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Reviewed work(s):

Source: Journal of Law and Economics, Vol. 52, No. 1 (February 2009), pp. 171–196

Published by: The University of Chicago Press for The Booth School of Business of the University of Chicago and The University of Chicago Law School

Stable URL: http://www.jstor.org/stable/10.1086/589655

Accessed: 18/02/2013 01:14

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Do Smokers Value Their Health and Longevity Less?

Ahmed Khwaja  Duke University
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Abstract

One reason why individuals consume harmful addictive goods is that the “full” price of such goods is low. Using data on adults specifically collected for this study, we examine the internal cost of one such good by estimating the value that smokers and nonsmokers place on loss of health and longevity from a major lung disease, chronic obstructive pulmonary disease (COPD). Differences in the nonpecuniary internal cost of getting COPD between current smokers and people who have never smoked range from $80,000 to $260,000, implying that one reason people continue to smoke is that they face a lower full price of smoking. Our results suggest that although taxation and regulation of cigarettes may be justified for externality reasons, the principle of consumer sovereignty implies that the case is much weaker for interventions based on helping smokers internalize costs they impose on themselves.

1. Introduction

There are several economic explanations for why individuals consume harmful addictive goods, with considerably different implications for taxation and regulation of such activities. The case for regulation and taxation of consumption of harmful addictive goods has typically been based on the externalities generated by their consumption.

In this paper, we examine whether consumption of harmful addictive goods can be explained by lower “full” costs of such goods, which include pecuniary and nonpecuniary costs. We do this in the context of cigarette consumption. We focus attention on costs, although the benefits of consumption may also be higher for these individuals because it is extremely difficult to measure benefits

Frank Sloan is also at the National Bureau of Economic Research. We thank the editor, Sam Peltzman, a coeditor, and an anonymous referee for helpful comments on an earlier version of this paper. This research was supported in part by a grant from the Robert Wood Johnson Foundation Substance Abuse Research Policy Program to the Duke University study Why Do Mature Smokers Not Quit?

[Journal of Law and Economics, vol. 52 (February 2009)]
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as these are often situation specific, for instance, smoking under stress. A major component of full cost in the context of cigarette consumption and other addictive goods is a potential loss of health and longevity, which can have considerable value (see, for example, Murphy and Topel 2006; Hall and Jones 2007). We assess the value individuals place on avoiding the loss of health and longevity related to smoking and analyze whether these values differ by smoking status. If smokers place a lower value on avoiding a loss of health and longevity related to smoking, this would partly explain why individuals continue to smoke. Our analysis distinguishes between two cases of differences in valuation for loss of health and longevity—those arising due to differences in budget constraints and those reflecting innate differences in tastes.

There is research on the external costs of smoking (for example, Manning et al. 1991; Sloan et al. 2004) and the relationship between cigarette prices and consumption (see, for example, Chaloupka and Warner 2000). Most studies of the cost of smoking do not distinguish between external and internal costs. One exception is Sloan et al. (2004), which quantifies internal cost for a generic smoker at age 24. Our study differs from Sloan et al. (2004) in that we estimate the subjective nonpecuniary internal cost for each respondent in the study. Sloan et al. (2004) assumes the same values of a life-year and a year in disability for each person. To our knowledge, there is no research on the subjective values that individuals attach to the internal cost of consuming harmful addictive goods.

We use data expressly collected for this research to compute the nonpecuniary internal cost of acquiring a major smoking-related disease, chronic obstructive pulmonary disease (COPD), a general term for chronic bronchitis and emphysema. It can be highly debilitating, uncomfortable, and inconvenient (for example, carrying an oxygen tank), can lead to high medical expenditures, and is often fatal. It is the fourth leading cause of death in the United States, and there are predictions that it will become the third leading cause by 2020 (U.S. National Institutes of Health 2003). Crucially for our analysis, even though smoking is the most important risk factor in developing COPD, other risk factors include exposure to chemicals, outdoor pollution, and particulates, which makes it a disease that afflicts both smokers and nonsmokers.

Our study takes account of two major concerns about the stated-preference approach.1 First, it has been argued that people may be cognitively unable to deal with complex trade-offs to reveal nonpecuniary values of commodities. We directly analyze the effect of cognitive ability on responses designed to elicit internal cost, among other individual characteristics. A second concern is the hypothetical nature of questions used to elicit internal cost in lieu of inferring such cost from actual transactions, which in turn can often provide incredibly inflated values. To assess the credibility of the responses, we compute internal

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1 There is an extremely large literature on the stated-preference approach. See, for example, Arrow et al. (1993), Portney (1994), Hanemann (1994), Diamond and Hausman (1994), and Carson, Flores, and Meade (2001) for excellent reviews.
cost in two different ways to assess the robustness of the estimates—a risk-dollar and a risk-risk method. As an additional check of the credibility of values, we use the estimates of the internal cost of COPD to derive discount rates and values of a life-year implicit in the responses.

We find that smokers have a lower internal cost of getting COPD than do nonsmokers. We obtain different estimates of internal cost depending on whether the risk-dollar or risk-risk method is used to elicit these values. The differences, however, can be reconciled by adjusting the subjective discount rates used to compute the internal cost in the risk-risk method. Controlling for cognitive ability and other individual characteristics, we find that differences in internal cost by smoking status persist. In particular, such variables as a measure of distaste for having COPD-like symptoms are related to the internal cost of COPD in a meaningful way, which supports the view that the estimates, although based on hypothetical questions, are credible. Our results suggest that people may continue to smoke because they face a lower full price of smoking in spite of its well-known harms. Although taxation and regulation of cigarettes may be justified on the grounds of externalities, the principle of consumer sovereignty implies that the case is much weaker for interventions based on helping smokers internalize their internal costs. Furthermore, policy interventions that emphasize the health benefits of quitting are unlikely to be as effective as they would be if smokers placed a higher value on avoiding the harms of smoking than they evidently do.

The rest of the paper proceeds as follows. Section 2 describes the data, while Section 3 presents the study’s approaches for measuring internal cost and shows how different estimates from the risk-dollar and risk-risk approaches can be reconciled. Section 4 presents results on the robustness of differences in estimates of internal cost to individual heterogeneity. Section 5 concludes.

2. Survey on Smoking

We use data from the Survey on Smoking (SOS), which was specifically collected for our analysis. The SOS was conducted by Battelle, a research firm, from October 2004 to January 2005 at three sites where Battelle offices are located: St. Louis, Seattle, and Durham, North Carolina. The SOS sample consisted of 663 adults ages 50–70 at the interview date, who were current or former smokers or who had never smoked (hereafter, “never smokers”). There were three interviews: a screener to determine age eligibility administered by telephone, a second longer interview also conducted by telephone, and an in-person computer-assisted interview. The response rate for the longer telephone interview was approximately 80 percent. This paper is based mainly on data from the in-person computer-assisted interview in which 431 persons participated.

Among the individuals in our sample, 35, 38, and 27 percent were current, former, or never smokers, respectively. Individuals were 59 years of age on average.
with a mean household income of $63,600. On average, sample respondents had 15 years of schooling. Thirty-eight percent were male.

