Computer Adoption and Use of Information Services by North Carolina Commercial Farmers

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Abstract

The extent of information use by farmers for farm management is tracked in terms of computer adoption and usefulness, and the use of professional providers of information services. The study is based on a survey conducted in 1991, on North Carolina, as part of a regional project involving about fourteen states. The results revealed a low rate of computer adoption by the farmers surveyed. However, computer adoption and usefulness were explained by farm size, educational attainment and farm income. Also farmers' use of professional services, such as that provided by tax preparers and extension agents were positively influenced by farm size, age and education level.

Key Words: computer adoption, farm information system, information services, farm management

Introduction

The most critical value of information to farmers may be in making farm production and marketing decisions. Information may enhance enterprise efficiency if it is used to aid decision-making and management of risk (King and Sonka). Information is more valuable in the presence of uncertainty, where it may be brought to bear on decision making processes to take advantage of changes in input or output pricing to enhance profitability.

Information is data processed in a form such that it becomes meaningful to the user, and it is of value in decision-making (Davis). Alternatively, information represents messages evaluated to be of value in dealing with a problem (McDonough). Information may also be defined as "screening, editing and evaluating data in the context of a particular decision-making process" (Casperie). The economic importance of a piece of information may, therefore, be tied to potential gains or losses involved in a particular decision-making process. However, the value of additional costless information can never make the decision maker worse off, but eventually it can make him better off (Chavas and Pope; Gould). Therefore, information serves as an input in the managerial decision process (Debertin, Rades, and Harrison).

Information requirements by farm producers have also been increasing as the agricultural sector has become increasingly affected by uncertainties brought about by global events, and as technology has become more complex (Holt; King and Sonka). The changing structure of agriculture, especially the increasing numbers of

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commercial farms, has contributed much to shaping the current information requirements of farm operators. As a result of this change, the number and type of sources providing information to farm operators have also changed.

To be sure, information may be obtained from a wide variety of sources. For example, management information system serves as an integrated system for providing information in support of the planning, control and operations of a given enterprise. According to Sen, the system must aid operations management and decision-making by providing previous, present, and future details about both internal operations and external intelligence. The system may constitute a broad decisions support, including manual as well as computer elements, to ensure analysis, planning, control and decision-making (Davis and Olson).

Various studies (Batte, Jones, and Schnitkey; Putler and Zilberman) suggest that socioeconomic characteristics of farm operators have impacts on the demand for information. The characteristics include farm size, type of farm, age and education of farm operators, and the kind of products grown by the farm operators. Perhaps these factors influence the demand for information because of the increasing size, cost, accuracy and timeliness associated with the production process.

To ascertain farmers' information systems requirements, and to design appropriate information systems that can effectively satisfy such requirements, information providers are required to study the characteristics of farm producers at different socioeconomic levels. This problem can be resolved through capturing and documenting better decision-making at the farm level. Therefore, efforts at designing adequate information systems by information providers call for better understanding of how farm producers make decisions and use information to support their decisions (Jones, Batte, and Schnitkey).

Information Technology Adoption

There are numerous studies on technology adoption in agriculture (Byerlee and de Polanco; Caffey and Kazmierczak; Casewell and Zilberman). These studies conclude that despite the importance attached to farm information, the adoption rate of information technology has been slow. Furthermore, recent advances in computer hardware, software, and telecommunications technology and corresponding reductions in their costs have greatly increased the potential for effective computer-based support of farm management decisions (Batte, Jones, and Schnitkey; Putler and Zilberman). Therefore, private sector firms and public sector institutions are responding by developing a wide range of software, training, and information service products for farmers. Nevertheless, adoption of the technology by farmers continues to lag behind its development. Studies have estimated computer adoption rates by farmers from 3 percent (Willimack) to just over 25 percent (Putler and Zilberman).

Lazarus and Smith found that only 15 percent of New York dairy farmers enrolled in the Farm Business Summary and Analysis Program in 1986 owned computers. A follow up study conducted by Lazarus, Streeter and Giraudo tracked a panel of record keeping farmers over a four year period and found an increasing cumulative computer adoption pattern of 3.6 percent, 5.6 percent, 8.7 percent and 11.7 percent, respectively, of the farmers who owned computers in the years 1984-87.

