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# The effect of tobacco advertising bans on tobacco consumption

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**Abstract**

Tobacco advertising is a public health issue if these activities increase smoking. Although public health advocates assert that tobacco advertising does increase smoking, there is significant empirical literature that finds little or no effect of tobacco advertising. In this paper, these prior studies are examined more closely with several important insights emerging from this analysis. This paper also provides new empirical evidence on the effect of tobacco advertising in 22 Organization for Economic Cooperation and Development (OECD) countries. The primary conclusion of this research is that a comprehensive set of tobacco advertising bans can reduce tobacco consumption and that a limited set of advertising bans will have little or no effect. 

*Keywords:* Tobacco advertising; Advertising ban; Tobacco consumption

## 1. Introduction

The evidence implicating smoking in the deaths of millions of people is substantial and well documented. The Office on Smoking and Health (1994) estimates that in the US there are over 400,000 premature deaths per year due to smoking. Peto et al. (1994) estimate that in developed countries there are about 2 million premature deaths per year due to smoking. These include death from

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cancer, heart disease, strokes, and other causes. Smoking is also responsible for a considerable amount of illness including chronic lung disease and low birth weight.

Tobacco advertising is a public health issue if it increases smoking. Although public health advocates (for example Roemer, 1993) claim that tobacco advertising does increase smoking, there is a significant empirical literature that finds little or no effect of tobacco advertising on smoking (for example Hoek, 1999). This empirical literature on advertising provides the basis for the tobacco industry claim that its advertising only affects market share among various competing brands. In this paper, the methodologies used in prior studies of tobacco advertising are examined more closely and new empirical evidence on the effect of advertising bans on tobacco consumption is presented.

## 2. Advertising and consumption

Advertising is an important method of competition in industries that are highly concentrated, such as the cigarette industry. Firms in industries of this type tend not to compete by price, but try to increase sales with advertising and other marketing techniques. Since a number of prior studies have found little relationship between advertising and tobacco consumption, it is important to examine this literature before proceeding with a new empirical study. Economic theory provides some insights into how econometric studies of tobacco advertising should be conducted. An important economic aspect of advertising is diminishing marginal product.[1] Diminishing marginal product suggests that, after some point, additions to advertising will result in ever smaller additions to consumption. This concept is the basis of the advertising response function. Advertising response functions have been used for some time in brand level research to illustrate the effect of advertising on consumption at various levels of advertising (Tull et al., 1986, Sasieni 1989, Lodish et al., 1995).

The same theory which describes the brand level advertising response function can be applied to the industry level. The industry level is defined as all tobacco products and includes all brands and all members of brand families. The industry level advertising response function is similar to the brand level function and is graphed in Fig. 1. The vertical axis measures industry level consumption and the horizontal axis measures the industry level stock of advertising. The stock of advertising is used since the effects of advertising linger over time. That is, advertising in period one will have a lingering, although smaller effect, in period two. Although the rate of decline over time remains an arguable issue, research

[1] For a discussion of other econometric issues in advertising, see Saffer (1995).

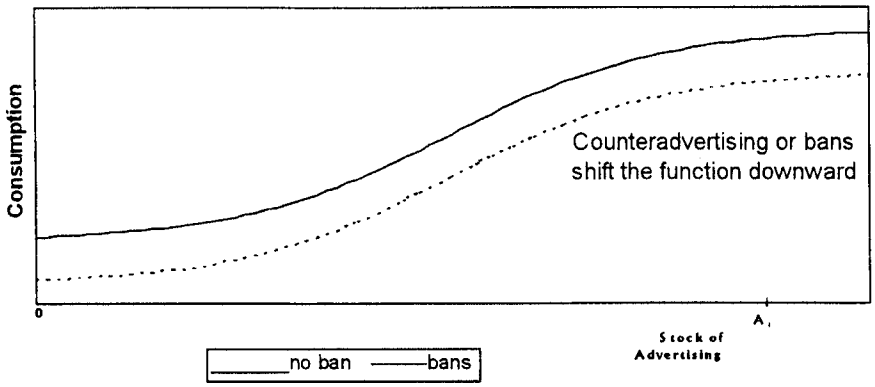


Fig. 1. National level.

such as Boyd and Seldon (1990) finds that cigarette advertising fully depreciates within a year. The industry level response function is different from the brand level response function in that advertising-induced sales must come at the expense of sales of products from other industries or savings. Increases in consumption come from new consumers or from increases by existing consumers.

Prior econometric studies of tobacco consumption use one of three alternative empirical measures of advertising. These three alternatives are annual or quarterly national aggregate expenditure data, cross-sectional measures of advertising, and advertising bans. The industry response function predicts the likely outcome of prior studies based on the choice of advertising measure. Table 1 categorizes this literature based on the choice of advertising measure.

The first category of prior studies are those which use annual national expenditures as the measure of advertising. Annual national advertising expenditures are the yearly total of all cigarette-advertising expenditures, for all advertisers, in all media, for all geographic market areas. This is a high level of aggregation of the advertising data and as a result the data have very little variation. Since cigarettes are heavily advertised, the marginal product of advertising may be very low or zero.[2] In Fig. 1, this is equivalent to measuring advertising in a small range around $A_1$. The loss of variance due to aggregation leaves little to correlate with consumption and since the advertising occurs at a level where the marginal effect is small, it is not likely that any effect of advertising will be found.

