Health Insurance Coverage for Pennsylvania Dairy Farm Managers

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A survey of more than 1200 Pennsylvania dairy farm managers showed that almost 20% of those managers do not have health insurance. Of those farm managers with health insurance, 67% had insurance acquired through the farm business. Farm characteristics and demographic information were used to determine indicators of health insurance coverage. Age, education, net farm income, off-farm income, milk marketing cooperative membership, and intensity of hired labor use all had significant effects on the likelihood of having health insurance and on whether such insurance was provided by the farm business.

The recent debate over comprehensive health insurance coverage has brought to light the lack of health insurance coverage for many residents of rural America. Health insurance for the self-employed is expensive, and farmers pay higher premiums because of the relative health risk in their profession (Frenzen 1993; Jensen and Saupe 1987; Kralewski, Liu, and Shapiro 1992). Furthermore, profit margins for dairy farms have tightened in recent years, often leaving little income for family living expenses. A 1992 survey of 1,237 Pennsylvania dairy farm managers indicated that almost 20% of the farm managers did not have health insurance (Gripp et al. 1993).

If public policy is to address the lack of health insurance on many farms, it is instructive to examine what farm and farm manager characteristics are likely to indicate who has health insurance coverage. With such information, policymakers will be better able to target policies to achieve public goals for insurance coverage for this segment of the rural population. The objective of the research presented in this paper is to analyze these determinants of having health care coverage and whether the farm operation provides it. After the significant determinants are identified, this information can be used by policymakers to improve health insurance coverage to rural farm families. Data from a 1993 survey of Pennsylvania dairy farm managers will be used in the analysis.

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Previously Reported Research

Theoretical models of insurance demand arise from the maximization of an expected utility function with wealth as an argument (Henderson and Quandt 1980; Robison and Barry 1987). Resulting models of insurance demand are increasing functions of the wealth at risk, Pratt-Arrow measures of risk aversion, and probabilities of loss. Empirical studies have approached the demand for health insurance through the maximization of consumer-expected utility subject to budget constraints (Farley and Wilensky 1983; Feldstein and Friedman 1977; Feldstein 1988; Friedman 1974; Gertler and van der Gaag 1990; Holmer 1984; Keeler, Morrow, and Newhouse 1977; Manning et al. 1987; Marquis and Holmer 1986; Rosko and Broyles 1988; Ward 1975). Insurance demand was found to be an increasing function of initial wealth, expected losses, and risk aversion, and a decreasing (inelastic) function of price. Other research has shown that the tax treatment of employer-paid fringe benefits has a positive effect on the demand for health insurance through their net negative impact on price (Feldstein and Friedman 1977; Holmer 1984). Other demographic factors that have sometimes been shown to have a positive effect on the demand for health insurance include age, education, and income (Bennefield 1994; Kralewski, Liu, and Shapiro 1992; Jensen and Saupe 1987; Loprest and Gates 1993).

Previously reported research suggests that a statistical model of health insurance coverage can be estimated that would have health insurance coverage affected positively by wealth at risk, risk aversion, probability of loss, age, education, income,

and negatively by price. The following section describes survey data used in the development of two empirical models based on these findings.

Pennsylvania Dairy Farm Data

A telephone survey with 1,237 Pennsylvania dairy farm manager respondents (defined as having a herd size of ten or more dry and lactating cows) was conducted from December 1992 to March 1993 (Gripp et al. 1993). The survey was conducted to provide a broad overview of the Pennsylvania dairy industry. In the survey, Pennsylvania dairy farm managers were asked if they had health insurance and, if they did, how it was provided. Respondents could indicate more than one provider of health insurance. A response rate of 46.9% percent was achieved, using the Modified CASRO Estimator formula (Gripp, Luloff, and Yonkers 1994).