A number of factors have been attributed to this slow adoption rate. First, the rapid rate of change in information technology and attendant concerns about obsolescence may have discouraged some farmers from investing in new information systems. In addition, widespread financial stress in the agricultural sector has reduced investment levels in general, further slowing the adoption of new products and services based on information technology. Perhaps the greatest impediment to adoption, however, may be that farm information systems and information services often do not adequately meet the needs of farmers (Dobson; Hardeker and Anderson). This rationale may stem from inadequate understanding of management information needs or from the lack of product integration that can occur in a rapidly evolving industry with no clearly defined leader. Hence there is a need to evaluate the factors that influence computer adoption.

The advent of the low cost microcomputer permits widespread application of computer technology by farmers in accomplishing various

tasks such as bookkeeping, planning capital expenditures, pest control, and many others. Many agricultural groups (such as Cooperative Extension, university researchers and teachers, farm groups such as the Farm Bureau, and software developers) have taken an active interest in computer use in agriculture (Putler and Zilberman). Despite this interest, studies related to computer ownership and adoption patterns in agriculture are limited. Understanding the factors that influence farm-level computer use will assist in developing appropriate and successful computer programs, as well as in identifying the needs of various clientele groups. Therefore, a primary goal of this study is to explore and determine the key socioeconomic characteristics of commercial farmers which influence their computer use. Related to this goal, we also determine the usefulness of computers to those farmers.

Computer adoption rates by farmers vary with operator and business characteristics. Survey results by Willimack, Lazarus and Smith, and the Farm Futures Magazine found an inverse relationship between adoption rates and the farmer's age. Consistent with Putler and Zilberman, these studies found that higher education and large business size were positively related to computer adoption rates. Willimack found higher adoption rates for crop farmers than for livestock producers. However, Putler and Zilberman found an opposite relationship. Willimack also found regional differences in adoption rates. The current paper studies the factors relating to computer adoption by some North Carolina commercial farmers, and it is intended to provide further evidence about how regional differences account for computer adoption among farm businesses.

Sources of Farm Information

Farm producers obtain information for farm decisions from various sources. These sources include agricultural professionals and consultants such as extension agents, farm management consultants, computer advisors, accountants, and tax preparers. These information providers are more important now than ever before because of uncertainties associated with economic and institutional environments surrounding the agricultural sector (King). Information providers who service farm operators do not have uniform impacts on the demand for information, because information varies according to the frequency of issue, method of delivery, focus, and cost.

Brown and Collins attempted to evaluate the capabilities of extension agents in satisfying farm operators' needs for information. They observed that extension agents and university professors were important sources of business management information. Therefore, the second goal of this study is to provide insights into the information providers used by commercial farmers in North Carolina. Specifically, we determine the relationship between selected socioeconomic characteristics of North Carolina commercial farmers that influence their use of the services rendered by agricultural information providers.

Analytical Procedure

Various studies have concentrated on agricultural technology adoption (Caffey and Kazmierczak; Casewell and Zilberman; Harper et al.). Others have focused solely on computer technology adoption (Putler and Zilberman). However, this study looks beyond adoption issues to determine professional services and their usefulness in providing information to commercial farmers. Following the study by Batte, Jones, and Schnitkey computer use at the farm level is hypothesized to be determined by two sets of variables. The first set relates to farmer and farm characteristics that influence the farmer's demand for information. The size of the farm (by acreage and income), farm type, farm manager's knowledge and skill (education attainment and record type maintained), are hypothesized to influence the demand for information.

In this study, the multivariate logit model is used to investigate the patterns of computer adoption and usefulness, based on various socioeconomic factors. The North Carolina farmers were classified as either adopters (coded 1) or non adopters (coded 0) of computer, who found computers useful (coded 1) or not useful (coded 0). These observations were used as the qualitative dependent variables in estimating factors influencing computer adoption and computer usefulness.

Specifically, the logit model was specified and estimated using maximum likelihood

procedures. Capps and Kramer, and Pyndick and Rubinfield provide good discussions of the methodology underlying the logit model. Press and Wilson describe the results from logit analyses as being meaningful and appropriate whether the explanatory variables are multivariate normally distributed, independent and dichotomous (zero-one), or multivariate normal and dichotomous. Thus, the robustness of the logit model coupled with its desirable statistical properties makes it appropriate for this analysis.

