The Risk Attitudes of Farmers and The Socioeconomic Factors Affecting them: A Case Study For Lower Seyhan Plain Farmers in Adana Province, Turkey.

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1. Introduction

The presence of risk in agriculture has long been recognized as a significant factor influencing farmers' decisions on production, investment and adoption of new technology. While risk can be viewed as an obvious characteristic of farm family, there are no clear consensus about the degrees of attitude that farmers have towards risk. Intuitively, farmers are likely to be risk averse; hence they prefer sure return to uncertain return given the same level of expected return. Farmers' attitudes toward risk can be affected by broad variety of things that range from cultural background to individual characteristics (Binswanger, 1980).

To cope with the presence of risk that farmers face, many government programs have been designed and implemented throughout the world. The success of government programs, usually is measured in terms of farmers' participation in program and benefits they receive, given the fixed government spending. Because farmers have different attitudes toward risk, they will get different levels of benefit or utility by participating in the underlying government program.

Thus, the type and degree of risk aversion of farmers play major role in: (1) evaluating the benefit of alternative projects that have different discounted sum of return and variance, and (2) determining the welfare increases in farm level by implementing government programs that aim to stabilize farm revenue.

In addition, by knowing the farmers' attitudes toward risk, it can be concluded that not producing commercial crops and failing to adopt new technology are the consequences of different attitudes toward risk or of other set of constraints such as limitations on credit and/or access to modern input. This question is of considerable policy importance because policy presumably can affect credit and other constraints faced by low-income farmers more easily than their attitudes toward risk (Binswanger, 1980).

Given the importance of farmers' attitudes toward risk and that there are no previous studies in this area to the authors knowledge regarding the issue of farmers' attitudes toward risk, we aim to determine farmers' risk aversion coefficient and possible relationship between farmers' risk attitudes and personal characteristics. This study has been undertaken in Lower Seyhan Plain in Adana in Turkey.

2. Literature Review

Lin and Chang (1978) developed and suggested a Box-Cox transformation to determine the most appropriate functional form of utility. However, Buccola (1982) showed that Box-Cox transformation did not satisfy the properties of valid Bernoullian utility function, which is a necessary condition for utility function.

Zuhair, Taylor, and Kramer (1992) determined the effects of choice of utility functional forms on classification of risk preferences and the prediction of farmer decisions. They estimated exponential, quadratic, and cubic utility functions by eliciting subjective utility values and probability distributions for price and yield from Sri Lankan producers of minor export crops.

Saha (1993) proposed expo power utility function, which is free of restrictions regarding risk aversion type. This utility function exhibits decreasing, constant, or absolute risk aversion and decreasing or increasing relative risk aversion, depending on parameter values. He demonstrated that expo power utility function performs well in incorporating risks preferences structures by using numerical analysis. He concluded, "arbitrary risk preference specifications may lead to biased risk response estimates".

Bond and Wonder (1980) used standard reference contract or von Neumann-Morgenstern method to estimate risk attitudes of Australian farmers. In their study, 201 farmers throughout Australia were surveyed and asked to provide their certainty equivalence levels, levels of indifference between sure amounts of income and risky prospects. They found that while risk aversion is the most prevalent risk attitude in the agriculture sector, the average degree of risk aversion of farmers is low and scattered. Bond and Wonder, also, investigated the role of socioeconomic and other variables on farmers' risk attitudes but no firm relationship could be identified.

Binswanger (1980) used both interview method and experimental gambling approaches to determine the farmers risk attitudes in Rural India. By using 240 households survey information, he found that the interview method was subject to interviewer bias and its results were inconsistent with the experimental measures of risk aversion. He, also, showed that while all farmers are moderately risk averse with little variations regarding personal characteristic at high payoff level, wealth did not appear to influence risk aversion significantly.

Hamal and Anderson (1982) used 30 samples of rice farmers from Nepal to determine farmers' attitudes toward risk in the context of the subjective expected utility maximization model. They found that farmers are generally risk averse and have diverse levels of absolute risk aversion. In addition, absolute risk aversion tends to diminish as wealth increases both for individuals and cross-sectional sense.

3. Data

The data were collected from Lower Seyhan Plain in Adana in Turkey by a research group affiliated to Agricultural Economics Research Institute in Turkey. Data collection was undertaken for the 2000-2001 production year. This particular area is selected for the study because it is possible to see both highly commercialized, wealthy farmers and subsistence farmers in the area.

Since in the study area, there were no central registry of citizens, no census tracts with home address, no comprehensive directories of who's where, sample size was determined by budget rather than sampling textbooks which is required sampling frame. Sample of 50 are considered as optimum sample size based on the previous studies, educated guess and given the homogeneity of farms within villages. A sample size of 25 to 30 farmers, usually, is regarded as sufficient in cases where the overall variations within the micro-area are not great (Friedrich, 1975).

