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Robert Kaestner; Michael Grossman

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Wages, Workers' Compensation Benefits, and Drug Use: Indirect Evidence of the Effect of Drugs on Workplace Accidents

By ROBERT KAESTNER AND MICHAEL GROSSMAN*

In the last 30 years there has been a significant decrease in the growth rate of labor productivity in the United States, and as a result of this experience the country is paying greater attention to workplace issues. Coinciding with the decline in productivity has been an increase in illicit drug use by the employed population. Not surprisingly, the two facts have been combined, and it has now become the conventional wisdom that drug use is a significant cause of declining productivity. Estimates of the dollar value of the productivity loss due to illicit drug use range from 8.6 to 33 billion dollars per year.

In response to these perceived losses, the government and the private sector have undertaken an extensive campaign to reduce drug use in the workplace. Hundreds of companies in the United States have developed extensive alcohol- and drug-abuse programs alternately aimed at prevention, detection, and treatment of employees who use illicit drugs. As of 1990, 46 percent of all firms with 250 or more employees had a drug testing program, and 79 percent of these firms had a formal employee assistance plan (Howard V. Hayghe, 1991). The federal government has also been quite active in its effort to control illicit drug use in the workplace. The Drug Free Workplace Act of 1988 requires federal government contractors to maintain drug-free workplaces, and Executive Order 12564 requires all federal agencies to establish drug-free-workplace policies.

The widespread acceptance of the causal link between drug use and declining productivity is surprising in light of the fact that most of the evidence on the issue is anecdotal in nature. On the other hand, the limited amount of scrutiny of the problem is understandable given the documented adverse physical and psychological consequences of drug use. The purpose of this paper is to examine the relationship between drug use and workplace accidents. Accidents on the job are often cited as an important consequence of drug use and a significant factor related to declining productivity.

This paper will examine the issue in a novel way. All previous studies in this area have examined whether individuals who use drugs are more likely than their nonusing counterparts to experience an accident on the job. An alternative approach, however, is to focus on the individual's consumption choices. Assuming that drug use affects the probability of having an accident, it can be shown that wages and workers' compensation benefits will have a significant impact on drug consumption levels. The logic underlying this hypothesis is relatively simple: an accident results in a loss of income the size of which is determined by the difference between wages and workers' compensation benefits. Thus, an examination of the effect of wages and workers' compensation benefits on drug use provides indirect evidence that drug use affects job safety. The results of this analysis suggest that drug use is not a significant factor related to workplace accidents. Variation in wages and workers' compensation benefits had little effect on the probability that an individual would be a drug user.

*Kaestner: Baruch College, Rider University, and National Bureau of Economic Research, 269 Mercer St., New York, NY 10003-6687; Grossman: Graduate Center, City University of New York, and NBER.

I. Previous Research

There have been several studies of the effect of illicit drugs on workplace accidents,[1] but none has appeared in the economics literature. Most of the information that makes its way into the public consciousness comes from the popular press. The most sensational reports are often based on the analysis of postaccident drug tests from the transportation industry. This type of information, however, is not useful because the prevalence rate of illicit drug use among employees who are not involved in an accident is unknown. In addition to the studies that examine postaccident drug tests, there have been several other studies which compare the accident rate of drug users to that of nonusers. In these studies, drug use in the past year tends to be positively correlated with an increase in the probability of experiencing an accident on the job, but the associations are usually not significant. Most of these studies use small regional samples or focus on only one industry, so the findings may not be generalizable. Furthermore, these studies use a relatively limited set of control variables and fail to take into account the possibility that the causality between drug use and workplace accidents may be bidirectional.

II. A Model of Drug Consumption

As noted above, an alternative way to examine the relationship between drug use and workplace accidents is to focus on the individual's consumption choices. Assuming that drug use affects the probability of having an accident, it can be shown that changes in wages and workers' compensation benefits will alter drug consumption levels. Thus, an examination of the effect of wages and workers' compensation benefits on drug use provides indirect evidence of the effect of drug use on workplace accidents. This strategy is particularly useful since it does not require information related to workplace accidents, which is unavailable in most data sets.