3. Measuring the Nonpecuniary Internal Cost of Avoiding Chronic Obstructive Pulmonary Disease

To assess the difference in one important source of the internal costs of cigarette consumption, we measure the nonpecuniary internal cost (IC) of COPD. To obtain this value, the SOS started with acquainting respondents with COPD. To this end, the interviewer showed slides describing the disease and its symptoms before eliciting measures of IC. These slides were based on medical histories of actual persons with COPD. Respondents were asked to assume that all pecuniary cost associated with COPD would be covered by insurance. They were then asked some questions designed to familiarize respondents with trade-off questions. After this, they were asked to respond to two sets of risk-dollar questions and one set of risk-risk questions (Table 1).

Given substantial discussion on designing surveys to elicit nonpecuniary values (for example, Arrow et al. 1993; Portney 1994; Hanemann 1994; Diamond and Hausman 1994; Carson, Flores, and Meade 2001), the questions in the SOS were designed to avoid commonly recognized deficiencies in some previous surveys. Specifically, (1) the IC questions in the SOS were posed as trade-offs so that receiving a benefit entails a cost; (2) the amounts in the questions were close-ended with stepwise increments for several iterations to avoid implausibly large responses; (3) to avoid starting point bias, starting values were randomized; (4) symptoms were described to respondents before the IC questions were asked to provide them with information about the costs of having COPD; (5) questions were asked of persons in an age group in which COPD has a relatively high incidence; (6) to gauge robustness, IC values were derived from two alternative approaches—risk-dollar and risk-risk; (7) our analysis retains all values and avoided a common deficiency of trimming outliers in such surveys; and (8) as another test of the consistency of responses, we examine relationships between the individual characteristics of respondents and IC and derive the subjective discount rates and values of life-year implicit in the responses.

A major criticism of stated-preference surveys is the nonsalience to respondents of the commodity being valued. The SOS by contrast asked people to value the loss of health and longevity, which is highly salient for respondents, especially in the respondent age group.

3.1. Risk-Dollar Analysis

Risk-dollar questions asked respondents to choose between two locations, one with a lower cost of living (COL) and a higher probability of getting COPD and vice versa. There were two scenarios, a low- and a high-probability scenario for the risk of getting COPD. This was done to assess the robustness of internal
<table>
<thead>
<tr>
<th>Risk-dollor trade-off: in which area would you rather live?</th>
<th>Full Sample</th>
<th>Current Smoker</th>
<th>Former Smoker</th>
<th>Never Smoker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low probability scenario:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of living (per year)</td>
<td>Same as your area 1.0/100</td>
<td>$c$ higher .8/100</td>
<td>305.8 (199.1)</td>
<td>256.2** (215.5)</td>
</tr>
<tr>
<td>Risk of disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High probability scenario:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of living (per year)</td>
<td>Same as your area 3.0/100</td>
<td>$c$ higher .2/100</td>
<td>247.0 (203.0)</td>
<td>197.7** (84.3)</td>
</tr>
<tr>
<td>Risk of disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk-risk trade-off: Would you choose to have the operation if the chance of dying was $x$%?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dollar value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.23</td>
<td>32.5</td>
<td>39.6</td>
<td>27.5</td>
<td>45.0</td>
</tr>
<tr>
<td>745.1</td>
<td>583.8</td>
<td>603.1**</td>
<td>464.6</td>
<td>787.3**</td>
</tr>
</tbody>
</table>

Note. The values used for the left- and right-censored responses are, for the low-probability risk-dollar trade-off, $(initial value/32)$ and $500, respectively; for the high-probability risk-dollar trade-off, $(initial value/48)$ and $500, respectively; and for the risk-risk trade-off, .5% and 99.5%, respectively. The values for the two risk-dollar trade-offs are the amounts of money needed to avoid a .1% chance of acquiring COPD. We use the answer to the risk-risk trade-off question to calculate the nonpecuniary internal cost of getting COPD. The annual value of life used here is $100,000. We also assume a subjective discount rate of 3%.

** Significant at the 1% level.
cost to changes in the probability of getting COPD since various studies show that individuals have difficulty in assessing low-probability events.

Respondents were asked to compare two areas: area A with lower COL and higher probability of having COPD and area B with higher COL and lower probability of having COPD. Let $c_{\text{NH}}$ be the extra amount of the COL in area B relative to area A and let $r_{\text{NH}}$ be the probability of having COPD in area $x = A, B$, where $r_{\text{NH}} > r_{\text{NH}}$. The respondent is indifferent between the two areas when the COL premium is sufficient to equalize the expected utilities in the two areas. Specifically, the point of indifference is

$$r_{\text{NH}}V(Y - c_{\text{NH}}) + (1 - r_{\text{NH}})U(Y) = r_{\text{NH}}V(Y) + (1 - r_{\text{NH}})U(Y),$$

(1)

where $U(Y)$ is defined as the utility of income when the respondent is healthy and $V(Y)$ is the utility of income when the individual has COPD. We allow the utility functions to differ in the sick and healthy states, but health is not an explicit argument of the utility function.2

Let $L$ be the nonpecuniary internal cost of getting COPD so that $V(Y) = U(Y) - L$. Let $W_i = e(L)$ be the monetary equivalent of such loss. Using the relationship between $V(Y)$ and $U(Y)$ and assuming that the utility function is linear in income, for example, $U(Y) = \lambda Y$, we see that equation (1) yields an expression for the monetary equivalent of IC:

$$W_i = e[\lambda c_{\text{NH}}/(r_{\text{NH}} - r_{\text{NH}})].$$

(2)

Moreover if $V(Y) = \gamma Y$, where $\lambda > \gamma$, then $L = (\lambda - \gamma)Y$ and $W_i = e[(\lambda - \gamma)Y]$. Since we do not have measures of $\lambda$ and $\gamma$, we normalize $\lambda = 1$ and $\gamma = 0$. In this case, $e(L) = L$, and equation (2) reduces to $W_i = [c_{\text{NH}}/(r_{\text{NH}} - r_{\text{NH}})]$, the expression we use to compute IC from our survey data.3

The linearity assumption and the imposition of a functional relationship that transforms the internal cost measured in utility units into dollars are strong assumptions, but they simplify our empirical analysis by yielding a closed-form expression for the internal cost. To the extent that people are risk averse, our estimated IC from this approach is a lower bound.4 On the other hand, the risk-risk analysis (described below) does not rely on these assumptions and hence provides a robustness check.

Equations (1) and (2) are used to calculate the IC of getting COPD for both the low-probability scenario, where persons living in area A have a 1 percent chance and residents of area B have a .8 percent of getting COPD, and the high-

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2 Since the goal of this study is to derive an estimate of the internal cost of getting COPD, a more general specification that allowed for health as a direct argument of the utility function would complicate the analysis and not necessarily yield additional insights.

3 We thank an editor for clarifying the assumptions underlying our empirical analysis.

4 Given concavity of the utility with respect to income, losses increase the marginal utility of income, which implies that risk-averse individuals would have a higher internal cost (IC) than if risk neutral. Empirically, this does not appear to be a major concern. As shown in Section 4, we find that IC has a low income elasticity and is not related to income in a statistically significant way.
probability scenario, where persons living in area A have a 3.0 percent chance and those in area B have a 2.4 percent chance of getting the disease.

