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High-resolution Behavioral Economic Analysis of Cigarette Demand to Inform Tax Policy

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Abstract

Aims—Novel methods in behavioral economics permit the systematic assessment of the relationship between cigarette consumption and price. Toward informing tax policy, the goals of this study were to conduct a high-resolution analysis of cigarette demand in a large sample of adult smokers and to use the data to estimate the effects of tax increases in ten U.S. States.

Design—In-person descriptive survey assessment.

Setting—Academic departments at three universities.

Participants—Adult daily smokers (i.e., 5+ cigarettes/day; 18+ years old; 8th grade education); *N*= 1056.

Measurements—Estimated cigarette demand, demographics, expired carbon monoxide.

Findings—The cigarette demand curve exhibited highly variable levels of price sensitivity, especially in the form of ‘left-digit effects’ (i.e., very high price sensitivity as pack prices transitioned from one whole number to the next; e.g., \$5.80-\$6/pack). A \$1 tax increase in the ten states was projected to reduce the economic burden of smoking by an average of \$531M (range: \$93.6M-\$976.5M) and increase gross tax revenue by an average of 162% (range: 114%- 247%).

Conclusions—Tobacco price sensitivity is nonlinear across the demand curve and in particular for pack-level left-digit price transitions. Tax increases in U.S. states with similar price and tax rates to the sample are projected to result in substantial decreases in smoking-related costs and substantial increases in tax revenues.

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Keywords

Nicotine Dependence; Cigarette Demand; Behavioral Economics; Tax Policy

Introduction

Cigarette smoking remains the single largest preventable cause of morbidity and mortality in the United States and the developed world [1-3], imposing a massive public health burden [1, 4, 5]. One of the major factors in cigarette consumption is its price. Macroeconomic studies using population-level price and consumption data have consistently found tobacco consumption is significantly related to price, with increases in cost decreasing overall consumption and increasing the number of individuals who quit smoking [6, 7]. In absolute terms, however, tobacco demand (i.e., the ratio of proportionate decreases in consumption relative to proportionate increases in price) has been estimated to be inelastic [6, 7], meaning that consumption decreases at a lower rate relative to increases in price. For example, price elasticity in the U.S. is estimated to be .25-.50 (i.e., a 10% price increase in price results in a 2.5- 5% decrease in smoking) [7].

The field of behavioral economics integrates principles and methods from psychology and economics to study individual-level preferences and consumption. With regard to the relationship between cigarette consumption and price, behavioral economics has also made significant contributions. Human laboratory studies have examined *in vivo* cigarette consumption under conditions of escalating cost, permitting comprehensive examination of the demand curve under controlled conditions [8-10]. A prototypic bitonic behavioral economic demand curve is presented in Figure 1, with an initial phase of relatively low price sensitivity and a subsequent phase of relatively high price sensitivity. Like population-level studies, these studies indicate that consumption is price sensitive and behavioral economic studies also permit fractionating the demand curve into multiple indices of the incentive value of cigarettes [11-13].

One of the most potent tobacco control strategies is increasing the cost of cigarettes via taxation [7, 14], which has historically been informed by macroeconomic data. This is largely because behavioral economic studies have been limited by very high experimental demands (e.g., multiple sessions of long duration per participant) and therefore have relatively low price resolution and very small sample size. However, the recent development of a novel behavioral economic assessment, a Cigarette Purchase Task (CPT), permits relatively efficient data collection that could be directly applied to informing tobacco tax policy. By assessing estimated daily cigarette consumption from very low prices to very high prices, a CPT permits full examination of an individual's cigarette demand curve. Moreover, a number of studies have supported the validity of the indices of demand from this approach. For example, CPT indices of demand have been significantly positively associated with smoking rate, nicotine dependence, and *in vivo* smoking topography [15-18]. In addition, CPT indices have been found to be stable over time [19].

