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The Wage Effects of Personal Smoking History

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Abstract

This study explores determinants of the wage penalty borne by smokers. The authors reconstruct individual smoking histories by pooling PSID (Panel Study of Income Dynamics) data for 1986-2001. They find no wage gap between former smokers and those who had never smoked, but statistically significant wage gaps between smokers who would continue smoking and three other groups: those who would later quit smoking, those who had quit smoking already, and those who never smoked. The wage penalty for smoking, observed in the 1986 cross-section, is largely driven by those who would continue smoking over the years 1986-2001. These results suggest that the smoker/ nonsmoker wage differential observed at any given time may be driven by a non-causal explanation rather than by smoking per se. For example, persistent smokers may be characterized by myopia that leads to reduced investment in health capital and firm-specific or other human capital.

KEYWORDS: smoking, wages, health capital

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This study explores determinants of the wage penalty borne by smokers. The authors reconstruct individual smoking histories by pooling PSID (Panel Study of Income Dynamics) data for 1986–2001. They find no wage gap between former smokers and those who had never smoked, but statistically significant wage gaps between smokers who would continue smoking and three other groups: those who would later quit smoking, those who had quit smoking already, and those who never smoked. The wage penalty for smoking, observed in the 1986 cross-section, is largely driven by those who would continue smoking over the years 1986–2001. These results suggest that the smoker/nonsmoker wage differential observed at any given time may be driven by a non-causal explanation rather than by smoking *per se*. For example, persistent smokers may be characterized by myopia that leads to reduced investment in health capital and firm-specific or other human capital.

An apparent causal relationship between smoking and coronary heart disease was reported at Mayo Clinic in 1940. Since that time the various costs that smokers impose on themselves and others have been extensively studied and widely and continually broadcast in public and even private advertising campaigns. It has been established that smoking adversely affects one's health and often causes premature death and increased health care costs. Smoking is empirically shown to be

the leading cause of lung cancer, chronic bronchitis, and emphysema, as well as a major cause of heart disease and stroke. It is also associated with a variety of other conditions, including slowed healing from injuries and increased susceptibility to some infections (Napier 1996; Blake, Abell, and Stanley 1988). Overall, smoking is among the leading causes of premature death and avoidable morbidity and disability in the United States. From a behavioral economic perspective, smoking seems to have an adverse effect on wages. The goal of the present paper is to analyze data over a long panel period to understand better the relationship between smoking and wages and to evaluate possible explanations.

Explanations for a wage gap between smokers and non-smokers can be broadly

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The data can be downloaded from <http://psidonline.isr.umich.edu/data/>. Also, a data appendix with additional results, and copies of the computer programs used to generate the results presented in the paper, are available from Irina B. Grafova at School of Public Health, University of Medicine and Dentistry of New Jersey, 683 Hoes Lane West, Room 321, Piscataway, NJ 08854; e-mail grafovib@umdnj.edu.

classed as causal and non-causal. Causal explanations suggest that the smoking behavior itself leads to an adverse effect on wages via, for example, impaired health and reduced productivity. Non-causal explanations suggest it is possible that one or more common factors are associated with differences in preferences or behaviors; smoking behavior is not the cause, it is rather an indicator of preferences¹ that lead to less investment in both health and labor market capital. These lower levels of health and human capital are only partly captured by observed indicators, such as education, years of work experience, and self-reported health.

This study examines several smoking history groups, but focuses in particular on “persistent” smokers—those who are observed not to have quit smoking over a long period. Biomedical studies have suggested that persistent smokers are different from those who do not smoke and from those who currently smoke but are eventually able to “kick the habit” (Uhl et al. 2007). Does this show up in the labor market? In particular, do the wages of persistent smokers differ from those of non-smokers, former smokers, or both?

Background and Literature Review

Among the causal explanations for the wage gap are those that point to health and productivity effects. Smoking may reduce productivity either by taking employees away from their job—for smoking breaks, usually—while they are at the workplace or by causing them to miss work due to illness. The reduced productivity due to smoking-related health effects takes both readily observable forms, such as more frequent absences (Bertera 1991; Kristein 1983), and forms that are more difficult to quantify, such as lower physical and mental endurance.

Another causal explanation of a wage gap between persistent smokers and other groups is discrimination-based: relative to non-smokers, smokers may tend to receive unfavorable treatment in the workplace. Smoking may, for example, adversely affect physical attractiveness, whether visual (notably, through skin damage, an effect of smoking found in many clinical studies) or olfactory (because of tobacco smoke’s stale-smelling residue). Even though attractiveness is not related to productivity, its positive relationship with wages is well documented in the sociology, psychology (Frieze et al. 1990; Freize et al. 1991; Martel and Biller 1987), and economics literatures (Hamer-mesh and Biddle 1994; Persico et al. 2001; Mirta 2001). Discrimination could also be invoked to explain lower compensation for smokers if, as a result of their poorer health, they incur greater benefit provision costs than non-smokers, and employers respond by imposing a compensating (negative) wage differential.²

Non-causal explanations of the smoking-related wage gap fall into two sets. In the first set are hypotheses suggesting that smokers receive lower wages because they invest less than non-smokers in both human and health capital. Many studies show a correlation between schooling and health.³ Grossman (1972, 1976) and Michael (1973) hypothesized that schooling increases the efficiency of household health production. In contrast, Farrel and Fuchs (1982) and Fuchs (1982) argued that unobservable differences in the rate of time preference determine the level of human capital investment as well as the level of health capital investment, and Lahiri and Song (2000) provided evidence to argue that persistent smokers have a higher rate of time preference. Those with low rates of time preference, runs this argument, tend to

¹The role of preference formation in choice has been developed by several authors (Becker and Mulligan 1997; Cunha et al. 2006). Here we assume that the adverse health effects of smoking are widely known. It could be argued that some smokers are not informed or choose not to assess the intertemporal cost-benefit aspects of their decision. Being myopic or uninformed may shape the smoking decision and carry over to earnings, in terms of unobserved capacities or labor market knowledge.