Overall, 19.7% of the responding Pennsylvania farm managers did not have health insurance, which is a higher level than found in previous studies (table 1). A 1989 study of Minnesota farm families found only 6.6% with no insurance and 2.7% who had some household members uncovered (Kralewski, Liu, and Shapiro 1992). A study of Wisconsin farm families in late 1992 found 11.6% of the farm population with no health insurance (Slesinger and Monson 1993). These results from Pennsylvania, Minnesota, and Wisconsin are below national estimates of 25.9% of the rural agricultural population being uninsured (Kralewski, Liu, and Shapiro 1992) and 28.3% reported by Bennefield (1994). However, the Pennsylvania estimate is above the 11.4% reported by De Jong, Cornwell, and Steven (1994) for all Pennsylvanians, the 15% cited by Cutler (1994) for the U.S. population, and the 17% cited by Garkovich and Harris (1994) for rural America.

Of those with health insurance in the current study, the farm operation was the only source of health insurance for 67.1% of all farm managers (53.9% of the total sample), while 11.0% had health insurance provided through off-farm employment, 9.5% had coverage through other means, and 3.1% received health coverage from federal insurance programs (table 1).

Model Development

An empirical model was developed from the theoretical and heuristic relationships reported in previous studies to identify determinants of health insurance coverage. Seven variables were used to explain whether a dairy farm manager had health insurance coverage:

$$\text{HEALTH INSURANCE COVERAGE} = f(\text{Age, Education, Farm Workers, Income, Off-Farm Income, Milk Marketing Cooperative Member, Business Organization}).$$

Although these variables are not exactly the same as those arising from theoretical and empirical relationships found in previous studies, they were chosen from the survey data because of their correspondence and correlation with those variables used previously.

The first determinant in the model of health insurance coverage is age. No strong a priori expectation for the sign of the age parameter can be predicted from previous studies because the significance and sign of age variables have not been

Table 1. Health Insurance Provisions for Those Respondents in the Entire Sample and Those Included in the Models

	Total Telephone Sample			Those in Logistic Regression Analysis*		
Type of Provision	Number of Respondents	Percentage of Total	Percentage of Total with Insurance	Number of Respondents	Percentage of Total	Percentage of Total with Insurance
No health insurance	243	19.7	———	153	18.0	———
Farm operation	664	53.9	67.1	478	56.4	68.8
Off-farm employment	136	11.0	13.8	95	11.2	13.7
Other provider	117	9.5	11.8	75	8.8	10.8
Medicare/Medicaid	38	3.1	3.8	27	3.2	3.9
Two providers	24	1.9	2.4	16	1.9	2.3
Did not specify insurance provider(s)	10	0.8	1.0	4	0.5	0.6
Total usable answers	1232	100	100	848	100	100

*Observations that had missing values for variables in the logistic regression estimation are deleted, resulting in a total number of usable answers less than the total number in the telephone survey.

consistent across studies. Jensen and Saupe (1987) found that the youngest farm families were less likely to have insurance, but others hypothesized that families with young children would be more likely to have coverage. However, Bennefield (1994) reported that health insurance coverage increases with age, and those who are sixty-five or older also qualify for government assistance through Medicare. Farmer age, however, is correlated with greater accumulated wealth and probability of illness, so the parameter estimate is expected to be positive.

The level of education of the farm manager also has an inconclusive relationship with having health insurance coverage, because those who have more education generally also have higher incomes. Relating this to the dairy farm managers, the better-educated farm managers or their spouses may also hold higher paying off-farm jobs that provide health benefits (Ward 1975). However, a positive correlation between education and health insurance coverage was reported by Bennefield (1994) and is expected a priori in this study.

The number of farm workers may be a positive determinant for predicting health insurance coverage because larger farm operations with more employees may qualify for cheaper, group rates and reduced premiums for the farm manager. Furthermore, larger farms would perhaps offer a more attractive benefits package in order to attract and retain quality personnel because such farms often delegate more managerial responsibility to their employees, particularly in dairy. This would apply especially to full-time workers, as benefits are rarely paid to part-time workers. Loprest and Gates (1993) reported that only 22% of part-time workers had health insurance through their employers. Furthermore, Loprest and Gates found that as firm size increases, as measured by number of workers, the probability of the farm manager having health insurance coverage increases. This relationship is also supported by Garkovich and Harris (1994). The relationship between the number of workers and having health insurance is expected to be positive.

