Public Policy and Youth Smokeless Tobacco Use

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Much is known about the effects of prices and tobacco control policies on cigarette smoking, but little is known about their impact on smokeless tobacco use. This paper uses data from the Monitoring the Future Surveys, augmented with tobacco tax and policy-related measures, to estimate smokeless tobacco demand equations for young males. The estimates indicate that higher smokeless tobacco taxes would significantly reduce the number of young men using smokeless tobacco and the frequency of smokeless tobacco use. In addition, the estimates imply that strong limits on youth access to tobacco products reduce smokeless tobacco use by young males.

1. Introduction

Tobacco use has gone through many stages in the U.S. Prior to 1900, over 60% of all tobacco consumed in the U.S. took the form of smokeless tobacco (U.S. Department of Health and Human Services [USDHHS] 1993). Cigarette smoking gained popularity in the early 1900s and, by 1935, more tobacco was being consumed in the form of cigarettes than all other tobacco products combined (USDHHS 1993). As the popularity of cigarettes increased, the consumption of smokeless tobacco declined. This decline continued until the 1970s, when smokeless tobacco consumption experienced a resurgence. This resurgence may have initially been spurred by the 1964 Surgeon General's report identifying smoking as a major cause of lung cancer. With the public's heightened awareness of the hazards of smoking, many people began consuming increased quantities of smokeless tobacco. The resurgence of smokeless tobacco consumption was further spurred by the tobacco industry's aggressive marketing of new smokeless tobacco products.

Smokeless tobacco consumption continued to increase at a rate of 10–11% per year (USDHHS 1993) until 1986, when two significant events occurred: the Surgeon General's report entitled *The Health Consequences of Using Smokeless Tobacco* (USDHHS 1986) was released, and Congress passed the Comprehensive Smokeless Tobacco Act of 1986. The Surgeon General's report stated that smokeless tobacco use is not a safe substitute for cigarette smoking and

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represents a significant health risk. It also emphasized that smokeless tobacco can cause cancerous and noncancerous oral conditions and can lead to nicotine addiction and dependence. The Comprehensive Smokeless Tobacco Act of 1986 banned advertising of smokeless tobacco products on television and radio and required three health warnings be placed on smokeless tobacco packages.

Despite the actions taken in 1986, which were followed by a three-year decline in sales for smokeless tobacco products, the prevalence of smokeless tobacco use in the U.S. has been increasing in recent years, particularly among young adult and adolescent males (USDHHS 1993). From 1972 to 1991, total U.S. consumption of smokeless tobacco has risen from 99 million pounds per year to 125 million pounds per year (USDHHS 1993). Almost 90% of all adolescent smokeless tobacco use is done by male youths (USDHHS 1994). From 1970 to 1985, the percentage of males aged 16–19 years using smokeless tobacco products increased by 321%, from 1.4% to 5.9% (Marcus et al. 1989). After declining from 1986 through 1989, however, some recent surveys indicate that smokeless tobacco use among young males is again on the rise (USDHHS 1994). These trends, coupled with the growing evidence on the addictive nature of smokeless tobacco (USDHHS 1986), have led to an increased emphasis on policies aimed at discouraging the use of smokeless tobacco among adolescents.

This paper examines the effectiveness of several tobacco control policies in discouraging smokeless tobacco use among male adolescents. These policies include increased smokeless tobacco taxes (which result in higher smokeless tobacco prices) and limits on the availability of tobacco products to youths. The data used in this research are taken from the 1992, 1993, and 1994 surveys of 8th-, 10th-, and 12th-grade students conducted by the University of Michigan's Institute for Social Research as part of the Monitoring the Future Project. This is a particularly interesting age group to study since addictive behaviors are most likely to become established during adolescence. As the recent Surgeon General's report concludes, nearly all first use of tobacco occurs before high school graduation (USDHHS 1994), suggesting that, if adolescents can be kept free of tobacco, most will never start using tobacco. Therefore, tobacco control policies aimed at this age group may be the most effective way of achieving and sustaining long-run reductions in smokeless tobacco consumption in all segments of the population.

