

The Effects of the Anti-Smoking Campaign On Cigarette Consumption

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Abstract: The impact of the anti-smoking campaign on the consumption of cigarettes is measured by fitting cigarette demand functions to pre-campaign data, projecting "ahead" as if the campaign had not occurred, and then comparing these predictions with realized consumption. The analysis suggests that major "events" in the campaign (e.g., the Surgeon General's Report) caused immediate though transitory decreases of 4 to 5 per cent in annual per capita consumption.

However, the cumulative effect of persistent publicity, supported by other public policies, has been substantial: in the absence of the campaign, per capita consumption likely would have exceeded its actual 1975 value by 20 to 30 per cent. This is a conservative indication of the effectiveness of the campaign, for it ignores other potentially important and desirable behavior changes, such as the shift to low "tar" and nicotine cigarettes. (Am. J. Public Health 67:645-650, 1977)

Introduction

Cigarette smoking is generally acknowledged to be one of the leading causes of preventable morbidity and mortality. Since the publication of the Surgeon General's Report on Smoking and Health in 1964,¹ numerous individuals and organizations interested in health have engaged in a variety of activities designed to encourage people to quit smoking or to adopt less hazardous smoking behaviors. As a result of the anti-smoking campaign,* attitudes toward smoking have been altered considerably.²⁻⁴ A recent major survey demonstrates that behavioral change has accompanied attitudinal change,⁴ but knowledge about the specific nature and significance of the behavioral response remains limited.**

The purpose of this paper is to contribute to an improved understanding by examining the effects of the anti-smoking campaign on annual U.S. per capita cigarette consumption, defined as total domestic cigarette sales divided by the population over 17 years of age. Though this is a very common measure of smoking activity, it is deficient in that it masks changes in the composition and individual behavior of the smoking population: it offers no insight into variations in the sex, age, income, or education distribution of smokers; it fails to distinguish a change in the number of smokers from a change in the number of cigarettes the average smoker consumes; and it ignores several other potentially important reported changes in smoking behavior, such as reductions in the amount of each cigarette smoked and shifts from one brand to a lower "tar" and nicotine brand.²⁻⁴

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*The anti-smoking "campaign" is not a single orchestrated program. The term is used here to refer to the collective, mostly uncoordinated activities of a variety of organizations, including government agencies, private voluntary agencies, and for-profit business firms, united only by their objective of encouraging people to quit or to reduce smoking. The 1964 "starting point" for the campaign is somewhat arbitrary; it was selected because the Surgeon General's Report initiated the first period of significant sustained anti-smoking activity and public consciousness of smoking and health issues. During the early 1950s, evidence linking smoking to disease produced the first smoking-health "scare" in recent history, but a major sustained anti-smoking campaign did not materialize.

**Most of our knowledge of specific behavioral responses derives from survey research. As I discuss elsewhere, the validity of

The chief virtues of using this measure are the following: First, basing a consumption measure on objective data rather than on subjective survey responses eliminates the problem of underreporting inherent in the latter.^{5, 6} Second, many other studies have employed the same or a similar dependent variable, permitting direct comparison of results.⁷⁻¹⁵ Finally, this variable ignores many potentially important and predominantly desirable behavioral changes. Hence, as a partial measure, it is not likely to overstate the effectiveness of the campaign in inducing desired behavioral changes. Indeed, most of the changes ignored by the simple consumption measure would increase one's estimation of the

smoking survey results is suspect. Furthermore, it appears that reporting accuracy has deteriorated since the Surgeon General's Report.⁵

campaign's impact. For example, smokers' switching to low "tar" and nicotine cigarettes would not be captured in per person consumption. In fact, the consumption measure would record a detrimental effect if switchers increased the number of cigarettes they smoked to partially compensate for the decrease in per cigarette "tar" and nicotine intake. Assuming that they did not overcompensate, the switch would represent a positive accomplishment of the anti-smoking campaign, yet it would register negatively in the per capita consumption measure. Similar phenomena could occur for reductions in the amount smoked of individual cigarettes, and so on. The important point is that the assumption of product and use homogeneity implicit in the measure likely biases downward any estimate of the behavioral impact of the anti-smoking campaign. Hence, this study's findings can be taken as conservative, lower bound estimates of the true behavioral impact.‡