The SOS randomized starting values. For the low-probability scenario, initial COL differences ranged from $100 to $900. The COL differential was increased or decreased in amounts of $100 to determine the respondent’s point of indifference. In the high-probability scenario, the initial COL differences ranged from $300 to $2,700, and the amounts were changed in units of $300. If the person preferred location A initially, then the SOS decreased the COL by half of the previous COL difference in location B to make location B more attractive, and vice versa. This iterative process continued until a preference reversal occurred, in which case the midpoint was used as the COL differential to make people indifferent or the respondent was left or right censored. Left censoring occurred when the COL differential was one-eighth of the initial COL differential and there was still no preference reversal. The COL differential was accordingly recorded as one-sixteenth of the initial value in such cases. Right censoring occurred when respondents still preferred area B even when the COL differential reached its maximum value: $1,000 ($3,000 for the high-probability scenario). At the right-censored values, the IC of getting COPD was a maximum of $500,000 in both scenarios. For the high-probability risk-dollar scenario, .20 observations are left censored and .31 are right censored. For the low-probability scenario, .15 observations are left censored and .39 are right censored. The high rates of right censoring could potentially affect our results. However, as we show below, the never and former smokers are disproportionately right censored, and current smokers are disproportionately left censored, which suggests that, if anything, our estimates underestimate the differences in IC of getting COPD by smoking status.

In the risk-dollar analysis, under the low-probability (high-probability) scenario, the mean nonpecuniary internal cost of getting COPD for the full sample is $305,800 ($247,000) (Table 1). The mean IC for current smokers is $256,200 ($197,700), for former smokers is $322,900 ($270,000), and for never smokers is $345,000 ($277,600). The difference in IC between current and never smokers is statistically significant in both the low- and high-probability scenarios. The corresponding median values for current, former, and never smokers are $215,500, $412,500, and $453,000 for the low-probability scenario and $84,300, $240,600, and $225,000 for the high-probability scenario. The medians are well within the upper and lower limits of the allowable responses, showing that the results are not driven by censored responses. These results suggest that smokers face lower internal costs of cigarette consumption owing to the lower subjective value they place on loss of health and longevity from COPD.

3.2. Risk-Risk Analysis

The SOS used an alternative risk-risk approach for measuring IC, based on a standard gamble (see Magat, Viscusi, and Huber 1996). This approach elicits
the probability of failure of an operation that leads to indifference between having an operation that completely cures the disease if it succeeds but otherwise kills the person painlessly. To obtain estimates of IC, we multiply this probability by a measure of the value of life. The point of indifference is calculated at the point of a preference reversal.

For the risk-risk trade-off, respondents were asked to choose whether to undergo an operation that could either permanently cure the individual’s COPD or kill the person instantly and painlessly with probability \( p \). Without the operation, respondents were told that they would have COPD for life.

Assuming that utility depends only on income and the marginal utility of income can differ by health state, but, unlike the risk-dollar analysis, making no assumption about the utility function being linear in income, the probability of death (\( p^* \)) is chosen so that the utility of permanently having COPD is equalized to the expected utility of good health (that is, no COPD) versus death:

\[
V(Y) = (1 - p^*)U(Y) + (p^*)W(Y),
\]

where \( W(Y) \) denotes utility when dead and is normalized to zero; \( U(Y) \) and \( V(Y) \) are as defined in the risk-dollar analysis. Therefore, the relationship between the utility when healthy and the utility when ill is

\[
V(Y) = U(Y) - (p^*)U(Y).
\]

The initial values of the probability of failure were randomized between .2 and .8. Left censoring occurred when individuals were unwilling to undergo the operation even at a probability of failure of .01. For such persons, the SOS assigned a value of .005 to the probability of failure. At the opposite end, the SOS considered a value to be right censored if people were willing to have the operation even with the probability of failure at .99. In such cases, the SOS assigned a value of .995 to the probability of failure. For the risk-risk analysis, left censoring is .030 and right censoring is .075 of the sample, respectively. Thus, for three reasons censoring is not an issue in the risk-risk analysis. First, the probability responses are naturally bounded by zero and one. Second, only about 11 percent of values are censored. Third, as we discuss below, former and never smokers are more likely to be right censored and current smokers are more likely to be left censored, as with the risk-dollar calculations, which implies that our estimates of IC differences are understated.

Using the relationship between \( V(Y) \) and \( U(Y) \) from equation (3), the IC of getting COPD is

\[
W_2 = (p^*)U(Y).
\]

In equation (4), \( U(Y) \) is the present discounted value of the remaining life-years.
In our calculation of the IC of getting COPD, we use a hedonic measure of the value of a life-year of $100,000. In our calculation of the IC of getting COPD, we use a hedonic measure of the value of a life-year of $100,000. 5

The value of remaining life-years is calculated using

\[ U(Y) = \sum_{t=1}^{T} q_t \frac{[100,000]}{(1 + r)^t}, \]

(5)

where \( q_t \) is the survival probability computed for each individual based on a mortality hazard estimated using 1992–2004 Health and Retirement Study (HRS) data (Juster and Suzman 1995) for a similar age group (see Khwaja, Sloan, and Chung 2007), \( r \) is the discount rate, \( T \) ranges from 1 for current age to the terminal age \( T \), which is set at 100. In the base case, we assume the discount rate is 3 percent. 8 Survival probabilities \( q_t \) on average are monotonically decreasing from current to never smokers.

In the risk-risk analysis, the mean IC for the full sample is $745,100, and for current, former, and never smokers, the means are $603,100, $787,300, and $862,500, respectively. 9 The means for current and former smokers are statistically different from the mean for never smokers. Underlying these values are the mean probabilities of dying that make someone indifferent between having and not having the operation. The mean probabilities are .40, .45, and .42 for current, former, and never smokers, respectively. The corresponding median probabilities are .28, .41, and .33, well within the upper and lower limits on the probability, which again implies that the results are not driven by censored responses. These probabilities indicate that current smokers are least willing to accept the mortality risk of surgery.

A factor other than IC that could drive the choices of bearing the mortality risk of the operation is the individual’s degree of risk aversion. In a previous study, we find that current smokers are less risk averse than never or former smokers (Khwaja, Sloan, and Salm 2006). Thus, on the basis of risk aversion

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5 There is an extensive literature on the value of life and a life-year. The vast majority of estimates for the value of an extra year of life are in the $70,000–$373,000 range. Of these, most are at $100,000 or higher. See, for example, Moore and Viscusi (1988), Viscusi (1993), Tolley, Kenkel, and Fabian (1994), Cutler and Richardson (1997), Ferreira and Sloan (2002), Viscusi and Aldy (2003), and Murphy and Topel (2006).


7 Most work treats time discounting as a primitive form of an economic model, with the exception of Becker and Mulligan (1997). We follow this convention here. Becker and Mulligan show that if time preference is endogenous, then individuals who are addicted to smoking would invest less in making themselves more patient. To the extent that this is so, this may be another rationale for regulating smoking.

8 Real interest rates on 30-year U.S. Treasury notes and bonds are 3.0 percent. The U.S. Office of Management and Budget (2007) uses 3 and alternatively 7 percent in its analysis of federal program budgets.

