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THE EFFECTS OF JOB SITE SANITATION
AND LIVING CONDITIONS ON THE HEALTH AND WELFARE
OF AGRICULTURAL WORKERS

by

George Frisvold, Richard Mines, and Jeffrey M. Perloff

Frisvold, G. B., R. Mines, and J. M. Perloff.--"The Effects of Job Site Sanitation and Living Conditions on the Health and Welfare of Agricultural Workers"

The lack of field sanitation on agricultural job sites increases the probability of agricultural workers reporting gastrointestinal disorders by 60 percent. Adverse living conditions significantly increase the probability of gastrointestinal, respiratory, and muscular problems. These three health problems do not appear to increase the probability that a worker's family is on welfare or to lower workers' earnings. Respiratory problems, however, substantially increase the probability that the worker receives unemployment compensation. American Journal of Agricultural Economics, November 1988.

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The Effects of Job Site Sanitation and Living Conditions

On the Health and Welfare of Agricultural Workers

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Abstract

The lack of field toilets on agricultural job sites increases the probability of gastrointestinal disorders by 60%. Adverse living conditions significantly increase the probability of gastrointestinal, respiratory, and muscular problems. These three health problems do not appear to increase the probability that a worker's family is on welfare or lower workers' earnings. Respiratory problems, however, substantially increase the probability that the worker receives unemployment compensation.

**The Effects of Job Site Sanitation and Living Conditions
on the Health and Welfare of Agricultrual Workers**

A survey of hired agricultural workers in Tulare County, California was
used to examine whether job site sanitation rules are enforced, the effects of
lack of sanitation and other factors on health, and the resulting effects of
poor health on earnings and the use of the welfare system. These issues have
not been quantified despite a vociferous debate between the U. S. Department
of Labor and labor groups over the necessity of farm sanitation standards.[1]

After 12 years of pressure by labor groups, in 1984 the Occupational
Safety and Health Administration (OSHA) rejected the requirement that farmers
provide sanitation to fieldworkers. In 1985, the Secretary of Labor called
for action by the states. At that time, however, only 13 states had sanita-
tion standards and studies by Congress and OSHA indicated that there was
little compliance or enforcement. Moreover, a report by a panel of public
health experts commissioned by the Labor Department stated that American farm
workers suffer rates of infection comparable to those of Third World peasants
and that these problems are largely due to employers' failure to provide
drinking water, toilets, and a place to wash hands.

In 1987, in response to a suit brought by various workers groups, the
U. S. Court of Appeals for the District of Columbia found that the Secretary
of Labor had abused his discretion by leaving protection to state regulators.
The agriculture exception was remarkable, the court said, since every other
type of employee is covered by such standards. Currently, 19 states have
their own field sanitation rules, but these rules will be preempted by new
federal standards if the federal ones are stricter. Federal standards are

binding in states without any rules of their own. As the Department of Labor has announced it will put a low priority on enforcing these rules, the problems associated with poor sanitation are likely to continue.

To determine the magnitude of these problems, we examine the impact of job site sanitation and other factors on three health health problems -- gastrointestinal (GI) disorders, respiratory problems, and muscular problems. Of the three, GI disorders are the diseases most likely to result from poor sanitation conditions. Since such disorders are similar to those caused by intestinal parasites that workers could bring from Mexico or that could result from poor sanitation in a worker's living environment, we used statistical techniques to isolate the effects of poor sanitation in the work environment.

Even if poor sanitation leads to physical discomfort, the health problems may not have a a significant impact on an individual's ability to work productively. If these health problems are debilitating, individuals suffering from them should be more likely to be on welfare or unemployment compensation or to have lower earnings. This hypothesis is tested in a model where the probability of being in a welfare program and earnings are a function of personal characteristics and poor health.

The next section discusses the survey and the data set utilized in this study. The following section, describes the estimation techniques used. Next, three probit equations for gastrointestional disorders, repiratory problems, and muscular problems conditional on measures of demographic characteristics, living environment, and work environment are presented. Conditional on these health measures, the probability of receiving welfare (including food stamps)

or unemployment compensation is calculated. Next, the effect of these health measures on earnings is examined. The paper concludes with a discussion of the policy implications of these findings.

The Data

Our data come from Mines and Kearny's 1981 survey, "The Health of Tulare County Farmworkers," sponsored by the Tulare County Department of Health. Interviewers chosen to administer the questionnaire were fluent in colloquial Spanish and either had farmwork backgrounds or had extensive familiarity with farmworkers.

