consumes the good now, her preferences tomorrow will be changed, so that she will then decide to continue smoking.

The individual is schizoidly separated into his two selves, his self today (the mother) and his self tomorrow (the son). Consuming one unit in period 0 increases the (marginal) utility of consumption in period 1, so that $u^s(1,1) > u^s(1,0)$, whereas $u^s(0,1) = u^s(0,0)$. However, when seen from the beginning of period 0, the worst possible consumption path is $(1,1)$, and the best is moderate use. We have: $u^m(1,0) > u^m(0,0) = u^m(0,1) > u^m(1,1)$.

The mother thinks that the marginal utility of consuming the good in period 1 is negative, whereas the son thinks that it is positive. The only subgame perfect equilibrium in that game is complete abstinence.

In our context, this corresponds to a case of strong disagreement between the two selves. The important point made by Hammond is that the temporal inconsistency of preferences may be perfectly anticipated by the individual:

this assumption defines a "rationally inconsistent" agent, who may take ex ante decisions to minimise the ex post cost of some future choices.

Hyperbolic discounting

An other important case of disagreement occurs in the context of intertemporal choice. In particuliar, the most frequently studied case of intertemporal inconsistency, hyperbolic discounting, takes the following form (see Laibson, 1997):

$$U^t(x_t, x_{t+1}, \ldots) = u(x_t) + \beta \sum_{s \geq 1} \delta^s u(x_{t+s}),$$

with $x_t \in I\!R$ (again, for simplicity), U^t represents the utility of a remaining path, as seen from current time t (agents are forward-looking), and $\beta < 1$ represents the additional weight given by the agent to current choices, what Akerlof (1991) defines as a "salience" or "vividness" effect, and psychologists such as Ainslie (1975) attribute to "impatience" or "impulsiveness."

The marginal rate of substitution between consumption in period τ and in period $\tau' > \tau$ is equal to:

$$MRS^t_{\tau\tau'} = \delta^{\tau - \tau'} \frac{\partial u}{\partial x_\tau} / \frac{\partial u}{\partial x_{\tau'}}$$

when evaluated by any self t with $t < \tau$, and to:

$$MRS^s_{\tau\tau'} = \frac{1}{\beta} \delta^{\tau - \tau'} \frac{\partial u}{\partial x_\tau} / \frac{\partial u}{\partial x_{\tau'}}$$

when $s = \tau$. Therefore we have, for any $t < s = \tau$:

$$MRS^t_{\tau\tau'} = \beta MRS^s_{\tau\tau'}.$$

Denote by $\delta^{t,s}_{\tau\tau'}$ the degree of disagreement between the self of time t (the mother) and the self of time s (the son) about the good at future times τ and τ' (with $t \leq s \leq \tau < \tau'$). We have $\delta^{t,s}_{\tau\tau'} = \frac{MRS^t_{\tau\tau'}}{MRS^s_{\tau\tau'}} - 1$, and therefore:

$$\begin{cases} \delta^{t,s}_{\tau\tau'} = 0 & \text{if } t \leq s < \tau, \\ \delta^{t,s}_{\tau\tau'} = \beta - 1 & \text{if } t < s = \tau. \end{cases}$$

In that case $\beta - 1$ is the degree of disagreement between the two selves. When $\beta < 1$, salience of current events induces consumption in period τ

to be less desirable (with respect to some reference period τ' in the remote future) when seen from period $t < \tau$ (the mother's point of view) than when seen from the son's period $s = \tau$. Again, notice that as long as $\beta \in [0, 1]$, disagreement is weak, and current consumption is a demerit good with respect to future consumption.

A first important feature of the three models above is that the degree of disagreement is independant of the point at which it is estimated, though this may not be the case in more general models; indeed, it seems reasonable to assume that the degree of disagreement may increase with the amount consumed by the son.

Second, when disagreement is limited to the relative weight of present and future, or to relative likelihood of future events, disagreement is weak. Only in Besley's model for $\theta < 0$, son's goods may be mother's bads.

2.3 "Good" price distorsions

The way in which the mother can determine the son's budget set may take various forms, either through X, p, or y. When it is possible to costlessly reduce the choice set X to a singleton, then of course full commitment is obtained. More generally, any device that reduces the size of the son's choice space X, such as the ropes in the case of Ulysses, but also retirement accounts in which an individual may commit to some saving strategy (Thaler, 1990), improves temporal consistency, i.e., reduce the discrepancy between the mother and the son's point of view. However, such a reduction depends crucially on the characteristics of the choice space X and the commitment device, and it is impossible to characterize the solution without further specification.

We follow here an alternative route, in which the choice set X is given, and the mother may act only on price p or income y. The mother determines the son's price vector within a price set $\mathcal{P}$ (specifications of this set will of course lead to different solutions), which contains the exogenous price $\bar{p}$.

We assume that income y is normalised to one; this assumption is of course not restrictive if the price of each good can be either increased or decreased, since the son's marshallian demand is homogenous in (p, y). The general problem writes:

$$\max_{p \in \mathcal{P}} u^m(x^s(p, y)). \tag{1}$$

To fix the idea, we may distinguish four important specifications of the price set $\mathcal{P}$, depending on the availability of income transfers and actions on prices:

- Income transfers are available: $\mathcal{P} \supset \{\lambda \bar{p}, \lambda \in I\!R\}$;
- Only income taxes: $\mathcal{P} = \{\lambda \bar{p}, \lambda \geq 1\}$;
- Commodity taxes without income transfers: $\mathcal{P} = \{p, p \geq \bar{p}\}$;
- Self-financed tax and subsidy policy: $\mathcal{P} = \{p, \bar{p}x^s(p, y) = y\}$.