The goal of the current study was to apply the CPT methodology to inform tobacco tax policy. To date, CPT studies have had limitations that prevented direct application of the resulting data to policy questions. These include relatively modest sample sizes, preventing generalizability; and, in terms of the prices, previous studies used only a small number of total prices and had relatively large gaps between prices, creating relatively low-resolution data. In addition, initial versions of the CPT did not include both price per cigarette and the associated pack price, meaning that participants may have been making choices without extrapolating the prices to the common unit of purchase. This study sought to extend the

previous literature by directly addressing these issues and, in turn, examine the resulting demand curve data in the context of tobacco tax policy. Specifically, the first goal was to characterize the overall cigarette demand curve and identify highly sensitive and insensitive regions. Based on previous behavioral economic studies, we predicted that overall tobacco demand would exhibit a curvilinear form, including both inelastic and elastic regions, indicating varying levels of price sensitivity depending on the portion of the demand curve. The second goal was to apply the data directly to tax policy by using it as the basis for projecting the effects of increased taxation on the economic burden of smoking and tax revenue in ten U.S. states.

Method

Participants

Participants were recruited via newspaper, Internet, and flyer advertising. Eligibility criteria were intentionally broad for a maximally representative sample of daily smokers. Inclusion criteria were 18 years old, 5 cigarettes/day, and 8th grade education. A sample of 1,124 participants was enrolled in three sites: Providence, RI; Athens, GA; and Aiken, SC. Of these, 13 participants were excluded due to excessive missing data (i.e., >10% CPT items missing) and 55 participants were excluded due to low effort (i.e., 3 positive contradictions, reflecting random responding). The final sample comprised 1,056 participants of whom the large majority were enrolled in Athens, GA ($n=891$), followed by Providence, RI ($n=113$) and Aiken, SC ($n=52$). Smoking prevalence in the three states is estimated to be 19.3% (GA), 21.1% (RI), and 23.3% (SC) [20]; of the three, only RI has comprehensive smoke-free laws [21]. Participant characteristics are provided in Table 1; characteristics by site are provided in supplementary materials.

Procedure

Potential participants completed a telephone screen and eligible participants completed an in-person assessment in private. Upon arrival, study procedures were discussed with participants and informed consent was completed. The primary assessment comprised questionnaire packets and collection of expired carbon monoxide (CO; PiCO+ Smokerlyzer, Bedfont™ USA). The protocol lasted 90 minutes; the vast majority of participants received \$30 for their time, although a small proportion of student participants received research credit (7.5%). Participation for research credit was considered non-coercive as it was voluntary and alternative options were provided. Participants reporting they were full-time students comprised 36% of the overall sample, which was not surprising as the catchment areas are “college towns”; 21 different educational institutions were represented. All study procedures were approved by the respective Institutional Review Boards.

Assessments

Descriptive variables were initially assessed by questionnaire. Cigarette consumption and nicotine dependence were assessed using the Fagerström Test of Nicotine Dependence (FTND) [22]. Cigarette demand was assessed using a CPT with the previously published instructions [15], asking participants to estimate their cigarette consumption on a typical day at escalating levels of price with only their existing resources, no access to any other tobacco products, and no stockpiling. Estimated hypothetical cigarette consumption was assessed at 73 prices, from \$0 to \$10. The price schedule was 1¢ increments from 0-50¢, 4¢ increments from 50¢-\$1, and \$1 increments thereafter; an exception was a 2¢ increase from 98¢ to \$1. The study originally included prices \$2-\$10 in \$1 units, but only responses up to \$1 were ultimately included because of the very large intervals between prices and divergence from market prices. The prices were intended to provide maximum resolution prior to, following,

and at market prices. Equivalent prices per pack were provided immediately to the right of price/cigarette.

Data Processing and Analysis

For participants with single missing data points on the CPT (but less than 10% total), mean imputation was conducted between the individual's adjacent prices (19 instances, .03%). Missing values on the FTND were also imputed using mean imputation (6 instances, .3%). Five participants did not complete the FTND and no values were imputed, and CO was not collected for three participants; these participants were not included in analyses of these variables. Similarly to previous studies, outliers were defined as $Z > 3.29$ and iteratively recoded as the highest non-outlying value (2.75%) [23].

