A Behavioral Economics Perspective on Tobacco Taxation

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Economic studies of taxation typically estimate external costs of tobacco use to be low and refrain from recommending large tobacco taxes. Behavioral economics suggests that a rational decision-making process by individuals fully aware of tobacco's hazards might still lead to overconsumption through the psychological tendency to favor immediate gratification over future harm. Taxes can serve as a self-control device to help reduce tobacco use and enable successful quit attempts. Whether taxes are appropriately high depends on how excessively people underrate the harm from tobacco use and varies with a country's circumstances. Such taxes are likely to be more equitable for poorer subgroups than traditional economic analysis suggests, which would strengthen the case for increased tobacco taxation globally. (*Am J Public Health.* 2010;100: 609–615. doi:10.2105/AJPH.2009.160838)

A growing international consensus favors measures to reduce tobacco use in both developed and developing countries[1,2] despite the controversy such policies often engender. Tobacco taxation, which affects both public health and public finance, is especially contentious.[3]

By some estimates, taxes that raise the real price of cigarettes by 10% can reduce consumption between 1.2% and 3.36% in high-income countries and by 4% to 6% in low-income countries, where consumers are more price sensitive.[4] From a public health perspective, raising taxes has a straightforward logic: it encourages smokers to quit, saving more lives.

By contrast, economists' skepticism of tobacco taxation as a policy tool stems from theoretical and empirical concerns regarding efficiency and equity. Economists typically agree that taxes are required when prices in a market understate the harm that individual decisions cause to society as a whole, but they also hold that taxes should not interfere with private choices that do not harm others. Higher taxes are inefficient if the harm from restricting individuals' overall consumption choices exceeds the societal benefits of reducing tobacco use. Further, higher tobacco taxes can be regressive if poorer groups bear a disproportionately larger burden because of reduced overall ability to purchase and consume other goods.

A more recent and growing body of economic research suggests that this conventional analysis might be inadequate as applied to tobacco taxation. The recognition that tobacco is addictive, that intent to quit is widespread, and that attempts to quit are difficult underlie most tobacco control policies, from cessation assistance to advertising restrictions. But the issue of self-control has generally not been incorporated into analyses of optimal tobacco tax levels.

Self-control problems in economic contexts are among the phenomena investigated by behavioral economics. This field uses psychological research on individual decision making to analyze market outcomes where some individuals display common cognitive and perceptual limitations and complications disregarded by more conventional economic models.[5] Jonathan Gruber and Botond Kőszegi[6,7] used a behavioral economics approach to suggest that taxes higher than the rates typically recommended may be appropriate.

The main rationale for recommending higher taxes is that price increases can counter some of the harm to society that private markets ignore. Like conventional economic approaches, behavioral economics holds that tobacco use reflects interactions of supply and demand factors. Traditional economic models usually predict that the amount of tobacco individuals consume at any given price precisely reflects their private preferences. Behavioral economics instead suggests that some demand for tobacco reflects overconsumption attributable to poor self-control. Although current tax structures often redress some harm smokers cause others, they are not specifically designed to reduce the harm that smokers inflict on themselves when they are unable to reduce consumption despite an intent to do so.

INSIGHTS FROM BEHAVIORAL ECONOMICS

Several clinical and public health policies address the biological and psychosocial dimensions of habit-forming and addictive behaviors, including the processes that encourage users to seek reinforcement through repeated use and to develop tolerance, requiring higher levels of use to attain the same effect.[8] Economists have little to say about the biological basis of tobacco use—when studying markets, including those for tobacco products, they typically take individuals' preferences as a given and investigate how these preferences, translated into demand behaviors, interact with supply to determine prices. Individuals might well recognize that tobacco is harmful but act rationally to the extent that rational economic behavior consists in responding to prices in consistent ways, including reducing consumption when prices increase.[9]

Economists studying tobacco use attempt to address the paradoxical behavior of individuals who act in their best interest in most circumstances but harm themselves through tobacco use. Rather than attributing smoking to irrational choices, economists try to find ways that tobacco use by individuals is consistent with such behaviors as a tendency for risk taking, lower awareness of the harm from tobacco use,[10] and lower investments made in future career prospects.[11] Because smoking is an activity

that has consequences over an individual's lifetime, a particularly useful framework is the one used to understand decisions that have long-term consequences—decisions about savings, education, and health-related actions. The primary concept used to analyze decisions involving the time dimension is discounting, or the tendency to attach a lower value to the future than to the present.

