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Abstract

Using the Annenberg Perception of Tobacco Risk Survey 2, this paper finds that perceived risk deters smoking among persons aged 14-22 years who think that it is relatively difficult to quit smoking and that onset of deleterious health effects occurs relatively quickly. Perceived health risk, however, does not affect smoking status of young people who hold the opposite beliefs. These results are consistent with predictions of rational addiction models and suggest that young people who view smoking as more addictive and health effects as more immediate may have greater incentive to consider long-term health effects in their decision to smoke.

Perceptions of Health Risk and Smoking Decisions of Young People

1.   *Introduction*

Appropriate public policies to curb youth smoking and assignment of legal responsibility for health damages that result from smoking rest importantly on whether young people know the risks and whether they make the decision to smoke in light of this information. Views on these issues, however, are sharply divided. Viscusi (1991, 1992), Lundborg and Lindgren (2004), Lundborg (2007), and Lundborg and Andersson (2008), for example, present evidence that the smoking decisions of young people are not unlike those made by adults. The clear message from these papers is that young people make forward-looking decisions about whether to smoke based in part on their risk perceptions and learn about the health risks of smoking through both experience and acquisition of information. In contrast, Romer and Jamieson (2001), Slovic (2001) and Slovic *et al.* (2004) argue that young people do not consider long-term health consequences in deciding whether to smoke and instead make a spur of the moment decision based on an "affect heuristic" or a feeling that it would be fun to try something new and exciting. More pointedly, Leventhal, Glynn, and Fleming (1987, p. 3376) refer to the idea that young people make an informed choice to initiate smoking as "clearly absurd."

This paper takes a step toward reconciling these divergent views by analyzing data from the Annenberg Perception of Tobacco Risk Survey 2. The main results presented here demonstrate that: (1) the effect of health risk perceptions on smoking status of young people exhibits substantial heterogeneity and (2) this heterogeneity is systematically linked to beliefs about the difficulty of permanently giving up cigarettes

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(Orphanides and Zervos (1995)) and the length of time it takes for the onset of health damages to occur (Suranovic, Goldfarb, and Leonard (1999)).[1] Thus, these results offer direct support for models of utility maximization including the rational addiction model proposed by Becker and Murphy (1988) in explaining smoking uptake.

Results presented also are related to the work of Cutler and Glaeser (2005) who find that participation in smoking and other risky activities is better explained by factors other than beliefs about health risk. This paper obtains a related result that the effect of health risk beliefs on smoking status operates in conjunction with related beliefs about difficulty in quitting and time to onset of health damage. In particular, perceived health risk deters smoking among young people who think that they would find it difficult to quit smoking and this relationship is especially strong for those who also believe that onset of deleterious health effects occurs quickly. Perceived health risk, however, has no effect on the smoking status of young people who think that it would be less difficult to quit and think that it takes a relatively long time for adverse health effects to develop. A possible interpretation of this finding is that young people who view smoking as less habit-forming and who view health effects as less immediate may have more confidence in their ability to give up cigarettes altogether before they are harmed and therefore may have less incentive to consider long-term health effects of prolonged tobacco use.

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[1] The model of Orphanides and Zervos (1995) classifies people as either potential addicts or non-addicts. They show that individuals that believe they are of the non-addictive type are more likely to experiment with goods like cigarettes, alcohol, and narcotics; whereas if they see themselves as potential addicts they are more likely to abstain. Suranovic, Goldfarb, and Leonard (1999) treat time remaining to onset of health effects by looking at the role of age after fixing the discount rate together with years of lost life expectancy due to smoking.

The remainder of this paper is divided into four sections. Section 2 outlines the (simple) econometric approach taken here. Section 3 describes the data more fully. Section 4 presents econometric results and Section 5 concludes.

2. *Background and Conceptual Framework*

Empirical work presented below makes use of data obtained in the Annenberg Perception of Tobacco Risk Survey 2 conducted in 1999-2000 by a professional survey firm overseen by the Annenberg School of Communications at University of Pennsylvania. The survey was not designed by economists; thus its measures do not always match those that economists might choose to include. Nonetheless, as demonstrated later on, the survey is a rich source of information about youth smoking and facilitates exploring a novel set of ideas.

Data were collected from a national random sample of 2002 persons aged 14-22 years identified by random digit dialing. Respondents are identified in the data only by a numerical ID code and state of residence. Parental permission was obtained prior to interviewing persons aged 14-15. As discussed more fully later on, the sample included both smokers and non-smokers. Survey questions focused on smoking behavior, imagery associated with smoking, beliefs about risk associated with smoking and related issues. Jamieson and Romer (2001) provide a more detailed description of the data. A copy of the survey instrument may be found in Appendix B of the volume in which their paper appears.

The empirical analysis below is framed by a well-known model of utility maximization.[2] The idea behind the model (see Lundborg and Lindgren 2004 for details)

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[2] Romer and Jamieson (2001), in their study using the Annenberg 2 data, rejected the economist paradigm of utility maximization and instead focused on the role of "feelings" as a determinant of smoking status.

is that young people maximize expected utility and become smokers when the expected

benefits of smoking exceed the expected costs. Expected costs include not only the out-

of-pocket cost of cigarettes but also restrictions on availability of cigarettes to young

people and on locations where smoking is allowed, together with perceptions of long-

term health damage arising from tobacco use. Thus, young people are taken to be

forward-looking agents similar to those recently modeled by Manski (2004), Lochner

(2007) and Delavande (2008).