2. Selected Review of Econometric Studies of Tobacco Demand

Numerous econometric studies of cigarette demand have been published over the past several decades.[1] Most of these have used diverse data and methods to estimate the effects of cigarette prices and taxes on smoking participation and cigarette consumption in the overall population and have concluded that higher cigarette prices reduce cigarette smoking. Relatively few of these econometric studies have focused on the price responsiveness of youth, with the

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[1] For comprehensive reviews of these studies, see the 1989, 1994, and forthcoming Surgeon General's reports (USDHHS 1989, 1994, in press).

majority of these concluding that cigarette demand among youths and young adults is more sensitive to price than cigarette demand among adults.[2]

Unlike the numerous econometric studies published pertaining to cigarette demand, only two studies have examined the impact of price and tobacco control policies on smokeless tobacco use (Ohsfeldt and Boyle 1994; Ohsfeldt, Boyle, and Capilouto 1995). In the only published study, Ohsfeldt and Boyle (1994) estimated smokeless tobacco participation equations for adults (ages 16 and older) using state-level aggregates constructed from the 1985 Current Population Survey. They estimated an own-tax elasticity of demand for adults of -0.55, which is at the higher end of the range when compared to the elasticities obtained from studies of adult cigarette smoking. In addition, they estimated that the cross-tax elasticity of any smokeless tobacco use with respect to cigarettes was 0.49. Given that cigarette taxes were increasing relative to smokeless tobacco taxes throughout the early 1980s, Ohsfeldt and Boyle concluded that the increase in smokeless tobacco use during this period was, in part, the result of substitution away from cigarettes towards smokeless tobacco products.

Expanding on their original study, Ohsfeldt, Boyle, and Capilouto (1995) used the individual level data from the September 1985 Current Population Survey to estimate cigarette smoking and smokeless tobacco participation equations for males aged 16 years and older. In addition, for males, they estimated separate participation equations for the 16–24-year-old and 25 and older samples. They found a negative and significant effect of smokeless tobacco taxes on smokeless tobacco use among males, with an estimated own-tax elasticity of any smokeless tobacco use of -0.15. However, they find that restrictive laws on cigarette smoking have no impact on smokeless tobacco use. In addition, they estimated cross-tax elasticities of any smokeless tobacco use with respect to cigarettes of 0.10 and with respect to beer of 0.04. Finally, they generally estimated larger own- and cross-tax elasticities for younger males relative to older males.

While the recent study by Ohsfeldt, Boyle, and Capilouto (1995) examines the impact of smokeless tobacco taxes on smokeless tobacco use among young males, it uses data from 1985. As they note, these data predate the Comprehensive Smokeless Tobacco Act of 1986, which they suggest may lead to different conclusions about the impact of smokeless tobacco taxes on smokeless tobacco use. Similarly, it predates the widespread passage of legislation at the state level resulting from the Synar amendment, which restricts youth access to all tobacco products. Thus, this study is the first to examine the impact of smokeless tobacco taxes on young males' smokeless tobacco use after the Comprehensive Smokeless Tobacco Act of 1986, as well as the first to examine the effects of policies restricting youth access to tobacco products.

3. Data and Methods

The data for this study are taken from the 1992, 1993, and 1994 surveys of 8th-, 10th-, and 12th-grade students conducted by the Institute for Social Research (ISR) at the University of Mich-

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[2] The first studies of youth and young adult cigarette smoking concluded that demand was up to three times more sensitive to price than adult cigarette demand (Lewit, Coate, and Grossman 1981; Lewit and Coate 1982). Two recent studies, by Wasserman et al. (1991) for youths and by Chaloupka (1991) for young adults, found little or no differences in the price responsiveness of demand. Unpublished recent studies, however, confirm that youth and young adult cigarette demand is more responsive to price than demand among adults (Chaloupka and Grossman 1996; Evans and Farrelly 1996; Chaloupka and Wechsler in press).

igan as part of the Monitoring the Future Project. ISR has collected a nationally representative sample of 15,000 to 19,000 high school seniors each year since 1975. In 1991, ISR began conducting an annual survey of similar numbers of 8th- and 10th-grade students. These surveys focus on the use of alcohol, tobacco, and illicit drugs among youths. Given the nature of the data being collected, extensive efforts are made by ISR to ensure that the data collected are informative. For example, parents are not present during the completion of the surveys and are not informed about their child's responses. By special agreement, ISR provided a restricted data set containing variables reflecting youth tobacco use and identifiers for each respondent's county of residence. Data on a variety of socioeconomic and demographic information were also provided.

In each year, approximately half of the 8th- and 10th-grade samples and about one sixth of the 12th-grade sample were asked about their current and past smokeless tobacco use. These data were used to construct three alternative dependent variables: frequency of smokeless tobacco consumption, participation in smokeless tobacco use, and average monthly smokeless tobacco consumption. The first measure, constructed from the categorical data collected in the survey, is an ordered level of smokeless tobacco use variable, reflecting the number of times the youth consumed smokeless tobacco in the previous 30 days. This variable takes on a value of 0 for youths who did not use smokeless tobacco in the 30 days prior to the survey, 1 for light users (used once or twice in the previous 30 days), 2 for moderate users (used 1 to 5 times per week in the previous 30 days), and 3 for heavy users (used once or more per day for the previous 30 days). The second variable (participation in smokeless tobacco use) is a dichotomous indicator equal to 1 for youths who indicate that they used smokeless tobacco in the 30 days prior to the survey and is equal to 0 otherwise. The final dependent variable is a continuous measure of monthly smokeless tobacco consumption based on the midpoints of the categorical responses reflecting smokeless tobacco use in the 30 days before the survey. This variable takes on values of 0, 1.5, 6, 16, and 30, corresponding to the 5 categorical responses from the survey. While not ideal, this continuous measure will be helpful in estimating the tax elasticity of smokeless tobacco demand among adolescent male users.