Respondents with higher incomes are expected to have a greater probability of having health insurance than those with lower incomes. Loprest and Gates (1993) relate health insurance coverage to income as a proportion of the poverty level. For income levels greater than twice the poverty level, the percentage of uninsured in Pennsylvania is only 7%. For income levels closer to the poverty level, the percentage of uninsured increases to 20%.

Off-farm employment is included to reflect the price effect on the level of demand for health insurance. Health insurance provided through off-farm employment is often acquired at lower cost through lower premiums associated with group coverage and/or through the employer subsidy of the premium amount directly and/or as a tax-free fringe benefit. In addition to the price effect, the off-farm employment variable also reflects an income effect. The additional income earned from an off-farm job, even a part-time job, can be applied to purchase health insurance either through the farm operation or through self-insurance.

Membership in a milk marketing cooperative is hypothesize to provide an additional source of lower-priced health insurance coverage available through group participation. This hypothesis is consistent with that of Jensen and Saupe (1987), who included a dummy variable for dairy farms for the same reason. A positive coefficient is expected, as a cooperative is another means of acquiring health insurance coverage at a lower price.

Business organization is the last determinant used in the model to predict health insurance coverage of farm managers. It is expected that the more formal the business organization of the dairy farm is, the more likely it is that the farm will provide health insurance to its employees.

The exclusion of premium price variables in this model may appear to be troublesome. However, when one considers that all individuals in this cross-sectional data set face comparable premiums for health insurance coverage through opportunities for individual coverage (e.g., through Blue Cross), the choice of other coverage is likely to be a reflection of a lower net price of coverage. Price effects in these models are already captured through being over age sixty-four, farm work force, off-farm employment, and cooperative membership. Furthermore, premium prices are poor reflections of insurance demand because they depend on variable rates of coverage, deductibles, and copayments.

A second model is hypothesized to explain whether a farm operation provides the health insurance coverage. This model is expressed as:

$$\begin{aligned}\text{FARM OPERATION PROVIDE HEALTH INSURANCE} = g\,(&\text{Age, Education,}\\ &\text{Farm Workers, Income,}\\ &\text{Off-Farm Income,}\\ &\text{Milk Marketing Cooperative Member,}\\ &\text{Business Organization}).\end{aligned}$$

The same determinants that were used in the first model are also used in this model. For five of the seven determinants, the same expectations for parameter signs apply to this model. However, the

expected signs for two of the seven determinants are expected to be different. For the age determinant, as the farm managers get older and turn sixty-five, they will become eligible for Medicare. When this happens, they will not rely as heavily on the farm operation to provide health insurance. Therefore, a negative coefficient is be expected for the age variable if the farm manager is sixty-five or older. For the off-farm income determinant, having an off-farm job may decrease the probability of the farm operation providing the health insurance because health benefits are likely to be provided by the off-farm job at a much reduced cost. However, this variable may reflect an income effect. If the farm managers or spouses who work off the farm do not receive health benefits there, the additional income earned at this off-farm job may allow the farm family to obtain health insurance through the farm operation or through self-insurance. However, a negative coefficient is expected because of the tax and fringe benefits effects of employer-provided insurance.

Model Estimation

A logistic regression model (Maddala 1983) was developed to predict the existence of health insurance coverage for Pennsylvania dairy farm managers. This model relates several farm manager and farm characteristics to the respondent having any type of health insurance coverage. The binary dependent variable, INSURANC, takes the value of one if the respondent has health insurance and zero if not. All the dependent and independent variable names, descriptions, values, and means are presented in the appendix.

The variable AGE is the age of the dairy farm manager. Another age-related variable, OVER65, was also used in the logistic regression models. This dummy variable had a value of one if the farm manager was age sixty-five or older and a value of zero if the farm manager was age sixty-four or younger. This variable indicates whether the farm manager qualifies for Medicare. Education was entered into the models as a categorical variable, with eight categories ranging from no formal education to a graduate degree. These categories are listed in the appendix. To represent the number of farm workers, the variables FULLTIME and PARTTIME, the numbers of full-time and part-time workers on the farm, were included in the logistic regression model.

