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Farm Computer Adoption in the Great Plains

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ABSTRACT

Computers change rapidly, yet the last survey on computer use in agriculture was in 1991. We surveyed Great Plains producers in 1995 and used logit analysis to characterize adopters and non-adopters. About 37% of these producers use computers which is consistent with the general population. We confirmed previous surveys emphasizing the importance of education, age/experience, and other farm characteristics on adoption. However, we also found that education and experience may no longer be a significant influence. Future research and education could focus on when and where computers are most needed, and therefore when adoption is most appropriate.

Key Words: adoption, agriculture, computers, farmers, Great Plains, logit.

At the close of the last decade, several studies relating to computer use in agriculture concluded that computer adoption lagged behind other technology and predicted that most farmers would be using computers by 1990 (Woodburn, Ortmann, and Levin; Batte, Jones, and Schnitkey; Amponsah). Technology adoption, however, has been characterized by a logistics curve where adoption is slow at first and then picks up at an increasing rate if the technology is going to be accepted (Buttel, Larson, and Gillespie). Indeed, personal computers (PCs) have changed a great deal in recent years, making them even more accessible (e.g., faster, cheaper, and easier to use), yet the last published survey on agricultural computer use was conducted in 1990 (Amponsah; Batte). Furthermore, only one earlier survey was regional or national in scope (Batte). Most were selected samples of known computer users or top managers (Iddings and Apps; Ortmann, Patrick, and Musser), were at a state scale or below (Amponsah; Batte, Jones, and Schnitkey; Baker 1991; Putler and Zilberman), or concentrated on a specialized group of producers (Baker 1992; Jarvis) or software applications (Willimack).

Previous studies found computer adoption rates ranging from 3% (Willimack) to 44% (Baker 1992). However, many of these findings have characteristics that imply they may not be representative of overall adoption rates. For example, Willimack studied only recordkeeping and Baker (1992) looked at non-farm agribusinesses. Results from studies that did not focus on a special group of producers ranged from computer adoption rates of 12% (Baker 1991) to 25% (Putler and Zilberman) in the mid 1980s to 14.4% (Amponsah) to 25% (Schmidt et al.).

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A key question now is whether or not producers have moved up the computer adoption curve. The number of computer owners in U.S. households is growing at a 13% annual rate (Flanagan). Twenty percent of households owned PCs in 1990 and 37% owned them in 1996 (Flanagan). Since adoption should depend on perceived value in the operation, another interesting question is which producers are using computers and how are they using them?

In the summer of 1995 we conducted a random survey of Great Plains producers to determine how adoption rates have changed from earlier studies. These advantages enable a better estimate of current computer adoption rates and clarification of contradictions that occurred in earlier works.

Previous Research

Several studies were conducted on agricultural computer use between 1986 and 1991. Willimack did the only nationwide study based on the 1987 Farm Costs and Returns Survey, but only recordkeeping was examined. A multistate effort was conducted by the North Central Regional Research Committee, Farm Information Systems (NC-191), in which 750 producers in each of 13 states were surveyed. Implications for use and adoption, based on descriptive statistics, are summarized in Batte.

Putler and Zilberman used logit analysis to examine both computer use and adoption in 1986. They found that farm size, education, and land tenure significantly increased the probability of adoption and that age significantly decreased it. They also found that owning a farm-related, non-farming business increased the probability of computer adoption. They suggest that this could be due to exposure to computers in a different environment where they are more commonly used. Their study also used logit analysis to compare adoption rates for various software applications such as spreadsheets, accounting systems, payroll, decision aids, and crop/livestock management. They found that the type of farm products produced (which was not significant in adoption) influenced use of these program applications; they also found farm size and education to be important.

Lazarus and Smith also surveyed producers in 1986, although they concentrated only on dairy producers. In 1987 Batte, Jones, and Schnitkey surveyed Ohio producers and used a logit model to determine factors that affect adoption and those that affect usefulness. In a survey of New Mexico producers, Baker (1991) did not use any statistical analyses but noted that the 12% of respondents who used computers were younger, better educated, operated bigger farms, and had better attitudes toward change than non-adopters. This finding is consistent with results from other studies.