Based on the survey data, a variety of independent variables was constructed to control for other factors affecting smokeless tobacco demand. These include the age of the respondent, in years; average weekly income from all sources, in 1982–1984 dollars (employment, allowances, etc.); separate indicators for youths surveyed in 1993 and 1994; an indicator for youths surveyed in the 8th/10th-grade survey; indicators of race/ethnicity (white–omitted, black, and others); indicators of parental education (less than high school graduate, high school graduate–omitted, and more than high school graduate for mother and father separately); indicators of family structure (live alone, mother only parent present, father only parent present, both parents present–omitted, no parents present—live with other relative, and other); indicators of mother's work status while youth was growing up (mother worked part-time, mother worked full-time, and mother did not work–omitted); an indicator for youths with siblings; average number of hours worked weekly; an indicator for youths living in rural areas; and an indicator for frequency of participation in religious services (none–omitted, infrequent participation, and frequent participation).

Based on each respondent's county of residence, smokeless tobacco tax and tobacco control policy data were added to the survey data. Measures of state level taxes on smokeless tobacco were obtained from the Tobacco Institute's (1995) annual *Tax Burden on Tobacco*. These tax rates are expressed as a percentage of the wholesale price of the product.[3]

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[3] Alabama and Alaska impose excise taxes on smokeless tobacco products. None of the youths surveyed resided in

As numerous studies of cigarette demand have described, differences in taxes and prices among states may lead smokers in high tax and price states to purchase cigarettes in nearby low tax and price states (e.g., Lewit and Coate 1982; Chaloupka 1991; Wasserman et al. 1991; Becker, Grossman, and Murphy 1994; Coats 1995). As these studies note, failing to account for this possibility will result in biased estimates of the effect of price on demand. Several strategies have been used to account for this potential cross-border purchasing in cigarette demand studies using survey data, including limiting the sample to those who do not live near the border of a state with lower cigarette taxes and prices, using an average price variable for persons residing near states with lower taxes and prices, and including a dichotomous indicator for persons living near the border of states with lower taxes and prices.

The same potential exists for cross-border purchases of smokeless tobacco products in response to interstate differences in smokeless tobacco taxes. However, as Wasserman et al. (1991) note, this may be less problematic when looking at demand by teenagers, given that many are unable to drive and are likely to have fewer other opportunities to engage in cross-border purchasing. Indeed, Wasserman et al. (1991) found no significant differences between their estimates for their full sample and their estimates for a sample excluding those living near lower-priced states, although the estimates for the full sample were more precise.

Two variables are defined to control for possible cross-border purchases of smokeless tobacco in response to interstate tax differentials. The first is a dichotomous indicator equal to 1 for youths living in counties that are within 25 miles of a state with a lower smokeless tobacco tax and is equal to 0 otherwise. The second is a dichotomous indicator for youths living within 25 miles of Alabama, since a comparable smokeless tobacco tax rate cannot be defined for Alabama.[3]

The tobacco control policy variables include the state minimum legal purchase age for smokeless tobacco[4]; a dichotomous indicator for states with restrictions on the distribution of free samples of tobacco products to youths; a dichotomous indicator for states that have tobacco licensing provisions that penalize tobacco vendors for furnishing tobacco products to minors, with additional penalties of license revocation for subsequent offenses; and a dichotomous indicator for states that require a sign indicating the minimum purchase age for tobacco products be posted where those products are sold.

Given that few young women consume smokeless tobacco products, the sample was restricted to young males.[5] After eliminating respondents with missing or inconsistent data, a sample of 19,581 young males was obtained. Table 1 contains brief definitions and the descriptive statistics for the dependent and independent variables employed.

Given the limited nature of the dependent variables, ordinary least squares techniques are not appropriate. Instead, two alternative approaches are used. For the ordered frequency of smokeless tobacco use variable, ordered probit methods are employed. These methods will provide a general sense of the relationship between smokeless tobacco taxes and limits on youth access to tobacco products and youth smokeless tobacco consumption. To more clearly examine

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Alaska. Due to the lack of information on wholesale or retail smokeless tobacco prices, an estimate of the tax as a percentage of wholesale price could not be constructed for Alabama. Consequently, youths residing in Alabama were dropped from the sample.