This farmworker population largely consists of Mexican-born immigrants with varying degrees of experience with and assimilation into American society. While a large segment of the population -- the long-term settled immigrants -- have relatively stable living and employment conditions, many of the more recent immigrants do not.

The recent immigrants are primarily young Mexican families or "lone Mexican males" (males unaccompanied in the United States by their wives, children, or parents). These workers are usually hired by crew leaders or foremen who work for several growers, associations, or packing houses. As a result, the immigrants frequently change from job to job on a daily or weekly basis. Many workers frequently switch crew leaders as well during the season. These mercurial employment conditions are often associated with informal housing arrangements including make-shift shacks, public and private labor camps, and overcrowded apartments in small towns. Many such residences provide inadequate sanitation and food preservation facilities.

Many of the survey population are foreign nationals without visas. The threat of apprehension by the Immigration and Naturalization Service induces these workers to be wary of government agencies. Thus, even when such workers are located, they are reluctant to provide comprehensive information to government officials about their employment or legal status. Moreover, most county and other government officials these immigrants meet are non-Hispanic and do not speak Spanish (Mines & Kearney). As a result, more general government surveys often overlook this farmworker population, which is probably exposed to greater health risks than other groups.

This study is restricted to the 367 farmworkers who are the reported head of their household for whom no data are missing on key variables (78% of the heads of households). Table 1 presents the means and standard deviations and formal definitions for the variables used in the analysis. The average worker is a 34 year old male, has lived in Tulare County for nearly 9 years, has access to a refrigerator and water at home, consumes nearly 8 beers a week and 5 cigarettes, has travelled to Mexico to visit his family 1.3 times in the last 5 years, has an observed family of 4 people, has a 1 in 5 chance of having been deported in the last year, is probably a harvester of grapes or citrus, and has a 30% chance that he lives in either a field or a public or private camp. Of these workers, 57% do piece work, 25% receive unemployment compensation, and 17% of their families receive welfare payments.

Workers reported whether or not they exhibited various acute or chronic health problems at least once a month, and these self-reported illness are not separately confirmed. These problems are coded as binary dummy variables. As a result, each of these health variables captures both serious and relatively

minor problems. The probability that a worker reports a GI problem is 17%; a respiratory problem, 26%; and a muscular problem, 50%. (See Mines and Kearney for more details on the survey and variable definitions.)

The average values for these health variables are virtually the same for the 308 people who were born in Mexico and the 59 who were not. Of the 82 lone Mexican males in the sample, 22.0% had a GI problems, 48.8% had a respiratory problem, and 59.8% had a muscular problem; compared to 15.4%, 20.0%, and 47.4% for the rest of the sample. The figures for the 24 people who lived in public camps are 33.3%, 41.7%, and 75.0%, respectively.

The Model

A model with six equations is used to study the health and welfare of hired agricultural workers. The three (ill) health variables are functions of individual characteristics and home and job site conditions. The two welfare measures and earnings are functions of individual characteristics and health.

As in Lee (1982), the health variables are viewed as continuous but unobservable. Each of the three unobservable health indexes, H_i (i = GI disorders, repiratory problems, and muscular problems), is normalized so that:

$$(1) \qquad\qquad H_i = X\beta_i + \varepsilon_i,$$

where X is a vector of personal characteristics and living and working conditions of a worker, β_i is a vector of coefficients for the ith health measure, and ε_i is distributed normal with mean zero and variance one.[2] If H_i is positive, the observed binary response variables, h_i, take on a value of one, and is zero otherwise.

A probit model is used to measure the incidence of adverse symptoms, where the probability of reporting a health problem, P_i, is:

$$(2) \qquad P_i = P(0 \leq H_i) = F(H_i),$$

and F is the normal cumulative distribution function. The larger the value of H_i, the greater the probability that a farmworker will report a health disorder ($h_i = 1$).

The welfare and earnings indexes are also continuous, unobserved variables, W_j (j = welfare, unemployment compensation, and earnings). They are a function of exogenous personal characteristics and living and working conditions, Z, and the health variables, h_i:

$$(3) \qquad W_j = ZY_j + \sum_{i=1}^{3} h_i \delta_i + n_j.$$

If the welfare or unemployment compensation indexes are positive, then the individual's family received payments as reflected by a binary, observed variables that take on the value one. If the earnings index is positive, earnings equal the index; whereas, if the index is negative, earnings equal zero.

