Federal Trade Commission

Staff Report on CONSUMER RESPONSES to CIGARETTE HEALTH INFORMATION

Bureau of Economics

August 1979

FTC news

Federal Trade Commission *Washington, D.C. 20580*

FOR IMMEDIATE RELEASE Sept. 21, 1979

SMOKING INFORMATION HAS REDUCED TAR AND NICOTINE CONSUMPTION, CONCLUDES FTC STAFF REPORT

The 1964 Surgeon General's Report and other publicity about the dangers of cigarettes have resulted in substantially lower per capita tar and nicotine consumption, concludes a Bureau of Economics study released today by the Federal Trade Commission.

According to the study, average tar and nicotine consumption would have exceeded current levels by as much as 80 percent if consumers had not been alerted to the health hazards of smoking.

The study examines the nature and extent of consumer reactions to information programs that stress the dangers of cigarettes and provide data to help continuing smokers reduce their tar and nicotine intake.

A key finding is that other researchers have overestimated the impact of the anti-smoking commercials that ran from 1968-70. The authors find no evidence that these counter-commercials were a uniquely powerful smoking deterrent. The report says that per capita smoking fell steadily after 1964 at an annual rate of about 3.5 percent. The authors conclude that "Contrary to prior findings and predictions, no evidence could be found that this decline in smoking intensified when the anti-smoking commericals aired from 1968-70 or moderated when the counter-commercials were withdrawn in 1971 .... Our results ... suggest that the counter-commercials were not a uniquely powerful smoking deterrent."

The study includes an estimate of the gain in average life expectancy that can be attributed to health disclosures. The authors find that individuals who decided not to begin smoking have gained approximately two years of life, while continuing smokers have gained three months as a result of reductions in the average tar and nicotine content of cigarettes.

(more)

The report also examines the impact of health information on the start and quit rates of consumers in specific age, income and education groups. Older adults (aged 46-55) and more highly educated consumers have exhibited the greatest resolve in giving up cigarettes. Confirming the findings of other studies, the authors report that "... the very young have not responded to health warnings ... start rates among young females (aged 12-16) have actually increased from 1964-1975."

This report has not been reviewed or adopted by the FTC. The views expressed are not necessarily those of the Commission or any of its members. It was written by Richard A. Ippolito, R. Dennis Murphy and Donald Sant.

# # #

MEDIA CONTACT: Dee Ellison, Office of Public Information, 202-523-3830

STAFF CONTACT: Donald Sant, Bureau of Economics, 202-624-7690

R. Dennis Murphy, Bureau of Economics, 202-632-5100

I015/TAR
(8.64)

STAFF REPORT ON

CONSUMER RESPONSES TO

CIGARETTE HEALTH INFORMATION

BUREAU OF ECONOMICS

FEDERAL TRADE COMMISSION

Richard A. Ippolito
R. Dennis Murphy
Donald Sant

August 1979

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

FEDERAL TRADE COMMISSION

This report has been prepared by the Bureau of Economics of the Federal Trade Commission. It has not been reviewed by, nor does it necessarily reflect the views of the Commission or any of its members.

ACKNOWLEDGMENTS

The authors wish to thank Ronald Bond, Keith Anderson, Steven Salop and Darius Gaskins for their helpful comments on earlier drafts of this study. Lester Taylor of the University of Arizona reviewed the econometric methodology and offered many constructive suggestions. We also wish to express our gratitude to Clare Wadbrook and Betsy Zichterman for typing the numerous revisions, and to Sharon Plummer, John Hamilton, and Emily Robinson for their valuable data gathering and computer programming services.

TABLE OF CONTENTS

CHAPTER I

Introduction and Summary

Evidence linking cigarette smoking to lung and heart disease has been mounting for several decades. Press coverage of the cigarette health controversy intensified during the 1950's,[1] partially in response to articles in Consumer Reports and Reader's Digest listing comparable laboratory measurements of the tar and nicotine content of major cigarette brands. These tabulations revealed that the tar and nicotine content of some filtered brands exceeded that of many non-filtered brands, thereby largely contradicting health claims for filtered cigarettes.

Suspicions concerning the health risks of smoking were generally confirmed in 1964 with the publication of the Surgeon General's Report on Smoking and Health. Since that date, the federal government has rejected outright bans on cigarette sales as a policy response to these health concerns and has, instead, initiated or encouraged informational programs that stress the dangers of cigarettes and provide information to help continuing smokers reduce their tar and nicotine intake. Health warnings were required on cigarette packages in 1965 and were strengthened in tone in 1970. These warnings were extended to print advertising in 1972. Since 1971, cigarette companies have participated in a voluntary plan to disclose the tar and nicotine content of their brands in advertising, using the most recently published results of the Federal Trade Commission's cigarette testing laboratory. Public service

---

[1] For example, according to the Survey of Current Periodicals, an average of eight cigarette health articles appeared in popular magazines in each year from 1947 through 1953. From 1954 through 1963, this number increased to 24 per year. In the year of the first Reader's Digest report, 1957, 44 articles were written. In 1964, the year in which the Surgeon General's Report was published, a total of 57 smoking health articles appeared.

anti-smoking messages were aired heavily from 1968 until cigarette television and radio commercials were banned in January 1971.

This report provides a detailed statistical examination of the nature and extent of consumer reactions to these information programs and to the less focused cigarette health publicity of the 1950's. The study analyzes per capita cigarette and tar and nicotine consumption data for the 50-year period 1925-1975 and explores individual smoking behavior in greater depth, relying primarily on data collected by the National Center for Disease Control profiling the lifetime smoking histories of 12,000 Americans. Of particular importance, the study has been structured to identify both immediate and more gradual consumer responses and to estimate the long-run impact of these changes in smoking behavior on cigarette consumption and life expectancy.

The report employs a statistical model of consumer smoking behavior to identify the key factors that have influenced smoking decisions over time and among individuals. These possible influences include economic factors, such as cigarette prices and consumer income, a variety of demographic characteristics, and, of course, cigarette health disclosures and attendant publicity. Controlling for the independent effects of these smoking determinants allows prediction of the path cigarette consumption and tar and nicotine intake would have followed had consumers not been alerted during the past 25 years to the dangers of smoking.

The report should not be construed as an assessment of the overall success or failure of health disclosures and warnings as a public policy approach. These information programs presumably are grounded on the belief that consumers are willing and able to gauge the hazards of smoking and determine for themselves whether or not the pleasures of smoking compensate for the increased risk of disease and shortened life. Our results can reveal only whether consumers have changed their smoking habits once health information is provided, not whether the nature and magnitude of these changes are in any sense consistent with rational, fully informed appraisals of the costs and benefits of smoking.

Prior Research

Previous statistical studies of consumer response to cigarette health disclosures have focused exclusively on annual movements in the average number of cigarettes purchased by adult Americans.[2] These studies generally have concluded that the Surgeon General's Report and the 1968-70 anti-smoking TV and radio commercials significantly reduced per capita cigarette consumption. Kenneth Warner estimates that by 1975 per capita consumption would have exceeded actual reported levels by 22 percent had public concern over the safety of cigarettes not increased after 1964.[3] Warner also concludes that the anti-smoking commercials were responsible for over two-thirds of this impact.[4]

An implication frequently drawn from these findings is that the advertising ban might actually have increased cigarette consumption since, under the

---

2 See in particular J. L. Hamilton, "The Demand for Cigarettes: Advertising, The Health Scare, and the Cigarette Advertising Ban," Review of Economics and Statistics (November 1972), pp. 401-411; R. H. Miller, Factors Affecting Cigarette Consumption, U.S. Department of Agriculture Economic Research Service, 1974, and Kenneth E. Warner, "The Effects of the Anti-Smoking Campaign on Cigarette Consumption," American Journal of Public Health (July 1977), pp. 645-650.

3 Warner, p. 648.

4 Ibid.

terms of the Fairness Doctrine, the apparently effective counter commercials were largely withdrawn in 1971.[5]

These earlier research efforts suffer from two serious limitations. First, and most important, their sole reliance on per capita consumption data obscures or ignores important alterations in smoking behavior. For any given year, per person cigarette sales depend upon both the average number of cigarettes smokers consume (hereafter identified as "smoking intensity") and upon the proportion of adult Americans who smoke (the "participation rate"). The percentage of adults smoking depends in turn upon the rate at which young adults decide to start smoking and the rate at which existing smokers successfully quit the habit.

The ultimate benefits of health warnings and disclosures depend critically upon which of these components of aggregate consumption are affected. For example, a permanent reduction in start rates would almost certainly confer important health benefits, whereas an increase in quit rates might have only trivial life-prolonging effects if quitters were primarily very light smokers or had smoked so long and heavily that irreversible injury had already occurred.

Information on these and other aspects of smoking behavior clearly cannot be gleaned from aggregate data alone. In addition, these data cannot chart the increasing popularity of low tar and nicotine cigarette brands. The per capita sales figures thus completely mask what may be one of the most important market responses to public concern over the health risks of smoking.

---

5 John Hamilton estimates that the deterrent effect of the counter commercials was almost six times as powerful as the sales stimulus provided by industry advertising. See Hamilton, p. 406.

Prior research efforts have also been hindered by a statistical methodology that confounds immediate and more gradual changes in smoking behavior. In particular, the variable chosen to measure the effects of the 1964 Surgeon General's Report has been specified in a manner that will distort the Report's true relative impact on smoking behavior unless consumers reacted fully to its findings almost instantaneously.[6] However, as the previous discussion indicated, movements in per capita consumption reflect a rather complex interplay of adjustments in smoking intensity and start and quit rates. It is unrealistic to assume that all such adjustments would occur, say, within one year. Some potential quitters would need more time to break the habit completely or even to moderate their consumption. More significantly, adjustments in start rates would almost certainly not have been confined to 1964. Young adults approaching smoking age from 1964 to 1968 were exposed to continuing publicity concerning the Report's findings. Since previous researchers assigned no variables specifically to measure these aftereffects of the Surgeon General's Report, cumulative reductions in per capita consumption induced by falling start rates from 1965-67 may have been captured by variables representing the 1968-70 anti-smoking commercials. Thus, as will be discussed shortly, the impact of these commercials may have been overstated.

Summary of Results

The following discussion provides a synopsis of the study's principal findings for readers who are not familiar with the statistical techniques employed in multivariate regression analysis. Readers with a thorough

---

6 See Chapter II, pp 15-18, for a description of these specification problems.

background in this area are referred to Chapter II, which presents a detailed description of methodology and regression results.

Per Capita Consumption

The present study confirms many prior conclusions regarding the determinants of per capita consumption during the past 50 years. Economic factors have clearly influenced the aggregate demand for cigarettes. All else equal, consumption has been higher the lower the price of cigarettes and the greater the average annual income of consumers. Per capita smoking has also exhibited a secular upward trend, independent of strictly economic influences, which presumably reflects a host of social factors that have increased the popularity of cigarettes.