Income was the fourth determinant described. Income was included in the logistic regression models as a series of dummy variables, where INCOME1 indicated a net farm income of under $5,000, INCOME2 indicated a net farm income of $5,000 to $14,999, and so on, continuing to INCOME7, which indicated a net farm income of $100,000 and over. The first variable, INCOME1, was omitted from the model to provide a base level for estimation. The more discrete divisions are used to provide more explanatory power to the model. Specifically, the effects of changes in the independent variable on the dependent variable can easily be calculated, especially when dummy variables are being analyzed. This type of analysis will be presented later, after the logistic regression results are presented.

Off-farm income was included in the logistic regression model through the dummy variable OFFFARM, which indicates whether a respondent or spouse has income from an off-farm job. The membership of a milk marketing cooperative variable, COOPMEMB, was included in the model as a dummy variable. A value of one was assigned if the farm manager was a milk marketing cooperative member and a value of zero was assigned if the farm manager was not a member.

The last set of variables included in the model was a series of dummy variables describing the business organization of the dairy farm. PARTNER represents a partnership and CORPORTN represents a corporation. The sole proprietorship is the base case that is omitted from the model.

A second logistic regression model relates the same characteristics to the provision of health insurance coverage through the farm operation as opposed to coverage through an off-farm source, another provider, or Medicare/Medicaid. The dependent variable is FARMOPER, where a one indicates that the farm operation provides the health insurance and a zero indicates that the farm operation does not provide the health insurance for the respondent. As mentioned in the model development section, the same determinants were described for both models and, similarly, the same independent variables are also used for both models.

The two models were tested for endogeneity of the farm income and off-farm income variables using the Hausman (1978) test as outlined in standard econometrics texts (Greene 1997; Judge et al. 1985; Kennedy 1992.). The test normally uses the residuals from an instrumental variables approach to test explanatory power of the instruments and, as a result, possible endogeneity in the models. The application of this test as outlined in Kennedy (1992) yielded inconclusive results. Therefore, an artificial regression approach (Davidson and

MacKinnon 1993) was applied to this problem. An additional complication involved the discrete nature of the categorical variables to be tested for endogeneity. Therefore, instruments were created through the estimation of linear probability models where the income variables were regressed on milk sold per cow, herd size, the use of Dairy Head Improvement Association (DHIA) records, the feeding of a total mixed ration, having regularly scheduled veterinary visits, years of experience, total crop acres, and cows per worker. These variables have been previously characterized as important determinants of dairy net farm income (Ford and Shonkwiler 1994). Eight variables were required to properly identify the categorical income variables.

The farm income and off-farm income variables were found to be endogenous in the first model explaining health insurance coverage. However, these variables were not endogenous in the second model explaining whether health insurance was paid for by the farm. These results suggest that net farm income, perhaps through the choice of farm size or productivity, is determined simultaneously with health insurance coverage decisions. Farm structure may be determined to provide a target income level that will support family living needs, including the payment of health insurance premiums. However, the exogeneity of the income variables in the second model suggests that off-farm employment decisions are not made with the intent of acquiring health insurance coverage from the off-farm employer, while the endogeneity in the first equation suggests that off-farm employment decisions may be made to pay for health insurance, whether benefits are received through fringe benefits or income is used to pay for insurance directly.

Model Results

The first logistic regression model relates the set of farm and farm manager characteristics to whether or not the respondent had health insurance. Seven parameter estimates are statistically significant at the 0.05 level and four are significant at the 0.10 level. Most of the signs on the statistically significant estimated parameters are consistent with a priori expectations. The logistic regression results for both models are presented in table 2.