[4] Given the very limited variation in the minimum legal purchase age for smokeless tobacco products (18 for nearly every state), the potential for cross-border purchases in response to interstate differences in minimum legal purchase ages is not controlled.

[5] In the 1992–1994 MTF data, smokeless tobacco use participation rates for young females were approximately 2%, compared to over 15% for young males.

Table 1. Variable Definitions and Descriptive Statistics

Variable	Definition, Mean (*m*), and Standard Deviation (SD)
Frequency of Smokeless Tobacco Use	Ordered variable equal to 0 for nonusers, 1 for light users (1 or 2 times in past month), 2 for moderate users (1 to 5 times per week), and 3 for heavy users (once a day or more); $m = 0.28$, SD $= 0.73$
Smokeless Tobacco Participation	Dichotomous indicator equal to 1 if male youth reports consuming smokeless tobacco in the past 30 days, equal to 0 otherwise; $m = 0.15$, SD $= 0.36$
Smokeless Tobacco Consumption by Users	Natural logarithm of number of times smokeless tobacco was used in the month prior to the survey (users only); $m = 0.73$, SD $= 1.47$
Smokeless Tobacco Tax	State level tax on smokeless tobacco, expressed as a percentage of wholesale price of the product; $m = 11.26$, SD $= 10.90$
Lower Border Tax	Dichotomous indicator for young males living in counties within 25 miles of a state with a lower smokeless tobacco tax; $m = 0.177$, SD $= 0.381$
Borders on Alabama	Dichotomous indicator for young males living in counties within 25 miles of Alabama; $m = 0.027$, SD $= 0.163$
Minimum Purchase Age	State minimum legal purchase age, in years, for tobacco products; $m = 17.99$, SD $= 0.11$
Restriction on Distribution of Free Samples	Dichotomous indicator for states restricting the distribution of free samples of tobacco products to youths; $m = 0.58$, SD $= 0.49$
Tobacco Licensing Provisions	Dichotomous indicator for states that have tobacco licensing provisions that penalize tobacco vendors for furnishing tobacco products to minors; $m = 0.92$, SD $= 0.28$
Minimum Purchase Age Signs	Dichotomous indicator for states that require a sign indicating the minimum purchase age for tobacco products be posted where those products are sold; $m = 0.79$, SD $= 0.41$
Black	Dichotomous indicator equal to 1 for blacks and 0 otherwise; $m = 0.10$, SD $= 0.30$
Other Race	Dichotomous indicator equal to 1 for individuals who are not black or white and 0 otherwise; $m = 0.19$, SD $= 0.39$
Age	Age, in years; $m = 15.61$, SD $= 1.59$
Infrequent Religious Attendance	Dichotomous indicator equal to 1 for male youths who attend religious services infrequently and 0 otherwise; $m = 0.47$, SD $= 0.50$
Frequent Religious Attendance	Dichotomous indicator equal to 1 for male youths who attend religious services frequently and 0 otherwise; $m = 0.38$, SD $= 0.48$
Rural	Dichotomous indicator equal to 1 for male youths residing in rural communities and 0 otherwise; $m = 0.24$, SD $= 0.43$
Live Alone	Dichotomous indicator equal to 1 for male youths who live alone and 0 otherwise; $m = 0.004$, SD $= 0.06$
Father Only	Dichotomous indicator equal to 1 for male youths in families with the father the only parent present and 0 otherwise; $m = 0.04$, SD $= 0.19$

Table 1. Continued

Variable	Definition, Mean (*m*), and Standard Deviation (SD)
Mother Only	Dichotomous indicator equal to 1 for male youths in families with the mother the only parent present and 0 otherwise; $m = 0.14$, SD = 0.34
Other Family Structure	Dichotomous indicator equal to 1 for male youths in families with neither parent present and 0 otherwise; $m = 0.03$, SD = 0.16
Siblings	Dichotomous indicator equal to 1 for male youths with at least one sibling and 0 otherwise; $m = 0.77$, SD = 0.42
Father Less Than High School Graduate	Dichotomous indicator equal to 1 for male youths with fathers who did not graduate from high school and 0 otherwise; $m = 0.12$, SD = 0.32
Father More Than High School Graduate	Dichotomous indicator equal to 1 for male youths with fathers who have more than a high school education and 0 otherwise; $m = 0.60$, SD = 0.49
Mother Less Than High School Graduate	Dichotomous indicator equal to 1 for male youths with mothers who did not graduate from high school and 0 otherwise; $m = 0.10$, SD = 0.30
Mother More Than High School Graduate	Dichotomous indicator equal to 1 for male youths with mothers who have more than a high school education and 0 otherwise; $m = 0.58$, SD = 0.49
Not Single	Dichotomous indicator equal to 1 for male youths who are either married or engaged and 0 otherwise; $m = 0.01$, SD = 0.09
Mother Worked Part-Time	Dichotomous indicator equal to 1 for male youths whose mothers worked part-time while they were growing up and 0 otherwise; $m = 0.21$, SD = 0.41
Mother Worked Full-Time	Dichotomous indicator equal to 1 for male youths whose mothers worked full-time while they were growing up and 0 otherwise; $m = 0.59$, SD = 0.49
Average Hours Worked	Average hours worked weekly for pay; $m = 6.15$, SD = 9.16
Real Weekly Income	Average weekly income, in dollars, from employment and other sources, deflated by the national Consumer Price Index, (1982–1984) = 1; $m = 31.4$, SD = 36.5
Grade 8 or 10	Dichotomous indicator equal to 1 for male youths surveyed in the 8th/10th-grade survey and 0 otherwise; $m = 0.87$, SD = 0.34
Year = 1993	Dichotomous indicator equal to 1 for male youths surveyed in 1993 and 0 otherwise; $m = 0.33$, SD = 0.47
Year = 1994	Dichotomous indicator equal to 1 for male youths surveyed in 1994 and 0 otherwise; $m = 0.35$, SD = 0.48