²On the other hand, earlier post-retirement mortality could reduce employer pension costs in defined benefit plans with life annuities.

³It has been found that individuals with more education have lower mortality rates (Kitagawa and Hauser 1973; Grossman 1976; Rosen and Taubman 1982), lower incidence of most chronic disease (Pincus et al. 1987), and better self-reported health status (Grossman 1976).

care more about their future, and therefore invest more in both human and health capital, resulting in an observed wage gap between smokers and non-smokers exceeding the gap that would be predicted based only on the usual measures of human capital and general health. Self-selection into smoking is a variant of the preferences perspective (Lahiri and Song 2000). For instance, the Surgeon General's report of 1985 noted differences in smoking behavior, both for initiation and cessation, between white- and blue-collar workers. More recently, evidence has been reported of a biologically based joint addiction to smoking and alcohol consumption (Uhl et al. 2007). Here we consider such an addiction as an exogenous "preference," since it creates a predisposition to behave in certain ways. The extent to which biological and learned factors⁴ combine to shape a set of preferences is outside the scope of this paper.

Studies empirically examining the relationship between smoking and wages have found a differential in favor of nonsmokers in the range of 2–10%, depending on data source, time, and country. Using the 1973 Quality of Employment Survey (QES) to obtain point estimates of the earnings gap, Leigh and Berger (1989) reported a statistically insignificant differential of 1.5–3.5%. Levine et al. (1997) found that smoking reduced wages by roughly 4.2% and 6.9%, respectively, in 1984 and 1992 data samples from the National Longitudinal Survey of Youth (NLSY). International evidence is consistent with U.S. evidence. Van Ours (2004) reported a 10% wage gap between smokers and non-smokers using the Dutch 2001 CentER data; Auld (2005) found an 8% wage gap using the 1991 Canadian General Social Survey; and Lee (2003) reported a 5% wage gap based on data from the Australian Twin Registry of 1980–82 and 1988–89.

While Leigh and Berger (1989) used cross-sectional analysis only and worked with an adult population sample of relatively mod-

est size, Levine et al. (1997) estimated the wage effect of smoking more precisely using both a larger cross-sectional sample and a complementary panel analysis. In contrast to the PSID, which has details on smoking and wages only for those who are household heads or spouses, the NLSY, used by Levine et al. (1997), is limited to young people. While most PSID household heads are over 25, the oldest NLSY respondents were no more than 26 years old in the initial year of the survey, 1984. Clearly, results could differ based on the sample design.

We start our analysis in this paper by estimating a series of models that use current smoker and former smoker dummy variables similar to those used in the previous research, an approach that treats smokers as a homogeneous group. The main methodological contribution of this study, however, is our recognition of the heterogeneity of smokers, and our investigation of this heterogeneity to gain insight into the nature of the wage gap.

Exploiting the longitudinal nature of the data, we reconstructed the prospective pattern of the individual's smoking behavior. These reconstructed patterns of smoking behavior allowed us to identify several groups: those who smoke and never quit smoking (*persistent smokers*), those who used to smoke and have successfully quit smoking (*former smokers*), those who will quit smoking in the future (*future quitters*), those who repeatedly but unsuccessfully try to quit (*on-and-off smokers*), those who never smoked in their life (*never smokers*), and so on.

Data

This study uses waves of the Panel Study of Income Dynamics (PSID) in which smoking was reported. The PSID, which began in 1968, is a longitudinal study of a representative sample of U.S. individuals (men, women, and children) and their family units. It concentrates on dynamic aspects of economic, health, and demographic behavior. The sample size grew from the original 4,800 family units in 1968 to over 8,400 family units in 1996; then, due to changes after 1997, the number fell to 7,406 by 2001. In this paper we use information on men from three waves

⁴For example, smoking at an early age tends to lead to smoking as an adult, and factors such as the effectiveness of local laws prohibiting smoking by youth may play a role.

of the data: 1986, 1999, and 2001. In these waves, information on life course smoking behavior was reported for both male and female family heads, as well as for their spouses if they were married.

In the health module of the survey during these years, individuals were asked whether they currently smoked. Current smokers were further asked about their average daily cigarette consumption and the age when they first smoked regularly. Current non-smokers were asked whether they smoked previously; former smokers were identified and asked about their average cigarette consumption and at what age they first and last smoked cigarettes regularly. These questions enable us to construct smoking histories that include average daily cigarette consumption and duration of smoking.

This study is based on male household heads between the ages of 25 and 60 who were employed full-time (defined as 1,500+ hours annually). This selection restricts the sample to individuals who had established themselves as heads of separate households⁵ and who were unlikely to be either still in school or retired. We believe these restrictions enable us to overcome some of the limitations of previous research.

Methodology

Separating the wage effects of smoking from the wage effects of correlated personal characteristics presents an empirical challenge. Previous studies have dealt with this challenge by enriching the set of controls, or using available sibling information, or considering regression models based on first differences. One feature these studies have in common is the treatment of both smokers and non-smokers as homogeneous groups. We argue that there may be substantial differences within each of these groups that can be used to estimate and understand wage effects of smoking.

