RISK BELIEFS AND SMOKING BEHAVIOR

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We analyze smoking risk beliefs and smoking behavior using individual data from 1997 for the United States and 1998 for Massachusetts. Smokers and adults more generally overestimate the lung cancer risks of smoking and the mortality risks and life expectancy loss. Higher risk beliefs decrease the probability of starting to smoke and increase the probability of quitting among those who begin. Better educated smokers have lower and more accurate risk beliefs, but education decreases the probability of smoking. Higher state cigarette taxes correlate with risk beliefs but not with smoking status. The uninsured are especially likely to remain current smokers. (*JEL* I12, I18, D80)

I. INTRODUCTION

More people die from smoking each year than from any other consumption activity. These risks arise from consumer choices in a market context. As a result, whether consumers are cognizant of the attendant hazards is a central concern in assessing whether there is a market failure and the extent of such a failure. Influencing people's risk beliefs has been a primary focus of many government interventions in this market, including warnings requirements and public information campaigns.

Public opinion poll data provide some insight into general trends in smoking risk beliefs but do little to resolve the more fundamental concern of whether people underestimate the risks posed by cigarettes. Typical questions ask respondents if cigarette smoking is "one of the causes of lung cancer" or whether smoking is "harmful."[1] These general measures of risk awareness provide a useful historical perspective on smoking risk beliefs but do not make it possible to determine whether the public perceives the risk accurately. Recognizing that smoking is harmful does not imply that the perceived risk level is as great as the actual risk.

The first exploration of the adequacy of risk beliefs was in Viscusi (1990, 1992), which examined the adequacy of lung cancer risk beliefs using a quantitative risk question.[2] The 1985 national survey used in these studies asked respondents how many smokers out of 100 would get lung cancer because they smoke. People generally overestimate the risks of getting lung cancer due to smoking. These risk beliefs in turn affect the decision to smoke in the expected manner. At least for this risk component, which has been the most prominent smoking risk since the 1964 Surgeon General report linking smoking and lung cancer, the empirical evidence does not indicate a market failure.

Notwithstanding these results, a variety of puzzles remain. Do smokers also perceive the other hazards of cigarettes, such as the total mortality risk of smoking? If they understand the risk of death, do they also properly assess

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1. These and similar questions from Gallup polls are summarized in Viscusi (1992). For example, the Gallup survey on July 18, 1990 (Question ID: U.S. Gallup 071890.R08), asked, "Do you think smoking is or is not harmful to your health?"

2. Viscusi (1992) also presented exploratory results on other risk measures using a North Carolina sample but did not include any regression analyses for these data.

ABBREVIATIONS

LR: Likelihood Ratio
OLS: Ordinary Least Squares

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how much life expectancy will be lost due to their premature mortality?

Even if there is such a general understanding on average for the population, are there major pockets of ignorance? The difference between the smoking and the nonsmoking populations is striking. The current U.S. smoking population is less well educated and has lower income levels than the nonsmoking population. A possible explanation for this difference is that the higher education levels of nonsmokers enable them to obtain a better understanding of the hazards of smoking, leading to lower smoking rates among the better educated. Such differences in risk beliefs have never been analyzed previously due to the absence of smoking risk belief surveys that include such demographic information.

In this article, we exploit the more refined capabilities of two large data sets: a 1997 national survey of smoking risk beliefs and a 1998 survey undertaken in Massachusetts. Each of these surveys includes several quantitative risk perception measures as well as much more comprehensive data on background characteristics than in the 1985 survey analyzed in Viscusi (1990, 1992).

In Section II, we introduce the survey data and provide an overview of smoking risk beliefs. Irrespective of the risk measure, there is a pronounced tendency to overestimate the risk level compared to objective scientific measures of the risk. These results contrast with the frequently expressed claim in the literature that cigarette smokers are the victims of companies' advertising. [3] According to this alternative view, companies have allegedly designed their advertising strategies to exploit potential irrationalities in order to foster higher rates of smoking.

Section III explores the determinants of these risk beliefs, yielding some intriguing results. Better educated respondents do have more accurate beliefs, but because people generally overestimate the risks of smoking, the greater accuracy is reflected in a lower assessment of the risks. Some of the results are surprising, such as the effect of state cigarette tax rates on the level of risk beliefs. How these risk beliefs affect smoking behavior is the focus of Section IV. The evidence reveals the expected negative relationship between smoking and risk beliefs as well as the influence of other variables, such as education, in accordance with economic predictions. Section V concludes the paper.

3. See Hanson and Kysar (1999) for articulation of this view.

II. SMOKING RISK BELIEFS

A. Data

Two data sources will serve as the basis for our analysis of perceptions of the risks of smoking: a 1997 national survey and a 1998 Massachusetts survey. The 1997 national survey was administered by Audits and Surveys Worldwide, and the 1998 survey was administered by Roper Starch. Each of these surveys was a random digit dial probability sample of all telephone households. However, the Massachusetts survey oversampled the Medicaid population and is consequently less representative than the U.S. sample. Both listed and unlisted numbers were included, and there were multiple callbacks to complete the interview. The selection of the respondent at the household was randomized based on the most recent birthday of an adult household member. Each of these surveys focused on respondents aged 18 yr or older.[4]

The number of completed interviews was 1,013 for the 1997 U.S. survey and 1,002 for the 1998 Massachusetts survey. The sample used in the subsequent empirical analysis is usually 895 for the U.S. survey and 843 for the Massachusetts survey because we limit the analysis to observations in which none of the key variables of interest have missing values.

The structure of the Massachusetts survey is fairly similar to the U.S. survey. The 1997 U.S. survey first inquired whether the respondent had heard each of five different statements about cigarettes, such as whether "smoking is not bad for a person's health." These questions were intended to start respondents thinking about the main topic of the survey: cigarettes. Responses do not serve as a measure of risk belief but are simply indicators of the types of statements the

4. Although the surveys were undertaken in response to litigation, that aspect was never revealed to survey respondents. The 1997 survey was an attempt to replicate on a national basis the North Carolina survey reported in Viscusi (1992), which had no external funding. The senior author of this paper designed the 1998 survey with no client involvement. The authors will make the data available to any interested researcher for purposes of replication and verification of our results.

respondent may have heard regarding cigarettes. We use one of these questions, which asks whether respondents had heard that "cigarette smoking causes flat feet," as a separate variable below to identify people who were confused or not attending to the survey task, or perhaps willing to blame smoking for all physical ailments.