Exponential Discounting in the Traditional Approach

Time preference—the principle that individuals value the present more than the future—is fundamental to economic analyses of decisions involving any time horizon, including health-related decisions. Economists agree that smokers tend to place a higher value on current rewards from smoking than on future health. Valuing present consumption higher than future outcomes—a positive rate of time preference—is common to most economic contexts. The factor by which harm or benefit at any future date is diminished is termed the discount rate. A 5% annual discount rate, for instance, implies that a smoker values a $100 health-related expense faced 1 year in the future at $95 today.

The traditional and behavioral approaches differ in how this time preference is modeled. The traditional approach models the discounting process as smooth, or free of sudden changes in preferences from one period to the next. The mathematical principle of exponential discounting with a constant discount rate captures the idea that from the viewpoint of the present, harm experienced on any future date is perceived as a constant fraction of the previous date's harm.

Consider a hypothetical smoker who knows that smoking is harmful and is deciding whether to smoke a full pack of 20 cigarettes in a day. As with any other purchase decision, smoking 20 cigarettes makes economic sense if benefits experienced are at least as high as costs incurred. These private costs of smoking, so called because they are fully borne by smokers themselves, include both the retail price paid and the individual's perception of the value of health harm.

If a smoker places a value of $25 on the experience of smoking a pack, and the purchase price of a pack is $5, health harm must be perceived as worth $20 or less (total costs of $25 or less) to make it worth smoking the entire pack. Whether a smoker values the health damages of the single pack at more or less than $20 depends on 2 key factors—the expected harm over the individual's time horizon and how much weight is given to harm incurred at all instances in the future.

To simplify, consider that the smoker has a 10-year time horizon, has full information about the health harm from smoking, and estimates that a pack results in exactly 1 cent's worth of health harm every day. Simple multiplication yields a total health harm over 10 years (3652 days) of $36.52. However, the smoker's decision today is based not on the total health harm of $36.52, but on its discounted value from the perspective of the present.

The conventional approach to modeling how a consumer collapses this future harm of 1 cent per day into the present is to apply exponential discounting smoothly over time. The exponential discounter column of Table 1 and the dotted curve in Figure 1 illustrate this point: perceptions of harm are lower the further into the future this harm is incurred but are not substantially lower from period to period. Adding the discounted harm over the smoker's 10-year time horizon yields a total cost of $28.74, the area under the dotted curve in Figure 1. Adding the pack price of $5 results in total private costs of $33.74, higher than the perceived benefit of $25. With the estimated discounted costs (pack price and perceived harm) being higher than the benefit, the smoker in this example would consume less than the whole pack.

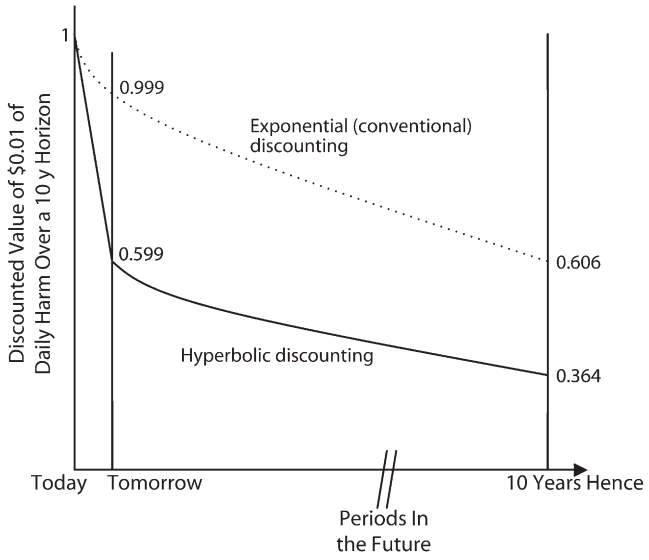
Hyperbolic Discounters and Tobacco Overconsumption

By contrast to exponential discounting, recent research[6,7] builds on the principle of hyperbolic discounting,[12] in which the costs and benefits consumers experience in the immediate future substantially outweigh those in the distant future.