The results from the first model indicate that higher age and educational levels increase the probability that the respondent will have health insurance. In addition, respondents have a higher probability of having health insurance if they or their spouses have off-farm jobs. Membership in a milk marketing cooperative also increases the respondents' likelihood of having health insurance. Five of the six income variables are statistically significant, indicating that those with higher incomes, as compared with the base income level of $5,000 or less, are more likely to have health insurance coverage. The signs on the number of full-time and part-time workers are negative, which is inconsistent with a priori expectations.

The estimated parameters suggest that increasing income to levels below $15,000 would have no significant effect on the probability of having health insurance coverage. Twenty-nine percent of the sample had farm incomes below that level.

These results indicate that if the dairy farm manager has several choices of where to acquire health insurance, such as from an off-farm job or a milk marketing cooperative, then the farm manager will be more likely to have health insurance coverage. Multiple sources of insurance coverage may provide price incentives that make insurance affordable. Insurance subsidies provided by off-farm employers also carry a tax advantage, as the employer-contributed proportion of the insurance premium is a tax-free source of income and employee payroll deductions for health insurance premiums may also be tax sheltered.

The negative sign on the number of part-time and full-time workers is surprising. A priori expectations suggest that if the farm employs a large number of workers, health insurance would be provided to both the workers and the family. These results, however, suggest that this is not the case, and it may be that small group insurance rates may not be sufficiently low to generate demand from dairy farm managers.

The results generated by this model are consistent with previous multivariate analyses. Although other variables in addition to age and education were used, Jensen and Saupe (1987) found higher incomes significant in explaining which farm managers had health insurance coverage. Coward, Clarke, and Seccombe (1993) found that age, education, and income, among other variables, were significant in explaining health insurance coverage. The results presented in the current study found a statistically significant positive relationship between health insurance coverage and the farm manager's age, education level, and net farm income.

The Jensen and Saupe analysis (1987) included a dummy variable of whether or not the farm was a dairy operation (67% were dairy operations). Because this variable was not significant in their regression, they suggested that dairy milk marketing

Table 2. Logistic Regression Results

	Dependent Variable			
	Model 1: Whether the Respondent Has Health Insurance		Model 2: Whether the Farm Provides the Health Insurance	
Independent Variables	Parameter Estimate	Odds Ratio	Parameter Estimate	Odds Ratio
INTERCEPT	−20.2714	0.000	0.9731	2.646
AGE	0.0593*	1.061	0.0066	1.007
OVER65	0.3888	1.475	−1.6727*	0.188
EDUCATE[a]	1.0190*	2.770	−0.0543	0.947
FULLTIME	−0.4001*	0.670	0.2033*	1.225
PARTTIME	−0.1776**	0.837	−0.0449	0.956
INCOME2[b]	11.8654	[c]	0.0946	1.099
INCOME3[b]	14.2848**	[c]	0.8678*	2.382
INCOME4[b]	14.0818*	[c]	0.1821	1.200
INCOME5[b]	12.6717*	[c]	0.4135	1.512
INCOME6[b]	15.4214**	[c]	−0.3171	0.728
INCOME7[b]	22.0007*	[c]	−0.0459	0.955
OFFFARM	14.8778*	[c]	−2.0122*	0.134
COOPMEMB	0.3983**	1.489	0.0839	1.088
PARTNER	0.2984	1.348	−0.1270	0.881
CORPORTN	−0.2898	0.748	0.2339	1.263
Pseudo R^2	0.2425		0.1683	
−2 Log Likelihood	800.574***		836.004***	

[a]The educational categories are: 1 = elementary school, 2 = junior high school, 3 = some high school, 4 = completed high school, 5 = some post–high school work, 6 = completed technical/business school, 7 = completed college degree, and 8 = started/completed graduate degree.
[b]The income categories are: INCOME2 = $5,000 to $14,999, INCOME3 = $15,000 to $24,999, INCOME4 = $25,000 to $49,999, INCOME5 = $50,000 to $74,999, INCOME6 = $75,000 to $99,999, and INCOME7 = $100,000 and over.
[c]Odds ratio >100.
*Wald statistic is significant at $p < 0.05$.
**Wald statistic is significant at $p < 0.10$.
***Chi-square is significant at $p < 0.05$.

cooperatives do not have the special access or rates to offer health insurance to dairy farm managers. This is contradictory to the results in this paper, which suggest that membership in a cooperative, which was directly entered into the statistical model, increases the farm manager's likelihood of having health insurance coverage. The difference in the results of this study and the Jensen and Saupe study may arise because not all dairy farms in either state are dairy cooperative members and the current study was able to identify cooperative membership explicitly.