B. Risk Belief Questions

The survey then asked three quantitative smoking risk questions about the lung cancer risk to a population of 100 smokers, the mortality risk from smoking to 100 smokers, and smokers' life expectancy loss by gender. The 1997 national survey first asked the total mortality risk question, "Among 100 cigarette smokers, how many of them do you think will die from lung cancer, heart disease, throat cancer, or any illness *because* they smoke?" The next question on the survey was, "Among 100 smokers, how many of them do you think will develop lung cancer *because* they smoke?"[5] Thinking in terms of the risk for a well-defined denominator, such as a population of 100 smokers, yields more meaningful and well-behaved probability responses than asking people to report the risk in percentage or decimal terms.

The life expectancy loss question provides information on the normal life expectancy, so that the responses will isolate the perceived incremental life expectancy loss. Otherwise, the response may be confounded by misassessment of the base level of life expectancy. The life expectancy loss question was worded, "As you may know, an average 21-year-old male (female) would be expected to live to age 73 (80). What do you think the life expectancy is for the average male (female) smoker?" with female respondents being asked the parenthetical version of the question.

Not all individuals initially were able to give a response to each of the risk belief questions. Just under 5% of the sample required a probe after not giving a risk estimate when first asked. The probes were of the following form, typified by the lung cancer question: "Just your best estimate will do. How many out of 100 cigarette smokers do you think will develop lung cancer *because* they smoke?" The subsequent empirical analysis will incorporate a variable designated Probe to indicate responses to the follow-up probe question rather than the initial risk belief question. The Massachusetts survey also included the same probe follow-up questions, queried respondents regarding whether they had heard that smoking causes flat feet, and included a more extensive set of other risk-related variables such as whether the respondent uses a seat belt when a passenger in a car. These variables will be discussed further below.

Table 1 summarizes the risk perception responses to each of the three risk questions. For the 1997 national survey, on average people believe that 47 out of 100 smokers will develop lung cancer because they smoke.[6] Although the selection of people into smoking behavior will lead us to expect that smokers will have lower risk beliefs than nonsmokers, even current smokers believe that 40 out of 100 smokers will develop lung cancer. Former smokers have somewhat higher risk beliefs, and never-smokers have the highest risk beliefs. The 1998 Massachusetts survey yields similar results with respect to lung cancer mortality from smoking, with the overall risk belief being 48 lung cancer deaths per 100 smokers, with current smokers assessing the risk as 41 per 100.

Although smokers consistently have lower risk beliefs than former smokers and never-smokers, these comparisons do not imply that smokers underestimate the risk. This result is what one would expect from rational selection into smoking behavior. Other things being equal, the people who engage in risky behaviors will always have lower risk beliefs than those who do not. Moreover, the pertinent comparison from the standpoint of market failure is how these risk beliefs compare to scientific estimates of the risk, not how smokers' risk beliefs compare to those of nonsmokers. Based on reports by the U.S. Surgeon General and estimates of the size of the smoking population, the

5. In the 1998 Massachusetts survey, the wordings were quite similar, although the order of the questions was reversed. The lung cancer question was worded, "Out of 100 smokers, how many do you think will die from lung cancer *because* they smoke?", while the total mortality risk question followed in the form, "And out of every 100 cigarette smokers, how many of them do you think will die from lung cancer, heart disease, throat cancer, or any other illness *because* they smoke?" Our results show that the ordering and wording differences did not have any apparent effect on the results.

6. This estimate is a bit higher than the risk belief of 43 out of 100 reported for a 1985 national survey in Viscusi (1992).

TABLE 1
Risk Beliefs, by Smoking Status and Gender

	n	Lung Cancer Risk	Total Mortality Risk	Expected Years of Life Lost
United States, 1997				
All respondents	895	47.2 (28.7)	50.8 (28.6)	12.7 (8.2)
Male respondents	413	44.7 (29.1)	48.1 (29.4)	10.1 (7.4)
Female respondents	482	49.4 (28.1)	53.2 (27.7)	14.8 (8.3)
Current smokers	215	40.4 (28.3)	43.7 (28.5)	10.2 (8.1)
Male current smokers	111	41.7 (30.1)	44.4 (30.9)	8.4 (7.6)
Female current smokers	104	38.9 (26.3)	42.9 (25.8)	12.1 (8.3)
Massachusetts, 1998				
All respondents	843	47.6 (29.5)	53.9 (29.1)	13.5 (11.9)
Male respondents	389	43.5 (29.2)	49.7 (29.0)	10.4 (10.9)
Female respondents	454	51.1 (29.3)	57.5 (28.8)	16.1 (12.2)
Current smokers	183	41.1 (29.5)	46.0 (30.7)	11.3 (12.0)
Male current smokers	89	39.4 (29.5)	43.5 (30.5)	8.7 (11.8)
Female current smokers	94	42.7 (29.6)	48.3 (30.9)	13.8 (11.7)

Notes: For United States, 1997, sample limited to 895 observations for which all explanatory variables in regression analysis have values. For Massachusetts, 1998, sample limited to 843 observations for which all explanatory variables used in regressions have values.

Standard deviations appear in parentheses.

estimated actual lung cancer fatality risk from smoking is 0.06–0.13, with a midpoint estimate of 0.10.[7] Even smokers overestimate the lung cancer risk by a factor of 4.

For all respondent categories in Table 1, the assessed total mortality risk from smoking is somewhat greater than the perceived lung cancer risk. Respondents overall believe that the risk per 100 smokers is 51 in the 1997 U.S. data and 54 in the 1998 Massachusetts data. Current smokers continue to have lower risk beliefs, with fatalities per 100 smokers equal to 44 in the 1997 U.S. survey and 46 in the 1998 Massachusetts survey.

These risk beliefs also exceed scientific estimates of the actual smoking mortality risk, which is 0.18–0.36 based on evidence from the U.S. Surgeon General combined with data on the size of the U.S. smoking population.[8] Using results from more recent studies by researchers at Johns Hopkins University and the Office on Smoking and Health of the Centers for Disease Control generates estimates of a risk range of 0.15–0.30 and 0.13–0.26 depending on the study used.[9] All these mortality risk reference points are below the perceived risk of smoking but not to the same extent as lung cancer risk, which has been the most highly publicized hazard of smoking.

