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Utilization of farm management risk strategies at the rural/urban fringe

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Government policy-intervention programs offer U.S. farmers protection from a variety of risk sources. However, the utilization of farm-management risk strategies to address those risks might differ because of location or the crop-mix patterns. This paper utilizes principal component analysis (PCA) and regression analysis to examine the utilization of risk management strategies at the rural/urban fringe. The regression results provide insights into the current utilization of tools and risk management strategies used by farm operators, while the PCA examines tools that are currently utilized to manage farm risks and new tools that may be utilized to do so. The results from the PCA suggest that farm operators would like the addition of new tools such as tax-deferred savings accounts that allow farm operators to withdraw funds in a low-income year or at retirement as a risk management strategy. The PCA results further show that farm operators would like an incentive payment for using various risk management tools, including hedging, insurance, and debt and equity financing as part of federal risk management programs. With respect to the current tools utilized to manage farm risks, the PCA and regression results identify three such categories – enterprise diversification, information collection from the internet, and off-farm income sources.

Key words: Risk, PCA, farm management.

INTRODUCTION

The risks faced by agriculture are well known. These risks are associated with price, production, income, finance and institutions. While the nature and sources of risk change over time due to changes in production technology, weather, government policy, regulations, structure of downstream industries, and global trade relations, the spatial dimension of risk, given farm location on the rural/urban fringe, provide unique challenges for farming in that location. Some of the risk sources may be more pronounced in certain areas or regions, and may require innovative management approaches to address them. For example, weather variability is a greater source of production variability on the African continent compared to North America. Thus mitigation efforts to address that reality may include reducing losses to tolerable levels, by improving management of climate-sensitive natural resources and economic production systems, promoting economic diversification to reduce over reliance on climate-sensitive primary industries, and, emphasizing agricultural processes that guarantee minimum yields even under the worst conditions (Vordzorgbe, 2007). Competition between urban development and agriculture may not now be a major issue on the continent but is sure to become so in places where land in farms on that fringe are of higher value, much smaller in size and carry a wider range of product mix and higher value crops than their rural counterparts.

The diversity of crop mix exposes farmers to a wider set of risks in an ever-changing environment of possible price, yield, institutional, regulatory, and general business outcomes that may affect farm financial returns and the overall welfare of farmers. Farming on the rural/urban fringe also facilitates the participation of farm households in the off-farm labor market. Despite the uniqueness offered by such farming, there exists a paucity of research examining the tools or strategies that farmers on the rural/urban fringe utilize to manage risk on their farms or ranches. The lack of research fails to inform the debate on the various risk management strategies and techniques that are, and in some cases may be utilized to

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achieve acceptable levels of risk on farm operations.

Historically, government intervention programs in agricultural markets in the U.S. and elsewhere have offered farmers significant protection against downward price movements. In the U.S., the price intervention policy covers a wide range of crops. However, the 1996 Farm Bill changed the direction of government farm policy by proposing a gradual elimination of price intervention programs and an increasing reliance on market-based risk management strategies. Such policy changes in U.S. and elsewhere are changing the overall risk environment in the agricultural sector (Coble and Heifner, 1998). Thompson (2005) argues that the 2002 Farm Bill reverses the market orientation of the 1996 Farm Bill and increases government spending and intervention levels in U.S. farm subsidies. Tavernier (2006a) finds that 64% of farmers in New Jersey would like the government to fund programs that provide income support for agricultural producers and partially protect them from the full impact of the market conditions.

While farms in all regions of the U.S. face the same risks associated with production, prices, business and institutional factors, farms on the rural/urban fringe are at a disadvantage compared to their rural counterparts because they receive few benefits from federal farm programs. For example, from 1995 to 2002, agricultural producers in Iowa received $11.3 billion in subsidies from the USDA compared to $85.5 million in New Jersey, the most urbanized state in the nation (www.ewg.org). This finding is not surprising given the structure of farms in the mid-west and south. These farms produce “program crops” that are structurally different from the rest of the country in terms of product mix, farming environment and farm characteristics. For instance, New Jersey agriculture is characterized by much smaller farm size with a much wider range of product mix compared to those in major agricultural states. Less than 10% of farmers who responded to a 2001 policy survey said they received benefits from or participated in federal farm programs in 2000 (Tavernier, 2005). The programs include commodity, conservation, risk management, agricultural credit, disaster assistance and other federal programs.

