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THE POTENTIAL FOR USING EXCISE TAXES TO REDUCE SMOKING

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ABSTRACT

We examine the potential for reducing cigarette smoking through increases in cigarette excise taxes by estimating the price elasticity of demand for cigarettes. Using information on individual smoking behavior for a sample of adults in the 1976 Health Interview Survey, we estimate the adult price elasticity of demand for cigarettes to be -.45. Moreover, we find that price has its greatest effect on the smoking behavior of young males and that it operates primarily on the decision to begin smoking regularly rather than via adjustments in the quantity of cigarettes smoked by smokers. It follows that, if future reductions in cigarette smoking are desired, Federal excise tax policy can be a potent tool to accomplish this goal, but only in the long run. An excise tax increase, if maintained in real terms, would discourage smoking participation by successive cohorts of young adults and those reduced smoking levels would be reflected in aggregate smoking as these cohorts mature. In the short run however, the impact of an excise tax increase on aggregate cigarette consumption would be relatively small.

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THE POTENTIAL FOR USING EXCISE TAXES TO REDUCE SMOKING

Eugene M. Lewit and Douglas Coate

1. Introduction

In the last decade, soaring health care expenditures in the U.S. have been associated with only small improvements in health levels. As a result, many health care observers have concluded that the primary potential for improving health and moderating the growth in health care costs lies in preventive medicine and in encouraging individuals to alter unhealthy behaviors (Fuchs, 1974; Zook, Moore and Zeckhauser, 1981). Cigarette smoking, regarded for over 25 years as a significant contributor to poor health, is perhaps the best example of an unhealthy behavior leading to substantial health care costs. The direct (health-care) and indirect costs of smoking were estimated to have been nearly $30 billion in 1976 (Luce and Schweitzer, 1977).

Public and private sector initiatives to discourage smoking have included the dissemination of information from the 1964 Surgeon General's Report on smoking and health, anti-smoking television advertising tied to cigarette commercials (the Fairness Doctrine), a ban on all cigarette advertising on radio and television, and the labelling of cigarettes with warning messages. Warner (1977) presents evidence that these policies may have had a substantial effect on smoking and estimates that 1975 per capita cigarette consumption would have been 20 to 30 percent higher in the absence of these anti-smoking policies.[1] On the other hand, cigarette consumption per capita, while currently about 10% below the peak established in 1963, has not declined appreciably in the past decade (U.S. Department of Agriculture, 1981).

[1] The effects of these policies are also discussed in Hamilton (1972); Ippolito, Murphy and Sant (1979); Klein, Murphy and Schneider (1981); Lewit, Coate and Grossman (1981); and Warner (1981). Not all of these studies agree on the relative importance of different government policies on smoking behavior.

In this paper, we examine the potential for reducing cigarette smoking through increases in excise taxes, a public policy that could lead to permanent reductions in smoking. During the past three decades, the federal excise tax has not been used as a policy tool to discourage smoking despite the large and growing federal share of health care expenditures and the large number of studies linking cigarette smoking and poor health.[2] In fact, the federal policy of holding the excise tax constant at eight cents per pack since 1952 translates into a substantial reduction in the tax in real terms. There is evidence, however, that state and local governments have used their cigarette excise taxes to discourage smoking. The considerable anti-smoking publicity associated with the Surgeon General's Report in 1964 was followed by 23 state and local tax increases compared with no more than a dozen in any of the preceding 14 years (Warner, 1977). State and local taxes have continued to increase over time in many states; however, the ability of state and local governments to raise their own cigarette taxes is limited because of the presence of cigarette bootlegging from low to high tax areas (Intergovernmental Perspective, 1978).[3]

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[2]There have been several attempts to increase the federal excise tax in recent years because of concern over the health effects of cigarette smoking (Miller, 1976).

[3]The economies of several states depend importantly on the growing of tobacco and the production of cigarettes. At the state level, these states maintain very low excise taxes. At the federal level, the economic interests of these states and the tobacco industry have apparently succeeded in blocking any increases in the federal tax since 1952, despite the Surgeon General's Report in 1964 and the anti-smoking campaign waged by government and voluntary groups since then.

2. Previous Estimates of the Price Elasticity of Demand for Cigarettes

The impact of excise tax changes on cigarette demand depends on the extent to which changes in excise taxes are reflected in cigarette prices[4] and on the responsiveness of cigarette demand to price. The literature shows a broad range of cigarette price elasticity estimates. Studies completed since 1970 using U.S. data have yielded estimates ranging from -.4 to -1.3 (Miller (1970); Mann (1971); Padillo (1971); Hamilton (1972); Schrabel (1972); Kellner (1973); Miller (1974); Fujii (1980); Klein, Murphy and Schneider (1981)). These estimated elasticities are generally high enough to suggest that excise taxes rates can have a substantial impact on cigarette consumption. For example, Warner (1977) borrows from these findings to attribute a substantial portion of the decline in cigarette consumption which took place between 1963 and 1972 to the significant increase in cigarette prices during the period. There is reason to believe, however, that such conclusions may not be reliable guides for policy makers with an interest in reducing health care costs through excise tax induced reductions in cigarette smoking. This is true for two reasons: 1) the cross-section estimates are biased upwards because cigarette consumption is inaccurately measured; and 2) the time series estimates are not stable because of the high correlation between cigarette price, income, and trend variables, and furthermore, reflect a short run response to changes in price rather than the long run or permanent response which is of interest to policy makers.

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[4] If cigarette supply is perfectly elastic, excise tax changes will be fully reflected in cigarette prices. This would appear to be a reasonable approximation for most modest tax changes. In fact, Barzel (1976) presents evidence that cigarette prices have risen by more than the amount of state unit tax increases.

Cross section studies are generally relied on to provide price elasticity estimates because multicollinearity among the independent variables is usually less of a problem than in time series estimation and because the estimates are considered in most cases to represent the long run or complete response of quantity demanded to changes in price. Cross section studies of cigarette demand, however, have generally provided elasticity estimates that are biased upward in absolute value because the unit of observation has been the state and the dependent variable has been tax-paid cigarette sales per capita. For many states, tax-paid sales do not reflect actual consumption. This disparity results from the fact that excise taxes vary substantially between states while state cigarette markets are not completely distinct or separable. Therefore, smuggling or bootlegging of cigarettes from low tax to high tax states occurs and as a result, tax-paid sales are a biased measure of consumption. Using sales data causes the elasticity of demand to be biased because in high tax (price) states own consumption is underestimated by sales and in low tax (price) states own consumption is overestimated. Thus, the response of cigarette demand to price is exaggerated.