9 On the basis of the mean probabilities of accepting the risk of having the operation, it might appear that IC should be the highest for former smokers. However, the value of the remaining life-years calculated according to equation (5) accounts for the survival \( q_t \) probability, which on average is smaller for former than for never smokers.
alone, one would expect to find that on average the probability that current smokers are willing to undergo the operation would be higher than for the other groups. Since we do not find this to be the case, if anything, our results on differences in IC by smoking status are understated. Thus, differences in risk aversion do not drive our conclusion that current smokers’ IC is lower. Furthermore, our risk-dollar analysis provides a robustness check.\(^{10}\)

Two distinct patterns emerge in both of these analyses. First, current smokers tend to value their health and longevity less than never smokers, which implies lower ICs of cigarette consumption for current smokers relative to others. Second, although the two risk-dollar calculations yield roughly similar estimates of IC, the risk-risk estimates are substantially higher for all groups. The risk-dollar estimates of IC are based directly on the responses to the SOS. By contrast, the risk-risk estimates are based on a combination of responses and additional assumptions, described earlier.

The advantages of the risk-dollar approach are that it requires no explicit assumptions about time preference, probabilities of survival, and the value of a life-year, which are the disadvantages of the risk-risk approach. On the other hand, disadvantages of the risk-dollar approach are the linearity assumption about the functional form of the utility function, the high rate of right censoring, and the imputations required for such responses; avoiding these issues is an advantage of the risk-risk approach. In view of these pros and cons, we make no judgment as to which is the better approach.

In what follows we attempt to reconcile the differences between the approaches using the risk-dollar values as a benchmark for two reasons. First, using either approach, we find significant and substantial differences in IC. Second, the risk-dollar approach provides conservative estimates of differences in IC by smoking status.

In addition to differences in the proportions of the samples that are right censored and the values imputed in such cases, the differences between risk-dollar and risk-risk estimates could reflect one or more of the following assumptions: (1) the subjective discount rate used by respondents is higher than 3 percent, (2) the value of a life-year is lower than $100,000, and (3) the respondents’ subjective probabilities of survival differ from those we used.

The third possibility is highly unlikely. Other work with these data (see Khwaja, Sloan, and Chung 2007) finds that individuals are highly accurate in gauging their survival probabilities. This leaves the first two possibilities, discounting and the value of a life-year, which we examine next.

### 3.3. Reconciling the Differences in Nonpecuniary Internal Cost from the Risk-Dollar and Risk-Risk Analyses

To examine the effect of the subjective discount rate on the risk-risk estimates of IC, we recalculate IC using discount rates ranging from 5 to 15 percent (Table

\(^{10}\) We thank an anonymous referee for providing this insight.
2). Mean IC ranges from $573,000 at a discount rate of 5 percent to $249,300 at a discount rate of 15 percent. The latter estimate is close to the mean IC under the high-probability risk-dollar scenario. The mean IC at a discount rate of 12 percent is near the low-probability risk-dollar scenario. This suggests that subjective discount rates are substantially higher than the base case of 3 percent.

Hence, we calculate the subjective discount rates that equalize the mean IC from the risk-dollar analysis with that from the risk-risk analysis (Table 3). The risk-dollar questions are phrased to apply to a single period. Thus, we assume that respondents did not discount in responding to these questions. To obtain the discount rate implied by the low-probability (high-probability) scenario risk-dollar question, we use equation (5). We calculate the discount rate that equates the risk-risk IC to the IC from the low-probability (high-probability) risk-dollar questions. Specifically, we search over a range of \( r \) to find the value of \( r \) that minimizes the difference between the mean IC under the low-probability (high-probability) scenario and the one calculated using the answers to the risk-risk questions. Standard errors of the implied discount rates are obtained by bootstrapping 1,000 samples of same size as the original sample, each created by sampling with replacement.

For the low- and the high-probability scenarios, we find that for the full sample, the implied discount rates are 12 and 15 percent, respectively. Never smokers have discount rates of 11 and 14 percent, respectively. Current smokers have higher discount rates than never smokers—13 and 17 percent under the two scenarios, respectively. Former smokers have discount rates in between current and never smokers. These results imply that under the risk-risk scenario, (1) respondents behaved “as if” they used a much higher discount rate than the 3 percent that was assumed in our baseline analysis, and (2) smokers tend to have higher subjective discount rates. These implied discount rates, though high, are not implausible, which suggests that our estimates of IC are credible.

Next, we examine the alternative in which the discount rate is fixed at the baseline value of 3 percent but the value of a life-year is allowed to vary. We seek a value of a life-year that equates the mean risk-dollar IC with the mean risk-risk IC (Table 4) instead of the assumed baseline value of $100,000 per life-year in equation (5). Here, the implied values of a life-year for the full sample are $41,100 and $33,200 in the low- and high-probability scenarios, respectively.
Table 3

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Full Sample</th>
<th>Current Smoker</th>
<th>Former Smoker</th>
<th>Never Smoker</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td>Low probability</td>
<td>.12</td>
<td>.0045</td>
<td>.13**</td>
<td>.0089</td>
</tr>
<tr>
<td>High probability</td>
<td>.15</td>
<td>.0032</td>
<td>.17**</td>
<td>.011</td>
</tr>
</tbody>
</table>

Note. Standard errors are bootstrapped using 1,000 samples.
** Significant at the 1% level.

Mean values of a life-year by smoking status are very similar. Under both scenarios, current smokers attach a slightly higher value to a life-year than never smokers. Intuitively, this result arises because survival probabilities are sufficiently lower for current than for never smokers (see Khwaja, Sloan, and Chung 2007). Hence, on the basis of equation (5), the value of a life-year that equates the risk-dollar and the risk-risk mean IC is lower for smokers than for never smokers, even though the mean risk-dollar IC for current smokers is appreciably lower than for never smokers.11

This second method of reconciling the difference between the risk-dollar and the risk-risk estimates is much less plausible than the first for three reasons. First, other research has shown values of a life-year to be much higher than this (see note 5). Second, the implied values of life are far lower than the mean household income of $64,000 of SOS respondents. One would expect that the opportunity cost of a life-year of a member of the household would be at least as high as household income (see, for example, Murphy and Topel 2006, p. 881). Third, the higher value of a life-year for current smokers contradicts the results from the risk-dollar questions. Thus, in subsequent analysis, we rely on using a higher subjective discount rate rather than the baseline rate of 3 percent.

4. Robustness of Differences in Nonpecuniary Internal Cost to Individual Heterogeneity

Thus far, we have established that current smokers have a lower IC than others. We have also found that using a higher subjective discount rate can reconcile the differences between IC derived from the risk-dollar and risk-risk questions. The comprehensive nature of the SOS questions allows us to investigate the robustness of these differences to several sources of heterogeneity regarding the economic, psychological, and health characteristics of an individual.