The welfare and unemployment compensation equations can be consistently and efficiently estimated using standard probit methods under the null hypothesis that the health variables are uncorrelated with the n_j terms. Under the alternative hypothesis of correlation, a nonlinear instrumental varibles technique may be used to obtain consistent estimates.

A Hausman test may be used to test the null hypothesis of no correlation. The variance-covariance matrix for the instrumental variable technique was calculated based on a variant of the Amemiya technique for probit equations in Lee (1981). The Hausman tests statistics were 1.14 for the unemployment compensation equation and 2.16 for the welfare equation. Since $\chi^2_{.05}(1) = 3.84$, we cannot reject the null hypothesis in either case, so standard probit estimation techniques were used. An analogous Hausman test statistic for the earnings equation was 3.04, so a standard tobit estimation technique was used.

Health Empirical Results

The health probit equations were estimated first. We expect GI problems to be a function of sanitary conditions (i.e., whether toilets are provided). There is no reason to expect respiratory or muscular problems to result from the lack of sanitary conditions; however, that variable is included as a proxy for other dangerous working conditions. Thus, all the health probits use the same right-hand side variables.

Gastrointestinal Disorders

Table 2 shows the estimation results for the three probit equations. As expected, the sanitary workplace variable (the presence of field toilets) is statistically significant at the 0.05 level in determining gastrointestinal disorders. A hypothesized sample selectivity problem -- that individuals who work for a firm that did not provide toilets were not randomly selected -- was rejected.[3] For a worker with average characteristics, not having a toilet on the job increases the probability of GI disorders by 7.8 percentage points (from 13.1% to 20.9%). That is the probability of having the disorder increases by 60% (20.9/13.1 = 1.60).[4]

Although the survey only recorded the presense or absence of a job site toilet, this variable probably represents the effects of the lack of toilets, fresh drinking water, and water for washing hands. That is, the lack of toilets is believed to be highly correlated with the lack of water for drinking and washing.

Other statistically significant variables also have substantial effects on the probability of having a GI disorder. Compared to the typical worker, a female worker's probability of having a GI disorder is 127% higher than a male's (19.3 percentage points higher). Interviewers reported, however, that females were more likely to complain about both major and minor illnesses than men, so that this difference may be due to reporting difference rather than difference in health. Similar results were found in Wisconsin (Slesinger and Cautley).

Not having a refrigerator tripled the probability (43.3% versus 13.4%). An individual who lives in a public camp has a 325% higher probability (42.8 percentage points differential) of GI disorders. A worker who lived in Mexico six months ago has a 136% higher probability (17.6 percentage points) of disease. The likelihood-ratio test statistic that none of the household amenities matter (water, refrigeration, and toilets in the home) equals 8.46 and hence that hypothesis is rejected at the 0.05 level.

Since there are only 35 households headed by a female or lacking a refrigerator and these variables have large coefficients, the health equations were reestimated dropping those families. The resulting equations were virtually identical in terms of the effects of on the remaining variables on the proba-

bility of health problems and the asymptotic t-statistics. Based on this weak robustness test, including these two variables and the entire sample does not qualitatively alter the probit estimates.

The elasticity of the probability with respect to the number of times an individual has been deported in the last year, at the sample means, is -0.16. The sign of this variable is puzzling. Other variables that are significant at the 0.10 level include the number of times one visited his or her family in Mexico in the last five years, which has the expected positive effect, and whether one is a non-Mexican foreigner, which has a positive effect.

This equation correctly predicts the health of 84% of the sample, but is over-likely to predict that one does not have the disorder. This over-prediction of health is not surprising since only 17% of the sample have GI problems, and probits typically have difficulty predicting relatively rare events -- that is, events on the tail of the distribution. Four pseudo-R^2 measures (see Maddala (1977) and Hensher and Johnson (1981)), which range from 0.10 to 0.17, are reported in Table 2. These measures do not have the usual ordinary least squares interpretation.

McFadden has suggested an alternative measure of goodness of fit for an estimated dichotomous model called a prediction success index. This index compares the proportion successfully predicted for an alternative compared to that which would be predicted by chance.[5] This model's prediction success index is 0.12. These results suggest that being exposed to a bacteria, parasite, or virus in Mexico; lacking sanitation at work; lacking refrigeration at home; other living and working conditions; and gender are the primary factors in determining gastrointestinal problems, but not the only ones.