TABLE 1—Hypothetical Cost-Benefit Calculations by an Exponential Discounter and 2 Hyperbolic Discounters

	Exponential Discounter	Hyperbolic Discounter A	Hyperbolic Discounter B
Smoker's valuation of benefit, $	25.00	25.00	25.00
Retail pack price paid by the smoker, $	5.00	5.00	5.00
Smoker's perception of health cost/day, $	0.01	0.01	0.01
Long-term discount factor, %	5.0	5.0	5.0
Short-term discount (multiplicative)	NA	0.9	0.6
Discounted value, today, of hypothetical health costs incurred at different points in the future,[a] cents			
Today (day 0)	1.0000	1.0000	1.0000
Tomorrow (day 1)	0.9999	0.8999	0.5999
In 1 wk (day 7)	0.9990	0.8991	0.5994
In 1 mo (day 30)	0.9959	0.8963	0.5975
In 1 y (day 365)	0.9512	0.8561	0.5707
In 5 y (day 1826)	0.7787	0.7008	0.4672
In 10 y (day 3652)	0.6064	0.5458	0.3638
Sum (discounted value of costs, day 0–3652), $	28.74	25.87	17.25
Total costs (retail pack price + discounted value of perceived health harm), $	33.74	30.87	22.25

Note. NA = not applicable. Discounting behavior refers to the extent to which costs and benefits further ahead in the future are undervalued from the perspective of the present. Exponential discounters do not make sudden jumps in their assessment of costs from 1 period to the next. A hyperbolic discounter's overemphasis on the current period underrates all future periods. A short-term discount factor of 0.6 implies a greater premium on immediate gratification than a short-term discount factor of 0.9, a lower assessment of the costs of smoking, and a correspondingly higher likelihood of smoking more cigarettes than intended at any point in the future. The exponential discounter and hyperbolic discounter A perceive the cost of a pack of cigarettes as exceeding the benefits of smoking it, thus will smoke fewer than 20 cigarettes. Hyperbolic discounter B perceives the cost as lower than its benefits and will smoke the whole pack or more.
[a]Hypothetical health costs = 1 cent/day.



Note. The area under the solid line represents net present value of perceived harm under hyperbolic discounting with a short-term discount factor of 0.6.

Figure 1—Model of exponential discounting and hyperbolic discounting.

This approach formalizes the observation that some decisions, such as smoking, are made under exceptionally impatient circumstances.

Gruber and Köszegi proposed that the discount rate smokers apply to the immediate future is considerably higher than that used when considering trade-offs in successive periods in the long term. This is illustrated by the bold curve in Figure 1. Unlike the dotted curve, which depicts exponential discounting, the discounted value of tomorrow's costs as perceived by the hyperbolic discounter falls steeply relative to costs today, even as discounting continues to proceed smoothly without jumps in successive periods thereafter.

This simple change in modeling preserves the general mathematical approach that economists use to understand decision making over time but fundamentally alters the analysis of individuals' decision to smoke by suggesting that perceived future harm has both short-term and long-term components. Hyperbolic discounters A and B (Table 1) both apply a 5% discount rate when considering harm in the long term, just as they would if they were exponential discounters. But, as Table 1 suggests, placing a higher premium on the present over the immediate future results in underrating all cumulative future harm.

Figure 1 shows this discounted cumulative health harm as perceived by hyperbolic discounter B, who, with a short-term discount factor of 0.6, weights future harm at 60% of the value an exponential discounter would place on it. The region under the bold curve is smoker B's perception of health harm, $17.25. Adding the $5 retail price of a pack yields a total cost of $22.25, less than the $25 value that smoker B places on the experience of smoking a pack.