Two other random surveys of producers were conducted in 1990 and 1991 (Jarvis and Amponsah, respectively). Jarvis used a logit model to study computer adoption for Texas rice producers. She concluded that farm size, business complexity, and number of peers with computer knowledge increase the probability of adoption. Amponsah also used logit analysis to examine both computer use and adoption. He found that farm income and size, and the user's education level, increased the probability of adoption. Finally, Jones and Schnitkey and Baker (1992) used multinomial logit to compare the probability of various intensities of adoption (i.e. 0–3 applications, 4–5 applications, and 6–8 applications).

In summary, computer adoption studies commonly found that farm size (acres), farm income (or sales), ownership (tenancy), and education had positive effects on adoption, and that age had a negative or suppressing effect. Other variables that were found to have an impact were farm complexity, debt-asset ratio, exposure or perception that risk is important, and farm type (crop or livestock) (Baker 1992; Batte, Jones, and Schnitkey; Jarvis; Putler and Zilberman; Woodburn, Ortmann, and Levin).

Software applications mentioned most frequently in these studies were financial records, taxes, accounting, business planning, budgeting, livestock records, crop records, market and price analysis, and decision making. Financial records and business planning were cited most. Livestock records were more common than crop records. Market and price analysis and decision making were consistently and markedly below all other uses. Producers in the Woodburn, Ortmann, and Levin study rated this category at 2.9 on a scale of 1 to 5 and only 8.3% of the producers in Amponsah's study used these tools.

Survey and Data

Techniques from the Dillman Total Design Method (1978) were used to survey 800 producers in the Great Plains, which contains 398 counties in 10 states. The USDA National Agricultural Statistics Service (NASS) provided names since they conduct surveys on a regular basis. NASS divided the sample into four strata—small crop, large crop, small livestock, and large livestock—where small was considered to be less than $100,000 in gross annual farm sales. Crops included cash grain, tobacco, cotton, other field crops, vegetables, melons, and strawberries. Livestock included beef, hogs, sheep, poultry, and dairy. Samples were drawn randomly from these groups. A total of 772 usable addresses were drawn and 219 completed surveys were returned. To protect the confidentiality of the mailing list, a second survey was mailed to the entire sample. The response rate of 28% was comparable to other studies (Amponsah, 31%; Batte, Jones, and Schnitkey, 40%; Woodburn, Ortman, and Levin, 35%).

A second group of producers was also chosen for survey to obtain more detail about computer users. A sample of 200 producers was drawn from a list of over 900 names of individuals who were likely to use computers, such as subscribers to farm computer periodicals. The response rate from this group of "computer users" was 83%.

The survey was divided into five parts with a total of 26 questions. Section 1, *Producer Information,* elicited information about the producer including age, education, off-farm employment and production experience, and their operation including farm size, gross sales, and commodities produced. Producers were also asked if they owned a PC and, if not, why not and were they likely to buy one in the future. Respondents who did not own a computer did not provide answers in Sections 2 and 3. Section 2, *Computer Ownership,* collected information about hardware, including processing speed, hard drive size, year purchased, if the computer had a CD-ROM, and if they used Microsoft® Windows™. Information about who uses the computer and what it is used for was found in Section 3, *The Usefulness of Computers.* In this section we asked respondents who was the primary computer user, what his/her skill level was, where he/she learned to use a computer, and which software applications he/she used most (e.g., taxes, word processing, production records, etc.). We also asked the producers to indicate how useful they found the computer to be in their agribusiness. Sections 4 and 5 asked questions related to computer use and decision support system design for software. They are not relevant to the present analysis.

