

Age in the Internet Age: Is the Age of the Farm Operator a Factor in On-line Business Use?

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Introduction

Farm business Internet access as well as its use has become more prevalent, but use is neither universal nor uniform. Our analysis shows that approximately 56 percent of farms had Internet access in 2004. Sixty-nine percent of sole proprietorship non-farm businesses in the same year had Internet access.

Access to the Internet, however, does not necessarily mean the Internet is used as a management tool. In 2005 nearly 30 percent of farms, approximately 600 thousand farms, used the Internet as an integral part of the farm operation. In 2000 24 percent of farms had used it as a management tool. Through the broader e-government initiative many farm programs and services are available to USDA customers on the Internet. For example, Electronic Loan Deficiency Payments (eLDP) service allows producers to request loan deficiency payments (LDPs) online. Yet, nearly one and half million farms still do not use the Internet as a management tool. The 2002 Farm Bill has a number of provisions aimed at encouraging the use of the Internet in farm and rural non-farm businesses.

¹ The views expressed are those of the authors and do not necessarily reflect the views of the Economic Research Service or the U.S. Department of Agriculture.

Is farm operator age a critical factor of Internet use proclivity in farm operations? This is the focus of the study here. Many studies suggest that age is a factor in determining the likelihood of Internet use. Does the difference in age structure between farm and nonfarm businesses, however, explain the lower incidence of Internet use for farm businesses? Is the observed increase in Internet use across all ages due to the early adopters own aging or is it truly because it is becoming more widely used by all ages? These are some of the questions addressed here.

Factors Determining Internet Use

In the literature a number of factors have repeatedly been identified and postulated as determinates of Internet use (Stenberg and Morehart [2006]). They are income, education, and age (Stenberg [2006]). Earlier gender and other factors had also been postulated as important factors but they, as the Internet became commonplace, have largely disappeared (NTIA[2004]).

Oden and Strover; PEW; Grant and Meadows; NTIA[2000]; and many others have cited age as a factor in determining the likelihood of Internet use. The literature suggests that older individuals are reticent about adopting the Internet while the young readily adopt. As can be seen in table 1 age may be factor but it does not follow the same linear rules as other factors such as education or income (Stenberg [2006]). In the table, a bell-shaped curve can be observed. This pattern may be due to the fact that younger workers may less likely have jobs that require the use of the Internet, while workers at the other end of the age spectrum may indeed be more reticent or perhaps feel less need to adopt the Internet into their work environment. The observed behavior holds for both

metropolitan and nonmetropolitan workers with lower Internet use across all age groups for rural workers vis-à-vis urban workers.

Table 1: Internet use by age and metropolitan status, 2003

Age	Total (percent)	Metropolitan (percent)	Nonmetropolitan (percent)
19 to 25	58.3	60.2	48.1
26 to 35	62.0	63.0	56.3
36 to 45	67.9	69.6	59.7
46 to 55	67.1	69.0	58.9
56 to 65	57.3	59.6	48.6
over 65	33.4	35.8	25.6
Total	60.5	62.3	51.9

Source: Stenberg and Morehart (2006)

Farm operators exhibit the same behavior as nonfarm workers (table 2), the same bell-shaped curve for Internet access can be observed. The youngest and oldest farm operators were the least likely to use the Internet, but over 70 percent of farm operators between the ages of 35 and 54 had Internet access.

Table 2.—USDA Agricultural Resource Management Survey estimates, by operator age, 2004

Item	Operator age					48-State total
	Less than 35 years	35 to 44	45 to 54	55 to 64 years	65 years or older	
Number of farms	81,112	286,713	531,834	553,202	569,676	2,022,538
Percent of farms	4	14.2	26.3	27.4	28.2	100
Percent with Internet access	60.5	71.9	70.2	57.4	34	56.4
Used for farm purchases	16.8	21.1	18.4	20.8	19.5	19.7
Used for household purchases	36.7	29.5	30.3	28.3	24.3	28.9

Source: Stenberg and Morehart (2006).

Observed Internet purchase behavior, however, does not exhibit a bell-shaped curve. Irrespective of what age group a farm operator belongs to, once they are on the Internet an operator of one age group is nearly as likely to make farm purchases over the

Internet as an operator of another age group. With respect to making household purchases, however, young operators are more likely to make household purchases over the Internet than older operators. It has been hypothesized that young Internet users are less risk averse with respect Internet security than older Internet users (PEW). While the observed appears does this mean that age is a significant factor in Internet use?