In this paper, we more accurately measure the price elasticity of demand for cigarettes than has heretofore been possible by using information on the actual amount of cigarettes smoked by individuals who face different cigarette prices. The data set we employ is the recently released 1976 Health Interview Survey (HIS), which contains information on the smoking behavior of a large sample of individuals in different tax (price) locations.

In addition, the data contains information on an array of individual and household characteristics sufficient to allow for the estimation of a well specified demand relationship.

3. Specification of the Demand for Cigarettes Equation

In specifying the demand function that we estimate in this paper, we assume that the demand for cigarettes is a linear function of price, income and taste variables where health and other considerations can enter the relationship via the taste component. Specifically, the function is

$$Y_{ij} = a + b\,P_j + c\,X_{ij} + d\,R_j + \varepsilon_{ij} . \qquad (1)$$

The dependent variable in the equation can either be the amount smoked by the i^{th} individual in the j^{th} locality or a dichotomous variable indicating whether the individual is a smoker. The independent variables include the "average" price (P_j) of cigarettes in the j^{th} locality; a vector (X_{ij}) of individual and household characteristics including family income, family size, education, age, sex, marital status, health status, and race; a vector (R_j) of region and city size characteristics; and a random disturbance team (ε_{ij}). Some of the X_{ij} variables are measures of an individual's command over resources and others are proxies for "taste" variables. Almost all of them have been shown in previous studies to be related to differences in the propensity to smoke cigarettes (National Clearing House for Smoking and Health, 1976). The region of residence and size of place of residence variables are included to partially control for cross-sectional differences in the cost of living which are not otherwise reflected in our price or income measures.

We estimate the demand for cigarettes equation over all individuals (smokers and non-smokers) as well as over smokers only. Implicit in our single equation approach is the assumption that variation in the supply curves across sample locations due to differences in excise tax rates identifies the demand curves we specify.

Average Cigarette Prices

Differences in state and local cigarette tax rates in the U.S. are substantial and account for almost all the variation in the market price of cigarettes. In 1976, state taxes equalled 24% of the retail price of cigarettes on average and varied from 6% in North Carolina to 43% in Massachusetts. Because of the state tax differences, the "average" price of cigarettes in 1976 was 57.3¢ a pack in Massachusetts and 36.6¢ a pack in North Carolina. In addition, local taxes can substantially increase cigarette prices in certain markets. The most notable of these in 1976 were in New York City (8¢ per package) and in Chicago (5¢ per package).

Information on retail cigarette prices, excise tax rates, sales taxes and a composite cigarette price is available from the Tobacco Tax Council (1980). The Council calculates an "average" retail price per state by taking a weighted average of reported retail prices plus applicable sales taxes of cigarettes sold by carton lot, by the single pack over-the-counter, and by the single pack through vending machines. The weights are the national proportions of cigarettes sold in these ways.[5] This composite retail price is the basis

[5]In all states, the unit price of cigarettes is lowest when they are purchased in carton lots while substantial mark ups are associated with purchasing cigarettes by the single pack. In 1976, 56% of all cigarettes were purchased in carton lots while 29% of sales were of over-the-counter single packs and 15% single packs in vending machines. Because the price of cigarettes within a locality may vary according to the way in which they are purchased, the use in a demand equation of the weighted average price variable as a measure of the price faced by actual and potential smokers is preferred to using the price actually paid by smokers. This is because heavier smokers have a greater incentive to purchase cigarettes cheaply. To the extent that they economize on the purchase price of cigarettes, the price paid is a function of the quantity demanded and the coefficient of an actual price paid variable in a demand equation would be biased due to the reverse causality.

for the price measure used in this study. In order to determine the prevailing cigarette price for each observation in the HIS, we located each of the 430 Primary Sampling Units (PSU's) in the HIS on a map. The composite cigarette price for each state was assigned to each PSU depending on state of location. If there was any local cigarette tax applicable to the site, the local tax rate was added to the composite retail price. When there was more than one price attributable to a particular PSU, prevailing price was determined by using population weights of the various geographic components within the PSU to calculate an average composite price for the PSU.

Cigarette Price Differentials and Bootlegging

Because of differences in state and local excise taxes on cigarettes, substantial price differentials exist across geographic boundaries. Since cigarettes are relatively easy to transport across these boundaries, they are not infrequently purchased in low tax areas for resale or personal consumption in high tax areas. This bootlegging activity falls into three categories: 1) large scale smuggling of truckloads of cigarettes from low tax areas for distribution through regular retail/wholesale channels in high tax areas; 2) minor smuggling from low tax areas for resale to friends and acquaintances at a profit but at less than full retail price in higher tax areas; and 3) the crossing of tax boundaries by individual consumers to purchase cigarettes at lower prices for personal consumption.

Large scale smuggling for resale has become an important law enforcement and tax collection problem in certain high tax states. There is reason to believe that many cigarettes processed in this manner are sold through regular distribution channels at prices approximating the fully taxed

retail level (Advisory Commission on Intergovernmental Relations, 1977). This is because large scale smuggling requires distribution through a large network of retail dealers and the sale of these cigarettes at substantial discounts from fully taxed retail price would greatly facilitate their detection by law enforcement officials.[6] To the extent that cigarettes smuggled on a large scale are sold at fully taxed retail prices, individuals in a PSU where large scale smuggling exists can still be assumed to pay the prevailing retail price for cigarette as reported by the Tobacco Tax Council (1980). Accordingly, large scale smuggling should not bias estimates of the price elasticity of demand for cigarettes obtained from our methodology.

Little information exists on the prevalence of or the prices charged by small scale cigarette smugglers. Because, for the majority of smokers, the transactions costs associated with relying on small scale smugglers are likely to be high, it is unlikely that the presence of small scale smuggling substantially biases our estimates of the average price of cigarettes.