The final risk belief questions pertain to life expectancy loss from smoking. This value is 12.7 in the 1997 U.S. sample and 13.5 in the 1998 Massachusetts sample. Smokers assess a smaller life expectancy loss. In the 1997 U.S. sample, these values for current smokers are 10.2 yr overall, with an assessed loss of 8.4 yr for men and 12.1 yr for women. The 1998 Massachusetts results for current smokers likewise indicate a gender gap, as the expected years of life lost is 11.3 yr overall, with a loss of 8.7 for men and 13.8 for women. These gender differences are not unexpected, given the greater life expectancy for women.

These life expectancy loss perceptions also are in excess of the scientific reference points. Coupling the mortality risk estimate with the Surgeon General's estimate of the number of years of life lost conditional on a smoking-related death leads to a life expectancy loss estimate of 3.6–7.2 yr.[10] Evidence cited by the Institute of Medicine (2001, 1–2) indicates a life expectancy loss of 6.6 yr, and an earlier estimate by the U.S. Department

7. See Viscusi (1992) for derivation of this result.

8. The procedures for this calculation and the data sources are discussed in Viscusi (1992, 2002).

9. These studies are discussed in conjunction with the derivation of these risk estimates in Viscusi (2002, 148–149).

10. See Viscusi (1992, 80) for documentation of this estimate.

of Health and Human Services (1989, 206) concludes that a pack-a-day smoker at age 30 would lose 6–8 yr of life. Each of these risk reference points is exceeded by the perceived risk levels.

Comparison of each of the three risk perception variables with the scientific estimates of the risk fails to indicate any evidence of market failure based on the average level of risk beliefs for the different population groups. These results should not be entirely surprising, as cigarettes have had on-product warnings since 1966. There have been reports by the Surgeon General on smoking on almost an annual basis since 1964, as well as a wide range of public health policies directed at raising the public's assessment of the risks of smoking.

III. REGRESSION ESTIMATES OF THE DETERMINANTS OF RISK BELIEFS

Although average risk beliefs are quite high, the awareness of smoking risks may vary across the population in systematic ways, as does smoking behavior.[11] A principal phenomenon that this article will address is why the U.S. population is largely segmented into a well-educated, high-income, white-collar nonsmoking population and a less well-educated, lower income, blue-collar smoking population. Whereas formerly there was a strong positive income elasticity for cigarette demand in the United States, that is no longer the case, though it remains true in other countries.[12] More generally, it will be desirable to distinguish whether particular population segments, such as the young, are especially ill informed. As in our discussion in Section II, the reference point for whether people are ill informed is whether people's risk perceptions are accurate given scientific evidence on the levels of the risk.

Consider the following model of risk beliefs, using the mortality risk of smoking as the example. Let RISK be the probability of death due to smoking, which we assume can be characterized by a beta distribution. The individual has available m different information sources, $i = 1$ to m, each of which has an associated informational content δ_i and an implied probability of death q_i. This information source i is equivalent to observing δ_i Bernoulli trials, of which a fraction q_i indicates death. The share of the total information accounted for by information source i is

$$(1) \qquad \delta_i' = \delta_i \Big/ \sum_{i=1}^{m} \delta_i.$$

The various components i include the respondent's prior risk beliefs, the effect of smoking experiences, the influence of education, and other sources of information, such as cigarette warnings. Based on these various information sources, the person forms a risk belief given by the weighted average of these information sources or

$$(2) \qquad \text{RISK} = \sum_{i=1}^{m} \delta_i' q_i.$$

The effect of the different variables on risk beliefs will reflect the joint influence of the relative information weight and the implied risk level.

The specific forms of equations estimated will reflect the survey questions: ordinary least squares (OLS) regressions for the number of lung cancer deaths per 100 smokers, the number of smoking-related deaths per 100 smokers, and the expected number of years of life expectancy loss.

The set of explanatory variables is quite extensive for our two data sets. Here, we will present the empirical results in conjunction with discussion of the hypothesized effects of the variables based on Equation (2). Consider first the national regressions (United States, 1997) in Table 2 (Columns 1–3). Respondent Age in years should be negatively related to risk beliefs, to the extent that older people were raised prior to the antismoking movement and younger people who have been raised in a stronger antismoking environment will have a higher q_i. Note that the age variable in cross-sectional analyses such as this is not a pure age effect but also embodies cohort effects. Age has a negative but diminishing

11. For analysis of the effect on smoking of gender and income, see Hersch (2000) and DiCicca, Kenkel, and Mathios (2000) for the effect of race.

12. The data reported by Antonanzas et al. (2000) for Spain indicate that education, which is strongly correlated with lifetime wealth, is positively related to smoking status. In particular, the average number of years of education is 11 for smokers, 10 for former smokers, and 9 for never smokers.

TABLE 2
Risk Belief Regression Equations

	United States, 1997			Massachusetts, 1998		
	Model 1: Lung Cancer Risk 1	**Model 2: Total Mortality Risk 2**	**Model 3: Expected Years of Life Lost 3**	**Model 1: Lung Cancer Risk 4**	**Model 2: Total Mortality Risk 5**	**Model 3: Expected Years of Life Lost 6**
Age	−0.804*** (0.266)	−0.638** (0.266)	−0.154** (0.072)	0.112 (0.300)	−0.110 (0.299)	−0.017 (0.117)
Age squared	0.0073*** (0.003)	0.0052* (0.003)	0.0011 (0.001)	−0.0012 (0.003)	0.0007 (0.0027)	0.0002 (0.0011)
Female	4.311** (1.881)	4.499** (1.881)	4.563*** (0.513)	7.111*** (2.018)	7.608*** (2.011)	5.389*** (0.790)
Nonwhite	6.953** (2.930)	1.879 (2.930)	1.412** (0.799)	1.117 (2.759)	−1.925 (2.749)	5.689*** (1.081)
Education (yr)	−1.164*** (0.353)	−0.960*** (0.353)	−0.309*** (0.096)	−0.748** (0.332)	−0.196 (0.331)	−0.295** (0.130)
Married	2.416 (2.068)	4.422** (2.068)	−0.687 (0.564)	1.702 (2.095)	0.477 (2.088)	−0.327 (0.821)
Household Size	1.400** (0.667)	0.768 (0.667)	0.387** (0.182)			
Job Injury				13.238*** (4.415)	11.460*** (4.399)	0.792 (1.729)
Medicaid				3.908* (2.250)	2.697 (2.242)	3.067*** (0.881)
Not Insured				10.556** (4.862)	8.223* (4.843)	1.956 (1.904)
Blue Collar				−0.270 (2.603)	0.493 (2.593)	2.125** (1.019)
Probe	−6.352 (4.465)	−9.286** (4.465)	−0.231 (1.217)	−18.493*** (3.778)	−18.275*** (3.765)	0.331 (1.480)
Flat Feet	4.498 (5.952)	−6.683 (5.951)	−0.093 (1.622)	10.542** (5.304)	2.291 (5.285)	4.657** (2.078)
Cigarette Tax	0.106** (0.053)	0.122** (0.053)	−0.003 (0.014)			
Current Smoker	−10.988*** (2.370)	−11.565*** (2.370)	−3.779*** (0.646)	−9.842*** (2.673)	−11.487*** (2.663)	−3.790*** (1.047)
Former Smoker	−3.160 (2.282)	−5.035** (2.281)	−1.038* (0.622)	−0.063 (2.292)	−1.476 (2.283)	−0.262 (0.898)
Constant	72.524*** (8.278)	69.734*** (8.277)	20.108*** (2.256)	52.891*** (9.137)	58.308*** (9.103)	13.140*** (3.579)
R^2	0.087	0.083	0.158	0.097	0.081	0.154