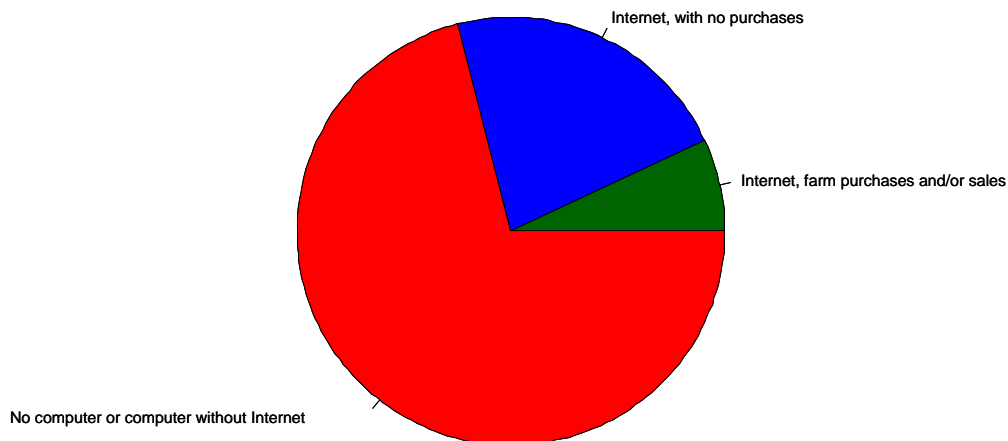
Data and methodology

We use data from the 2000 and 2005 Agricultural Resource Management Survey (ARMS) for analyzing farm use of the Internet. We asked approximately 18,000 farm operators questions about Internet use as part of the annual Agricultural Resource Management Survey (ARMS). We provide descriptive analysis of age and other factors in farm Internet use.

We test the significance of age as a factor in a predictive model. As is often the case when the dependent variable is categorical, we employ the logit model to examine factors that influence Internet use by farm operators and rural workers. The logistic specification is well suited to this type of application and has been used in similar studies. See for example Gloy and Akridge.

For our analysis we have divided farm operators into 3 groups based on Internet business use behavior: non Internet farm business users, farm business Internet users that did not conduct e-commerce and farm business Internet users that made on-line farm sales or purchases (figure 1).

Figure 1: Relative Proportions of CIT Groups, 2005



Source: authors using 2005 ARMS.

By 2000 the Internet had already become commonplace on the farm (table 3). Twenty-three percent of farms used the Internet in their business practices. Younger farm operators were the most likely to use the Internet. The average age of Internet users was under 50 while non-users had an average age of 57. Other factors are also apparent. Farms using the Internet were larger, had greater income, more family members, greater education, and greater household expenditures. A large percentage of Internet users had college educations.

Table 3: USDA Agricultural Resource Management Survey estimates, by cit, 2000

Item	CIT			48-State total
	Internet access with farm purchase or sales	Internet used on farm	No Internet use on farm	
Number of farms	46,015 ^{BC}	451,125 ^{AC}	1,624,445 ^{AB}	2,121,586
Percent of farms	2.2	21.3	76.6	100
Gross farm income	139,082 ^C	119,909 ^C	51,565 ^{AB}	67,996
Value of farm production	130,272 ^C	128,129 ^C	52,206 ^{AB}	70,043
Total household income	72,730	74,028 ^C	58,738 ^B	62,292
Log total household income	9.8	10.1	10	10
Acres operated	547 ^C	673 ^C	350 ^{AB}	423
Household size	3.6 ^C	3.1 ^C	2.6 ^{AB}	2.7
Operator age	46 ^{BC}	50 ^{AC}	57 ^{AB}	55
Operator education in years	13 ^C	13 ^C	12 ^{AB}	12
Household expenditures	37,262 ^C	31,374 ^C	24,116 ^{AB}	25,945
Dummy variables				
Percent with college	75.3 ^C	64.3 ^C	37.9 ^{AB}	44.3
Percent participate in gov program	40.6	48.2 ^C	41.7 ^B	43.1
Operator age group				
Less than 35 years	8	8	6	6
35 to 44	39	24	13	16
45 to 54	37	35	25	28
55 to 64 years	13	23	23	23
65 years or older	3	9	32	27
Operator age group (2005 adjusted)				
Less than 35 years	15	17	11	13
35 to 44	54	34	19	23
45 to 54	22	30	27	27
55 to 64 years	9	15	21	19
65 years or older	1	4	22	18

Source: 2000 USDA Agricultural Resource Management Survey.