The basic relationships among drug use, wages, and workers' compensation benefits can be derived from a simple model of intertemporal consumer choice. Assume that there are only two periods, $(i = 1,2)$, and that utility is a function of drug (D_i) use and other consumption (X_i) in each period. Furthermore, assume that utility is intertemporally separable and, within each period, separable with respect to drug use and other consumption. Under these conditions the individual's expected utility (EU) may be written as

$$\begin{aligned}(1)\quad \mathrm{EU} = {} & U(D_1) + V(X_1) \\ & + [1 - \pi(D_1)]U(D_{21}) \\ & + \pi(D_1)U(D_{22}) + [1 - \pi(D_1)] \\ & \times V(X_{21}) + \pi(D_1)V(X_{22}).\end{aligned}$$

Due to the separability assumption, there are different utility functions for drug use (U) and other consumption (V). Accidents occur in period 2, and the probability of an accident, π, is dependent on first-period, or current, drug use with the assumption that π_D is greater than zero; an increase in drug use increases the probability of an accident. Thus, in period 2, the consumer will find himself in one of two states, healthy $(j = 1)$ or injured $(j = 2)$, depending on whether an accident has occurred. The model is applicable to a class of individuals with identical tastes for risk. The variation in risk of injury on the job is solely a function of differences in drug use. In addition to affecting the probability of accident, drug use also has an impact on the second-period wage (W), with the assumption that W_D is less than zero: an increase in drug use lowers the wage.

Assuming that the consumer has no ability to borrow or lend, the relevant budget

[1] See the studies of R. W. Hingson et al. (1985), J. Normand et al. (1990), C. Zwerling et al. (1990), and M. L. Holcum et al. (1993).

constraint for period 1 is the following:[2]

$$X_1 + pD_1 = W \tag{2}$$

and for period 2 the budget constraint may be written in two parts corresponding to the two states of the world that may occur:

$$X_{21} = W(D_1) - pD_{21} \tag{3}$$

and

$$X_{22} = bW(D_1) - pD_{22}. \tag{4}$$

In equations (2), (3), and (4) the price of the composite good (**X**) has been normalized. It is assumed that an injury results in a complete loss of earnings and that the only income the worker receives while injured is the workers' compensation benefit (bW). The benefit level is expressed as a proportion ($b < 1$) of the wage which is consistent with the way in which workers' compensation benefits are established in most states.

Substituting equations (2), (3), and (4) into equation (1) yields the following expression for expected utility:

$$\begin{aligned}\text{(1a)}\quad \text{EU} = {} & U(D_1) + V(W - pD_1) \\ & + [1 - \pi(D_1)]U(D_{21}) \\ & + [1 - \pi(D_1)]V(W(D_1) - pD_{21}) \\ & + \pi(D_1)U(D_{22}) + \pi(D_1) \\ & V(bW(D_1) - pD_{22}).\end{aligned}$$

The consumer's problem is consequently to choose a level of current drug use to maximize expected utility (1a). The first-order condition for this problem is

$$\frac{U_D}{V_X} = p + \text{Z1} + \text{Z2} \tag{5}$$

where

$$\text{Z1} = \frac{\pi_D}{V_X}\{[U(D_{21}) - U(D_{22})] + [V(X_{21}) - V(X_{22})]\} > 0$$

and

$$\text{Z2} = \frac{-W_D}{V_X}\{[1 - \pi(D_1)]V_X^1 + \pi b V_X^2\} > 0.$$

The U_D and V_X are the marginal utility of current drug use and other consumption respectively, and the U_D^j and V_X^j are the marginal utility of period-2 drug use and other consumption in the healthy ($j = 1$) and injured ($j = 2$) state. Equation (5) is the familiar consumer equilibrium condition. The components of the "full" price Z1 and Z2 are positive and reflect additional costs of drug use associated with (i) an increase in the probability of having an accident (Z1) and (ii) a decrease in consumption in the period-2 healthy state due to a lower second-period wage (Z2).

III. Wages, Workers' Compensation Benefits, and Drug Use

The effect of wages and workers' compensation benefits on drug consumption can be derived from equation (5), and details of the derivation are contained in Kaestner and Grossman (1994). The results indicate that workers' compensation benefits and drug use should be positively related. An increase in benefits increases consumption in the period-2 injured state, and the difference in the level of utility between the healthy and injured states will decrease. Thus, the full price of drug use will decrease because the two terms on the right-hand side of equation (5) that include π_D will become smaller. The reduction in price

[2]The model neglects the fact that one of the goods that make up the composite commodity, **X**, is leisure, and that the wage is the price of leisure. Thus, in addition to the effects of the wage on drug use described in the text, the wage would be expected to affect drug use negatively (positively) if leisure and drug use were complements (substitutes) in consumption. Our intuition is that drugs and leisure should be complements in consumption, and thus the wage and drug use should be negatively related.

should result in an increase in consumption. These results suggest that drug use should be greater in states with more generous workers' compensation benefits. In addition to this effect, however, a change in benefits has a second-order effect on the full price of drugs that works through the expression Z2. The effect of a change in benefits on this part of the full price is positive but should be small. Thus it is expected that an increase in benefits should lead to an increase in current drug use. This last statement would be particularly true if drug use did not have an adverse impact on wages since in this case Z2 is equal to zero. Recent studies that have investigated the impact of drug use on wages have found that drug use has a positive or insignificant effect on wages (Kaestner, 1994). Given this evidence, it is expected that benefit levels will have a positive effect on drug use.