4. Identifying The Most Appropriate Utility Function

Identifying the most appropriate utility function is a quite challenging and a state of the art procedure. Pratt (1964) argued that utility functions exhibiting decreasing absolute risk aversion (DARA) are logical candidates to use when aiming to describe the behavior of people. However, empirical evidences are ambiguous regarding risk aversion that may decrease, increase or remain constant (Pope; 1982). Thus, choosing a particular functional form arbitrarily, or assuming a particular risk preference structure might lead to misguidance.

There are different utility functional forms that differ by decision makers' risk attitude toward risky prospect, called an agent's risk aversion coefficient. Risk aversion coefficient reflects curvature properties of the agent's utility function. It has been well recognized that utility function has a positive slope over the whole range of payoffs, hence, more payoffs are always preferred to less. Thus, it can be represented as follows:

$u'(w) \succ 0$

Where $u'(w)$ is the first derivative of utility function with respect to income or some other argument.

Risk aversion is indicated by a utility function that shows decreasing marginal utility as the level of payoff increases. In the language of mathematics,

$u''(w) \prec 0$ implies risk aversion

$u''(w) = 0$ implies risk indifference

$u''(w) \succ 0$ implies risk preference

Where $u''(w)$ is the second derivative of utility function of income.
Since utility is measured in the form of ordinal scale, it is not a trivial matter to go from the shape of the utility function to some quantitative measure of the degree of risk aversion. However, this problem has been solved by using a measure that is constant for any positive linear transformation of utility function known as the coefficient of absolute risk aversion $r_a(w)$ and defined as follows(Pratt 1964, Arrow, 1964):

$$r_a(w) = -u''(w)/u'(w) \qquad (1)$$

Absolute risk aversion can be interpreted as a change in marginal utility per unit of outcome space (Raskin and Cochran, 1986). This coefficient is positive for risk aversion and diminishes (increases) for increasing in w if there is diminishing (increasing) risk aversion.

4.1 Common Utility functions

In this section, the most commonly used utility functional forms and corresponding type of risk measures are introduced.

4.1.1 Quadratic Utility Function

Early applied researchers often used quadratic utility function in practice. This function is tractable computationally and lends itself nicely to empirical studies. Quadratic utility function, however, may not be appropriate when the decision involves reasonably moderate changes in wealth because it assumes the increase of wealth causes the increase in risk aversion which is not appropriate assumption on real life.

The quadratic utility function has the form:

$$u(w) = \alpha_1 + \alpha_2 w + \alpha_3 w^2 \qquad (2)$$

Where u denotes utility, and w refers to wealth or income. Parameter restrictions of the utility function are $\alpha_2 \succ 0, \alpha_3 \prec 0$.

Absolute risk aversion coefficient for quadratic utility function is:

$$A(w) = -u''(w)/u'(w) = 2\alpha_3 /(\alpha_2 + 2\alpha_3 w) \qquad (3)$$

As explained before, this coefficient increases in wealth or income, and therefore, it makes the quadratic utility function an implausible functional form in real life situations.

4.1.2 Cubic Utility Function

Cubic utility function can be written as follows:

$$u(w) = \alpha_1 + \alpha_2 w + \alpha_3 w^2 + \alpha_4 w^3 \qquad (4)$$

Where u is the utility, and w is wealth or income. This utility function can exhibit, both, increasing or decreasing risk aversion coefficient depending on the sign of the second derivative of utility function that is given by

$$2\alpha_3 + 6\alpha_4 w \qquad (5).$$

Absolute risk aversion coefficient for cubic utility function is:

$$A(w) = -u''(w)/u'(w) = -[(2\alpha_3 + 6\alpha_4 w)/(\alpha_2 + 2\alpha_3 w + 3\alpha_4 w^2)] \qquad (6)$$

Where $A(w)$ denotes to absolute risk aversion coefficient that can be positive or negative depending on the second derivative of utility function.

4.1.3 Negative Exponential Utility Function

The negative exponential utility function exhibits constant absolute risk aversion (CARA). It implies changes in the location of initial wealth do not alter decision (Pope and Just, 1991). Though this utility function's use in applied situation criticized by Arrow (1964) because of CARA, it has been widely used in empirical analysis (Hardaker, Huirane, and Anderson;1997). For example, the Freundian (1956) mean-variance approach relies on negative exponential utility function.