An implication of expected utility maximization is that a person will choose (not)

to become a smoker if the benefit (i.e., monetized expected utility gain) from smoking

minus the expected cost of smoking is positive (negative). While the perceived net

benefit of smoking is latent, smoking status ($SMOKER_i = 1$ if the ith respondent is a

smoker; $SMOKER_i = 0$ otherwise) is observed. Thus, smoking status is expressed as a

function of variables that determine the net benefits of smoking. As shown in equation

(1), these variables are perceived health risk $(RISK_i)$ and a $K \times 1$ vector of controls (X_i)

including the price of cigarettes, restrictions on locations where smoking is allowed,

income, and socio-economic/demographic factors (i.e., age, race, gender) and other

variables that may be associated with tastes for smoking.

$$(1) \qquad\qquad SMOKER_i = \delta\, RISK_i + X_i^T \gamma + v_i \qquad i = 1,...n$$

In equation (1), δ and the $K \times 1$ vector γ are the parameters to be estimated and v_i is a

disturbance term. The parameter δ is expected to be negative because as perceived health

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Their regressions suggest that "feelings" are a more important determinant of smoking status than beliefs about health risk. "Feelings", however, were measured by ascertaining whether respondents believed that smoking a cigarette would make them feel very good, somewhat good, somewhat bad, or very bad. Eighty-three percent of smokers reported that they feel somewhat good or very good about smoking, whereas 80% of nonsmokers reported that they would feel somewhat bad or very bad about smoking. Thus, "feelings" may only represent an indirect way of ascertaining whether a respondent is a current smoker.

risks increase, costs of smoking increase and as costs of smoking increase a person is less likely to become a smoker. The magnitude of this parameter is determined by the weighting assigned to perceived health risk in the expected utility calculation. An important empirical issue considered in Section 4 is whether δ is constant for all sample members or whether it varies systematically with other perceived attributes of smoking such as perceived difficulty in quitting and perceived immediacy of health effects.

3.   *Data*

The analysis reported below uses 1930 of the 2002 available observations.[3] The remainder of this section describes key variables of interest for the empirical estimates presented in Section 4, namely smoking status, and aspects of perceived health risk from smoking. Other variables used in the analysis are described later on.

A.   *Smoking status*

The survey permits cigarette smokers to be identified in alternative ways by asking whether the respondent: (1) has ever smoked a cigarette (even one or two puffs), (2) has smoked cigarettes of any kind in the last 30 days, (3) has smoked flavored cigarettes ("bidis") in the past 30 days and (4) considers himself/herself to be a smoker. For persons who indicated that they have smoked in the past 30 days, a follow-up question asked for an estimate of average daily cigarette consumption during that time (<1 cigarette per day, 1-5 per day, 6-10 per day, 11-14 per day, 15-19 per day, 20 per day, more than 20 per day). In the analysis presented below, smokers were taken to be those reporting average current consumption of one or more cigarettes per day over the 30 days prior to being interviewed. These respondents represent 18.8% of the sample.

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[3] Seventy-two observations were removed because respondents did not answer questions relevant to the empirical analysis in Section 4.

Respondents whose average consumption is less than one cigarette per day were considered to have too little attachment to smoking to be considered smokers.

B. *Perceived health risk*

The survey also measured respondents' perceived risk of health damage from smoking in several ways. Perceived risks were elicited qualitatively, for example, by asking: "In your opinion, would your smoking everyday be very risky for your health, somewhat risky, a little risky or not at all risky for your health?"[4] This question has the advantage of seeking a personal assessment of risk; however, responses exhibit too little variation to be useful: 83% of respondents answered "very risky" and 13% of respondents answered "risky."

Perceived health risks of smoking were quantitatively assessed with a question similar to that used by Viscusi (1991): "Now I would like you to imagine 100 cigarette smokers, both men and women, who smoked cigarettes for their entire adult lives. How many of these 100 people do you think will die from lung cancer?"[5] This question has limitations in that it does not call for a personal assessment of risk, does not pin down how many cigarettes per day these hypothetical smokers might smoke, and does not address health risks of smoking other than lung cancer (e.g., heart disease, emphysema, chronic bronchitis, bladder cancer).[6] Nonetheless, it has advantages in that it can be interpreted as a subjective probability estimate that can be compared across sample

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[4] Respondents also were asked "In your opinion, would your smoking only once in a while, say at parties or with friends be very risky for your health, somewhat risky, a little risky, or not at all risky for your health?" Sixty-four percent of respondents answered either "very risky" or "risky."

[5] The question on which Viscusi's (1991) work is based asked about chances of getting lung cancer, rather than dying from it. He contends that because lung cancer victims have relatively low five-year survival rates, there may be little difference between perceptions of morbidity risk and mortality risk.