At the rural/urban fringe, farmers face higher land prices and input costs, and a much greater regulatory burden compared to farmers in rural areas (Adelaja, 1995; Tavernier et al., 1996). The product mix of highly urbanized states like New Jersey comprise of fruits, vegetables, and nursery and greenhouse products which have not been generally covered by federal farm programs. The absence of coverage in such states denies farmers protection against downward movements in market prices that is afforded to their rural counterparts. Moreover, some of the market-based risk-transferring or output price risk hedging tools such as futures, options and cash forward contracts are not available to most producers in the region. Until recently (2001), the federal revenue insurance program was not available to New Jersey farmers. Consequently, most farmers in the state have had to rely on their own resources and expertise to manage farm risks.

Given the reliance on their own resources, farmers are likely to concentrate on risk management strategies that lend themselves to farming on the rural/urban fringe. These strategies may include the utilization of and participation in the off farm labor market. Particularly in the northeast U.S. where land values are very high, farms on the rural/urban fringe may be easily converted to non-farm uses. Thus the ownership structure of farm land on that fringe plays a significant role in the decision of farm households to seek off-farm labor supply opportunities (Tavernier et al., 1997). The authors show that participation in the off-farm labor market is low in states where farm incomes are high. Other risk management strategies may include diversification mechanisms that incorporate agritourism, value added products and the use of direct marketing channels.

Standard risk modeling involves the quantitative evaluation of outcomes which may lead to the exclusion of certain risk management activities that are inherently difficult to quantify. For instance, the use of forward and futures markets are amenable to risk analysis whereas the use of market information is not, although farmers typically find the use of such information an increasingly important risk management activity in a market-oriented environment (Martin and McLean, 1998; Tavernier et al., 2004). Despite their popularity of the risk programming models in agricultural risk management, the solutions obtained are often sensitive to completeness of model specification and resource constraints and are rather difficult to attain in practice (Mapp and Helmers, 1984). In the real world, farmers operate in a multi-attribute environment where multiple forces, choices, preferences and events affect behavior and performance. Moreover, modeling bias may arise if an incomplete set of risk management alternatives is considered for analysis (Martin and McLean, 1998).

Clearly, optimal risk management strategies in agriculture vary with farm characteristics and the risk environment (Hope and Lingard, 1992). Farmers' perceptions, attitudes, objectives as well as the available resource base, influence their decisions and actions (Teague et al., 1995; Oglethrope, 1996). Yet very little empirical information is available on the risk perception of farmers and their preference over available risk management strategies (Boggess et al., 1985; Martin, 1996). Even less is known about the diversity of risk perceptions and risk management practices across different socio-economic groups (Boggess, Anaman and Hanson, 1985). This lack of knowledge presents significant challenges to policymakers who may wish to design risk management strategies to facilitate farm operations on the rural/urban fringe.

The relationship between farm characteristics, farmers' risk perceptions and their use of risk management strategies is crucial to the design of risk management strategies. Boggess, Anaman and Hanson (1985) find relative uniformity across various socioeconomic groups in the use of production and marketing techniques but a divergence in financial strategies to manage risk in a study of Alabama and Florida farmers. The authors show that the use of financial strategies vary by farm size, debt and farming experience and suggest the existence of two distinct groups of farmers in terms of their risk management strategies. Patrick and Musser (1997) find that risk perceptions and risk management strategies used by farmers are influenced by farm and farmer characteristics in a study on large-scale farmers from corn-belt states. Studies by Martin and McLean (1998) on New Zealand farmers and Meuwissen, Hurine and Hardaker (1999) on Dutch livestock farmers report similar findings.

The above literature shows that understanding the relationship between farm (and farmer) characteristics and the use of risk management tools is critically important in developing market-based risk management tools and in formulating public policy to help producers attain risk-efficient outcomes. While the literature provides some information on those tools, none of those studies is based on the agricultural sector at the rural/urban fringe.

Moreover, little is known about the risk perception of farmers and their preference over available or potential risk management strategies. Given such deficiencies, this paper contributes to the literature by positing that determinants of a risk strategy are likely to depend on the strategy utilized to manage risk. To test that hypothesis, the paper examines whether farmers utilize enterprise diversification, information collected from the internet or off-farm sources to manage risk on their farms or ranches in a New Jersey case study. The paper further investigates farm operators' preference for future or potential risk management approaches.

The paper proceeds as follows. The next section outlines the data collection method and examines characteristics of the sample. This section is followed by the methodology used in the analysis. The results from principal component analysis and the regression model are then presented. The paper ends with discussion and policy implications.