Table 1 lists 15 cigarette advertising expenditure studies that use national annual or quarterly time series data. As expected, all of these studies find either no

[2] Advertising expenditures are typically measured as a percent of sales which is known as the advertising-to-sales ratio. Schonfeld and Associates (1997) report that the advertising-to-sales ratio for cigarettes in 1997 was 5.9% while advertising-to-sales ratios typical of other industries are around 2% to 3%.

Table 1
Prior empirical studies

| Study | Data | Conclusion |
|---|---|---|
| *Time series studies* | | |
| Hamilton (1972) | US 1925–1970 | no effect of advertising |
| Grabowski (1976) | US 1956–1972 | no effect of advertising |
| Schmalensee (1972) | US 1955–1967 | no effect of advertising |
| Schneider et al. (1981) | US 1930–1978 | no effect of advertising |
| Baltagi and Levin (1986) | US 1963–1980 | no effect of advertising |
| Johnson (1986) | Australian 1961–1986 | no effect of advertising |
| Porter (1986) | US 1947–1982 | no effect of advertising |
| Wilcox and Vacker (1992) | US quarterly 1961–1990 | no effect of advertising |
| Duffy (1995) | UK quarterly 1963–1988 | no effect of advertising |
| Bishop and Yoo (1985) | US 1954–1980 | small positive effect of advertising |
| Abernethy and Teel (1986) | US 1949–1981 | small positive effect of advertising |
| Valdes (1993) | Spanish 1964 to 1988 | small positive effect of advertising |
| Chetwynd et al. (1988) | New Zealand quarterly 1973–1985 | small positive effect of advertising |
| McGuinness and Cowling (1975) | UK quarterly 1957–1968 | small positive effect of advertising |
| Seldon and Doroodian (1989) | US 1952–1984 | small positive effect of advertising |
| *Cross-sectional studies* | | |
| Lewit et al. (1981) | 7000 youths 1966–1970 | positive effect of advertising |
| Goel and Morey (1995) | US states 1959–1982 | positive effect of advertising |
| Roberts and Samuelson (1988) | 1971–1982 for five firms | positive effect of advertising |
| *Ban studies* | | |
| Hamilton (1975) | 11 OECD countries | no effect of a ban |
| Laugesen and Meads (1991) | 22 OECD countries 1960–1986 | negative effect of a ban |
| Stewart (1993) | 22 OECD countries 1964–1990 | no effect of a TV ban |

effect or a small effect of advertising on cigarette demand. Chetwynd et al. (1988) find a small effect with quarterly data that is lost when aggregation is increased to the annual level. This supports the theory that annual data have too little variance. Duffy (1996) reviews these studies, and a few more, which also use national level advertising data. He also reports that these studies find either no effect or a small effect and concludes that these studies show that cigarette advertising has no effect on cigarette consumption. An alternative conclusion, however, is that studies that use a single time series of national level data are inappropriate to measure the effect of advertising on consumption.

The second category of prior studies uses cross-sectional data as the measure of cigarette advertising. These types of data can vary but would typically be local

level, such as a Metropolitan Statistical Area, for periods of less than a year. This type of data can have greater variation than national level data for several reasons. One reason for the variation in this type of data is that the mix of target markets and their relative size in each MSA is different. Another reason for variation in advertising levels is that the cost of advertising varies across local areas. An econometric study that uses monthly or quarterly local level data would include a relatively larger variation in advertising levels and in consumption data. When the variation in advertising levels is greater, the probability of being in an upward sloping portion of the response function increases. Local level advertising data are thus more likely to find a positive relationship between advertising and consumption.

Table 1 lists three studies that use cross-sectional data. The reason for so few cross-sectional studies is that the data are expensive and difficult to assemble. Cross-sectional data may measure advertising over a wider range and be more likely to fall in an upward sloping portion of the response function. The study by Roberts and Samuelson (1988) is somewhat different but may still be classified as cross-sectional. In their study the cross-sectional unit is the firm. These three studies show that when advertising is measured with cross-sectional data, a significant positive effect of advertising is observed.

The third category of prior studies are studies of advertising bans in specific media. The process by which an advertising ban can affect consumption is important to examine since there is more than one outcome possible, and bans are the empirical measure used in the empirical section of this paper. The first point to consider is that tobacco advertisers use a number of media and that each medium is subject to diminishing marginal product. The second point is that, although each medium has certain advantages and disadvantages, media are substitutes. An advertising ban will result in substitution into the non-banned media. The increased use of the non-banned media lowers the average and marginal product for these media. This shifts the industry response function in Fig. 1 downward. In a perfectly competitive model, firms will respond to this decrease by decreasing advertising. However, in an oligopoly, with response to rivals, all firms may react to reduced sales by increasing advertising and other promotion activities.[3] This would be illustrated by moving to a higher level of advertising on a lower industry advertising response function.