[6] Khwaja, Silverman, and Sloan (2009) show that among older adult smokers, assessments of perceived lung cancer risk are about the same if the question is worded in the second person or third person.

members and it focuses attention on a single health endpoint (mortality from lung cancer).[7]

Table 1 presents the frequency distribution for perceived lung cancer risk for smokers. Responses exhibited a marked tendency to pile up at 10, 20, 30 etc. The modal estimate of the number of lung cancer deaths among smokers (50) raises concerns that some respondents may have been uncertain about their answer (see Bruine de Bruin *et al.* 2000), although "Don't know" was provided as a possible answer option.[8] Overall, however, respondents provided both extreme as well as intermediate risk values. About 91% of respondents believed that smokers have a 25% or greater chance of dying from lung cancer and 53% of respondents believe this chance is 50% or greater.

On average, respondents perceived that 60.25% of smokers would die from lung cancer. This figure exceeds by at least 17 percentage points the estimates of lung cancer risk obtained in several surveys reported by Viscusi (2002) in samples consisting largely of adults and is roughly six times an estimate of actual risk of lung cancer from smoking that can be computed from epidemiological data (Viscusi 2002, p. 145). Particularly in recently conducted surveys, overestimation of risk of lung cancer from smoking might be expected because, among other things, respondents possibly: (1) focused heavily on publicity given to the association between lung cancer and smoking, or (2) used lung cancer mortality risk as a marker for death risk from other smoking-related diseases (see Khwaja, Silverman, Sloan, and Yang 2009 for additional evidence on this point). In

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[7] The survey asked a follow-up question with identical wording to assess perceived lung cancer risks faced by nonsmokers. Thus, an indirect estimate of lung cancer mortality risk due to smoking could be obtained by subtracting the response from the nonsmoker question from the response of the smoker question. This approach was not pursued, however, because it yielded negative risk estimates for 45 of the 1930 observations.

[8] Out of all 2002 survey respondents, 20 people responded "Don't know" to this question and 5 people refused to answer.

contrast, an earlier confidential survey conducted for the tobacco industry (Roper 1964), showed that respondents on average perceived that 16% of smokers would get lung cancer.[9]

C.   *Perceived difficulty in quitting smoking*

In the Annenberg 2 survey, respondents' perceived difficulty in quitting smoking was assessed using both qualitative and quantitative questions. The qualitative question asked, "In your opinion, if you were to smoke a pack of cigarettes per day, how easy would it be for you to quit and never smoke again?" Possible responses were: (1) very easy; you could quit with no trouble, (2) hard, but you could do it if you really tried, (3) very hard, you do not know that you could do it, and (4) almost impossible, you doubt that you could do it. About 11% of respondents said that quitting smoking for good would be easy, 41% said that it would be hard, 31% said that it would be very hard, 15% said that it would be almost impossible, and about 2% (44 respondents) did not know or refused to answer. The quantitative question asked, "I would like you to imagine ten people your age who smoke a pack of cigarettes a day. All ten of these people SAY that they would like to quit in the next five years. How many of the ten do you think would actually quit permanently in the next five years?"[10] On average, respondents thought that about 3.1 such smokers in ten would quit permanently; 7% thought that no such smokers

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[9] In Roper (1964), 1938 U.S. adult respondents were asked: "Out of 100 pack a day smokers how many would you say would get lung cancer—5 out of 100, 25 out of 100, 50, 75, 95 out of a 100, or how many?' On average, respondents who gave a numerical answer said that about 16 in 100 such smokers would get lung cancer. 41% of respondents provided no answer to this question or said that they did not know the answer. Later confidential surveys conducted for the tobacco industry asked closely related questions. For instance, Roper (1980) asked 2512 U.S adult respondents "Out of every one hundred people who have been cigarette smokers, how many would you estimate get lung cancer at some point in their lives. The mean response was 26.25. 14% of respondents did not answer the question or said that they did not know the answer. A similar question in Roper (1977) posed to 1047 U.S adult respondents produced a mean response of 42.58. 12% of respondents in this survey did not answer the question or said that they did not know the answer.

[10] The survey documentation states that respondents were asked how many smokers out of four would quit smoking. This appears to be an error because in the data, responses range from zero to ten.

would quit permanently, 37% thought that 1 or 2 smokers would quit, and 56% thought that 3 or more smokers would quit.

Both of these questions have advantages and disadvantages in measuring the perceived difficulty in quitting smoking. With the qualitative question, it may be difficult to compare answers between respondents because there is no objective standard for classifying tasks as easy, hard, difficult or impossible. On the other hand, this question calls for an assessment of the difficulty that respondents believe that they themselves would face. This personal assessment more closely captures the spirit of the model presented by Orphanides and Zervos (1995) in which individuals make consumption decisions based on whether they consider themselves to be of the addictive or non-addictive type. Individuals of the addictive type would be expected to weight the long-term health risks of smoking more heavily than individuals of the non-addictive type.[11]

An advantage of the quantitative question is that it calls for a numerical response that can be more easily compared across respondents. This question, however, does not call for a personal assessment of risk, may not even measure the difficulty in quitting smoking, and in any event, the correct answer is unclear. Tabulations from the National Health Interview Surveys suggest that five-year quit rates among young smokers are lower than 3 in 10, but these data do not permit this calculation to be refined so as to consider only those who say they wish to quit. Moreover, answers to this question may reflect more about whether respondents think smokers' statements regarding quitting intentions are believable than about whether it is difficult to quit smoking. Some