11 The probability of survival, q_t, in equation (5) differs by smoking status, being the highest for never smokers and the lowest for current smokers on average. Thus, the value of life is lowest for current smokers. From equation (4), IC is \( W_t = (p^*U(Y)) \). Although \( p^* \) is low for never smokers compared to former smokers, \( U(Y) \) is the highest on average for never smokers by an amount sufficient to offset the low value of \( p^* \) for never smokers, making IC highest for never smokers on average.
### Table 4

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Full Sample</th>
<th>Current Smoker</th>
<th>Former Smoker</th>
<th>Never Smoker</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean SE</td>
<td>Mean SE</td>
<td>Mean SE</td>
<td>Mean SE</td>
</tr>
<tr>
<td>Low probability</td>
<td>41.1 .56</td>
<td>42.9** 2.18</td>
<td>41.5** 2.18</td>
<td>40.8 2.44</td>
</tr>
<tr>
<td>High probability</td>
<td>33.2 .46</td>
<td>33.1** 1.68</td>
<td>34.7** 1.83</td>
<td>32.8 1.97</td>
</tr>
</tbody>
</table>

Note. Standard errors are bootstrapped using 500 samples.

** Significant at the 1% level.

In this part of our study, we account for some of the major criticisms of the stated-preference approach: the role of cognitive ability as a determinant of IC and the hypothetical nature of the questions used to elicit estimates of the IC of getting COPD.

On the basis of measures of IC recovered from the risk-dollar and risk-risk questions, we estimate regressions of the following form:

\[
\text{IC}_i = \alpha + X_i^\prime \beta + e_i.
\]  

We regress the respondent’s IC of getting COPD on the following variables \(X_i\): smoking status (current smoker, former smoker, and never smoker, the omitted reference group), an index of the level of addiction, self-assessed probability of quitting smoking in 2 years, an index of the person’s aversion to pain, a measure of whether or not the person has serious lung disease, cognitive ability, household income, years of education, age, and indicator variables to distinguish among the three cities in which the respondents lived.\(^{12}\)

One important difference between those who continue to smoke and those who do not is the cost of quitting. People who face a higher quitting cost plausibly have a higher IC of getting COPD because they think they will not be able to prevent it by quitting. We consider this possibility by examining the effect of the level of addiction on IC. For current smokers, we define a variable for the level of addiction. The SOS contained five questions related to addiction (asked only of current smokers). These were the following: (1) How soon after you wake up do you smoke your first cigarette? (We convert this question into a binary variable equal to one if the person smoked within an hour after waking up and zero otherwise.) (2) Do you find it difficult to refrain from smoking in places where it is forbidden, for example, in church, in the library, or in a movie theater? (3) Which cigarette do you most hate to give up? (We specify a binary

\(^{12}\) In the initial analysis, we included a variable for the initial cost-of-living (COL) differential between the two communities randomly assigned to the respondent by the SOS. The randomized initial value did not have a statistically significant effect on the respondents’ IC of getting COPD. The point of randomizing the starting values was to avoid the starting-point bias. A statistically significant effect would have meant that people were strongly affected by the original values of the COL differential they were given, instead of having their predetermined, independent value of the IC of getting COPD.
Table 5
Factor Analysis for Measures of Level of Addiction

<table>
<thead>
<tr>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Factor Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>First cigarette within an hour after waking up</td>
<td>0.32</td>
<td>0.47</td>
<td>0.88</td>
<td>0.037</td>
<td>-0.11</td>
</tr>
<tr>
<td>Difficulty refraining from smoking in places where it is forbidden</td>
<td>0.078</td>
<td>0.27</td>
<td>0.41</td>
<td>0.33</td>
<td>-0.085</td>
</tr>
<tr>
<td>Hate most to give up the first cigarette</td>
<td>0.17</td>
<td>0.37</td>
<td>0.69</td>
<td>-0.34</td>
<td>-0.075</td>
</tr>
<tr>
<td>Smoke more during the first half of the day</td>
<td>0.14</td>
<td>0.35</td>
<td>0.69</td>
<td>-0.18</td>
<td>0.17</td>
</tr>
<tr>
<td>Smoke even when ill in bed</td>
<td>0.13</td>
<td>0.34</td>
<td>0.59</td>
<td>0.31</td>
<td>0.11</td>
</tr>
</tbody>
</table>

variable if the cigarette given up was the first of the day as opposed to some other time.) (4) Do you smoke more in the first hours after waking than during the rest of the day? (5) Do you smoke even when you are so ill that you are in bed?

We perform factor analysis of the responses to the five questions and use factor loadings from the first factor as an explanatory variable if the person was a current smoker at the interview date. Correlations among the discomfort variables are all positive and statistically significant. All items are positively related to the first factor (Table 5), and the first factor accounts for 84 percent of the total variance.

The internal cost may also differ on the basis of subjective beliefs about future behaviors—in this study, quitting smoking in the near future. Smokers who expect to quit may have a lower IC because they do not expect to get COPD. On the other hand, people may expect to quit in the future because they either have or expect to have severe health problems in the near future. The SOS asked smokers how many cigarettes they anticipate smoking per day in 2 years. We construct a binary variable, which is one if the respondent expects to smoke zero cigarettes a day in 2 years and is zero otherwise, to account for such effects on IC.

Another source of variation in IC is the disutility resulting from discomfort, which is likely to vary among individuals (see, for example, Viscusi and Evans 1990). Lower tolerance of discomfort should increase IC. To account for this, we include a direct measure of discomfort associated with the symptoms of COPD.

The SOS provided a description of symptoms that a person with COPD would experience. Respondents were asked to rate on a scale from 0 ("not unpleasant") to 10 ("extremely unpleasant") how a person would feel with the following conditions: (1) persistent coughing, difficulty in (2) walking up several flights of stairs, (3) carrying an oxygen tank, and (4) walking several blocks, and (5) needing help getting across the room.

Using the ratings for each item, we perform factor analysis and use the loadings on the first factor as the discomfort index. Correlations among the variables just described are all positive and statistically significant. All items are positively
related to the first factor (Table 6), and the first factor accounts for 82 percent of the total variance.

There may be a difference in the IC elicited from individuals based on their own histories of choices or experiences, which may also have affected responses to the questions on which the discomfort is based. Hence, we control for the respondent’s own experience with lung disease. We define a variable for serious lung disease. This is defined as persons who (1) have had lung cancer or (2) have chronic lung disease that limits their usual activities (for example, household chores or market work). It has been suggested that people who have a chronic disease may learn how to deal with it (U.S. Environmental Protection Agency 2000; Kahneman et al. 2004). Thus, the actual utility loss from acquiring a chronic disease may be less than one would predict prior to getting the disease. On the other hand, individuals with preexisting lung disease may have a higher IC of getting COPD since they actually have experienced substantial discomfort from lung disease—worse than they had previously imagined. Thus, this effect cannot be signed a priori.

A limitation of stated-preference surveys is that rationality may be limited by a person's ability to reason, which may in turn affect IC. Responding to willingness-to-pay questions is somewhat intellectually taxing. People with low cognitive ability may have a poorer understanding of the issues involved in making trade-offs. Evaluating trade-offs can be cognitively demanding, especially in an interview situation. This may be particularly true of persons with low levels of cognition; for example, they may lose patience and respond arbitrarily, leading to measurement errors in their responses. Hence, we assess whether levels of cognition affect responses of questions included in the SOS.