Our results also affirm that health publicity and disclosures have significantly affected per capita consumption since 1964 and may also have lowered consumption in 1953, the year of the first Consumer Reports tar and nicotine tabulations. However, since this first spate of cigarette health controversy coincided with the close of the Korean War, part of the observed decline in per capita smoking may have been a natural consequence of demobilization. Whatever the precise cause, the results suggest that per capita sales in 1953 were approximately 17.6 percent below the level expected, given prevailing price, income, and trend conditions. This adjustment did not extend beyond 1953, however, as per capita sales resumed their pre-1953 growth trend during the 10 years from 1954-63.

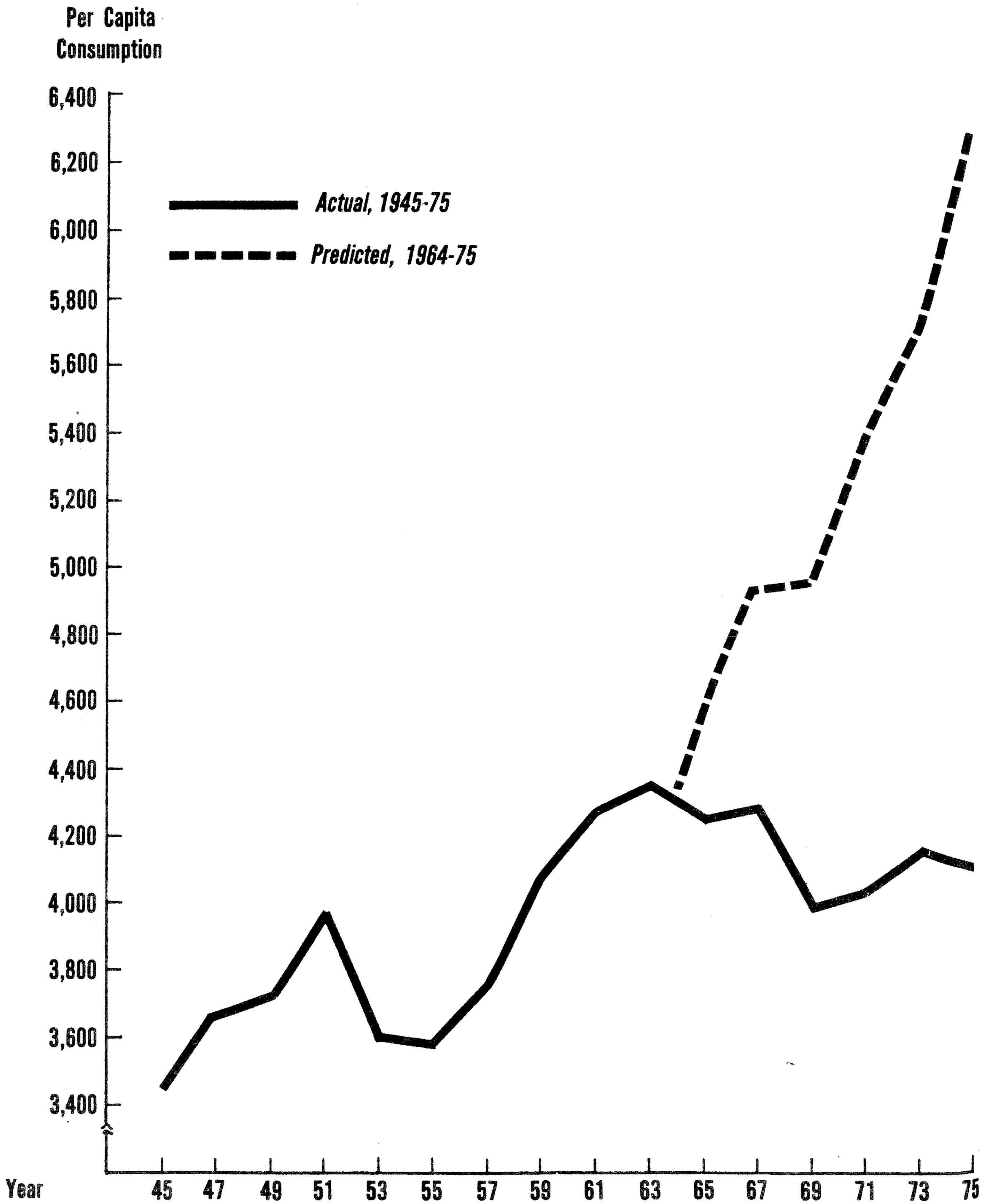
A different response pattern developed following publication of the Surgeon General's Report in 1964. Our results indicate that consumers reacted very gradually to the Report's findings and ensuing publicity. Compared to levels that would have been attained absent new public concern over cigarette health risks, per capita consumption fell at an annual rate of approximately 3.5 percent from 1964-75. Contrary to prior findings and predictions, no evidence could be found that this decline intensified when anti-smoking commercials aired from 1968-70 or moderated when the countercommercials were withdrawn in 1971. This is not to suggest that the anti-smoking messages were totally ineffective, since the post-1964 decline in smoking might have faltered in their absence or strengthened after 1971 had the counter commercials remained on the air. Further, there may, in fact, have been a slight or even moderate change in smoking trend during the 1968-70 period which the measurement technique could not detect. It is very difficult to identify any but very large trend changes when only three years of data are available. Nonetheless, our results do suggest that the counter commercials were not a uniquely powerful smoking deterrent.

Figure 1 illustrates the adjustments in per capita smoking that have occurred since the health risks of smoking were first widely publicized in 1964. The solid line on this graph charts actual per capita consumption levels since 1945.[7] The dashed line depicts an estimate of the path per person smoking would have followed in the absence of health information. It can be seen that by 1975 actual annual per capita consumption had fallen over 2,100 cigarettes (or 34 percent) below the projected level. This comparison is subject to the strict caveat that the prediction of post-1963 cigarette

7 The sharp but brief drop in per capita smoking in 1953 is clearly visible on this graph of actual sales. However, our projection of per capita consumption absent health publicity does not incorporate the 1953 episode because of our uncertainty over its cause.

FIGURE 1

Actual and Predicted Per Capita Cigarette Consumption



sales may well be unrealistically high. Any number of social factors unrelated to health concerns might eventually have moderated the increasing popularity of cigarettes.

Per Capita Tar and Nicotine Intake

Not evident in Figure 1 is the additional decline in per capita tar and nicotine consumption that accompanied the introduction of new low-tar brands of cigarettes. This reduction in average tar and nicotine content began in 1953 and continued at a constant annual rate of about 0.9 percent until the end of our observations in 1975.[8] Thus, when considered in conjunction with the 1964-75 decline in per person cigarette sales, consumer and producer reactions to health publicity had lowered per capita intake of tar and nicotine 45 percent by 1975.

Participation Rate and Per Capita Smoking

As outlined previously, per capita smoking is determined jointly by the participation rate and average smoking intensity. Data collected by the Milwaukee Journal and the National Center for Disease Control (CDC) permitted us to determine which of these elements of smoking behavior has been most affected by health disclosures. The results show a striking contrast between reactions to the early health publicity of the 1950's and those of the period since 1964. Virtually all of the decline in per capita consumption observed in 1953 was due to a sudden reduction in the intensity of smokers' habits. Precisely opposite reactions occurred after 1964. By 1974 the proportion of

[8] This figure almost certainly understates post-1953 reductions, since data were unavailable to trace annual changes in nicotine content within brands.

adults smoking was about 8 percentage points lower than it otherwise would have been. However, we found no evidence that health publicity affected the average number of cigarettes consumed by continuing smokers.

Long-Run Impact

The smoking decisions of young adults will largely determine whether the fall in the participation rate from 1964-75 proves to be a permanent or temporary development. If recent trends reflect nothing more than decisions by veteran smokers to break a life-long habit, the participation rate could eventually revert to former levels. Longer term reductions will occur only if start rates fall or if there is an increased tendency for new smokers to quit soon after starting.

The 12,000 individual smoking profiles contained in the CDC data base were probed to gauge the general impact of health information on start and quit rates and to determine whether reactions to health warnings have varied according to age, sex, and other demographic characteristics.[9] The CDC data reveal a general increase in quit rates since 1964. While there is evidence that older adults (aged 46-55) have exhibited the greatest resolve in giving up cigarettes, quit rates among individuals aged 29 and younger have also increased. Those adults who quit smoking within 10 years of their start date were singled out for separate analysis on the premise that such "temporary" smokers may not suffer any permanent injury from cigarettes. We estimate that about 12 percent of the individuals who started smoking after 1964 quit within 10 years strictly in response to health publicity.

---

9 See Appendix A for a full description of the CDC data base.

Significantly, the CDC smoking profiles disclose a general decline in start rates among most age groups. However, the very young have not responded to health warnings. Table 1 illustrates that start rates among young females (aged 12-16) have actually increased from 1964-75. Start rates for very young men also rose slightly during this period, although the increases are not statistically significant. Interestingly, these alterations in age and sex-specific start rates had no net impact on the average starting age for serious smokers, which remained virtually unchanged at 18.5 years.

Since virtually no one begins smoking past age 30, the long-term benefit of health information can be assessed conveniently by estimating its cumulative impact on the participation rate of 29-year-old adults. Again operating on the assumption that "temporary" smokers do not sustain permanent ill effects from cigarettes, individuals were classified as participating smokers only if they had smoked for at least 10 years prior to their 30th birthday. Thus defined, our regression results suggest that the participation rate at age 29 would have been .479 by 1974 had consumers received no additional health information after 1964. However, as a cumulative result of annual decreases in start rates among most age groups during the decade from 1964-74, the participation rate at age 29 was actually only .394, which represents a gain of 8.5 percentage points in the proportion of adults who, for all intents and purposes, can be considered nonsmokers.[10]

---

10 See Chapter II, pp. 31-32, for a complete description of the computations used to derive the cumulative impact of reductions in age specific start rates on the participation rate of 29-year-old adults in 1974.

TABLE 1

Comparison of Start Rates by Age and Sex
for 1964 and 1975

	Start Rates (Percent)*			
	Male		Female	
Age	1964	1975	1964	1975
12	.14	.5	.5	1.9
13	2.6	3.0	1.6	3.0
14	4.8	5.2	2.3	3.7
15	7.1	7.5	3.2	4.6
16	10.0	10.4	4.8	6.2
17	8.8	5.9	4.6	3.2
18	15.4	12.5	7.8	6.4
19	8.5	5.6	5.2	3.8
20	9.1	6.2	5.5	4.1
21	5.0	3.6	3.4	2.8
22	4.3	2.9	2.5	1.9
23	1.3	0.0	2.2	1.6
24	.6	0.0	1.3	.7
25	4.7	3.8	2.4	2.2
26	1.0	.1	.6	.4
27	.4	0.0	.4	.2
28	.9	0.0	.6	.4
29	.2	0.0	.4	.2

* The start rate is defined as the number of individuals in a given age and sex group who started smoking in a given year, expressed as a percentage of individuals in that group who were nonsmokers during the preceding year.