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[11] The qualitative measure of quitting difficulty also might be interpreted in terms of O'Donoghue and Rabin's (2002) distinction between naifs and sophisticates, who differ in their awareness of their own future self-control problems. In a model in which the temptation to smoke is the greatest earlier in life, they show that naifs are more likely to become smokers.

respondents, for example, may not even consider the issue of how difficult it might be to quit smoking when answering this question, but nonetheless say that few smokers will quit simply because they believe that smokers make casual statements about quitting intentions without any real conviction to alter their behavior. [12]

Additionally, both the quantitative and qualitative questions are deficient because the "technology" envisioned for quitting smoking was not controlled.[13] When answering the qualitative question, some people might have said that quitting smoking is easy if they thought in terms of using smoking cessation products (e.g., nicotine patch, gum, prescription medication) and believed these products to be effective, but others might have said that quitting smoking is almost impossible if they thought in terms of quitting "cold turkey" or if they believed that smoking cessation products do not work. Regarding the quantitative question, respondents who factored in the use of smoking cessation products might provide a higher estimate of the number of smokers who would successfully quit smoking than those who did not. This aspect weakens the main advantage of this question in that numerical answers are harder to compare between respondents.

The relationship between perceived health risk and smoking status is analyzed using answers to both the qualitative and quantitative questions about difficulty in quitting smoking.[14] When using each of the two questions, response categories are

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[12] In his survey of Swedish adolescents, Lundborg (2007, p. 222) asked: "In a group of 100 smokers who try to quit, how many do you think will succeed?" An advantage of this question over quantitative quitting difficulty question in the Annenberg 2 survey is that it focuses on the difficulty in changing smoking behavior rather than on the believability of statements regarding quitting intentions.

[13] This same issue also arises in the Lundborg (2007) study.

[14] When split samples were constructed using the qualitative quitting difficulty question, responses from 44 persons who did not answer this question were disregarded. When split samples were constructed using the quantitative quitting difficulty question, responses from 10 persons who did not answer this question were disregarded.

combined to ensure adequate sample sizes for regression analysis. In the case where the qualitative question is used, respondents who answered "easy" or "hard" (53% of respondents) are classified as believing that it would be "less difficult" for them to quit. Respondents who answered "very hard" or "almost impossible" (47% of respondents) are classified as believing that it would be "more difficult" for them to quit. In the case of the quantitative question, the 44% of respondents who thought that 2 or fewer smokers would quit were classified as believing that quitting smoking is "more difficult". The remaining 56% of respondents are classified as believing that quitting smoking is "less difficult".[15]

D.   *Perceived immediacy of health effects*

Suranovic, Goldfarb, and Leonard (1999) emphasize the role of age in determining smoking status. Because of discounting, younger people would be expected to weight the long-term health effects of smoking less heavily than older people if both groups use the same discount rate. In general, using a single cross-section of data, the relationship between age and smoking status is difficult to investigate because age effects cannot be disentangled from cohort membership effects. The Annenberg 2 data, however, provide an unusual opportunity to indirectly examine the role of age in determining smoking status because all respondents are young (i.e., roughly the same age) and information is available about their beliefs regarding the length of time it takes for deleterious health effects of smoking to materialize. The variable definitions have the

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[15] These responses were further analyzed using a 2x2 contingency table. Results indicated that respondents whose answer to the qualitative question indicated that it would be more difficult (less difficult) to quit smoking were disproportionately more likely to indicate that it would be more difficult (less difficult) to quit smoking when answering the quantitative question. A chi-square test of independence of the two variables based on the contingency table yields $\chi^2(1) = 26.29$, which rejects the null hypothesis at 1%.

advantage of assigning roughly half of the respondents to the "less difficult" to quit category and roughly half of respondents to the "more difficult" to quit category.

Beliefs about immediacy of health effects of smoking were assessed using the question, "How long, if ever, do you think it takes for smoking to seriously harm the health of a new smoker. A few minutes of smoking, a few weeks of smoking, one year, five years, more than five years, or does smoking not affect one's health?" Responses to this question, interpreted as a marker for beliefs about the remaining time until onset of serious smoking related illness, were used to divide the sample according to whether respondents perceived health effects to be less immediate or more immediate. Respondents were classified as believing that onset of harmful health effects are more immediate if they thought these effects would occur in less than one year. Using this classification scheme, 42% of respondents believed that health effects would be more immediate and 57% of respondents believed otherwise. Observations on 24 persons that did not answer the immediacy of health effects question were eliminated.

4. *Results*

Discussion of results is divided into two parts. Part A considers determinants of smoking status and perceived lung cancer mortality risk in the full sample of 1930 observations. Part B discusses refinements in this relationship that emerge when perceived difficulty in quitting smoking and perceived immediacy of health risk are introduced into the analysis.