A potential problem arises, however, in the case of individuals who reside in areas bordered by lower price (tax) areas. In these cases, smokers and would-be smokers have the opportunity to purchase cigarettes at less than the own area retail price

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[6] In addition, anecdotal evidence suggests that large scale smuggling has become dominated by "organized crime". This would tend to discourage the price competition among suppliers of bootlegged cigarettes necessary to cause a decline in the price of smuggled cigarettes. (Advisory Commission on Intergovernmental Relations, 1977).

if they are willing to travel for that purpose or, perhaps more importantly, if they travel into the lower price areas for other reasons. There is evidence that the purchase of cigarettes in lower price adjacent areas is not uncommon.[7] For example, in 1978 per capita tax paid cigarette sales were 50% lower in New York City which imposed a local 8¢ per pack cigarette tax than in the rest of New York State. In fact, per capita cigarette sales in New York State outside New York City were above the national average despite the fact that state cigarette taxes and hence retail prices were also above the national average. Similarly, annual tax paid cigarette sales in New Hampshire were 278.8 packs per capita in 1977 while in neighboring Massachusetts the comparable figure was 118.9. State cigarette taxes were 9¢ a pack higher in Massachusetts than in New Hampshire in that year. If we assume that the cigarettes purchased in New Hampshire beyond the national average of 133.6 packs per capita were consumed in Massachusetts, per capita "consumption" in Massachusetts would rise to 139 or approximately to the national average. This would imply that as much as 15% of the cigarettes smoked in Massachusetts might have been purchased in New Hampshire. Although large scale smuggling may account for a substantial portion of these tax paid

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[7]Clearly, for any individual, the tendency to purchase cigarettes at the lower price depends on the size of the price differential and the transactions costs associated with purchasing cigarettes in the adjacent area. As transactions costs decline, a smaller price differential will be required to induce purchases in the adjacent market. Within a given market, transactions costs for individuals who live near or commute to a lower price area may be small or non-existent. For other individuals within the same general geographic area, such as those who live some distance from the boundary, transactions costs may be sufficiently high so that only a very substantial price differential would induce them to purchase cigarettes in the adjacent area.

sales differentials, the substantial amount of across boundary commuting for work and recreation in these areas affords ample opportunity for the "incidental" purchase of cigarettes in adjacent low price areas by many residents of high price areas.

Generally then, the "average" price of cigarettes reported by the Tobacco Tax Council will overstate the actual cigarette prices faced by individuals in high price areas which border lower price areas. Border price differentials are relatively common in the United States. In these cases, the use of this "average" price variable can lead to biased estimates of the price elasticity of demand for cigarettes. To correct for this problem, a procedure was developed to identify and eliminate from our sample observations in PSU's where because of the possible existence of "incidental" bootlegging average prices reported might not accurately reflect prices faced by consumers. A 20 mile wide band was drawn completely around each PSU and the prevailing retail price of cigarettes within this band determined for each PSU.[8] A "restricted" sample of the HIS data set was then obtained by deleting from the full sample individuals in PSU's where the own average price was greater than the price within the 20 mile band. This restricted sample should then consist almost solely of

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[8]As noted previously, the purchase of cigarettes in adjacent areas at lower prices is largely a function of travel costs. Twenty miles was arbitrarily chosen as the distance beyond which price differentials would not substantially affect cigarette purchases for own consumption.

individuals who face cigarette prices equal to those of their own state and accurately represented by the Tobacco Tax Council price series. In this paper, demand estimates are presented for the full HIS sample and the restricted sample.

4. Data

The 1976 Health Interview Survey (HIS) was a nationwide survey which collected data weekly by household interview for the purpose of determining the health status of the U.S. civilian noninstitutionalized population. The 1976 HIS sample is comprised of 28,033 individuals between the ages of 20 and 74 from 430 survey sites (PSU's) nationwide. The survey population is representative of the population of the United States. All the variables included in the analysis, with the exception of cigarette prices, are reported on the public use data tapes purchased from the National Center for Health Statistics (NCHS). Average cigarette prices were calculated for each PSU in the HIS based on data from the Tobacco Tax Council (1980) and placed on the data tape under an arrangement with NCHS which preserved the confidentiality of the respondents in the Survey. After editing, the data set

contained 19,266 observations with information on the smoking behavior of individuals 20-74 years of age.[9]

5. Results

Definitions, means, and standard deviations of the three dependent variables and the independent variables are presented in Table The summary statistics are presented for the entire HIS sample and for the restricted sample. Inspection of the sample means reveals that the two samples are not substantially different. Not unexpectedly, the mean price in the restricted sample is lower than the mean price in the entire sample and by extension the mean price in the excluded PSU's. There are, however, a substantial number of observations from high priced PSU's in the restricted sample and the range of cigarette prices for the restricted sample (35.8¢ to 57.6¢ per pack) is nearly as large as the range (35.8¢ to 62.2¢ per pack) for the entire sample.

The most substantial difference between the two samples is in their geographic representation of the nation. The restricted sample contains proportionately more observations from the West (29%) than the total sample (18%) and fewer observations from the Northeast (11% in the restricted sample vs. 24% in the total sample). This is largely because the Northeast contains many

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[9]Editing consisted primarily of eliminating observations for which little information on smoking behavior was available. In addition, the 1976 HIS included a small number of observations in PSU's that NCHS could not identify. Since we could not calculate appropriate average prices for these observations, they were eliminated from our working sample.

Table 1 - Descriptions, Means and Standard Deviations of Dependent and Independent Variables for the Entire Edited 1976 HIS Sample and the Restricted Sample

Variables	Description	Means/(Standard Deviations) Entire Sample Smokers & Non-Smokers (a)	Entire Sample Smokers Only (b)	Restricted Sample Smokers & Non-Smokers (c)	Restricted Sample Smokers Only (d)
Dependent Variables					
CIGDAY	Number of cigarettes smoked per day by smokers and nonsmokers.	7.401 (12.130)	-	7.264 (11.927)	-
SMOKER	Dummy variable that is equal to one when the individual is a smoker.	.367 (.482)	-	.364 (.481)	
CIGSMOKER	Number of cigarettes smoked per day by smokers.	-	20.144 (11.992)	-	19.940 (11.736)
Independent Variables					
PRICE	Composite price in cents per pack of cigarettes a consumer faces in his immediate area.	49.550 (5.474)	49.480 (5.593)	47.984 (5.205)	47.772 (5.419)
INCOME	Family income (measured continously in thousands of dollars) computed by assigning $500 to the lowest reported interval, $40,000 to the highest reported interval, and midpoints to the following closed income intervals: $1,000 - 1,999; 2,000 - 2,999; 3,000 - 3,999; 4,000 - 4,999; 5,000 - 5,999; 6,000 - 6,999; 7,000 - 9,999; 10,000 -14,999; 15,000 -24,999	15.330 (11,276)	15,238 (11,015)	15,084 (11,151)	14.960 (10.856)