The general descriptive statistics of the survey are provided in Table 1. The average age of respondents was 52 years and ranged from 21 to 89. Respondents had an average of 33 years of farming experience. Approximately 32% had a college degree, another 31% had a high school degree, and the remainder had some college or technical courses. The average farm size was 2,963 acres, with about one-third leased. Animal ownership varied widely. Fifty-six percent of the producers grossed under $100,000, 38% grossed between $100,000 and $250,000, and 6% grossed over $500,000 annually.

Approximately 37% of producers own an IBM®-compatible PC, comparable with projections of household use in 1995 (Flanagan). About one-third had an off-farm job, and about one-half of those used a computer in their other job. Over 40% of computer-owning producers owned a 486-class computer or better, and another 20% owned a 386. The rest owned older computers or Apple® brand products. Thirty-five percent of the computers have CD-ROMs. Sixty-five percent of producers owning a computer use Microsoft® Windows™ on average nearly 60% of the time that they use the computer. Producers rated their experience as 2.4 on a scale of 1 (beginner) to

Table 1. Descriptive Statistics of Producer Survey, Great Plains, 1995

Category	Adopters	Nonadopters	Overall
Age in Years	48	55	52
Years of Experience	26	38	33
Farm Size (acres)	4,589	1,721	2,963
Computer Ownership	—	—	37%
Education			
college degree	41%	27%	32%
technical/vocational	8%	5%	6%
some college	26%	27%	27%
high school	25%	36%	31%
Computer Platform Used[a]			
486 or greater	42%	—	—
386	20%	—	—
CD-ROM	35%	—	—
Windows	65%	—	—
Computer User[a]			
owner/spouse	95%	—	—
consultant	1.3%	—	—
PC skill (1–4)[b]	2.4	—	—
Perceived Usefulness of Computer[a]			
(1) Not Useful	2%		
(2) Intermediate	2%	—	—
(3) Useful—does not increase profits	31%	—	—
(4) Intermediate	33%	—	—
(5) Useful—increases profits	32%	—	—
Mean Score	3.9	—	—
Frequency of Use[a]			
daily	14%	—	—
weekly	29%	—	—
monthly	26%	—	—
annual	31%	—	—
Number of Applications Used[a]			
1 or 2	12%	—	—
3 or 4	19%	—	—
5 or 6	38%	—	—
7 or more	32%	—	—

[a] Pooled data including random survey and computer users survey.
[b] 1 = beginner, 4 = advanced.

4 (advanced). The primary user of the computer was generally the owner or spouse. Consultants accounted for only 1.3% of computer use.

Producers not owning a computer offered little hope that they would buy one soon, ranking the probability at only 2.9 on a scale of 1 to 10. Cost, difficulty to learn and use, a perception that a computer is unnecessary, and planning to buy later were cited most often as reasons for not owning a computer. As shown in Table 1, when asked if a computer was valuable to their operation, producers rated them 3.0 on a 5-point scale (1=not useful, 5=useful and profitable). Only 14% use a computer daily, and about 60% use it weekly or monthly. Over two-thirds of computer owners use five or more applications. The most common software applications were taxes, word processing, and spreadsheets. Planning software and electronic services ranked very low with most users saying that they never used these types of programs.

Computer Adoption

Buttel, Larson, and Gillespie explain that most models of diffusion are couched in terms of how such knowledge would help "change agents" such as Extension Agents increase adoption rates by recommending practices that presumably improve a person's individual situation. However, computers, like many other innovations, may not follow the classical "S-shaped" logistical growth curve if they are not appropriate for every farmer. Therefore change agencies such as the Cooperative Extension Service must examine whether their educational positions are appropriate.

According to Buttel, Larson, and Gillespie (p. 47), diffusion studies share the following components. First, adoption is a complex pattern of mental activities. Second, the process involves stages (awareness, information, evaluation, trial, and adoption). Third, new ideas and technologies can be classified by categories such as complexity, divisibility, congruence of new idea to existing practices, and economics. Fourth, adoption follows a logistical (or "S-shaped") growth curve with time. And fifth, personal and social characteristics influence the rate and point in time an innovation is adopted. Computers may already be fully adopted or may still be in the process of being adopted. Computers are complex, have low congruence to existing technologies, and can be costly; thus they may not be fully infused into farm society. However, costs are falling and society grows increasingly familiar with computer technology.