Whether or not health insurance is provided by the farm operation is the dependent variable in the second logistic regression model. Again, the statistically significant estimated parameter signs are as expected. If the farm manager has health insurance coverage, age and education play no significant explanatory role in whether the farm business provides that health insurance. However, if the farm manager is sixty-five or older, this characteristic has a significant negative effect on whether the farm business provides the health insurance coverage. This finding is consistent with a priori expectations, since those sixty-five or older qualify for Medicare. In this model, only one income category, representing the $15,000 to $24,999 category, has a significant and positive effect on whether the farm provides health insurance. This income category represents most single-family Pennsylvania dairy operations (Ford 1993).

The number of full-time workers, FULLTIME, was significant in the second logistic regression model. The positive coefficient indicates that as the number of full-time workers increases, the likelihood of the farm operation providing health insurance coverage also increases. This is consistent with the a priori expectations discussed earlier.

Off-farm income also has a significant and negative effect on whether the farm provides health insurance coverage. Having an off-farm job reduces the likelihood that the farm operation will provide the health insurance. As indicated in the variable discussion and in the first model, off-farm jobs can provide an alternative source of health insurance coverage for the farm family or provide

income to enable its purchase or self-insurance. In Pennsylvania, unlike some other states, the relatively large, rural, nonagricultural sector provides accessible employment opportunities for farm families. Farm business organization and membership in a milk marketing cooperative do not significantly affect the probability of the farm operation providing health insurance coverage.

The results from the second logistic regression model indicate that the income category representing most single-family Pennsylvania dairy operations has a positive effect on whether the farm operation provides health insurance coverage. In addition, as more full-time workers are employed, the probability that the farm operation provides the health insurance increases. Being sixty-five years of age or older decreases the probability of the farm operation providing the health insurance. Finally, having an off-farm job has a negative effect on whether the farm operation provides the health insurance coverage, as health insurance coverage may be provided through an off-farm employer.

Sensitivity of the Models to Changes in Farm Characteristics

The sensitivity of the likelihood of whether the farm manager has health insurance or whether the farm provides it can be evaluated with respect to the levels of the independent variables in the regression. The change in the probability of the dependent variable resulting from a change in an independent variable can be determined by evaluating the probability of the event occurring before and after the change. The probability of the event occurring is calculated with the following equation:

$$P(y) = \frac{1}{1 + e^{-\chi\beta}},$$

where $P(y)$ is the probability of having health insurance, χ is the vector of explanatory variables in the regression, β is the vector of their associated parameter estimates, and e is the natural logarithm base. By increasing the mean value of each variable by one unit (one variable at a time), a new probability can be calculated and compared with the base probability. Sample means and changes in probability for one-unit increases in the independent variables are presented in table 3.

All changes in the independent variables result in only marginal changes in the probability of having health insurance (Model 1). However, note that increasing the probability of having health insurance by 5% reduces the probability that a farm

Table 3. Changes in Probability of Having Health Insurance and Farm Provision of Health Insurance

		Dependent Variable	
		Model 1: Whether the Respondent Has Health Insurance	Model 2: Whether the Farm Provides the Health Insurance
Independent Variables	Sample Mean	Marginal Change in Probability	Marginal Change in Probability
		(%)	
AGE	45.6	0.62	NS*
OVER65	0.07	NS	−49.75
EDUCATE[a]	4.09	7.35	NS
FULLTIME	2.17	−5.01	4.84
PARTTIME	1.06	−2.04	NS
INCOME2[b]	0.18	NS	NS
INCOME3[b]	0.24	304.88	5.75
INCOME4[b]	0.30	87.77	NS
INCOME5[b]	0.08	−95.72	NS
INCOME6[b]	0.03	−45.84	NS
INCOME7[b]	0.05	95.57	NS
OFFFARM	0.20	503.47	−61.50
COOPMEMB	0.63	−97.65	NS
PARTNER	0.21	NS	NS
CORPORTN	0.15	NS	NS