Table 1 - continued

Variables	Description	Means / (Standard Deviations)			
		Entire Sample		Restricted Sample	
		Smokers & Non-Smokers (a)	Smokers Only (b)	Smokers & Non-Smokers (c)	Smokers Only (d)
EDNONE	Dummy variables that measure education categorically and equal 1 when examinee has no formal education(EDNONE); equal 1 when examinee is only a high school graduate (EDHSG); equal 1 when in addition the examinee has some college (EDSCOL); equal 1 when in addition the examinee is a college graduate (EDCOLG); and equal 1 when in addition examinee has some post-college education (EDGS); omitted class is examinees with some formal education but less than high school graduates.	.007 (.085)	.005 (.069)	.008 (.087)	.005 (.070)
EDHSG		.365 (.482)	.391 (.488)	.364 (.481)	.386 (.487)
EDSCOL		.151 (.358)	.151 (.358)	.159 (.366)	.159 (.366)
EDCOLG		.084 (.277)	.065 (.246)	.086 (.280)	.065 (.247)
EDGS		.062 (.241)	.041 (.199)	.061 (.239)	.044 (.204)

Table 1 - continued

Variables	Description	Means / (Standard Deviations)			
		Entire Sample		Restricted Sample	
		Smokers & Non-Smokers (a)	Smokers Only (b)	Smokers & Non-Smokers (c)	Smokers Only (d)
AGE	Age in years computed by assigning 75 years to the oldest interval and midpoints to the following intervals: 20-24 years 25-34 years 35-44 years 45-54 years 55-64 years 65-74 years	44.526 (16.415)	41.176 (14.426)	44.362 (16.456)	40.981 (14.419)
FEMALE	Dummy variable that is equal to one when examinee is female.	.549 (.498)	.483 (.500)	.546 (.498)	.475 (.499)
WIDOWED	Marital status dummy variables that equal one only when examinee reports status as "widowed", "never married", "divorced" or "separated" respectively; omitted class is currently "married".	.084 (.278)	.052 (.222)	.080 (.272)	.048 (.215)
NEVER		.123 (.329)	.119 (.323)	.120 (.325)	.113 (.317)
DIVORCED		.052 (.221)	.079 (.270)	.057 (.231)	.087 (.281)
SEPARATED		.025 (.155)	.034 (.182)	.020 (.140)	.030 (.170)

Table 1 - continued

Means/(Standard Deviations)

Variables	Description	Entire Sample		Restricted Sample	
		Smokers & Non-Smokers (a)	Smokers Only (b)	Smokers & Non-Smokers (c)	Smokers Only (d)
GOOD	Dummy variables that equal one when examinee reports health as "good"	.400 (.490)	.411 (.492)	.398 (.489)	.407 (.491)
FAIR	"fair" or "poor" respectively; omitted category is "excellent"	.121 (.326)	.121 (.326)	.122 (.327)	.125 (.330)
POOR	health.	.040 (.196)	.039 (.195)	.040 (.195)	.040 (.197)
BLACK	Dummy variable that equals one when examinee is black	.092 (.289)	.106 (.308)	.081 (.273)	.092 (.289)
OTHER	Dummy variable that equals one when examinee is neither black nor white.	.013 (.115)	.009 (.093)	.017 (.129)	.012 (.109)
FAMSIZE	Number of persons in examinee's family.	2.970 (1.928)	3.091 (1.981)	2.947 (1.917)	3.042 (1.970)
LABOR	Dummy variable that equals one if examinee is female and in the labor force.	.218 (.413)	.221 (.415)	.219 (.414)	.218 (.413)
NEAST	Dummy variables that equal one when examinee lives in the Northeast, North-	.237 (.425)	.240 (.427)	.114 (318)	.114 (.317)
NCENTRAL	central or South respec- tively; ommitted class is residence in West.	.275 (.447)	.271 (.444)	.279 (.449)	.276 (.447)
SOUTH		.305 (.460)	.309 (.462)	.318 (.466)	.328 (.469)

Table 1 - continued

Variables	Description	Means / (Standard Deviations)			
		Entire Sample		Restricted Sample	
		Smokers & Non-Smokers (a)	Smokers Only (b)	Smokers & Non-Smokers (c)	Smokers Only (d)
NONCITY	Dummy variables that equal one when examinee does not live in an SMSA (NONCITY); lives in an SMSA with a population over 3 million (LCITY); or lives in an SMSA with a population between 1 and 3 million (MCITY); omitted class is residence in an SMSA with population less than 1 million.	.310 (.463)	.302 (.459)	.327 (.469)	.320 (.467)
LCITY		.166 (.373)	.169 (.375)	.123 (.328)	.121 (.326)
MCITY		.181 (.385)	.186 (.389)	.203 (.402)	.209 (.407)

small political divisions with varying tax rates while the West is dominated by larger geographic areas with more uniform tax rates. Representation of the other regions is approximately equal in both samples.

OLS regression estimates of the demand for cigarettes (quantity smoked by smokers and non-smokers), the smoking participation rate and the quantity smoked by smokers for both the total and the restricted sample are presented in Table 2. There are substantial differences in the estimated price effects in the two samples - the price coefficients and corresponding elasticities at the mean are almost twice as large in the restricted sample as in the total sample. Moreover, the price coefficient only achieves statistical significance at the 5 percent level of a one-tailed test in the quantity smoked regression for the total sample (column (a)) while it is more robust in both the quantity smoked and smoking participation rate regressions (columns (b) and (d)) in the restricted sample.

The estimated coefficients of the other independent variables are generally not sensitive to the sample chosen.[10] These findings are consistent with measurement error in the full sample price variable which biases the full sample price coefficient toward zero. The exclusion of a disproportionate

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[10]Except for income, we do not discuss in this paper the effects of the other independent variables on smoking.