It is beyond the scope of this study to determine which stage of adoption farmers are in with regard to computers, but we can address where adoption is today and compare it to the past. The major thrust in diffusion-adoption research has been to relate farmers' socioeconomic status to adoption of recommended practices, as was done by all previous computer adoption studies (Buttel, Larson, and Gillespie). This will be our approach as well. Our results can serve to better target educational efforts and to make preliminary inferences about diffusion and adoption. For example, cost and difficulty to learn and use computers were cited as reasons for non-adoption. Extension can develop programs to overcome these problems. On the other hand, however, education and exposure to computers at work are no longer the limiting factors they were in earlier studies, indicating that computer education may not be a significant factor limiting adoption.

Methodology and Procedures

One of the survey questions was whether a producer owns or uses a PC on his/her farm. Adoption can be represented as a binary variable that is a function of a set of independent explanatory variables as has been done in previous studies (Amponsah; Batte, Jones, and Schnitkey; Jarvis; Putler and Zilberman; Woodburn, Ortman, and Levin). The logit model for computer adoption is specified as follows (Jarvis; Amponsah; Putler and Zilberman; Batte, Jones, and Schnitkey):

$$\log[P/(1 - P)] = \alpha_0 + \Sigma\alpha_i X_i + \epsilon$$

where P is the probability of adopting a computer at the farm level; (1 − P) is the probability of not adopting; α's are the parameter estimates for the independent variables, Xi, that influence adoption; and ϵ is the unexplained random component.

Based on previous studies, computer adoption appears to be a very personal choice. Several variables are included to capture the personal characteristics that may affect one's propensity to adopt computer technology. Previous studies have shown the respondent's age and level of education to be two factors that significantly influence computer adoption. These factors may be represented by the variables such as respondent's age and years of farming experience and the highest level of formal education attained, ranging from high school to a graduate degree. It is expected that the amount of practical experience acquired in production agriculture would also affect the decision to adopt computer technology. In addition, exposure to computer technology in other phases of life is also expected to affect adoption for farm use. An important source of exposure would be an off-farm job in which a computer was used.

The scale of the farming operation has been shown to be an important factor affecting the decision of whether or not to adopt computers. The size of the operation can be proxied by the number of acres operated and the annual gross sales for the farm.

To reduce apprehension about sensitive financial information, respondents were asked only to identify which one of four possible gross sales categories represented their farm, ranging from less than $100,000 to more than $500,000 annually. The variable that represents annual gross sales takes values from 0 to 3 corresponding to each of these categories.

The intensity of management required on the farm is also hypothesized to be an important factor in the adoption decision. The greater ownership stake that the farm operator has in the operation should likely imply greater interest, and thus emphasis, on management. If computers are viewed as beneficial tools for management, adoption could vary depending on the proportion of the operation owned. To capture this, the percentage of land that is leased is included as one of the factors that influence adoption. Similarly, if a producer splits time between farming and another job off the farm, the management focus would be somewhat different than for a full-time operator, all else being equal. A binary variable is used to differentiate producers without off-farm employment from those with another job.

Finally, characteristics that distinguish the types and number of enterprises may also be important factors in computer adoption. There are fundamental differences in the management of crop versus livestock enterprises. Two binary variables are specified to characterize the presence or absence of these types of enterprises. The greater the number of individual enterprises, the greater complexity for whole-farm management issues, suggesting that computer adoption rates may vary with the number of enterprises observed on a given farm. Thus, the number of major enterprises identified in the respondent's farm operation is also included in the model specification.

The adoption model is also estimated to compare commercial and non-commercial producers. Several of the explanatory variables could be ascribed to the definition of "commercial." However, the USDA and others commonly refer to commercial producers as agricultural operations that gross over $100,000 annually (Knutson, Penn, and Boehm). The adoption model was estimated separately for data set partitions for groups with gross sales above and below $100,000.