Respiratory Problems

Only two factors appear to explain respiratory problems. First, and most statistically significant (asymptotic t-statistic = 5.12), is whether the individual is a lone Mexican male worker (the interaction between the Mexican, male, and no family in Tulare County dummy variables). Nearly half (49%) of the lone Mexican male workers, who comprise 29% of the sample, reported respiratory problems, compared to 20% of the rest of the sample. The corresponding figures for GI problems are 22% versus 15%; and for muscular problems, the figures are 60% versus 47%.

These lone males are the workers most likely to have recently immigrated from Mexico. They have lived in Tulare County for an average of only 3.4 years compared to 10.5 years for the rest of the sample. Controlling for other factors, a lone Mexican male has a 46.8% probability of having a respiratory problem compared to 15.4% for other males (with average characteristics).

The second factor that is statistically significant (at the 0.10 level) is whether the individual lives in a public camp. Compared to a worker with average characteristics, someone who lives in a public camp is 83% more likely to have respiratory problems (19.1 percentage points higher).

The sanitary work conditions variable serves as a proxy for other job-related dangers. It was not a statistically significant determinant of respiratory problems, however.

The pseudo-R^2 measures vary between 0.11 and 0.18. The percentage of correct predictions is 73%, while McFadden's prediction success index is 0.13.

As an experiment, we added to the basic specification crop (citrus, nuts, berry, field crops, and others) and occupation (harvesting, spraying, other) variables. The coefficient on spraying is positive with an asymptotic t-statistic of 1.86, so that it is statistically significantly different from 0 at the 0.10, but not the 0.05 level. No other occupational or crop coefficient had an asymptotic t-statistic higher than 0.9. The explanatory power of that probit was about the same as the basic specification. Since this extended model produces similar results to the basic model, none of the crop and occupational variables have asymptotic t-statistics that are different from zero at even the 0.10 level in the other equations, and these variables may be endogenous, only the basic equations are reported.[6]

Respiratory problems, then, are primarily associated with lone Mexican males, but not with any particular living or working condition except, possibly, spraying and public camps. The factors that put lone Mexican males at greater risk of respiratory problems than others are unknown.

Muscular Problems

The results indicate that muscular problems have six statistically significant determinants. The number of deportations has an elasticity at the means of 0.05, while the number of trips to visit relatives in Mexico has an elasticity at the means of 0.08. Presumably these variables are correlated with being a worker who changes employers frequently and who lives in rough conditions, not otherwise measured. The same explanation of frequent employment changes can be applied to the lone Mexican male variable (38% higher probability), whether one lived in Mexico six months previously (49% higher), and the public camp variable (57% higher) as well.

Finally, males are 41% less likely to have muscular problems. This varia-
ble may reflect physiological differences, since males are more likely to have
jobs involving heavier lifting. Females may do jobs that involve more bending
over and may suffer from muscular problems relating to giving birth to and
raising children or they may report problems more frequently than men.

Again, the sanitary work conditions variable was included as a proxy for
other dangers at the workplace. However, it did not have a statistically
significant effect. The pseudo-R^2 measures range between 0.10 and 0.17. The
percentage correctly predicted is 64.6, while McFadden's prediction success
index is 0.13.

Apparently workers who change jobs often suffer from more muscular prob-
lems, although that factor is only indirectly measured in our sample. Pre-
sumably they work at jobs that involve more muscular strain or live in worse
conditions that are not measured explicitly by the sample questions. Again,
no particular crop or activity (harvesting, spraying, other) is statistically
significantly related to muscular problems.

Thus, individual characteristics and home and job site conditions have
statistically significant effects on three health problems. It is possible,
however, that these health problems do not have a significant impact on an
individual's ability to work productively. If these health problems are
debilitating, individuals suffering from them should be more likely to be
partially or totally unemployed or to be less productive on the job. These
effects should be reflected in higher probabilities of being on welfare or
unemployment compensation or to have lower earnings.

Welfare Program Empirical Results

We first test the hypothesis that ill-health contributes to higher par-
ticipation in welfare programs and then the earnings effects are considered.
Both welfare and unemployment compensation are modeled as functions of per-
sonal characteristics and the three health problems.

The sample includes a disproportionate number of employed agricultual
workers, so the following results probably underestimate the full effect of
ill-health for the population at large. Further, since only three health
problems are studied, all ill-health effects are not captured. Indeed, severe
health problems were excluded because their effects are self-evident. Since
our database does not contain information about the eligibility of individuals
or families for the programs, the participation rates examined in the follow-
ing equations reflect the combined effects of being eligible and applying to
the programs.