As a baseline, we present a standard human capital earnings model—containing such personal characteristics as highest level of education attained, years of work experience (specifically, years of work experience since 18, as reported by the respondent), job tenure, a white-collar job dummy, a race dummy, union status, and marital status—augmented by a whether-current-smoker variable. This baseline approach is very similar to the augmented human capital model of the effects of health status and health behavior on labor market outcomes used by previous researchers. The regression takes the form

$$(1) \quad \ln W_i = \alpha + \beta X_i + \gamma_0 Smk_i + e_i$$

where W_i is the average hourly wage rate, X_i is a vector of individual characteristics, and Smk_i is a current smoking behavior dummy—accompanied, in some specifications, by a former smoking behavior dummy as well. Specifications, including only a current smoking status dummy, estimate the average effect of current smoking status on the hourly wage. The specification that includes both current and former smoking dummies recognizes that not only may smoking be associated with lower wages while one is a smoker, but it may also produce a persistent wage effect after quitting. Thus, the entire sample is divided into three categories: current smokers, former smokers, and those who never smoked prior to the interview date. Interestingly, the results of this regression analysis suggest that there is no wage gap between former smokers and those who never smoked.

Health could play an important role in the relationship between smoking and wages if the adverse health effects of smoking lower smokers' productivity. However, the relationship between health and smoking is not straightforward. On one hand, the adverse health effects of smoking may alarm smokers, causing them to quit. On the other hand, poor health and adverse health events, whether related to smoking or not, may stress individuals psychologically, causing them either to start smoking or to continue the habit. To account for the possibility that smoking affects wages through lower productivity due to poorer health, the baseline model is augmented by self-reported

⁵A young adult living at home with parents is not counted as a separate household. However, one person living by herself or himself is counted as a head of household.

health status indicators $Health_i$:⁶

$$(1') \quad \ln W_i = \alpha + \beta X_i + \gamma_0 Smk_i + \gamma_1 Health_i + e_i$$

Model (1') is estimated in three different ways. First, we estimate this model for each of the three survey years (1986, 1999, and 2001) separately. Second, we pool the data from all three waves and estimate a pooled Ordinary Least Squares (OLS) model. Finally, we estimate model (1') using the OLS fixed effect technique. The fixed effect procedure accounts for unmeasured, time-invariant, individual-specific variables that could be correlated with both wages and smoking behavior.

Next, we exploit differences within current and former smoker groups. Using observations for those individuals for whom information is available in at least two waves out of the three that included the smoking behavior module, we thus divide the entire sample into five categories based on a reconstructed smoking history: those who report themselves as smokers in all waves of data available (*persistent smokers*); those who smoke in a year under consideration but will quit in later years (*future quitters*); those who smoke intermittently (*on-and-off smokers*); those smokers who successfully quit smoking prior to the interview (*former smokers*); those who will start smoking after the interview (*future smokers*); and those who have never smoked (*never smokers*). Henceforward, we refer to this sample as the "retrospective sample." This finer division facilitates comparisons that may help us determine which subgroups drive the wage gap between smokers and non-smokers. To maintain sample size, only the four largest groups from the retrospective sample are considered: *persistent smokers*, *former smokers*, *future quitters*, and *never smokers*. Interestingly, while *persistent smokers* and *never smokers* differ strikingly in education, health status, and job choice, *former smokers* and *persistent smokers* do not. Using the regression framework

$$(3) \quad \ln W_i = \alpha + \beta X_i + \gamma_3 Group_indicator_i + e_i$$

we can compare these groups.

⁶The concurrent validity of the self-reported health status measure is consistently supported (Idler and Benyamini 1997).

Results

Descriptive Statistics

Weighted descriptive statistics on various individual characteristics by current smoking status are presented in Table 1. Unconditional mean wage differences between current smokers and current non-smokers grew from 17% in 1986, to 25% in 1999, to almost 29% in 2001. Table 1 also shows substantial educational, occupational, and health status differences. For instance, smokers were only half as likely as current non-smokers to hold a college degree, and were 40% less likely to be in white-collar jobs. There are striking differences in self-reported health status between smokers and non-smokers. Indeed, smokers were 30–47% less likely than non-smokers to report excellent health status even though there was no substantial age difference between the two groups. Table 1 indicates that the relationships indicated above are rather stable over a span of 15 years.

Table 2 presents mean characteristics of smoking behavior for current and former smokers. As shown, average daily cigarette consumption for current smokers fell by almost 20% (by over 4 cigarettes a day) between 1986 and 2001. Over the same period, the percentage of heavy smokers among current smokers was cut almost in half: from 29% in 1986 to 15% in 2001. This last observation serves to underscore the dramatic decline in cigarette consumption over time, a pattern consistent with better information on health effects and a rising real cigarette price via rising taxes (Chaloupka and Warner 2000). Not surprisingly, the table shows that the percentage of former heavy smokers was higher than the percentage of current heavy smokers, and that former smokers' average cigarette consumption was higher than current smokers' average cigarette consumption.

Overall, the descriptive statistics indicate two major patterns. First, there were large educational, occupational, and health differences between current smokers and non-smokers. Second, cigarette consumption declined over time while mean real wage differences between current smokers and non-smokers increased over time.

Table 1. Mean Characteristics in 1986, 1999, and 2001 Cross-Section Data, by Smoking Status.