Methods

The objective of the present analysis is to predict what per capita cigarette consumption would have been in the absence of various anti-smoking "events," and then to compare these predictions with realized consumption. The differences constitute estimates of the effects of the anti-smoking campaign on number of cigarettes smoked. This procedure contrasts with the common approach of comparing present consumption with consumption in an earlier year, for example 1963, the year prior to the Surgeon General's Report. Implicit in the latter approach is the idea that consumption would have remained constant at the level of the earlier year had there never been an antismoking campaign,¹⁸ an assumption not warranted by the pre-1964 trends of increasing consumption (see Figure 1), particularly considering the increasing rate of smoking among women.‡‡

The procedure employed to predict what consumption per adult would have been was to estimate per capita ciga-

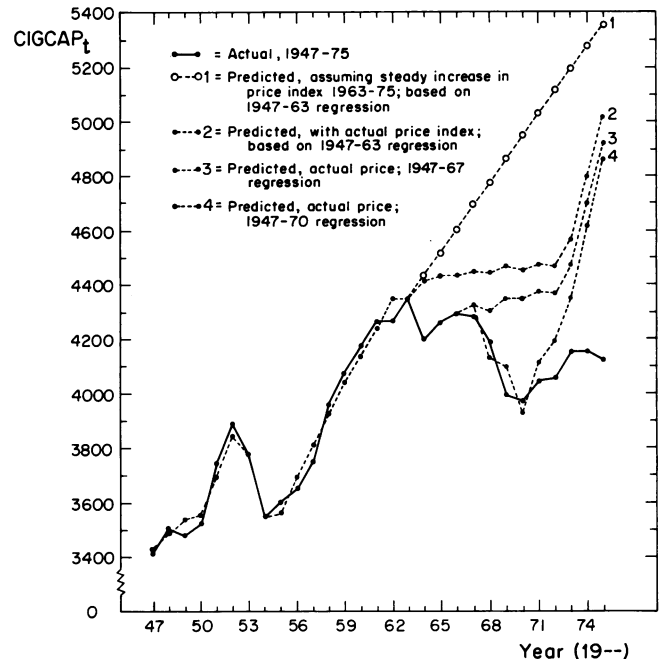


FIGURE 1—Actual and Predicted Per Capita Cigarette Consumption

rette demand functions for three post-World War II time periods—1947–1964, 1947–1967, and 1947–1970—and then to use these functions to generate predictions for the years following each period of estimation.* Thus the 1947–1963 equation permits a "forward" projection for the years 1964–1975, as if there had never been a Surgeon General's Report nor the anti-smoking campaign which followed it. (Negative publicity in the early 1950s on the relationship between smoking and health is taken into account in this and other equations.) The 1947–67 equation acknowledges the mid-1960s effects of the Surgeon General's Report, but does not include the 1968–70 television and radio anti-smoking ads required by the Federal Communication Commission's Fairness Doctrine.^{19, 20} Thus predictions based on this equation include the effects of the Surgeon General's Report but "assume away" the anti-smoking ads and ensuing publicity, permitting us to gauge their effectiveness. The final equation, for 1947–70, includes the effects of both the Surgeon General's Report and the television-radio ads, but it ignores the anti-smoking militancy of the 1970s in general and, in particular, the recent growth in legislation banning smoking in public places.

The equations were specified as

$$CIGCAP_t = \beta_0 - 21.664 PRICE_t + \beta_2 CIGCAP_{t-1} + \beta_3 \ln T + \beta_4 D1953 + \beta_5 D1954 + \beta_6 D1964 + \beta_7 D1968-70 + \epsilon_t$$

where CIGCAP_t = adult per capita cigarette consumption in year t
 PRICE_t = value of a relative real cigarette price index in year t (1967 = 100)

ln T = natural logarithm of last two digits of year t
 D1953 = 1 in 1953, 0 all other years; a dummy variable for the first year of significant publicity on smoking and health; included in all three equations

*Data were supplied by the Economic Research Service, U.S. Department of Agriculture.