Data collection and sample characteristics

The data for this study are obtained from the National Agricultural, Food and Public Policy Preference Survey. The survey began in the spring of 2001 and concluded in the summer of the same year. The mail only survey was a collaborative effort among the National Agricultural Statistics Service (NASS), faculty from land grant universities and the Farm Foundation. The NASS was responsible for sample selection, printing and mailing of the questionnaires, telephone follow up and data collection activities. The data collection efforts consisted of first and second mailing of questionnaires. Faculty from the land grant universities provided input into the survey process while the Farm Foundation, a publicly supported non-profit organization, helped to fund the project.

Though national in scope, the survey contains state-specific data and thus provides an opportunity to investigate issues of relevance to particular states. The NASS chose a random sample of 631 agricultural producers for the New Jersey component of the study. One hundred and forty four questionnaires were returned giving a response rate of 23%. Although response rates as low as these are not uncommon in mail surveys they raise the question of nonresponse bias (Dillman, 1978). If there exists divergence in responses between respondents and non-respondents, error is introduced into the sample and may bring into the question the conclusions drawn from the study. To address that issue characteristics of respondents to known characteristics of the population are often examined. This examination is done using the 1997 Census of Agriculture (USDA, 1999).

In most cases there does not exist a one-to-one correspondence between Census data and data from the study. According to the 1997 Census of Agriculture, there are 9,101 farms in New Jersey. The random sample is drawn from that population. Eighty seven percent or 7,940 of those farms are considered small and the remaining 13% or 1,161 farms are considered large. Large farms in this study are defined as farms having $100,000 or more in annual gross sales (Lubben et al., 2001). Farms with annual gross sales of less than $100,000 are defined as small. By that definition, 78% of the farms in the study are small while 22% of the farms are considered large. Farms are also classified by other gross sales categories. For example, 1997 Agricultural Census data suggest that 21% of farms in New Jersey have gross sales between $10,000 and $49,999 compared to 23% in this study. Also, 6% of the farms in the census data have sales between $50,000 and $99,999 compared to 8% in this study.

The 1997 Agricultural Census data suggest that where reasonable comparisons are possible, the study data are representative of the farm population. However, deleting data for individuals who fail to report relevant socio-economic information may also lead to bias and compromise the results of the study. To examine that issue, researchers often evaluate the means of the whole sample and the sample with deleted observations. A comparison of the means suggests that this may not be a problem. Table 1 presents summary statistics for the variables used in this study.

METHODOLOGY

The methodology used in this study has been presented elsewhere but is repeated here to facilitate the discussion (Tavernier, 2006b). Additionally, we apply the principal component factor analysis to decompose the potential and current risk management practices that reflect the similarity of approaches adopted by farmers.

The econometric model that examines the determinants of the current utilization of risk management practices assumes that farm operators maximize an inter-temporal profit function. The model fur-

Table 1. Descriptive statistics of variables.

Variables	Description	Mean	Std.Dev.
Dependent Variables			
DIVERSIFICATION	Enterprise diversification	0.16	0.36
INTERNENT	Information collection from the internet	0.21	0.41
OFF-FARM INCOME	Off-farm income sources	0.60	0.49
Explanatory Variables[a]			
AGE3544	35 to 44 years old	0.14	0.35
AGE4554	45 to 54 years old	0.30	0.46
AGE5564	55 to 64 years old	0.28	0.45
AGE65OVE	65 years old and older	0.28	0.45
SALES10U	Gross sales under $10,000	0.48	0.50
SALES104	Gross sales between $10,000 and $49,000	0.24	0.43
SALES509	Gross sales between $50,000 and $99,000	0.08	0.28
SALES100	Gross sales between $100,000 and $249,000	0.07	0.26
SALES250	Gross sales between $250,000 and $499,000	0.05	0.22
SALES500	Gross sales between $500,000 and $999,000	0.03	0.17
SALES1MI	Gross sales, $1,000,000 and over	0.04	0.21
INCNONE	Earns no family income from farming	0.15	0.36
INC125	Earns between 1 and 25% of family income from farming	0.46	0.50
INC2650	Earns between 26 and 50% of family income from farming	0.16	0.36
INC5175	Earns between 51 and 75% of family income from farming	0.02	0.15
INC76100	Earns between 76 and 100% of family income from farming	0.22	0.41
EDUCGRAD	Grade school level of education	0.02	0.15
EDUCHS	Some high school education	0.04	0.21
EDUCHSDI	High school diploma	0.23	0.42
EDUCCOLL	Some college	0.22	0.42
EDUCBA	Bachelor's degree	0.28	0.45
EDUCMA	Advanced degree	0.19	0.40
TENNONE	Owns none of the land that is farmed	0.07	0.26
TEN125	Owns 1 to 25% of the land that is farmed	0.07	0.26
TEN2650	Owns 26 to 50% of the land that is farmed	0.06	0.24
TEN5175	Owns 51 to 75% of the land that is farmed	0.07	0.25
TEN76100	Owns 76 to 100% of the land that is farmed	0.72	0.45

"a" May not add to 1 because of rounding.

ther assumes that a farm operator chooses a mix of management strategies that maximizes income subject to uncertainty. The random component comes from maximization errors, and other unobserved characteristics of choices or measurement errors in the exogenous variables.