A. *Perceived health risk and smoking status*

Empirical analysis begins by estimating equation (1) using binomial probit. Results are presented in Table 2, Column (3) Table 2. The variables *SMOKER* and *RISK*

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were defined in Section 3. Other covariates measure: (1) whether the respondent lives in a rural, urban, or suburban area, (2) respondent age, race and gender, (3) whether other adults (e.g., parents, siblings, other family members) in the household smoke cigarettes, (4) whether the respondent lives with his/her parents, and (5) whether the respondent attends school at least part-time.[16] Covariates also include a complete set of state-effects to control for factors including interstate differences in attitudes toward smoking (see DeCicca, Kenkel, and Mathios 2002, 2008), cigarette prices (Chaloupka and Warner 2000, Carpenter and Cook 2008, Sen and Wirjanto 2010), locations where smoking is allowed (Evans, Farrelly, and Montgomery 1999), and aspects of regulation of tobacco sales to minors (Hersch 1998).[17] Table 2, Column (1) more precisely defines covariates used in the analysis. Table 2, Column (2) presents sample means.[18]

A concern in estimating equation (1) is that *RISK* may be endogenously determined with smoking status. To test for this possibility, instrumental variables are needed that are correlated with *RISK* but uncorrelated with the error (v) (see Murray 1996). The Annenberg 2 data are not ideal in this regard in that no available variables appear to satisfy both of these criteria. In consequence, there is little choice but to

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[16] Data are missing for 233 (12%) of the 1930 respondents on whether they lived with their parents; in consequence an indicator variable was included to distinguish these respondents from those who said that they did not live with their parents. An alternative would be to set aside all observations for respondents who refused to say whether they lived with their parents, however, this approach would have reduced the number of usable observations from 1930 to 1697.

[17] Coefficients of the state indicator variables are not reported, but are available from the authors on request.

[18] In addition to the covariates listed in Table 3, it would be desirable to have a measure of the respondent's spending money or family income. The survey requested that respondents indicate the level of their family's income, but the modal response to this question was "don't know" (37% of observations).   This outcome suggests that respondents generally may not have been well-informed about their family's income. In any case, the income measure is not used as a covariate in the analysis below.

assume that *RISK* is exogenously determined and to more cautiously interpret the probit

estimates of equation (1) in light of the possibility that this assumption is incorrect.[19]

The main result in the Table 2 *SMOKER* equation is that respondents who

perceive higher risk of lung cancer mortality from smoking are less likely to be smokers.

Consistent with prior results reported by Viscusi (1991), Viscusi and Hakes (2008),

Lundborg and Lindgren (2004), Lundborg (2007) and others, the probit coefficient of

RISK in this equation is negative and differs significantly from zero at less than the 5%

level. This result supports the notion that young people make forward-looking decisions

about whether to engage in smoking in light of health problems that may be encountered

later on in life. Nonetheless, consistent with results of Cutler and Glaeser (2005) and as

discussed more fully in connection with Table 7, the effect of a change in *RISK* on the

probability of smoking appears to be relatively small. Evaluated at the means of

SMOKER and *RISK* it would take a 13.7% increase in *RISK* (from 60.25 to 68.50) to

reduce the proportion of smokers in the sample by one percentage point (from 18.7% to

17.7%).

Regarding the remaining estimates in the *SMOKER* equation, the positive

coefficients of the indicators for years of age may indicate that smoking is more prevalent

as respondents become older; but this outcome may instead reflect decreases in the rate of

smoking uptake in the cohort of younger teenagers and/or a greater willingness on the

part of older respondents to acknowledge their smoking. Whites and males are more

likely to be smokers as are respondents that live with adults that smoke.[20] Respondents

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[19] In a similarly specified regression, Viscusi (1992) tested and did not reject the null hypothesis that perceived risk of lung cancer is an exogenous determinant of smoking status.
[20] Otter, Engels, and Prinstein (2009) find that smoking by parents (who are likely to be adult household members) is associated with adolescent smoking.

that live with their parents and those still in school are less likely to smoke. Whether a respondent lives in an urban, suburban or rural area and whether a respondent's information about whether he/she lives with parents is missing are unimportant determinants of smoking status. Additionally, the state-effects jointly contribute to explanatory power of the equation at the 5% level under a likelihood ratio test.[21]

B.   *Perceived addictiveness and perceived immediacy of health risk*

Heterogeneity among respondents in how perceived risk of lung cancer mortality is related to smoking status is examined by re-estimating equation (1) for split samples.[22] Two split samples are defined by classifying respondents according to whether they perceive less difficulty or more difficulty in quitting smoking. These split samples were created using both the qualitative and quantitative measures of quitting difficulty. Results presented below are based on the qualitative quitting difficulty variable because it produced relatively stronger results. Outcomes based on using the quantitative variable, which as indicated previously may not actually measure quitting difficulty, are noted below but not presented in tabular form.

Two additional split samples were defined according to the perceived length of time it takes for smoking to seriously harm the health of a new smoker. The four split samples based on quitting difficulty and length of time to harm then were crossed to make four more split samples. If predictions of the models presented by Orphanides and Zervos (1995) and Suranovic, Goldfarb, and Leonard (1999) are correct, then beliefs about lung cancer risk will turn out to be a more important determinant of smoking status

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[21] Unreported regressions show that the coefficients of covariates listed in Table 3 are virtually unchanged if the state-effects are dropped.
[22] A related paper by Paterson *et al.* (2009) looks at heterogeneity among smokers in preferences for smoking cessation.

among respondents who think that it is more difficult to give up cigarettes and who think that health damage from smoking is more immediate.