For smoker B, this results in overconsumption of tobacco. Critically, the behavioral approach demonstrates how overconsumption can arise, not through ignorance of the future harm of smoking but through erroneous undervaluing of this harm. An analogy to this behavior is the tendency of credit card customers to select cards with attractive initial rates and to place a lower weight on the more disadvantageous rates often charged in the long run.[13]

Gruber and Köszegi's hyperbolic discounting model is an example of the more general phenomenon of time-inconsistent preferences. Choices are said to be time inconsistent when the pattern of behavior predicted for a future time diverges from what seems optimal when that future instance occurs. In the example of hyperbolic discounter B (Table 1, Figure 1), inconsistent preferences manifest from smoker B's prediction—like that of the exponential discounter—that smoking a full pack will not be worthwhile a week later. In 1 week's time, an exponential discounter would continue to smoke less than a full pack. By contrast, smoker B would again undervalue total future harm and find it worthwhile to smoke an entire pack.

The hyperbolic discounting model does not claim that tobacco overconsumption arises from individuals being irrational. Rather, Gruber and Köszegi changed a single assumption in the model that economists usually use to arrive at a very different prediction of addictive behavior. Their approach has the advantage of retaining conventional economic analysis for the evaluation of private and social costs to smoking, but also suggests an expanded role for public policy in addressing these costs.

TOBACCO TAXATION IN THE TRADITIONAL AND BEHAVIORAL APPROACHES

The conventional economic rationale for taxing tobacco is also used when taxing other products. Rational users are assumed to internalize the private costs or effects of tobacco consumption on themselves but not the unintended effects they impose on others. Effects imposed on others, termed externalities, are not reflected in the untaxed price of tobacco. By this thinking, optimal product taxes should offset externalities but not private costs.

Table 2, drawn from work by Sloan et al.,[14] illustrates an accounting of the costs per pack of cigarettes for a person aged 24 years in the United States and compares them to taxes typically imposed. Costs can be imposed on nonsmokers outside the household (external), within the household (quasi external), or on smokers themselves (private). Some costs are negative for smokers: shorter life spans, for example, mean that smokers make social security and private pension contributions that are not fully recovered because of earlier death. Life insurance outlays by nonsmokers, mortality costs imposed on spouses, and costs attributable to shorter life are, respectively, the largest estimated external, quasi-external, and private costs.

The traditional approach used in several analyses of smoking costs[15,16] considers only

TABLE 2—External, Quasi-External, and Private Costs per Cigarette Pack for US Smoker Aged 24 Years Over a Lifetime

Private Costs Confined to Smokers		Quasi-External Costs Imposed by Smokers on Household Members		External Costs Imposed by Smoking on Society[a]	
Cause	Cost, $	Cause	Cost, $	Cause	Cost, $
Mortality cost	20.28	Spousal mortality + infant death[b]	5.34	Work loss (sick leave)	0.76
Medical care cost	0.24	Medical expenditures	0.14	Medical care cost not borne by smoker	0.49
Disability cost	3.44	Spouse disability cost	0.25	Productivity losses	0.24
Social Security outlays lost	1.01	Social Security survivor benefits[c]	–0.17	Social Security outlays[c]	–0.84
Private pension outlays foregone	1.36	Private pension spouse benefits[c]	–0.12	Private pension outlays[c]	–1.24
Life insurance outlays avoided[c]	–1.78			Life insurance outlays	1.78
Social Security taxable earnings foregoned	5.10			Income taxes on foregone Social Security taxable earnings[d]	1.02
Cost of cigarettes[e]	3.12				
Total	32.78	Total	5.44	Total	2.20