We will turn to these different characterizations in turn.

2.4 Interpretations

This model first applies to changing tastes. Price, in the model, can also be seen as a commitment device for an temporally inconsistent individual who anticipates his change in tastes. The "mother" is Ulysses before coming close to the Sirens, and the "son" is Ulysses in front of the Sirens. Ulysses as the mother may decide to increase the price of going to the sirens faced by Ulysses as the son.

Hammond...

A related case is (state)*paternalism*, as defined by Musgrave (1959). The mother is the state, the son is the consumer. Preferences differ if there are some merit (or demerit) goods. Smoking is bad, but consumers keep smoking. The health authority taxes tobacco and then lets consumers decide how much tobacco they buy. But then there lacks a model of what determines "the state's preferences." The state here is paternalistic: not only does the consumer wrongly evaluates what is in his best interest, but the state has sufficient information to perform a better evaluation of individual welfare. This is, of course, in sharp contrast with the modern view of public economics, in which the state has an information deficit of some sort with respect to individuals (e.g., Atkinson and Stiglitz, 1980).

Standard paternalism, in which parents ("the mother") know better than their children ("the son") what is in their best interest, offers a third interpretation of the model. In many cases, parents may directly decide what their children consume, but in other cases, they may also alter the price system faced by their child who keeps some degree of autonomy in his decisions: a reward may be given if the child eats some food that he dislikes but which parents assume is good for his health, etc.

A fourth interpretation is "second degree paternalism." Parents may take, though on their childrens' behalf, wrong decisions for their children's welfare. Assuming that the state is the child's perfect agent, it may improve welfare by taxing or subsidizing goods given that parents will take consumption decisions. In the context of the present paper, the "mother" is the child (represented by his perfect agent, the state), and the "son" represents the parents. The state may decide to subsidize education (or even make it compulsory) that is better for the child than what the parents think. In that case the state acts to protect children from their (well-intentioned) parents. Beyond the "public good" aspect of children, such a second-degree paternalism provides a frequent justification for government intervention in education (see, e.g., Stiglitz, 1986).

Notice that rational addiction based upon habit formation, as introduced by Becker and Murphy (1988), does not lead to temporal inconsistency, since MRS^t does not depend on t (even though it may depend on past consumption). This is true even under models of rational addiction which account for uncertainty (Orphanides-Zervos), in which the expected value of MRS does not change.

2.5 Taxes and subsidies

First case: we assume that the mother may tax or subsidize prices, given that the tax/subsidy scheme is self-financed, i.e.: $(p - \bar{p})x^s(p, y) = 0$. Moreover, we assume that the son does not have access to the "regular" market goods at price $\bar{p}$ (if he did, the only self-financing price strategy would be $p = \bar{p}$.) Since the son's preferences are monotonically increasing, Walras' law imposes that $px^s(p, y) = y$, the price set is: $\mathcal{P} = \{p, \bar{p}x^s(p, y) = y\}$, and the problem writes:

$$\max_{p,\ \bar{p}x^s(p,y)=y} u^m(x^s(p,y)). \tag{2}$$

This first case is easily solved:

Proposition 1 *If both taxes and subsidies are allowed, the mother can perfectly determine the son's choice according to her own preferences: there exists a price vector p in $\mathcal{P}$ such that $x^s(p,y) = x^m(\bar{p},y)$.*

PROOF: Case where x^m is interior. The mother may modify the price vector such that it is the gradient to the son's indifference curve at mother's optimal choice x^m.

INSERT HERE FIGURE 1.

Precisely, define the price vector p as:

$$p_l \equiv y \left(\sum_{k=1}^{L} \frac{\partial u^s}{\partial x_k}(x^m) x_k^m \right)^{-1} \frac{\partial u^s}{\partial x_l}(x^m).$$

(Notice that if l is a bad for the son, then p_l may be negative.) Then we have for each l, $\frac{\partial u^s}{\partial x_l}(x^m) = \lambda p_l$, with $\lambda \equiv y^{-1} \left(\sum_{l=1}^{L} \frac{\partial u^s}{\partial x_l}(x^m) x_l^m \right)$. Moreover, by construction, $\bar{p}x^m = y$. Since x^m satisfies the first-order conditions and the budget constraint for the son's budget and preferences, it is equal to $x^s(p,y)$. (Strict quasi-concavity of u^s guarantees uniqueness of solution).

The self-financing condition is met, since $x^s = x^m$, and by definition of x^m, we have $\bar{p}x^m = y$ (by Walras law).

□

Notice that this problem is equivalent to the decentralization of a socially optimal allocation in a multi-agent framework. If we interpret the mother as a central planner maximizing social welfare, and if this planner can make sure each individual faces a specific price (or tax), then the first-order conditions that determine the socially optimal allocation can be met under Lindahl prices.

Also notice that if price subsisdies are not allowed, the first best allocation can still be decentralized under self-financed income transfers.

Besley (1988) studies the case in which mother and son only disagree about one good, in the sense that $u_l^m = u_l^s$ for all $l \neq 1$, and $u_l^m = \theta u_l^s$, with $\theta > 1$ in the case of a merit good, and $\theta < 1$ in the case of a demerit good.

Moreover, he allows taxes and positive income transfers, as long as the policy is self-financed. In that case, the price vector p defined above is proportional to:

$$\left(\frac{\bar{p}_1}{\theta}, \bar{p}_2, \ldots, \bar{p}_L\right),$$

and the proportionality coefficient is determined by the self-financed condition; this is the solution given by Besley.