As a prelude to looking at the split sample regression results, it is useful to first have an overview of the numbers of observations available and of relationships between the main variables of interest. Table 3 shows that 881 respondents indicated that it would be more difficult to quit smoking, 817 respondents believed that onset of health effects from smoking is more immediate, and 411 respondents held both beliefs.

Table 4 shows that when split samples are created using the qualitative quitting difficulty variable, prevalence of smoking is higher among respondents who believe that it is less difficult to give up smoking (22.7%) as compared to those who think that it would be more difficult (15.1%). The difference between these two proportions is significantly different at 5% under an independent samples test. Smoking prevalence also is higher among respondents who perceive that health damages due to smoking are less immediate (21.8%) rather than more immediate (14.3%). Prevalence of smoking is more than twice as great among respondents who believe that it is both less difficult to quit and that onset of health effects is less immediate (24.9%) as compared to those holding the opposite view (10.9%).

Table 5 shows that when split samples are created using the qualitative quitting difficulty variable, mean perceived risk is higher among respondents who think that it would be more difficult to quit smoking (62.88 vs. 57.92) and among those who think that onset of health effects are more immediate (63.39 vs. 57.86). Mean perceived risk is highest (64.40) among respondents who believe it is both more difficult to quit and onset

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of health effects is more immediate and lowest (54.93) among respondents who hold the opposite beliefs.

Results in Tables 4 and 5 can be placed in perspective using the estimates of the *SMOKER* equation reported in Table 2. According to these estimates, the change in mean *RISK* between the less difficult to quit—less immediate onset of health effects subsample (54.93) and the more difficult to quit—more immediate onset of health effects subsample (64.40), a 17% increase, will decrease the probability of smoking by 1.24 percentage points. Nonetheless, Table 4 shows that the probability of smoking among respondents who believe that it is more difficult to quit smoking and that onset of health effects is more immediate is 14 percentage points lower than among respondents holding the opposite belief. A possible explanation for this outcome rests on heterogeneity in the way people weight *RISK* in making the decision to smoke.

To investigate this possibility, Table 6 reports probit estimates of the coefficient of *RISK* in the *SMOKER* regression for each of the split samples. Each of these equations uses the same covariates as in the Table 2 regression for smoking status.[23] Coefficient estimates in each of the split sample *SMOKER* regressions (available from the authors on request) are broadly similar to those in the corresponding regression in Table 2, except that coefficient significance levels are lower because of smaller sample sizes.

Key results from Table 6 are broadly consistent with predictions of Orphanides and Zervos (1995) and Suranovic, Goldfarb, and Leonard (1999) and demonstrate that some people (predictably) consider long-term health risk when deciding whether to

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[23] State-effects were excluded from the split sample regressions because with the resulting smaller sample sizes, no observations were available for some states. The Table 1 (full sample) regression was re-estimated without state effects so that the estimated coefficient of *RISK* is directly comparable to those obtained in split sample regressions.

smoke, while other people do not take this factor into account. In the split sample of respondents who believe that quitting smoking is less difficult, the probit coefficient of *RISK* does not differ significantly from zero at the 5% level, whereas in the split sample of respondents who believe that quitting smoking is more difficult, the probit coefficient of *RISK* is negative and significant at the 5% level.

Further disaggregated analysis strengthens this result. In four split sample regressions, the estimated coefficient of *RISK* increased in absolute value between respondents who classified quitting difficulty as "easy," "hard," "very hard," and "almost impossible". Estimated coefficients of *RISK* differed significantly from zero at 5% only in the regressions for respondents who thought that it would be "very hard" or "almost impossible" to quit smoking. Estimated probit coefficients obtained were -0.0063 and -.0162, respectively.

Evidently, then, only respondents who believe that quitting is more difficult consider long term health risks in deciding whether to smoke. Young people who believe that quitting is less difficult (and perhaps that they can quit at any time they like) simply have less incentive to pay attention to long term health consequences of smoking, so they weight these consequences less heavily. Also, in the split sample of respondents who thought that quitting is more difficult, the coefficient of *RISK* is more than twice its (absolute) value in the full sample regression (estimated without state effects) (-0.864E-02 v. -0.346E-02). Thus, the full sample regression underestimates the extent to which beliefs about lung cancer mortality risk deter smoking for those who think that quitting smoking is more difficult.

Table 6 also shows how perceived immediacy of health effects from smoking affects the relationship between perceived lung cancer mortality risk and smoking status. In the split sample regression for respondents who believe that onset of health effects from smoking is more immediate, the probit coefficient of *RISK* is negative and differs significantly from zero at the *5%* level.[24] In absolute value, this coefficient exceeds its counterpart from the full sample regression by about 80%. In contrast, in the split sample regression for respondents who believe that onset of health effects of smoking is less immediate the probit coefficient of *RISK* is not significantly different from zero at conventional levels. Thus, respondents who believe that onset of health effects is more immediate weight lung cancer mortality risks more negatively in their decision to smoke.

Respondents who believe both that the onset of health effects is more immediate and quitting smoking is more difficult weight perceived lung cancer risks most heavily. The probit coefficient of *RISK* for this split sample is about four times larger in absolute value than the corresponding coefficient from the full sample regression. Thus, perceived risk of lung cancer mortality has the greatest deterrent effect on smoking for those who both think that the habit is more difficult to give up and believe that onset of harmful health effects is more immediate.