As the number of media banned increases, there are less options for substitution and larger decreases in the average and marginal products of advertising. Additional advertising expenditures in the non-banned media may no longer be able to compensate or may be too costly to justify the gains. This theory suggests that a

[3] Data from the Federal Trade Commission (1998) indicate that after broadcast advertising of tobacco was banned in the US, advertising expenditure initially fell but were soon back to earlier levels and then continued to rise.

limited set of bans may have little or no effect but that a comprehensive set of bans could significantly reduce the level of advertising expenditure and consumption.

Table 1 lists three studies of cigarette advertising bans using pooled international data sets.[4] Hamilton (1975) used data on 11 countries over the period from 1948 to 1973. Hamilton presents a set of regressions using pooled data of countries with bans and countries without bans. The regressions show no effect of a ban. Laugesen and Meads (1991) used data from 22 Organization for Economic Cooperation and Development (OECD) countries for the period 1960 to 1986. Like Hamilton, they also find that prior to 1973 cigarette advertising bans had no effect on consumption. However, they find that after 1973 cigarette advertising bans and warning labels have had a significant negative effect on consumption. Laugesen and Meads argue that prior to 1973 manufacturers were able to increase alternative marketing efforts in response to broadcast advertising restrictions but that after 1973 this was more difficult. The third study of cigarette advertising bans was done by Stewart (1993) who analyzed data from 22 OECD countries for the period 1964 to 1990 and found that a television advertising ban had no effect. This study does not control for other offsetting increases in advertising in other media.

In summary, prior econometric studies of tobacco consumption use one of three alternative empirical measures of advertising. These three alternatives are annual or quarterly national aggregate expenditure data, cross-sectional measures of advertising, and advertising bans. Prior studies which use national expenditures as the measure of advertising lose variance from aggregation and measure advertising where the marginal product is likely to be very low or zero. Prior studies that use cross-sectional data have greater variation in the advertising data and are more likely to measure advertising where the marginal product is positive. Prior studies that use advertising bans as the measure of advertising must include bans which are sufficiently comprehensive to reduce the average and marginal products of the non-banned media such that the industry cannot compensate for this loss by increasing advertising or other marketing expenditures.

## 3. Empirical analysis of advertising bans

One reason that the empirical results from prior studies of the effects of advertising bans are mixed is that the bans must be sufficiently inclusive to reduce

[4] In addition, there are a few univariate time series studies that examine the effect of advertising bans in a specific country. This simply shows a before and after effect, for a single country, without holding constant the effect of other variables.

the average product of the non-banned media. The studies by Hamilton (1975) and Laugesen and Meads (1991) suggest that this may not have been true in the past. However, since the late 1980s, a number of countries have enacted more comprehensive tobacco advertising bans. These changes provide an opportunity to reexamine the effects of advertising bans on tobacco consumption. Consumer demand theory provides the conceptual framework for the empirical models. Tobacco advertising is included in the demand function as an information variable.

The effect of advertising bans can be tested with an international data set that provides both cross-section and time series variance in the advertising ban variable. Farley and Lehmann (1994) conclude that cross-national differences in the response to advertising are relatively small. The advantages of this data set also include no self-reporting measurement error problems. However, the aggregate data set has a limited number of independent variables and may have serial correlation in the error terms for each country.[5]

An international aggregate data set consisting of 22 countries for the years 1970 through 1992 was constructed. The 22 countries are members of the OECD. The OECD countries were chosen because they have attempted to maintain a database of comparable economic and social data since 1960. The member countries of the OECD are also the most developed free market countries in the world. The data set was limited to 22 countries as data from Luxembourg and Turkey are not available.

Four alternative dependent variables are used in the regressions. There are two measures of per capita annual consumption of cigarettes, one from Health New Zealand (1995) and the other from the United States Department of Agriculture (USDA)[6]. There are also two measures of per capita consumption of tobacco in grams, one from Health New Zealand (1995) and one from Stewart (1993). The data from Stewart go only to 1990, and the USDA data include only 17 OECD countries. The reason for employing four alternative dependent variables is the controversy over the differences in the data. The four data series actually correlate fairly closely with each other and with the available tobacco use data from the OECD (1997). The correlation coefficient between the HNZ and Stewart tobacco data sets is 0.81 for the period 1970 to 1990 and 0.71 for the period 1984 to 1990. The correlation coefficient between the HNZ and USDA cigarette data sets is 0.92 for the 1970 to 1992 time period and 0.93 for the period from 1984 to 1992.[7]

[5] Endogeneity between consumption and advertising bans is also possible. However, a test for endogeneity is dependent on an identifying variable that is difficult to find with this type of data.

[6] The USDA data were provided by the World Bank.

[7] Luik (1994) reports that in the case of RJR Macdonald v. The Attorney General of Canada, the Court concluded that the HNZ data were unreliable. Given the correlations between the HNZ data and the other data sets and the regression results reported below, the Court's conclusion cannot be substantiated.