Welfare

No evidence was found that GI, respiratory, or muscular problems of the
head of the household affected the probability that the worker's family would
receive welfare payments (public assistance or food stamps). The probit
equation reported in table 3 shows, however, that three other variables had a
statistically significant effect at the 0.05 level. First, if the head of the
household were male, the probability of receiving welfare is 11% lower than if
the head is female.

Second, Mexican born workers had a probability of receiving welfare of
only about one third that of others. Third, if family size grows by one
person, the probability of being on welfare goes up by about a fifth or 3

percentage points. Lone Mexican males do not have a statistically signifi-
cantly lower probability of being on welfare than Mexican-born males with
families in the United States.

The pseudo-R^2 measures for this equation ranged from 0.10 to 0.18. McFad-
den's prediction success index is 0.11 and 85% of the sample were correctly
predicted. This equation predicts fewer people are on welfare than is actually
the case.

Unemployment Compensation

The only health problem to have a statistically significant effect on the
probability of receiving unemployment compensation payments is respiratory
disorders, as shown in table 3. Having a respiratory problem causes the
probability of being on unemployment compensation to rise by two-thirds, or
16.5 percentage points.

An individual born in Mexico is twice as likely to be on unemployment
compensation as others. A lone Mexican male with average characteristics,
however, has a 5.3 percentage point lower probability of receiving unemploy-
ment compensation than those not born in Mexico and 32.9 percentage points
lower probability than other Mexican born individuals. Lone males are more
likely to be ineligible for compensation compared to other workers. The more
years of school one has, the higher the probability of receiving unemployment
compensation, presumably because such people are more likely to understand how
to qualify for such assistance. An extra year of schooling raises the proba-
bility by 2 percentage points.

The pseudo-R^2 measures for this equation range between 0.11 and 0.17. The
McFadden prediction success index is 0.11, while 75% of the observations are
correctly predicted by this equation.

Earnings

We also examined whether these three relatively nondebilitating medical problems affected earnings of the heads of households, where earnings (cents per day) are defined as the sum of the worker's daily piece rate earnings and wages. Since five individuals in the larger sample reported implausible earnings, a sample of 362 individuals was used in the tobit regression reported in in table 4. Thirty-one of these individuals (8.6%) had zero earnings. This figure is lower than the percentage on unemployment compensation (24.8%) or welfare (16.6%).

The explanatory variables include demographic characteristics (age, which captures physical strength and experience; sex; formal education; birthplace; lone Mexican male; and union); how long the worker had lived in Tulare County (a proxy for knowledge of and contacts in the local labor market); and the three health variables. None of the three health measures had a statistically significant effect.

Indeed, only the age variables had statistically significant effects. Earnings rise with age until one reaches 35.6, then they fall with age. The effects, however, are small. A 45 year old worker only earns $1.31 less per day than one who is a decade younger and a 55 year old worker earns $5.58 less a 35 year old worker.

Thus, in our sample, agricultural earnings do not vary much with respect to personal characteristics. Other studies of agricultural workers (e.g., Perloff) find substantial effects of union status and personal charcteristics on earnings. The difference across studies is probably due to the relative homogeneity of our sample, which was restricted to field workers in crop

agriculture. Many census-based surveys also include dairy, livestock, and non-field worker employees. The narrowed focus of this survey explains the lack of impact of gender, education, or other factors on earnings. Further, in the surveyed county, unions have relatively little market power.

A measure of job sanitation could be included in the earnings equation to capture a compensating earnings differential for more sanitary employment. Including a dummy variable for sanitary conditions has virtually no effect on the other coeffients. The coefficient on the sanitation dummy is 0.0844 with an asymptotic t-statistic of 0.68. Thus, there is no evidence of a compensating differential.

Concluding Comments

Five major policy-oriented conclusions can be drawn from this study. First, in spite of California law mandating field toilets, over a quarter of all Tulare County workers, and half of workers younger than 20, did not have access to toilets. Second, as was expected, unsanitary work conditions, as reflected by the lack of field toilets, led to substantially higher rates of gastrointestinal disorders. However, the lack of sanitary conditions on the job is not a proxy for other dangerous conditions that cause respiratory or muscular problems. Third, living conditions also greatly affect health. Although the lack of a home toilet did not have a comparable effect, the lack of a home refrigerator more than tripled the probability of gastrointestinal problems.