‡Theoretically the consumption measure could suggest an exaggerated importance of the behavioral impact. For example, if the principal effect of the campaign was to encourage quitting among those who smoke only a few cigarettes a day, and if low consumption levels had little deleterious effect on health, then decreases in per capita consumption might not be associated with significant beneficial health outcomes. The analysis in this paper focuses exclusively on behavior and not on its health implications. The health consequences of cigarette smoking have been thoroughly documented elsewhere.^{1, 16, 17} My assumption underlying this study is that significant decreases in smoking have significant positive implications for health. The nature and magnitude of health outcomes depend on the distribution of smoking reductions by age, sex, smoking history, etc.

‡‡It is obviously impossible to know with certainty what the ceiling rate of smoking would have been in the absence of the anti-smoking campaign. However, reasonable assumptions suggest that there was still plenty of room for growth in the per capita measure from its 1963 peak level of 4345 cigarettes. For example, if the rate of smoking among men remained steady at its early-1960s level (over 50% of adult males), if the rate of smoking among women eventually equaled the male rate, and if the average smoker consumed a pack and a half of cigarettes per day, the annual per capita measure would exceed 5500.

D1954 = 0 prior to 1954, $.5^{(1954-t)}$ in 1954 and on; a dummy for the second year of smoking-health publicity (=1 in 1954) and a continuing though rapidly diminishing additional effect in ensuing years; included in all equations

D1964 = 1 in 1964, 0 all other years; a dummy for the Surgeon General's Report; included in the equations for 1947-67 and 1947-70 only

D1968-70 = 1 in 1968, 1969, and 1970, 0 all other years; a dummy for the Fairness Doctrine anti-smoking ads on TV and radio; included in the 1947-70 equation only

ϵ_t = error term

Consumption lagged one year ($CIGCAP_{t-1}$) captures the effect of habit among existing smokers, while the time trend ($\ln T$) reflects increases in the smoking population and in the consumption levels of smokers. (Taking the logarithm of time implies that the relative smoking population and consumption levels increase from year to year but at a diminishing rate.)

The dummy variables reflect important, well-publicized smoking-health scares. While the variables are equal to 1 only in the year of the scares, the impact of a given scare is transmitted to the next year through the effect on lagged consumption. For example, the Surgeon General's Report was associated with a decrease of β_6 cigarettes per adult in 1964. In 1965, the continuing effect of the Report equaled $\beta_2 \cdot \beta_6$, the 1964 decrease (β_6) times the fraction of consumption which is a function of habit alone (β_2). β_2 is constrained to be less than or equal to 1 (i.e., habit can be maintained, diminished, or ceased; additions to the smoking population are accounted for in the time trend); hence the effects of the Surgeon General's Report are modeled to continue but diminish over time. The only dummy specified to have a continuing effect greater than that transmitted by habit was D1954. This was recommended by empirical testing of alternative specifications. The logic is that strong and repeated publicity in the early 1950s continued to affect additional smokers for a few years following the major publicity.

The only economic variable in the equation is an index of real relative cigarette price. Numerous studies have found that cigarette consumption responds to real price

changes.^{10-15, 21, 22} This does not necessarily mean that people quit or start smoking in response to price changes; it may reflect simply marginal changes in the number of cigarettes some smokers consume. The average calculated value of the price elasticity of cigarette demand—the percentage change in quantity demanded divided by the percentage change in price—is about -0.5 ; the same value was determined by Lyon and Simon using a quasi-experimental estimation technique.²¹ The fixed coefficient of -21.664 corresponds to an elasticity of -0.5 at the means of the dependent and independent variables. Use of an extraneous coefficient estimate was recommended by multicollinearity between price and time and by the problems which plague time series estimation of demand elasticities.⁸

