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THE INCIDENCE OF SIN TAXES

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The Incidence of Sin Taxes[*]

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Abstract

We show that contrary to traditional incidence analysis, the burden of sin taxes does not necessarily fall most heavily on individuals with the highest level of consumption. We also derive a condition for cases where sin taxes improve individual welfare. We further argue that taxes on goods such as unhealthy food can be progressive when consumers have time-inconsistent preferences.

Keywords: tax incidence, self-control

JEL: H22, H30, I18

1   Introduction

We analyze the incidence of taxes on goods whose current consumption causes utility costs (for example negative health effects) in the future. When consumers have time-inconsistent preferences, they consume too much of such goods. Using "sin taxes" to

correct distortions in the consumption of harmful goods has also been considered in O'Donoghue and Rabin (2003; 2006).

In addition to the monetary cost of taxation, sin taxes affect individual utility due to the corrective nature of the tax when preferences are time-inconsistent. In order to take this positive effect into account, traditional incidence measures need to be modified. Gruber and Köszegi (2004) have suggested the use of such a utility based incidence measure in the case of taxes on addictive goods such as cigarettes[1]. Because of the complexity of the problem analyzed in their paper, Gruber and Köszegi (2004) are restricted to consider a particular form of the periodic utility function (quadratic utility). By restricting attention to the simpler case of goods that are harmful but not addictive, we can consider more general utility functions. We are also able to derive an explicit condition for the case where sin taxes improve an individual's welfare.

Contrary to traditional incidence analysis, the burden of sin taxes does not necessarily fall most heavily on individuals with the highest level of consumption: when consumption is high, the tax does imply a higher monetary cost, but also a higher utility benefit from self-control. It may even be the case that those with the highest level of consumption are hurt least by (or benefit the most from) the tax. Further, we show that the welfare effect of sin taxes depends importantly on the elasticity of demand, as well as on the extent of self-control problems and the marginal harm caused by consumption. To the extent that individuals with low income have more elastic demand than individuals with higher income, it is possible that taxes on goods such as unhealthy food are progressive, in the sense that their overall utility cost (benefit) is lowest (highest) for poor individuals. This is contrary to the common counter-argument against heavy VAT rates on necessities, which are usually regarded as regressive.

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[1]For addictive goods, consumption today not only causes harm tomorrow, but also increases the marginal benefit of future consumption.

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2 Quasi-hyperbolic discounting and over-consumption of harmful goods

We consider a model where consumers use quasi-hyperbolic discounting (Laibson 1997), using a set-up that is similar to O'Donoghue and Rabin (2003, 2006). Lifetime utility of an individual is given by

$$U_t = (u_t, ..., u_T) = u_t + \beta \sum_{s=t+1}^{T} \delta^{s-t} u_s, \tag{1}$$

where $\beta, \delta \in (0,1)$ and u_t is the periodic utility function. Individuals derive utility from a composite good (z), which can be interpreted as leisure, and another good (x) which is harmful in the sense that it yields positive utility in the short-run, but has some negative effects in the long-run. Specifically, we assume that periodic utility is given by

$$u_t (x_t, x_{t-1}, z_t) = v(x_t) - h (x_{t-1}) + \alpha z_t \tag{2}$$

where α is the marginal utility of income. The function v is increasing and concave. The harm function h is increasing and it can in principle be either concave or convex, as long as $v'' - h'' < 0$. In our view the most likely case is the one where $h'' \geqslant 0$.

We assume that there is no borrowing or lending. In each period, consumers then maximize $u_t = v(x_t) - \beta\delta h (x_t) + \alpha z_t$ subject to a per-period budget constraint $qx_t + z_t \leq 1$, where we have normalized the wage and the consumers' fixed time endowment to 1, and q denotes the consumer price of good x. The demand for good x therefore satisfies[2] $v'(x^*) - \beta\delta h' (x^*) - \alpha q = 0$.