Sandmo (1983) studies the case where mother and sons differ in terms of subjective probabilities but not preferences. In that case the optimal price p_l is proportional to:

$$\left(\bar{p}_1 \frac{\pi^1}{P^1}, \ldots, \bar{p}_L \frac{\pi^L}{P^L}\right),$$

and the proportionality coefficient is such that the budget constraint is satisfied. In short, when the son underevaluates the likelihood of a given state l (when $\pi^l < P^l$), the mother subsidizes insurance contracts that transfer resources to that state of nature.

2.6 Only taxes

Second case: the mother may only tax prices, and positive income transfers are not available. If $\bar{p}$ is the exogenously given price vector, the price set is $\mathcal{P} = \{p, p \geq \bar{p}\}$, and the problem writes:

$$\max_{p,\, p \geq \bar{p}} W(p), \tag{3}$$

where $W(p) \equiv u^m(x^s(p, y))$. Notice that in that case, the tax scheme produces net revenues to the mother, since $(p - \bar{p})x^s(p, y) \geq 0$.

The rest of this paper is devoted to the study of the following question: Under what conditions is it "optimal" (from the mother's point of view) to impose a positive tax on some commodity? In contrast with the previous case (when positive income transfers were available), the answer to that question now strongly depends on the various elasticities of the son's demand, and first best allocation is not attainable in general.

The following proposition gives sufficient conditions (yet very strong ones) under which the optimal tax is zero: the commitment price is equal to the exogenous price.

Proposition 2 *Assume that: from the son's point of view, all goods are ordinary; all pairs of goods are gross complement; son's goods are not mother's bads. Then the solution to (3) is $p = \bar{p}$ (no tax).*

PROOF: We have for each l :

$$\frac{\partial W}{\partial p_l} = \sum_{k=1}^{L} \frac{\partial u^m}{\partial x_k} \frac{\partial x_k^s}{\partial p_l}.$$

If l is ordinary, and k and l are gross complement to the son, then $\frac{\partial x_k^s}{\partial p_l} \leq 0$ for all k and l; if all commodities are goods to the mother, then $\frac{\partial u^m}{\partial x_k} \geq 0$. Therefore, W is decreasing in each p_l and the optimum is reached on the boundary, for $p = \bar{p}$.

□

Notice that this is a very restrictive condition, and certainly not a necessary one. Obviously, if there is no disagreement between mother and son about preferences ($u^s = u^m$), W is their common indirect utility, which is always decreasing in price, without any assumption on complementarity (or even ordinarity) of goods.

2.7 A simple specification

We specify the model in the simplest case, when the mother and the son only disagree about the utility associated to one commodity (good 1), so that :

Assumption 1 *The marginal utilities of both agents differ only with respect to good 1:*

$$\begin{cases} \dfrac{\partial u^m}{\partial x_1} & \neq & \dfrac{\partial u^s}{\partial x_1} \\ \dfrac{\partial u^m}{\partial x_k} & = & \dfrac{\partial u^s}{\partial x_k} \quad \forall k = 2, \ldots, L \end{cases}$$

In that case, we immediately have that $\delta_{ij}(x)$ is equal to 0 for any $i, j \neq 1$; moreover, $\delta_{1j}(x)$ independant of j and we denote it by $\delta(x)$ in the sequel, with $\delta(x) = (u_1^m/u_1^s - 1)$.

Denote by:

- ω_1 the share of good 1 in total spending;
- ε_{l1} the crossed price elasticity of demand for commodity l with respect to p_1;
- ε_1 the price elasticity of demand for commodity 1;
- ε_{ly} the income elasticity of the demand for commodity l,

all evaluated at (p, y), and from the son's point of view. The following lemma characterizes the marginal impact on mother's welfare of changes in the price system faced by the son.

Lemma 2.1 *Under Assumption 1 we have:*

$$\left\{ \begin{array}{rcl} \dfrac{\partial W}{\partial p_1} & = & \dfrac{\partial v^s}{\partial p_1}\left[1-\delta\varepsilon_1\right] \\ \dfrac{\partial W}{\partial p_l} & = & \dfrac{\partial v^s}{\partial p_l}\left[1-\delta(\varepsilon_{l1}+\omega_1(\varepsilon_{ly}-\varepsilon_{1y}))\right], \forall l \neq 1, \end{array} \right.$$

where δ is evaluated at $x^s(p, y)$.

PROOF: See Appendix.

When the price of the good increases, the mother's indirect utility decreases like the son's through a direct effect; but an increase in price may reduce consumption of commodity 1, and therefore reduce disagreement, which has a positive effect on the mother's welfare. How much a price increase may reduce the discrepancy depends on the elasticity of demand for that good, and of the degree of disagreement, both evaluated at the son's optimal bundle x^s. Notice that, if commodity 1 is an ordinary good, then $\varepsilon_1 < 0$; therefore, in the case of a merit good ($\delta > 0$), an increase in price would increase even more disagreement: from this perspective, merit goods should never be taxed.

On the other hand, demerit goods may be taxed if both the degree of disagreement and the elasticity of demand are large enough (see proposition 3 below).

Other commodities may potentially be taxed if the substitution effect reduces disagreement ($\delta\varepsilon_{l1} > 0$) and/or if income effects are large enough and of the right sign ($\delta\omega_1(\varepsilon_{ly} - \varepsilon_{1y}) > 0$).