Notes: The U.S. sample contains 895 observations. Indicators for Northeast, North Central, and West regions were included in models as control variables, but the coefficients are not reported. The Massachusetts sample contains 843 observations.

Standard errors are in parentheses.

*Significant at 90% confidence level.

**Significant at 95% confidence level.

***Significant at 99% confidence level.

effect on risk beliefs.[13] There is no clear-cut effect of being Female (0–1 dummy variable [d.v.]) in terms of their smoking risk or available risk information, but Hakes and Viscusi (2004) presented evidence that women often have higher risk beliefs with respect to mortality risks generally. Women have higher smoking risk beliefs, consistent with their higher risk beliefs generally. Nonwhite (0–1 d.v.) respondents may be less well informed about the risks, which could imply either lower risk beliefs if they are ignorant of the risks or higher risk beliefs if their lack of information leads to an exaggerated perception of the risk. The observed effect in Table 2 (U.S. survey) is positive and significant in two of the three instances.

The Education (in years of schooling) variable is of fundamental interest. Education embodies the effects of schooling as well as personal characteristics correlated with education, such as IQ and parental background. More years of education should lead to a greater information weight δ_i on risk levels q_i that are accurate reflections of the risk. Given the general overestimation of smoking risks in the population, the hypothesized effect of Education is negative, as is the case throughout the results in Table 2. The puzzle created by this result, and which will be explored below, is why smoking is less prevalent among the well educated, given that they have lower perceptions of the risk.

Household characteristics also may affect one's risk attitudes. People who are Married (0–1 d.v.) or are members of a large household, as reflected in the Household Size variable (number of people in household), are less likely to be risk takers and would be expected to have higher risk beliefs. To the extent that there are significant effects for these variables, the influence is positive.

The Probe (0–1 d.v.) variable indicates risk responses made after the follow-up question that probed for the risk beliefs. If people who did not answer the risk perception question initially have less prominent risk beliefs, one would expect this variable to have a negative effect on each of the risk belief variables, which is in fact the case. Respondents who required a probe to give a total cigarette mortality estimate believe that almost ten fewer smokers out of 100 will die from smoking-related causes than does the average respondent. The Flat Feet variable is a 0–1 d.v. that indicates whether respondents have heard that "cigarette smoking causes flat feet." Individuals who indicate that smoking causes flat feet should be expected to attribute a broad range of risks to cigarettes, but no such effect is apparent in the national survey regression results in Table 2.

The Cigarette Tax variable (cents tax per pack by state in 1997)[14] is of particular interest wholly apart from its effect on cigarette prices.[15] States with high cigarette taxes tend to have much stronger antismoking environments than states with low tax rates, such as the tobacco-producing states of North Carolina, Virginia, and Kentucky. The Cigarette Tax variable consequently serves in part as a proxy for state antismoking information and should have a positive effect on risk beliefs. It also provides a price signal to consumers of the dangerousness of the product. The Cigarette Tax variable has a significant positive effect on both lung cancer risk beliefs and total mortality risk beliefs. Interestingly, the high-cigarette tax states, in which one would expect the antismoking efforts to be most prominent, have a strong effect in boosting smoking risk assessments. It also may be the case that the presence of a high tax at the time of purchase is a signal to those purchasing cigarettes that the product is risky. Thus, one mechanism by which higher taxes may reduce smoking is by raising risk beliefs.[16]

13. This evidence is consistent with the 1985 age-related results in Viscusi (1992) indicating that very young respondents who have been raised in a strong antismoking environment tend to have higher risk beliefs.

14. The source of this variable is Orzechowski and Walker (2005). Data were formerly published by the Tobacco Institute.

15. Note that this variable and other policy variables are potentially endogenous as levels of risk beliefs in the state may affect smoking policies. The major determinants of tax rates, however, will also include public finance considerations such as alternate revenue sources, whether tobacco is commercially grown in the state, and so on. Structural modeling of the determinants of each of the policy variables is beyond the scope of this paper.

16. To explore whether this effect was due to taxes or cigarette policies correlated with taxes, we included measures of tobacco prevention spending in the risk belief models. Due to a lack of older data, we use data released by Campaign for Tobacco-Free Kids on December 7, 2005, for fiscal year 2006 as these expenditure variables. The measure used is state-level tobacco prevention spending as a percentage of tobacco revenue, which closely correlates with state-level tobacco prevention spending per capita. The auxiliary regressions, which we do not report here, showed that prevention spending is not correlated significantly with any of our risk belief measures.

The final variables in the 1997 U.S. regressions are for whether the respondent is a Current Smoker or a Former Smoker, each of which is a 0–1 d.v. These variables will reflect the combined influence of smokers' morbidity experiences with cigarettes, their greater familiarity with on-product cigarette warnings, and their prior beliefs that led to their initial selection into smoking behavior. Current smokers consistently have much lower risk beliefs, and former smokers have lower risk beliefs than do never-smokers except for lung cancer risks.

The smoking status variables in the smoking risk belief equations could potentially be simultaneously determined. If smoking status is endogenous, then not only do one's experiences as a smoker or nonsmoker inform risk beliefs, but high smoking risk perceptions influence decisions on whether to start or stop smoking. When endogenous variables are included in an OLS regression equation, estimates of smoking risk beliefs would be biased and inconsistent.[17]

The parallel risk belief equations for the 1998 Massachusetts survey reported in Table 2 (Columns 4–6) include a somewhat different set of variables. There is, for example, no Cigarette Tax variable because taxes within the state do not vary. Several additional variables included in this survey also entered the regressions. The 1998 Massachusetts sample also was not representative of the state's population, as it oversampled the poor. Two variables that reflect this mix are whether the respondent is covered by Medicaid (0–1 d.v.) and whether the respondent had health insurance coverage, which we denote as Not Insured (0–1 d.v.). The omitted groups are those covered by a private plan or by Medicare.