Fourth, only respiratory problems, of these three health variables, lead to higher unemployment compensation rates. None of the three health variables was statistically significantly related to either receiving welfare or lower

daily earnings. Fifth, Mexican-born agricultural workers and their families were (as of 1981) relatively unlikely to use the welfare system. However, these workers were relatively more likely than others to receive unemployment compensation.

These results indicate that the probability of gastrointestinal disorders can be substantially reduced by improving living conditions (providing refrigerators) and job site sanitation. While these disorders apparently are not severe enough to reduce earnings or increase demands upon the welfare system, they lower workers' standard of living.

Similarly, the standards at public camps should be examined more closely. Although such camps are subject to routine health inspections, whereas private camps are not, only public camps are associated with health problems in this sample. Indeed, inhabitants of public camps had over 4.25 times as high a probability of gastrointestinal disorders, 1.8 times as high a probability of respiratory problems, and 1.6 times as high a probability of muscualar problems as those who lived elsewhere.

The net welfare effect of improving work place sanitation depends on (a) the value workers' place on such amenities, (b) the costs to employers of providing sanitation, (c) the negative effects of disease on labor productivity, and (d) the societal cost of treatment of disease symptoms. Dunn has shown that the value workers put on field toilets is greater than the cost of providing them (points (a) and (b)).

These results indicate that the productivity losses from the three dis-
eases studied are relatively minor, as wages are little affected (c).[7]   Thus,
although Dunn's study shows that workers value field toilets six times as much
as the cost of providing them, this study failed to find additional benefits
due to the improvement in societal output.

Given the nature of the data set, we are unable to obtain precise measures
of the social cost of providing medical care (d). The cost to workers at
local public clinics ranged from $12 up per visit. These costs exclude medi-
cine, physician time, and the externality cost on local facilities (Mines and
Kearney). Consideration of these factors can only strengthen the case for
providing more sanitation on the job.

This study shows additional social benefits of reduced respiratory illness
due to lesser demands on the unemployment compensation system, an issue large-
ly ignored to date. Since many adverse living conditions contribute to all
three types of disease, the public policy debate should also consider the
costs and benefits of ameliorating living conditions, particularly for sea-
sonal workers.

Table 1

Variable Defintions, Means, and Standard Deviations for

367 heads of households employed in agricultural field work

Dependent Variables:		Sample Means	Standard Deviation*
Health Problems:	Self-reported to occur at least monthly		
Gastrointestinal	diarrhea, vomiting, stomach pains	0.169	
Respiratory	asthma [wheezing], coughing, shortness of breath, tuberculosis	0.264	
Muscular	backache, arthritis, rheumatism	0.501	
Welfare Programs:	Received payments within the last year		
Welfare	public assistance and food stamps	0.166	
Unemployment Compensation		0.248	
Agricultural Earnings:			
Earnings/day (¢)**	piece work earnings + wages (includes workers who earned zero)	3339.2	1571.4
Exogenous and Predetermined Variables:			
Demographic and Experiences Variables:			
Age		34.025	12.247
Male	1 if male; 0 otherwise	0.935	
Born in Mexico	1 if true	0.839	

Lone Mexican Male	1 if Mexican male with no family in Tulare County	0.223	
Other Foreign born	1 if non-Mexican foreigner	0.049	
Cigarettes/Week	average number per week	4.872	9.544
Beers/Week	average number per week	7.687	10.045
Number of Times Deported	Number of times the individual was deported in the last 5 years	0.204	0.708
Trips to Mexico	Vacations to Mexico last 5 years	1.341	1.989
In Mexico 6 Months Ago	1 if individual was living in Mexico 6 months ago	0.076	
Years in Tulare	Years lived in Tulare County	8.935	8.218
Education	Years of formal education	4.534	3.387
Union	1 if a union member	0.074	
Household Size	as counted by survey taker	3.804	2.429

Living Conditions:

Water in Home	1 if drinkable tap water	0.946	
Toilet in Home	1 if toilet in home	0.918	
Refrigerator in Home	1 if refrigerator	0.970	
Field	1 if lives in field	0.057	
Private Camp	1 if lives in private camp	0.229	
Public Camp	1 if lives in public camp	0.065	

Type of Work:

Harvesting	1 if occupation is harvesting	0.840	
Spraying	1 if occupation is spraying	0.011	
Other	1 if occupation is other agricultural	0.139	

Citrus	1 if crop is citrus	0.286
Deciduous/Nuts	1 if crop is deciduous/nuts	0.109
Berry & Truck	1 if crop is berry & truck	0.011
Field crops	1 if crop is field crops	0.049
Grapes	1 if crop is grapes	0.338

Job Site:

| Sanitary Conditions | 1 if toilet provided | 0.730 |

[Field toilets are required under California Law]

*   Standard Deviations are only given for continuous variables.