Let the profit function of farm operator *i*, making the *j-th* choice be,

$$\pi_{ij} = U_{ij} + \varepsilon_{ij} \tag{1}$$

Where Uij = (lnX $_{i1}$, lnX $_{i2}$, ….., lnX $_{ik}$) with lnX $_{im}$ representing the set of *m* observable characteristics of the *i-th* farm operator, and ε_{ij} is a random variable. If the *i*-th farm operator maximizes profit s/he will choose decision *j* rather than *k* according to the expression,

$$\pi_{ij} > \pi_{ik}, \forall k, k \neq j. \tag{2}$$

Note that the profit function has a random component. Then the probability that choice *j* is made by the *i-th* farm operator can be defined as,

$$P_{ij} = \Pr ob(\pi_{ij} > \pi_{ik}), \forall k, k \neq j. \tag{3}$$

It can be shown that if the error term ε_{ij} has standard Type 1 extreme distributions with density

$$f(\varepsilon) = \exp\{-\varepsilon - \exp\{-\varepsilon\}\} \tag{4}$$

then (Maddala, 1983)

$$P_{ij} = \frac{\exp\{U_{ij}\}}{\sum \exp\{U_{ik}\}}, \tag{5}$$

Which is the basic equation defining the multinomial logit model. In the case where *j = 2*, the *i-th* farm operator will choose the first alternative if $\pi_{i1} - \pi_{i2} > 0$. If the random π_{ij} have independent extreme value distributions, their difference can be shown to have a logistic distribution, and we can obtain the standard logistic regression model. That model is chosen for this study because of its mathematical simplicity and because its asymptotic characteristic constrains the predicted probabilities to a range between zero and one (Maddala, 1983).

Using equation (5) and assuming that π_{ij} is a linear combination of the explanatory variables, we can estimate the coefficient of each variable using maximum likelihood estimation (MLE) because the data set contains individual rather than aggregate observations (Gujarati, 1992). The parameter estimates from the MLE are consistent and asymptotically efficient (Pindyck and Rubinfeld, 1991).

Equation (5) can also be written as,

$$\Pr ob(Y = j) = \frac{e^{\beta_j' x}}{\sum_k e^{\beta_k'} x} \tag{6}$$

Where *Y* represents a discrete choice among *j* alternatives, and the set of parameters, β, reflect the impact of changes in *X* on the probabilities. The marginal effects which are the partial derivatives of probabilities with respect to the vector of characteristics and computed at the means are given by,

$$\frac{\partial P_j}{\partial X_i} = P_j(\beta - \sum_{i=1}^{m} P_i \beta_i) \text{, j = 1,2,....,m.} \tag{7}$$

The model assumes that the probability of observing a particular outcome is dependent on a vector of explanatory variables, *X*.

The study also uses principal component and factor analysis to assess the importance of current and potential future risk management approaches. The main purpose of using that analysis is to reduce the number of variables and to detect patterns in the relationship between the variables. The importance of such relationships can be detected by factor loadings, also called component loadings in principal component analysis (PCA). These loadings are the correlation coefficients between the variables and factors. Essono et al. (2007) use PCA to analyze cassava production and processing characteristics in southern Cameroon.

The PCA also uses two sets of data from the National Agricultural Food and Public Policy Preference survey. The first data set is compiled from the question that asks respondents to rank the importance of risk management programs with the greatest potential for application on their farms on a four-point scale, where 1 represents *most important* and 4 represents *least important*. In particular, respondents are asked the following question: If funding for risk management programs is increased (in the Farm Bill), which approach would be most preferred? A.) Increase coverage regions, protection levels, and premium subsidies for crop and revenue insurance; B.) Expand federal programs to include insurance for livestock; C.) Establish tax-deferred savings accounts for farmers, providing for withdrawals in low-income year or retirement; and D.) Provide an incentive payment for using various risk management tools, including hedging, insurance, debt and equity financing, savings accounts, and education.