Cigarette demand was analyzed using several approaches. Within subjects t -tests were used to compare consumption at adjacent time points. Aggregate price elasticity was assessed using an exponential model [24]: $\log_{10} Q = \log_{10} Q_0 + k(e^{-\alpha Q_0 C} - 1)$, where Q = consumption at a given price; Q_0 = maximum consumption (consumption at zero or minimal price); k = a constant across individuals that denotes the range of consumption values in $\log_{10}$ powers, in this case, a constant of 4; C = the cost of the commodity (price); and α = the derived demand parameter reflecting the rate of decline of consumption in standardized price. A trivial nonzero value (.1) was used to permit modeling of zero consumption values. Local elasticity (i.e., elasticity between two adjacent prices) was defined as the arithmetic ratio percent decrease in consumption to percent increase in price (i.e., $\% \Delta \text{consumption} / \% \Delta \text{price}$) and reported in positive units. Elasticity was also generated across the two phases of the bitonic demand curve by identifying the "tipping point" demarcating the less sensitive first phase and the more sensitive second phase. This was defined at an aggregate level as $P_{\max}$ (i.e., the price at which expenditure is maximized) [25]. Specifically, consumption from 1¢ to $P_{\max}$ was designated as the first phase and consumption from $P_{\max}$ to \$1 was designated as the second phase. Finally, for comparison across proportionate changes of the same magnitude, arithmetic elasticity was generated between six price changes, each reflecting approximately a 100% price increase (1-2¢, 2-4¢, 4-8¢, 8-16¢, 16-32¢, and 32-62¢).

To apply the data to tax policy, the projected effects of an increase of \$1/pack of cigarettes were calculated for both savings in healthcare costs/productivity and changes in revenue in the ten US states with average pack prices most similar to the prices where the majority of the data were collected (Georgia). Estimates were generated for the cost fully passed through to the consumer (i.e., a 50¢ increase in taxation would result in a 50¢ increase in price for the consumer), with increases of 20¢, 40¢, 60¢, and 80¢ to permit estimated effects of an incomplete pass-through. Estimation of the reduction in healthcare costs and lost productivity was calculated by multiplying the projected reduction in packs sold by the estimated economic burden per pack sold [26]. Estimation of the effects on gross tax revenue was generated by calculating the 2010 gross tax revenue based on packs sold and the 2010 tax rate, and then comparing it to the projected revenue based on the projected decrease in packs sold and new revenue rate. As absolute amounts are substantially affected by the state population size, proportionate effects were generated to provides an adjusted estimate.

Results

High-Resolution Characterization of Cigarette Demand

Overall demand for cigarettes across prices is presented in Figure 2. Consistent with previous behavioral economic studies, cigarette demand exhibited a prototypic bitonic

curvilinear form, with one phase reflecting low initial sensitivity followed by a second phase reflecting substantially higher elasticity. For overall demand, the model provided an excellent fit ($R^2=.98$, $\alpha = .02$) and, for individuals, the model provided a very good fit (median $R^2=.75$ [IQR=.71-.82], mean $\alpha = .03$ [SEM=.002]). Aggregate elasticity suggested relatively low overall price sensitivity, but the local elasticity values were highly variable across prices, ranging from very low to very high levels. Reflecting this, statistically significant decreases were present between each successive price interval ($p < .05$ -.00001****), but magnitudes of reduction ranged dramatically. The largest decreases took place as pack prices transitioned from one whole number dollar amount to the next whole number dollar amount (e.g., \$5.80 to \$6/pack), revealing clear “left digit” effects for pack price. Illustrative left digit transitions are provided in Table 2 and Figure 2.

For elasticity estimates across the two phases of the curve, $P_{\max}$ was determined to be 24¢/cigarette. The two elasticity estimates suggested highly inelastic demand during the first phase and substantially greater price sensitivity during the second phase (Table 2), with an absolute magnitude that was relatively close to previous macroeconomic estimates. Similar findings were present when examining consistent doubling of price (Table 2), which illustrated progressively greater price sensitivity across the demand curve. The complete list of prices, consumption, changes, and price elasticity are presented in supplementary materials.

Application to Tobacco Tax Policy: Projections of a \$1 Tax Increase in Ten U.S. States

Projected effects are presented in Table 3. With regard to economic burden, the projections suggested that a \$1 increase would result in substantial savings in terms of healthcare costs and lost productivity, with an average of \$530.6M. For tax revenue, the projections suggested uniform increases that were substantial in magnitude, with an average of \$250.8M. This was equally evident in proportionate effects, with an average of 162%.