The advertising ban variables were created from data on television advertising, radio advertising, print advertising, outdoor advertising, point of purchase advertising, movie advertising, and sponsorship bans. The advertising ban data were obtained from Chapman and Wong (1989), Health New Zealand (1995), and WHO (1997). Since the theory suggests that the effect of bans will increase as the number of banned media increases, there is likely to be a non-linear relationship between the number of bans and consumption. The most general specification which allows for a non-linear relationship between the number of media banned and consumption is eight dummy variables, one for no bans and one for each of the included media. However, a more parsimonious specification can also allow for a nonlinear relationship without creating additional collinearity problems. The alternative chosen is a set of three dummy variables. The first dummy is defined as Weak Ban and equals one if there are zero, one or two bans in effect. The second dummy, defined as Limited Ban, equals one if there are three or four media banned. The third dummy is defined as Comprehensive Ban, and equals one if there are five, six or seven media banned.[8]

Table 2 and Fig. 2 present some descriptive data on the relationship between bans and consumption. Causality cannot be inferred from the data in Table 2 nor from the data in Fig. 2. Table 2 presents data for the three ban variables and per capita cigarette consumption, by year. The number of countries with Weak, Limited and Comprehensive Bans are reported along with per capita cigarette consumption for the countries in each ban category. The countries used to compute the mean consumption change each year since there are ban changes each year. The mean number of bans is also reported along with mean per capita cigarette consumption. It is interesting to note that the countries in the Comprehensive Ban category have the lowest consumption and the greatest decline in consumption over time. Fig. 2 shows mean consumption before a ban change and after a ban change, for the sample period from 1984 to 1992. The five increases in the number of bans were associated with a decrease in consumption. In the case of Sweden, which decreased the number of bans, the theory would predict no change or an increase in consumption. The decrease in consumption in Sweden may be attributable to other factors.

The data set also contains a price variable, an income variable, a percent filtered variable, and an unemployment variable. The tobacco price variable is the price of 20 cigarettes. The price data were converted to United States dollars and are in 1992 prices. The price data were obtained from Health New Zealand (1995). Real income was computed by first dividing gross domestic product by population. This was then divided by the gross domestic product deflator and the purchasing

[8] Alternative aggregation definitions for these three dummy variables produced essentially the same regression results as the definitions above. The first dummy variable is not included in the regressions.

Table 2
Advertising bans and per capita cigarette consumption

| Year | Weak Ban | | Limited Ban | | Comprehensive Ban | | Mean number of bans | Mean Consumption |
|---|---|---|---|---|---|---|---|---|
| | Number of countries | Mean consumption | Number of countries | Mean consumption | Number of countries | Mean consumption | | |
| 1970 | 19 | 2394 | 3 | 1906 | 0 | – | 0.9 | 2328 |
| 1971 | 17 | 2472 | 5 | 2020 | 0 | – | 1.2 | 2370 |
| 1972 | 16 | 2602 | 5 | 2077 | 1 | 2034 | 1.6 | 2457 |
| 1973 | 15 | 2665 | 6 | 2230 | 1 | 2038 | 1.7 | 2518 |
| 1974 | 15 | 2714 | 6 | 2230 | 1 | 2291 | 1.7 | 2563 |
| 1975 | 15 | 2643 | 5 | 2356 | 2 | 1998 | 2.0 | 2519 |
| 1976 | 15 | 2582 | 4 | 2806 | 3 | 1549 | 2.2 | 2482 |
| 1977 | 15 | 2619 | 4 | 2758 | 3 | 1492 | 2.2 | 2491 |
| 1978 | 14 | 2676 | 4 | 2646 | 4 | 1573 | 2.5 | 2470 |
| 1979 | 14 | 2748 | 4 | 2665 | 4 | 1632 | 2.5 | 2530 |
| 1980 | 13 | 2690 | 5 | 2717 | 4 | 1645 | 2.5 | 2506 |
| 1981 | 13 | 2656 | 5 | 2719 | 4 | 1647 | 2.5 | 2487 |
| 1982 | 13 | 2633 | 5 | 2725 | 4 | 1646 | 2.5 | 2474 |
| 1983 | 10 | 2777 | 7 | 2506 | 5 | 1731 | 3.1 | 2453 |
| 1984 | 10 | 2688 | 7 | 2496 | 5 | 1703 | 3.1 | 2403 |
| 1985 | 10 | 2670 | 8 | 2294 | 4 | 1710 | 3.1 | 2359 |
| 1986 | 9 | 2700 | 9 | 2196 | 4 | 1726 | 3.2 | 2317 |
| 1987 | 9 | 2607 | 9 | 2135 | 4 | 1754 | 3.2 | 2280 |
| 1988 | 9 | 2609 | 9 | 2112 | 4 | 1741 | 3.2 | 2248 |
| 1989 | 8 | 2569 | 10 | 2050 | 4 | 1666 | 3.4 | 2169 |
| 1990 | 8 | 2618 | 9 | 1980 | 5 | 1784 | 3.4 | 2167 |
| 1991 | 7 | 2616 | 9 | 2063 | 6 | 1736 | 3.5 | 2150 |
| 1992 | 7 | 2599 | 9 | 2004 | 6 | 1654 | 3.6 | 2098 |