Note: Letters A, B, and C indicate significant column difference tests based on pairwise two-tailed [H₀:B1=B2] delete-a-group Jackknife t-statistics at a 90 percent confidence level or higher with 15 replicates and 28 degrees of freedom. A=column 1, B=column 2, etc.

The combined category in column 4 is excluded from testing due to a lack of sample independence.

The 2005 allows further detail on the characteristics of farm operators that use the Internet (table 4). Nearly 30 percent of farms now use the Internet as part of their business practices, but the basic relationships still held. The mean values, however, changed. The means indicate that farms using the Internet were doing even better than the non-users. The value of production, gross farm income, and household income means for users all outpaced those of nonusers. A significant difference exists between users and non-users. Multi-generational farm management was significantly more likely for Internet users than non-users.

Table 4: USDA Agricultural Resource Management Survey estimates, by cit, 2005

Item	CIT			48-State total
	Internet access with farm purchase or sales	Internet used on farm	No Internet use on farm	
Number of farms	#150,756 BC	446,769 AC	1,447,379 AB	2,044,904
Percent of farms	*7.4	21.8	70.8	100
Percent with Internet access	100	100	0	29.2
Used for farm purchases	87.0 B	0.0 A	na	*21.9
Used for farm sales	#15.4 B	0.0 A	na	*3.9
Total internet purchases	^a 387191755	0	0	^a 387191755
Total internet sales	*462792743	0	0	*462792743
Gross farm income	^a 145,811	172,283 C	54,110 B	86,689
Value of farm production	#135,169	165,655 C	53,161 B	*83,784
Total household income	102,791 C	98,544 C	68,105 AB	77,312
Log total household income	10.5	10.5 C	10.2 B	10.3
Acres operated	*537	598 C	342 B	413
Household size	3.0 C	2.9 C	2.5 AB	2.6
Number of school age children	*1	1 C	0 B	0
Operator age	52 C	53 C	59 AB	57
Operator age, 2000 adjusted	47 C	48 C	54 AB	52
Miles to city	*22.6	24.8	23.8	23.9
Operator education in years	16 C	15 C	14 AB	14
Combined education in years	31 C	30 C	27 AB	28
Household expenditures	*46,799	46,502 C	35,246 B	38,557
Combined off farm wages	*52,843	48,970 C	29,228 B	35,282
Dummy variables				
Percent with college	*30.9	17.6 C	10.5 B	13.5
Percent non-white ethnic background	*1.4 BC	*4.6 AC	6.9 AB	6
Percent with spouse working off farm	*53.5	52.9 C	36.9 B	41.6
Percent with operator working off farm	*56.3	56.1 C	42.6 B	46.6
Percent with school age children	*33.5	31.4 C	20.5 B	23.8
Percent participate in gov program	*36.0	55.1 C	39.2 B	42.4
Percent hire professional services	*52.1	67.2 C	43.9 B	49.6
Decision making/management business functions	*53.6	39.8 C	26.2 B	31.2
crop or livestock enterprises	*42.5	35.3 C	24.6 B	28.3
generational lines	^a 31.1	30.9 C	19.1 B	22.6
other	*11.0	10.2	7.9	8.6
Operator age group				
Less than 35 years	6	5	4	4
35 to 44	19	16	10	12
45 to 54	37	34	23	27
55 to 64 years	24	32	26	27
65 years or older	14	13	36	30
Operator age group,2000				
Less than 35 years	15	11	7	9
35 to 44	29	26	17	20
45 to 54	33	35	28	30
55 to 64 years	12	22	23	22
65 years or older	11	6	24	19

Source: 2005 USDA Agricultural Resource Management Survey.

Note: Letters A, B, and C indicate significant column difference tests based on pairwise two-tailed [Ho:B1=B2] delete-a-group Jackknife t-statistics at a 90 percent confidence level or higher with 15 replicates and 28 degrees of freedom. A=column 1, B=column 2, etc.