Unlike previous quantitative smoking risk belief surveys, the 1998 Massachusetts survey included occupational information. The personal characteristic variables in Table 2 (Massachusetts survey) follow a pattern similar to the national estimates: Female, Education, and Married exhibit the same pattern as before, as does the Current Smoker variable. The Age variables are not significant, perhaps due to the unbalanced nature of the 1998 Massachusetts sample. Former Smoker risk beliefs are not significantly different from those of never-smokers, but they are higher than those of a Current Smoker.

People who have experienced a Job Injury have higher risk beliefs. Apparently, the effect of physical injuries has increased the weight respondents place on the possible risks of cigarettes, leading to considerable overestimation of the risks. The magnitude of the effect boosts lung cancer risk beliefs by 13 per 100 smokers and total mortality risks by 11 per 100 smokers.

Blue Collar respondents perhaps surprisingly have higher estimates of the expected years of life lost that are 2 yr more than white-collar workers' beliefs. Their higher risk beliefs may reflect greater personal contact with smokers who died. Note that the direction of the effect is the opposite of what one would expect if higher smoking rates among Blue Collar workers stemmed from risk underestimation.

The Medicaid and Not Insured variables each have significant positive effects in two of the three equations. The people identified by these policy variables, who are often poor and who are not covered by standard health insurance, have higher risk beliefs. The extent of their additional risk overestimation is especially great for the lung cancer risk beliefs of the Not Insured, as they assess an additional 11 lung cancer deaths per 100 smokers. As with the negative Education coefficient, the segments of society who are least well informed tend to have greater and less accurate risk beliefs than those who are better informed.

Much the same type of educational background result is reflected in the Massachusetts regressions by the Flat Feet variable. People who have heard that smoking causes flat feet, which it does not, have higher risk beliefs.

17. We tested for this possibility using the two-stage conditional maximum likelihood estimation technique of Rivers and Vuong (1988), a technique that is closely related to the Hausman test but is more appropriate for situations in which the second-stage equation has a discrete dependent variable. The structural equation of smoking status is estimated but includes both the actual risk perceptions variable and a variable containing the residuals from a reduced-form risk perception estimate. The test of significance for the coefficient on the residual variable also addresses the null hypothesis of no simultaneity. The Rivers-Vuong test coefficients fail to reject the null hypothesis that smoking status is an independent variable, implying that the OLS estimates in Table 2 are not biased due to endogeneity. For both data sets (United States and Massachusetts) and each smoking status (current, former, and never), we tested total mortality risk perceptions and expected years of life lost perceptions using this test. None of the 12 resulting z scores were higher than 1.53 and only two exceeded 0.60, where 1.96 is the critical value at the 95% confidence level.

Finally, the Probe variable has a significant negative effect for the first two equations. People who did not initially volunteer a lung cancer risk estimate or a mortality risk estimate have lower risk beliefs.

IV. SMOKING STATUS REGRESSIONS

Risk beliefs regarding the hazards of smoking can affect smoking status in a variety of ways—influencing whether the person chooses to smoke cigarettes, whether the person quits smoking after starting, how many times the person tries to quit, and how much the person smokes.

Both the 1997 U.S. survey and the 1998 Massachusetts survey elicited the smoking status of each respondent, making it possible to construct categories of current smokers, former smokers, and never-smokers. A person's current smoking status, however, is the result of a sequence of two distinct but interrelated smoking decisions. The first decision node is the initial never-smoker/ever-smoker decision node. If the person chooses the ever-smoker path, there is a subsequent decision node involving the choice to become a former smoker or remain a current smoker. While each decision might be revisited many times in a person's life, the first-stage decision on starting to smoke is only appropriate for those who have never chosen "yes" to that question before, and after a person has chosen "yes" at the first stage, a subsequent second-stage decision must be made. One cannot become a former smoker without first becoming an ever-smoker. The first-stage decision, in short, selects those for whom the second decision is relevant.

Excluding never-smokers from the analysis of the quit decision makes the estimates conditional on the first-stage outcome. However, following Heckman (1979), ignoring the initial ever-smoker/never-smoker choice node in the second-stage estimates will lead to potentially biased and inconsistent estimates of the coefficients from the standpoint of the overall population's behavior. Because the second-stage decision involves a binary outcome rather than a continuously distributed choice, we will also report estimates using Van de Ven and Van Pragg's (1981) adaptation of Heckman's model to test for self-selection.

We begin our analysis of the pivotal discrete smoking choices with full-sample estimates of the probability of being a never-smoker and the probability of being a current smoker. For people who have ever been smokers, we also estimate the probability of being a former smoker. This is the individual choice analog of an equation for whether the person has quit smoking, which is estimated for smoking populations.

Because of the conceptual overlaps and the empirical correlations among our three smoking risk belief variables, we first explore the effects of these variables on the different smoking status probabilities, estimating them in pairs as well as collectively. The different panels of Table 3 summarize the risk belief estimates only, where each equation also includes the full set of explanatory variables used below. Because of the high correlation of Lung Cancer Risk and Total Mortality Risk beliefs, including all three risk variables in Columns 4 and 8 creates multicollinearity problems. The strongest consistent results are those in Columns 3 and 7, including the mortality risk and life expectancy loss variables.

Consider the 1997 U.S. results in Column 3 of Table 3, which are similar to the 1998 Massachusetts estimates in Column 7. An additional 10 expected deaths per 100 smokers boost the probability of being a never-smoker by 0.02, decrease the probability of being a current smoker by 0.02, and increase the probability of being a former smoker by 0.02. An additional expected year of life lost raises the probability of being a never-smoker by 0.01 and raises the probability of being a former smoker by 0.01. These effects are in addition to the influence of mortality risk beliefs.

The full set of regression results based on the two key risk belief measures appears in Table 4. For the U.S. and Massachusetts samples, the probability of being a never-smoker increases in a statistically significant manner with Mortality Risk and, in the case of the U.S. sample, with Expected Years of Life Lost as well. Education also has a significant positive influence on being a never-smoker. In the U.S. sample, being Nonwhite has a positive effect on being a never-smoker. Age has a diminishing negative effect on being a never-smoker in Massachusetts but no significant effect in the U.S. sample.