The CDC data also allowed us to explore whether developments since 1964 have triggered any long-run adjustments in smoking intensity that are not yet strong enough to measure directly. In particular, the number of cigarettes a typical smoker consumes would eventually fall if individuals who have begun smoking since 1964 were smoking fewer cigarettes than were pre-1964 starters, who may not have been able to moderate a well-entrenched habit. However, analysis of CDC data shows clearly that while smoking intensity is influenced by such demographic variables as age, income, education, and sex, a smoker's starting date does not affect smoking intensity. Nor is there any evidence that post-1964 starters are choosing cigarette brands lower in tar and nicotine than are earlier starters. Thus the long-run benefits of health information during the least three decades stem solely from a general reduction in cigarette tar and nicotine content since 1953 and a fall in participation rates beginning in 1964.

Impact on Life Expectancy

Our statistical results can be placed in better perspective by estimating the gain in average life expectancy attributable to the measured decline in participation rates and cigarette tar and nicotine content. If concern over the safety of cigarettes had not altered smoking behavior, the CDC data suggest that a typical smoker today would be expected to begin smoking at 18.5 years of age and consume 21 cigarettes daily, each one of which would contain an average of 1.5 mgs. of nicotine. Based upon calculations described in Appendix C, this daily intake of 32 mgs. of nicotine would, if continued for life, shorten this representative smoker's life by approximately two years. As previously reported, health publicity has in fact lowered the proportion of 29-year-old adults who smoke by 8.5 percentage points. These nonsmokers will presumably gain an added two years of life.[11] Those who choose to continue smoking for more than 10 years will consume 18 percent less tar and nicotine because of the fall in average cigarette tar and nicotine content since 1953. As explained in Appendix C, this reduced tar and nicotine content (which is the equivalent of smoking five fewer pre-1953 cigarettes per day) on average will lengthen a smoker's life by about three months. Expressed as a weighted average of the life-prolonging effects of total abstinence and reduced smoker intake of tar and nicotine, information concerning the dangers of cigarette smoking has thus added about .6 years to the lives of adult Americans.

---

11 A more conservative estimate would adjust this figure to reflect the historical fact that approximately 17 percent of all smokers quit before age 50 for reasons not directly related to post-1953 health publicity. It could be argued that 17 percent of those consumers who never started smoking or who quit within 10 years in response to new health information would have quit in any event and should not be included in the benefit calculations. Thus, if we adopt the rather heroic assumption that none of these individuals would have smoked long enough to suffer ill effects before finally quitting, only 7 percent (0.83 X 8.5) of consumers age 29 would have gained two years of life strictly by heeding health warnings.

CHAPTER II

Statistical Methodology and Detailed Results

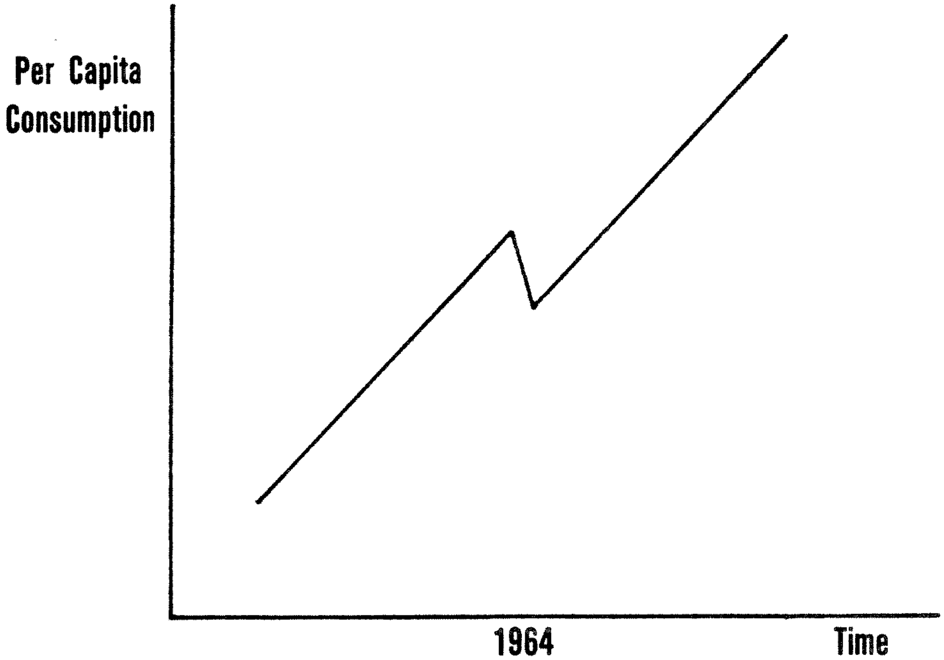
This chapter describes the statistical models that were used to identify the determinants of aggregate cigarette consumption and other smoking behavior during the past 50 years and presents a technical analysis of the regression results.

<u>Per Capita Consumption</u>

Let C_t represent the quantity of cigarettes consumed per adult (over age 17) in the United States in year t. Absent health disclosures, C_t might reasonably be expected to exhibit an upward secular trend and to be influenced by levels of cigarette prices and consumer income. Presumably, the appearance of new health information would also affect per capita consumption, but the results might be sensitive to the particular model specification chosen. Prior econometric studies of the determinants of per capita smoking have chosen simple zero-one dummies to measure the independent effects of various health disclosures. For example, the impact of the Surgeon General's Report generally has been measured by introducing a categorical variable, say D_{64}, which assumes the value of zero for all years preceding 1964 and equals one for 1964 and subsequent years.

Such a specification is appropriate if consumers assimilate new information and adjust their smoking habits instantaneously. If we ignore for the moment the independent effects of prices and income on cigarette consumption, such an instantaneous reaction to the Surgeon General's Report can be represented graphically as follows:

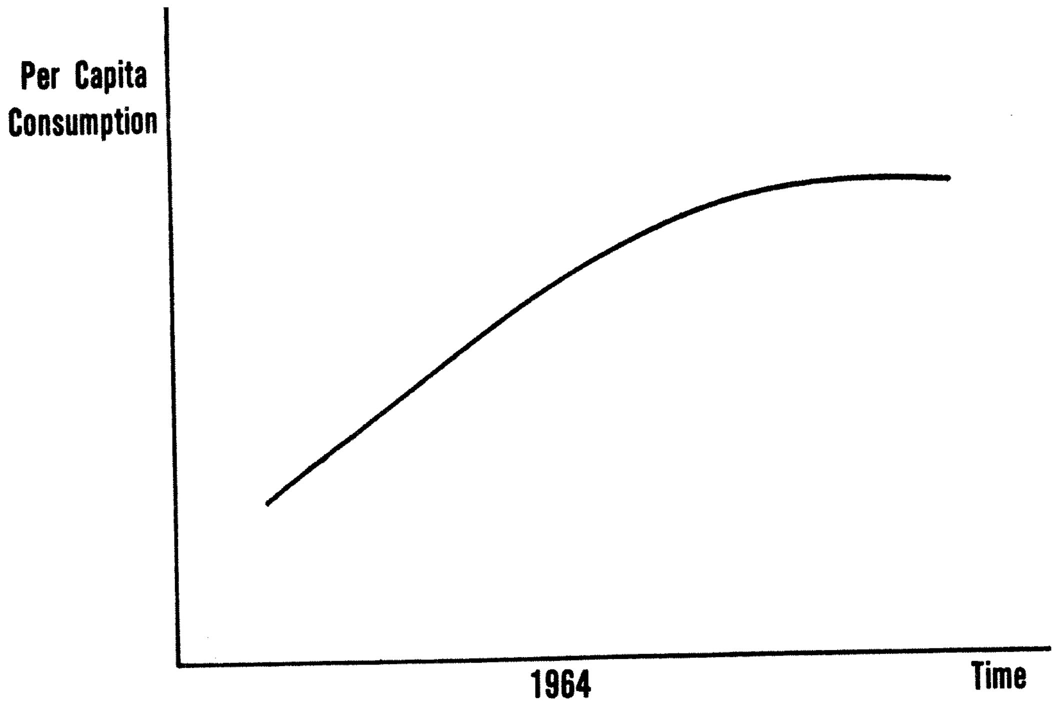
FIGURE 1



A simple dummy that assumes the value of one beginning in 1964 will fully capture the sudden and permanent downward shift in per capita consumption. Since consumers are assumed to reach their new smoking equilibrium immediately, the coefficient for the secular trend variable should not be affected by the episode.

However, as discussed in Chapter I, there are strong a priori reasons for assuming that consumers will, in fact, react to new cigarette health information only gradually. One such response pattern is depicted in Figure 2.

FIGURE 2



Under these conditions, a simple categorical variable will track the moderation in trend after 1964 only approximately and produce large unexplained residuals over most of the post-1964 period. In particular, there is a danger that any unexplained reductions in per capita consumption between 1964 and 1968 will be captured by the variable chosen to represent the 1968-70 anti-smoking commercials, thereby distorting the true relative importance of the Surgeon General's Report and the later media campaign.

To overcome these difficulties, this Report employs the following more generalized model of consumer smoking behavior which includes variables to measure both sudden shifts in cigarette consumption and changes in trend that reflect more gradual smoking adjustments:

(1) $C_t = a + b_1 P_t + b_2Y_t + b_3T_{25} + b_4D_{53} + b_5T_{53}D_{53} + b_6D_{64} + b_7T_{64}D_{64} + b_8D_{68} + b_9D_{71}$,

where C_t is the natural logarithm of cigarettes per adult, P_t is the log of the BLS retail cigarette price index deflated by the Consumer Price Index, Y_t is the log of per capita income deflated by the CPI, T_{25} is a time counter (with a starting value of one in 1925) used to measure secular trend, D_{53} is a zero-one dummy (equal to one in 1953 and subsequent years) that represents the health publicity of the 1950's, D_{64}, D_{68}, and D_{71} are similarly constructed dummies representing the Surgeon General's Report, the antismoking commercials, and the 1971 advertising ban respectively, and T_{53} and T_{64} are time counters with starting values of one in 1953 and 1964 respectively. The coefficient b_4 measures the permanent percentage change in consumption after 1953 that was not due to a change in trend. The coefficients b_6, b_8, and b_9 perform similar functions for their respective information dummy variables. Any changes in trend that might have occurred after 1953 and 1964 are measured by b_5 and b_7.[12]

Equation 1 of Table I summarizes the regression results obtained using the Cochran-Orcutt iterative techniques. T statistics are shown in parentheses.

---

12 Models incorporating lagged values for P and Y were also tested to determine whether consumer responses to price and income have been gradual rather than instantaneous. While the results indicated that long-run elasticities are in fact higher than the short-run elasticities generated by equation (1), no single best lag structure could be indentified. In any event, the more complex model specifications produced only minor changes in the coefficients on the various health information variables reported in equation 1 of Table I. Depending upon the lag structure chosen for P and Y, the coefficient on D_{53} ranged between -.165 and -.181 and that on $T_{64}D_{64}$ from -.035 to -.039.