2.7.1 Homothetic preferences

This latter income effect is absent if the son's preferences are homothetic: in that case, the income elasticity is the same for all goods, and for each l (under the notation $\varepsilon_1 \equiv \varepsilon_{11}$):

$$\frac{\partial W}{\partial p_l} = \frac{\partial v^s}{\partial p_l}\left[1 - \delta\varepsilon_{l1}\right].$$

If commodity 1 is a demerit good (cigarettes), it is never optimal to tax a commodity l if l and 1 are gross substitute (raw tobacco), providing that good l itself is not a demerit good. Under general preferences, it remains to be checked that the income effect does not dominate this substitution effect.

2.7.2 The case of increasing disagreement

The following proposition characterizes the optimal price of good 1 if we assume in addition: that the good is ordinary; that the degree of disagreement increases, and that the elasticity of demand does not increase, with the amount consumed.

Assumption 2 (Son's preferences) *Good one is ordinary: $\varepsilon_1 < 0$; and the elasticity of demand $\varepsilon_1(p, y)$ does not increase with p_1.*

This assumption is met in particuliar when elasticity is constant[7]

Assumption 3 *Good 1 is a demerit good ($\delta(x) < 0$); $\delta(x)$ decreases with x_1, and does not depend on x_l for $l \neq 1$.*

A decreasing negative δ indicates that the mother and the son disagree more the more the son consumes of the good.

Proposition 3 *Under assumptions 1, 2, and 3, three cases may occur:*

[7] This is true under Cobb-Douglas or Constant Elasticity of Substitution preferences. Notice that if demand elasticity is constant, it cannot be larger than -1: if $x_l(p, y) = Kp_l^{-\varepsilon}$, then $p_l x_l$, the amount dedicated to good l, is equal to $Kp_l^{1-\varepsilon}$, which goes to infinity (and eventually becomes larger than y) as p_l increases to infinity). Therefore, empirical estimates of elasticity smaller larger than -1 cannot be used to study the effects of policies which induce very large price increases.

- *if* $\delta(x^s(\bar{p},y))\varepsilon_1(\bar{p},y) < 1$, *then* $p^* = \bar{p}$ *(no tax);*
- *if* $\delta(x)\varepsilon_1(\bar{p},y) > 1$ *when* $x_1 = 0$, *then* $p_1^* = +\infty$ *(prohibition);*
- *in all other cases, the optimal price* p_1^* *is finite, such that* $p_1^* > \bar{p}_1$, *and characterized by:*

$$\delta(x^s(p^*))\varepsilon_1(p^*) = 1.$$

INSERT HERE FIGURES 2 AND 3

PROOF: Under assumption 3, $\delta(x)\varepsilon(x_1)$ increases with x_1; under assumption 2, x_1^s decreases with p_1. Therefore, if $\delta(x^s(\bar{p},y))\varepsilon(x^s(\bar{p},y)) < 1$, for any $p_1 \leq \bar{p}_1$, $\partial W/\partial p_1 \leq 0$, and any increase in price is welfare decreasing: the reduction in disagreement never compensates the direct effect. If $\delta(x)\varepsilon(x) > 1$ when $x_1 = 0$, then this condition also holds for any x, and any increase in price increases welfare: the optimal policy is to ban the product. In the third case, the solution is interior and characterised by the first order condition $\partial W/\partial p_1 = 0$.

□

A finite tax should be such that disagreement is equal to the inverse of elasticity. Such a finite tax may exist if disagreement increases with quantity and/or if elasticity decreases with price, since in that case $\delta\varepsilon$ decreases with price. (See Figure 3 above.) If both disagreement and elasticity are constant, then two locus may be distinguihed (See Figure 4.)

INSERT HERE FIGURE 4

First, goods for which disagreement is weak ($\delta \in [-1, 0]$) or even strong ($\delta < -1$) should not be taxed or prohibited unless the son's demand is sufficiently elastic.

This is in contradiction with the standard view of optimal taxation in the spirit of Ramsey, for which taxed induced distortions are less costly when demand is inelastic. The discrepancy comes from the fact that, here, distortions are *not* costly, but are precisely the objective of taxes under a paternalistic criterion. For goods with inelastic demand, the cost to manipulate choices through prices would be very high.

Second, goods with an elastic demand and a sufficiently large degree of disagreement should be prohibited. This comes from the fact that ex ante welfare is monotonically increasing with price, since there is always a marginal gain due to reduction of disagreement by increasing price.

In an intertemporal choice context with changing preferences, the result indicates that an individual who anticipates that his preferences for a good will increase ($\beta < 1$ and therefore $\delta^{t,s} < 0$) may be willing to tie his hands with a higher price if this indeed has a sufficiently "distortive" impact on his choices tomorrow. If not, the cost in terms of foregone income will overweight the gain in terms of comittment to an ex ante better choice.

3 Tobacco taxes

The negative consequences of smoking on smokers' health has been largely documented[8] since the eary work of Doll and Hill (1954), or Wydney and Graham (1950). More recently, the consequences of smoking on non-smokers' health (so-called passive, or second hand, smoking) has also been studied, and negative effects have been demonstrated, even if they are not of the same order of magnitude that "active" smoking [9]. Moreover, wide diffusion of this scientific knowledge among the general public has been constant, ever since the first US Surgeon General Report (1964).

Most of the adverse effects of smoking on health induce monetary and non monetary costs, be it by increasing mortality or health care spendings. To what extent are these costs internalized by smokers? Death risk may be, at least partially, internalised by smokers[10]. Hospital costs, which are paid in a large part by public or private health insurance, could induce a discrepancy between private and social costs, but it has been argued that the monetary costs of, say, lung cancer treatment may be negligeable with respect to the non monetary costs (pain, suffering) associated with the illness itself. Moreover, some authors estimate that tobacco taxes paid and pensions unreceived by smokers outweigh their cost on health services (Leu and Shaub,

[8] According to Chaloupka and Warner (2000), "some 70 000 scientific articles have implicated smoking in a wide variety of ailments, constituting the largest and best documented literature linking behavior to diseases in humans."