** Sample size is 362 for earnings.

Table 2

Health Probit Equations

	Gastrointestinal Problems		Respiratory Problems		Muscular Problems	
		Asymptotic		Asymptotic		Asymptotic
	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio
Age	-0.0210	-0.55	-0.0283	-0.81	0.0536	1.62
Age Squared	0.000168	0.37	0.000419	1.01	-0.000637	-1.61
Male	-0.734	-2.37	0.0734	0.23	-0.956	-3.01
Lone Mexican Male	0.0793	0.33	1.102	5.12	0.454	2.23
Born in Mexico	0.0718	0.26	-0.283	-1.17	-0.307	-1.34
Other Foreign Born	0.806	1.82	0.283	0.71	-0.254	-0.65
Beers/Week	0.00256	0.29	0.00421	0.54	-0.00599	-0.82
Cigarettes/Week	0.0102	1.22	0.00368	0.46	0.0139	1.84
Times Deported	-0.494	-2.10	-0.0302	-0.28	0.289	2.53
Trips to Mexico	0.0716	1.79	0.0410	1.11	0.0731	2.08
In Mexico 6 Months Ago	0.620	1.95	-0.466	-1.45	0.640	2.10
Lives in Field	0.244	0.68	-0.504	-1.36	0.138	0.45
Refrigerator in Home	-0.934	-2.05	-0.594	-1.38	-0.614	-1.37
Water in Home	-0.242	-0.60	0.268	0.66	0.476	1.35
Toilet in Home	-0.221	-0.67	0.412	1.21	0.116	0.38

Field Toilets

on Job	-0.379	-2.03	0.269	1.46	0.0988	0.62
Private Camp	-0.287	-1.24	-0.024	-0.12	-0.203	-1.13
Public Camp	0.719	2.30	0.542	1.89	0.756	2.50
Constant	1.489	1.52	-0.696	-0.79	-0.181	-0.21

Log-Likelihood Function	-147.52	-188.89	-229.70
Likelihood Ratio Test			
(zero slopes)	38.35	46.11	49.36
Degrees of Freedom	18	18	18

Pseudo R^2 Measures:

Chow	0.12	0.12	0.12
Maddala	0.10	0.12	0.13
Cragg-Uhler	0.17	0.17	0.17
McFadden	0.12	0.11	0.10

Prediction Success Table

Actual

		0	1	0	1	0	1
	0	302	56	249	77	133	80
Predicted	1	3	6	21	20	50	104

Percentage of Correct Predictions	0.84	0.73	0.65
McFadden's Prediction Success Index	0.12	0.13	0.13

Table 3

Unemployment Compensation and Welfare Probit Equations

| | Received Unemployment Compensation | | Received Welfare | |
	Coef	Asymptotic t-ratio	Coef	Asymptotic t-ratio
Age	0.0698	1.86	0.0209	0.44
Age Squared	-0.000749	-1.67	-0.000389	-0.68
Male	-0.237	-0.60	-0.623	-1.93
Lone Mexican Male	-0.920	-3.44	-0.214	-0.68
Born in Mexico	0.745	2.64	-0.653	-2.32
Other Foreign Born	0.746	1.73	-5.729	-0.01
Education	0.0631	2.50	0.00428	0.15
Household Size			0.121	2.41
Years in Tulare County	0.00800	0.69	-0.00613	-0.45
Gastrointestinal Disorder	-0.349	-1.55	-0.0716	-0.30
Respiratory Problem	0.461	2.46	-0.101	-0.48
Muscular Problem	-0.110	-0.68	-0.0382	-0.21
Constant	-2.936	-3.42	-0.449	-0.48
Log-Likelihood		-183.43		-146.38
Likelihood Ratio Test (zero slopes)		44.24		37.42
Degrees of freedom		11		12

Pseudo R^2 Measures:

Chow	0.11	0.11
Maddala	0.11	0.10
Cragg-Uhler	0.17	0.18
McFadden	0.11	0.12

Prediction Success Tables

Actual

	0	1	0	1
Predicted 0	268	84	304	54
Predicted 1	8	7	2	7

Percentage of Correct Predictions	0.75	0.85
McFadden's Prediction Success Index	0.11	0.11