[a]The educational categories are: 1 = elementary school, 2 = junior high school, 3 = some high school, 4 = completed high school, 5 = some post–high school work, 6 = completed technical/business school, 7 = completed college degree, and 8 = started/completed graduate degree.

[b]The income categories are: INCOME2 = $5,000 to $14,999, INCOME3 = $15,000 to $24,999, INCOME4 = $25,000 to $49,999, INCOME5 = $50,000 to $74,999, INCOME6 = $75,000 to $99,999, and INCOME7 = $100,000 and over.

*Variables were not found to be significantly different from zero in the previous logistic regression analyses.

manager is uninsured by 20% because of the large number of farm managers who are insured in the sample. Changes in probabilities were calculated only for those variables with statistically significant parameter estimates. For example, having an off-farm job (compared with not having an off-farm job) results in a 503.47% increase in the probability that a farm manager will have health insurance. Although this is a very high increase in the probability, it is not unrealistic, as data from the Pennsylvania dairy farm survey indicate that 93% of the farm managers who worked off-farm had health insurance coverage.

In Model 2, the probability that the farm operation provides health insurance is affected most by off-farm income and whether the farm manager is over sixty-five. The probability of health insurance being provided by the farm operation is reduced by 61.50% if the farm manager has income from an off-farm job. The probability that the farm operation provides health insurance is reduced by 49.75% if the farm manager is age sixty-five or older. If the net cash farm income increases from category 2 ($5,000 to $14,999) to category 3 ($15,000 to $24,999), then the probability of the farm operation providing health insurance increases by 5.75%.

Larger changes in some of the explanatory variables result in larger increases in the probabilities explored in this analysis (table 4). Evaluating at sample means is often misleading for logistic regressions because of the shape of the logistic function curve. For example, those farm operators with a college education are 14.2% more likely to have health insurance than are those with only a high school education. Only 7.2% of Pennsylvania dairy farm managers were reported to have a college degree in a 1988 survey (Borton et al. 1990) compared with 6.8 and 5.9% for Minnesota and Wisconsin, respectively. However, those states reported significantly higher percentages of post–high school, non–college degree education levels (24.0% and 23.8%) than Pennsylvania (8.4%), which most likely explains differences between the significance of education in this research and the insignificance of the education variables reported by Jensen and Saupe (1987). Large differences in age also increase the probability of having health insurance coverage for older farm managers, especially in Model 1. Borton et al. (1990) also reported that the average age of dairy farm managers is younger in Pennsylvania (forty-six years) than in Wisconsin (forty-nine years) but is the same as in Minnesota.

Summary and Implications

Although 80.3% of all the sampled dairy farm managers indicated that they had health insurance, the percentage with no insurance (19.7%) is slightly lower than the national estimates of rural agricultural populations without health insurance coverage (Kralewski, Liu, and Shapiro 1992). Two-thirds of those farm managers with health insurance had it provided solely by the farm operation, while another 13.8% had it provided through an off-farm job. However, only 53.9% of all the farms had health insurance provided through the farm operation.

The logistic regression analysis results indicate that age, income, education level, an off-farm job, and membership in a milk marketing cooperative are indicators of health insurance coverage for dairy farm managers. The second logistic regression model predicts which farm operations provide the health insurance. Having net farm income between $15,000 and $24,999 and having full-time workers have significant positive effects on the likelihood of the farm operation providing health insurance. Being sixty-five or older and having an off-farm income reduce the likelihood of the farm providing health insurance to the farm manager.