On the other hand, the levels of consumption that would maximize lifetime utility are those that maximize $\bar{u}_t = v (x_t) - \delta h (x_t) + \alpha z_t$. The optimal level of consumption

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[2] We have dropped the time index t, since with our specification consumption is constant accross periods.

therefore satisfies $v'(\bar{x}^*) - \delta h'(\bar{x}^*) - \alpha q = 0$: because of quasi-hyperbolic discounting ($\beta < 1$), the equilibrium level of consumption of the harmful good (x^*) is higher than the level that would maximize long-run welfare of the individual himself ($\bar{x}^*$).

3 Incidence of sin taxes

As market-based mechanisms for correcting the distortion caused by time-inconsistent preferences are likely to be ineffective (see Köszegi (2005)), the government can consider imposing a tax on the consumption of the harmful good. To the extent that laws on commodity taxation cannot be changed each period, this will provide an effective commitment-device for consumers. Optimal sin taxes have been analyzed in O'Donoghue and Rabin (2003, 2006).

We do not analyze the question of optimal sin taxes here, but simply examine the factors affecting their incidence. As in Gruber and Köszegi (2004), we measure incidence by the overall impact of the tax on individual utility. We assume that the tax comes into effect starting from the period after the decision to impose the tax is made. Therefore, each consumer evaluates the effect of the tax according to his long-run utility function (but taking into account that consumption decisions will be taken to maximize utility each period and will therefore be distorted, as above). The effect of a price (or tax) increase on a consumer's welfare (measured per period) is therefore given by

$$\frac{d\bar{u}(x^*)}{dq} = \frac{\partial \bar{u}(x^*)}{\partial q} + \frac{\partial \bar{u}(x^*)}{\partial x^*}\frac{\partial x^*}{\partial q}. \tag{3}$$

For time-consistent consumers, $x^* = \bar{x}^*$ and the effect of the tax on utility is given by Roy's identity, $\frac{d\bar{u}(\bar{x}^*)}{dq} = \frac{\partial \bar{u}(x^*)}{\partial q} = -\alpha x^*$. However, to obtain a correct incidence measure for the case where $x^* > \bar{x}^*$, we need to consider the second term, $\frac{\partial \bar{u}(x^*)}{\partial x^*}\frac{\partial x^*}{\partial q}$. This term is zero for time-consistent consumers but positive for time-inconsistent consumers,

reflecting the fact that the price increase helps such consumers to overcome a distortion in consumption.

In order to analyze tax incidence in more detail, we note that the derivative in (3) is given by

$$\frac{d\bar{u}\left(x^*\right)}{dq} = -\alpha x^* + \left(v'(x^*) - \delta h'\left(x^*\right) - \alpha q\right)\frac{\partial x^*}{\partial q}. \tag{4}$$

Denoting the elasticity of demand for the harmful good by $\varepsilon = \frac{\partial x^*}{\partial q}\frac{q}{x^*}$, the welfare effect of a tax increase can be written as

$$\frac{d\bar{u}\left(x^*\right)}{dq} = -\alpha x^* \left[1 - |\varepsilon|\frac{\left(1 - \beta\right)\delta h'\left(x^*\right)}{\alpha q}\right]. \tag{5}$$

Our main results follow from equation (5), which shows that the traditional incidence measure is in our context multiplied by the term $1 - |\varepsilon|\frac{(1-\beta)\delta h'(x^*)}{\alpha q}$. Therefore, if there are no self-control problems ($\beta = 1$) we obtain the traditional incidence measure. On the other hand, when $\beta < 1$, the tax has both monetary costs ($-\alpha x^*$) and self-control benefits ($x^* |\varepsilon|\frac{(1-\beta)\delta h'(x^*)}{q}$).

In traditional incidence analysis, the burden of taxation always falls most heavily on individuals with the highest level of consumption. A key point to note here, however, is that not only the monetary costs, but also the self-control benefits of taxation are in most cases monotonically increasing in the quantity consumed. This is always the case for example when $h''\left(x^*\right) \geq 0$ and when the elasticity of demand is constant or increasing in x. If self-control benefits increase more rapidly than the monetary costs, the burden of taxation falls *least* heavily on those with the highest level of consumption. This is more likely to happen if self-control problems are extensive (β is low), consumption causes a lot of harm (h' is high), demand is highly elastic or when future utility is discounted relatively little (δ is high). In these cases, there is more to be gained from better self-control.