The combined category in column 4 is excluded from testing due to a lack of sample independence.

Age still appears as a factor with non-users being older on average than Internet users. The average age is significantly greater for non-users than for users. The population, however, has aged 5 years between the surveys making some comparisons more difficult. Controlling for this effect it appears from the data that older farmers were becoming more likely to use the Internet, but some of the increased age appearing in table 4 as compared to table 3 is due to the natural aging process.

Logistic Regression

In order to test the significance of age in the likelihood of Internet use we fitted a full defined multinomial logistic regression model for each year, 2000 and 2005. The model uses data that are comparable between the 2000 and 2005 surveys and has the independent variables:

- Government payments
- Household size
- Years of education of farm operator
- Gross farm income
- Age of farm operator

Under USDA's e-commerce initiative transactions for participating farms can be conducted more quickly and efficiently on-line. We hypothesize that this may encourage adoption by those who receive government payments

A household size greater than two would be indicative of children or young adults presence in the farm operation. It is commonly hypothesized that the presence of children or young adults increases the rate of Internet usage among their elders in any

household. It is hypothesized that the higher the educational attainment the greater the likelihood of farm Internet use. It is hypothesized that the greater the gross farm income the larger the business increasing the likelihood the Internet is used in the farm operation.

Number of years of education is one of the many proxies for educational attainment. It is hypothesized that the higher the educational attainment the greater the likelihood of farm Internet use. It is hypothesized that the greater the gross farm income the greater the business and the greater the likelihood the Internet is used in the farm operation.

The results from the 2000 model show that age was a significant factor in the likelihood of Internet use, both in the use of the Internet in general farm business practices as well as making farm purchases or sales on-line. The only factor that was clearly not significant was the government payments proxy. The gross income proxy was significant for making purchases or sales on-line, but in general Internet use.

Table 5: Multinomial Logistic Regression Estimates using the Jackknife Variance Estimator, 2000.

	Estimate	Std.Err	T.value
Intercept: 1	-3.05	1.41	-2.16
Intercept: 2	-1.79	0.65	-2.76
Government Payments: 1	-0.03	0.28	-0.12
Government Payments: 2	-0.05	0.11	-0.49
Household Size: 1	0.25	0.12	2.06
Household Size: 2	0.13	0.04	3.66
Education (in years): 1	0.11	0.06	1.92
Education (in years): 2	0.06	0.03	2.23
Gross income proxy: 1	-0.02	0.14	-0.13
Gross income proxy: 2	0.11	0.03	3.26
Operator age: 1	-0.05	0.01	-5.45
Operator age: 2	-0.03	0.01	-5.44

Note: 1 is Internet only (no sales and no purchases)
2 is Internet with purchase and/or sales

The results from the 2005 model show again show that age was a significant factor in Internet use with age negatively significantly related to the likelihood of Internet use for making farm purchases or sales. It was negative but not significant for general Internet use, perhaps indicating greater acceptance of the Internet in general across all age groups. Household size was less of factor perhaps indicating greater acceptance of the Internet in households with no children. Gross income was significant in using the Internet for making purchases and sales, but not so for general Internet use.

Table 6: Multinomial Logistic Regression Estimates using the Jackknife Variance Estimator, 2005.