Discussion

The goal of this study was to use behavioral economics to inform tobacco tax policy by addressing previous methodological challenges and directly applying the findings to projected effects of various price increases. Consistent with laboratory-based behavioral economic studies, we found evidence that the cigarette demand curve was curvilinear in form, with periods of inelastic and elastic demand, and highly variable local price elasticities. Here, perhaps the most important finding was that a major influence on price effects came in the form of pack-level ‘left-digit effects,’ or large magnitude influences on consumption based on the pack price transition from one whole dollar amount to the next. For example, the change in pack price from \$6.60 to \$6.80 was associated with a 2.41% decrease in consumption (local elasticity = .80), but the change from \$6.80 to \$7 was associated with a 13.98% consumption decrease (local elasticity = 4.57). Although the adjacent prices both involved a 3% increase in price, the left-digit transition was associated with a fivefold greater level of elasticity. Indeed, as illustrated in Table 2, the price changes prior to a left digit transition were consistently associated with inelastic demand, whereas the left digit price transition was consistently associated with elastic demand. Importantly, the prices were assessed sequentially and both the individual price and pack price were available, meaning that participants did not have incomplete information and were aware of the similarly sized intervals of price increases.

The disproportionate influence of left-digit effects has been established in relatively small experimental consumer research studies [27, 28] and the strategy is ubiquitous in the market at large. However, no previous studies (to our knowledge) have detected left-digit effects in a sample of this size and in relation to tobacco demand. These findings suggest that

polymakers and public health researchers should be aware of these price changes of disproportionate influence. Toward the goal of maximally reducing tobacco consumption, these data suggest that enacting tax changes to traverse whole dollar pack prices will augment the success of tax increases alone. In other words, in the same way that tobacco companies and retailers may seek to make cigarettes more appealing with prices below left-digit transitions (e.g., \$4.99/pack, \$5.99/pack), these data suggest that tobacco control policies may similarly use an “anti-marketing” strategy to make cigarettes less appealing by increasing pack prices into new whole dollar amounts.

The second goal was to apply the data to a projected \$1/pack tax increase in states that were most similar to the sample collected. These data converge with macroeconomic studies suggesting robust positive economic consequences of increasing tax rates [e.g., 14]. Projections suggested the tax increase would generate substantial savings in healthcare costs and lost productivity in all ten states. Further, the tax increase was projected to substantially increase tax revenue in all ten states in the year following the increase. In proportionate terms that adjust for state size, state tax revenues were predicted to at least double in all cases and, in some cases, more than triple. These data suggest the short-term economic effects of this tax increase would yield a “win-win” outcome by alleviating the economic burden of smoking and increasing tax revenue.

There are several important considerations that apply to the preceding findings. First, the primary assessment, the CPT, assessed estimated consumption, not actual consumption, raising the question of how well estimated consumption would reflect actual behavior if price changes were enacted. Previous behavioral economic studies have found evidence that there is a substantial overlap between choices for hypothetical and actual commodities [29-34].^{ENREF_38}^{ENREF_38} This is putatively because the choices that are being made are for highly familiar commodities (e.g., cigarettes for daily smokers) that are organized in discrete and well-understood units (e.g., dollars, cigarettes). For these reasons and based on the previous empirical studies [15-19], estimated consumption on the CPT is considered generally valid.

Importantly, however, close correspondence is not the same as perfect correspondence. At both the level of the individual and the overall sample, the reported consumption preferences reflect *estimates*, that, like other estimates in health economics, are assumed to be imperfect. For example, macroeconomic studies and computer simulations both include diverse sources of imperfect estimation [7, 35]. Thus, in each domain, the estimates are recognized as reflecting a combination of signal and noise. Imperfect estimation is another reason that multiple projections are useful to characterize alternative outcomes. As illustrated, if a \$1 tax increase had only 60% of the predicted effect (i.e., individuals overestimating the consequences of price increases), the economic savings and revenue increases would nonetheless be very substantial. Moreover, it will be important to verify these findings using methods that examine choices for actual outcomes and, more generally, to ascertain the parameters of relationship between choices for hypothetical cigarettes and actual cigarettes. In other words, even if hypothetical CPT choices substantially correspond with choices for actual cigarettes in relative terms, there is nonetheless a need for future studies to determine whether there is systematic overestimation or underestimation in absolute terms.