Cigarette Tax does not have a significant effect on the never-smoker decision or on any of the other smoking choices in Table 4. To the extent that cigarette taxes influence cigarette consumption directly, it is through

TABLE 3
Effects of Risk Beliefs on Smoking Status

	United States, 1997				Massachusetts, 1998			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Panel A: Never-smokers								
Lung Cancer Risk	0.0007 (0.0009)	0.0018*** (0.0006)		0.0002 (0.0009)	−0.0003 (0.0010)	0.0011* (0.0006)		−0.0004 (0.0010)
Total Mortality Risk	0.0023*** (0.0009)		0.0024*** (0.0006)	0.0022** (0.0009)	0.0017* (0.0011)		0.0015** (0.0006)	0.0018* (0.0011)
Expected Years of Life Lost		0.0095*** (0.0024)	0.0094*** (0.0024)	0.0094*** (0.0024)		0.0024 (0.0016)	0.0025 (0.0016)	0.0025 (0.0016)
Pseudo R^2	0.0514	0.0590	0.0641	0.0641	0.0913	0.0909	0.0933	0.0934
LR χ^2	63.79	73.15	79.47	79.52	104.85	104.35	107.08	107.20
Panel B: Current smokers								
Lung Cancer Risk	−0.0014* (0.0007)	−0.0018*** (0.0005)		−0.0009 (0.0007)	−0.0006 (0.0008)	−0.0021*** (0.0005)		−0.0007 (0.0008)
Total Mortality Risk	−0.0014* (0.0007)		−0.0019*** (0.0005)	−0.0013* (0.0007)	−0.0017** (0.0008)		−0.0022*** (0.0005)	−0.0017** (0.0008)
Expected Years of Life Lost		−0.0095*** (0.0020)	−0.0097*** (0.0020)	−0.0094*** (0.0020)		−0.0047*** (0.0013)	−0.0046*** (0.0013)	−0.0046*** (0.0013)
Pseudo R^2	0.0854	0.1051	0.1066	0.1081	0.1216	0.1328	0.1366	0.1374
LR χ^2	84.24	103.73	105.18	106.73	107.24	117.10	120.50	121.17
Panel C: Former smokers								
Lung Cancer Risk	0.0026* (0.0014)	0.0022** (0.0009)		0.0017 (0.0014)	0.0008 (0.0015)	0.0029*** (0.0008)		0.0009 (0.0015)
Total Mortality Risk	0.0005 (0.0014)		0.0018** (0.0009)	0.0006 (0.0014)	0.0022 (0.0014)		0.0031*** (0.0008)	0.0023 (0.0014)
Expected Years of Life Lost		0.0122*** (0.0037)	0.0129*** (0.0036)	0.0122*** (0.0036)		0.0061*** (0.0020)	0.0061** (0.0020)	0.0061*** (0.0020)
Pseudo R^2	0.0973	0.1154	0.1132	0.1157	0.1118	0.1235	0.1271	0.1276
LR χ^2	60.49	71.75	70.37	71.92	72.07	79.62	81.92	82.28

Notes: All models included controls for Age, Age squared, Female, Nonwhite, Education (yr), Married, Income (thousands), Income unreported, Income top-code, Household Head, Total Mortality Risk, and Expected Years of Life Lost. For the U.S. sample, models in Panels A and B have 895 observations and models in Panel C have 449 observations, as those who had never smoked were excluded. For the Massachusetts sample, models in Panels A and B have 843 observations and models in Panel C have 487 observations, excluding those who had never smoked. Models including only one risk belief were also estimated, with results similar to Columns 1–3. LR = likelihood ratio. Coefficients represent dF/dx for unit changes at the mean.

Standard errors are in parentheses.

*Significant at 90% confidence level.

**Significant at 95% confidence level.

***Significant at 99% confidence level.

TABLE 4
Probit Regression Estimates for Smoking Status

	United States, 1997			Massachusetts, 1998		
Variable	**Model 1: Never-Smoker 1**	**Model 2: Current Smoker 2**	**Model 3: Former Smoker 3**	**Model 1: Never-Smoker 4**	**Model 2: Current Smoker 5**	**Model 3: Former Smoker 6**
Age	0.001 (0.005)	0.008 (0.005)	−0.013* (0.008)	−0.010* (0.005)	−0.012*** (0.004)	0.028*** (0.007)
Age squared	−0.00003 (0.00005)	−0.00011** (0.00005)	0.00022*** (0.00008)	0.00008* (0.00005)	0.00010*** (0.00004)	−0.00022*** (0.00006)
Female	0.029 (0.037)	−0.005 (0.030)	−0.020 (0.053)	0.015 (0.038)	0.033 (0.030)	−0.050 (0.049)
Nonwhite	0.098* (0.052)	−0.032 (0.041)	−0.051 (0.082)	0.054 (0.051)	−0.031 (0.036)	0.047 (0.064)
Education (yr)	0.023*** (0.007)	−0.032*** (0.006)	0.039*** (0.010)	0.031*** (0.006)	−0.013** (0.005)	0.003 (0.009)
Married	0.046 (0.038)	−0.070** (0.031)	0.093* (0.053)	0.038 (0.040)	−0.027 (0.031)	0.028 (0.053)
Income (1000s)	0.00096 (0.00077)	−0.00103 (0.00065)	0.0015 (0.0011)	0.00089 (0.00099)	0.00025 (0.00075)	0.00029 (0.00125)
Income unreported	0.096** (0.048)	−0.082** (0.035)	0.083 (0.074)	0.077 (0.051)	−0.063 (0.035)	0.069 (0.067)
Income top-code	−0.046 (0.195)	0.001 (0.189)	−0.0003 (0.3185)	0.147 (0.100)	−0.065 (0.063)	−0.012 (0.138)
Household Head	−0.133** (0.055)	0.036 (0.043)	0.082 (0.091)			
Cigarette Tax	0.0001 (0.0008)	0.0002 (0.0007)	−0.0001 (0.0012)			
Total Mortality Risk	0.0024*** (0.0006)	−0.0019*** (0.0005)	0.0018** (0.0009)	0.0015** (0.0006)	−0.0022*** (0.0005)	0.0031*** (0.0008)
Expected Years Life Lost	0.0094*** (0.0024)	−0.010*** (0.002)	0.0129*** (0.0036)	0.0025 (0.0016)	−0.0046*** (0.0013)	0.0061*** (0.0020)
Medicaid				−0.067 (0.043)	0.048 (0.035)	−0.040 (0.055)
Not Insured				0.008 (0.089)	0.158** (0.083)	−0.312** (0.117)
Blue Collar				−0.089* (0.046)	0.070* (0.039)	−0.054 (0.060)
Uses Seatbelts				0.156*** (0.038)	−0.139*** (0.033)	0.133*** (0.049)
Diet Carefully				0.110** (0.042)	−0.077** (0.036)	0.074 (0.053)
Pseudo R^2	0.064	0.107	0.113	0.093	0.137	0.127

Notes: For the U.S. sample, 895 observations in Models 1 and 2 and 449 observations in Model 3 (nonsmokers excluded). For the Massachusetts sample, 843 observations in Models 1 and 2 and 487 observations in Model 3. Coefficients represent dF/dx for unit changes in continuous variables at the mean, or for discrete changes of d.v. from 0 to 1.