The relationship between the wage and current drug use is expected to be negative, although as was the case with benefits this prediction is subject to some qualification. A change in the wage will affect both components of the full price of drugs, and it is possible to determine the sign of the effect of wages only for the component Z1. In this case an increase in the wage will increase the full price of drug use as the difference between period-2 consumption in the healthy and injured state increases. This should lead to a decrease in drug use, although a change in the wage has other effects on the full price of drugs that preclude a definitive statement regarding the expected relationship between wages and drug use. If drug use does not have an adverse effect on the wage, however, the expected relationship between wages and drug use is negative. Note that this is an income-compensated effect, since in addition to this price effect a change in the wage will alter income, and consequently the level of drug use.

IV. Empirical Model and Data

To investigate whether wages and workers' compensation benefits have an effect on drug use, a drug demand function needs to be estimated. In this paper the demand for drugs will be specified as

$$(6) \quad D_{nt} = Z_{nt}\Gamma + \gamma W_{nt} + \delta B_{nt} + \phi_n + \eta_{nt}$$

where D is an indicator of drug use (e.g., cocaine or marijuana) in the past year, $\mathbf{Z}$ is a vector of exogenous variables, W is the wage, B is a measure of workers' compensation benefits, Γ, γ, and δ are parameters, ϕ is an unobserved person-specific attribute, η is an error term, and $t = 1–2$ is an index of calendar time.[3] The vector $\mathbf{Z}$ in equation (6) contains proxy variables for an individual's tastes for drugs (e.g., age, education, mother's education, number of reported illegal activities in 1980), past-year nonlabor income, and as a proxy for the market price of drugs, several geographic and area specific measures (e.g., region of residence, local crime rate).

The data used in the analysis come from the National Longitudinal Survey of Youth (NLSY), a longitudinal survey of the labor-market experiences of young adults. The data contain detailed information on a respondent's labor-market experience, family and personal background, and illicit drug use. Central to the purposes of this paper are the questions related to respondent's illicit drug use. In 1984, 1988, and 1992 the respondent was asked questions about lifetime and recent use of marijuana and cocaine. The drug-use measures included in the NLSY are relatively crude and measure the frequency of lifetime and recent use as of the interview date. Because a significant portion of the sample was dropped after 1990, we will use data from the 1984 and 1988 waves of the survey.

Our sample was restricted to white respondents, who were employed at the time of interview and who had worked at least 500 hours in the previous year. The resulting sample size was approximately 1,800 males and 1,500 females. The race restriction was imposed due to potential under-

[3]A more flexible functional form would be preferred, but the linear model is employed to facilitate estimation of the model. Future work in this area will address this issue.

reporting of drug use by nonwhites (see Barbara S. Mensch and Denise B. Kandel, 1988), and the employment restrictions were used to exclude individuals with only a weak attachment to the labor force. Individuals with only a marginal attachment to the labor force may be less aware of the risk of injury on the job or of the benefits available in case of injury.

The main variables of interest in this analysis are the respondent's wage, and the workers' compensation benefit level. In this model, the benefit measure used is the income replacement rate, and it is calculated by dividing the expected weekly workers' compensation benefit for temporary total disability by the actual weekly earnings of the respondent. Significant differences in the replacement ratio can arise due to differences in the maximum and minimum benefit levels across states, although for this sample of young adults there is less variation than usual because many of the respondents are not constrained by the minimum and maximum.

Estimates of the parameters of the model specified in equation (6) were obtained separately using the 1984 and 1988 cross-sectional samples. In addition, we constructed a matched sample of respondents present in both years and estimated a model using individually differenced data. All models will be estimated by a two-stage least-squares (2SLS) procedure suggested by James Heckman and Thomas MaCurdy (1985), in which the wage and workers' compensation benefit measure are treated as endogenous.

V. Results

Table 1 lists the parameter estimates of the effect of wages and workers' compensation benefits on drug use. A complete set of results can be found in Kaestner and Grossman (1994). The estimates in Table 1 are not supportive of the hypothesis that drug use affects the probability of having a workplace accident. In contrast to expectations, the estimates of the wage effects are usually positive. This result may reflect an income effect associated with wage changes.