Table 4

Tobit Equation of Daily Earnings (cents)

of Tulare County Agricultural Workers

	Normalized coefficient	Asymptotic t-ratio	Regression coefficient
Age	0.0638	2.58	105.23
Age Squared	-0.000897	-3.04	-1.479
Male	-0.319	-1.44	-526.06
Lone Mexican Male	0.152	0.95	249.82
Born in Mexico	0.185	0.93	304.58
Other foreign born	0.305	0.96	502.16
Education	0.0195	1.09	32.106
Union	-0.122	-0.59	-200.52
Gastrointestinal Disorder	-0.271	-1.88	-477.55
Respiratory Problems	0.169	1.29	277.79
Muscular Problems	-0.0867	-0.77	-142.86
Constant	0.934	1.67	1539.8

Normalized coefficient of dependent variable = 0.000607

Standard error of dependent variable = 0.0000243

Predicted probability of nonlimit earnings = 0.977

Actual observed frequency of nonlimit earnings = 0.914

At the mean value of all right-hand-side variables, expected earnings = 32986

Standard error of the estimate = 1648.5

Mean-square error = 2317555.6

Mean error = -37.23

Squared correlation between observed and expected values = 0.06

Footnotes

[1]The following description is based on: Ward Sinclair, "Toilet Rules: Down the Drain, Farm sanitation standards for field hands dropped," Washington Post National Weekly Edition, April 29, 1985, p. 33; Dunn; Associated Press, "Key Court Ruling Backs Farm Workers," San Francisco Chronicle, February 7, 1987, p. 7; Kenneth B. Noble, "U.S. Told to Set Sanitation Rule for Field Hands: Court Acts to Guarantee Facilites for 500,000," New York Times, February 7, 1987, p. 1; and Robert L. Jackson, "Improved Sanitation for Farm Workers Ordered," Los Angeles Times, Februrary 7, 1987, Part I, p. 1.

[2]Many of the personal characteristics (e.g., family size) and living and working conditions could be viewed as endogenous decisions. These variables cannot be well-explained by other variables in the data set, however. As a result, they are treated as exogneous or predetermined.

[3]The hypothesis that there is a sample selection bias was tested by using a maximum likelihood technique (in William Greene's LIMDEP program) to simultaneously estimate a pair of probit equations. The first equation was a probit explaining who worked for a firm that provided toilets conditional on personal characteristics, while the second equation was the GI equation specified in Table 2. If the errors in these equations are correlated, then there will be a sample selection bias from treating the GI variable as exogenous. Since the correlation coefficient was -0.000043 with an asymptotic standard error of 8.01, the sample selectivity hypothesis was rejected. Unfortunately, the power of this test is not known.

The only statistically significant coeffients in the probit explaining who worked for a firm that provided toilets were related to age. The probability of working for a firm that provides toilets increases with age until one is 33.9 and then decreases. The youngest workers have the lowest probabilities of working for a firm that provides toilets (only 50% of workers less than 20 work for such firms).

[4]Instead of evaluating at sample means, the means could be rounded to zero or one for the dummy variables. The calculations reported here and below, however, are little changed if this alternative method is used. Such a typical worker is a 34.14 year old male; has a refrigerator, toilet, and fresh water at home; smokes the average number of cigarettes per week (4.956) and drinks the average number of beers (7.773); has lived in Tulare County for 8.943 years; does not live in a field or camp; has visited his family in Mexico once in the last five years, but has not been in Mexico in the last six months; and has access to a toilet on the job.

[5]See Hensher and Johnson for a discussion. The overall prediction success index equals $\Sigma \ [(N_{ii}/N_{..}) - (N_{.i}/N_{..})^2]$, where N_{ii} is the number correctly predicted to be in group i, $N_{.i}$ is the total number of individuals predicted to be in group i, and $N_{..}$ is the sample population. This index is nonnegative with a maximum value of $1 - \Sigma \ (N_{.i}/N_{..})^2$. Normalizing using this maximum value, the index has a maximum value of 1.

[6]No crop or occupational variable was statistical significant at even the 0.10 level in the other health probits.

[7]These results are consistent with Baldwin and Weisbrod's study, which found

few statistically significant effects of parasitic disease on labor productiv-
ity of agricultural workers in St. Lucia.