Note. Traditional economic calculations call for excise taxes to offset negative externalities and quasi-externalities of tobacco use. Negative externalities are the harm that private actions cause society and quasi-externalities are the harm caused to immediate family members. The traditional approach recognizes private costs to smokers, but these are not corrected by taxes because they are assumed to reflect smokers' personal preferences rather than an unsuccessful history of quitting. Calculations are in year 2000 dollars.
Source. Adapted from Sloan et al, 2004.[14]
[a]External costs are limited to effects outside households. After subtracting per-pack federal excise taxes ($0.40) and state excise taxes ($0.36), net external costs are $1.44.
[b]Spousal mortality costs = $5.20; infant death costs = $0.14.
[c]The negative values result from earlier deaths of smokers.
[d]Earlier deaths result in foregone Social Security earnings, but also imply foregone taxes on those earnings.
[e]Taxes per pack over the lifetime of a 24-year-old smoker, calculated in year 2000 dollars and assuming that tax rates stayed constant after 2002, are $0.40 and $0.36 for federal and state excise taxes, respectively.

external costs, which, as noted in the first column of Table 2, total $2.20 per pack (in year 2000 dollars). By this criterion, current tax rates are nearly appropriate, with costs uncompensated by taxes totaling $1.44 per pack for a person aged 24 years in 2000 (total external costs less total taxes paid). Earlier estimates of optimal tax rates were as low as $0.33 per pack (in 1995 dollars).[17] Expanding the definition of costs to include quasi-external costs (second column of Table 2) yields a higher cost estimate of $5.44 a pack—by which measure existing taxes are insufficient.

THE BEHAVIORAL APPROACH TO PRIVATE COSTS

External and quasi-external costs are what most economists consider when suggesting optimal tobacco taxes. But economists would typically not recommend taxes sufficient to offset the largest costs, the private costs to smokers. The mortality costs in Table 2 are the largest of these private costs, totaling $20.28 for the 24-year-old smoker considered. Economists refrain from taxing private harm because smokers are assumed to be aware of these costs when they decide whether and how much to smoke.

However, behavioral phenomena such as hyperbolic discounting suggest that some portion of these private costs results not from reasoned decisions by smokers but from overrating immediate benefits of smoking against future harm. Taxation can thus potentially correct tobacco overconsumption resulting from excessive discounting of future costs. A higher price effectively provides a self-control device that cannot be circumvented. Such a tax is analogous to correcting for an externality ignored by the market, except this tax corrects for an internality, a consequence on individual health that the smoker would not desire if the decision whether to smoke the next cigarette were made under less impatient circumstances.

Table 3 draws on work by Gruber and Köszegi that uses the behavioral approach to compute optimal cigarette taxes in the US context that would reduce consumption by exactly offsetting 2 types of cost to society.[6,18] The first, as with the traditional approach, comprises externality costs, for which a consensus estimate of $0.40 per pack, derived from existing studies, is assumed. The second cost is the fraction of the harm of $35.64 attributed to smokers being hyperbolic rather than exponential discounters.

Computing an internality tax requires 2 estimates: the health damage to smokers and the portion of that damage that represents overconsumption attributable to undervaluing future harm through hyperbolic discounting. Gruber and Köszegi based their estimate of the value of life-years lost per pack (up to $35.64 in the United States) on assessments of the value of productive life; smokers' life expectancy, which is 6 years shorter than nonsmokers'; and data on smoking by age group.

If smokers are exponential discounters, none of these internal costs should be rectified by taxes—smoking a pack involves an implicit decision to forego $35.64 worth of life-years, and the optimal tax is limited to amounts needed to offset external harm. But if smokers make errors in discounting, as is more likely, tobacco taxes can potentially address these errors.

As Table 3 indicates, if smokers undervalue discounted future harm at 90% of the true harm, their tax is about 10% of the harm, or $3.56. In effect, price is increased to explicitly include costs underestimated by the hyperbolic discounter. The more smokers value immediate gratification, the larger the fraction of their cigarette consumption that can be attributed to failures in self-regulating use and the larger

TABLE 3—Calibrating Optimal Internality Taxes on Cigarettes in the United States in the Presence of Hyperbolic Discounting

	Short-Term Discount Factor			
	1[a]	0.9	0.8	0.6
Discounted health damages,[b] $	35.64	35.64	35.64	35.64
Fraction of discounted health damages ignored by hyperbolic discounters	0	0.1	0.2	0.4
Implied optimal internality tax, $	0.00	3.56	7.13	14.26
Implied optimal tax (offsetting externality + internality), $	0.40	3.96	7.53	14.66