Several economic and policy considerations also apply. First, one assumption was that the tobacco industry would fully pass through the tax increase to consumers. This is generally consistent with empirical studies [7], but it is also possible that the industry would pass on more or less than the tax increase [36-38]. Table 3 also addresses how estimates would change if the tobacco industry absorbed some of the tax increase (for example, to avoid left-digit transitions in a market) and suggests that even if much of the tax increase was not

passed through (i.e., undershifted), substantial savings and added tax revenue will remain. Second, for savings in healthcare costs and lost productivity, another factor that may play a role is that a portion of smokers may not reduce consumption, but switch to low cost brands. However, previous studies do not suggest this happens extensively and increased taxation reduces price differences between brands [39, 40], thus actually reducing the probability of brand substitution. Nonetheless, as with the previous consideration, the data suggest that even if this happens to an extent, the alleviation of tobacco-related economic burden would nonetheless be substantial. Third, with regard to generalizability, it is important to keep in mind these data are most applicable to smokers in the U.S. and other high-income countries and may not apply to low or middle income countries. For example, the pack-level left-digit effects may be specific to catchment areas where the pack is the most common unit of purchase. Similarly, a CPT presumes an approximately 7th grade level of literacy and may not be viable in samples with low levels of literacy, regardless of the overall country income level. Finally, a consequence of increasing taxes is the prospect of increased blackmarket sales, such as inter-jurisdictional trafficking (e.g., smuggling cigarettes across state lines for resale). Although this is a legitimate concern, the empirical evidence suggests that risk of extensive cross-border smuggling, at least in developed countries, is both exaggerated by the tobacco industry [41] and can be substantially controlled [42].

These issues also raise the important point that although tax policy is one of the most powerful tobacco control tools, it is not a finely calibrated instrument. Tobacco taxation optimally ought to take place as part of a coordinated tobacco control strategy that also includes comprehensive clean air laws, strategies to minimize blackmarket sales, and availability of efficacious prevention and treatment programs. Indeed, low-cost access to efficacious treatment may be critical for low income or otherwise marginalized individuals [43, 44]. Thus, although increased tobacco taxes may generate additional revenue, an optimal multi-pronged tobacco control strategy will also require funding for enforcement and resources for prevention and cessation. From the standpoint of Pigouvian taxation (i.e., taxes to offset unaddressed costs associated with consumption of the commodity), for which a tobacco tax can be considered prototypic, a logical use of additional revenue would be in these domains, but that is ultimately a policy decision.

The current study applied behavioral economics to better understand tobacco demand and to inform tobacco tax policy. The high-resolution CPT brought the tobacco demand curve into sharp relief and revealed particular regions of sensitivity, especially at the pack-level interface between whole dollar amounts. When extrapolated to a potential tax increase, the data suggested substantial reductions in the economic burden of smoking and substantial increases in short-term tax revenue. Finally, the need for applying behavioral economic methodologies to public policy is increasingly discussed [45] and the current study provides proof-of-concept that scaling-up behavioral economic paradigms is both feasible and may indeed yield novel insights.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

A prototypic behavioral economic demand curve. Note the characteristic bitonic curvilinear form, with an initial period of price insensitivity and a subsequent period of substantially greater price sensitivity. Also note that behavioral economic demand curves differ from traditional economic demand curves by presenting price on the X axis and consumption on the Y axis.

Figure 2.

High-resolution tobacco demand in a large community sample of smokers. Panel A provides the overall empirical cigarette demand curve, $N = 1056$. All differences in consumption are statistically significant ($p < .05$ -.00001). Panel B provides the same data in proportionate (log-log) coordinates to clarify different phases of relative price sensitivity; the lines indicate the inflection point ($P_{\max}$) of 24¢/cigarette. Panel C provides variation in the absolute magnitude of decreases in cigarette consumption across prices.

Table 1Participant characteristics (*N* = 1056).