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Further, for some parameter values, it is possible that the gain from enhanced self-control exceeds the monetary loss from the tax[3]. This is in stark contrast to traditional incidence analysis, where tax incidence is always negative. Rearranging (5) and using the individual's first order condition, a price increase leads to an increase in a consumer's welfare if

$$|\varepsilon| > \frac{v'(x^*) - \beta\delta h'(x^*)}{(1-\beta)\,\delta h'(x^*)} \tag{6}$$

As discussed above, sin taxes can improve welfare only if demand for the harmful good is elastic enough (that is, if (6) is satisfied) - only when demand is responsive enough to price changes will taxation be an effective self-control device. We can consider two simple special cases. When harm is proportional to initial enjoyment from consumption, that is if $h(x) = \gamma v(x)$, where $\gamma \in (0,1)$, (6) simplifies to $|\varepsilon| > \frac{1-\beta\delta\gamma}{(1-\beta)\delta\gamma}$. The right hand side of this inequality is greater than 1 and therefore $|\varepsilon| > 1$ is a necessary (though not always a sufficient) condition for the tax to be welfare-improving in this special case. However, in the more realistic case where harm is proportional to consumption rather than initial enjoyment ($h(x) = \gamma x$), condition (6) becomes $|\varepsilon| > \frac{v'(x^*) - \beta\delta\gamma}{(1-\beta)\delta\gamma}$. $|\varepsilon| > 1$ is then no longer necessary for the tax to be beneficial for welfare.

The above analysis has interesting implications for the discussion on whether taxes on goods such as unhealthy food are regressive. By regressivity, we mean that the overall utility cost (benefit) of a tax, as measured by equation (3), is higher (lower) for the poor than for the rich. We showed above that in the context of sin taxes, it is no longer necessarily the case that individuals with the highest level of consumption bear most of the tax burden. Therefore, in the present context, the traditional argument that high taxes on necessities must be regressive because they occupy a higher proportion of the budget of the poor simply has no bite.

Further, to the extent that demand is more elastic for the poor, the burden of sin

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[3]See Gruber and Mullainathan (2005) for empirical evidence that higher cigarette taxation can make smokers happier.

taxes falls *less* heavily on the poor than on the rich.[4] It can further be noted that the observation that food is a necessity and therefore has a low income elasticity, in no way precludes the possibility that the price elasticity may be high enough for (6) to be satisfied. In particular, if we concentrate on the example of unhealthy food, this has a natural and a very close substitute - namely healthy food - and therefore demand can be expected to be rather elastic, and such substitution will only reinforce the beneficial effects of the tax[5]. Further, the fact that the poor spend a larger share of their budget on food only tends to make the price elasticity higher for them, as implied by the Slutsky equation. Individuals with a low income may therefore be hurt less by - or benefit more from - sin taxes than the rich.

4   Conclusion

We have examined how traditional incidence measures have to be adapted in the case of sin taxes. In particular, we have emphasized that sin taxes do not necessarily fall most heavily on individuals with the highest level of consumption, since such individuals have the most to gain from the corrective nature of the tax.

Further, we have shown that the welfare effects of sin taxes depend importantly on the elasticity of demand for the harmful good. We can therefore conclude that to the extent that individuals with low income have more elastic demand than individuals with higher income, it is possible that sin taxes are in fact progressive. It is interesting to contrast this finding with a remark made by James Mirrlees, who has stated that "it is not inevitable that taxes distort the economy, but if they are fair, then they almost

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[4]If β and/or δ vary across population groups, this has an effect on incidence. In their analysis of cigarette taxation, Gruber and Köszegi (2004) argue that the effect on incidence of varying δ is relatively small, whereas there is no evidence on how β varies in the population. The exact magnitude of the different effects in our context is a matter for empirical study, and is beyond the scope of this note.

[5]This is in contrast to the example of cigarettes, where substitution is at least in part likely to be towards untaxed bads such as drugs, which serves to partially undermine the positive health effects of taxation.

certainly do" (Mirrlees 2000, 2). If we make the usual interpretation that taxation that hurts low income individuals the most is "unfair", sin taxes are in fact a case of taxes that can be *both* fair and reduce distortions.

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