Variables excluded here, which have been used in previous studies, include cigarette advertising expenditures, the percentage of filter cigarettes, and real per capita income. The first has been found to be of little importance, with generally nonsignificant and very small elasticity estimates.^{8, 23, 24} Percentage of filters has been employed to reflect heavy promotion campaigns for filter cigarettes, and perhaps to take partially into account the lower drug intake associated with filters;^{9, 12} however, this variable is endogenous and introduces estimating bias. Finally, recent studies have found income elasticities to be small and nonsignificant,^{11, 13} with time trends performing equally well or better.¹⁴

Results

Table 1 presents ordinary least squares regressions for the three time periods. The results are as would be expected. The habit factor ($CIGCAP_{t-1}$) is clearly significant, indicating the continuation from year to year of roughly 70 per cent of the preceding year's consumption. The entrance of new smokers and increased consumption by existing smokers is reflected in the time trend ($\ln T$). All of the dummy variables are significant and have the following inter-

TABLE 1—Cigarette Demand Functions†

| Years of Estimation | Variables | | | | | | | R ² | Durbin-Watson statistic | F-statistic (degrees of freedom) |
|---------------------|-----------|--------------------|----------------|----------|-------------------------------------|----------|----------------------------------|----------------|-------------------------|----------------------------------|
| | Constant | Price (extraneous) | $CIGCAP_{t-1}$ | $\ln T$ | D1953 (First smoking-health scares) | D1954 | D1964 (Surgeon General's Report) | | | |
| 1947-63 | -6084.81 | -21.664 | 0.695* | 2286.52* | -116.36** | -304.01* | | .9906 | 1.88 | 316.9 (4,12) |
| 1947-67 | -5712.80 | -21.664 | 0.704* | 2184.05* | -116.84** | -296.54* | -207.45* | .9935 | 1.77 | 461.7 (5,15) |
| 1947-70 | -5779.39 | -21.664 | 0.694* | 2210.10* | -114.81** | -297.76* | -205.73* | .9914 | 2.41 | 327.9 (6,17) |

†Annual per capita consumption. Numbers in parentheses are standard errors, except as indicated in last column.

*Significant at $p = .01$.

**Significant at $p = .05$.

pretations: the smoking-health scares of the early 1950s reduced consumption by about 3 per cent in 1953 (D1953) and about 8 per cent the following year (D1954), with the effect trailing off throughout the 1950s. In 1964, the Surgeon General's Report decreased per capita consumption by almost 5 per cent (D1964). The anti-smoking TV and radio ads reduced consumption an average of better than 4 per cent each of the three years they were aired under the Fairness Doctrine (D1968-70).

Figure 1 plots actual annual per capita consumption (the solid line) and the values predicted by the equation for each time period (dashed lines 2-4).*

Comparison of the actual and predicted values indicates the following: in the absence of the Surgeon General's Report, per capita cigarette smoking would have increased in 1964. Had the Report and the ensuing anti-smoking campaign never materialized, the analysis suggests that per capita consumption would have remained remarkably steady from 1964 through 1972, growing only a total of 1 per cent (line 2), as contrasted with 21 per cent growth during the preceding eight years. This predicted "holding pattern" occurred during a period in which actual consumption fell from its 1963 peak of 4,345 cigarettes per adult to a 1970 trough of 3,971, rebounding only to 4,053 in 1972, still almost 10 per cent below the predicted values. From 1972 through 1975, predicted consumption rose rapidly; actual consumption rose from 1972 to 1973, leveled out in 1974, and fell slightly in 1975. By 1975, predicted consumption was approximately 22 per cent greater than actual consumption. This is one measure of the effect of the anti-smoking campaign on the number of cigarettes consumed.

The "holding pattern" in predicted consumption and then the substantial increases of 1973-1975 are a function primarily of the movement in relative cigarette prices. From 1964 through 1972, the relative price index rose *every* year, from 93.68 at the beginning of the period to 107.98 at the end. Assuming some responsiveness of cigarette consumption to price changes, one would expect the steady price rises to have a dampening effect on consumption. Thus the flatness of predicted consumption through 1972 reflects the effect of price rises countering the other forces which tended to increase consumption. Similarly, the large increases in predicted consumption in 1973-1975 represent a response to relative price dropping rapidly from 107.98 to 97.05.