[9] See, e.g., Environmental Protection Agency (1994). Glantz and Parmley (1995) show that a non-smoker living for *** years with a smoker has an increased risk of heart disease of 1.4 (CHECK). As a benchmark, for smokers themselves, this risk factor is... 50 (CHECK FIGURES).

[10] Viscusi (1992) reports that even smokers estimate (or so they declare) a death risk from smoking-related causes of 47%, a figure actually *larger* than estimates from the epidemiological litterature (around 16 to 32 %).

1983; Viscusi, 1995).

Apart from this much debated "standard" externality argument, an other rationale for public price intervention may be a less standard "externality to oneself" argument (Shelling, 1983). This paternalistic argument views tobacco as a demerit good, and assumes that individuals do not internalise all the costs to themselves associated with their (especially, early one) consumption. In fact, the argument goes a lot further and assumes, not only that agents make mistakes when they compute their own welfare (which is likely to be true), but also that public agencies makes less mistakes (with much less information about preferences but much more about probabilities, to make it short). This view is of course in sharp contrast with modern public economic theory, in which the government has an information disadvantage with respect to individuals.

3.1 Tax as a comittment device

Assume away (for now) all external effects (to others) of tobacco smoking. Assume that the level of tobacco price is the result of a rationally inconsistent utility maximizing agent, who uses high price as a way to restric his future choices. We may wonder what would be the degree of temporal inconsistency for the current level of taxes to be optimal?

3.1.1 Calibration

Empirical measures of price elasticity of demand for tobacco (among the young population) was estimated at -1.31 by Chaloupka and Grossman (1996).

If the actual tax level is optimal, it means that the resulting price is such that the product of the elasticity of demand and the degree of disagreement is equal to 1. This corresponds to a degree of disagreement between the two selfs of $\delta = 1/\varepsilon = -0.76$, and therefore to an "impatience," "salience," or "vividness" parameter value β of 0.24. Present net benefits would be roughly weighted four times larger than future net benefits.

Whether this implies a huge change in preferences or not is an interpretation left to the reader...

Even though some form of hyperbolic discounting seems to be compatible with many observed facts[11], empirical estimates of the salience parameter are

[11] This is especially true in explaining savings behaviour (Laibson, 1997; Thaler, 1998.)

difficult to obtain, since this parameter needs to be distinguished from pure time preference, which itself must be separated from risk aversion parameters (Barsky et al., 1997).

In a broader perspective, the degree of disagreement represents the fraction of all (private and social) future costs and benefits associated with current decisions. If negative external effects to others are large, this reduces by as much the size of negative non-internalised effects to oneself needed for actual price levels to be optimal.

The same back-of-the-envelope calculations can be made for illegal drugs. Saffer and Chaloupka (1995) found that the long run demand elasticity for heroin was much larger in absolute terms (about -1.8 to -1.6) than for cocain (about -1.1 to -0.7). Using the lower bound of these estimates, this implies that the current prohibition policies reveal an implicit degree of disagreement smaller than -0.9 for cocain ($\beta < 0.1$) , and smaller than -0.6 for heroin ($\beta < 0.4$). In short, the comittment argument may be more valid for prohibiting heroin than for prohibiting cocain.

4 Conclusion: smoking and welfare?

In a paternalistic world, the social objective is not (only) derived from individual welfare. The implicit asumption is that the government has better information than individuals themselves about the effect of consumption on their own utility. Whether this is reasonable is indeed a matter of debate, but this paper has taken the social objective as given, without questioning the validity of paternalistic arguments, and attempted to determine the optimal price, given this objective.

The model also applies to temporal inconsistencies of choices. Under hyperbolic discounting, the degree of disagreement between the two selves is the additional weight given by the self tomorrow to his consumption.

The main result is that only goods with sufficiently highly elastic demand may be candidates for paternalistic, or comittment, taxation.

Second, in a "revealed preference" approach, we tried to estimate the implicit degree of disagreement (between an agent and himself at different points in time) about the costs and benefits of smoking, if actual prices are to be optimal according to this objective. The first analysis showed that, even under relatively high values for the elasticity of demand, the degree of

disagreement must be very large (one to four) for actual prices to be optimal under current estimates of elasticity.

The theoretical model developed in this paper indicates two directions for future research. First, the model needs to be completed to integrate substitution effects induced by high taxes. In particular, the special case of an infinite price (prohibition) should take into account the potential existence of a parallel illegal market for similar goods. Preliminary analysis indicates that a key parameter is the elasticity of black market size with respect to legal price changes. If such an elasticity is high, then the degree of disagreement must be even higher for prohibition to be optimal.

Second, empirical measures of the salience parameter, either through questionnaires[12] or through econometric analysis of actual behavior towards goods such as tobacco or other drugs, could also bring useful guidance to public health policies.

5 Conclusion

A Proof of Lemma 2.1

We have for all k:

$$\begin{aligned}
\frac{\partial W}{\partial p_l} &= \sum_{k=1}^{L} \frac{\partial u^m}{\partial x_k} \frac{\partial x_k^s}{\partial p_l} \\
&= \sum_{k=1}^{L} \frac{\partial u^s}{\partial x_k} \frac{\partial x_k^s}{\partial p_l} + \left(\frac{\partial u^m}{\partial x_1} - \frac{\partial u^s}{\partial x_1} \right) \frac{\partial x_1^s}{\partial p_l} \\
&= \frac{\partial v^s}{\partial p_l} + \frac{\partial u^s}{\partial x_1} \left(\frac{\partial u^m}{\partial x_1} / \frac{\partial u^s}{\partial x_1} - 1 \right) \frac{\partial x_1^s}{\partial p_l} \\
&= \frac{\partial v^s}{\partial p_l} + \frac{\partial u^s}{\partial x_1} \delta \frac{\partial x_1^s}{\partial p_l}.
\end{aligned}$$

[12] Arrondel, Masson and Verger (1997) conducted a survey on a subsample of the "Wealth and Assets 1997," with many questions aimed at estimating time preference and risk attitudes.