Table 2 - OLS Regression Coefficients of the Demand for Cigarettes in the 1976 HIS Sample and the Restricted Sample[a]

Independent Variables	Quantity Smoked by Smokers and Nonsmokers (CIGDAY)		Smoking Participation Rate (SMOKER)		Quantity Smoked by Smokers (CIGSMOKER)	
	Entire Sample (a)	Restricted Sample (b)	Entire Sample (c)	Restricted Sample (d)	Entire Sample (e)	Restricted Sample (f)
PRICE	-.033 (-1.708)	-.063** (-2.729)	-.001 (-1.538)	-.002* (-2.252)	-.015 (-.501)	-.043 (-1.188)
INCOME	.393** (4.417)	.384** (3.299)	7.84E-03* (2.211)	7.59 E-03 (1.618)	.732** (5.036)	.735** (3.823)
EDNONE	-3.555** (-3.550)	-4.296** (-3.363)	-.105** (-2.624)	-.116* (-2.253)	-7.117** (-3.549)	-9.546** (-3.708)
EDHSG	-.973** (-4.392)	-.759** (-2.621)	-.046** (-5.239)	-.047** (-4.028)	-.088 (-.256)	.431 (.957)
EDSCOL	-1.957** (-6.757)	-1.612** (-4.323)	-.091** (-7.888)	-.087** (-5.799)	-.430 (-.943)	.223 (.379)
EDCOLG	-3.745** (-10.536)	-3.310** (-7.226)	-.166** (-11.735)	-.165** (-8.941)	-1.383* (-2.212)	-.225 (-.277)
EDGS	-5.255** (-13.085)	-4.283** (-8.168)	-.217** (-13.604)	-.192** (-9.050)	-2.798** (-3.739)	-1.742 (-1.834)
AGE	-.114** (-17.498)	-.112** (-13.207)	-.006** (-21.860)	-.006** (-17.187)	.003 (.277)	.018 (1.207)
FEMALE	-4.112** (-20.437)	-4.030** (-15.374)	-.129** (-16.080)	-.132** (-12.487)	-4.392 (-12.990)	-4.102** (-9.251)
WIDOWED	-.222 (-.632)	-.225 (-.484)	-.011 (-.776)	-.012 (-.654)	-1.045 (-1.524)	-.886 (-.966)
NEVER	-2.028** (-7.063)	-2.395** (-6.302)	-.071** (-6.210)	-.083** (-5.437)	-1.818** (-3.785)	-2.305** (-3.572)

Table 2 - continued

Independent Variables	Quantity Smoked by Smokers and Nonsmokers (CIGDAY)		Smoking Participation Rate (SMOKER)		Quantity Smoked by Smokers (CIGSMOKER)	
	Entire Sample (a)	Restricted Sample (b)	Entire Sample (c)	Restricted Sample (d)	Entire Sample (e)	Restricted Sample (f)
DIVORCED	4.953**	4.861**	.179**	.176**	2.655**	2.814**
	(12.365)	(9.690)	(11.260)	(8.698)	(4.852)	(4.077)
SEPARATED	3.532**	4.148**	.102**	.140**	3.056**	3.016**
	(6.279)	(5.168)	(4.556)	(4.324)	(3.900)	(2.776)
GOOD	1.143**	1.194**	.026**	.029**	1.653**	1.769**
	(6.047)	(4.846)	(3.461)	(2.895)	(5.408)	(4.431)
FAIR	1.399**	1.348**	.043**	.052**	1.396**	.998
	(4.809)	(3.577)	(3.721)	(3.428)	(2.975)	(1.649)
POOR	1.742**	1.993**	.044*	.059*	2.298**	2.235*
	(3.796)	(3.330)	(2.421)	(2.454)	(3.058)	(2.314)
BLACK	-2.498**	-2.282**	.018	.008	-6.660	-6.078**
	(-8.051)	(-5.367)	(1.429)	(.459)	(-14.139)	(-9.317)
OTHER	-3.912**	-3.368**	-.124**	-.100**	-6.036	-5.636**
	(-5.246)	(-3.892)	(-4.169)	(-2.856)	(-4.054)	(-3.379)
FAMSIZE	.041	-.108	-.003	-.005	.004	-.049
	(-.785)	(-1.580)	(-1.266)	(-1.822)	(.044)	(-.456)
LABOR	.868**	.507	.041**	.031*	.544	.074
	(3.560)	(1.597)	(4.198)	(2.457)	(1.329)	(.138)
NEAST	.965**	.956*	.028*	.028*	1.137*	1.010
	(3.136)	(2.196)	(2.310)	(1.594)	(2.292)	(1.429)
NCENT	.336	.224	.005	.005	.539	.193
	(1.290)	(.730)	(.460)	(.420)	(1.269)	(.386)

Table 2 - continued

Independent Variables	Quantity Smoked by Smokers and Nonsmokers (CIGDAY)		Smoking Participation Rate (SMOKER)		Quantity Smoked by Smokers (CIGSMOKER)	
	Entire Sample (a)	Restricted Sample (b)	Entire Sample (c)	Restricted Sample (d)	Entire Sample (e)	Restricted Sample (f)
SOUTH	.483 (1.801)	.598 (1.882)	.012 (1.088)	.017 (1.355)	.526 (1.209)	.476 (.929)
NONCITY	-.398 (-1.856)	-.331 (-1.209)	-.016 (-1.832)	-.010 (-.895)	-.457 (-1.301)	-.603 (-1.412)
LCITY	.232 (.855)	-.083 (-.205)	.015 (1.380)	.007 (.410)	-.271 (-.619)	-.781 (-1.183)
MCITY	.283 (1.121)	.399 (1.243)	.014 (1.401)	.020 (1.566)	.031 (.077)	-.053 (-.102)
Intercept	15.121** (15.672)	17.326** (13.953)	.765** (18.683)	.819** (16.334)	21.355* (13.161)	21.832 (11.277)
R^2	.069	.069	.067	.069	.078	.075
N	19,268	11,052	19,268	11,052	7,079	4,026
Price Elasticity at Sample Means	-.221	-.416	-.135	-.264	-.037	-.103

a) t- statistics are reported in parentheses below coefficients.

* Statistically significant at 5% on two tailed test.
** Statistically significant at 1% on two tailed test.

number of observations from the Northeast from the restricted sample adds additional support to this hypothesis. In particular, Connecticut, Massachusetts, New Jersey, New York and Pennsylvania have all been identified as states with serious cigarette smuggling problems (Advisory Commission on Intergovernmental Relations, 1977). It is estimated that as many as one out of each two packs of cigarettes sold in New York City are bootlegged (Advisory Commission on Intergovernmental Relations, 1977). Because of the apparent measurement error bias in the full sample results, we will rely on price effects estimated from the restricted sample in the remainder of this paper.