	%/Mean (Standard Deviation; Range)
Sex	61% M; 39%F
Race	White: 68%; African American: 23%; Asian: 3%; Mixed Race: 3%; American Indian/Alaskan Native: 1%; Other: 1%; Pacific Islander: .1%
Hispanic Ethnicity	2.4%
Income	<\$15k: 50%; \$15-30k: 21%; \$30-45k: 8%; \$45-60k: 4%; \$60-75k: 4%; \$75-90k: 3%; \$90-105k: 2%; \$105-120k: 3%; >\$120,000: 5%
Education (years)	12.89 (2.09; 8-26)
Age	31.61 (12.70; 18-70)
C/D	16.51 (10.95; 0-120)
FTND	4.17 (2.50; 0-10)
COppm	16.73 (12.27; 0-82)
Cost/Pack	\$4.57 (\$0.92; \$1-\$9)

Note: C/D = Cigarettes/Day; FTND – Fagerström Test of Nicotine Dependence; COppm = Carbon monoxide parts per million; Cost/Pack refers to the participants self-reported typical cost of a pack of cigarettes.

Table 2

Illustrative effects of price increases on cigarette consumption across the demand curve, including changes across left-digit transitions, the two phases of the curve, and proportionate price doubling. Note that rounding error makes absolute decrease not always identical to the difference between two means.

Unit Prices	Pack Prices	Means	Absolute Decrease	% Decrease	% Price Increase	% $\Delta C/\Delta P$	Price Sensitivity
<i>Illustrative Left-Digit Transitions</i>							
18¢-19¢	\$3.60-\$3.80	17.45-17.12	0.32	1.86%	5.56%	0.34	Inelastic
19¢-20¢	\$3.80-\$4.00	17.12-16.11	1.02	5.93%	5.26%	1.13	Elastic
23¢-24¢	\$4.60-\$4.80	14.90-14.33	0.57	3.82%	4.35%	0.88	Inelastic
24¢-25¢	\$4.80-\$5.00	14.33-13.36	0.97	6.78%	4.17%	1.63	Elastic
28¢-29¢	\$5.60-\$5.80	11.72-11.36	0.36	3.09%	3.57%	0.87	Inelastic
29¢-30¢	\$5.80-\$6.00	11.36-9.89	1.47	12.96%	3.45%	3.76	Elastic
33¢-34¢	\$6.60-\$6.80	8.57-8.36	0.21	2.41%	3.03%	0.8	Inelastic
34¢-35¢	\$6.80-\$7.00	8.36-7.19	1.17	13.98%	2.94%	4.75	Elastic
38¢-39¢	\$7.60-\$7.80	6.52-6.38	0.13	2.05%	2.63%	0.78	Inelastic
39¢-40¢	\$7.80-\$8.00	6.38-5.48	0.9	14.09%	2.56%	5.49	Elastic
43¢-44¢	\$8.60-\$8.80	5.02-4.95	0.07	1.41%	2.33%	0.61	Inelastic
44¢-45¢	\$8.80-\$9.00	4.95-4.49	0.46	9.32%	2.27%	4.1	Elastic
48¢-49¢	\$9.60-\$9.80	4.30-4.27	0.03	0.79%	2.08%	0.38	Inelastic
49¢-50¢	\$9.80-\$10.00	4.27-3.55	0.71	16.76%	2.04%	8.21	Elastic
<i>Two Phase Demand Curve Price Sensitivity</i>							
1¢-24¢	20¢-\$4.80	22.84-14.33	8.52	37.28%	2300%	0.02	Inelastic
24¢-\$1	\$4.80-\$20	14.33-.85	13.48	94.06%	316.67%	0.30	Inelastic
<i>Proportionate Price Doubling</i>							
1¢-2¢	20¢-40¢	22.84-22.59	0.25	1.09%	100%	0.01	Inelastic
2¢-4¢	40¢-80¢	22.59-21.98	0.61	2.70%	100%	0.03	Inelastic
4¢-8¢	80¢-\$1.60	21.98-21.13	0.85	3.87%	100%	0.04	Inelastic
8¢-16¢	\$1.60-\$3.20	21.13-18.01	3.12	14.77%	100%	0.15	Inelastic
16¢-32¢	\$3.20-\$6.40	18.01-8.89	9.12	50.64%	100%	0.51	Inelastic
32¢-62¢	\$6.40-\$12.40	8.89-2.31	6.58	74.02%	94%	0.79	Inelastic

Table 3. Projected effects of a \$1 tax increase on tobacco-related economic-burden (healthcare costs and lost productivity) and tax revenue in ten U.S. states based on the observed tobacco demand curve.