The analysis reported in Table 6 also was carried out by adding dummy variables for quitting difficulty and immediacy of deleterious health effects together with interactions between these dummies and perceived risk to the Table 2 regression specified without state-effects. The dummy variables were defined so as to match the

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[24] This outcome is driven mainly by respondents who believed that a few minutes of smoking would harm a new smoker. Results from a split sample regression for this group (n=298) yielded a coefficient of *RISK* (-0.0101) that differed significantly from zero at 5%. The coefficient of *RISK* in a split sample regression for respondents who believed that a few weeks of smoking would harm a new smoker (n=519) did not differ from zero at 5%.

split samples. Estimates obtained hold coefficients of covariates other than *RISK*

constant, whereas the results reported in Table 6 allows these coefficients to vary

between subsamples. Similar to the estimates presented in Table 6, results of the

dummy/interaction variable analysis show (available from the authors on request) that:

(1) *RISK* plays a significantly (at 1%) stronger role in deterring smoking among those

who believe that they would find it more difficult to quit smoking and (2) *RISK* plays a

significantly (at 10%) strong role in deterring smoking among those who believe that

onset of deleterious health effects is more immediate.

It might also be noted that results presented in Table 6 are weakened by using the

quantitative quitting difficulty variable (see Section 3C for a definition of this variable) to

create the split samples. For instance, the percentage of smokers among respondents who

view quitting smoking as less difficult is 19.3%, and the percentage of smokers among

respondents who view smoking as more difficult is 18.2%. These proportions do not

differ at 5% assuming independent samples (compare to Table 4). Additionally,

coefficients of *RISK* did not differ significantly from zero in the subsamples of

respondents who saw: (1) more difficulty in quitting smoking and (2) more difficulty in

quitting smoking together with more immediate onset of health effects (compare to Table

6). As previously discussed, however, the quantitative variable may be an inferior

measure of respondents' beliefs about the difficulty to quit smoking.

Table 7 uses the probit coefficients from Table 6 to compute elasticities of the

probability of smoking with respect to perceived risk of lung cancer mortality. These

calculations reinforce the earlier conclusion that perceived risk of long term-health

damage is a more important determinant of smoking to some people than others.

Elasticities are evaluated at the means of both variables for the various split samples. The estimated elasticities are larger in all of the split samples of respondents who believed that quitting smoking is more difficult or that onset of health damage from smoking is more immediate. For instance, among respondents who believe that it is more difficult to quit smoking, the estimated elasticity is -0.97 and the estimated elasticity is -1.81 for those who believe both that it is more difficult to quit smoking and that health effects occur more immediately after initiating smoking. These results suggest that the full sample regression: (1) underestimates the deterrent effect of perceived lung cancer mortality risk on smoking among those who believe that smoking is more difficult to give up and that adverse health effects begin more immediately after a person initiates smoking and (2) overestimates this deterrent effect for those who believe that it is less difficult to quit smoking and that health effects are less immediate.

5. *Conclusion*

This paper has examined data from the Annenberg Perceptions of Tobacco Risk Survey 2 focusing on the relationship between perception of lung cancer mortality risk and smoking status of 14-22 year-old respondents. The empirical analysis demonstrates that young people exhibit substantial heterogeneity in the way that perceptions of long-term health damage from smoking affects smoking status and that variations in this relationship can be linked to two related beliefs about cigarette smoking that have been featured prominently in the literature on rational addiction. These beliefs involve: (1) the difficulty of permanently giving up cigarettes and (2) the length of time it takes for health damage from smoking to occur. Results presented also are consistent with prior work suggesting that participation in smoking and other risky activities is better explained by

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factors other than beliefs about health risk, but additionally demonstrates that the role of beliefs about long-term health damage from smoking can be better understood once beliefs about difficulty to quit and time to onset of health damage are taken into account.

In particular, perceived health risk is a deterrent to smoking among those who think that it is more difficult to quit smoking and among those who think that deleterious health effects are more immediate after smoking initiation. This deterrent effect is especially strong for those who hold both of these two views. On the other hand, perceived lung cancer mortality risk plays no role in determining smoking status among those who believe that it is less difficult to quit smoking and among those who believe that deleterious health effects are less immediate. These results support the notion that young people who believe that quitting is more difficult and that onset of serious health effects is more immediate have a greater incentive to pay attention to long term health consequences of smoking.

In any case, results presented here are in line with a growing number of recent papers by demonstrating that expectations or subjective probability judgments about future events may be important to determining current choices, even choices about consumption of a potentially addictive good. Yet, results also suggest that some young people may initiate smoking while ignoring the long-term health risk of this activity. These young people are not necessarily uninformed about the health dangers of tobacco use or subject to cognitive errors in processing warnings about future illness. In fact, the overwhelming majority of respondents substantially overestimated the risk that a lifetime smoker will get lung cancer. Young people instead may choose to smoke if they believe (even mistakenly) that they have the requisite personal skills (e.g., willpower) or an

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effective technology (e.g., smoking cessation aids) that would allow them to quit before it is too late.