Regression estimates over the restricted sample for smoking participation, and quantity smoked by smokers are presented in columns (d) and (f) of Table 2. The results suggest that an increase in the price of cigarettes would reduce cigarette consumption primarily through reductions in the smoking participation rate (price elasticity = -.26), while having a much smaller impact on the quantity of cigarettes demanded by smokers (price elasticity = -.10).[11] Because quantity smoked by smokers is not very sensitive

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[11] These elasticities are computed at the means and the price coefficient in the quantity of cigarettes demanded by smokers regression is not statistically significant at conventional levels.

to price, higher cigarette prices would appear to effect cigarette demand by affecting the decision to smoke or not rather than by causing existing smokers to reduce the amount of cigarettes they smoke. This distinction is developed more fully in the next section. The combined or total price elasticity of -.42 is at the low end of the range of recent estimates. This is not surprising given the reliance on tax paid sales as the quantity measure in previous cross section studies.[12]

The income elasticity of .08 is also small relative to previous estimates. This point is taken up in the concluding section of the paper. In contrast to price, income appears to impact cigarette demand primarily by influencing the number of cigarettes consumed by smokers rather than by affecting the smoking particpation rate.[13]

Cigarette Demand by Different Age Groups

Because price appears to impact cigarette demand primarily through its affect on the decision to smoke or not, demand equations were estimated across the following age groups in the restricted sample:20-25 years, 26-35 years, and over 35 years. The price coefficients and elasticities at the means from these estimated demand equations are presented in Table 3. These

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[12] Actually,the bias away from zero in the price elasticity estimates of these previous studies is offset to some extent by the bias toward zero resulting from the failure to take account of the lower prices in adjacent jurisdictions faced by many smokers. However, the sale of cigarettes smuggled on a large scale at the legal price level suggests that the former effect dominates the latter. As further evidence of this upward bias, we estimated a demand for cigarettes equation across states using 1976 state taxable sales as the dependent variable and a number of state specific variables including per capita income and composite price as independent variables. The estimated price and income coefficients were both statistically significant at conventional levels and the estimated elasticities at the means of 0.77 for income and -1.70 for price were both substantially greater than our estimates of these parameters using the HIS data.

[13] The income elasticity of the smoking participation rate at the means is .03 and the income elasticity of the quantity smoked by smokers is .06.

Table 3 Regression Price Coefficients and Elasticities, Means and Standard Deviations in the Restricted 1976 HIS Sample According to Age and Smoking Status[a]

Variables	20-25 Yr. Olds	26-35 Yr. Olds	Over 35 Yrs. Old
A. Regression Coefficients			
1. Demand for Cigarettes by Smokers and Nonsmokers (CIGDAY) (OLS)			
PRICE	-.125* (.057)	-.081 (.047)	-.066* (.030)
Elasticity at the Means	-.89	-.47	-.45
R^2	.091	.098	.052
Sample Size	1,492	2,593	6,967
2. Smoking Participation Rate (SMOKER) (FIML Logit)[b]			
PRICE	-.024* [-.006] (.012)	-.016 [-.004] (.009)	-.004 [-.001] (.006)
Elasticity at the Means	-.74	-.44	-.15
D^c	.084	.086	.071
Sample Size	1,492	2,593	6,967
3. Demand for Cigarettes by Smokers (CIGSMOKE)(OLS)			
PRICE	-.074 (.090)	-.015 (.065)	-.065 (.049)
Elasticity at the Means	-.20	-.04	-.15
R^2	.067	.091	.091
Sample Size	586	1,109	2,331

Table 3 Continued

	20-25 Yr. Olds	26-35 Yr. Olds	Over 35 Yrs. Old
B. Means and Standard Deviations of Price and Dependent Variables[d]			
CIGDAY	6.74 (10.60)	8.25 (11.93)	7.01 (12.17)
SMOKER	.39 (.49)	.43 (.50)	.33 (.47)
PRICE	47.78 (5.14)	47.77 (5.17)	48.11 (5.23)
CIGSMOKER	17.15 (10.37)	19.29 (10.94)	20.95 (12.28)
PRICE (CIGSMOKER)[e]	47.44 (5.37)	47.54 (5.41)	47.97 (5.43)

a) Standard errors of regression coefficients are in parentheses below coefficients.

b) $\partial y/\partial x$'s evaluated at the mean of SMOKER are reported in brackets [ ] alongside coefficients.

c) The D statistic, which varies between 0 and 1, measures the goodness of fit of the model. It is the value such that D(n-p)/(1-D)=model chi-square, where p= the number of variables in the model and n= the number of observations.

d) Standard deviations reported below means in parentheses.

e) Mean of PRICE in the smokers only sample.

* Statistically significant at 5% on two tail test

** Statistically significant at 1% on two tail test

estimates are from regressions which included all the independent variables included in the regressions in Table 2. While we do not present or discuss the effects of these other independent variables on smoking, it should be realized that all the estimated price effects presented in this paper control for the effects of these other variables. The estimated price effects from the smoking participation regression are estimated by a FIML logit procedure, the preferred estimation procedure when the dependent variable is dichotomous (Nerlove and Press, 1973).[14]

Since most regular smokers begin smoking before age 25(National Clearing House for Smoking & Health,1976) and since smoking is in some sense "addictive" (Krasnegor,1976a), our previous results suggest that the smoking participation decision of the younger age group may account for much of the aggregate price effects found across all age groups. To a great extent, the results summarized in Table 3 bear this out. The cigarette demand equations for smokers and non-smokers yielded a price elasticity of -.89 for the 20-25 years age group, a figure twice as large in absolute value as the price elasticity for the other age groups. Furthermore, the smoking participation price elasticity of -.74 for the 20-25 year olds accounts for a great portion of the aggregate price elasticity of this age group. This

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[14] The smoking participation rate equations were estimated by both OLS and FIML logit procedures for all the age and sex subsamples of the restricted sample reported in Tables 3,4 and 5. In all cases, the price effects obtained from the OLS regressions were almost identical to those obtained when the FIML logit procedure was used. We present the results of the logit estimates because they are preferred on theoretical grounds. The entire HIS sample and the entire "restricted" sample were too large to be accommodated by our logit program. Those results, reported in Table 2, were obtained by OLS regression. Given the size of the sample in each of these two instances and the similarity between the OLS and logit estimates in the subsample estimates, we feel confident that the OLS estimates presented in Table 2 are nearly identical to what logit estimates would be.

is not to say that the results for the older age groups do not show some price sensitivity. The price coefficient is statistically significant in the demand for cigarette equations for the over 35 year old group and nearly significant for those 26-35 years old. The price elasticity of demand at the means for both these groups of about -.45 is not insubstantial. In the case of the 26-35 year olds, price appears to operate primarily through smoking participation while the decomposition of the aggregate price effect for the older age group is less conclusive.