This is noteworthy because much of the rise in relative cigarette prices undoubtedly owes to the anti-smoking campaign. For years, the principal component of cigarette price increases has been state and federal taxes.^{9, 22} Many of the cigarette tax increases during this period must have been direct or indirect responses to the anti-smoking publicity. For example, in 1965 there were 23 state and local tax increases, compared with no more than a dozen in any of the preceding 14 years.⁹ Thus some portion of increased taxation, and hence of tax-induced reductions in consumption, should be considered an effect of the anti-smoking campaign.

*A table of the precise values plotted in Figure 1 is available from the author upon request.

Ideally one would like to quantify consumption responses to both economic incentives and "pure" publicity. The effects of the campaign would be the sum of the pure publicity response and the response to *campaign-induced* tax (hence price) increases. Unfortunately it is not possible to separate campaign-induced taxation from that which would have occurred in the absence of the campaign. However, one may assume an arbitrary alternative structure of price changes to illustrate how predicted consumption would be affected.

Suppose, for example, that the 1975 price level would have been reached by steady price increases throughout the period, instead of the rapid rises during the first eight years and then the decreases which marked the end of the round of heavy tax increases. The resultant predicted consumption path is plotted as line 1 in Figure 1. Averaging the price changes from 1964 through 1975 produces a steadily rising predicted consumption path. The growth in the differences between predicted and actual consumption is spread over the entire period, with 1975 predicted consumption now exceeding realized consumption by 30 per cent.

The remainder of this section returns to the predictions based on the observed prices, as if the realized pattern of prices would have emerged without the anti-smoking publicity. Thus differences between predicted and actual consumption reflect "pure" publicity effects. To the extent that anti-smoking publicity induced additional cigarette taxation, and to the extent that such taxes deterred smoking, the results here further understate the effectiveness of the anti-smoking campaign.

From the predictions based on the 1947-1967 regression (line 3 in Figure 1), it is seen that the anti-smoking ads on TV and radio in 1968-70 were associated with a significant reduction in cigarette consumption: actual consumption (the solid line) fell from 4,280 cigarettes per adult in 1967 to 3,971 in 1970, rather than continuing the slow but steady growth which would have been expected following the immediate reaction to the Surgeon General's Report. Had the ads and later publicity not occurred, by 1975 consumption would be predicted to have been 19.5 per cent greater than it actually was. In other words, by themselves, the Surgeon General's Report and associated mid-1960s publicity would have had a lasting but small effect a decade later. This is seen by comparing the 19.5 per cent with the equivalent figure (22 per cent) from the prediction which assumes away the entire campaign (i.e., based on the 1947-1963 regression).

Finally, one can take account of both the mid-1960s publicity and the TV-radio ads and then ask what would have happened to cigarette consumption had there been no continuity to the anti-smoking cause in the 1970s, assuming that the only continuing effects of the ads were those captured in the habit factor (i.e., transmitted through lagged consumption). This is accomplished by comparing predictions from the 1947-70 equation (line 4 in Figure 1) with actual 1971-1975 consumption. While actual consumption rose through 1973, it leveled off in 1974 and dropped slightly in 1975, years of growing anti-smoking militancy reflected in the passage of legislation recognizing the rights of nonsmokers. (This past year alone, over 160 bills restricting smoking were in-

roduced in 43 state legislatures. Currently over one-half the states have smoking restrictions on the books.)²⁵ Predicted consumption—ignoring the new militancy and related developments—rose rapidly throughout the period. In 1975 it exceeded actual consumption by 18 per cent.

It should be emphasized that these results are not highly sensitive to specification variations. Reasonable alternatives to the price coefficient, to specification of the time trend and of the dummy variables, and to the general functional form all produced slightly different estimates. However, all of the alternatives tested preserved the orders of magnitude reported here; qualitative results were unaffected.