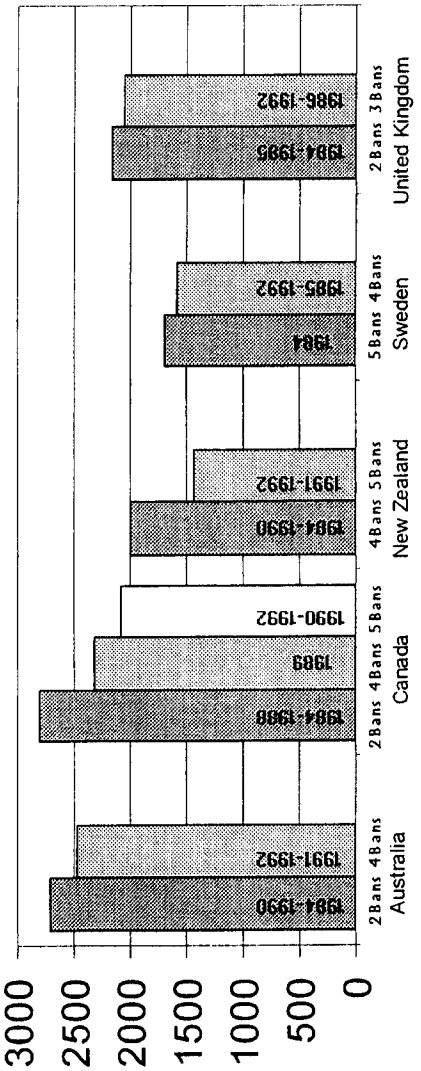


Fig. 2. Per capita cigarette consumption.

power parity. The data are in thousands of U.S. dollars and come from the OECD National Accounts. The demand equation also includes a measure of the percent of cigarettes that are filtered. This variable is included because several studies have shown that people who smoke filtered cigarettes smoke more than people who smoke unfiltered cigarettes. This variable could also reflect accumulating health information that induces a shift to filtered cigarettes. The demand equation also includes a variable for unemployment since a number of studies have shown that stress factors such as unemployment increase smoking. These data also come from HNZ. All of the data from HNZ were derived from OECD publications and the statistical yearbooks of specific countries. Table 3 contains summary definitions and mean values for all the variables.

A final set of variables included in all regressions is time and country dummy variables. These variables are particularly important in an international data set. In an international data set it is difficult to collect comparable data on many factors which may influence tobacco use. The unmeasured factors that vary over time, but are the same in all countries, are controlled by the time dummies. The unmeasured factors that vary across countries, but are the same in all time periods, are controlled by the country dummies.

An initial set of regressions for all four dependent variables with two alternative specifications of independent variables were estimated. Since the Durbin–Watson statistics indicate serial correlation, all specifications were estimated with robust standard errors (Greene, 1997).[9] These results are presented in Table 4. The advertising ban coefficients were generally insignificant. These results may reflect a problem with the variance in the ban variables in the early years of the data set. The theory predicts that media substitution will prevent one or two bans from having any effect on the level of advertising. In the earlier years of the data set, there may not have been a sufficient number of media banned to have any impact on the level of advertising. An examination of Table 2 reveals that from 1970 to 1982 on average about 70% of the data were in the Weak Ban category. This may not be a sufficient number of bans to have any effect on advertising and thus on consumption.[10] In 1983, France, Italy, and Portugal enacted stringent new restrictions on tobacco advertising, increasing the number of countries with Limited and Comprehensive Bans. Table 2 reveals that from 1983 to 1992 on average about 39% of the data were in the Weak Ban category. This suggests that the data after 1983 may include enough bans for an effect to be found.

[9] These standard errors were computed with the robust variance estimator in STATA using country as the cluster variable. This procedure, which is also known as the Huber or White estimator, corrects for within cluster dependence. This allows for a country specific correction to the serial correlation problem. All other regressions presented in this paper also use robust variance estimators.

[10] Laugesen and Meads (1991) found significant effects after 1973. However, they did not correct for serial correlation and did not allow for a non-linear effect of the bans.

Table 3
Definitions and means of variables[a]

| Variable | Definition | 1970–1992 mean | 1984–1992 mean[b] |
|---|---|---|---|
| Per capita tobacco consumption (HNZ) | Per capita annual consumption of tobacco in grams. | 2860.26 | 2648.68 |
| Per capita tobacco consumption (Stewart) | Per capita annual consumption of tobacco in grams. | 2795.46 | 2655.09 |
| Per capita cigarette consumption (HNZ) | Per capita annual consumption of cigarette in grams. | 2384.24 | 2243.33 |
| Per capita cigarette consumption (USDA)[c] | Per capita annual consumption of cigarette in grams. | 2590.70 | 2406.90 |
| Weak Ban | A dichotomous variable which is equal to one if cumulative ban is 0, 1, or 2, and is equal to zero otherwise. | 0.56 | 0.39 |
| Limited Ban | A dichotomous variable which is equal to one if cumulative ban is 3, or 4, and is equal to zero otherwise. | 0.29 | 0.40 |
| Comprehensive Ban | A dichotomous variable which is equal to one if cumulative ban is 5, 6, or 7, and is equal to zero otherwise. | 0.15 | 0.21 |
| Cigarette price | Price of 20 cigarettes. The variable is converted to U.S. dollars by dividing by the purchasing power parity. | 2.00 | 2.16 |
| Real income | Gross domestic product divided by population. The variable is adjusted by dividing by the GDP deflator and converted to thousands of U.S. dollars by dividing by the purchasing power parity. | 16.30 | 18.71 |
| Unemployment rate | Unemployment rate as percent of total labor force. | 5.72 | 7.56 |
| Percent of filter cigarettes | Measure of the percent of cigarettes that are filter. | 84.24 | 89.46 |

[a]All data are for the 22 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

[b]Stewart(1993) data on per capita tobacco consumption are for the years 1984 through 1990.