TABLE 1

Equation	Variable	T_{25}	D_{53}	$T_{53}D_{53}$	D_{64}	$T_{64}D_{64}$	D_{68}	D_{71}	P_t	Y_t
1	Per capita consumption	.021 (4.78)*	-.176 (-5.66)	-.0004 (-.056)	-.034 (-.971)	-.035 (-3.95)	-.011 (-.282)	-.006 (-.093)	-.811 (-4.659)	.735 (8.178)
		R^2=.99 (.78)**				DW= 2.05			ρ = .267 (1.75)	
2	Nicotine per cigarette	.0005 (.318)	.012 (1.12)	-.009 -(3.415)	.010 (.859)	.0007 (.236)	.003 (.276)	-.0005 (-.025)	-.030 (-.488)	-.027 (-.755)
			R^2= .98 (.39)			DW= 1.52			ρ = .55 (4.15)	
3	Nicotine per capita	.022 (5.13)	-.173 (-5.62)	-.010 (-1.629)	-.018 (-.499)	-.035 (-3.86)	-.012 (-.300)	-.010 (-.148)	-.830 (-4.83)	.713 (8.267)
			R^2= .99 (.79)**			DW= 2.03			ρ = .17 (1.10)	

* Figures in parentheses are t statistics.

** R^2 after correction for autocorrelation.

The coefficients for trend and income elasticity are significant and of the expected sign. The significant coefficient on P_t, which measures price elasticity, suggests that per capita smoking would fall by about 8 percent given a 10 percent increase in cigarette prices. Thus, additional taxes on cigarettes would reduce smoking should such a policy approach be considered appropriate and necessary to supplement the impact of information programs. The early health publicity of the 1950's apparently had no lasting impact on trend, since the coefficient for $T_{53}D_{53}$ is insignificantly different from zero. The highly significant coefficient on D_{53}, however, indicates a sudden fall in per capita smoking of about 17.6 percent that might either be associated with the first Consumer Reports tar and nicotine comparison or with the return to peace following the close of the Korean War in 1953.

Our results do not support the conventional wisdom that the 1968-70 anti-smoking commercials were the primary deterrent to smoking after 1964. Rather, the significant, negative coefficient on $T_{64}D_{64}$ and the insignificant coefficients for D_{64}, D_{68}, and D_{71} suggest an annual moderation in trend of about 3.5 percent beginning in 1964, which did not alter perceptively during the period of the counter commercials or when TV and radio cigarette advertising was banned in 1971. These findings do not preclude the possibility that per capita consumption might have reverted to its pre-1964 growth trend had these counter commercials not aired. It is also possible that a more elaborate model of consumer smoking behavior that included, say, lagged advertising effects, might reveal that the antismoking commercials were a more important influence on cigarette consumption than our results suggest. However, the strongest conclusion that can be drawn from equation 1 is that the combined effects of the Surgeon General's Report, media publicity, public service announcements, and warning labels gradually reduced aggregate smoking to the extent that by 1975 per capita cigarette consumption was about 34 per cent lower than it would have been absent any new health information after 1964.

Nicotine Content Per Cigarette Smoked

As discussed in Chapter I, per capita consumption data provide a very incomplete measure of consumer responses to smoking health publicity. In particular, they completely ignore smoker substitutions toward what may prove to be less harmful brands of cigarettes.

The relative harm associated with smoking a particular type of cigarette is generally indexed by its tar or nicotine content. Since the simple correlation between tar and nicotine content among existing brands and varieties in 1975 was 0.92 (FTC, 1975), either might usefully index harm. Nicotine content per cigarette was chosen for this Report.

Market shares for all except trivially important cigarette brands are available from 1934-1975 (Maxwell Associates, 1975). Using 1975 FTC measures of nicotine content,[13] consumer substitution toward lower nicotine cigarette brands can be measured by $N_t = \Sigma_i V_i N_i$, where t = 1934, ..., 1975, N_i = nicotine content of the ith brand, and V_i = market share of the ith brand. This, N_t is the weighted average nicotine content per cigarette consumed in year t.[14]

---

13 Eighty-two brands were included in the sample. Ten additional brands existed over the period but were eliminated from the sample because they had disappeared prior to 1975.

14 Nicotine reductions within brands, which may also represent market reactions to consumer health concerns, cannot be measured with available data.

Equation 2 of Table I presents the results of regressing N_t on the same variables that were used to predict per capita consumption in Equation 1. The only significant coefficient is for $T_{53}D_{53}$. This indicates that cigarette nicotine content began to fall in 1953 at a constant annual rate of about 0.9 percent and continued to decline at this rate until the end of our observations in 1975.

Equation 3 details the combined impact of reductions in per capita smoking and average cigarette nicotine content on per capita nicotine intake. Based upon the reported coefficient values for $T_{53}D_{53}$ and $T_{64}D_{64}$, it is estimated that by 1975 consumers were on average consuming 45 percent less nicotine than would have been true had concern over the safety of cigarettes not increased after 1953.

<u>Participation Rates</u>

Per capita consumption measures incorporate changes in smoker intensity rates and smoker participation rates. To separate these effects, data on smoker participation were analyzed from two sources. First, as a result of an effort coordinated by the Milwaukee <u>Journal</u> beginning in 1947, approximately 30 cities conducted annual marketing surveys that included questions to determine the proportion of adults that smoked; the results were published annually in the <u>Consolidated Consumer Analysis</u> (CCA) from 1947 to 1975;[15] a total of 370 city/time observations were available from this source. Second, the Center for Disease Control (CDC) conducted a survey in 1975 that reported the lifetime smoking histories of 12,000 individuals. After making

15 The consolidation was not published after 1972 but many individual newspapers continued the surveys; data were assembled from these sources after this period.

minor modifications described in Appendix A, a cross section-time series data set detailing smoking participation rates for ages 14 - 63 and years 1947-75 was constructed; a total of 1,309 age/time observations were generated from this source.

The model chosen to estimate participation rates over time and among individuals was structured to reveal how rapidly consumers have adjusted their smoking behavior in response to new cigarette health disclosures and changes in economic conditions. Specifically, it was hypothesized that the movement to a new equilibrium smoking participation rate could be represented by:

$$(2) \quad P_{it} - P_{it-1} = \theta(P_{it*} - P_{it-1})$$

This equation says that for any class of people i, the change in the proportion of people smoking, $P_{it} - P_{it-1}$, is only a fraction θ of the difference between P_{it*}, the equilibrium proportion for this class of people in year t, and the actual proportion P_{it-1} in year t-1. For the two data sets, it was hypothesized further that the equilibrium proportion P_{it*} could be modeled by:

$$(3) \quad P^*_{it} = b_0 + b_1T + b_2D_{53} + b_3T_{53}D_{53} + b_4D_{64} + b_5T_{64}D_{64} + b_6D_{68} + b_7D_{71} + Q_{it},$$

where Q_{it} is a set of age variables for the CDC data set and a set of city variables for the CCA data set variables for the CCA data set. Price and income variables do not appear in (3) because probit analysis of the two data sets found neither variable to influence an individual's likelihood of smoking. (See Appendix B for complete results.) This suggests that the sensitivity of per capita consumption to price and income which was reported earlier in Table 1 is due entirely to intensity effects.

Substituting (3) in (2) permits investigation of two interesting response characteristics. The parameter θ reveals how quickly new equilibrium participation rates are reached. The coefficients b_3 and b_5 on the other hand, tell us whether the desired changes in equilibrium rates themselves occur only gradually. Hypothetically, health disclosures might have been incorporated quickly into desired behavior but only gradually into actual behavior. It is also possible that health information might have influenced desired goals only gradually.

Least squares parameter estimates for the equation

(4) $P_{it} = \theta P_{it^*} + (1-\theta)P_{it-1}$

appear in Table II. Full parameter estimates appear in Appendix D.

The CCA and CDC data sets do not tell exactly the same story. The CCA data give good evidence that both the Surgeon General's Report and the counter advertisements were effective in reducing smoking rates. There is, however, weak evidence from the positive coefficient on $T_{64}D_{64}$ that the impact of the Surgeon General's Report gradually diminished over time. The CDC data, on the other hand, document only the gradual post-1964 reduction in the participation rate, with no significant evidence that any particular event was immediately important. The CDC results indicate a faster response rate with an estimate for θ of 0.76 compared to the CCA estimate of $\theta = 0.45$.

The probable course of events during the 1950's is much clearer. Both equations report unambiguously that the participation rate was totally unaffected by health publicity during this period. We conclude, therefore, that the precipitous fall in per capita consumption noted previously for the year 1953 was due entirely to a sudden decline in the intensity of smokers' habits.

TABLE II

Variable	CDC Estimate	CDC Standard Error	CDC T Value	CCA Estimate	CCA Standard Error	CCA T Value
Intercept	24.18	4.225	5.72	25.31	2.482	10.20
Lagged proportion	.24	.028	8.59	.55	.004	12.58
T (time index 1947=1, 1948=2, etc)	.19	.203	.92	-.41	.269	-1.53
D_{53} (1 for years after 52)	.24	.567	.43	1.21	.832	1.46
$D_{53}T_{53}$ (time index 1953=1,1954=2, etc)	-.13	.194	-.65	-.03	.303	-.09
D_{64} (1 for years after 63)	-.09	.640	-.15	-5.12	.873	-5.86
$D_{64}T_{64}$ (time index 1964=1,1965=2, etc)	-.52	.168	-3.10	.40	.305	1.31
D_{68} (1 for years after 67)	.36	.670	.53	-2.85	1.176	-2.42
D_{71} (1 for years after 70)	-.52	.591	-.89	-.70	1.243	-.56

Long-Run Impact

The post-1964 changes in smoker participation rates presumably reflect an acceleration of quit activity among established smokers and/or reduced starting rates of potential smokers. Similarly, changes in smoking intensity are jointly determined by the average consumption of new starters, persistent smokers, and the previous consumption of quitters. To evaluate the long-run impact of health information, particularly after 1964, it is necessary to estimate the reactions of young consumers who have made the decision to smoke or not to smoke within the new environment of concern over the safety of cigarettes. If, for example, post-1964 disclosures have affected only the smoking habits of established smokers, the long-run impact on consumer health will be inconsequential.

The appearance of cigarette health information can affect the probability that individuals will ever start smoking, the rate at which they subsequently quit, the average start age, intensity, and the type of cigarette smoked. These variables will be examined using data provided in the CDC data base.

Start Rates

The start rate at age i in year t is the number of individuals that start smoking at age i in year t as a proportion of those that did not smoke at age i-1 in year t-1. Ninety-five percent of smokers start smoking between the ages 12 and 29. Hence, start rates were grouped by sex into four age cohorts (12-16, 17-20, 21-24, and 25-29). The following equation was fitted for each age cohort for males/females:

(5) $S_{it} = a_1 D_{64} + a_2 T_{64} D_{64} + a_3 T + b_i D_i + e,$

where S_{it} is the start rate for individuals of age i in year t, D_i is a zero-one dummy variable equal to one for individuals of age i, and the other variables are as previously defined.