The SOS used the same cognition questions as the Health and Retirement Study.\(^\text{13}\) The cognition measure consists of five parts: knowledge, language, and orientation (4 points), counting backward (2 points), word list memory check

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\(^{13}\) See Sloan and Wang (2005) for a description of the Health and Retirement Study (HRS) questions. There is one exception. The SOS did not ask one question from the HRS set, “What is today’s date?” Sloan and Wang (2005) discuss the properties of the HRS cognition measure as well as data on distributions of cognitive scores. Thus, in SOS a perfect score is 34, while in HRS a perfect score is 35.
We array the frequency distribution of scores and define the top third of scores as indicating high levels of cognition. Ex ante, we cannot predict the direction of effect in that a boundedly rational individual could systematically under- or overvalue the benefits of avoiding a bad.

Subjective beliefs about outcomes related to the good being valued may also affect responses to the IC questions. In our case, subjective beliefs about getting lung disease or the subjective probability of survival may be expected to affect IC. The latter can have two offsetting effects on IC. First, persons who expect to die soon would not be willing to pay as much to avoid a particular disease. Second, it may reflect current health and expectations about future health, in which case persons in better current health would be willing to pay less. A relatively high self-assessed probability of getting lung disease should increase IC. The SOS elicited subjective beliefs about the likelihood of survival and getting lung cancer by age 75. The questionnaire asked for beliefs on a scale from 1 to 10. The question was, “On a scale from 1 to 10, with 1 being ‘not at all likely’ and 10 being ‘very likely,’ what is the chance you will be alive (get lung cancer) at age 75?” These questions were asked of persons who had not had lung cancer as of the interview date. To convert responses into probabilities, we rescale these to be in the range 0–1. A relatively high self-assessed probability of getting lung disease should increase IC. The SOS elicited subjective beliefs about the likelihood of survival and getting lung cancer by age 75. The questionnaire asked for beliefs on a scale from 1 to 10. The question was, “On a scale from 1 to 10, with 1 being ‘not at all likely’ and 10 being ‘very likely,’ what is the chance you will be alive (get lung cancer) at age 75?” These questions were asked of persons who had not had lung cancer as of the interview date. To convert responses into probabilities, we rescale these to be in the range 0–1. We also include family income, years of education, and age in the regressions. Age is excluded in the regression for IC based on the risk-risk questions since age is reflected in the measure of IC that is computed using equation (5).

Summary statistics for the explanatory variables included in the regressions are shown in Table 7. We do not find any effect of the level of addiction on internal cost (Table 8, columns 1, 3, and 5). Nor is IC influenced by subjective beliefs about quitting, with one exception (column 3). Among the other measures of individual heterogeneity, the discomfort index is the only one that is robust to changes in specification. As anticipated, people who experience higher levels of discomfort when they have symptoms of COPD have a higher IC of getting COPD.

The addiction index and the self-assessed probability of quitting are nonzero only for current smokers since the SOS did not ask these questions of non-smokers.
Smokers’ Health and Longevity

Table 7
Explanatory Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current smoker</td>
<td>.35</td>
<td>.48</td>
</tr>
<tr>
<td>Former smoker</td>
<td>.38</td>
<td>.49</td>
</tr>
<tr>
<td>Never smoker</td>
<td>.27</td>
<td>.45</td>
</tr>
<tr>
<td>Addiction index(^a)(^b)</td>
<td>−.067</td>
<td>.89</td>
</tr>
<tr>
<td>Quit in 2 years</td>
<td>.13</td>
<td>.33</td>
</tr>
<tr>
<td>Discomfort index(^a)</td>
<td>.00</td>
<td>.95</td>
</tr>
<tr>
<td>Serious lung disease</td>
<td>.13</td>
<td>.33</td>
</tr>
<tr>
<td>High level of cognition</td>
<td>.39</td>
<td>.024</td>
</tr>
<tr>
<td>Subjective probability of surviving to age 75</td>
<td>.79</td>
<td>.27</td>
</tr>
<tr>
<td>Subjective probability of having lung disease by age 75</td>
<td>.23</td>
<td>.29</td>
</tr>
<tr>
<td>Years of education</td>
<td>14.6</td>
<td>2.59</td>
</tr>
<tr>
<td>Family income ($1,000s)</td>
<td>63.6</td>
<td>48.8</td>
</tr>
<tr>
<td>Age</td>
<td>59.3</td>
<td>5.74</td>
</tr>
<tr>
<td>Income missing</td>
<td>.060</td>
<td>.24</td>
</tr>
<tr>
<td>Respondent in Durham, N.C.</td>
<td>.42</td>
<td>.49</td>
</tr>
<tr>
<td>Respondent in St. Louis, Mo.</td>
<td>.37</td>
<td>.48</td>
</tr>
<tr>
<td>Respondent in Seattle, Wash.</td>
<td>.21</td>
<td>.41</td>
</tr>
</tbody>
</table>

Note. There were 431 respondents to the in-person computer-assisted interview. The number of observations for income is 621 for the full sample: 405 for those who participated in both interviews, and 216 for those who participated in only the telephone interview.

\(^a\) Constructed using factor analysis.

\(^b\) Conditional on being a current smoker.

smokers. Thus, we perform a joint test of statistical significance of the binary variable for current smoker, the measure of the level of addiction, and the probability of quitting and find that the variables are jointly significant, which implies that current smokers have a lower IC (columns 1, 3, 5). In an alternative specification, we exclude the latter two variables (columns 2, 4, 6–8) and find that current smokers have lower IC.

The level of addiction has no statistically significant effect on IC on its own. On the basis of these results, our preferred specification excludes addiction level and the probability of quitting. In this specification, except in column 4, current smokers are willing to pay less to avoid COPD than are never smokers, even controlling for other individual attributes. Controlling for heterogeneity, the differences between IC for current and never smokers from the risk-dollar questions (columns 2, 4, and 6) are lower than the differences reported in Table 1. The observed differences in IC are robust to controlling for other sources of heterogeneity that plausibly might have an effect on IC. There may be other sources of heterogeneity that are related to smoking status, which we cannot account for due to limitations of the SOS data. However, we are able to include sources of individual heterogeneity of first-order importance, including the level of addiction (or intensity of consumption), beliefs about future behaviors and outcomes, distaste for discomfort, personal history of disease, cognition level, as well as variables often included in previous analyses of IC, such as income and education.
Table 8
Determinants of Nonpecuniary Internal Cost of Acquiring Chronic Obstructive Pulmonary Disease (COPD)