Characteristic	1986 Data		1999 Data		2001 Data	
	Smokers	Non-Smokers	Smokers	Non-Smokers	Smokers	Non-Smokers
Avg. Hourly Wage (in 2000 Dollars)	17.06	20.58	16.64	22.13	17.48	24.48
<i>Highest Educational Level Attained</i>						
College Degree	.17	.37	.17	.38	.15	.38
Some College, No College Degree	.18	.18	.25	.23	.26	.24
High School Diploma or GED	.41	.33	.40	.25	.40	.25
No. Years Experience with Current Employer	6.92	7.69	7.51	8.24	7.24	8.38
No. Years Worked for Money Since 18 Years Old	17.25	18.01	18.43	18.09	18.15	18.72
White-Collar Job	.31	.51	.31	.52	.36	.53
Job Covered by Union Contract	.22	.20	.19	.18	.17	.20
Marital Status	.77	.84	.77	.85	.72	.86
Non-White Race	.32	.26	.34	.32	.33	.31
<i>Self-Reported Health Status</i>						
Excellent	.25	.36	.18	.34	.20	.31
Very Good	.36	.36	.36	.36	.39	.37
Good	.28	.20	.32	.23	.30	.24
Age	36.69	37.56	40.60	40.23	40.84	41.67
Sample Size	1,087	1,969	719	2,343	652	2,246

Note: The sample in Table 1 includes male household heads between 25 and 60 years old, working at least 1,500 hours a year.

Cross-Sectional Analysis

Results of the baseline cross-sectional analysis corresponding to equations (1) and (1') can be found in Table 3. The baseline model (1) indicates that the wage gap between current smokers and current non-smokers increased from 4.1% in 1986 to 10.8% and 11.8% in, respectively, 1999 and 2001. Since previous researchers adopted approaches very similar to our baseline approach, it is useful to compare their results to ours. In their 1973 QES data analysis, Leigh and Berger obtained statistically insignificant point estimates of 1.5–3.5%. Levine et al., using the 1984 and 1992 waves of the NLSY, estimated the wage gap at 4.2% and 6.9%, respectively. As can be seen from the above comparison, the previous studies are consistent with the current study's baseline model for 1986.

The adverse effect of smoking on health

provides one of the most important explanations of the wage gap between smokers and non-smokers. This hypothesis is incorporated into the analysis by augmenting specification (1) with self-reported health status dummies. The estimation results of specification (1') suggest that health status had important effects on wages. In addition, introducing health status into the analysis reduces the smokers/non-smokers wage gap, suggesting that part of the gap is in fact explained by health differences. However, the wage gap reduction is not very large, so other explanations for the gap merit analysis.⁷ The wage effect might also result from

⁷The 1999 and 2001 waves of the PSID contain the information on whether respondents had certain chronic conditions. When equation (1) is run for these two waves with the chronic condition dummy instead of self-reported health status dummies, the results show little change.

Table 2. Mean Characteristics of Smoking Behavior in 1986, 1999, and 2001 Cross-Section Data.^a

Characteristic	1986 Data		1999 Data		2001 Data	
	Smokers	Former Smokers	Smokers	Former Smokers	Smokers	Former Smokers
Average Hourly Wage (in year-2000 Dollars)	17.06	21.44	16.64	22.36	17.48	24.36
Number of Cigarettes Consumed Daily	20.71	23.00	17.26	19.83	16.62	19.36
Number of Smoking Experience Years	19.26	13.48	23.26	14.83	23.11	14.57
Share of Heavy Smokers	.29	.32	.18	.23	.15	.23
Age	36.69	40.16	40.60	43.40	40.84	44.85
Sample Size	1,087	770	719	669	652	646

Note: The sample in Table 1 includes male household heads between 25 and 60 years old, working at least 1,500 hours a year.

smoking-induced health shocks that reduce labor market hours well below the full-time threshold or lead to labor force exit. While important, this probably is not a very common concern among men under 60 and can be studied as additional waves of PSID data are collected.

Since smoking may lower one's productivity, it may also affect the choice of occupation. Thus, job type variables (white-collar, union status) are potentially endogenous. To conduct a sensitivity check, we estimated model (2) from Table 3 omitting white-collar and union status variables. The results, we found, did not change significantly. Similarly, we verified that our results were robust to the exclusion of tenure.

As another sensitivity check, we examined the effect of intensity of smoking on wages. We found that conditional on smoking, the level of cigarette consumption, years of smoking experience, and heavy smoker status all have a small and statistically insignificant additional effect on wages (results available on request).

Table 3 indicates that the former smoker dummy has a small and statistically insignificant coefficient in all three waves of data. Thus, there is evidence that only current smoker status reduces wages and that those who have ever smoked are a different group in terms of wage potential.

Fixed Effect Analysis

To exploit the panel nature of the data, we pooled 1986, 1999, and 2001 waves of

the survey and estimated model (1') using first a pooled OLS approach and then fixed effect OLS. The results of these estimation procedures are presented in the last two columns of Table 3. The pooled OLS model suggests that smokers received, on average, 7.3% lower wages than non-smokers. This estimate is consistent with our wage gap estimates described above. The fixed effect estimates are dramatically smaller than the cross-sectional estimates. The estimated wage gap between smokers and non-smokers becomes small and statistically insignificant. As a robustness check, we estimated the fixed effects model on a sample that excludes *future smokers* from the analysis. The results (not shown) did not change significantly. In addition, we estimated a fixed effect model while excluding self-reported health status from the specifications (not shown). The estimated wage gap remained small and statistically insignificant.