	Alabama	Georgia	Idaho	Kentucky	Louisiana	North Carolina	North Dakota	South Carolina	Virginia	West Virginia
2010 Pack Cost	\$4.48	\$4.37	\$4.56	\$4.45	\$4.34	\$4.53	\$4.24	\$4.56	\$4.43	\$4.45
State Tax	\$0.425	\$0.37	\$0.57	\$0.60	\$0.36	\$0.45	\$0.44	\$0.57	\$0.30	\$0.55
2010 Packs (Millions)	336.8	544.0	71.8	477.4	333.5	577.3	44.9	385.5	543.3	205.6
Effects on Smoking-related Economic Burden										
CDC Economic Cost/Pack	\$8.97	\$9.02	\$7.84	\$5.07	\$8.82	\$7.18	\$10.48	\$7.66	\$6.27	\$8.94
<i>Savings in Healthcare Costs/Lost Productivity (Millions)</i>										
Pack Price (% Reduction)										
\$4.40-\$4.60 (1.58%)	\$47.7	\$77.5	\$8.9	\$38.2	\$46.5	\$65.5	\$7.4	\$46.7	\$53.8	\$29.0
\$4.40-\$4.80 (5.35%)	\$161.6	\$262.5	\$30.1	\$129.5	\$157.4	\$221.8	\$25.2	\$158.0	\$182.2	\$98.3
\$4.40-\$5.00 (11.76%)	\$355.3	\$577.0	\$66.2	\$284.6	\$345.9	\$487.5	\$55.3	\$347.3	\$400.6	\$216.2
\$4.40-\$5.20 (16.86%)	\$509.4	\$827.3	\$94.9	\$408.1	\$495.9	\$698.8	\$79.3	\$497.9	\$574.3	\$309.9
\$4.40-\$5.40 (19.90%)	\$601.2	\$976.5	\$112.0	\$481.7	\$585.4	\$824.9	\$93.6	\$587.6	\$677.9	\$365.8
Effects on State Tax Revenue										
2010 Revenue (Gross)	\$144.8	\$201.3	\$40.9	\$286.4	\$120.1	\$259.8	\$19.8	\$219.7	\$163.0	\$113.1
<i>Change in State Tax Revenue (Millions)</i>										
Pack Price (% Reduction)										
\$4.40-\$4.60 (-1.58%)	+\$64.0	+\$103.9	+\$13.5	+\$89.4	+\$63.7	+\$109.5	+\$8.5	+\$72.4	+\$104.4	+\$38.7
\$4.40-\$4.80 (-5.35%)	+\$119.9	+\$195.2	+\$25.0	+\$165.4	+\$119.8	+\$204.7	+\$15.9	+\$134.2	+\$197.0	+\$71.8
\$4.40-\$5.00 (-11.76%)	+\$161.5	+\$264.3	+\$33.2	+\$219.1	+\$162.4	+\$275.1	+\$21.4	+\$178.3	+\$268.5	+\$95.6
\$4.40-\$5.20 (-16.86%)	+\$199.9	+\$327.9	+\$40.9	+\$269.2	+\$201.6	+\$340.2	+\$26.5	+\$219.4	+\$333.9	+\$117.7
\$4.40-\$5.40 (-19.90%)	+\$241.3	+\$395.7	+\$49.4	+\$325.4	+\$243.2	+\$410.7	+\$32.0	+\$265.1	+\$402.7	+\$142.2
<i>Change in State Tax Revenue (%)</i>										
Pack Price (% Reduction)										
\$4.40-\$4.60 (-1.58%)	45%	52%	33%	31%	53%	42%	43%	33%	64%	34%
\$4.40-\$4.80 (-5.35%)	84%	97%	61%	58%	100%	79%	81%	61%	121%	63%
\$4.40-\$5.00 (-11.76%)	113%	131%	81%	76%	135%	106%	109%	81%	165%	85%
\$4.40-\$5.20 (-16.86%)	140%	163%	100%	94%	168%	131%	134%	100%	205%	104%
\$4.40-\$5.40 (-19.90%)	169%	197%	121%	114%	203%	158%	162%	121%	247%	126%