these relationships, a two-part model of smokeless tobacco demand is estimated based on the model developed by Cragg (1971). In the first step, probit methods are used to estimate a smokeless tobacco use participation equation. In the second step, ordinary least squares methods are used to estimate average monthly smokeless tobacco consumption by users, where the dependent variable is the natural logarithm of the continuous monthly consumption measure. The same set of independent variables is included in both equations.

4. Results

The estimates from the ordered probit models for frequency of smokeless tobacco use and the two-part models of smokeless tobacco demand by young males are presented in Table 2. Two alternative models are estimated for each measure of smokeless tobacco use, given the potential correlation among the various tobacco control policies and the smokeless tobacco tax. Model 1 contains the estimates from a limited specification that includes the smokeless tobacco tax, the two cross-border indicators, and the various socioeconomic and demographic variables. Model 2 adds the four variables reflecting the limits on youth access to tobacco products to the variables included in Model 1. Including only the smokeless tobacco tax minimizes the multicollinearity resulting from the inclusion of a group of correlated measures of tobacco control policy. Omitting these variables, however, may lead to biased estimates of the effects of smokeless tobacco taxes and other factors on smokeless tobacco use by young males.

The smokeless tobacco tax has a negative and statistically significant impact in all equations estimated for the frequency of smokeless tobacco consumption and for participation in smokeless tobacco use. In addition, the smokeless tobacco tax has a negative, albeit statistically insignificant, impact on smokeless tobacco use by users. These estimates clearly show that increases in smokeless tobacco taxes would reduce the frequency of smokeless tobacco use by adolescent males and would reduce the probability that a male youth consumes smokeless tobacco products. However, the estimates do not provide strong evidence that higher smokeless tobacco taxes would have a significant impact on the consumption of smokeless tobacco by young male users.[6]

Table 3 contains the estimated tax elasticities from the two-part models of smokeless tobacco use by young males. The estimates of the overall tax elasticity of male youth smokeless tobacco demand range from −0.057 to −0.097. Over two-thirds of the effect of the tax on young males' smokeless tobacco use is on the decision to use smokeless tobacco products (the average participation elasticity is −0.056). The remainder of the effect is on the average smokeless tobacco consumption among users (average elasticity of −0.021), although this estimate is based on statistically insignificant estimates of the effect of the tax on demand. These estimates are somewhat below Ohsfeldt, Boyle, and Capilouto's (1995) estimates for young males aged 16 through 24 years obtained using 1985 data. This suggests that the price responsiveness of smokeless tobacco use by young males may be falling over time. This could be the result of the stronger limits on youth access to tobacco products in place during the 1992 through 1994 period covered by this study; that is, a comparable increase in the smokeless tobacco tax in the more recent period results in a smaller increase in the full price of smokeless tobacco for underage youths than it did in 1985 when there were relatively fewer limits on youth access.[7]

Estimated price elasticities of smokeless tobacco demand by young males are also presented in Table 3. Two assumptions are made in converting the tax elasticities to price elasticities. The first is that a one-cent increase in smokeless tobacco taxes will result in a one-cent

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[6] In an effort to estimate the potential substitutability/complementarity of smokeless tobacco products and cigarettes, models including the real price of cigarettes were also estimated. Unfortunately, very unstable estimates resulted. Belsley, Ku, and Welsch (1980) collinearity diagnostics indicated that the estimates for the smokeless tobacco tax, cigarette price, and time dummy variables were confounded by the presence of multicollinearity in these models.