The combined effects of D_{64}, $T_{64}D_{64}$, and T are reported in the second column of Table III. Thus, the coefficients reported in the table measure the change from the 1964 start rates as of 1974. After the appearance of the Surgeon General's Report, start rates fell for males and females in all age groups, except for ages 12-16. Thus, the youngest age cohort was apparently unaffected by the provision of cigarette health information. Indeed, start rates for young females appear to have risen slightly since 1964.

The coefficients in Table III that are statistically significant represent approximately a one-third change over the corresponding mean start rates for each group during the period 1947 through 1963. As was true of aggregate consumption and participation rates, start rates did not fall suddenly after 1964, but rather declined gradually over the 1964-74 period.

Start rates alone, however, do not necessarily reflect the entire long-run effect of information on smoking participation. The decision to smoke is not irreversible. Some individuals who started smoking after 1964 may subsequently quit as a result of the health disclosures, many before any significant adverse life expectancy effects occur.

Available data do not permit an analysis of quit rates for post-1964 starters compared to pre-1964 patterns over the entire life cycle. Most individuals start smoking prior to age 25. Thus, post-1964 starters are typically less than 35 years of age in 1975. Even if data were available, the life-saving benefits of quitting after smoking for significant periods of time are difficult to estimate.[16] For these reasons, it was not possible to estimate the benefits of acceleration in temporary smoking rates at all ages.

---

16 See Appendix C.

On the other hand, if estimates are confined to an analysis of start rate reactions, per se, the true impact of the disclosures may be seriously underestimated. As a middle ground approach, then, we supplemented our previous estimates of start rate reactions with estimates of temporary smoking rates of young consumers who quit smoking before 30 years of age and within 10 years of their start date. If young consumers start smoking after 1964 but stop shortly thereafter as a delayed response to the disclosures, the health benefits would likely be as large as if these individuals had not started in the first place.

Temporary Smoking

A conditional quit rate Q_{itj} is the number of individuals who quit smoking permanently at age i in year t as a proportion of individuals who started smoking at age i-j in year t-j, where $1 \leq j \leq 10$; $13 \leq i \leq 29$. In the CDC data base, a quitter is considered a former smoker if he has not resumed the smoking habit as of the sample date, 1975. The possibility therefore exists that some individuals counted as permanent quitters as of 1975 could, in fact, be temporary quitters. But the data were easily adjusted to correct for this bias.[17]

---

17 3,600 individuals in the CDC data base who had ever smoked reported all periods of quitting over their lifetime. Analysis showed that during the pre-1964 period most temporary quitters during ages 12-29 resumed smoking within two years and all temporary quitters resumed within four years. Quits during years after 1970 were, therefore, multiplied by the factor $\bar{V}_t = Q_t/Q_{tj}$, j=1975-t, where Q_{tj} is the proportion of quits in year t that are still quits in year j, and $\bar{Q}_t$ is the estimated proportion of quits in year t that are permanent. Values of V_t for males and females are calculated directly from the above sub-sample.

The conditional quit rates were grouped by sex into the four start age categories previously considered (12-16; 17-20; 21-24; 25-29). Each group was then separated into two categories: those quitting within five years of starting and those quitting within six to ten years of starting. Hence, for these two groups and, for males and females, the following equation was estimated for the period 1948-74:

(6) $Q_{itj} = a\, D_{64} + \Sigma b_i D_i + \Sigma c_j E_j + e,$

where D_i is a zero-one dummy equal to one for the ith starting age, and E_j is a zero-one dummy equal to one for individuals who smoked j years before quitting. The 1964 dummy variable equals one for individuals who started and quit during or after 1964, and zero for individuals who started and quit before 1964; individuals who quit during or after 1964, but started before 1964, were eliminated from the sample. Because of the sample characteristics, time trends before or after 1964 were not determined.

The estimated coefficients on D_{64} are reported in columns (3) and (4) of Table III.[18] The coefficients are significantly positive at least at the five percent level (one tail test) in nine of fourteen instances. Thus, while many young consumers may not always react initially to health information, the evidence suggests that some do subsequently change their consumption habits in the expected direction. Roughly speaking, the results suggest that individuals who began smoking after 1964 exhibited subsequent quit rates that were one to three percent higher than those exhibited by pre-1964 starters. The acceleration in temporary smoking rates after 1964 suggests that

---

18 Full coefficient estimates are presented in Tables X-XIII of Appendix E.

TABLE III

Effect of the Surgeon General's Report and Ensuing Publicity on Start Rates and Temporary Smoking

	Sex/Age	Start Rate (10 yr. effect)	Temporary Smoking Rates X < 5	5 < X < 10
	(1)	(2)	(3)	(4)
Male	12-16	.40 (1.614)	1.43 (.648)	1.30 (.484)
	17-20	-2.95 (1.30)	1.91 (.408)	1.11 (.539)
	21-24	-1.37 (.781)	1.10 (.691)	3.95 (1.73)
	25-29	-.91 (.574)	1.85 (1.43)	
Female	12-16	1.46 (.814)	1.19 (.423)	.207 (1.36)
	17-20	-1.44 (.632)	3.13 (.471)	1.64 (.573)
	21-24	-.59 (.377)	2.06 (.637)	.17 (.976)
	25-29	-.17 (.241)	.408 (1.67)	

Numbers in parenthesis are standard errors. X is the number of years of smoking experience.

approximately 12 percent of starters quit permanently within 10 years of their start date as a direct result of the health disclosures.

From a health viewpoint, accelerations in temporary smoking rates of young starters are probably as important as reductions in start rates, per se.[19] We will, therefore, summarize the long run impact of the post 1964 smoking-health publicity by comparing the smoking participation rate of 29-year old individuals predicted by pre- and post-1964 estimates of start and temporary smoking rates. For this purpose, estimates of time dependent responses in start rates will be cumulated to include their 10 year effect; further changes in responses after 1974 will be ignored.

Net Effects on Smoking Participation and Starting Ages

We will define the participation rate at age 29 as the proportion of individuals that smoke at age 29, or have smoked for more than 10 years prior to that age. This rate can be calculated from knowledge of start rates and conditional quit rates over early adult life. To illustrate, suppose that no one starts smoking before 12 years of age. Then for each 100 individuals who enter their twelfth year, it is easily verified that, by the end of the ith age, the proportion of individuals who will smoke or will have smoked for 10 years of their life will be

$$(7)\quad P_i = P_{i-1} + S_i\left(100 - \sum_{j=12}^{i-1} X_j\right) - \sum_{j=i-1}^{i-10} Q_{ij}X_j, \qquad 12 \leq j \leq 30,$$

where S_i is the start rate at age i, X_j is the number of individuals that start smoking at age j, and Q_{ij} is the proportion of smokers that quit at

19 That is, cancer/heart diseases are caused by substantial and persistent exposure to harmful agents for lengthy periods of time. Hence, individuals who smoke for less then 10 years may not experience significant reductions in their expected life.

age i, given that they started at age j. Note that X_j is strictly a function of start rates; thus, $X_{12} = S_{12}$ 100, etc.

The parameters S_i and Q_{ij} have previously been estimated in the regressions that support the results reported in Table II. Substituting these values in (7) allows us to estimate participation rates at age 29 for the years 1964 and 1974, say P_{64} and P_{74} respectively.

The simple average of these calculations for males and females combined is $P_{64} = 0.479$ and $P_{74} = 0.394$. Since the start rate past age 30 is virtually zero, the proportion of individuals who, for all intents and purposes, will never smoke[20] because of the disclosures is 8.5 percent. Pre-1964 experience suggests that 83.5 percent of individuals who smoke at age 30 are still smoking at age 50.[21] Hence, we can conclude very conservatively that approximately 7 percent of potential consumers will save themselves from the adverse health effects associated with a lifelong habit of smoking.

---

20 Recall that, for our purposes, individuals who smoke briefly prior to 30 years of age are counted as if they had never smoked.

21 This ratio represents the average experience of males in the CDC data base for the period 1947-63. Male figures are used because their participation rate was stable over time for all ages over the period.

Interestingly enough, the data also suggest that the average starting age of serious smokers has not been significantly affected by the disclosures.[22] But post-1964 starters will generally not consume as much nicotine over their life as they would have absent the appearance of health disclosures.

Intensity/Nicotine Content

Long run health effects for persistent smokers will depend upon future smokers' choice of intensity and type of cigarette smoked. Available data do not permit a direct examination of new smokers' habits over time in these dimensions. But enough data are available to allow a tolerable estimate of nicotine consumption levels of future smokers. In particular, recall that, using aggregate data, nicotine content per cigarette was estimated to have fallen by .9 percent annually from 1953-75, while no evidence was found that health information had any lasting impact on smoking intensity. To test whether these aggregate data on smoking intensity and nicotine contents accurately reflect post-1964 starters' consumption habits, data on individuals aged 21-35 in 1975 were analyzed.

It was postulated that smoking behavior in 1975 could be modeled by

(8) $n_j = a_1 x_j + \Sigma\, b_i D_{ij} + \Sigma\, d_K D_{jK} + a_2 D_{64} + e$

(9) $y_j = a_3 x_j + \Sigma\, c_i D_{ij} + \Sigma\, g_K D_{jK} + a_4 D_{64} + e,$

---

22 Average starting age for individuals smoking at age 29, smoking at least 10 years prior to age 29, is calculated by

$$A = \sum_{i=12}^{29} i\, X_i \,(1 - \sum_{j=i+1}^{i+10} Q_{ji}) / \sum_i X_i (1 - \sum_{j=i+1}^{i+10} Q_{ji}),\ j < 30,$$

where all parameters are defined above (see text). Assuming no health disclosures, the average starting age equals 18.7 years old. Incorporating the effects of health disclosures, A equals 18.4.

where n_j is the log of nicotine content per cigarette of the particular brand smoked by the jth individual, y_j is the log of the number of cigarettes smoked by the jth individual, x_j is number of years the jth individual has smoked, D_{ij} is a zero-one dummy variable equal to one for the ith age cohort to which the ith individual belongs, D_{jk} is a vector of zero-one dummies that reflect sex, income and educational characteristics, and D_{64} is a zero-one dummy equal to one for individuals that started smoking during or after 1964. Nicotine content was also added as an independent variable in the intensity equation to test whether smokers of lower tar and nicotine cigarettes have increased their consumption to compensate for any loss in taste or stimulus that these brands might provide. Information on n_j and y_j is available for 1,801 21-35 year-old smokers in 1975 from the CDC data base. Significant coefficients on the variable D_{64} would indicate that post-1964 starters are systematically choosing levels of nicotine consumption that are different from those of pre-1964 starters.