The Kuhn and Tucker conditions that characterize an interior solution to the son's maximization problem imply (using Roy's identity) that:

$$\frac{\partial u^s}{\partial x_1} = p_1 \frac{\partial v^s}{\partial y} = -\frac{p_1}{x_l^s}\frac{\partial v^s}{\partial p_l}.$$

Therefore:

$$\begin{aligned}\frac{\partial W}{\partial p_l} &= \frac{\partial v^s}{\partial p_l} - \frac{p_1}{x_l^s}\frac{\partial v^s}{\partial p_l}\delta\frac{\partial x_1^s}{\partial p_l} \\ &= \frac{\partial v^s}{\partial p_l}\left[1 - \delta\frac{p_1}{x_l^s}\frac{\partial x_1^s}{\partial p_l}\right].\end{aligned}$$

The Slutsky equation implies that, for any l, we have that:

$$\begin{aligned}\frac{\partial x_1^s}{\partial p_l} &= \frac{\partial x_l^s}{\partial p_1} + \frac{\partial x_l^s}{\partial y}x_1^s - \frac{\partial x_1^s}{\partial y}x_l^s \\ \frac{p_1}{x_l^s}\frac{\partial x_1^s}{\partial p_l} &= \varepsilon_{l1} + \omega_1(\varepsilon_{ly} - \varepsilon_{1y}).\end{aligned}$$

Therefore, we can write for any l:

$$\frac{\partial W}{\partial p_l} = \frac{\partial v^s}{\partial p_l}\left[1 - \delta\varepsilon_{l1} + \omega_1(\varepsilon_{ly} - \varepsilon_{1y}))\right]. \tag{4}$$

In particuliar, for $l = 1$, we obtain:

$$\frac{\partial W}{\partial p_1} = \frac{\partial v^s}{\partial p_1}\left[1 - \delta\varepsilon_1\right].$$

□

References

[1] Ainslie, George (1975), "Specious reward: a behavioral theory of impulsiveness and impulse control," *Psychological Bulletin*, 82: 463-509.

[2] Akerlof, George (1991), "Procrastination and obedience," *American Economic Review* 72: 307-319.

[3] Allais, Maurice (1947), *Economie et Intérêt*, Paris, Imprimerie Nationale.

[4] Arrondel, Luc, André Masson, and Daniel Verger (1997), "Comportements face au risque et à l'avenir: une enquête méthodologique," DELTA working paper 97-29.

[5] Barky, Robert, Thomas Juster, Miles Kimball, and Matthew Shapiro (1997), "Preference parameters and behavioral heterogeneity: an experimental approach in the health and retirement study," *Quarterly Journal of Economics.*

[6] Besley, Timothy (1988), "A Simple Model for Merit Good Arguments," *Journal of Public Economics*, 35(3): 371–83.

[7] Carillo, Juan, and Thomas Mariotti (2000), "Strategic ignorance as a self-disciplining device," forthcoming, QJE?

[8] Chaloupka, Frank J. and Michael Grossman (1996), "Price, Tobacco Control Policies and Youth Smoking," NBER Working Paper No. 5740

[9] Chaloupka, Frank J. and Ken Warner (2000), "The economics of smoking," forthcoming in *The Handbook of Health Economics*

[10] Churchill, Wynston. ???

[11] Doll, R., and A. B. Hill (1954), "The mortality of doctors in relation to their smoking habits: a preliminary report," *British Medical Journal* 1: 1451-5.

[12] Elster, Jon (1979), *Ulysses and the Sirens*, Cambridge University Press.

[13] Environmental Protection Agency (1992), *Respiratory effects of passive smoking: lung cancer and other disorders,* EPA, Office of Research and Development.

[14] Glantz, S. A., and W. W. Parmley (1995), "Passive smoking and heart disease: mechanisms and risk," *Journal of the American Medical Association* 62 (2): 451-459.

[15] Hammond, Peter (1976), "Changing tastes and coherent dynamic choice," *Review of Economic Studies*, 43(1): 159–173.

[16] Hammond, Peter (1981), "Ex ante and ex post welfare optimality under uncertainty," *Economica* 48: 235-250.

[17] Holly, Alberto (1999), "Relation(s) entre la consommation tabagique et la taxation du tabac - divers scénarios," working paper, Institut d'Economie et Management de la Sante, Université de Lausanne.

[18] Harsanyi, J. (1955), "Cardinal welfare, individualistic ethics, and interpersonal comparisons of utility," *Journal of Political Economy* 63: 309-321.

[19] Laibson, D. I. (1997), "Golden eggs and hyperbolic discounting," *Quarterly Journal of Economics* 112: 443-477.

[20] Leu, Robert, and Thomas Shaub (1983), "Does smoking increase medical expenditures?" *Social Science and Medicine* 17: 1907-14.

[21] Leu, Robert, and Thomas Shaub (1984), "Economic aspects of smoking," *Effective Health Care* 2(3): 111-123.

[22] Musgrave (1959), *The theory of public finance*, McGraw-Hill, New York.