Note. Tobacco taxes should offset externalities that tobacco users' behavior imposes on society plus the internalities associated with difficulty in self-control. Taxes do not interfere with the component of use that reflects a personal preference, but do counter the considerable component of harm that arises from users overconsuming because they underestimate the magnitude of future costs of present actions.
Source. Adapted from Gruber and Köszegi, 2008.[6]
[a]Exponential discounting.
[b]Health costs reflect age-specific usage and the lower value placed on periods further into the future and were calculated in 6 steps: (1) assess the value of life, assuming that the main health damage from smoking is loss of life ($6.8 million); (2) assess the average loss of life for a smoker relative to the life expectancy of 79 years for nonsmokers (typically 6 years); (3) value the 6 extra years lost at the end of a smoker's life; (4) compute, for each year of life between 15 and 73, the discounted value of 6 years of life lost with a discount factor of 3% (i.e., the mortality cost at each age); (5) adjust mortality cost incurred by a smoker at each age by the fraction of cigarettes smoked at that age; (6) divide the costs of lifetime cigarette consumption by the average number of cigarettes smoked for a cost per pack of $35.64.

the optimal internality tax. The higher-end estimate in Gruber and Köszegi's approach is $14.26 per pack. These estimates are in addition to taxes that correct for externalities and are much larger than conventional estimates of optimal tobacco taxes.

Table 3 illustrates a range of tax estimates that are not definitive but that suggest that existing tax structures rarely acknowledge the psychological basis of decisions that involve harm incurred at future dates. The estimates further assume that smokers are fully aware of the costs of smoking—in that sense, internality taxes correct for cognitive errors in decision making rather than for addictive or risk-seeking behavior and are a part of a broader set of economic tools to address the problems of tobacco use.

More generally, the possibility that smokers underrate future costs prompts the question of how aware individuals are of these costs and how the undervaluing of costs interacts with addiction as a medical condition. From policy and research perspectives, this issue suggests the need for further examination of the relative roles of tax systems, health care systems, and insurance mechanisms in addressing 2 dimensions of tobacco use—overconsumption as an outcome of hyperbolic discounting and overconsumption as an outcome of biologically driven addictive behavior.

EVIDENCE AND POLICY FROM BEHAVIORAL ECONOMICS

Justifying a tobacco internality tax requires evidence on the pervasiveness of erroneous discounting and data on whether policies can address behavioral misjudgments in economic decision making. Behavioral economics emerged from psychological laboratory experiments, and a frequent concern is that it has limited validity in real-world markets. Although individuals may display cognitive errors in the artificial context of a laboratory study, in the aggregate, they likely respond to prices as economists traditionally expect them to. Empirical economists have been extending the behavioral approach to the field and have found broader validation of many of the inconsistencies observed in decision making. Recent population-based studies suggest that errors of overvaluing present benefits and undervaluing future risks are fairly widespread in economic decision making around the world.

Khwaja et al. found evidence supporting time-inconsistent preferences, or the use of different implicit discount rates, when smokers were asked to consider near and distant future periods.[19] Individuals in that study, drawn from a US survey, assessed 20 days of good health in the current year to be equivalent to 68, 84, 100, and 110 days of good health 1, 5, 10, and 20 years from the present. This corresponded to discount rates as high as 50% for the current year but lower and more reasonable long-term discounting (5%–14%). Interestingly, although both smokers and nonsmokers were susceptible to the tendency to be more impatient in the short run, current smokers tended to have shorter financial planning horizons and assessed themselves to be more impulsive. In a different cultural context, a survey eliciting time preference rates for nonfatal health outcomes in northern Tanzania found that variants of hyperbolic discounting were a better fit for individual preferences than was the traditional discounting model used for more serious illnesses.[20]

Behavioral research on tobacco, even when not explicitly addressing economic discounting, has uncovered similar patterns of excessive impatience and misjudgment of ability to self-regulate tobacco use. Analysis of a panel of adolescent smokers indicated that individuals who predicted they would not be smoking after 5 years actually had a higher smoking rate at the 5-year follow-up (74%) than did respondents who predicted they would continue to smoke (72%).[21]

Public policy experiments in diverse contexts have begun to incorporate the finding that self-control devices can help individuals attain their financial and health goals.[22] Tobacco users attempting to quit are known to rely on commitment devices, both volitional and mandatory. Two examples illustrate the latent demand for additional help to quit smoking that is likely present in many smokers.