Standard errors are in parentheses.

*Significant at 90% confidence level.

**Significant at 95% confidence level.

***Significant at 99% confidence level.

the tax's effect on the amount of cigarettes demanded, not on the discrete smoking status decision. This result in many respects parallels the finding with respect to the inconvenience costs of smoking, as smoking restrictions have been found to have a greater effect on the number of cigarettes smoked than on smoking participation.[18] Note that Cigarette Tax does have an indirect effect on smoking status by raising risk beliefs.

Three variables included in the 1998 Massachusetts survey but not in the 1997 U.S. survey are influential as well. Blue Collar workers have a 9% lower chance of being a never-smoker, as the blue-collar orientation of the smoking population is independent of any correlation of blue-collar status with informational deficits. Respondents who undertake self-protective behaviors in other arenas by using seat belts or being careful about their diet are much more likely to be never-smokers. The decision to be a never-smoker reflects consistent behavior to reduce health risks across different choice domains.[19]

The second set of full-sample estimates in Table 4 for whether the person is a current smoker tends to reflect influences that are in the opposite direction from what affects the probability of being a never-smoker. For both samples, the total mortality risk and expected years of life lost reduce the probability of being a current smoker, as does years of education. Age has overall net negative effects on being a current smoker, but the results are more mixed across the two samples. Married respondents in the U.S. sample are less likely to be current smokers.

Several distinctive Massachusetts survey data set variables are influential. The blue-collar orientation of smoking is apparent with the positive effect of the blue-collar variable on being a current smoker. People who use seat belts (Uses Seatbelts) or are careful with their diets (Diet Carefully) are more health conscious and are less likely to be current smokers. One would expect that people who are not covered by health insurance (Not Insured) are more likely to smoke for a variety of reasons. Aside from income level, for which we have already controlled, the primary influences captured by the Not Insured variable are that these individuals are more willing to expose themselves to health risks or that they have less access to medical care, possibly because they have been denied coverage. That greater risk tolerance is borne out, as those who are not insured have a 0.16 higher probability of being a current smoker, controlling for a broad range of other influences.

The Model 3 estimates in Table 4 are for whether the respondent is a former smoker. Conditional on being in the ever-smoker sample, has the respondent quit smoking to become a former smoker? Both of the risk belief variables have positive effects on transiting to the former smoker state in each set of results. In the U.S. results in Table 4, there is a diminishing negative effect of Age, a positive effect of Education, and a positive effect of Married, as married smokers may be more concerned about the effects of smoking on their family and on their own health, which in turn will affect the family's well-being.

The estimated effects of the background variables in the Massachusetts survey are somewhat different from the U.S. estimates given the different mix of explanatory variables available for the Massachusetts survey. Being averse to health risks, as reflected in Uses Seatbelts, boosts the probability of being a former smoker by 0.13. The most striking risk behavior result is the huge effect of the Not Insured variable, which decreases the probability of becoming a former smoker by 0.31 controlling for a quite extensive set of personal characteristics.

The sequential smoking decision model incorporates the former smoker equation from Table 4 as the second-stage quit decision but includes a different first stage to account for selection into the sample. Thus, we will be estimating the probit analog of Model 3 in Table 4 for the ever-smoker subsample, as was also done in that table, except that the probit equation will also include the appropriate adjustment for being in the ever-smoker condition.[20]

The results for the Stage 2 equation in Table 5 are qualitatively very similar to those in the "former smoker" model of Table 4, as

18. For detailed analyses of responses to smoking restrictions, see Evans, Farrelly, and Montgomery (1999) and the U.S. Department of Health and Human Services (2000).

19. See Viscusi and Hersch (2001) for analysis of the relationship of smoking to job risks and other personal hazards.

20. This adaptation of the Heckman (1979) selection model is based on Van de Ven and Van Pragg (1981).

TABLE 5
Two-Stage Probit Selection Model for Smoking Decisions

	United States, 1997		Massachusetts, 1998	
Variable	**Stage 1: Start Smoking**	**Stage 2: Quit Smoking**	**Stage 1: Start Smoking**	**Stage 2: Quit Smoking**
Age		−0.034* (0.020)		0.049*** (0.017)
Age squared		0.00056*** (0.00021)		−0.00040*** (0.00015)
Female	−0.087 (0.092)	−0.060 (0.138)	−0.040 (0.097)	−0.133 (0.107)
Nonwhite	−0.249* (0.136)	−0.154 (0.226)	−0.200 (0.126)	−0.017 (0.147)
Education (years)		0.098*** (0.029)		−0.017 (0.017)
High School Dropout	0.642*** (0.181)		0.462*** (0.141)	
Married	−0.123 (0.093)	0.231* (0.138)	−0.060 (0.097)	0.039* (0.113)
Income (1000s)	−0.00411** (0.00184)	−0.00369 (0.00317)	0.00080 (0.00245)	0.00055 (0.00271)
Income unreported	−0.201 (0.123)	0.221 (0.204)	−0.203 (0.126)	0.222 (0.154)
Income top-code	0.267 (0.496)	0.008 (0.810)	−0.397 (0.249)	−0.200 (0.288)
Household Head	0.373*** (0.141)	0.236 (0.277)		
Cigarette Tax	−0.0003 (0.0021)	−0.0001 (0.0031)		
Medicaid			0.273** (0.111)	0.021 (0.120)
Not Insured			0.012 (0.220)	−0.646** (0.274)
Blue Collar			0.213* (0.119)	−0.026 (0.130)
Uses Seatbelts			−0.467*** (0.103)	0.015 (0.131)
Diet Carefully			−0.283** (0.112)	−0.011 (0.126)
Total Mortality Risk	−0.0061** (0.0016)	0.0048 (0.0031)	−0.0047*** (0.0016)	0.0037* (0.0021)
Expected Years of Life Lost	−0.023*** (0.006)	0.033*** (0.012)	−0.006 (0.004)	0.008* (0.005)
Heard smoking "not bad"	−0.257*** (0.099)		−0.072 (0.090)	
Heard smoking causes flat feet	−0.313 (0.289)		0.071 (0.220)	
Constant	0.681*** (0.235)	−2.165*** (0.582)	1.014*** (0.199)	−1.579*** (0.586)
Wald χ^2(16 d.f.)	50.31***		27.19**	
atanh ρ	−0.266		1.457*	
LR test of independent Equations, χ^2(1 d.f.)	0.00		3.50*	