The second data set is compiled from the question that asks respondents: Which, if any, of the following tools or strategies do you use to manage risk on your farm or ranch? The options include: a) insurance policies on production or revenue; b) input cost hedging; c) grain storage; d) enterprise diversification; e) debt and equity financing or savings accounts; f) information collection from the internet; g) management education and information; and h) off-farm sources. In identifying the importance of the potential and current risk management strategies for distinguishable farmer groups, the principal components factor analysis method reduced the investigation to 12 research questions grouped under five potential and current risk management categories (Table 2).

RESULTS

This section presents the empirical results from the principal component and factor analysis and the econometric model. The results examine the importance of the relationships between variables in explaining risk management approaches preferred by farm operators.

Factor analysis of potential and current risk management approaches

The factor analysis and the econometric results are presented in this section. The results of principal component and factor analysis obtained under varimax rotation of the farmers' responses are presented in Tables 2. These results represent the farmers' responses to the 12 questions addressing risk management approaches. The factors are ranked in order of the proportion of variance explained and are named to reflect the risk management categories that they represent.

According to Table 2, the five dimensions of the potential and current risk management approaches identified by the factor analysis explain about 69% of the total variance. The categories reflect the preferences of farm operators for two futures or potential risk management approaches factors 3 and 4). In particular, farm operators express a preference for the expansion of federal programs to include insurance coverage for livestock producers, and a preference for establishing nontradetional approaches to risk management, such as the establishment of tax-deferred savings accounts and increasing coverage regions. The three remaining categories reflect current farm management risk practices. The five categories are summarized as follows.

Traditional approaches to risk management (factor 1): The factor loadings for the first component representing "traditional" approaches to risk management has high loadings that relate to grain storage, insurance policies on production or revenue, and management education and information. The loadings show positive

Table 2. Varimax rotated factor loadings on potential current risk management practices.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Total
Factor 1: Traditional risk management approaches						
Grain storage	0.796					
Insurance policies on production or revenue	0.767					
Management Education and Information	0.701					
Factor 2: Off-farm & other income stabilizing approaches						
Off-Farm Income sources		0.745				
Debt and equity financing or savings accounts		0.635				
Information collection from the internet		0.542				
Factor 3: Livestock coverage and & incentive payments						
Expand coverage to include Livestock products			0.8995			
Provide incentives payments to use such tools as hedging, debt and equity financing, saving accounts etc. tools			-0.6390			
Factor 4: Expanded Regional Coverage & non-traditional Approaches						
Increase coverage regions, protection levels, and premium subsidies for crop and revenue insurance.				-0.9019		
Establish Tax Deferred savings Accounts				0.7131		
Factor 5: **Diversifiers**						
Enterprise Diversification					0.726	
Input cost hedging					0.506	
% of Variance Explained	15.63	14.00	13.95	13.82	11.34	68.75

values ranging from 0.701 to 0.796 and explain the largest percentage (about 16%) of the total variance. The positive values mean that whenever these approaches to risk management increase the value of the first component also increases and vice versa.

Off-Farm approaches to risk management (factor 2): This factor is named to reflect the high loadings associated with approaches that involve the least farm activity, i.e., dependence on off-farm activities such as debt equity financing and increasing use of the internet for market information. The factor loadings show positive values ranging from 0.745 to 0.542 and explain 14% of the total variance. As indicated above, the positive values mean that whenever these approaches to risk management increase the value of the second component also increases and vice versa. Thus, for example, the contribution of off-farm income to farm household income (either by the operator or by other family members) as well as activities from off-farm investments provide income diversification benefits to farm families and increases the value of that component.

Future approaches (factor 3): The factor loadings for the third component represent potential or future approaches to risk management and relate to expanding federal programs to include insurance for livestock and providing incentive payments for using various risk management tools, such as hedging, insurance, debt and equity financing, savings accounts, and education. In some cases, while farm operators may be utilizing some risk management strategies such as debt and equity financing, they express a preference for the federal government to increase funding for such strategies. The loadings show a positive value of 0.899 for expanding insurance coverage to include livestock and a negative value -0.639 for various incentive payment mechanisms. The different signs clearly illustrate that these components are related, to some extent, to the specific risk management approach utilized in component three. This factor accounts for about 14% percent of the total variance.