In a randomized, controlled study in the Philippines, smokers opened bank accounts and deposited money saved from avoiding cigarette purchases.[23] After 6 months, clients could withdraw their money if they passed a urine cotinine content test; if they failed the test, their account was donated to charity. This program resulted in a 3.1% increase in cessation, 38% higher than for the control group.

In another study, smokers in Taiwan who expressed a greater intent to quit were found to more strongly support tobacco control measures, including smoking bans and cigarette tax increases, than did nonsmokers.[24] This difference remained even after control for confounders and the possibility that unobserved factors might

drive both higher tobacco consumption and higher intensity of support for tobacco control.

INTERNALITY TAXES AROUND THE WORLD

Although the internality taxes in Table 3 are specific to the United States, the widespread prevalence of time preference inconsistencies suggests that this analysis translates to other contexts, though with several qualifications. Research on tobacco control in developing countries has filled some information gaps,[25] but data inputs that enable recommendations in the United States are not always available elsewhere.

Behavioral economics provides a way to ground the economic analysis of tobacco markets and tobacco control policy in a better understanding of the psychological basis of individual demand while retaining the usefulness of more conventional ways of analyzing taxes. Its application to global contexts is likely to differ depending on several factors: differences between countries' existing tax structures, systematic variations in discount factors and consumption patterns, and the use of different forms of tobacco. This makes it unlikely that a single internality tax rate would work in all contexts.

At the very least, any internality tax would need to have an inflation adjustment built in, in addition to recognizing that affordability differs from one context to the next; wide variations can occur between countries in tobacco price changes and economy-wide trends. For example, between 1980 and 2000, tobacco prices relative to gross domestic product fell in Indonesia and South Asia but more than tripled in New Zealand.[26]

As Table 3 indicates, greater difficulties with self-control merit larger internality taxes. Estimates of the short-term discount factor vary between 0.5 and 0.9, but field evidence of the actual magnitude for smokers is sparse. The extent to which tobacco use is accompanied by self-control problems is likely not uniform across cultures. Behavioral economics does suggest that a larger fraction of smokers with self-control problems would necessitate a higher prescriptive tax, however. If a sizeable minority of smokers need a commitment device to reduce smoking, tobacco taxes larger than usually levied may be called for.

In many countries, cigarettes are not the primary form of tobacco consumption. Other tobacco products may be associated with types of hyperbolic discounting that differ from the simple example illustrated in Figure 1. Where local variants (e.g., hand-rolled bidis and chewing gutkha in India, kreteks in Indonesia) are taxed at lower rates, any self-control benefits of a higher tax on one product can be circumvented by switching to another that is cheaper. This underscores the importance of coordinated tax increases across all, rather than particular, tobacco products.

Price Sensitivity

Estimates of how tobacco consumption responds to price increases in lower- and middle-income countries are less prevalent, but they suggest that higher taxes often lead to larger reductions in consumption than in developed countries. This conforms to evidence that higher income levels within and across societies are accompanied by lower price sensitivity.

Price responsiveness differs across markets. China and Russia in particular appear to be much less sensitive to cigarette price increases, with tobacco consumption declining less than 1.5% when price rises 10%.[27] Other sources indicate that price responsiveness in China might be higher, possibly 5%, because many consumers purchase at lower-than-retail prices.[28] Better estimates of the effect of taxes on consumption by users at different income levels are needed to implement effective tobacco tax policies.