The results, listed in Table IV, show that chosen intensity and nicotine content levels are highly sensitive to smoking experience and various demographic variables. Compared to low income smokers, more affluent consumers smoke more cigarettes but of lower average nicotine content. Holding income constant, college graduates smoke fewer and slightly lower nicotine cigarettes than their less educated counterparts. However, the coefficients on D_{64} are insignificant in both regressions. The data therefore suggest that post-1964 starters have chosen cigarette types and intensities that do not differ significantly from aggregate smoking patterns. Thus, using previous results, we conclude that, as a result of cigarette health publicity, smokers will

TABLE IV

Nicotine Consumption of Post 1964 Starters

Independent Variables	Dependent Variable	
	Intensity	Nicotine
D64	.027 (.46)*	-.015 (-.85)
Income		
$5,000 - 9,999	.016 (.27)	-.040 (2.26)
$10,000 - 14,999	.103 (1.69)	-.041 (2.25)
$15,000 - 19,999	.103 (1.53)	-.051 (2.52)
$20,000 +	.154 (2.14)	-.078 (3.63)
Education		
College Grad.	-.184 (3.18)	-.030 (1.73)
Less than H.S. Grad.	.047 (1.01)	.035 (2.50)
Nicotine Content	-.017 (.21)	
Male	1.34 (3.75)	.037 (3.48)
x	.425 (7.67)	.047 (2.89)
Number of Observations	1801	1801
R^2	.934	.992

Age dummy variables were included in the regressions and are reported in Table XIV of Appendix E.

* Figures in parentheses are t statistics.

choose cigarette types that are about 18 percent lower in nicotine content than would otherwise have been the case. This estimate ignores any further changes that may have taken place after 1975.

Trade-Off Between Consumption and Expected Life

But for the health disclosures, the typical smoker today would be expected to start smoking at approximately 18.5 years,[23] and would smoke an average of 32 milligrams of nicotine per day.[24] Available evidence suggests that if such a smoking pattern continued for life, the typical smoker would lose approximately two years of life (see Appendix C).[25]

It was previously estimated that 8.5 percent of potential consumers would, for all intents and purposes, never smoke because of health disclosures. But it was also noted that, had they smoked, approximately 17 percent of these individuals would have quit prior to age 50 and, hence, would not have incurred the full cost of smoking for life. To be conservative, we will ignore the health benefits to these individuals. This leaves approximately 7 percent of potential consumers who might safely be labeled as lifelong smokers <u>but for</u> the health disclosures. We have previously estimated that the participation rate at age 29 absent health disclosures would have been .479. At age 50 it would have been 83 percent of this figure, or about .40. Thus, about 17.5 percent (.07/.40) of potential smokers have traded lifelong cigarette consumption for approximately two years of life.

---

23 See note 19 above.

24 Using 1975 FTC measures, the typical cigarette consumed prior to 1953 contained 1.5 mg. of nicotine. Average smoking intensity of 8,000 individuals in the CD data base is approximately 21 cigarettes per day.

25 Using the equation in Appendix C, two years approximately equals -2.35 + .122(18.5-17).

Smokers aged 29 who continue to smoke for life, despite health warnings, will also accumulate some health benefits. In particular, previous estimates suggested that post-1964 starters will consume approximately 18 percent less nicotine because of reductions in cigarette nicotine content since 1953. On balance, these individuals, who represent 82.5 percent of all potential smokers (100-17.5), have traded 6.25 mgs. of daily nicotine consumption for approximately .23 years of life.[26] Overall, potential smokers have reduced their nicotine intake by approximately 32 percent[27] to cut the life shortening effects of smoking by .53 years, or 27 percent.[28]

Further Demographic Analysis

The scope of our study has been limited by the lack of a fully realistic model of lifetime nicotine consumption. Such a model would incorporate life-time responses in the context of a cumulative harm function, and hence would yield rich predictions regarding expected responses of individuals depending upon age, expected length of life, and other factors. To suggest the implications that might arise from analysis of individual responses, consider the hypothesis offered by Schultz (1975) that disclosures such as we have been

---

26 Using the equation in Appendix C, an 18 percent reduction in nicotine intake translates to approximately four cigarettes of pre-1953 nicotine intensities; thus, (.058)(4) = .23..

27 This number is a weighted average of a 100 percent reduction by 17.5 percent of potential smokers and an 18 percent reduction by the remaining 82.5 percent.

28 That is, 17.5 percent of potential smokers save two years of life and 82.5 percent save .23 years. Hence, the average saving is .53 years or approximately 27 percent of the expected 2 years of lost life associated with lifelong smoking.

discussing will be assimilated more efficiently by more highly educated individuals. This hypothesis can be tested using information provided in the CDC data base. In particular, consider two random samples of adults (25 or older) who smoked in 1958 and 1963, respectively.

We wish to explain the five year probability of quitting in either sample as a function of individuals' characteristics such as sex, age, income and education. But, more importantly, we wish to determine (a) whether the probability of quitting in the post 1964 period is higher compared to the pre-1964 period, and (b) whether all individuals evinced the same change in the probability of quitting after 1964. The samples were therefore combined, and individuals in the post-1964 sample were identified by a zero-one dummy variable (D_{64}) equal to one.

The following relation was then estimated by probit analysis:

(10) $Q_{ij} = f\ (X_i,\ D_{64}X_i)$,

where Q_{ij} is the probability that the ith individual smoking in sample j, i.e., in year t, will quit during years t thru t+4, and X_i is a vector of individual characteristics. The coefficients on the vector of variables X measure their influence on the decision to quit, absent the existence of the 1964 Report. The coefficients on the interaction terms ($D_{64}X$) measure the marginal effect of these variables on the probability of quitting, given the appearance of the 1964 Report.

Column 1 in Table V lists the estimated pre-1964 coefficients on various sex, age, income and education characteristics. Translating the meaning of the probit coefficients, the value of the constant term suggests that, prior

Table V

Probit Analysis of the Probability of Quitting Cigarette Smoking

	Coefficient (Asymp. t-value)	Interaction terms: D_{64} Variable
Constant	-1.31 (7.70)	
Age		
Less than 35	-.144 (.88)	-.333 (1.74)
35-45	-.110 (.67)	-.312 (1.61)
46-55	.059 (.36)	-.364 (1.85)
Income		
Less than $5,000	.001 (.02)	.0001 (.04)
More than $15,000	.220 (2.62)	-.026 (.23)
Education		
Less than H.S. Grad.	-.015 (.19)	-.067 (.68)
College Grad.	.065 (.10)	.249 (1.75)
Female	-.251 (3.64)	-.068 (.74)
D_{64}	.454 (2.27)	
Number of Observations	6457	
Mean Prob. of Quitting	.101	

Table V (continued)

The coefficients represent the number of standard deviations from the midpoint of the normal distribution. Thus, the constant term implied that a male over 55 years old who graduated high school, but not college, and who earned \$5,000-\$15,000, annually, exhibited a five-year probability of quitting prior to 1964 that is represented by the area under the normal curve that lies to the left of 1.31 standard deviations from the midpoint. This probability is .095. Females with the same demographic characteristics exhibited a probability of quitting equal to .06, which is the area under a normal curve to the left of -1.31 -.251 standard deviations from the midpoint, etc.

to 1964, males over 55 who graduated from high school and who earned $5,000 - $15,000 per year,[29] exhibited a 9.5 percent probability of quitting during a five year period.

The significant coefficient on the dummy variable D_{64} suggests that the same probability of quitting rose by .454 standard deviations or 9.9 percent after the appearance of the Surgeon General's Report. Interaction terms, shown in column 2 of the table, summarize the differential impact of the information by individual characteristics. These coefficients show that the post-1964 effect was significantly smaller, but still positive, for younger age groups, and significantly greater for individuals who possessed a college degree.

An evaluation of these age results would require a full specification of expected responses to new information over lifetimes, given cumulative harm from smoking. But the stronger reaction of more educated individuals (i.e., college graduates) is consistent with Schultz's hypothesis. Perhaps information disclosure policies are more effective when goods are consumed intensely by more educated individuals.

Conclusion

The results of this study must be interpreted cautiously and, with respect to the magnitude of the estimated consumption responses, somewhat skeptically. As we have stressed previously, the report cannot by itself establish the success or failure of information disclosures as a public policy approach. Such a judgment would require that we know precisely how rational consumers should react to cigarette health warnings. Further, reductions in

29 The income variable reflects an individual's family income in 1975. It is, hence, only a proxy for relative income position in 1959 or 1964.

cigarette consumption attributable to these warnings may have been considerably smaller than we have estimated. Since the catchall secular trend variable plays such a prominent role in the estimating equations, unidentified factors may have been responsible for at least part of the measured change in trend after 1964.

Nevertheless, our results do seem powerful enough to reject the hypothesis that health disclosures have had no impact on cigarette consumption. In addition, it is clear that the disclosures have influenced start and quit rates rather than smoking intensity, and that the resulting decline in smoking participation has conferred important long-run health benefits. Finally, and most surprisingly, the study casts some doubt on the popular belief that the 1968-71 counter commercials were a uniquely potent anti-smoking influence.

Appendix A

Description of Cohort Data Base

In 1975, the Center for Disease Control (CDC) developed a data base on 12,000 individuals' lifetime smoking habits for a national sample of men and women aged 21 and older. The age and date at which each individual started smoking, if ever, and the age and date each individual quit, if ever, is provided for all sample participants.[1] Hence, each individual can be classified as a never, current, or former smoker for each age and year of his life. Using this data, smoking participation rates can be determined, by age, to create a time series that accurately reflects temporal changes in national patterns of smoking.[2]

Prior to this aggregation, however, the data must be adjusted because smokers tend to die faster than nonsmokers. For example, to estimate the proportion of 50-year-old men smoking in 1955, the information provided by the 75-year-old men must be used. But of the 50-year-old men living in 1955, fewer smokers than nonsmokers are alive in 1975. This biases upward the probability of sampling 75-year-old men in 1975 who were nonsmokers in 1955. The data were adjusted as follows to account for this systematic difference in death rates.

---

[1] Periods during which individuals quit temporarily are not reported. But of a sub-sample of 3,600 individuals who did report all quit periods over their lifetimes, 9 percent quit smoking temporarily for an average of four years. Hence, the average smoker quit smoking for .36 years over a lifetime of smoking that exceeds 30 years.

[2] Note that because the sample respondents are at least 21 years of age in 1975, observations on smoking habits of, say, 16-year-olds, can only be generated for years prior to 1971. Similarly, because respondents are typically 75 years old or less, observations on smoking habits for 60-year-olds can only be generated for years after 1959. Thus, a time series from cohort data cannot include all ages for the full time series.