[c]USDA data on per capita cigarette consumption are not available for Finland, Iceland, Ireland, New Zealand, and Norway.

Table 4
1970–1992

| Dependent variable | HNZ | | Stewart | | HNZ | | USDA | |
|---|---|---|---|---|---|---|---|---|
| | Tobacco consumption | | Tobacco consumption | | Cigarette consumption | | Cigarette consumption | |
| Limited Ban | −52.126 | −157.503 | 105.596 | 48.636 | −77.638 | −152.664 | 123.582 | −35.126 |
| | (−0.46) | (−1.07) | (0.60) | (0.20) | (−0.74) | (−1.06) | (1.43) | (−0.18) |
| Comprehensive Ban | 158.864 | −156.786 | 244.418 | 35.831 | 127.827 | −141.649 | 98.072 | −127.691 |
| | (1.20) | (−0.78) | (2.08) | (0.19) | (1.18) | (−0.76) | (0.88) | (−0.34) |
| Cigarette price | −528.014 | – | −839.566 | – | −504.531 | – | −726.100 | – |
| | (−3.86) | | (−3.72) | | (−3.42) | | (−6.82) | |
| Real income | 31.761 | – | 30.290 | – | 35.975 | – | −8.360 | – |
| | (1.28) | | (0.92) | | (1.54) | | (−0.50) | |
| Unemployment rate | 6.795 | – | 11.235 | – | 0.406 | – | 11.771 | – |
| | (0.31) | | (0.57) | | (0.02) | | (0.66) | |
| Percent of Filter | 2.863 | – | 0.703 | – | 3.365 | – | 0.309 | – |
| Cigarettes | (1.11) | | (0.21) | | (1.47) | | (0.05) | |
| Constant | 3242.413 | 2350.970 | 4212.079 | 2586.766 | 2851.437 | 2248.491 | 4279.108 | 2267.030 |
| | (7.57) | (67.40) | (5.34) | (18.23) | (5.73) | (63.99) | (6.55) | (45.67) |
| $R^2$ | 0.879 | 0.812 | 0.860 | 0.801 | 0.904 | 0.844 | 0.886 | 0.844 |
| Number of observations | 487 | 528 | 443 | 462 | 487 | 528 | 373 | 528 |

HNZ and Stewart data are for the 22 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. USDA data on cigarette consumption are not available for Finland, Iceland, Ireland, New Zealand, and Norway. Calculated standard errors are robust. Asymptotic $t$-statistics are in parentheses. Country and time dummy variables are included in the regressions.

A new set of regressions limited to the period 1984 to 1992 was estimated. These results are presented in Tables 5 and 6. Table 5 presents the results for tobacco consumption and Table 6 presents the results for cigarette consumption. Each table presents a specification that includes independent variables as well as dummy variables and a specification that includes only dummy variables. The dummy variables are the bans, time, and country variables. Since splitting the sample at 1984 is somewhat arbitrary, it is important to examine the results from alternative subsamples of the data. Table 7 presents the ban coefficients and the results using HNZ cigarette and tobacco consumption derived from four alternative time subsamples. These subsamples begin with the period 1983 to 1992 and end with the period 1987 to 1992. These models also include the price, income, unemployment, and percent filter cigarette variables. The subsample for 1984 to 1992 is also included in this table to facilitate comparisons with Tables 5 and 6.

In Tables 5–7, the advertising ban variables are all negative. The Limited Ban variable coefficients are generally not significant, while the Comprehensive Ban coefficients are almost all significant. There are several interesting comparisons between the ban variable coefficients. These comparisons support the hypothesis that the effects of advertising bans is cumulative, show that the Stewart data is inconsistent with the other series, and provide some guidance for studies of tobacco control in developing nations.

First, the coefficients of the Limited Ban variable are generally not significant. In the five regressions in Table 7 where the Limited Ban coefficients are significant, they are less than one-half the size of the coefficients of the Comprehensive Ban variable. This suggests that moving from a Limited Ban to a Comprehensive Ban has a compounding effect, which is consistent with the theory that Limited Bans allow substitution to other media. The results show that limited sets of bans will be minimally effective in reducing the impact of advertising. However, Comprehensive Bans have a clear effect in reducing tobacco use. Also, Table 7 indicates that the effect of advertising bans increases in magnitude and significance as more current samples are used. This may be due, in part, to the increase in the number of bans over time, or due to the effect of lagged consumption on current consumption.