<table>
<thead>
<tr>
<th></th>
<th>Low-Probability Scenario</th>
<th>High-Probability Scenario</th>
<th>r = 3%</th>
<th>r From Low-Probability Risk-Dollar Question</th>
<th>r From High-Probability Risk-Dollar Question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Current smoker</td>
<td>-73.7</td>
<td>-59.6*</td>
<td>-128.6**</td>
<td>-55.5</td>
<td>-230.8</td>
</tr>
<tr>
<td></td>
<td>(50.6)</td>
<td>(29.2)</td>
<td>(49.2)</td>
<td>(29.0)</td>
<td>(139.7)</td>
</tr>
<tr>
<td>Former smoker</td>
<td>-13.1</td>
<td>-11.0</td>
<td>-3.71</td>
<td>-4.13</td>
<td>-82.9</td>
</tr>
<tr>
<td></td>
<td>(24.4)</td>
<td>(24.3)</td>
<td>(25.6)</td>
<td>(25.6)</td>
<td>(79.2)</td>
</tr>
<tr>
<td>Addiction index</td>
<td>-12.0</td>
<td>20.4</td>
<td>34.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(24.3)</td>
<td>(23.4)</td>
<td>(62.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quit in 2 years</td>
<td>59.1</td>
<td>107.3**</td>
<td>-17.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(37.0)</td>
<td>(36.3)</td>
<td>(86.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discomfort index</td>
<td>18.8</td>
<td>23.4**</td>
<td>25.2*</td>
<td>32.6**</td>
<td>96.6**</td>
</tr>
<tr>
<td></td>
<td>(10.4)</td>
<td>(10.3)</td>
<td>(10.3)</td>
<td>(10.1)</td>
<td>(29.7)</td>
</tr>
<tr>
<td>Serious lung disease</td>
<td>-27.2</td>
<td>-26.7</td>
<td>29.4</td>
<td>32.8</td>
<td>-194.1*</td>
</tr>
<tr>
<td></td>
<td>(34.4)</td>
<td>(34.6)</td>
<td>(34.4)</td>
<td>(33.2)</td>
<td>(80.7)</td>
</tr>
<tr>
<td>High level of cognition</td>
<td>-16.2</td>
<td>-15.5</td>
<td>-12.8</td>
<td>-7.48</td>
<td>-186.5**</td>
</tr>
<tr>
<td></td>
<td>(20.8)</td>
<td>(20.4)</td>
<td>(21.3)</td>
<td>(20.8)</td>
<td>(62.7)</td>
</tr>
</tbody>
</table>

Note: All values are in $1,000. Significant levels: *p < 0.05, **p < 0.01.
<table>
<thead>
<tr>
<th>Subjective probability of surviving to age 75</th>
<th>Subjective probability of having lung disease by age 75</th>
<th>Family income ($1,000s)</th>
<th>Years of education</th>
<th>Intercept</th>
</tr>
</thead>
<tbody>
<tr>
<td>-50.3 (39.4)</td>
<td>-3.20 (38.5)</td>
<td>.36 (0.20)</td>
<td>9.20* (4.32)</td>
<td>104.8</td>
</tr>
<tr>
<td>-25.2 (39.1)</td>
<td>-21.0 (38.0)</td>
<td>.38 (0.20)</td>
<td>8.08 (4.29)</td>
<td>116.8</td>
</tr>
<tr>
<td>-3.16 (40.2)</td>
<td>-16.9 (37.1)</td>
<td>.25 (0.22)</td>
<td>11.3** (4.22)</td>
<td>126.5</td>
</tr>
<tr>
<td>4.01 (40.0)</td>
<td>-20.7 (38.2)</td>
<td>.32 (0.22)</td>
<td>12.4 (4.26)</td>
<td>126.5</td>
</tr>
<tr>
<td>-45.6 (110.0)</td>
<td>161.0 (112.0)</td>
<td>.19 (0.67)</td>
<td>11.9 (12.4)</td>
<td>834.9**</td>
</tr>
<tr>
<td>-20.0 (106.6)</td>
<td>127.8 (111.2)</td>
<td>.20 (0.66)</td>
<td>10.9 (12.4)</td>
<td>860.8**</td>
</tr>
<tr>
<td>-36.6 (43.4)</td>
<td>51.2 (43.6)</td>
<td>.037 (0.26)</td>
<td>1.66 (4.26)</td>
<td>374.4**</td>
</tr>
<tr>
<td>-33.9 (34.5)</td>
<td>41.3 (34.1)</td>
<td>.012 (0.21)</td>
<td>1.58 (4.26)</td>
<td>303.5**</td>
</tr>
</tbody>
</table>

Note. The dependent variable for the risk-dollar regressions is the internal cost in dollars of facing a .1 percent increase in probability of acquiring COPD. Location dummies were included but not reported in all regressions. Income missing was included in the regressions but not reported, and age was included in the risk-dollar regressions but not reported.

*Significant at the 5% level.
**Significant at the 1% level.
If IC is determined primarily by income, IC-based benefit-cost analysis could be biased toward wealthier households. When we control for income, the heterogeneity in IC persists. The income elasticities with respect to IC are .1 or lower. The low magnitude of income effects and the lack of statistical significance indicate that income alone does not explain differences in IC. These results on the magnitude of the response to income are within the range of income elasticities of demand for medical care found in cross-sectional analysis of microdata (Zweifel and Manning 2000) but differ from aggregate time series and cross-country evidence, which yield income elasticities greater than one (for example, Costa and Kahn 2004; Gerdtham and Jönsson 2000).

If responses to questions designed to elicit values of IC reflect the bounded rationality of individuals, then the case for using estimates of IC in benefit-cost analysis is weakened on efficiency and distributional grounds. When we control for educational attainment, persons with high levels of cognition have a lower IC based on the risk-risk questions, but the effect is not significant in the risk-dollar analysis. Given the lack of robustness, we cannot arrive at a strong conclusion on this issue, and additional research is warranted, especially since data on cognition are now available in economic surveys. If IC responses depend on expectations about future behaviors, then benefit-cost analysis has to recognize the strategic element in responses to questionnaires that are linked to anticipated personal choices of individuals. Similarly, if IC depends on past behaviors or histories of individuals, this calls into question the validity of responses of people who did have the relevant experience. However, we find no empirical support for either of these effects.

We find that distaste for discomfort has a significant effect in raising estimated IC; that is, persons who have a greater aversion to symptoms common to COPD have a higher internal cost of getting the disease. Hence, differences in IC reflect not just income but also importantly innate differences in tastes, including tolerance for discomfort. Furthermore, this result provides evidence that although the questions used in the SOS to elicit IC are hypothetical, respondents understood the implied trade-offs and were able to give credible answers.

There is some censoring in our data. Right censoring is much less common and left censoring is much more common among current smokers relative to the other groups.17 To address the sensitivity of the differences in IC to right censoring, we use ordered probit analysis in which the dependent variable is 1 if the observation is left censored, 2 if it is not censored, and 3 if it is right censored.

17 The proportions of current smokers who were right censored in the low- and high-probability risk-dollar questions are .30 and .23, respectively. By contrast, the corresponding proportions for never smokers are .44 and .33. The proportions for former smokers are .44 and .36. For the risk-risk analysis, the proportion of current smokers who are right censored is .061 and is .087 for former smokers and .103 for never smokers. For left censoring, the proportion of current smokers in the risk-dollar low-probability scenario is .24 and is .30 for the risk-dollar high probability scenario and .047 for the risk-risk scenario. Corresponding proportions for former smokers are .12, .17, and .031 and for never smokers are .08, .12, and .009.
5. Conclusion

People who smoke have a lower nonpecuniary internal cost of getting a major smoking-related disease than those who do not smoke. We find differences in IC of getting COPD between current and never smokers in the range of about $80,000–$260,000. Differences in the estimates of IC from the low- and high-probability risk-dollar questions are much smaller, $80,000–$90,000. The risk-dollar- and risk-risk-based estimates can be reconciled if people respond as if they have high subjective discount rates in the 11–17 percent range, with never smokers tending to have the lowest discount rates. When we control for other sources of heterogeneity, differences in IC between current and never smokers remain substantial.