If the death rate for 74-year-old never smokers is d, and if the ratio of the death rate of smokers to nonsmokers at this age is g, then one 75-year-old smoker in 1975 should be counted as 1/(1-dg) smokers at age 74 in 1974, and one nonsmoker should be counted as 1/(1-d) individuals in 1974. In general, a smoker at age i-1 at year t-1 must be counted as

$$X_{i-1,t-1} = X_{it} / 1-d_i g_i$$

smokers where g_i is the relative mortality rate of smokers to nonsmokers at age i (Dorn, 1958), and d_i is the mortality rate for (male-female) never smokers at age i,[1] with a similar correction for nonsmokers. Mortality statistics do not exhibit significantly lower death rates for former compared to current smokers;[2] hence, adjustments were made for all former and current smokers in 1975. The death-adjusted data base was then used to analyze the particulars of consumer responses to the 1964 Report.

Finally, it is noted that the CDC deliberately biased the sample to include more "ever" smokers. While the random probability of interviewing an "ever" smoker is P, where is the true proportion of "ever" smokers in the population, the sample increased this probability to fP/(fP + 1-P); for males, f = 1.56 and, for females, f = 1.93. Thus, to convert the computed

---

1 d_i is equal to $D_i/(1+(g_i-1)h_i)$, where D_i is the death rate for smokers and nonsmokers in standard mortality tables, and h_i is the proportion of males/females that smoke at age i (HEW, 1956).

2 Theoretically, smokers who quit are assumed to increase their life expectancy compared to nonquitters. But because of selectivity problems, former smokers in general are not necessarily expected to live longer than current smokers. More detail on this matter is provided in Appendix C.

proportion of adults that smoke to reflect the actual level of participation, male/female proportions were adjusted by the appropriate value of f.

To compute an unbiased start rate (also utilized in the text), the following adjustment was made. Let R_{it} be the number of individuals that started smoking at age i in year t, and let $N_{i-1,t-1}$ be the number of individuals of age i-1 in year t-1 who had not yet started smoking. Then the start rate in a nonstratified sample is $R_{it}/(N_{i-1,t-1})$. In a stratified sample, it is easily shown that the unbiased start rate is equal to $R_{it}/[N_{i-1,t-1} + (f-1)N_b]$ where b = [i+(1975-t), 1975] appropriately adjusted for the different death rates.

Appendix B

Sensitivity of Smoking Participation to Price and Income

To test the sensitivity of the smoking decision to levels of price and income, two data sets were employed. The CDC data base (see Appendix A) reported income levels for its survey respondents in 1975; the Dorn data base (see Appendix C) effectively reported average retail price facing each consumer in its survey in 1955.[1] In each case, an attempt was made to explain the probability of smoking as a function of income or price; other independent variables were available in the CDC data base. Since older individuals typically quit for various health reasons, the analysis was performed for relatively young adults. The probit results, as well as relevant sample information, are listed in Table VI.

While education, sex and age variables have a significant impact on the probability of smoking, income and price exhibit no apparent effect. The t-values on the price and income variables are insignificant at any reasonable level of significance. These results are consistent with the hypothesis that aggregate price and income effects on per capita cigarette consumption owe their existence solely to intensity effects. Hence, participation rates are left unadjusted for price and income effects in the text.

---

[1] In fact, the survey reports state of residence; average price statistics are then available from the Tobacco Tax Council. Prices in 1955 vary between 18 and 29 cents per pack owing primarily to differential tax rates across states.

Table VI

Probit Analysis of the Probability of Smoking Cigarettes

Independent variable	CDC Data: 1975		Dorn Data: 1955	
	Coeff.	Asymp. "t"	Coeff.	Asymp. "t"
Constant	.007	.35	.420	25.57
Income (family)				
Less than $5,000	.015	.26		
$5,000 - 9,999	.044	.74		
$10,000 - 14,999	-.095	1.44		
more than $20,000	-.070	.99		
Price (per pack)				
Less than 20 cents			.005	.16
More than 24 cents			.009	.20
Education				
Not H.S. Grad.	.322	6.04		
College Grad.	-.316	5.64		
Age				
Less than 25	-.097	1.98		
25-29	-.053	1.16		
Female	-.210	5.53		
Mean	.44		.66	
Age Limits	21-35		30-35	
Number of Obs.	4555		10286	
Log of Likelihood	-3046		-6543	

Appendix C

Life Expectancy and Nicotine Intake

To evaluate the life-saving benefits of consumer substitutions away from nicotine intake, an estimate of the relation between cigarette smoking and age of death was derived using data collected for the Dorn study on some 200,000 (mostly) white male veterans holding U.S. life insurance policies in 1954.[1] This study provides information for each individual regarding intensity and duration of cigarette smoking and the age of death is provided for all individuals who died during ensuing years.

For our purposes, the tape is particularly useful because it summarizes individuals' smoking histories over a period in which most smokers consumed similar (i.e., nonfiltered regular) cigarettes; hence, there tends to be a one-to-one correspondence between cigarettes smoked and nicotine consumed. To maintain this correspondence, only individuals who died between 1954 and 1958 were included in the data pool. This choice resulted in an initial sample size of over 15,000 deaths. But owing to a serious selectivity problem, and because we were not interested in calculating the short run benefits of quitting, decedents who were former smokers were eliminated from the sample.[2] The sample was also purged of individuals who provided incomplete information

---

[1] The medical literature has reported various results that relate the probability of death to the activity of smoking. But because these probabilities are lumped for wide age groups and because the effects of cigarette smoking intensity and age started are not considered separately, it is not generally possible to derive a continuous relation between smoking and age of death from published data.

[2] Smokers that quit smoking are normally expected to enhance their life expectancies. Hence, age stopped smoking is presumably a relevant determinant of life expectancy for former smokers. But, many individuals who quit prior to the 1964 Surgeon General's Report, did so because smoking was noticeably causing or aggravating health problems.

on smoking habits. Thus, 11,007 decedents were included in the analysis. Of these, approximately half were never smokers and half current smokers.

Smokers' lifespans were expected to be generally shorter than never smokers. Among smokers, the life-shortening effect of smoking was expected to be greater for intense smokers and earlier starters. Thus, the following equation was estimated:

$$A = b_1 + b_2C + b_3CI + b_4CS + BK + e.$$

A is the number of adult years lived by the decedent (i.e., A is actual years minus 17), I is the number of cigarettes smoked <u>in excess of 20</u> per day,[1] S is the age at which a smoker began his habit <u>minus 17</u>, and C is a zero-one dummy variable that equals one for smokers. Thus, the coefficient b_1 is an estimate of adult life expectancy for never smokers and b_2 is an estimate of life lost for a smoker that starts the habit at age 17 and consumes 20 regular nonfiltered cigarettes per day. The coefficients b_3 and b_4 measure the life-shortening effects of consuming more than 20 cigarettes per day or starting before age 17. When interpreting these coefficients, recall that most male smokers begin smoking after age 12 and before age 30; hence the equation cannot legitimately be extrapolated beyond these ages.

---

1 The intensity figure relevant at the time of the survey, 1954, was averaged with each smoker's maximum smoking intensity over his life span. In most cases, the two rates were identical. Each individual in the sample was assumed to continue his 1954 smoking habit until the time of his death, one to four years later.

Daily cigarette consumption is reported in five year categories: 10 or less, 11-20, 21-40, and more than 40. To create a continuous intensity index, these variables were set equal to 5, 15, 30 and 45.

Finally, K represents numerous zero-one dummy variables that account for accidental deaths, and decedents' occupation and place of residence (by region and city size). But other variables that are clearly relevant to age of death, including alchohol consumption, weight-height ratios, family medical histories, etc., were not available. Hence, much of the variation in age of death was not explained by the model.

Various nonlinear equations were fitted to the data but were found inferior to a simple linear fit. The linear equations were estimated using ordinary least squares and the results are listed in Table VII. The signs on all the smoking variables are correct and highly significant. Never smokers in the sample enjoyed an adult life expectancy of 49.01 years (i.e., an expected life of 48.96 + 17 = 65.96 years). An individual who smoked 20 cigarettes per day beginning at age 17 lost approximately 2.35 years of life. The 95 percent confidence intervals fall roughly in the range 2-2.5 years. An individual who started five years later generally saved approximately .6 years of life and one that smoked 40 cigarettes per day expected to lose an additional 1.16 years of life.

TABLE VII

Smoking and Adult Life Expectancy
(t-value in parenthesis)

Intercept	C	CS	CI	R^2	n
48.96 (80.37)	-2.35 (-10.30)	.122 (11.02)	-.058 (-8.05)	.067	11007

Additional Parameter Estimates Supporting Life Expectancy Equation

Accidental Death	-4.00 (-10.28)
Professional	.75 (3.53)
Managers	-.30 (-1.38)
Clerical and Sales	-.57 (-2.60)
Craftsmen	-.14 (-.57)
Household workers	-.80 (-1.89)
Large city (over 100,000)	.80 (.63)
Rural	.02 (.08)
Male	-1.00 (-1.61)
CT, ME, NH, RI, VT	.62 (1.72)
NJ, NY, PA	.07 (.42)
IL, IN, MI, OH, WI	-.36 (-2.02)

TABLE VII (Continued)

IA, KS, MN, MO, NE, SD	-.19 (-.91)
DE, DC, FL, GA, MD, NC, SC, VA, WV	.26 (1.26)
AL, KY, MS	.02 (.05)
AR, LA, OK, TX	-.25 (-.97)
CO, ID, MT, NV, NM, UT, WY	-.45 (-1.21)

Appendix D

Complete Results for Regressions Supporting Table II

The questionnaire used to collect the CCA data was altered in 1955 and 1961. The variables A1 and A2 were included to account for these changes. Prior to 1955, the smoking participation rate could be estimated directly from responses to a question which asked simply whether or not survey respondents smoked. Beginning in 1955, however, consumers were asked first whether they smoked nonfilter cigarettes and, in a separate question, whether they smoked a filter brand. We aggregated these two sets of responses to derive an overall smoking participation rate and introduced the variable A1 to adjust for any double counting that would result if some respondents smoked both filter and nonfilter cigarettes.

In 1961, the questionnaire was redesigned to ascertain actual purchase behavior. Rather than asking consumers whether they considered themselves smokers or nonsmokers, the new questionnaire asked whether respondents had purchased any cigarettes for their own use during the preceding week. The variable A2 should correct for any systematic response changes caused by this shift in questionnaire orientation.