Second, a comparison of the ban coefficients estimated with the four dependent variables shows that the results from the two HNZ series and the USDA series are fairly consistent while the results from the Stewart data is the least consistent with the other three. The ban coefficients estimated with the HNZ tobacco data are about 30% lower than the HNZ cigarette coefficients. This may be due to the fact that bans have less effect on non-cigarette tobacco use. The ban coefficients estimated with HNZ cigarette data are about 20% lower than the coefficients estimated with USDA cigarette data. The two cigarette estimates are fairly close. However, the ban coefficients estimated with Stewart tobacco data are only about one-half the coefficients estimated with the HNZ tobacco data. That is, the effects of advertising bans estimated with the two HNZ variables and the USDA variable

Table 5
Tobacco consumption, 1984–1992/1990

| Dependent variable | HNZ | | Stewart | |
|---|---|---|---|---|
| Specification | 1 | 2 | 1 | 2 |
| Limited Ban | −45.960 (−0.57) | −102.075 (−1.14) | −6.941 (−0.10) | −86.463 (−0.86) |
| Comprehensive Ban | −173.397 (−1.42) | −446.783 (−4.41) | −51.610 (−0.60) | −252.184 (−2.25) |
| Cigarette price | −220.464 (−1.63) | – | −349.032 (−1.81) | – |
| Real income | 24.966 (0.71) | – | 40.757 (0.85) | – |
| Unemployment rate | −0.552 (−0.03) | – | 12.064 (0.58) | – |
| Percent of filter cigarettes | 1.461 (1.30) | – | 1.969 (1.78) | – |
| 1985 | −70.325 (−1.89) | −75.472 (−2.32) | −56.148 (−1.14) | −56.215 (−1.73) |
| 1986 | −123.720 (−2.15) | −129.397 (−2.96) | −86.607 (−1.01) | −90.375 (−1.68) |
| 1987 | −178.815 (−2.44) | −184.420 (−3.69) | −117.021 (−1.00) | −123.194 (−2.04) |
| 1988 | −228.571 (−2.69) | −225.297 (−4.35) | −180.176 (−1.32) | −176.284 (−2.97) |
| 1989 | −301.068 (−2.89) | −297.207 (−4.38) | −214.172 (−1.27) | −212.082 (−2.79) |
| 1990 | −302.119 (−2.49) | −284.541 (−3.71) | −220.425 (−1.18) | −208.867 (−2.79) |
| 1991 | −265.945 (−2.17) | −255.680 (−2.82) | – | – |
| 1992 | −337.245 (−2.31) | −355.716 (−4.55) | – | – |
| Constant | 2530.310 (3.47) | 2646.272 (52.55) | 2589.904 (2.30) | 2782.145 (56.94) |
| $R^2$ | 0.953 | 0.947 | 0.983 | 0.977 |
| Number of observations | 198 | 198 | 154 | 154 |

Data are for the 22 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Regressions based on Stewart's data are from 1984 to 1990. Calculated standard errors are robust. Asymptotic $t$-statistics are in parentheses. Country dummy variables are included in the regressions.

Table 6
Cigarette consumption, 1984–1992

| Dependent Variable | HNZ | | USDA | |
|---|---|---|---|---|
| Specification | 1 | 2 | 1 | 2 |
| Limited Ban | −75.572 (−0.95) | −119.192 (−1.25) | −47.106 (−0.49) | −212.814 (−1.45) |
| Comprehensive Ban | −229.654 (−1.95) | −513.785 (−4.78) | −265.047 (−2.63) | −635.558 (−2.70) |
| Cigarette price | −221.383 (−1.52) | – | −341.912 (−2.02) | – |
| Real income | 17.068 (0.65) | – | −39.380 (−0.65) | – |
| Unemployment rate | −6.983 (−0.49) | – | −45.726 (−2.48) | – |
| Percent of filter cigarettes | 2.042 (1.75) | – | 13.576 (1.20) | – |
| 1985 | −53.909 (−1.66) | −62.524 (−1.99) | −18.032 (−0.30) | −38.994 (−1.10) |
| 1986 | −87.582 (−1.75) | −98.900 (−2.29) | −99.245 (−1.13) | −125.227 (−2.93) |
| 1987 | −121.981 (−1.93) | −135.423 (−2.66) | −107.835 (−0.84) | −137.342 (−2.39) |
| 1988 | −162.260 (−2.28) | −167.806 (−3.15) | −154.413 (−0.99) | −180.700 (−4.17) |
| 1989 | −231.844 (−2.60) | −241.430 (−3.52) | −196.678 (−1.11) | −207.288 (−3.35) |
| 1990 | −229.156 (−2.31) | −224.901 (−3.26) | −163.559 (−0.84) | −162.851 (−2.29) |
| 1991 | −211.928 (−2.14) | −219.052 (−2.84) | −142.999 (−0.71) | −164.998 (−1.70) |
| 1992 | −228.267 (−1.93) | −271.240 (−3.74) | −116.020 (−0.58) | −210.292 (−1.99) |
| Constant | 2523.886 (3.60) | 2529.497 (52.85) | 2840.033 (1.63) | 2482.899 (55.13) |
| $R^2$ | 0.970 | 0.963 | 0.942 | 0.921 |
| Number of observations | 198 | 198 | 153 | 153 |

Data are for the 22 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. USDA data on cigarette consumption are not available for Finland, Iceland, Ireland, New Zealand, and Norway. Calculated standard errors are robust. Asymptotic $t$-statistics are in parentheses. Country dummy variables are included in the regressions.