Nontraditional risk management approaches (factor 4): The factor loadings for the fourth component also represent potential or future approaches to risk management and reflect the farmers' preference for expanded regional coverage, and the establishment of tax-deferred savings accounts for farm operators. The loadings show a positive value of 0.713 for the establishment of tax-deferred accounts and a negative value -0.902 for increasing coverage regions, protection levels, and premium subsidies for crop and revenue insurance. The different signs again clearly illustrate that these components are related to the specific risk management approach utilized in component four. This potential approach to risk management explains 13.82% of the total variance.

Diversification approach to risk management (factor 5): The loadings show positive values of 0.726 for enterprise diversification, and 0.506 for input cost hedging. That factor also explains 11.34% of the total variance. The positive values mean that whenever these approaches to risk management increase the value of the fifth component also increases and vice versa.

REGRESSION RESULTS

Recall from Table 1 that among the 134 respondents included in this study, 16% applied diversification strategies, 21% used internet-based tools, and 60% used off-farm income-based risk management approaches. The econometric results from these three risk management approaches are summarized below. The maximum likelihood estimates of the coefficients and the associated t-ratios from the logit model are presented in Tables 3 - 5. The tables also present the estimated values of the log-likelihood (LL) functions of the unrestricted and the restricted (that is, all slope coefficients are zero) models. The reported values of the McFadden's R^2 are measures of goodness of model fit. The marginal effects of the independent variables on the dependent variable (i.e., farmer's use of a particular risk management approach) are reported in the last column. The tables also present information on model prediction success.

Diversification Risk management approaches

Table 3 presents the results for diversification as a risk management approach from the model that gives the best model fit. In addition to the results, Table 3 also presents goodness of model fit measures such as the Chi-square statistic, the Mc Fadden R^2 statistic, and the percent of successful predictions. The estimated log likelihood ratio based Chi-square statistic of 36.09 exceeds the 95% critical value of the test statistic with 13 degrees of freedom (DF) and indicates that the model has significant explanatory power. The Mc Fadden R^2 value of 0.31 also indicates an extremely good fit for the estimated model (see Bell et al., 1994). This statistic is generally low in binary dependent variable models estimated with cross-section data (Pindyck and Rubinfield, 1991). The percent of correct predictions is also very high. This measure predicts likelihood of an event occurring given a set of explanatory variables (Judge et al., 1982). The model correctly predicts 86% of the responses.

The results show that the coefficients of *SALES104*, *SALES250*, *SALES509, SALES1MI, AGE3544,* and *EDUCMA* are positive and statistically significant. In particular, the results suggest that there exists a positive relationship between the relevant sales, age and education variables, and respondents who use enterprise diversification as a major approach to managing risk on their farm. The estimated marginal effects of these variables measure the influence on respondents who use enterprise diversification as a major risk management tool. Thus, for example, the results indicate that respondents with farm sales between $10,000 and $99,999 are 11 -14% more likely to use enterprise diversification as a risk management tool, compared to respondents with sales under $10,000. The results further show that respondents in the 35 - 44 age category are 15% more likely to use enterprise diversification, while those with a masters degree will be 14% more likely to use this strategy compared to those with those with less that college education.

Internet-based risk management approaches

Table 4 presents the results for the Internet-based approach to risk management. In addition to the results, Table 4 also presents goodness of model fit measures such as the Chi-square statistic, the Mc Fadden R^2 statistic, and the percent of successful predictions. The estimated log likelihood ratio based Chi-square statistic of 47.055 exceeds the 95% critical value of the test statistic with 16 degrees of freedom and indicates that the model has significant explanatory power. The Mc Fadden R^2 value of 0.34 also indicates an extremely good fit for the estimated model (Bell et al., 1994). The model correctly predicts 86% of the responses.

The results show that the coefficients of *SALES104*, *AGE3544, AGE4554, AGE5564, EDUCBA, EDUCMA, TEN125,* and *TEN2650* are positive and statistically significant. In particular, the results suggest that there exists a positive relationship between the relevant sales, age, education and tenancy variables, and farm operators who use internet-based approaches to manage risk. The estimated marginal effects of these variables mea-

Table 3. Risk management diversification.