LR = likelihood ratio. See Table for sample sizes.
Standard errors are in parentheses.
*Significant at 90% confidence level.
**Significant at 95% confidence level.
***Significant at 99% confidence level.

would be expected given their structural similarities. In the U.S. sample, quitting is more likely for individuals who are older, more educated, married, and who perceive smoking as being more dangerous, while income, race, gender, and cigarette tax levels do not directly affect quit choices. The Massachusetts sample also had the same pattern of significant predictors of quit behavior as in Table 4, with education here having no effect but with Not Insured individuals much less likely to quit. The one qualitative difference between the tables is that Uses Seatbelts is statistically insignificant in Table 5.

To model the first-stage equation in which individuals decide whether or not to start smoking, we have altered some regressors so that the structural equation is more appropriate to the context in which the decision is taken. Most current smokers smoked their first cigarette while teenagers.[21] As a consequence, the age of the sample members who are age 18 and over at the time of the survey would likely provide little information about the decision to become an ever-smoker. Similarly, the person's ultimate education will not be completed at the age most individuals decide whether to become smokers or abstain. The only individuals for whom educational attainment will be predeter-

21. See the U.S. Department of Health and Human Services (1994).

mined at the time of the ever-smoker/never-smoker decision are those dropped out of school prior to high school graduation.

To incorporate these differences, the Stage 1 equations in Table 5 do not include the survey respondent's age, substitute the respondent's eventual educational attainment with an indicator for High School Dropout, and include an indicator as to whether the respondent has heard that smoking is "not bad" for a person's health.

Uptake of smoking as shown in the estimates in Table 5 depends upon some of the same factors which predict never-smokers in Table 4. People with higher smoking risk beliefs who have not dropped out of high school and who are nonwhite are less likely to start smoking. While Married is not statistically significant, a Household Head is more likely to have smoked at some time, which might be picking up higher historical smoking rates for men. The lower likelihood of smoking for people with higher incomes is not surprising, but for this result to be meaningful teenagers making the initial smoking decision must be acting on the basis of their subsequent lifetime income.

The analogous regression of Stage 1 in Table 5 (Massachusetts survey) shows the same effects for education and smoking risk perceptions. Because people on Medicaid have low income levels, the higher smoking initiation rates by those eventually on Medicaid are consistent with the income coefficient for Stage 1 in Table 5 (U.S. survey). Among the variables unique to the Massachusetts sample, we see that Blue Collar workers are less likely to have abstained from smoking and that seat belt users and those who eat carefully are less likely to ever have smoked. These results suggest that individuals tend to be consistent across health and safety decisions.

The one anomalous result in Stage 1 of Table 5 is that those in the U.S. sample who have heard that smoking is not bad for people are less likely to have begun smoking. This result, however, is likely due to the fact that those individuals are also more likely to report having heard that smoking is bad for people.[22] In the Massachusetts sample, where people were asked the same set of questions, this anomalous result does not occur.

The statistics at the bottom of Table 5 test the validity of the functional and structural form. The Wald statistics indicate that all the selection models explain a significant portion of the variation in smoking decisions. The insignificant estimates for the error correlation term (labeled atanh ρ) and for the test of independent equations suggest that selection is not affecting the second-stage results in the U.S. sample. The corresponding estimates in the Massachusetts sample, however, are less clear-cut. The estimate for the error correlation term (atanh ρ) is sufficiently high that the equations could be considered linked at the 90% confidence level, although not at the 95% level. At the 5% significance level, then, the Massachusetts sample models give qualitatively similar results to those for the U.S. sample, but the estimators are possibly not as efficient.

V. CONCLUSION

Examination of the 1997 U.S. smoking survey and the 1998 Massachusetts smoking survey revealed some expected results in line with economic theory and general expectation but also yielded some surprises as well. The smoking populations in these samples tend to be less well-educated, blue-collar individuals. However, smokers are not isolated from the considerable public information about the hazards of cigarettes. They are very much aware of the risks. Indeed, they overestimate the smoking-related risks of lung cancer, life expectancy loss, and total mortality loss. Perception of these hazards affects the decision to ever smoke, to be a current smoker, and to become a former smoker in the expected manner. Moreover, there is evidence of consistent risk-taking behavior, as people who use seat belts or exercise care in their diets make risk-reducing choices in the smoking domain as well. People who forego health insurance and place their well-being substantially at risk by doing so are especially likely to smoke and not to quit once they have begun. Cigarette smoking is a large risk that is highly correlated with other risk-taking activities among the current smoking population.

22. For the 273 people in our U.S. sample who reported having heard that smoking is not bad for them, 53.8% also report having heard that it was bad. Among the 610 people who had not heard smoking is not bad, only 26.9% reported hearing that it was bad. It should be emphasized that these questions pertain to statements that the respondent has heard and are not measures of risk belief. Over 95% of survey respondents also reported having heard that smoking was "dangerous" and that smoking "shortens" life. Moreover, Gallup polls since the 1970s have found that over 90% of the public believe that smoking is harmful to one's health.

The effect of education is especially interesting. Those who are better educated do have more accurate risk beliefs, but this greater accuracy is reflected in lower risk beliefs, not higher risk beliefs, as the better educated are less prone to risk overestimation. Yet, better educated people are less likely to be smokers because of the larger direct effect of education on the smoking status decision after controlling for adjusted risk beliefs.

The effect of state cigarette taxes is also intriguing. Higher cigarette taxes do not directly influence the various smoking status decisions. However, people in the high–cigarette tax states have higher smoking risk beliefs, which in turn influence smoking behavior. Whether the tax effect on beliefs is due to higher taxes signaling to cigarette purchasers that the product is dangerous or due to the states with higher taxes simply having a strong antismoking environment is unclear.

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