[23] Orphanides, A. and D. Zervos (1995), "Rational addiction with learning and regret," *Journal of Political Economy*, 103: 739-758.

[24] Orphanides, A. and D. Zervos (1998), "Myopia and addictive behaviour," *The Economic Journal*, 108(446): 75-91.

[25] Saffer, Henry, and Frank Chaloupka (1995), "The Demand for Illicit Drugs," NBER working paper 5238.

[26] Sandmo, Agnar (1983), "Ex Post Welfare Economics and the Theory of Merit Goods," *Economica*; 50(197): 19-33.

[27] Schelling, Thomas (1983), "Choice and Consequence," Harvard University Press.

[28] Stiglitz, Joseph (1986), *The economics of the public sector*, Norton.

[29] Strotz, R. (1956), "Myopia and inconsistency in dynamic utility maximization," *Review of Economic Studies*, 23(3): 165–180.

[30] Thaler, Richard (1990), "Saving, fungibility, and mental accounts," *Journal of Economic Perspectives* 4: 193-205.

[31] US Department of Health and Human Services (1994), "Preventing tobacco use among young people: report of the Surgeon General" US Government Printing Office.

[32] Viscusi, Kip (1992), *Smoking: making the risky decision*, Oxford University Press.

[33] Viscusi, Kip (1995), "Cigarette taxation and the social consequences of smoking," in *Tax Policy and the Economy*, J. Poterba, ed., MIT Press.

[34] Warner, Ken, Frank Chaloupka, P. Cook, et al. (1995), "Criteria for determining an optimal cigarette tax," *Tobacco Control* 4: 380-6.

[35] Wynder, E. L., and E. A. Graham (1950), "Tobacco smoking as a possible etiological factor in bronchiogenic carcinoma: a study of 684 proved cases," *Journal of the American Medical Association* 143: 329–396.

Figure 1. “Optimality”: m-choice implemented

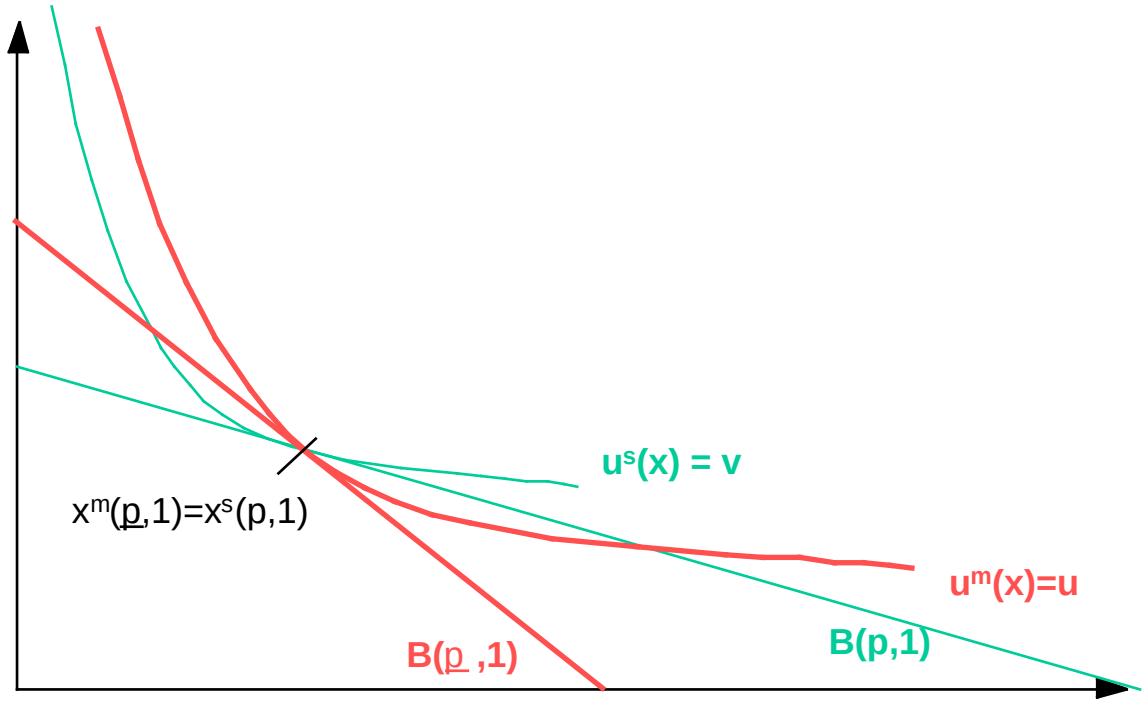

Figure 2. Positive price distorsion ?