[7] Using data from the 1982 and 1989 Monitoring the Future Surveys of High School seniors, Laixuthai and Chaloupka (1993) made a similar argument with respect to the price elasticity of youth alcohol demand after the change to a uniform minimum legal drinking age of 21 years.

increase in smokeless tobacco prices. This is consistent with much of the evidence on the effects of cigarette taxes on cigarette prices. For example, Barnett, Keeler, and Hu (1995) conclude that a one-cent increase in the federal cigarette tax would raise cigarette prices by 1.04 cents. The second assumption is that smokeless tobacco taxes are approximately 13% of the retail prices of smokeless tobacco products (Connolly 1994). Given these assumptions, the average overall price elasticity of young males' smokeless tobacco demand is -0.592. This suggests that increases in the prices of smokeless tobacco products would significantly reduce the consumption of these products by young males. For example, a 10% increase in price would reduce male youth smokeless tobacco consumption by about 5.9%. Larger increases in price would lead to even larger reductions in male youth consumption. This estimated price elasticity of young males' smokeless tobacco demand is about half the -1.31 Chaloupka and Grossman (1996) estimate for cigarette demand by all youth. Nevertheless, it is well above the consensus estimate of the price elasticity of cigarette demand by adults.

Some additional support for the hypothesis that higher smokeless tobacco taxes and prices reduce smokeless tobacco use by young males is provided by the positive and weakly significant estimates for the indicator for young men living in counties within 25 miles of a state with a lower smokeless tobacco tax in the smokeless tobacco participation equations. These estimates suggest that young men living near states with lower smokeless tobacco taxes are more likely to use smokeless tobacco than those without the opportunity for cross-border purchases at lower prices. However, the magnitude of this effect is relatively small. The estimates imply that eliminating existing tax-induced opportunities for cross-border purchases would lower the probability of smokeless tobacco use by about 1%.

In general, the variables capturing limits on youth access to tobacco products indicate that strong limits reduce smokeless tobacco use among young males. The minimum legal purchase age for smokeless tobacco products and the dichotomous indicator of strong tobacco licensing provisions are both found to have a negative and statistically significant impact on each of the three measures of smokeless tobacco consumption. Restrictions on the distribution of free samples and requiring signs indicating the minimum legal purchase age also have a negative and statistically significant impact on the frequency of smokeless tobacco use and participation in smokeless tobacco use, but have a statistically insignificant impact on smokeless tobacco use by users. These estimates clearly show that policies aimed at limiting youth access to tobacco products significantly reduce smokeless tobacco use among young males.

The estimates obtained from Model 2 of the two-part model were used to simulate the effects of changes in limits on youth access to tobacco products. The estimates imply, for example, that raising a uniform minimum legal purchase age for smokeless tobacco products from 18 years to 19 years would reduce the probability that a young male would use smokeless tobacco by approximately 3.5 percentage points, a reduction of nearly 25%. Likewise, if all states that did not have limits on the distribution of free samples of tobacco products to youth, strong tobacco licensing provisions, and requirements that signs indicating the minimum purchase age be posted where tobacco products are sold had enacted these policies during the time period covered by the sample, the probability of smokeless tobacco use by young males would have been reduced by nearly 9%.

Young males with higher real weekly incomes, either from employment or from other sources, are significantly more likely to use smokeless tobacco products and to consume more often than young males with lower incomes. This positive relationship between income and smokeless tobacco consumption contrasts with much of the recent empirical evidence for cig-