Discussion

The finding that the Surgeon General's Report induced a 5 per cent decrease in 1964 cigarette consumption, with slightly smaller annual effects realized for the 1968–70 anti-smoking ads on television and radio, is generally consistent both with previous research on American data and with results from studies of the British experience. (Concerning the former, one researcher found that the ads had more effect than the Report,⁸ while other studies failed to distinguish specific smoking-health scares.^{9, 13}) British researchers have credited the Royal College of Physicians' 1962 report on *Smoking and Health*²⁶ with decreasing cigarette consumption from 4.6 to 9 per cent that year, and the 1965 British cigarette ad ban on TV, combined with "considerable public discussion of the issue," with producing a consumption decrease of from 3 to 8 per cent. (The significance of the latter has been debated.)^{14, 27} Both effects were observed to die away over time.^{7, 28}

While the effectiveness of the anti-smoking TV-radio ads has been questioned,²⁹ empirical evidence supports this study's finding that the ads did contribute to significant reductions in cigarette consumption. Hamilton, who has reported large estimates of the effects of the ads, concluded that the TV and radio ad ban beginning in 1971 was bad public policy: the elimination of pro-smoking ads reduced broadcasters' contributions of free time to anti-smoking groups, required by the Federal Communications Commission's Fairness Doctrine. The anti-smoking ads, Hamilton found, deterred smoking much more powerfully than pro-smoking ads encouraged it.⁸ However, neither Hamilton's study nor this one can accurately gauge the long-run effects of the broadcast media ad ban. While both studies conclude that the anti-smoking ads were very effective in the short-run, it is plausible that their marginal effectiveness would have diminished over time as their early successes reduced the smoking population to more "hard-core" smokers. In addition, though the absence of pro-smoking TV and radio ads may have had little immediate effect, the reduction in the exposure of young people to such ads may have significant consequences in future generations.

While individual anti-smoking "events," such as the Surgeon General's Report, appear to have had a transitory and relatively small impact on cigarette smoking, the evidence from this study indicates that the cumulative effect of

years of anti-smoking publicity has been substantial. The analysis suggests that per capita consumption would have been one-fifth to one-third larger than it actually is, had the years of anti-smoking publicity never materialized. Increases in per capita cigarette smoking from 1970 through 1973 have been cited as evidence that the campaign has been ineffective; yet those increases totaled only 40 per cent of what might have been anticipated in the aftermath of the TV-radio ads had there been no continuing effects of the campaign. Furthermore, in 1973 through 1975, abstracting from the effects of the campaign, conditions were conducive to the largest increases in consumption during the post-Report years—relative cigarette prices were falling for the first time; predicted consumption increased 16 per cent during those three years—yet following a 2 per cent increase in 1973, actual consumption leveled out in 1974 and declined slightly in 1975.

Whatever success the anti-smoking campaign has achieved must be credited to a number of different actors, both within and outside of government, and to a variety of policies. While the aggregative nature of this study precluded precise attribution of effects, I have indicated that, in addition to publicity, taxation and legislation have each contributed to altering smoking behavior. This suggests the importance of refining our understanding of the roles of individual policy instruments so that effective mixes of policies can be determined for future efforts to influence health behavior.

Smoking is representative of a constellation of individual behaviors which, if modified, seem likely to have great potential for improving health. The question of the effectiveness of the anti-smoking campaign is germane to the general issue of whether or not health education can significantly alter behavior presumed to be deleterious to health. Focusing exclusively on the number of cigarettes smoked, this study has ignored a myriad of behavioral responses which would appear to serve the original health objectives of the anti-smoking campaign, possibly dramatically. Even so, the study provides evidence suggesting that a sustained health education campaign has had a significant impact on the smoking behavior of Americans.

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A Spectrum of the Biological Sciences

Parallel to the chain in industry which runs from the applied research laboratory to the consumer is a similar chain connecting the work of the chemist and biologist with the clinician. To vary the metaphor, I suggest we speak of a spectrum of the biological sciences. At one end we place the investigators who are interested only in advancing science; and at the other extreme, the physicians and surgeons concerned with curing patients, as well as the public health men committed to the task of preventing human beings from becoming patients. . . . And here, too, just as in industry, it is difficult to draw any hard and fast lines between the different areas; rather, it is of first importance to see to it that there be close cooperation between those working at these different points on the spectrum.

James B. Conant, *Science and Common Sense*, New Haven: Yale University Press, 1961, pp. 314–315.