Our results imply that one reason people may be willing to smoke is that they expect to incur a lower nonpecuniary internal cost from the adverse consequences of smoking in spite of the well-known harms of smoking. That is, the internality of smoking, or equivalently the full price, is lower for people who smoke. An important implication is that although taxation and regulation of cigarettes are justified on the basis of externalities, under the principle of consumer sovereignty, our findings weaken the case for such interventions based on helping smokers internalize their internal costs.

A possible limitation of our findings is that causation may run from being a smoker to the value people place on health rather than the reverse. Since the SOS is a cross section, there is no way of knowing what the smokers’ preferences were when they started smoking many decades ago. Even if this were so, our results establish a correlation between continued smoking and a lower internal cost of being in bad health. An implication of this is that smoking cessation programs emphasizing the health benefits of quitting are unlikely to be effective.

However, there are various reasons for believing that causation runs from preferences for health to the smoking decision. Many smokers in this age group do quit (see, for example, Avery et al. 2007). Thus, not every smoker could have convinced him- or herself that avoiding ill health is not valuable.

A further argument against this type of cognitive dissonance (that is, the reverse causality) is that smokers exhibit rational beliefs about their future health. Smith et al. (2001) find that smokers update their subjective probability of living to age 75 after experiencing a smoking-related health shock. Using data from the SOS, Khwaja, Silverman, and Sloan (2007) find that (1) smokers have higher subjective probabilities of getting various morbidities than do nonsmokers, in-

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18 We find that includes only the smoking status variables; current smokers are significantly less likely to be not censored or right censored than are never smokers in both the risk-dollar and risk-risk analysis. These results are robust to the inclusion of other characteristics of respondents.
cluding morbidities commonly associated with smoking (for example, chronic lung disease), and (2) smokers overestimate the probabilities of their acquiring various morbidities, that is, are pessimistic about their future health. This result is consistent with earlier work by Viscusi (1990), who found that smokers overestimate their probability of getting lung cancer.

Unfortunately, there are no data on individuals’ preference for health at time of smoking initiation, which among persons in the SOS who ever smoked was in the late teens. It is plausible to conjecture that, in youth, most individuals have very limited information about the diseases that occur in mid- or late life, in any case reasoning that they can quit before they become unhealthy due to smoking. They learn about these diseases with age, and their preferences are more likely to become well defined as they acquire information. Thus, even if we had empirical evidence that youth who smoke have no different views on the health consequences of smoking, it is not clear that one would want to disregard the stated preferences of adult smokers.

Gruber and Köszegi (2001) have argued that if smokers are hyperbolic discounters, then benignly paternalistic interventions such as excise taxes might serve as a commitment device to help individuals exercise self-control. Thus, such taxes could be welfare improving by helping to internalize the costs smokers impose on themselves. In other research based on the SOS (Khwaja, Silverman, and Sloan 2007), we find the same stylized facts that Gruber and Köszegi use to motivate their research; however, we find no empirical support for hyperbolic discounting as an explanation for continued smoking. Whether internal costs should be considered in setting excise taxes remains an unsettled issue.

Our findings allow us to compute a value for the loss of health and longevity attributable to COPD for the U.S. population. Using an annual incidence of

Gruber and Köszegi (2001) do not provide direct empirical evidence on hyperbolic discounting. Instead, they find that people are forward looking in their smoking decisions and desire to quit but tend to be unsuccessful in quitting. In addition to our study, other recent empirical work provides mixed evidence that time-inconsistent preferences or self-control problems can account for the consumption of harmful addictive goods such as cigarettes; Kan (2006) finds that smokers who intend to quit are more likely to favor increases in excise taxes and implementing smoking bans. This evidence is consistent with time-inconsistent preferences but is not direct evidence of this phenomenon. Khwaja et al. (2007) investigate the relationship among wealth, smoking, and individual propensities to plan, which are a measure of self-control. Planning propensity affects wealth but not smoking, which suggests that planning is not an all-purpose skill and that financial planning may draw on different abilities than those that facilitate smoking cessation. Blondel, Lohéac, and Rinaudo (2007), on the basis of experimental data, find that consumption decisions of drug users do not contradict standard theories of intertemporal decision makers and that there is no difference in the discount rate between drugs users and others. Khwaja, Silverman, and Sloan (2007) find very high rates of time discount in the financial realm for a horizon of 1 year, irrespective of smoking status, and the implied rates of time discount decline with the length of the time delay, which is consistent with hyperbolic discounting. However, using a series of questions about the willingness to undergo a colonoscopy, they find no evidence that short-run and long-run discount rates (in the health domain) differ by smoking status.
810,000 COPD cases in a population of 300 million persons \(^{20}\) and our lowest estimate of the IC of getting COPD (from the high-probability risk-dollar questions; Table 1) of $247,000 per case avoided, the annual nonpecuniary internal cost of new cases of COPD in the United States is approximately $200 billion. \(^{21}\) Since smoking is a leading cause of COPD, \(^{22}\) this clearly indicates that the health costs of smoking are considerable, especially if one also considers the internal and external pecuniary costs and external nonpecuniary costs not quantified here. Therefore, further research in understanding the causes and consequences of smoking is warranted.

Our study has used the stated-preference approach to valuing internal cost. In this approach, to make welfare comparisons, one must also compute the benefits of the activity. Quantifying the benefits of smoking and other harmful addictive behaviors is not a trivial empirical exercise but is necessary for welfare comparisons of policy changes such as increasing the excise tax on cigarettes. An advantage of the stated-preference approach we use in our study is that it allows us to obtain values for choices for which there is no market. But although revealed preference has this limitation, both costs and benefits are reflected in actual choices. Thus, future research might consider using a combination of methods in making welfare comparisons in policy analysis about the consumption of harmful products.

References


\(^{20}\) There is a lack of consensus about the prevalence of COPD in the United States and other countries (Stang et al. 2000; Mannino 2002; Halbert et al. 2003). A conservative estimate is that 5.4 percent of the U.S. population has COPD (Adams, Hendershot, and Marano 1999), which translates to about 16.2 million lives, given a population of 300 million. Incidence is the number of cases per year, and prevalence is the stock of cases. Since there are no credible estimates of the annual incidence of COPD, we calculate incidence by dividing prevalence by 20, yielding a value of 810,000 new cases in a population of 300 million. There are estimates of the cumulative incidence of COPD for as long as a decade (8.2–13.5 percent of the Swedish population ages 55 and older, 10-year cumulative incidence [Lindberg et al. 2003]; 6.1 percent of the adult Norwegian population [Johannessen et al. 2005]). Given the estimates of cumulative incidence from these papers, our estimate of annual incidence in the U.S. (27 percent) is conservative.

\(^{21}\) In comparison, the direct medical cost of COPD in the United States was estimated to be $18 billion in 2002 (U.S. National Institutes of Health 2003).

\(^{22}\) It is estimated that 10–15 percent of smokers will eventually develop COPD (Stang et al. 2000).


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