TABLE VIII

CCA Data Set

Variable	Estimate	Standard Error	T Value
Intercept (Milwaukee)	25.31	2.482	10.20
Lagged Proportion	.55	.004	12.58
t (time index 1947=1, 1948=2, etc)	-.41	.269	-1.53
D53 (1 for years after 1952)	1.21	.832	1.46
D3 (time index 1953=1,1954=2, etc)	-.03	.303	-.09
D64 (1 for years after 1963)	-5.12	.873	-5.86
D4 (time index 1954=1, 1955=2, etc)	.40	.305	1.31
D68 (1 for years after 1967)	-2.85	1.176	-2.42
D71 (1 for years after 1970)	-.70	1.243	-.56
A1 (1 for years after 1954)	3.27	.796	4.11
A2 (1 for years after 1960)	2.73	.793	3.44
Omaha	.11	.779	.14
Philadelphia	1.32	2.061	.64
Indianapolis	-.36	.820	-.44
St. Paul	-1.05	.725	-1.45
Columbus	.82	.744	1.11
Fresno	-2.25	.973	-2.31
Modesto	-3.29	.973	-3.39
Sacramento	-.75	.875	-.86
San Jose	-.81	.925	.38
Seattle	-1.50	.790	-1.90
Birmingham	-.61	1.662	-.37
Spokane	-4.46	2.054	-2.17
Duluth-Superior	-3.27	.977	-3.35
Washington, D.C.	-1.14	1.103	-1.03
Portland, ME	3.64	1.380	2.64
Cincinnati	-.36	1.221	-.29
Long Beach	-1.68	.936	-1.79
Honolulu	.51	1.095	.46
Phoenix	.22	.863	.25

TABLE VIII (continued)

Portland, OR	-2.18	1.182	-1.85
Newark, NJ	1.06	1.347	.79
Chicago	1.51	1.460	1.03
Denver	-.96	.820	-1.17
Wichita	-1.80	1.109	-1.62
Providence	3.05	1.000	3.05
Pensacola	-1.28	1.654	-.77
West Palm Beach	-3.05	1.462	-2.08

TABLE IX

CDC Data Set

Variable	Estimate	Standard Error	T Value
Intercept (age 21)	24.18	4.225	5.72
Lagged proportion	.24	.028	8.59
t (time index 1947=1,1948=2, etc)	.19	.203	.92
D53 (1 for years after 52)	.24	.567	.43
D3 (time index 1953=1,1954=2, etc)	-.13	.194	-.65
D64 (1 for years after 63)	-.09	.640	-.15
D4 (time index 1964=1,1965=2, etc)	-.52	.168	-3.10
D68 (1 for years after 67)	.36	.670	.53
D71 (1 for years after 70)	-.52	.591	-.89
Price (real price of cigarettes)	.005	.005	1.08
Inc. (Real income per capita)	.009	.024	.37
Age 12	-31.23	1.627	-19.19
13	-29.79	1.535	-19.41
14	-27.68	1.445	-19.15
15	-24.79	1.361	-18.21
16	-20.38	1.253	-16.26
17	-16.51	1.159	-14.24
18	-9.54	1.031	-9.25
19	-5.63	.982	-5.73
20	-1.90	.951	-2.00
22	1.46	.941	1.55
23	2.30	.944	2.44
24	2.92	.946	3.09
25	4.16	.955	4.36
26	4.37	.953	4.59
27	4.05	.953	4.24
28	4.22	.953	4.43
29	3.97	.952	4.17

TABLE IX (Continued)

Variable	Estimate	Standard Error	T Value
Age 30	4.47	.955	4.68
31	4.00	.950	4.21
32	3.76	.949	3.96
33	3.46	.948	3.65
34	3.09	.946	3.26
35	3.30	.948	3.49
36	2.78	.944	2.94
37	2.38	.942	2.52
38	1.80	.941	1.92
39	1.22	.940	1.29
40	1.09	.940	1.16
41	.21	.940	.22
42	-.39	.940	-.41
43	-.90	.941	-.95
44	-1.65	.943	-1.75
45	-2.33	.944	-2.47
46	-3.14	.948	-3.31
47	-3.57	.952	-3.75
48	-4.35	.964	-4.51
49	-4.75	.977	-4.86
50	-5.27	.990	-5.32
51	-6.32	1.010	-6.27
52	-6.58	1.026	-6.41
53	-7.08	1.044	-6.78
54	-8.03	1.066	-7.52
55	-8.68	1.086	-8.00
56	-9.40	1.111	-8.47
57	-9.99	1.135	-8.80
58	-10.38	1.159	-8.96
59	-10.75	1.184	-9.07
60	-11.59	1.214	-9.55
61	-12.25	1.256	-9.75
62	-12.85	1.293	-9.94
63	-13.39	1.336	-10.02
64	-14.78	1.387	-10.66
65	-15.62	1.439	-10.85
66	-16.15	1.494	-10.80
67	-16.40	1.562	-10.50
68	-16.96	1.638	-10.35
69	-17.25	1.737	-9.93
70	-17.37	1.853	-9.38

Appendix E

Full Parameter Estimates for Table III

TABLE X

	Males 12 - 16		Females 12 - 16	
	$X \leq 5$	$5 < X \leq 10$	$X \leq 5$	$5 < X \leq 10$
D_{64}	1.43 (.65)*	1.30 (.48)	1.19 (.42)	2.07 (1.36)
D_{12}	.48 (.85)	1.35 (.60)	-1.02 (.62)	1.17 (1.96)
D_{13}	.64 (.86)	.91 (.61)	-.98 (.57)	.31 (1.73)
D_{14}	-.34 (.82)	1.75 (.58)	.09 (.54)	-.16 (1.62)
D_{15}	.17 (.82)	1.60 (.58)	-.46 (.54)	.17 (1.62)
D_{16}	.42 (.81)	1.84 (.58)	1.05 (.54)	-.66 (1.62)
E_2	1.16 (.85)		.69 (.57)	
E_3	1.12 (.86)		.86 (.57)	
E_4	.39 (.88)		1.42 (.59)	
E_5	.54 (.89)		1.31 (.60)	
E_7		-.83 (.58)		1.74 (1.66)
E_8		-.58 (.61)		-.11 (1.74)
E_9		-1.30 (.64)		2.37 (1.85)
E_{10}		-1.20 (.68)		2.55 (2.00)

* Standard errors in parentheses.

TABLE XI

	Males 12 - 16		Females 12 -16	
	X < 5	5 < X < 10	X < 5	5 < X < 10
D_{17}	.63 (.55)	1.04 (.62)	.95 (.64)	.82 (.66)
D_{18}	1.29 (.55)	.54 (.62)	1.27 (.64)	1.05 (.66)
D_{19}	1.85 (.55)	.94 (.62)	1.88 (.63)	1.00 (.66)
D_{20}	.52 (.55)	1.54 (.62)	1.19 (.63)	-.29 (.66)
E_2	.08 (.58)		-.14 (.67)	
E_3	-.01 (.60)		-.88 (.69)	
E_4	-.01 (.61)		-.72 (.71)	
E_5	-2.82 (.63)		.30 (.73)	
E_7		-.26 (.66)		.66 (.70)
E_8		.94 (.68)		.66 (.73)
E_9		-.10 (.72)		.39 (.77)
E_{10}		-.28 (.78)		1.66 (.83)

TABLE XII

	Males 21 - 24		Females 21 - 24	
	$X \leq 5$	$5 < X \leq 10$	$X \leq 5$	$5 < X \leq 10$
D_{64}	1.10 (.69)	3.95 (1.73)	2.06 (.64)	.17 (.98)
D_{21}	1.49 (.91)	-.34 (1.57)	1.01 (.85)	.50 (.90)
D_{22}	1.04 (.91)	-.47 (1.80)	.21 (.86)	.03 (1.05)
D_{23}	.56 (.96)	-1.51 (2.15)	1.13 (.86)	-1.08 (1.13)
D_{24}	-.66 (.99)	7.54 (2.76)	-.15 (.89)	-.05 (1.40)
E_2	-.04 (.99)		.73 (.91)	
E_3	-.91 (1.01)		-.21 (.94)	
E_4	1.28 (1.04)		-.74 (.96)	
E_5	1.12 (1.08)		-.55 (.99)	
E_7		.28 (1.89)		2.20 (1.07)
E_8		-.57 (2.25)		.71 (1.29)

TABLE XIII

	Males 25 - 28	Females 25 - 28
D_{64}	1.85 (1.43)	.41 (1.67)
D_{25}	1.36 (1.39)	-.17 (1.61)
D_{26}	-1.24 (1.83)	-1.79 (2.13)
D_{27}	3.48 (2.55)	3.20 (2.50)
D_{28}	-2.97 (2.24)	3.90 (2.53)
E_2	4.33 (1.78)	2.23 (2.01)
E_3	-1.60 (1.99)	4.66 (2.26)
E_4	-1.09 (2.18)	1.09 (2.58)

TABLE XIV

Coefficients on Age Variables
for Table IV

	Intensity	Nicotine
Age 21	1.91 (.24)*	2.38 (.05)
22	1.88 (.25)	2.39 (.05)
23	1.66 (.25)	2.41 (.05)
24	1.89 (.25)	2.38 (.05)
25	1.67 (.26)	2.38 (.05)
26	1.81 (.25)	2.35 (.05)
27	1.66 (.25)	2.35 (.05)
28	1.64 (.25)	2.35 (.05)
29	1.77 (.26)	2.38 (.05)
30	1.61 (.26)	2.38 (.05)
31	1.50 (.26)	2.36 (.05)
32	1.59 (.26)	2.35 (.05)
33	1.63 (.26)	2.34 (.05)
34	1.47 (.26)	2.37 (.05)
35	1.51 (2.6)	2.38 (.05)

* Standard Errors in Parenthesis.

Bibliography

H.F. Dorn, "The Morality of Smokers and Non-smokers," Proceedings of the Society of the American Statistical Association, 1958, 34-71

J.L. Hamilton, "The Demand for Cigarettes: Advertising, The Health Scare, and The Cigarette Advertising Ban," Review of Economics and Statistics (November 1972), 401-411.

Federal Trade Commission, Report of Tar and Nicotine Content. (Semi-Annual).

K.M. Friedman, Public Policy and The Smoking-Health Controversy. D.C. Health and Co., Lexington, Mass. 1975.

Maxwell Associates, Historical Trends in the Tobacco Industry. Richmond, Va., July 31, 1975.

Milwaukee Journal, Consolidated Consumer Analysis. (Annual).

S.M. Sackrin, "Factors Affecting the Demand for Cigarettes," Agricultural Economic Research, V. 14 (July 1962), 81-88.

T.W. Schultz, "The Value of the Ability to deal with Disequilibria," Journal of Economic Literature, V. 13 (September 1975), 827-946.

Lester Telser, "Advertising and Cigarettes," Journal of Political Economy, V. 70 (October 1962), 471-499.

Tobacco Tax Council, The Tax Burden on Tobacco. (Annual).

U.S. Department of Agriculture, Tobacco Situation. (Quarterly)

U.S. Department of Health Education and Welfare, Cigarette Smoking and Health Characteristics: United States July 1964-June 1965, National Center for Health Statistics, 1967.

________________, The Health Consequences of Smoking (Annual).

________________, Adult Use of Tobacco, 1970, 1975.

_________________, Tobacco Smoking Patterns in the United States. Public Health Monograph #45, 1956.

_________________, Smoking and Health: Report of the Advisory Committee to the Surgeon General, 1964.

K.E. Warner, "The Effects of the Anti-Smoking Campaign on Cigarette Consumption," American Journal of Public Health, V. 67 (July 1977), 645-650.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1979 -630-265/2535