	Coefficient	t-ratio		Marginal Effect	
CONSTANT	-5.5260	-3.96		-	
SALES104*	2.0179	2.43		0.14	
SALES509**	1.6801	1.60			
SALES100	1.6972	1.23		0.11	
SALES250*	5.0652	3.88		0.34	
SALES1MI**	2.4054	1.56		0.16	
AGE3544*	2.2461	2.07		0.15	
AGE4554	1.4367	1.34			
AGE5564	1.0745	1.07			
EDUCCOLL	0.0230	0.02			
EDUCBA	-0.3641	-0.40			
EDUCMA*	2.0816	2.35		0.14	
INC125	0.7313	0.85			
INC2650	1.1218	1.26			
LL	-40.13				
Restricted LL	-58.18				
Chi Square	36.09				
DF	13				
McFadden's R^2	.31				
Correct Prediction (%)	.86				
Predicted					
		Actual	0	1	**Total**
		0	107	6	113
		1	13	8	21
		Total	120	14	134

* denotes that the variable is significant at 0.05 level. ** denotes that the variable is significant at 0.10 level.

sure the influence of farm operators who use internet-based approaches as a major risk management tool. Thus, for example, farm operators in the age categories *AGE3544*, *AGE4554*, and *AGE5564* compared to those less than 35 years old are 21 to 29% more likely to use internet-based risk management strategies. Farm operators with *SALES104* compared to those with sales under $10,000 are 11% more likely to use internet-based sources to manage their farming risks. Farm operators with first and second degrees are more likely to use internet-based sources to manage risks compared to farm operators with less than a college education. Farm operators with such degrees are 19 to 27% more likely to use such internet-based sources. Similarly, farm operators who own 25 - 50% of the land that they farm are 15% more likely to use the internet- based sources compared to those who own less than 25% 25% of the land that they farm.

Off-Farm income risk management approaches

Table 5 presents the results for off-farm income as an approach to risk management. In addition to the results, Table 5 also presents goodness of model fit measures such as the Chi-square statistic, the Mc Fadden R^2 statistic, and the percent of successful predictions. The estimated log likelihood ratio based Chi-square statistic of 57.250 exceeds the 95% critical value of the test statistic with 21 degrees of freedom and indicates that the model has significant explanatory power. The Mc Fadden R^2 value for the model is 0.32. The model correctly predicts 74% of the responses.

The results show positive and statistically significant coefficients in the percent of family income earned from farming and ranching ("*INC*"), tenancy ("*TEN*"), and education ("*EDUC*") categories. In particular, the results show that in the "INC" category, there exists a positive

Table 4. Internet-base risk management

	Coefficient	t-ratio	Marginal Effect
CONSTANT	-7.1630	-4.32	-0.57
AGE3544*	3.3043	2.41	0.26
AGE4554*	3.6299	2.69	0.29
AGE5564*	2.6667	2.02	0.21
SALES104*	1.3869	1.98	0.11
SALES509	-0.3635	-0.33	
SALES100	1.3732	1.06	
SALES250	1.6095	1.22	
SALES1MI	0.7416	0.57	
INC125	0.4065	0.54	
INC2650	-0.0857	-0.09	
EDUCCOLL	1.0282	0.95	
EDUCBA*	2.3655	2.43	0.19
EDUCMA*	3.3506	3.32	0.27
TEN125*	2.1469	2.10	0.17
TEN2650**	1.8602	1.66	0.15
TEN5175	0.1048	0.09	
LL			-45.157
Restricted LL			-68.6843
Chi Square			47.05462
DF			16
McFadden's R^2			.34
Correct Prediction (%)			.86

	Predicted		
Actual	0	1	**Total**
0	101	5	106
1	14	14	28
Total	115	19	134

* denotes that the variable is significant at 0.05 level.** denotes that the variable is significant at 0.10 level.

relationship between farm operators who earn between no income and 50% of their income from farming, and the utilization of off-farm income as a risk management strategy. Similarly, farm operators who own between 26 and 75% of the land that they farm are morel likely to use off-farm income as a risk management strategy. However, the results suggest that farm operators with a high school education are less likely to use off-farm income as a risk management strategy to augment their income.

DISCUSSION AND POLICY IMPLICATIONS

Government policy-intervention programs offer U.S. farmers protection from a variety of risk sources. While farmers throughout the world face many of the same sources of risks, the utilization of farm-management risk strategies to address those risks might differ because of location or the crop-mix patterns. Thus understanding the utilization of risk management strategies is important particularly for policy design and implementation. This paper takes a step in that direction by examining producer attitudes and their policy preferences for risk management approaches in an urban-influenced environment.

The paper draws from two approaches to examine the utilization of risk management strategies at the rural/ urban fringe. The regression results provide insights into the current utilization of tools and risk management strategies used by farm operators, while the PCA exa-

Table 5. Off Income farm risk management.