Adoption Results

Results are presented in Table 2. Extreme multicollinearity was observed in the original formulation of the computer adoption model. The explanatory variables representing a respondent's age and farming experience were highly correlated ($r = 0.729$). The model was estimated with both of these variables and with each one separately, with little penalty in goodness-of-fit measures or predictive ability. Likelihood ratio hypothesis tests showed using EXPYRS alone was not significantly different from using both a respondent's age and farming experience but was significantly better than using an age variable alone. Therefore the age variable was dropped from the set of explanatory variables in favor of EXPYRS.

The variables indicating off-farm employment and holding a job that used a computer were also highly correlated ($r = 0.827$). These variables were tested using the same procedures, indicating no significant penalty for dropping either one. Since both variables were nearly equal in explanatory power, either could be chosen. Because of a more general interpretation of response to the variable, the full-time variable was selected to remain in the model.

The estimated logit model, significance tests, estimated changes in probabilities, goodness-of-fit measures, and in-sample prediction success statistics for the probability of computer adoption for producers in the Great Plains are presented in Table 2. There were 170 responses that were complete for all 12 variables. Results are provided for the entire samples as well as the partitioned data set for producers with annual sales over and under $100,000.

The goodness-of-fit measures indicate that all three of the estimated models fit the data reasonably well. The chi-squared statistics for the hypothesis test of all coefficients being equal to zero are all significant above the 1% level. The McFadden R^2 statistics for all models, ranging from 0.35 to 0.49, are higher than those previous studies have generated. Overall prediction success was high; the all producers model predicted adoption accurately over 80% of the time, the large producers model was correct 75.7% of the time, and the model for smaller producers predicted the correct response 88.5% of the time.

Both coefficients and probability estimates convey information about the impact of each independent variable on adoption. The marginal probabilities are derived from the estimated coefficients and indicate the marginal impact of a one-unit change in each variable. For example, each year of experience reduces the probability of adoption by 1.76%. In the pooled responses of all producers, the characteristics of farmer experience, education, farm scale, and farm type are all highly significant factors determining computer adoption. Experience is one of the most significant factors observed. As shown by the negative coefficient on EXPYRS, the greater the experience, the less likely a producer is to own a computer (Table 2). For the average producer, all else being equal, an additional year of experience results in a reduction of nearly one and three quarters percentage points in likelihood of adoption.

The importance of experience is consistent with other studies that have used age as an explanatory variable. From a statistical standpoint, experience is a more appropriate variable. Intuitively, this result suggests that those who have acquired practical management knowledge feel less need to adopt computer technology. Age could simply be a proxy for experience, explaining why so many other studies have found age to be important. Perhaps further examination to disentangle these two effects may provide new information about adoption if both turn out to be important.

Education also appears to be a significant factor where those respondents with some college or a bachelors degree were significantly less likely (nearly 30% on average) to adopt computers than the reference group with only a high school education. This finding contradicts those of previous studies where education was found to be positively associated with adoption. However, further examination reveals this result to be somewhat tenuous, as the simultaneous test of all education variables (EDU2 through EDU5) does not indicate significant explanatory power. The lack of influence now compared to earlier studies may indicate that infusion is nearly complete across educational stratas. Rogers found that early adopters have more education, explaining why previous studies could have found education to be more important than this study did.

Factors indicating the scale of farming operations (ACRES and SALES) were both highly significant with positive effects on the likelihood of adopting computer technology. These variables were not highly correlated in our study since we covered a wide range of agricultural enterprises. An additional 1,000 acres in the mean farming operation results in a 3% increase in the probability of adoption. In the pooled response, moving up a sales category results in nearly a 30% increase in the likelihood of adoption. However, in the over $100,000 sales model, increased sales reduces probability by nearly 20%. In the pooled model, sales could be increased from under $100,000, to $100,000–$499,000, and to $500,000 and over. The sales over $100,000 model only allowed an increase from under $500,000 to $500,000 or more. Therefore, the midsize producers appear more inclined to adopt than either the large or small producers.