Table 2. Young Male Smokeless Tobacco Demand Estimates

Independent Variables	Frequency of Smokeless Use, Model 1	Frequency of Smokeless Use, Model 2	Smokeless Use Participation, Model 1	Smokeless Use Participation, Model 2	Smokeless Use by Users, Model 1	Smokeless Use by Users, Model 2
Smokeless Tobacco Tax	-0.004	-0.003	-0.004	-0.003	-0.003	-0.001
	(-4.11)	(-2.67)	(-3.89)	(-2.57)	(-1.16)	(-0.46)
Lower Border Tax	0.035	0.030	0.051	0.045	-0.118	-0.119
	(1.20)	(1.00)	(1.67)	(1.46)	(-1.77)	(-1.77)
Borders on Alabama	-0.082	-0.054	-0.078	-0.045	-0.143	-0.203
	(-1.17)	(-0.76)	(-1.08)	(-0.61)	(-0.87)	(-1.19)
Minimum Purchase Age		-0.236		-0.185		-0.545
		(-2.32)		(-1.73)		(-2.43)
Restrictions on the Distribution of Free Samples		-0.067		-0.041		0.022
		(-1.60)		(-1.73)		(0.42)
Tobacco Licensing Provisions		-0.188		-0.187		-0.158
		(-4.98)		(-4.79)		(-1.92)
Minimum Purchase Age Signs		-0.103		-0.101		-0.061
		(-3.86)		(-3.64)		(-1.02)
Black	-0.970	-0.965	-0.966	-0.960	-0.573	-0.549
	(-16.77)	(-16.64)	(-16.52)	(-16.38)	(-3.36)	(-3.22)
Other Race	-0.234	-0.223	-0.244	-0.234	-0.003	0.007
	(-7.47)	(-7.11)	(-7.58)	(-7.25)	(-0.04)	(0.10)
Age	0.101	0.102	0.096	0.096	0.102	0.101
	(9.73)	(9.73)	(8.93)	(8.96)	(4.16)	(4.12)
Real Weekly Income	0.004	0.004	0.004	0.004	0.003	0.003
	(11.13)	(11.05)	(10.75)	(10.68)	(3.57)	(3.55)
Grade 8 or 10	0.333	0.339	0.306	0.314	0.323	0.378
	(7.40)	(7.51)	(6.59)	(6.72)	(3.82)	(3.76)
1993	-0.110	-0.097	-0.101	-0.090	-0.127	-0.103
	(-3.85)	(-3.35)	(-3.42)	(-3.01)	(-1.92)	(-1.52)
1994	-0.063	-0.059	-0.043	-0.040	-0.207	-0.189
	(-2.27)	(-2.05)	(-1.49)	(-1.37)	(-3.23)	(-2.88)
Rural	0.362	0.356	0.343	0.337	0.324	0.323
	(14.68)	(14.44)	(13.39)	(13.16)	(5.94)	(5.92)
Infrequent Religious Attendance	0.030	0.026	0.031	0.028	0.009	0.001
	(0.96)	(0.82)	(0.97)	(0.85)	(0.12)	(0.02)

Table 2. Continued

Independent Variables	Frequency of Smokeless Use, Model 1	Frequency of Smokeless Use, Model 2	Smokeless Use Participation, Model 1	Smokeless Use Participation, Model 2	Smokeless Use by Users, Model 1	Smokeless Use by Users, Model 2
Frequent Religious Attendance	-0.095	-0.099	-0.102	-0.106	0.022	0.015
	(-2.79)	(-2.92)	(-2.91)	(-3.02)	(0.28)	(0.19)
Live Alone	0.397	0.393	0.420	0.416	0.111	0.105
	(2.57)	(2.54)	(2.55)	(2.52)	(0.37)	(0.35)
Live with Father Only	0.209	0.207	0.206	0.204	0.158	0.152
	(3.83)	(3.79)	(3.63)	(3.60)	(1.33)	(1.28)
Live with Mother Only	0.080	0.082	0.087	0.090	-0.019	-0.010
	(2.37)	(2.44)	(2.52)	(2.58)	(-0.25)	(-0.13)
Other Family Structure	0.189	0.188	0.193	0.193	-0.001	-0.001
	(2.70)	(2.69)	(2.64)	(2.64)	(-0.004)	(-0.01)
Siblings	-0.032	-0.028	-0.012	-0.008	-0.180	-0.181
	(-1.16)	(-1.02)	(-0.41)	(-0.27)	(-2.89)	(-2.90)
Father Less Than High School Graduate	0.144	0.143	0.141	0.139	0.083	0.086
	(3.71)	(3.68)	(3.50)	(3.45)	(0.97)	(1.01)
Father More Than High School Graduate	-0.060	-0.057	-0.064	-0.062	-0.026	-0.020
	(-2.21)	(-2.10)	(-2.29)	(-2.19)	(-0.41)	(-0.32)
Mother Less Than High School Graduate	-0.031	-0.034	-0.072	-0.075	0.347	0.340
	(-0.75)	(-0.82)	(-1.65)	(-1.72)	(3.68)	(3.61)
Mother More Than High School Graduate	-0.049	-0.050	-0.044	-0.045	-0.053	-0.056
	(-1.90)	(-1.92)	(-1.66)	(-1.69)	(-0.90)	(-0.94)
Not Single	0.061	0.568	-0.045	-0.049	0.899	0.912
	(0.52)	(0.48)	(-0.36)	(-0.39)	(3.46)	(3.52)
Mother Worked Part-Time	0.017	0.021	0.010	0.013	0.032	0.045
	(0.48)	(0.58)	(0.27)	(0.34)	(0.38)	(0.54)
Mother Worked Full-Time	0.117	0.115	0.112	0.111	0.116	0.116
	(3.97)	(3.92)	(3.71)	(3.67)	(1.68)	(1.69)
Average Hours Worked	0.002	0.002	0.002	0.002	0.004	0.004
	(1.48)	(1.56)	(1.04)	(1.12)	(1.27)	(1.22)

All equations also include an intercept. Asymptotic t-ratios are in parentheses. The critical values for the t-ratios are 2.58 (2.33), 1.96 (1.64), and 1.64 (1.28) at the 1, 5, and 10% significance levels, respectively, based on a two-tailed (one-tailed) test. All equations, based on a Chi-square test of $-2 *$ log-likelihood ratio or an F-test, are significant at better than the 1% significance level. The sample size for the frequency of use and participation equations is 19,581. The sample size for the conditional smokeless tobacco demand equations is 3009.