Differing income levels explain why groups with similar tobacco consumption levels and knowledge of tobacco's risks might not share the same sensitivity to taxes. But many countries face the more basic problem of low awareness of tobacco's harm. If people perceive the health costs of tobacco to be low, they are unlikely to rely on tobacco taxes as a self-control device. This does not suggest that tobacco taxes are redundant; rather, economists would recommend public health and market interventions that explicitly address the lack of awareness among users and those at risk for initiation about both the health effects of tobacco use and the difficulty of quitting once tobacco use is initiated.

Regressivity

Differing price sensitivity across income groups influences how fairly a given tax increase is borne within a society. In the traditional view, taxes reduce poor smokers' economic welfare in at least 2 ways.[29] First, for those whose tobacco consumption is unchanged or reduced, but whose tobacco expenses increase, a tax curtails nontobacco purchases more for a poor smoker than it would for a richer smoker, imposing a higher burden at lower income levels. Further, taxes tend to distort horizontal equity: 2 equally poor smokers end up bearing different burdens of the tax if one quits and the other does not: smoking no cigarettes implies that no cigarette taxes will be paid.

Behavioral economics balances some of these concerns by highlighting the question of equity in the burden of the harm arising from self-control problems. For a given level of difficulty in self-regulating use, higher taxes are relatively more beneficial to groups that reduce tobacco consumption more in response. The level of price sensitivity of poorer subgroups in any population is subject to empirical debate,[30–32] but the behavioral approach suggests that where economically disadvantaged groups bear a higher burden of health damage from tobacco use and are more price sensitive, a tobacco tax would likely be less regressive than most studies have concluded.

BEHAVIORAL ECONOMICS AND INFORMED POLICYMAKING

A common principle in the wide range of country-specific tobacco taxation strategies is that market mechanisms play an important role in tobacco control. Behavioral economics suggests that how individuals make tobacco consumption decisions critically affects assessments of whether tobacco taxes are at appropriate levels. Where users substantially overvalue immediate experiences over future costs, awareness of harm may not translate to successful avoidance, so higher taxes can augment other policies to assist with tobacco cessation.

A behavioral economics approach to computing optimal tax rates suggests some principles to guide policymaking that address both public health and public finance needs:

- At the very least, taxes should offset external costs imposed by tobacco use.
- Although governments generally implement tobacco taxes with revenue targets in mind,

higher real prices have an additional public health role in helping users reduce consumption or quit, and they address attendant self-control problems.
- For any given price of tobacco, undervaluing of health costs in the immediate future can result in overconsumption, even by informed individuals otherwise intent on reducing their use.
- Although the health consequences of tobacco use are similar across populations, country-level tobacco markets are quite diverse. Improved estimates of price sensitivity at different income levels and knowledge of the extent to which tobacco users underestimate health harm in each country's context can better inform tobacco control efforts.

Using tax policy to improve public health is often viewed as paternalistic in a climate where the risks of smoking are assumed to be well-known and where smoking rates decline in response to nontax interventions and increased wealth.[33] This view is less defensible for situations in which the majority of people underestimate the risks of smoking or when overconsumption of tobacco results from time preference inconsistencies and excessive impatience. In the context of global public health priorities, behavioral economics is a methodological innovation for analyzing tobacco taxes, prices, and demand behavior. It also strengthens the larger case for employing higher tobacco excises to reduce tobacco consumption and save more lives. ■

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This article was accepted August 5, 2009.

Acknowledgments

This study was supported by a grant from Bloomberg Philanthropies.

The article draws on earlier work by Jonathan Gruber of the Massachusetts Institute of Technology, and Botond Köszegi at the University of California, Berkeley, for the International Union Against Tuberculosis and Lung Disease, Paris, France. I thank Kelly Henning of Bloomberg Philanthropies and Thomas Frieden, formerly of the New York City Department of Health and Mental Hygiene, for their detailed comments over the course of writing several drafts of the article, and Sherry Glied at the Mailman School of Public Health for her encouragement, insights, and comments throughout. Drew Blakeman provided support during manuscript preparation. I also thank Jonathan Gruber and Botond Köszegi for their input on a later draft of the article.

Human Participant Protection

No protocol approval was needed for this study, which did not involve human participants.

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