The Model

The logit model for computer adoption (and computer usefulness) are specified as follows:

$$\log [P/(1-P)] = \alpha_0 + \alpha_1 AGE + \alpha_2 ACRES + \alpha_3 EDUCATION + \alpha_4 INCOME + \alpha_5 RECORD + \alpha_6 SPECIALTY \quad (1)$$

where log P is the logarithmic probability of adopting a computer (or finding computers useful) at the farm level, log $1-P$ is the logarithmic probability of not adopting a computer (or not finding it useful), *AGE* is the age of the respondent in years, *ACRES* is the total acreage operated (expressed in acres),*EDUCATION* is the level of education attained (where high school or less is 0 and college and post college is 1), *INCOME* is the annual farm income (*TOTEXP* is used in the computer usefulness model) in dollars, *RECORD* is the presence of a formal farm record system (where 1 is affirmative and 0 otherwise), and *SPECIALTY* is acreage under cultivation of specialty crops, including tobacco.

Farm size appears to be solely determined by total number of acres, which in turn determines business size. The probability of computer adoption is expected to increase as the number of acres farmed increases.

Rogers maintains that operator age is generally not a determinant of innovation, but it is believed that age would influence technology adoption. Therefore, *AGE* is hypothesized to be negatively related to computer technology adoption. Younger farmers are more likely to use computers, since older farmers may not find it profitable to learn the skills necessary to capture the potential returns derived from computer adoption on their enterprises. They are more likely to depend on traditional methods based on their experience.

Increased education is expected to increase understanding of the complexities of production, marketing and financial relationships and, therefore, lead to an increase in the demand for information. Furthermore, increased education is likely to correspond to an increased awareness of the capabilities of computers and an improved capability to judge their usefulness to the farm business.

A well-structured and maintained record system can substitute for other information sources and modify the type of information one seeks from external sources. *RECORD* is a binary variable that indicates the presence of a formal farm record system. It is expected to be negatively related to computer adoption.

Enterprise variable *SPECIALTY* was included because information requirements for specialty crops such as tobacco are very critical for commercial farmers in North Carolina. It is expected to be positively associated with computer adoption.

Also, *INCOME* is a continuous variable that measures the farmers' total gross income for 1989. It is expressed in dollars, and it is expected to positively influence computer adoption. *TOTEXP* is a continuous variable measuring the total annual expenditures on information services. This includes subscriptions from various professional sources, consultant fees, and expenditure on computer software and peripherals. Greater expenditure associated with the use of information services is expected to lower appreciation for them.

The logit model for the use of the services of professional information providers is specified as follows:

$$\log [P/(1-P)] = \beta_0 + \beta_1 ACRES + \beta_2 FARMTYPE + \beta_3 AGE + \beta_4 EDUCATION + \beta_5 SPECIALTY \quad (2)$$

where log P is the logarithmic probability of using a given professional information provider at the farm level, log 1-P is the logarithmic probability of not using any professional information provider, *ACRES* is the total acreage (expressed in acres), *FARMTYPE* is either a sole proprietor (coded 1) or partnership and corporation (coded 0), *AGE* is the age of the respondent in years, *EDUCATION* is the level of education attained as a binary variable (where high school or less is 0 and college and post college is 1); *SPECIALTY* is the total acreage under specialty crops including tobacco.

In the second equation, it is hypothesized that larger farms will find the services of information providers more useful because of the numerous activities involved in farm management. Also, with increasing age and experience, the appreciation for information services will be reduced. However, with greater education, there will be greater appreciation of the usefulness of information services.

Data Source

In April 1991, a questionnaire was mailed to a randomly stratified sample of 500 North Carolina commercial farmers as part of an overall regional project involving fourteen other states. An initial mailing and one follow-up were used. Of that number, 156 completed questionnaires were returned, which served as the basis for the ensuing analyses. According to Census of Agriculture data commercial farmers are defined as those that earn more than $25,000 in sales. However, a majority of respondents in this study earned more than $100,000.

Sections of the survey addressed a variety of issues about farm information, including the description and uses of farm financial records, crop and livestock records, the general use of farm records and the evaluation of the usefulness of these information for decision-making, the extent of on-farm computer and computer information services use, and the use of professional services.

Results and Discussion

Respondents owned an average of 250 acres of farm land, of which about 32 percent owned 500 or more acres. The average age was about 50 years, even though age ranged between 27 years and 90 years old. 52.6 percent had high school education or less, while 47.4 percent had some college or postgraduate education. Many farmers cultivated grain, livestock, and specialty crops (such as herbs, flowers and tobacco), which are important to North Carolina. Of more relevance to our study, farmers were asked to indicate whether they used computers in their farm business. Respondents in the affirmative were asked further to rank the extent of computer usefulness in managing their farm business.