	Coefficient	t-ratio		Marginal effect	
CONSTANT	-3.9328	-1.81			
AGE3544	0.3269	0.40			
AGE4554	-0.0038	-0.01			
AGE5564	-0.2292	-0.35			
SALES10U	0.9667	0.53			
SALES104	1.3426	0.73			
SALES509	2.9732	1.47			
SALES100	-0.2838	-0.16			
SALES250	2.3967	1.09			
SALES500	-1.7229	-0.93			
INCNONE*	3.1816	2.39		0.73	
INC125*	3.7470	2.92		0.85	
INC2650*	5.6014	3.58		0.82	
INC5175	2.9648	1.49			
TENNONE	1.3379	1.23			
TEN125	1.1112	1.09			
TEN2650*	5.5540	2.71		0.72	
TEN5175*	4.2125	2.19		0.96	
EDUCHS**	-4.6768	-1.66		-0.70	
EDUCHSDI	-0.1703	-0.24			
EDUCCOLL	-0.1083	-0.15			
EDUCBA	-0.5887	-0.87			
LL				-61.3095	
Restricted LL				-89.9347	
Chi Square				57.25044	
DF				21	
McFadden's R^2				.32	
Correct Prediction (%)				.74	
		Predicted			
		Actual	0	1	**Total**
		0	26	27	53
		1	8	73	81
		Total	34	100	134

*denotes that the variable is significant at 0.05 level. ** denotes that the variable is significant at 0.10 level.

mines tools that are currently utilized to manage farm risks and new tools that may be utilized to do so. Understanding the current and potential utilization of tools and strategies by farm operators at the rural/urban fringe is extremely important to the policy decision making process given the absence of program crops that benefit from significant commodity subsidies in those areas.

The results from the PCA suggest that farm operators would like the addition of new tools such as tax-deferred savings accounts that allow farm operators to withdraw funds in a low-income year or at retirement. While such a policy may diminish the liquid assets available to farm operators at retirement, it may serve as a short-term stopgap mechanism to tide farmers over challenging years. The policy may also serve to decrease reliance on government resources as farmers depend on their own resources to fund more of their farm operations in difficult times.

In addition to tax-deferred savings accounts, farm operators would also like the Federal government to increase the coverage regions, protection levels, and premium subsidies for crop and revenue insurance. In 2000, for example, 7% of farmers in New Jersey benefited from commodity programs such as production flexibility contracts or marketing loans (Tavernier, 2005). These programs allow producers of designated crops to receive a loan from the government at a crop-specific loan rate per unit of crop production by pledging production as loan collateral. However, a move away from the basic commodities to a more non-traditional commodity approach would clearly benefit New Jersey agriculture. The state is not a major producer of the basic commodities such as corn, sorghum, barley, oats, wheat, rice, soybeans and minor oilseeds, and upland cotton that have been the major beneficiaries of the federal commodity program.

The PCA results further show that farm operators would like an incentive payment for using various risk management tools, including hedging, insurance, and debt and equity financing as part of federal risk management programs. These tools are amenable to the education levels possessed by farmers in the state. Over 70% of respondents have at least some college education.

With respect to the current tools utilized to manage farm risks, the PCA and regression results identify three such categories – enterprise diversification, information collection from the internet, and off-farm income sources. In the case of enterprise diversification, the results strongly suggest that farm operators across sales categories are participating in diversification strategies. While the diversification strategies are not clear, farmers are involved in the production of feed grains and other coarse grains, forages, beef, sheep, poultry, fruits, vegetables and "other agricultural products" (Tavernier, 2006a). It is quite likely that the other agricultural products category includes agritourism related activities. These activities promote the use of agricultural amenities and resources, such as rustic farmhouses, open fields, and the use of livestock to offer fee-based recreational opportunities and are significant sources of supplemental income in New Jersey.

The education variable also plays an important role as a risk management tool in information gathering from the internet. Given the low cost of computers, it quite likely that most, if not all farms in New Jersey are connected to the internet. This connectivity provides a great opportunity to explore the "world wide web" and is more likely to be utilized by farm operators with high levels of educational attainment and by farm operators who are younger than their counterparts. Thus risk-based strategies that rely on the farmer's own initiative benefit greatly from increased levels of education.

Given the diverse risk management strategies and the make up of agriculture on the rural/urban fringe, one may argue that the education level of farm operators in New Jersey lends itself to understanding the complexities of the available pool of risk approaches. However, broader protection levels to include some of the non-traditional program crops grown in the state may come with some risk. As Knutson and Anderson (2001) argue, the inclusion of non-traditional commodities may require specifying the eligible commodities; the types of payments; the triggering mechanism for payments; the payment levels or the formula for determining payment levels; and any payment limitation provisions. Such institutionalization would clearly mean greater government involvement in agriculture, the potential for increased production, followed by lower market prices.

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