The last significant factor is the presence of at least one livestock enterprise. While the

Table 2. Logit Model of Computer Adoption, Great Plains Producers, 1995

Variable	All Producers Estimated Coefficient	All Producers Probability[a] (%)	Producers w/Sales > \$100,000 Estimated Coefficient	Producers w/Sales > \$100,000 Probability[a] (%)	Producers w/Sales < \$100,000 Estimated Coefficient	Producers w/Sales < \$100,000 Probability[a] (%)
Constant	2.644**		6.196**			
	(2.233)	61.91	(2.076)	124.75	5.774**	67.74
EXPYRS	−0.075***		−0.066**			
	(−4.034)	−1.76	(−2.057)	−1.33	−0.116***	−1.36
EDU2	−0.563		−1.019		0.425	
	(0.699)	−13.19	(−0.657)	−20.51	(0.346)	4.99
EDU3	−1.346**		−1.935*		0.069	
	(−2.074)	−31.51	(−1.954)	−38.96	(0.061)	0.81
EDU4	−1.213**		−0.853		−1.532	
	(−1.998)	−28.41	(−0.852)	−17.18	(−1.365)	−17.98
EDU5	−0.229		0.084		0.240	
	(−0.294)	−5.35	(0.063)	1.68	(0.193)	2.82
ACRES	0.001***		0.001		0.000217	
	(2.617)	0.003	(1.582)	0.00209	(0.706)	0.00255
SALES	1.278***		−0.956			
	(3.164)	29.92	(−1.329)	−19.25	—	—
LEASE	−0.010		0.010		−0.039***	
	(−1.587)	−0.24	(0.891)	0.20	(−2.933)	−0.46
FULLTIME	−0.616		1.514		−1.989**	
	(−1.232)	−14.41	(1.376)	30.48	(−2.366)	−23.34
CROPS	0.644		1.800		0.548	
	(0.947)	15.08	(0.985)	36.24	(0.469)	6.43
LVSTK	−2.967***		−2.813**		−4.506***	
	(−4.608)	−69.47	(−2.281)	−56.65	(−3.481)	−52.87
NUMENTRP	0.046*		−0.533**		0.387	
	(1.043)	1.07	(−2.184)	−10.74	(1.412)	4.53

Table 2. (Continued)

	All Producers		Producers w/Sales > $100,000		Producers w/Sales < $100,000	
Model Test Results	Estimated Coefficient	Probability[a] (%)	Estimated Coefficient	Probability[a] (%)	Estimated Coefficient	Probability[a] (%)
No. of observations	170		74		96	
McFadden R^2	0.3500		0.3570		0.4934	
Log Likelihood (LL)	−74.86		−31.56		−27.35	
Restricted LL	−115.17		−49.08		−53.98	
Model chi-square	80.62		35.05		53.27	
Prediction Success (%)						
Total	81.8		75.7		88.5	
Adopters	72.9		78.3		66.7	
Nonadopters	88.0		71.4		95.8	

Note: EXXPYRS = years of farming experience; EDU2 through EDU5 denote a set of binary variables for level of education attained that represents technical/vocational degree, some college, BA or BS degree, and graduate degree, respectively, and variable representing some high school education is the omitted reference group; ACRES = number of acres in operation; SALES = 0 if <$100,000, 1 if $100,000–$499,999, 2 if $500,000, 3 if >$500,000; LEASE = percent of farm leased; FULLTIME = 1 if no off-farm job; CROPS = 1 if at least one cropping enterprise; LVSTK = 1 if at least one livestock enterprise; and NUMENTRP = number of major enterprises identified. *, **, and *** signify coefficient significantly different from zero at the 0.10, 0.05, and 0.01 significant level, respectively. Numbers in parentheses are asymptotic t-ratios.