The analysis indicates that having several sources from which health insurance can be obtained, especially from off-farm employment, in-

Table 4. Percentage Changes in the Probability of Having Health Insurance over a Range for Selected Variables

Selected Independent Variables	Base Value	New Value	Dependent Variable: Model 1: Whether the Respondent Has Health Insurance	Dependent Variable: Model 2: Whether the Farm Provides Health Insurance
			% Change in Probability	
Education	High School	College	14.2	−4.18
Age	35	55	14.3	3.39
Age	35	65	17.7	5.01

creases the probability of a dairy farm manager having health insurance. Because insurance provided by off-farm employment is often subsidized by the employer, having an off-farm job decreases the probability of the farm operation providing the health insurance, since it becomes more affordable to acquire through the off-farm employer.

Several important observations can be made from this research. First, although 20% of Pennsylvania dairy farm managers had no health insurance, 53.9% of all farms had insurance provided through the farm business in 1993, indicating some degree of ability on the part of the farms in the survey sample to meet family living expenses. Second, increasing dairy farm income through farm policy instruments appears to have a significant impact on the acquisition of health insurance coverage, although incomes must be raised above the $15,000 threshold, and perhaps closer to the $25,000 level. However, the endogeneity result suggests that income levels are "chosen" in part to provide a certain standard of living. It is quite possible that for lower incomes, farm managers will forego insurance coverage, even if their incomes rise.

Finally, off-farm employment seems to be a stronger determinant of health insurance coverage than does farm income, and it is certainly an important determinant of whether the farm pays for the insurance or not. Tax consequences of both the employer- and the employee-provided portions of the health insurance premium must also be considered in the decision to have the farm business provide health insurance. Therefore, any policies aimed at improving health insurance coverage for dairy farm families should not focus solely on improving farm incomes, but should also consider rural development policies to provide greater off-farm employment opportunities in or near agricultural areas.

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Appendix
Variable Names, Descriptions, Values, and Means Used in the Logistic Regression Models

Variable	Description	Values	Means for Sample	Means for Model 1	Means for Model 2
Number of Observations			1237	848	695
	Dependent Variables:				
INSURANC (Model 1)	Whether the respondent has health insurance	1 = yes, 0 = no	0.80	0.82	———
FARMOPER (Model 2)	Whether the health insurance is provided through the farm operation	1 = yes, 0 = no	0.69	———	0.71
	Independent Variables:				
AGE	Age of the farm manager	Continuous	45.6	45.2	46.3
OVER65	Farm manager over 65 years of age	1 = yes, 0 = no	0.07	0.06	0.07
EDUCATE	Education level of the principal operator	Categorical[a]	4.09	4.22	4.42
FULLTIME	Number of full-time workers	Continuous	2.17	2.17	2.20
PARTTIME	Number of part-time workers	Continuous	1.06	1.13	1.13
INCOME2	Net farm income $5,000–$14,999	1 = yes, 0 = no	0.18	0.18	0.19
INCOME3	Net farm income $15,000–$24,999	1 = yes, 0 = no	0.24	0.25	0.24
INCOME4	Net farm income $25,000–$49,999	1 = yes, 0 = no	0.30	0.30	0.30
INCOME5	Net farm income $50,000–$74,999	1 = yes, 0 = no	0.08	0.08	0.08
INCOME6	Net farm income $75,000–$99,999	1 = yes, 0 = no	0.03	0.03	0.03
INCOME7	Net farm income over $100,000	1 = yes, 0 = no	0.05	0.05	0.05
OFFFARM	Any off-farm income	1 = yes, 0 = no	0.25	0.25	0.28
COOPMEMB	Member of a milk marketing cooperative	1 = yes, 0 = no	0.63	0.63	0.65
PARTNER	Partnership organization	1 = yes, 0 = no	0.21	0.22	0.23
CORPORTN	Family corporation organization	1 = yes, 0 = no	0.15	0.12	0.10

[a]The educational categories are: 1 = elementary school, 2 = junior high school, 3 = some high school, 4 = completed high school, 5 = some post–high school work, 6 = completed technical/business school, 7 = completed college degree, and 8 = started/completed graduate degree.