The results reported here that price has its greatest effect on the smoking behavior of younger people and that it operates primarily via the decision to begin smoking regularly rather than on the quantity smoked is consistent with results reported by Lewit, Coate, and Grossman (1981). Lewit, Coate and Grossman (1981) used another large micro-sample, the Health Examination Survey, 1966-1970, and a methodology similar to that described in this paper to examine cigarette demand by 12-17 year olds. They report a total price elasticity for the quantity smoked by teenage smokers and non-smokers of -1.4 and a smoking participation elasticity of -1.2. Thus, the pattern of larger price elasticities in the younger age groups and the attribution of price effects primarily to the smoking participation decision is confirmed in another sample.

Cigarette Demand by Age and Sex

Further insight into the effects of price on cigarette demand can be gained by looking in some detail at the price elasticities of different age and sex groups. In previous specifications, sex differentials in cigarette demand were represented by a dummy variable. The price elasticity

results presented in Table 4 for males and Table 5 for females are based on separate regressions for each sex in each age group. Thus, price effects can now differ by sex as well as by age.

The results indicate that cigarette demand by females is generally not sensitive to price (Table 5) while males (Table 4) appear more sensitive to price than was implied by previous results where male and female price effects were constrained to be equal. For 20-25 year olds, for example, the price elasticity for quantity smoked by smokers and non-smokers was -.89 for both sexes combined, -1.40 for males, and small and not significantly different from zero for females.

Even for males, however, the effect of price on smoking behavior varies with age. The coefficient of price in the regression for men aged 26-35 years fails to achieve statistical significance and price elasticities at the mean are much smaller than for the younger group. Price does, however, seem to act to reduce smoking by males more than 35 years old (Table 4). Here the impact of a price is split between changes in the smoking participation rate and changes in the quantity smoked by smokers. It appears, therefore, that to some extent price (tax) increases may have a beneficial effect on the health of older males, a group that has experienced the greatest health losses due to cigarette smoking(U.S. Public Health Service, 1979).

6. Implications of the Research

In this paper, we have attempted to assess the potential for using excise taxes to reduce smoking by measuring the price elasticity of demand for cigarettes. Excise tax increases will discourage smoking to the extent

Table 4

Regression Price Coefficients and Elasticities, Means and Standard Deviations for Males According to Age and Smoking Status (1976 HIS Restricted Sample)[a]

Variables	20-25 Yr. Olds	26-35 Yr. Olds	Over 35 Yrs. Old
A. Regression Coefficients			
1. Demand for Cigarettes by Smokers and Nonsmokers (CIGDAY) (CLS)			
PRICE	-.236* (.094)	-.066 (.075)	-.124* (.052)
Elasticity at the Means	-1.401	-.320	.658
R^2	.091	.091	.032
Sample Size	656	1,195	3,171
2. Smoking Participation Rate (SMOKER) (FIML Logit)[b]			
PRICE	-.050**[-.012] (.018)	-.013[-.003] (.013)	-.009[-.002] (.008)
Elasticity at the Means	-1.276	-.292	-.246
D^c	.097	.059	.069
Sample Size	656	1,195	3,171
3. Demand for Cigarettes by Smokers (CIGSMOKE) (OLS)			
PRICE	-.065 (.119)	.012 (.090)	-.100 (.074)
Elasticity at the Means	-.171	.029	-.204
R^2	.156	.101	.063
Sample Size	294	591	1,229

Table 4 Continued

	20-25 Yr. Olds	26-35 Yr. Olds	Over 35 Yrs. Old
	B. Means and Standard Deviations of Price and Dependent Variables[d]		
CIGDAY	8.06 (11.33)	9.85 (12.59)	9.06 (14.04)
SMOKER	.45 (.50)	.49 (.50)	.39 (.49)
PRICE	47.84 (5.14)	47.69 (5.13)	48.05 (5.25)
CIGSMOKER	17.98 (10.38)	19.92 (10.95)	23.39 (13.19)
PRICE (CIGSMOKER)[e]	47.22 (5.54)	47.39 (5.41)	47.78 (5.50)

a) Standard errors of regression coefficients are in parentheses below coefficients.

b) $\partial y/\partial x$ evaluated at the mean of SMOKER are reported in brackets [ ] alongside coefficients

c) The D statistic, which varies between 0 and 1, measures the goodness of fit of the model. It is the value such that D (n-p)/(1-D)=model chi-square, where p= the number of variables in the model and n=the number of observations.

d) Standard deviations reported below means in parentheses.

e) Mean of PRICE in the smokers only sample.

* Statistically significant at 5% on two tail test

** Statistically significant at 1% on two tail test

Table 5

Regression Price Coefficients and Elasticities, Means and Standard Deviations for Females According to Age and Smoking Status (1976 HIS Restricted Sample)[a]

Variable	20-25 Yr. Olds	26-35 Yr. Olds	Over 35 Yrs. Old
A. Regression Coefficients			
1. Demand for Cigarettes by Smokers and Nonsmokers (CIGDAY) (OLS)			
PRICE	-.036 (.071)	-.083 (.061)	-.013 (.034)
Elasticity at the Means	-.302	-.577	-.118
R^2	.103	.086	.039
Sample Size	836	1,398	3,796
2. Smoking Participation Rate (SMOKER) (FIML Logit)[b]			
PRICE	-.005 [-.001] (.016)	-.015 [-.003] (.012)	.002 [.0004] (.008)
Elasticity at the Means	-.136	-.388	.066
D^c	.093	.066	.068
Sample Size	836	1,398	3,796
3. Demand for Cigarettes by Smokers (CIGSMOKE) (OLS)			
PRICE	-.009 (.135)	-.052 (.097)	-.029 (.064)
Elasticity at the Means	-.026	-.134	-.077
R^2	.089	.106	.053
Sample Size	292	518	1,102

Table 5 Continued

	20-25 Yr. Olds	26-35 Yr. Olds	Over 35 Yrs. Old
	B. Means and Standard Deviations of Price and Dependent Variables[d]		
CIGDAY	5.70 (9.88)	6.88 (11.15)	5.29 (10.04)
SMOKER	.35 (.48)	.37 (.48)	.29 (.45)
PRICE	47.74 (5.15)	47.83 (5.20)	48.16 (5.21)
CIGSMOKER	16.32 (10.31)	18.56 (10.88)	18.23 (10.55)
PRICE (CIGSMOKER)[e]	47.65 (5.20)	47.71 (5.41)	48.18 (5.35)

a) Standard errors of regresstion coefficients are in parentheses below coefficients.

b) $\partial y/\partial x$'s evaluated at the means of SMOKER are reported in brackets [ ] alongside coefficients.

c) The D statistic, which varies between 0 and 1, measures the goodness of fit of the model. It is the value such that D (n-p)/(1-D)=model chi-square, where p= the number of variables in the model and n= the number of observations.

d) Standard deviations reported below means in parentheses.

e) Mean of PRICE in the smokers only sample.