From a public health viewpoint, the main results presented here suggest that messages about long term health consequences of smoking may or may not resonate with young people depending on their views about the difficulty in quitting smoking and about the amount of smoking that can be carried on before health damage occurs. Young people who believe that they can quit with less difficulty before their health begins to suffer may not pay attention to these messages, no matter what they think about the long term health risks. Additionally, improvements in smoking cessation methods aimed at adults may well get the desired results by lowering the cost of quitting. Nonetheless, these improvements also lower the long term costs associated with smoking initiation and thereby contribute to more smoking among young people.

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Table 1: Frequency distributions of mortality risk from lung cancer for smokers (n=1930)

Number of smokers in 100	Number of responses	Cumulative Frequency
0-4	32	0.017
5-9	18	0.026
10-14	34	0.044
15-19	22	0.055
20-24	60	0.086
25-29	52	0.113
30-34	92	0.161
35-39	36	0.179
40-44	80	0.221
45-49	31	0.237
50-54	442	0.466
55-59	14	0.473
60-64	121	0.536
65-69	57	0.565
70-74	102	0.618
75-79	221	0.733
80-84	154	0.812
85-89	52	0.839
90-94	92	0.887
95-100	218	1.000
Mean	60.25	---

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Table 2: Results of estimating the *SMOKER* equation[a]

Covariate	Sample Mean	*SMOKER*
Constant	----	-0.625
		(0.463)
=1 if respondent lives in an urban area, 0 otherwise	0.320	-0.007
		(0.108)
=1 if respondent lives in a suburban area, 0 otherwise	0.447	-0.041
		(0.103)
=1 if respondent lives in a rural area, 0 otherwise	0.233	---[b]
=1 if respondent is 14-16 years old, =0 otherwise	0.371	---[b]
=1 if respondent is 17-19 years old, =0 otherwise	0.358	0.593[*]
		(0.102)
=1 if respondent is 20-22 years old, =0 otherwise	0.272	0.598[*]
		(0.120)
=1 if respondent is white, =0 otherwise	0.713	0.446[*]
		(0.095)
=1 if respondent is male, 0 otherwise	0.479	0.192[*]
		(0.076)
=1 if adults in respondent's household are smokers, 0 otherwise	0.382	0.694[*]
		(0.077)
=1 if respondent lives with parents, 0 otherwise	0.672	-0.309[*]
		(0.100)
=1 if it is unknown whether respondent lives with parents, 0 otherwise	0.121	-0.182
		(0.131)
=1 if respondent is in school at least part-time, 0 otherwise	0.776	-0.607[*]
		(0.091)
RISK (Number of smokers out of 100 expected to die of lung cancer)	60.25	-0.387E-02[*]
		(0.150E-02)
State-effects included?/ Jointly significant?		Yes/Yes
Number of observations	**----**	1930

[a] Standard errors in parentheses
[b] Indicates variable omitted from regression
[*] Denotes significance at 5% or lower

Table 3: Number of observations by split sample[a]

	Health effects are more immediate	*Health effects are less immediate*	*Total*
Less difficult to quit smoking	388	611	1005
More difficult to quit smoking	411	464	881
Total	817	1101	1930

[a]Numbers of observations by subsample do not add to totals because some respondents did not know or refused to answer the questions about timing of health effects and relative difficulty of quitting (see text).

Table 4: Fraction of smokers by split sample[a]

	Health effects are more immediate	*Health effects are less immediate*	*Total*
Less difficult to quit smoking	0.186 (0.020)	0.249 (0.018)	0.227 (0.013)
More difficult to quit smoking	0.109 (0.015)	0.188 (0.018)	0.151 (0.012)
Total	0.143 (0.012)	0.218 (0.013)	0.188 (0.009)

[a]standard errors of proportions in parentheses

Table 5: Mean perceived risk of mortality from lung cancer by split sample[a]

	Health effects are more immediate	*Health effects are less immediate*	*Total*
Less difficult to quit smoking	62.51 (1.23)	54.93 (1.03)	57.92 (0.80)
More difficult to quit smoking	64.40 (1.17)	61.48 (1.16)	62.88 (0.83)
Total	63.39 (0.71)	57.86 (0.59)	60.25 (0.57)

[a]standard errors of means in parentheses

Table 6: Probit coefficients of *RISK* in the *SMOKER* equation by split sample[a]

	Health effects are more immediate	*Health effects are less immediate*	*Total*
Less difficult to quit smoking	-0.222E-02 (0.351E-02)	0.211E-02 (0.231E-02)	0.108E-03 (0.187E-02)
More difficult to quit smoking	-0.137E-01[*] (0.458E-02)	-0.614E-02[*] (0.315E-02)	-0.864E-02[*] (0.248E-02)
Total	-0.621E-02[*] (0.259E-02)	-0.126E-02 (0.180E-02)	-0.346E-02[*] (0.144E-02)

[a]Standard errors appear in parentheses beneath coefficient estimates
[*]denotes significance at 5%

Table 7: Elasticity of probability of smoking with respect to perceived mortality risk by split sample

	Health effects are more immediate	*Health effects are less immediate*	*Total*
Less difficult to quit smoking	-0.22[a]	0.16[a]	0.009[a]
More difficult to quit smoking	-1.81	-0.62	-0.97
Total	-0.70	-0.11[a]	-0.33

[a]denotes corresponding probit coefficient not significant at 5% (see Table 6)