[a] Represents the marginal impact of change in the probability of adoption for a one-unit change in independent variable.

presence of cropping enterprises had no significant effect, those producers with livestock enterprises were, on average, nearly 70% less likely to adopt computers, all else being equal. Variables representing operator tenure (LEASE and FULLTIME) and the number of enterprises in the operation did not have significant effects on the computer adoption decision. The sign on FULLTIME, while not significant, is consistent with the notion that off-farm employment offers exposure to computers and increases adoption.

As is apparent from the high significance of both farm scale variables, adoption is influenced differently on large farms and small farms. To further evaluate these differences, the data were partitioned into two sets and evaluated separately. Of the 170 observations in the original data set, 74 belonged to producers with annual sales exceeding $100,000 while 96 represented smaller operations. Individuals who are, on average, less experienced but more highly educated operate the larger farms, farms which are comprised of nearly six times the land area as those with lower sales and have over half-again as much of their ground leased. While over 86% of the larger farms are operated by full-time producers, this applies to less than half of the smaller farms. Smaller producers tend to have a greater number of distinct enterprises (4.3 versus 4.0), but large farms are equally likely to have at least one livestock enterprise and more likely to have a cropping enterprise.

The most significant factors affecting the adoption decision for the high-sales group are experience, the presence of a livestock enterprise, and the number of enterprises comprising the operation. As in the all-producers model, greater experience and the presence of livestock reduce the likelihood of adoption, though the effects are somewhat less dramatic. In this case, however, the greater the number of enterprises, the less likely the farm is to adopt computers, suggesting greater usefulness to the large farms specializing in fewer enterprises. Farm scale factors ACRES and SALES were not significant in distinguishing adoption rates among producers in the high-sales category. Educational factors were of less importance than for the overall model.

The factors affecting smaller firms were somewhat different. Farming experience had an even greater negative impact than for either of the previous models, but education became even less significant. The presence of livestock had an even greater negative impact than for either of the previous models.

The major distinction between small farms and larger farms is the significance of factors related to farm tenure. First, smaller producers leasing a greater proportion of their property were significantly less likely to adopt. Presumably they do not expect to reap the same benefits as those owning a greater proportion of their land. Second, full-time producers were less likely to have a computer than part-timers. As discussed previously, most part-time producers hold off-farm employment where computers are used. Familiarity with computers and the increased potential for non-farm use of a computer are strong candidates to explain this observation.

Summary and Conclusions

Our survey is based on a more recent, extensive, and comprehensive subject matter survey than previous studies of agricultural computer ownership. As such, we expected to confirm and extend findings from other studies. After surveying previous literature to identify possible explanatory variables we used logit to examine which factors affect adoption most.

At 37%, ownership by producers is consistent with use in U.S. households, an improvement from the mid to late 1980s when producer adoption lagged behind other industries and households. Our results confirmed that most of the parameters identified by earlier studies still had an impact. These included farm size (acres and sales), ownership of livestock, farm tenure, and off-farm employment exposure to computer use. Most previous studies used age, which is highly correlated with experience. However, we found that experience is a better predictor, and that it decreases the probability of adoption. One of our most surprising results was that education appears to have little or no impact, whereas previous studies have identified a link. A test of all education variables revealed no significant impact on adoption as a group, and those with some college or a bachelors degree were less likely to adopt. One conclusion that could be drawn from these results is that education and experience make one less likely to adopt. This could indicate that education and experience are substitutes for using computer applications—a concept that may be interesting for further review.

We have no way of knowing whether adoption has become totally infused into mainstream agriculture. However, we can say that adoption has caught up with households, and that farmers no longer seem to be limited by education or exposure to computers. Adoption does not appear complete, necessarily, since some people still cite difficulty to learn as a significant obstacle. In addition, satisfaction among users is rated high. Therefore people who cite cost as a reason to not adopt computers might be mistaken about its benefits. These people might be the "late majority" and "laggards" of adoption (Buttel, Larson, and Gillespie); however, they may be making wise decisions about the net benefits. The value of computers on farms would make an interesting study for further research. We found them to be less valued by smaller farmers, and provided some proof that experience and education are substitutes rather than complements for computer services.

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