Table 3. Estimated Tax and Price Elasticity of Smokeless Tobacco Demand by Young Males

	Model 1	Model 2
Tax Elasticity		
Participation in Smokeless Tobacco Use	−0.068	−0.045
Use of Smokeless Tobacco by Smokeless Tobacco Users	−0.029	−0.012
Total Elasticity of Smokeless Tobacco Demand	−0.097	−0.057
Price Elasticity		
Participation in Smokeless Tobacco Use	−0.523	−0.346
Use of Smokeless Tobacco by Smokeless Tobacco Users	−0.223	−0.092
Total Elasticity of Smokeless Tobacco Demand	−0.746	−0.438

Estimated elasticities are based on the estimates contained in Table 2 and are computed at the sample means.

arette demand that suggests that cigarette smoking is an economically inferior behavior for adults (e.g., Wasserman et al. 1991). However, it is consistent with Chaloupka and Grossman's (1996) estimates for youth cigarette smoking. The average estimated overall income elasticity of young males' smokeless tobacco demand is 0.21, with approximately two thirds of the impact of income on demand coming from the effect of income on the decision to use smokeless tobacco.

With respect to race and ethnicity, young black males are about one sixth as likely to use smokeless tobacco products as young whites, while other nonwhite young males are approximately two thirds as likely to use. Similarly among users, young black males consume nearly 45% less frequently than do other young male users.

Older male youths are more likely to use smokeless tobacco products and consume more often than younger male youths. Holding age constant, youths in both 8th and 10th grades were more likely to use smokeless tobacco products and to consume smokeless tobacco more frequently than high school seniors. Young males with a stronger attachment to religion, as measured by attendance at religious services, are nearly 16% less likely to use smokeless tobacco products than those with little or no attachment. Young males living in rural areas were two thirds more likely to consume smokeless tobacco products and consumed nearly 40% more frequently than those living in urban and suburban areas.

With respect to family structure, young males who live alone are most likely to use smokeless tobacco products and to consume more often, while those who live with both parents are least likely to use and consume least often. Those living alone are 85% more likely to consume smokeless tobacco than those living with both parents. Similarly, young males living with their father only (mother only) are approximately 38% (15%) more likely to use than those living with both parents. Male youths whose mothers worked full-time when they were younger are 20% more likely to use smokeless tobacco and consume approximately 12% more often than youths whose mothers stayed home. The probability of smokeless tobacco use for engaged or married male youths is not significantly different from that for unattached youths, but they do consume significantly more often.

Finally, male youth smokeless tobacco consumption is inversely related to paternal education. Young males who have fathers with less than a high school education are nearly 25% more likely to be smokeless tobacco users than those who have fathers with a high school education, while those having fathers with more than a high school education are nearly 10% less likely to consume. No clear relationship was observed between maternal education and young males' smokeless tobacco use.

5. Discussion

The results described above indicate that tobacco control policies, including higher smokeless tobacco taxes, higher minimum legal purchase ages for tobacco products, strong tobacco licensing provisions, restrictions on the distribution of free samples of tobacco products, and the posting of minimum purchase age signs are effective in reducing adolescent male smokeless tobacco use. The average overall estimated price elasticity of smokeless tobacco demand for male youths was −0.59. This implies that large increases in smokeless tobacco excise taxes, by significantly raising price, would lead to sharp reductions in smokeless tobacco use among young males, with much of the reduction coming from a drop in the number of young male smokeless tobacco users. Recently, substantial increases in federal smokeless tobacco excise tax rates were discussed as a source of revenues to finance U.S. health care reform. Increases in federal smokeless tobacco taxes were proposed in the Clinton Administration's Health Security Act of 1993. Had these increases been enacted, the federal tax on snuff, for example, would have risen from the 1994 level of 2.7 cents per tin of snuff to 96 cents per tin. This would have been an increase in the federal snuff tax of nearly 3500%. Comparable federal tax increases were proposed for other smokeless tobacco products. Given the relatively small share of the federal tax in the price of smokeless tobacco products (Connolly [1994] estimates this to be approximately 1%) and assuming that tax increases are fully passed on, federal tax increases of this magnitude on all smokeless tobacco products would raise the prices of these products by about 135%. Assuming that the price elasticity of demand is constant as price rises, based on the estimates presented above, this would lead to a 47–70% reduction in the number of young males using smokeless tobacco.

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