Table 1 provides information on farm computer adoption. Overall, the adoption rate for computers by the farmers was 14.4 percent. The slow adoption rate of computer technology by this sample of the farming community in North Carolina falls in the range of 3 percent to just over 25 percent, as reported by Willimack and Zilberman, respectively.

Respondents who had used a computer were asked whether they found the computer useful in managing their farms. According to Batte et al., even though the evaluation of performance standards in determining usefulness probably differ in rigor among farmers, such individual evaluations by farmers form the basis for adoption decisions. Furthermore, previous research, such as Lucas concluded that managers' perceptions of information system performance (or system usefulness) were significantly correlated with actual information system use, and presumably, with the system's value.

The usefulness scale ranged from 1 to 5; meaning "not useful at all" to "very useful." The average computer adopter rated computer usefulness at 3.7. Computers were used on the average of 14.8 hours per month for farm management tasks, and it took about 18.1 months on the average from the time of computer purchase until it was felt to be

Table 1. Farm Computer Adoption and Use

Computer adoption percent (%)	14.4
Computer usefulness score[a]	3.7
Hours of computer use per month[b]	14.8
Months before computer is useful[c]	18.1
Year of computer purchase (%)	
1983	8.3
1986	25.0
1987	16.7
1988	25.0
1989	16.7
1990	8.3
Total	100.0
Primary operator of the computer (%)	
Operator	58.3
Partner in the business	8.3
Spouse	25.0
Farm employee	8.3
Total	100.0
Type of computer system (%)	
Microcomputer - IBM or compatible	57.1
Microcomputer - Apple II or compatible	14.3
Microcomputer - Other	7.1
Mail-in computer service	21.4
Total	100.0

[a] Usefulness score ranged from 1 (low) to 5 (high)
[b] Hours of use of computer for farm management tasks
[c] Months from computer purchase until the computer was felt to be useful as a management tool

useful as a management tool. Additionally, computer purchase was documented from 1983; with highest levels of purchases being made in 1986 and 1988, respectively. In most cases, the key users of the computer were the farm operators (58.3 percent) or their spouses (25 percent). Also, IBM or compatible hardware and mail-in computer service were used by 57.1 percent and 21.4 percent of computer adopters, respectively. Apple II or compatible computers were used by 14.3 percent of the computer adopters.

Table 2 delineates the tasks for which a computer is used and its helpfulness. The farmers used computers more often for business financial accounting (75 percent), business correspondence (66.7 percent), business planning (58.3 percent), and tax computation (58.3 percent). Computer was rated fairly helpful in completing these tasks. Although they were rated high in the use of a computer, crop production recordkeeping (16.7 percent), and marketing and price analysis (8.3 percent) were some of the least likely tasks to be completed with computers. Indeed, the majority of farmers still depend on the traditional manual mode of keeping production and marketing records. In response to a question about the media used for internal farm financial records, for example, 82.8 percent of the respondents answered that they used a manual record system.

Estimated coefficients, *t*-statistics, and estimated changes in asymptotic probabilities for the regression of computer adoption are reported in table 3. A maximum likelihood estimator technique was used. The model was highly significant as indicated by the likelihood ratio test. Around 90 percent of the observations were correctly classified by the model.

Table 2. Tasks for which Computer is Used and Helpfulness Score.

	Percent	Helpfulness Score[a]
Business financial accounting	75.0	4.22
Business planning	58.3	4.43
Tax computation	58.3	4.17
Business correspondence	66.7	3.63
Herd production recordkeeping	33.3	4.67
Crop production recordkeeping	16.7	5.00
Marketing and price analysis	8.3	5.00
Access to an electronic information service	8.3	2.00

[a]Usefulness score ranged from 1 (low) to 5 (high)

Table 3. Maximum Likelihood Estimates for a Multivariate Logit Model of Computer Adoption[a]

Variable	Estimate	Change in Asymptotic Probabilities[b]	*t*-statistic
CONSTANT	-5.125300	-0.1082733	4.12
ACRES	1.000030**	0.3300000	2.71
AGE	-0.009700	-0.0009365	0.02
EDUCATION	2.171300**	0.4085687	2.73
RECORD	1.157300	0.1711543	1.05
SPECIALTY	0.006430	0.0006264	0.78
INCOME	0.000003*	0.0006000	2.05

Number of observations	156
Log-likelihood	-53.72
Log-likelihood function	-42.00
McFadden *R*-square	0.22
Prediction Success (percent)	89.72

[a] The dependent variable is 0 = no adoption, and 1 = adoption
[b] This is the derivative of the function with respect to the independent variable evaluated with all other variables at their mean (Maddala, p.23)
* Indicates significance at the 5 percent level
** Indicates significance at the 1 percent level

The estimated coefficient on *ACRES* is positive and significant, which suggests that operators of larger farms are more likely to adopt computer technologies than their smaller farm counterparts. The estimated changes in asymptotic probability for a 1000-acre increase in farm size, evaluated with all independent variables at their means is 33 percent.