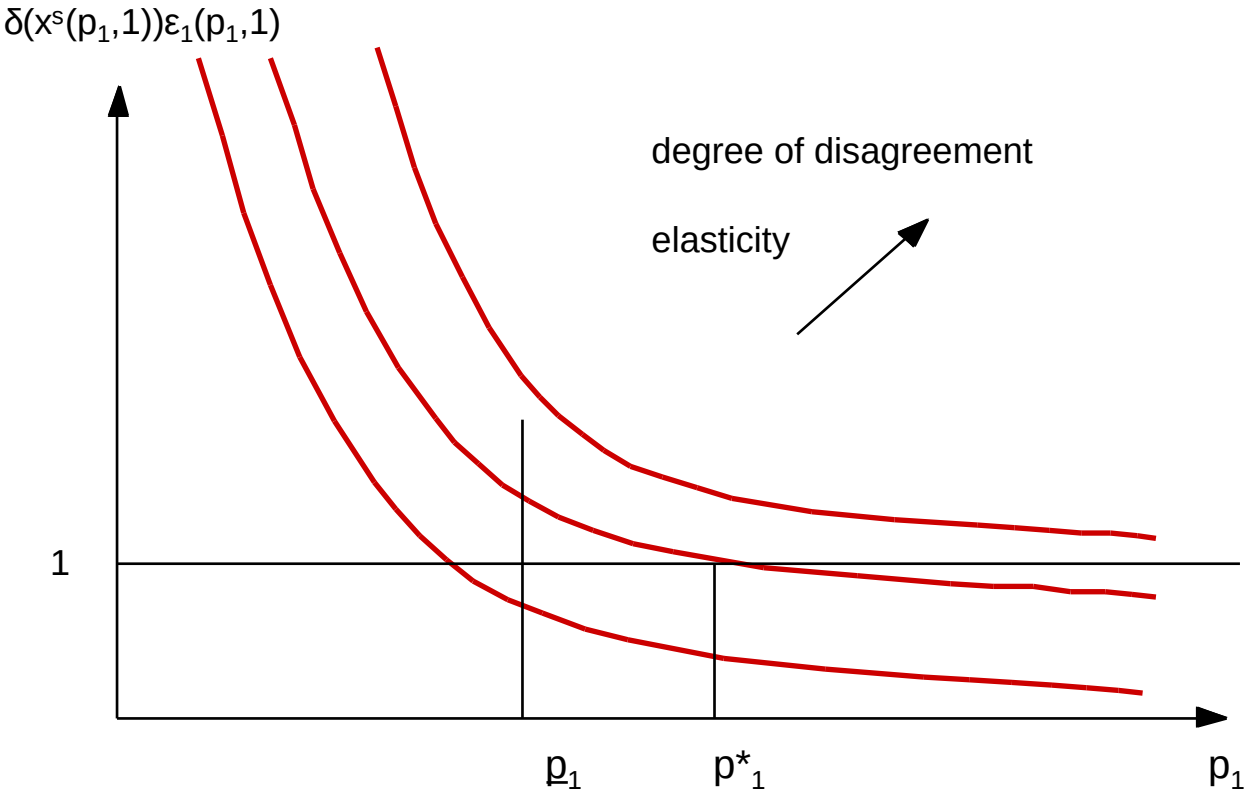

Figure 3. Positive price distorsion

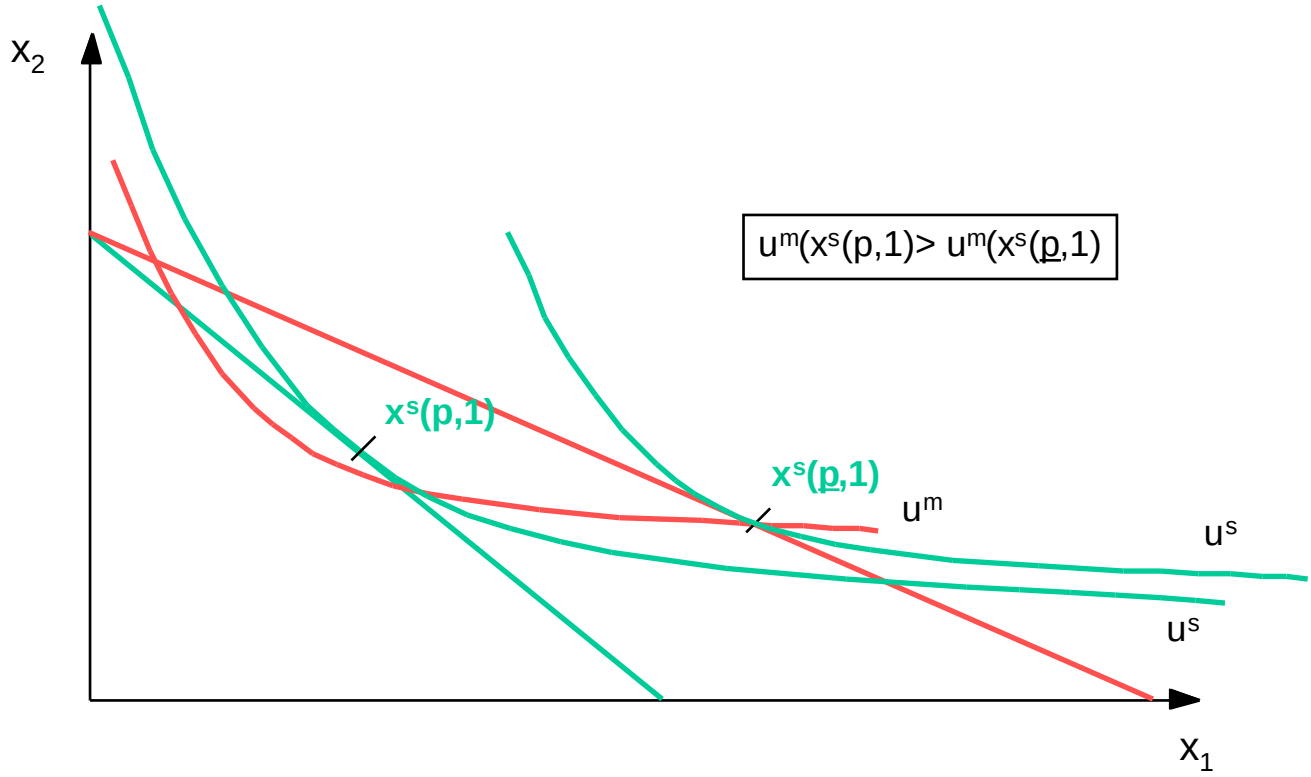

Figure 4. Optimal price comittment strategy