* Statistically significant at 5% on two tail test

** Statistically significant at 1% on two tail test

that excise tax increases are passed on to smokers in the form of higher retail cigarette prices. Barzel (1976) has presented evidence that retail cigarette prices have more than reflected state excise tax increases.[15]

Our empirical results have indicated: 1) that the price elasticity of demand for cigarettes is -.42; 2) that price impacts cigarette demand primarily by affecting the decision to begin smoking regularly among members of the population less than 25 years; and 3) that price effects are much larger for males than females - in fact our estimates show a price elasticity near zero for females over 20 years old.

The results have implications for any future Federal government attempts to influence cigarette demand through excise tax policy. The short run impact of an excise tax increase would be small. For example, if the federal excise tax was doubled to 16 cents a pack, and if the tax increase was completely passed on to the consumer, then the average retail price would increase by about 13% (using the average 1979 average retail price as a reference). Accordingly, applying our estimated price elasticity of -.42, cigarette consumption would fall by about 5.5%. The fall-off in demand would result from approximately a 3.9% decline in smoking participation and a 1.3% decline in the quantity of cigarettes smoked by smokers. In the long run, however, the impact of such a tax increase would be much more substantial.

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[15]Of course, increases in the retail price of cigarettes which result from increases in the costs of growing, manufacturing or marketing cigarettes will discourage cigarette smoking to the same extent as tax increases.

Our results imply that a doubling of the excise tax would lead to a 17% decline in smoking participation by males 20-25. Furthermore, it may be reasonable to expect that over time the response by females to price changes could approach that of males. Until the mid-1970's, trends in smoking participation of males and females in the United States were markedly different. Male smoking rates peaked in the mid-1960's at 51 percent of the male population and have fallen continously since then, to 37 percent in 1979, the latest year for which figures are available(U.S. Public Health Service, 1980) Female smoking rates peaked later than male rates and were relatively constant through 1976, the year in which the HIS data used in this study were collected. More recent data, however, show a decline in female smoking, with participation rates down to 28 percent from the 33 percent plateau of the late sixties to mid-seventies (U.S. Public Health Service, 1980). At least to some extent then, one aspect of female smoking is becoming similar to that of males.[16]

In the long run, an excise tax increase, if maintained in real terms, should continue to discourage smoking participation by successive generations of teenagers and young adults, while gradually impacting the smoking levels of older age group as the smoking discouraged cohorts move through the age spectrum. Moreover, since the discouraging effects of an excise tax increase would operate largely through the participation

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[16]It is beyond the scope of this paper to determine why price seems to affect male smoking behavior but not female smoking behavior or to explain differences in aggregate smoking behavior by the two sexes. We would only point out that since males and females face the same prices for cigarettes and since the real price of cigarettes has fallen during the 1970's, the differential behavior cited above cannot be attributed to the level of or to changes in the price of cigarettes.

decision rather than through quantity adjustments by existing smokers, several arguments that excise tax increases may not have beneficial health effects loose force. In particular, some have argued that smokers respond to higher prices by switching to higher tar and nicotine brands, by inhaling more deeply, or by reducing idle burn.[17] All of these compensatory behaviors by smokers would greatly reduce any health benefits which might be obtained from reducing the number of cigarettes smoked because of higher taxes. These arguments, however, are obviously not relevant to the smoking participation decision and are inconsistent with our findings of small quantity adjustments by smokers.

Some final words are reserved for a discussion of income elasticity of demand for cigarettes. The size of the income elasticity has had important implications for evaluations of federal government policies to discourage smoking (Hamilton 1972; Ippolito, Murphy, and Sant, 1979; Klein, Murphy, and Schneider, 1981). Our estimated income elasticity of demand, .08 (Table 2), is about one-tenth the size of the estimate obtained by Ippolito, Murphy, and Sant (1979) from time series data and about one-tenth the size of Hamilton's (1972) estimate which was obtained from a cross state analysis of tax paid sales data. As a result, the models of both Hamilton (1972) and Ippolito, Murphy, and Sant (1979) tend to attribute more of the secular variation in per capita cigarette consumption to variations in income than would a model incorporating our estimated income elasticity. For example, Hamilton (1972) estimates that annual cigarette consumption would have increased from 3506 cigarettes per capita in 1953-55 to 4482 cigarettes per capita in 1968-70 due to the substantial increase in income during that period. Since consumption only increased to 3868 cigarettes per capita in 1968-70, he credits the health scare and anti-smoking advertising under the Fairness Doctrine with

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[17] For recent discussions of these compensatory behaviors see Krasnegor (1979a and 1979b), and Gori and Bock (1980).

substantially reducing smoking below the level it otherwise would have been. To the extent to which Hamilton's estimate of an income induced increase in smoking may have been too large, he may have overstated the impact of the health scare. Moreover, his analysis of the differential effects of the Fairness Doctrine and advertising ban policies may also require reconsideration if they too rely substantially on an overstated income effect. Of course, it is possible that the income elasticity of demand for cigarettes has declined substantially in recent years for many reasons including the health scare and related government programs. In fact, Klein, Murphy, and Schneider (1981) assess the impact of government cigarette policies within the context of a time series model wherein the income elasticity of demand for cigarettes falls as income rises. As a result, their estimated income elasticity for 1976 is closer to our estimate than the estimates cited immediately above.[18]

[18]In the Klein, Murphy, and Schneider (1981) model, income can influence the demand for cigarettes in two ways: by affecting the demand for tobacco and by affecting the proportion of tobacco consumed as cigarettes. They assume that below a critical level of income ($551 1929 dollars) all tobacco is consumed in forms other than prerolled cigarettes whereas above this level all tobacco is consumed as cigarettes. Accordingly, as income rises over time the increase in cigarette demand that is due to switching declines as there are a declining number of non-cigarette smoking tobacco smokers who can switch to cigarettes. In the limit, when all smokers smoke cigarettes exclusively, they estimate the income elasticity of demand for cigarettes (and all tobacco) to be .47.

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