The operator's age is negatively associated with the likelihood of computer adoption, but it is not significant. However, The estimated coefficient for education is positive and significant at the 0.01 level of probability. Therefore, farmers with some college education are more likely to use a computer in the farm business. The estimated change in probability associated with movement from a lower to higher formal education classes is nearly 41 percentage points.

The estimated coefficients for *RECORD* and *SPECIALTY* are both positive, but they are not significant. Nevertheless, the variable *INCOME* is highly significant and positive in sign. This result indicates that increased incomes is associated with a willingness to add computer technology to the farm's information system.

The estimated coefficients, change in asymptotic probabilities and *t*-statistics for the evaluation of computer usefulness are reported in table 4. About 94 percent of the observations are

Table 4. Maximum Likelihood Estimates for a Multivariate Logit Model of Computer Usefulness[a]

Variable	Estimate	Change in Asymptotic Probabilities	t-statistic
CONSTANT	-30.20200	-0.00001300	0.002
ACRES	-0.00020*	-0.00011860	2.060
AGE	-0.02200	-0.34035700	0.300
EDUCATION	2.37950**	0.94022999	2.170
RECORD	25.98100	0.00040340	0.0002
SPECIALTY	0.00739	0.00081020	0.726
TOTEXP	-0.01500	-0.05769999	0.00002

Number of observations	156
Log-likelihood	-34.41
Log-likelihood function	-28.03
McFadden *R*-square	0.19
Prediction Success (percent)	94.23

[a] The dependent variable is 0 = not useful, and 1 = useful
** Indicates significance at the 1% level
* Indicates significance at the 5% level

Table 5. Use of Professional Services and Usefulness Score

	Percent	Usefulness Score*
Accountant of financial advisor	49.5	4.43
Farm record association agent	9.3	4.13
Tax preparer	73.2	4.58
Livestock management advisor	3.1	4.33
Crop/pest management consultant	18.6	4.19
Computer software vendor/advisor	6.3	3.80
Computer hardware vendor/advisor	5.2	4.33
Farm management consultant	8.2	3.80
Coop. Extension - county agent	70.1	4.10
Coop. Extension - specialist	39.2	4.31
University professor	18.6	4.18
Vocational agriculture teacher	5.2	4.67
Veterinary consultant	18.6	4.07

* Usefulness score ranged from 1 (low) to 5 (high)

correctly classified by the model. *ACRES* was negatively and significantly related to a farmer's perception of computer usefulness. The negative sign of the estimated coefficient implies that operators of larger farms find computers less useful the more acres they farm.

The estimated coefficient for *AGE* was negative, but it was not significant. However, an operator's educational level was positively and significantly related to computer usefulness. It implies that with higher educational attainment, a farmer seems to much more appreciate the use of computers. Yet, expenditure was negatively but not significantly related to computer usefulness. This result probably implies that increasing computer expenditure is associated with low appreciation of computer use.

Table 5 shows the use of professional services and their importance to farmers. Information is usually provided by professionals such as accountants, tax preparers, co-operative extension agents, farm management consultants, computer advisors, university professors and veterinary consultants. But farm operators do not necessarily use all of these professional services.

Table 6. Maximum Likelihood Estimates for a Multivariate Logit Model of use of a Tax Preparer by North Carolina Commercial Farmers.

Variable	Estimate	Change in Asymptotic Probabilities	*t*-statistic
CONSTANT	1.1538	0.2117	1.59
ACRES	0.0004*	0.0001	2.05
AGE	-0.0285*	-0.0066	2.44
EDUCATION	-0.0133	-0.0031	0.04
SPECIALTY	0.5795	0.1215	1.57
FARM TYPE	0.5095	0.1084	1.37
Number of observations	156		
Log-likelihood	-46.41		
Log-likelihood Restricted	-38.94		
McFadden *R*-square	0.53		
Prediction Success (%)	62.18		

* Indicates significance at the 5% level

Table 7. Maximum Likelihood Estimate for a Multivariate Logit Model of the use of a Cooperative Extension County Agent by North Carolina Commercial Farmers.