Table 7

| Dependent variable | HNZ tobacco consumption | | | | |
|---|---|---|---|---|---|
| Sample period | 1983–1992 | 1984–1992 | 1985–1992 | 1986–1992 | 1987–1992 |
| Limited Ban | −4.984 (−0.06) | −45.960 (−0.57) | −75.025 (−1.10) | −113.069 (−2.03) | −104.191 (−2.24) |
| Comprehensive Ban | −94.477 (−0.73) | −173.397 (−1.42) | −249.243 (−1.76) | −267.267 (−2.20) | −248.499 (−2.34) |
| Predicted % change in consumption OECD countries | – | 4.5 | 6.3 | 6.3 | 5.8 |
| Predicted % change in consumption EC countries | – | 5.0 | 7.0 | 6.9 | 6.5 |
| Dependent variable | HNZ cigarette consumption | | | | |
| Sample period | 1983–1992 | 1984–1992 | 1985–1992 | 1986–1992 | 1987–1992 |
| Limited Ban | −46.052 (−0.55) | −75.572 (−0.95) | −96.116 (−1.45) | −115.834 (−1.98) | −81.923 (−1.83) |
| Comprehensive Ban | −179.958 (−1.46) | −229.654 (−1.95) | −298.536 (−2.25) | −283.457 (−2.44) | −218.849 (−2.09) |
| Predicted % change in consumption OECD countries | 5.5 | 6.7 | 8.8 | 8.0 | 6.2 |
| Predicted % change in consumption EC countries | 6.3 | 7.5 | 10.0 | 8.9 | 7.1 |

Data are for the 22 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Calculated standard errors are robust. Asymptotic *t*-statistics are in parentheses. Regressions also include cigarette price, real income, unemployment rate, percent of filter cigarettes, country dummies, and time dummies. The EC countries include Belgium, Denmark France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, and the United Kingdom.

are about the same while the estimated effects with the Stewart variable are smaller.

Third, the specifications which omit the independent variables, price, income, unemployment, and percent filtered generate ban coefficients that are about twice the size of the coefficients from the specifications which include these variables. These results show that regression models that omit important correlates of tobacco use still find that advertising bans have a negative and significant effect, but overestimate the magnitude of the effect. One reason this result is important is that it provides evidence that studies of tobacco control in developing nations may find very limited data on independent variables such as price and income. Studies which exclude these variables will correctly measure the effect of advertising bans, but will probably overstate the magnitude of the effect.

The other independent variables in Tables 5 and 6 are mixed. The price coefficients are negative and significant in the regressions for the 1970 to 1992 period and in regressions for 1984 to 1992. The estimated price elasticities for the HNZ and USDA cigarette variables in the 1970 to 1992 period are $-0.41$ and $-0.55$, respectively. The comparable elasticities for 1984 to 1992 are $-0.21$ and $-0.31$. These estimates are consistent with many other studies of tobacco price elasticities (Chaloupka and Warner, 2000). Finally, income and unemployment are insignificant, while the percent filtered cigarettes generally has a positive effect on tobacco and cigarette use.

## 4. Conclusions

The primary conclusion of this research is that tobacco advertising increases tobacco consumption. The empirical evidence also shows that comprehensive advertising bans can reduce tobacco consumption, but that a limited set of advertising bans will have little or no effect. A limited set of advertising bans will not reduce the total level of advertising expenditure but will simply result in substitution to the remaining non-banned media. When more of the remaining media are eliminated, the options for substitution are also eliminated.[11]

The estimated ban coefficients can be used to predict the percentage change in consumption that would result from additional media bans. For example, the consumption level which would have occurred if all OECD countries had Comprehensive Bans during a sample period can be predicted. The regressions from Table 7 are used for this exercise since the HNZ data include more countries than the USDA and is more consistent than the Stewart data. The percentage change in

[11] The option of Internet advertising will increase the marginal product of the other media and is especially important as older media are increasingly banned.

consumption predicted from each regression is reported in Table 7. The data indicate about a 5.4% reduction in tobacco use and about a 7.4% reduction in cigarette use if all OECD countries had enacted Comprehensive Bans.[12]

The regression results can also be used to predict the effects of the new European tobacco advertising policy initiatives. A European Commission directive issued in late 1997 requires that tobacco advertising in the EC countries diminish progressively from 2001 and end entirely no later than October 2006. The data for the 11 included EC countries and regressions in Table 7 can be used to predict the effects of this directive. The data predict that the new legislation will reduce tobacco consumption by 6.3% and cigarette consumption by 7.9%.

Finally, the analysis presented in this paper suggests that the new ban on outdoor advertising, required by the 1999 US tobacco industry settlement, will have little effect on consumption. Under the settlement, print advertising, point of purchase advertising, and sponsorships will not be banned. In addition, other forms of promotion will not be banned. This will result in substitution to the remaining three forms of advertising and to increased use of tobacco promotion.[13]

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[12] Consumption was predicted with the Limited Ban variable equal to zero and the Comprehensive Ban variable equal to one and all other variables equal to their mean. Predicted consumption was subtracted from actual consumption, and the change was divided by actual consumption.

[13] The settlement requires that the tobacco industry contribute $1.5 billion over 5 years for public education on tobacco use. Prior studies show that this type of expenditure can reduce tobacco use.

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