The fixed effect analysis has two important limitations. First, it does not account for time-variant unobserved heterogeneity. Second, the identification in the fixed effect analysis comes from the individuals who changed their smoking behavior over time. There is potential endogeneity with regard to the individuals who chose to change their smoking behavior and quit smoking. These people might have been quite different from the ones who decided to continue smoking. Thus, the fixed effect model is informative with regard to people who changed their smoking behavior over time, but not with regard to people who chose to continue

Table 3. OLS Estimates of the Wage Effects of Smoking Behavior.
(Standard Errors in Parentheses)

Explanatory Variable	1986 Data		1999 Data		2001 Data		Pooled OLS	OLS Fixed Effects
	(1)	(2)	(1)	(2)	(1)	(2)		
<i>Health Status</i>								
Excellent	.1558 (.0382)	.1567 (.0382)	.2248 (.0410)	.2261 (.0410)	.2238 (.0430)	.2245 (.0431)	.1966 (.0236)	.0118 (.0327)
Very Good	.1326 (.0373)	.1327 (.0373)	.1867 (.0395)	.1877 (.0395)	.2137 (.0416)	.2140 (.0416)	.1721 (.0229)	.0215 (.0304)
Good	.0792 (.0380)	.0788 (.0380)	.1303 (.0404)	.1309 (.0404)	.1444 (.0424)	.1448 (.0425)	.1118 (.0233)	.0044 (.0292)
Former Smoker	.0251 (.0237)	.0251 (.0237)	.0216 (.0250)	.0216 (.0250)	.0059 (.0262)	.0059 (.0262)		
Current Smoker	-.0405 (.0197)	-.0242 (.0219)	-.0924 (.0237)	-.0856 (.0250)	-.1183 (.0254)	-.1073 (.0266)	-.0737 (.0131)	.0093 (.0276)
<i>Education</i>								
College	.4403 (.0339)	.4176 (.0343)	.3752 (.0360)	.3774 (.0361)	.4667 (.0379)	.4375 (.0380)	.3989 (.0207)	.0207 (.1160)
Some College	.2437 (.0337)	.2232 (.0339)	.1710 (.0344)	.1718 (.0344)	.2089 (.0367)	.1885 (.0367)	.1829 (.0200)	-.0169 (.0936)
High School or GED	.1896 (.0285)	.1747 (.0286)	.0895 (.0326)	.0895 (.0326)	.0873 (.0350)	.0705 (.0350)	.1072 (.0183)	.1509 (.0875)
Non-White	-.1566 (.0222)	-.1478 (.0223)	-.1598 (.0226)	-.1581 (.0227)	-.1880 (.0241)	-.1740 (.0241)	-.1586 (.0133)	-.0849 (.0928)
Tenure	.0202 (.0013)	.0203 (.0013)	.0110 (.0014)	.0110 (.0014)	.0118 (.0014)	.0117 (.0014)	.0140 (.0008)	.0073 (.0012)
Experience	.0314 (.0044)	.0313 (.0044)	.0190 (.0040)	.0188 (.0040)	.0251 (.0059)	.0257 (.0058)	.0207 (.0026)	.0034 (.0053)
Experience ²	-.0007 (.0001)	-.0006 (.0001)	-.0004 (.0001)	-.0004 (.0001)	-.0006 (.0001)	-.0006 (.0001)	-.0004 (.0001)	-.0007 (.00001)
Sample Size	3,056	3,056	3,062	3,062	2,898	2,898	9,016	9,016
R ² _{adj}	.3228	.3268	.2970	.2920	.2961	.3035	0.3970	

Note: The dependent variable is the Log hourly wage rate; other regressors include union and marital status, white-collar job, and regional dummies.

Table 4. Retrospective Smoking Behavior Information Consistency Check.

Smoking Behavior Groups	1986 Retro Sample		1999 Retro Sample	
	No. Observations	Percentage Out of Sample Size	No. Observations	Percentage Out of Sample Size
Never Smokers	636	43.7	1,788	50.6
Persistent Smokers	292	20.0	710	20.1
Former Smokers	152	10.4	489	13.8
Future Quitters	128	8.8	82	2.3
On-and-Off Smokers	104	7.1	181	5.1
Future Smokers	10	0.7	9	0.3
Inconsistent Responses	135	9.3	272	7.7
Sample Size	1,457	100	3,531	100

Note: No restrictions on hours of work or age are applied to Table 4.

smoking. In the next section we examine the wage gap for individuals with different types of smoking behavior histories.

Retrospective Data Analysis

The considerable length of the panel, which runs from 1986 to 2001, enables us to take smoking histories into account. Some of those who were smoking in 1986 would still be smoking in 2001, others would quit smoking, and others would be intermittent, or on-and-off, smokers. Among current non-smokers, various mutually exclusive categories can be recognized: those who had never smoked, future persistent smokers, future smokers, former smokers, and intermittent on-and-off smokers.

In order to reconstruct a smoking history, we include only those individuals who provided their smoking behavior information in at least two waves. Then, as shown in Table 4, tracking of each individual's responses across time can be used to discriminate seven mutually exclusive categories: never smokers, persistent smokers, former smokers, future quitters, on-and-off smokers, future smokers, and those with inconsistent responses.⁸ Even though the data span over fifteen years, the

inconsistent response category comprises only 8–10% of the sample. Observations in this category are dropped from further analysis.

The largest category of all is, of course, the *never smoker* category, which constitutes 43–51% of the sample. The *persistent smoker* category makes up about a fifth of the sample. The only other large category, constituting over 10% of the sample, is *former smoker*. Most of the other categories, though potentially very interesting, are not large enough to be included in the regression analysis. Thus, the regression analysis will mainly concentrate on the three largest groups: *never smokers*, *former smokers*, and *persistent smokers*.