Variable	Estimate	Change in Asymptotic Probabilities	*t*-statistic
CONSTANT	-0.3960	-9.0078	0.59
ACRES	0.0010*	0.0002	2.16
AGE	-0.0034	-0.0008	0.32
EDUCATION	1.1011**	0.2200	3.03
SPECIALTY	-0.0370	-0.0089	0.99
FARM TYPE	0.2134	0.0501	0.57
Number of observations	156		
Log-likelihood	-65.23		
Log-likelihood Restricted	-56.25		
McFadden *R*-square	0.49		
Prediction Success (%)	63.46		

** Indicates significance at 1% level
* Indicates significance at 5% level

Farm operators usually select those sources that yield the highest benefits.

The professional services that were frequently used by farmers were the tax preparer (73.2 percent), and the cooperative extension - county agent (70.1 percent). The service that was least used is that of livestock management advisor (3.1 percent). The rationale for modeling the most frequently used professional services is that it is important to determine how certain socioeconomic characteristics of North Carolina commercial farmers influence their static demand for providers of information. The frequency ratings for the use of the services of a tax preparer, and cooperative extension county agent compare favorably with Jones et al., in which they observed the use of these services at 79 percent and 89.3 percent, respectively.

The estimated coefficient, change in asymptotic probabilities and *t*-statistics for the use of the services of a tax preparer and extension agent, respectively, are reported in tables 6 and 7. About 62 percent and 63 percent of the observations, respectively, were correctly classified by the model. The sign on farm size (*ACRES*) in both tables 6 and 7 is positive and significant. This suggests that the farmers are more likely to use the

services of a tax preparer and an extension agent as the size of their farm operations increase. The estimated change in asymptotic probability for a 1000-acre increase in farm size, evaluated with all independent variables at their means is 0.01 and 0.02, respectively.

AGE is observed to have a negative relation with the use of both services. But it is significant in the tax preparer model. Probably, younger farmers would be more likely to use the services of a tax preparer, but older farmers may not find it useful to employ professionals for tax preparation. The farm operator's educational level showed a negative and insignificant relation with the use of the services of a tax preparer. However, it was positive and highly significant in the extension agent model. Thus, farmers with more education are more likely to use the services of extension agents. The estimated change in probability associated with movement from the lower to higher formal education classes is 22 percentage points for extension agents.

Specialty crops, including tobacco, are important for North Carolina commercial farmers. However, it was positive but insignificantly related to the use of the services of a tax preparer, while it was negative and insignificantly related to extension agents. Likewise, farm type showed a positive but insignificant relationship with the use of both agricultural professionals.

Summary and Conclusions

Even though the data on North Carolina commercial farmers confirm the usual low adoption rate for computers, nevertheless, important conclusions can be drawn from this study. For instance, it can be postulated that as farm size increases, more farmers would adopt computers. Furthermore, the farm manager's education level was found to be an important indicator of computer adoption. Critical implications can be drawn, especially from the level of educational attainment in that the probability of increased adoption will rise as the education levels of producers rise *ceteris paribus*.

The potential exists for better farm management, which should arise from the development and use of more efficient computer software. This observation will have substantial implications for North Carolina farmers, as they stand to augment their incomes. Increased incomes has also been found to significantly influence computer adoption, and therefore, may determine the potential synergy between enterprise profitability and computer adoption.

Additionally, it seems that as farm size increases, more farmers would demand the services of tax preparers and extension agents. Furthermore, younger farmers would more likely find professional services of tax preparers to be more useful. Higher education was also found to be an important indicator of the use of extension agents. Therefore, further crucial implications can be adduced for the future of agriculture, especially in light of the advent of the information "super highway." It seems that farmers' ability to utilize information systems will depend on their levels of educational attainment. For example, as farmers acquire more education, they would gain greater understanding about the usefulness and, therefore, rely more on the information services of not only extension agents, but all other sources of information, to ensure more efficient agricultural enterprise management.

Consequently, information providers but especially extension agents, must be aware of developments in computer hardware and software suitable for business accounting and planning, correspondence, and marketing which were found to be very important in this study. They also need to be provided with support for county level programming for producers in the use of such hardware and software. Certainly, greater farm management efficiency arising from better use of information by farmers will contribute to North Carolina, regional and U.S. agricultural competitiveness.

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