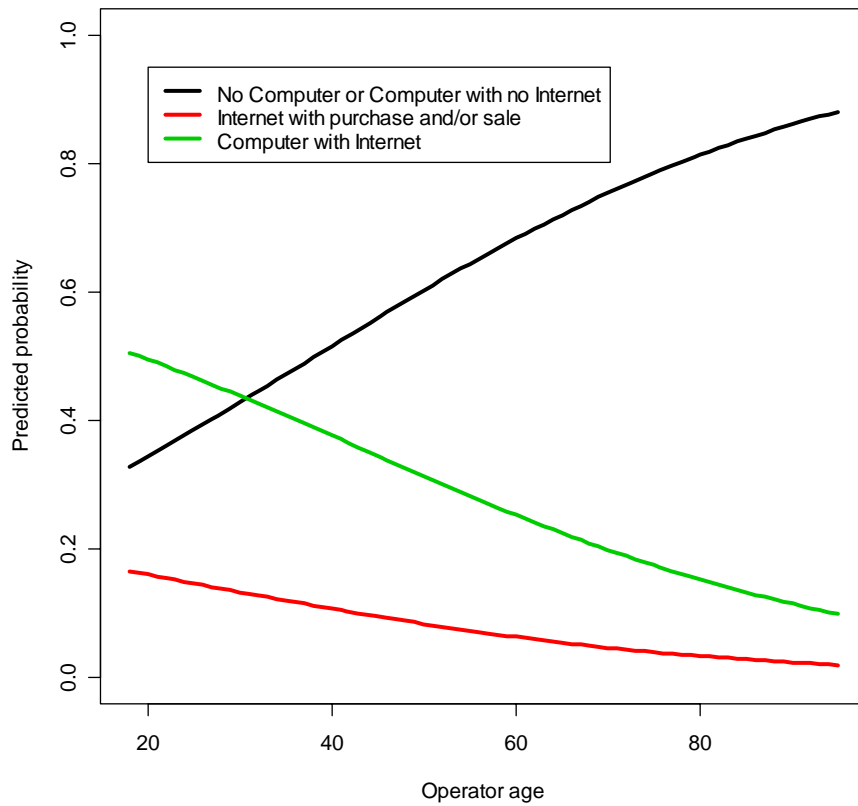
	Estimate	Std.Err	T.value
Intercept: 1	-6.42	1.11	-5.79
Intercept: 2	-3.55	0.66	-5.39
Government Payments: 1	-0.46	1.12	-0.41
Government Payments: 2	0.27	0.21	1.29
Household Size: 1	0.12	0.07	1.58
Household Size: 2	0.07	0.03	2.03
Education (in years): 1	0.34	0.12	2.94
Education (in years): 2	0.19	0.05	4.10
Gross income proxy: 1	0.11	0.23	0.50
Gross income proxy: 2	0.13	0.02	5.32
Operator age: 1	-0.04	0.02	-1.83
Operator age: 2	-0.03	0.00	-7.66

Note: 1 is Internet only (no sales and no purchases)
 2 is Internet with purchase and/or sales

Predicted probabilities are the most conclusive and clearest results that may be obtained from the multinomial logistic regression and here we get some of our most substantive and interesting results. They show clearly the interaction of one variable, constricted within the logistics model, on farm information technology use behavior.

The probability diagrams for age of farm operator show a uniform relationship than what appeared in the simple descriptive statistics (figure 1). The older the farm operator is, the increasing likelihood they will not use a personal computer or Internet in the farm business. The likelihood increases exponentially, but is only by age 50 where the majority of farm operators would not be expected to use it.

Figure 1: Predicted Probability by Age of Farm Operator, 2005



Source: authors using 2005 USDA Agricultural Resource Management Survey

The likelihood of business Internet use decreases with age. Within any age group a farm operator with the Internet is more likely not to make on-line business purchases or sales than will make on-line business purchases or sales. Interestingly, as age increases, the decline in probability is less for making on-line business purchases or sales than for not making purchases sales. The likelihood moved out between 2000 and 2005 for general Internet use and making on-line purchases or sales. The greatest movement occurred for younger farm operators than for older operators but all ages showed an increase.

Conclusion

Internet use has continued to increase on the American farm with the use becoming a more integral part of the operation. In 2004 56 percent of farm operators reported that they had a computer with Internet access. Nearly 30 percent of farm operators reported in 2005 that they used the Internet for farm business operations, a quarter of whom used the Internet to make farm business purchases and sales.

Characteristics of farms using the Internet and those that do not varies considerably. Difference in Internet use across farm size, as measured in farm sales, was striking as well as farm acreage. The share of farms with farm business Internet use was the highest for the largest farms, the lowest for the smallest farms. Education attainment was greater for Internet users

Age remains a factor though it has somewhat lessened between 2000 and 2005. Given the slopes of the lines in the graph it seems likely that this will continue to be the case for some time though it likely will continue to lessen as the population ages.

Continuing and extension education services have to some extent target older farm operators to encourage the adoption of the Internet by showing the ease of use as well as what the Internet has to offer. The results suggest that these continuing or extension education programs may indeed reduce some of the barriers of entry to Internet access for some of the smaller farms.

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