Descriptive statistics on various individual characteristics for the retrospective data sample for the years 1986 and 1999 are presented in Tables 5 and 6. As can be seen from these tables, the *never smoker* and *former smoker* groups are very similar with respect to key individual characteristics such as highest level of education attained, white-collar status, and health status. For instance, the percentage of respondents with at least a college degree is virtually identical across these two groups, at 46%. These similarities are particularly interesting since the results of this study seem to suggest that the wage gap between former smokers and never smokers is either very small or nonexistent.

A comparison of mean characteristics further suggests the presence of a self-selection process. Individuals who smoked at one point and later quit have characteristics very different from those of persistent smokers. Mean

⁸Smoking histories are reconstructed based on contemporaneous smoking behavior measures. However, a retrospective question on age of smoking onset was used to (a) identify the individuals who gave inconsistent responses and (b) distinguish the individuals who truly quit smoking from those who were on-and-off smokers. Further details on how smoking histories were reconstructed are available from the authors upon request.

Table 5. Mean Characteristics, 1986 Retrospective Sample.

Characteristic	Never Smokers	Persistent Smokers	Former Smokers	Future Quitters	On-and-Off Smokers	Inconsistent Responses
Average Hourly Wage Rate	12.40	9.928	14.35	11.26	12.43	12.68
<i>Highest Educational Level Attained</i>						
College Degree	.46	.16	.46	.20	.21	.38
Some College, No College Degree	.18	.18	.15	.21	.31	.16
High School Diploma or GED Recipient	.31	.46	.35	.45	.37	.38
No. Years Experience with Current Employer	5.63	5.64	6.81	5.93	5.55	6.37
No. Years Worked for Money Since 18 Years Old	12.35	12.86	17.08	15.65	14.11	13.67
White-Collar Job	.56	.31	.62	.35	.51	.49
Job Covered by Union Contract	.16	.21	.23	.20	.21	.26
Marital Status	.80	.74	.91	.88	.83	.76
Non-White Race	.22	.27	.16	.16	.22	.23
<i>Self-Reported Health Status</i>						
Excellent	.45	.26	.40	.22	.32	.32
Very Good	.38	.42	.36	.44	.43	.40
Good	.14	.24	.20	.24	.21	.21
Age	31.87	32.29	36.53	34.71	33.32	32.97
Sample Size	636	292	152	128	104	1345

Note: No restrictions on hours of work or age are applied to Table 5.

individual characteristics of two other groups, future quitters and on-and-off smokers, usually lie between those for persistent smokers and never/former smokers. From this we may expect that the wage effect of their smoking status should be smaller in magnitude than that of persistent smoker status.

Table 7 presents our estimation of the wage gap between the three largest groups: *persistent smokers*, *never smokers*, and *former smokers*. As can be seen from this table, wage gap estimates for *persistent smokers* versus *former smokers* are very close to those for *persistent smokers* versus *never smokers*. This pattern is reinforced by the finding that the former/never smokers wage gap is statistically insignificant.

Some results across Tables 3 and 7 may appear contradictory. Whereas Table 3 indicates that the wage gap between current smokers and those who currently do not smoke widened over time, estimation results displayed in Table 7 show that the wage differential between *persistent smokers* and *never smokers* was stable (7–11%) over time.⁹

To reconcile these two results we need to take into account results from Table 8. Table 8 uses the unique feature of our data that allows us to identify and analyze those smokers who smoked in 1986 and are known to have quit smoking in future years (*future quitters*). Table 8 compares these *future quitters* as of 1986 to (a) *former smokers* (those who quit smoking by 1986), (b) *never smokers*, and (c) *persistent smokers*. It shows that those smokers who were going to quit smoking in the future (*future quitters*) received, on average, 12% higher wages than those who smoked in 1986 and did not quit in the future (*persistent smokers*). It also indicates that *future quitters* tended to receive wages equal to those for both *never smokers* and *former smokers* (those who had already managed to quit smoking successfully).

These results in combination seem to suggest that the widening of the gap between current smokers and those who did not currently smoke was due to an increase in the

⁹The stability of the wage differential implies that the wage growth should be similar for *persistent smokers*

and *never smokers*. We estimated a wage growth equation showing that, indeed, *persistent smokers*, *never smokers*, and *former smokers* had similar wage growth.

Table 6. Mean Characteristics in 1999 Retrospective Sample.

Characteristic	Never Smokers	Persistent Smokers	Former Smokers	Future Quitters	On-and-Off Smokers	Inconsistent Responses
Average Hourly Wage Rate	20.27	15.01	20.96	17.67	20.59	
<i>Highest Educational Level Attained</i>						
College Degree	.39	.15	.34	.23	.23	.29
Some College, No College Degree	.26	.26	.26	.24	.26	.19
High School Diploma or GED Recipient	.25	.41	.26	.37	.37	.33
No. Years Experience with Current Employer	7.72	6.64	8.77	5.21	7.07	7.61
No. Years Worked for Money Since 18 Years Old	16.46	16.71	21.05	16.72	17.88	18.22
White-Collar Job	.54	.32	.51	.35	.50	.47
Job Covered by Union Contract	.17	.17	.22	.21	.16	.18
Marital Status	.79	.62	.76	.79	.74	.75
Non-White Race	.36	.35	.27	.30	.27	.41
<i>Self-Reported Health Status</i>						
Excellent	.35	.20	.26	.23	.34	.26
Very Good	.36	.35	.37	.41	.35	.40
Good	.24	.32	.28	.28	.23	.26
Age	38.58	39.01	44.55	39.32	40.62	40.37
Sample Size	1,788	710	489	82	181	272

Note: No restrictions on hours of work or age are applied to Table 6.

proportion of *persistent smokers* among current smokers. Smoking rates among working adults had been falling over the previous twenty years. Those who used to smoke in the mid-1980s included many individuals who successfully managed to quit smoking later on. As we know from Table 8, this group received wages that were, on average, equal to those of *never smokers*. Thus, a higher proportion of *future quitters* among current smokers can potentially bias the estimated wage gap downward, explaining why the estimated wage gaps between current smokers and non-smokers tended to be smaller in the 1980s than in the late 1990s.