TABLE 1—ESTIMATES OF THE EFFECTS OF WAGES AND WORKERS' COMPENSATION BENEFITS ON DRUG-USE PARAMETER ESTIMATES FROM 2SLS LINEAR PROBABILITY MODEL (STANDARD ERRORS IN PARENTHESES)

	Males		Females	
Variable	Cocaine	Marijuana	Cocaine	Marijuana
A. *1984:*				
Hourly wage (predicted)	0.103†	0.157†	0.043	0.015
	(0.060)	(0.095)	(0.035)	(0.050)
Workers' compensation (predicted)	−0.165	−0.326†	−0.168*	−0.273*
	(0.105)	(0.165)	(0.086)	(0.123)
Number of observations:	1,745	1,745	1,537	1,537
B. *1988:*				
Hourly wage (predicted)	0.044*	0.027	0.354	0.029
	(0.022)	(0.026)	(0.279)	(0.018)
Workers' compensation (predicted)	0.071	−0.076*	0.119†	0.014
	(0.165)	(0.222)	(0.068)	(0.104)
Number of observations:	1,862	1,862	1,529	1,529
C. *1988 − 1984:*				
Hourly wage (predicted)	−0.027	−0.011	−0.000	−0.026
	(0.036)	(0.032)	(0.023)	(0.037)
Workers' compensation (predicted)	−0.098	−0.056	0.068	0.011
	(0.091)	(0.092)	(0.121)	(0.194)
Number of observations:	1,167	1,167	902	902

†$p < 0.10$.
*$p < 0.05$.

This explanation, however, is not consistent with the sign on the coefficient associated with a measure of nonearned income, which in most cases is negative and frequently significant (Kaestner and Grossman, 1994). Thus, the income-compensated wage effect would still be positive. The estimates of the wage effects obtained using the panel data are negative but insignificant. In regard to the workers' compensation benefit measure, most of the estimated coefficients are either negative (cross-section estimates) or insignificant (panel estimates). These results are not consistent with the predictions of the model.

Other variables in the model had the effect that one would intuitively expect. For example, more educated individuals and those who have previously attended religious services frequently have a lower probability of being past-year drug users, while

those respondents who engaged in illegal activities when young and who live in areas with a high crime rate have a greater probability of being a drug user.

VI. Conclusion

In this paper we have developed an alternative strategy to examine the relationship between drug use and workplace accidents. Our empirical results suggest that drug use does not significantly affect workplace accidents and are consistent with other research which examines the relationship between drug use and workplace accidents directly (Kaestner and Grossman, 1994). The results of this analysis are important. It is a commonly held belief that drugs are a significant cause of employment-related accidents, and firms and the government dedicate a significant amount of resources to eradicate drug use by their employees. Our results suggest that this spending cannot be justified on the basis of the relationship between drug use and workplace accidents. It is important to note that, in our analysis of the effects of drug use on workplace accidents, we were comparing drug users to nonusers, and not on-the-job drug users to nonusers. This analysis is quite consistent with the reality of antidrug policies which do not distinguish between on-the-job and off-the-job drug use. This conclusion, however, does not rule out the possibility that drug use on the job can be and has been a cause of accidents. The important issue is whether antidrug policies should be aimed at drug users as a group, or at a more difficult-to-distinguish group, say, on-the-job drug users.

REFERENCES

Hayghe, Howard V. "1988 Bureau of Labor Statistics' Survey of Employer Anti-Drug Programs," in Steven W. Gust, J. Michael Walsh, Linda B. Thomas, and Dennis J. Crouch, eds., *Drugs in the workplace: Research and evaluation data*, Vol. II. Rockville, MD: National Institute on Drug Abuse, 1991, pp. 177–209.

Heckman, James and MaCurdy, Thomas. "A Simultaneous Linear Probability Model." *Canadian Journal of Economics*, February 1985, *18*(1), pp. 27–37.

Hingson, R. W.; Lederman, R. I. and Walsh, D. C. "Employee Drinking Patterns and Accidental Injury: A Study of Four New England States." *Journal of Studies on Alcohol*, July 1985, *46*(4), pp. 298–303.

Holcum, M. L.; Lehman, W. E. K. and Simpson, D. D. "Employee Accidents: Influences of Personal Characteristics, Job Characteristics, and Substance Use in Jobs Differing in Accidental Potential." *Journal of Safety Research*, Winter 1993, *24*(4), pp. 205–23.

Kaestner, Robert. "New Estimates of the Effect of Marijuana and Cocaine Use on Wages." *Industrial and Labor Relations Review*, April 1994, *47*(3), pp. 454–70.

Kaestner, Robert and Grossman, Michael. "The Effects of Illicit Drug Use on Workplace Accidents." Unpublished manuscript, Rider University, 1994.

Mensch, Barbara S. and Kandel, Denise B. "Underreporting of Substance Use in a National Longitudinal Youth Cohort." *Public Opinion Quarterly*, Spring 1988, *52*(1), pp. 100–24.

Normand, J.; Salyards, S. D. and Mahony, J. J. "An Evaluation of Pre-employment Drug Testing." *Journal of Applied Psychology*, December 1990, *75*(6), pp. 660–68.

Zwerling, Craig; Ryan, James and Orav, Endel John. "The Efficacy of Pre-employment Drug Screening for Marijuana and Cocaine in Predicting Employment Outcomes." *Journal of the American Medical Association*, 28 November 1990, *264*(20), pp. 2639–43.