The results shown in Tables 7 and 8 provide some other interesting insights. For example, it is well known that in recent years, social acceptance of smoking has diminished. Under a discrimination hypothesis, we would expect to see a widening of the gap between *never smokers* and *persistent smokers*. This seems not to be the case.

Also, the observation of a substantial wage gap between *persistent smokers* and *future quitters* at the time when the latter smoked could be interpreted as the evidence against the

work discrimination hypothesis. It would presumably be difficult for co-workers to single out the future quitters and exempt them from the discriminatory treatment of their other smoking colleagues as of 1986.

To summarize, smoking seems to have negatively affected the wages of current smokers but not of former smokers. Further, this wage gap was driven primarily by the persistent smoker group, and it was stable over time. Those who quit smoking seem to have suffered no significant wage disadvantage, suggesting that the main driving force behind this wage gap may have been a process of self-selection by those who were unable to quit, due possibly to addiction (Uhl et al. 2007) or possibly to preference, rather than any of the causal explanations. However, causal explanations cannot be completely ruled out. Quitting smoking is potentially an endogenous process.¹⁰ It is possible, for

¹⁰This is consistent with the observation that the wage differential between *former smokers* and *persistent* and *never smokers* differs by education group. However, the wage gap between *persistent smokers* and *never smokers* does not substantially differ across different education groups.

Table 7. OLS Estimates of Wage Gaps between Persistent Smokers, Former Smokers, and Never Smokers. (Standard Errors in Parentheses)

Specification	1986 Data	1999 Data	2001 Data
Persistent Smokers versus Never Smokers	-.0764 (.0406)	-.0821 (.0275)	-.1023 (.0277)
Persistent Smokers versus Former Smokers	-.1132 (.0563)	-.1243 (.0338)	-.1024 (.0362)
Former Smokers versus Never Smokers	.0371 (.0480)	.0391 (.0303)	-.0108 (.0306)

Notes: The dependent variable is the Log hourly wage rate; other regressors include education controls, experience, experience squared, tenure, and dummies for health status, race, union membership, marital status, and region. The sample includes male household heads between 25 and 60 years old, working at least 1,500 hours a year.

example, that workers who perceive that they will incur a higher wage loss in the future if they continue smoking are more likely to quit.

Conclusion

The wage effect of smoking has been examined in this paper from several different perspectives. Our baseline analysis treated smokers and non-smokers as essentially homogeneous apart from smoking. Human capital earnings regressions augmented by a current smoking status dummy show a wage gap in the 4–11% range and one that increases over time, at least up to 2001. Both the point estimates and their increasing pattern are consistent with the results of previous research.

In recognition of potentially important differences among individuals with respect

to smoking behavior, we divided the sample into seven categories by smoking history. Comparisons across the three largest categories—*persistent smokers*, *never smokers*, and *former smokers*—yielded evidence that the wage gap was largely driven by persistent smokers, and that the size of the gap was fairly stable over time. This interpretation is further reinforced by the finding of no wage gap between former smokers and those who had never smoked.

We have identified some important indirect wage effects of smoking via health status. Specifically, smoking is highly predictive of lower reported health status, and this in turn lowers wages. Thus, while smoking's observed negative wage effects appear to be explained in part by real effects on health status, they are also owing in large measure to unobserved preferences and behavior of persistent smokers.

Table 8. Future Quitters in 1986. (Standard Errors in Parentheses)

	Ref. Group: Never Smokers	Ref. Group: Former Smokers	Ref. Group: Persistent Smokers
Future Quitter Dummy	.0440 (.0507)	-.0175 (.0599)	.1236 (.0511)
Sample Size	628	256	355
R ²	.290	.261	.344

Notes: The dependent variable is the Log hourly wage rate; other regressors include education controls, experience, experience squared, tenure, and dummies for health status, race, union membership, marital status, and region. The sample includes male household heads between 25 and 60 years old, working at least 1,500 hours a year.

REFERENCES

- Auld, M. Christopher. 2005. "Smoking, Drinking, and Income." *Journal of Human Resources*, Vol. 40, No. 2, pp. 505–18.
- Becker, Gary M., and Casey B. Mulligan. 1997. "The Endogenous Determination of Time Preference." *Quarterly Journal of Economics*, Vol. 112, No. 3, pp. 729–58.
- Bertera, Robert L. 1991. "The Effects of Behavioral Risks on Absenteeism and Health-Care Costs in the Workplace." *Journal of Occupational Medicine*, Vol. 33, No. 11, pp. 1119–23.
- Blake, Gregory H., Troy D. Abell, and W. G. Stanley. 1988. "Cigarette Smoking and Upper Respiratory Infection among Recruits in Basic Combat Training." *Annals of Internal Medicine*, Vol. 109, No. 3, pp. 198–202.
- Chaloupka, Frank J., and Kenneth Warner. 2000. "The Economics of Smoking." In Anthony J. Culyer and Joseph P. Newhouse, eds., *Handbook of Health Economics*, Vol. 1, pp. 1539–1627. Amsterdam: Elsevier.
- Cunha, Flavio, James J. Heckman, Lance Lochner, and Dimitriy V. Masterov. "Interpreting the Evidence on Life Cycle Skill Formation." In Eric Hanushek and Finis Welch, eds., *Handbook of the Economics of Education*, Vol. 1, pp. 697–812. Amsterdam: Elsevier.
- Farrell, Phillip, and Victor Fuchs. 1986. "Schooling and Health: The Cigarette Connection." In Victor R. Fuchs, ed., *The Health Economy*, pp. 243–54. Cambridge, Mass., and London: Harvard University Press.
- Frieze, Irene H., Josephine E. Olson, and Debora C. Good. 1990. "Perceived and Actual Discrimination in the Salaries of Male and Female Managers." *Journal of Applied Social Psychology*, Vol. 20, No. 1, pp. 46–67.
- Frieze, Irene H., Josephine E. Olson, and Jane Russell. 1991. "Attractiveness and Income for Men and Women in Management." *Journal of Applied Social Psychology*, Vol. 21, No. 13, pp. 1039–57.
- Fuchs, Victor R. 1982. "Time Preferences and Health: An Exploratory Study." In Victor R. Fuchs, ed., *Economic Aspects of Health*. Chicago: University of Chicago Press.
- Grossman, Michael. 1972. "The Demand for Health: A Theoretical and Empirical Investigation." Occasional Papers No. 119. New York: Columbia University Press (for NBER).
- _____. 1976. "The Correlation between Health and Schooling." In Nestor E. Terleckyj, ed., *Household Production and Consumption*. New York: Columbia University Press (for NBER).
- Hamermesh, Daniel S., and Jeff E. Biddle. 1994. "Beauty and the Labour Market." *American Economic Review*, Vol. 84, No. 5, pp. 1174–94.
- Idler, Ellen L., and Yael Benyamini. 1997. "Self-Rated Health and Mortality: A Review of Twenty-Seven Community Studies." *Journal of Health and Social Behavior*, Vol. 38, No. 1, pp. 21–37.
- Kitagawa, Evelyn, and Philip M. Hauser. 1973. "Differential Mortality in the U.S." Cambridge, Mass.: Harvard University Press.
- Kristein, Marvin M. 1983. "How Much Can Business Expect to Profit from Smoking Cessation?" *Preventive Medicine*, Vol. 12, No. 2, pp. 358–81.
- Lahiri, Kajal, and Jae G. Song. 2000. "The Effect of Smoking on Health Using a Sequential Self-Selection Model." *Health Economics*, Vol. 9, No. 6, pp. 491–511.
- Lee, Yew Liang. 2003. "Wage Effects of Drinking in Australia." *Australian Economic Review*, Vol. 36, No. 3, pp. 265–82.
- Leigh, J. Paul, and Mark C. Berger. 1989. "Effects of Smoking and Being Overweight on Current Earnings." *American Journal of Preventive Medicine*, Vol. 5, No. 1, pp. 8–14.
- Levine, Phillip B., Tara A. Gustafson, and Ann D. Velenchik. 1997. "More Bad News for Smokers? The Effect of Cigarette Smoking on Wages." *Industrial and Labor Relations Review*, Vol. 50, No. 3, pp. 493–509.
- Martel, Leslie F., and Henry B. Biller. 1987. "Stature and Stigma: The Biopsychosocial Development of Short Males." Lexington, Mass.: Lexington Books.
- Michael, Robert T. 1973. "Education in Nonmarket Production." *Journal of Political Economy*, Vol. 81, No. 2, pp. 306–27.
- Mirta, Aparna. 2001. "Effects of Physical Attributes on the Wages of Males and Females." *Applied Economics Letters*, Vol. 8, No. 11, pp. 731–35.
- Napier, Kristine (with editing by William M. London, Elizabeth M. Whelan, and Andrea Golaine Case). 1996. *Cigarettes: What the Warning Label Doesn't Tell You. The First Comprehensive Guide to the Health Consequences of Smoking*. New York: American Council on Science and Health.
- Persico, Nicola, Andrew Postlewaite, and Daniel Silverman. 2004. "The Effects of Adolescent Experience on Labor Market Outcomes: The Case of Height." *Journal of Political Economy*, Vol. 112, No. 5, pp. 1019–53.
- Pincus, Theodore, Leigh F. Callahan, and Richard V. Burkhauser. 1987. "Most Chronic Diseases Are Reported More Frequently by Individuals with Fewer than 12 Years of Formal Education in the Age 18–64 United States Population." *Journal of Chronic Diseases*, Vol. 40, No. 9, pp. 865–74.
- Rosen, Sherwin, and Paul J. Taubman. 1982. "Some Socioeconomic Determinants of Mortality." In J. van der Gagg, William B. Neeman, and Theodore Tsukahara Jr., eds., *Economics of Health Care*. New York: Praeger.
- Uhl, George R., Qing-Rong Liu, Tomas Drgon, Catherine Johnson, Donna Walther, and Jed E. Rose. 2007. "Molecular Genetics of Nicotine Dependence and Abstinence: Whole Genome Association Using 520,000 SNPs." *BMC Genetics*, Vol. 8, No. 10, published online April 3, 2007.
- Van Ours, Jan C. 2004. "A Pint a Day Raises a Man's Pay; But Smoking Blows that Gain Away." *Journal of Health Economics*, Vol. 23, No. 5, pp. 863–86.