The negative exponential utility function can be written as follows:

$$u(w) = 1 - \exp(-\alpha w) \qquad (7)$$

Where $u(w)$ denotes utility, exp is exponential, α is the coefficient of absolute risk aversion and is higher than zero, and w refers to wealth or income. This utility function implies diminishing marginal utility for wealth or income because second derivative ($-\alpha^2 \exp(-\alpha w) \prec 0$) of this function is less than zero. The absolute risk aversion coefficient, $A(w)$, is equal to α which is constant and positive. Thus, it implies constant risk aversion over all levels of income that can be regarded as one of its major disfavor.

4.1.4 Power Utility Function

The power utility function has such form:

$$u(w) = \alpha + \beta w^{\gamma} \qquad (8)$$

Where $u(w)$ is utility with respect to wealth or income, α,β, and γ are parameters. Parameter restrictions of utility function is

$0 \prec \gamma \prec 1$.

Absolute risk aversion coefficient for power utility function is:

$$A(w) = -u''(w)/u'(w) = -(\gamma - 1)w \qquad (9)$$

And, it exhibits decreasing absolute risk aversion (DARA) because $A(w)'$ is less than zero. These futures make more attractive Power function because it seems plausible to afford to take a risk at higher levels of wealth or income. In fact, Pratt (1964) and Arrow (1965) argue that absolute risk aversion should be decreasing function of wealth.

4.1.5 The Expo-Power Utility Function

This utility function developed by Saha (1993). The major advantage of this function is that it has the flexibility to exhibit alternative risk preferences depending on parameter values. The expo-power utility function defined as follows (Saha, 1993):

$$u(w) = \gamma - \exp(-\phi w^{\alpha}) \qquad (10)$$

Where u denotes utility, exp denotes exponential, and w refers to wealth. Parameters restrictions of the utility function are

$\gamma \succ 1, \phi \neq 0, \alpha \neq 0$, and $\phi\alpha \succ 0$.

The expo-power utility function has the following absolute risk aversion coefficient.

$$A(w) = -u''(w)/u'(w) = (1 - \alpha + \alpha\phi w^{\alpha})/w \qquad (11)$$

Given the its parameters restrictions, the expo-power utility function exhibits decreasing absolute risk aversion, constant absolute risk aversion, and increasing absolute risk aversion if $\alpha \prec 1, \alpha = 1$, and $\alpha \succ 1$ respectively.

4.2. Derivation of Utility Function

Though as explained above there are different utility function, the major challenge is to choose the best one. This goal can be accomplished by fitting farmer's utility set data to underlying utility function such as quadratic, cubic or negative exponential. A number of different approaches have been developed and suggested to drive farmer's utility set (Officer and Halter, 1968; Dillon and Anderson, 1971). The cornerstone of these methods is based on the standard reference contract or the Von Neumann-Morgenstern (N-M) method.

4.2.1 Von Neumann-Morgenstern (N-M) Model

The N-M model is the most commonly used by economists for deriving utility functions. This method is based on the continuity axiom, which states that if there is an outcome w_1 is preferred to w_2, and $w_2$prefered to w_3, there exists a probability $p \succ 0$ such that

$$pu(w_1) + (1-p)u(w_3) = u(w_2) \qquad (12)$$

Where $u(w_1), u(w_3)$ and $u(w_2)$ refer to utilities of outcomes w_1, w_3 and w_2 respectively. In this approach, the utilities of w_1 and w_3 are arbitrarily set, and $u(w_2)$ is obtained. This method of deriving utility has been criticized on the grounds of two main shortcomings (Officer and Halter, 1968; Dillon and Anderson, 1971). First, the agent may have utility or disutility for gambling. If so, agent's choice of outcomes will be biased by the processes that determine the outcomes because the agent is asked to indicate his/her preference between the outcomes of a gamble and a certain event. Second, the agent may have preference for particular probabilities.

4.2.2 Modified Von Neumann-Morgenstern (N-M) Model

To overcome the problem of probability preference, the N-M model is modified by using neutral probabilities that is $p = (1-p) = 0.5$ and is called modified N-M model or Equally Likely Certainty Equivalent (ELCE) model (Dillon and Anderson,1971).

With this method, certainty equivalents for a sequence of risky prospects are derived and are matched with corresponding utility values. They impose an ordinal scale by assigning utility values to two levels of consequences or payoffs so that the utility of the best outcome as having utility value of one, and worst outcome of that is zero. In this method, the decision maker is asked to choose between hypothetical two risky choices with equal probability of 0.5 for each state. Hence, it avoids the problem of probability preferences, which is major drawback of standard von Neuman-Morgenstern approach (Bond and Wonder, 1980).

In ELCE method, a risky prospect with discrete payoffs can be represented in the format of $(a_1, a_2, \ldots a_n; p_1, p_2, \ldots p_n)$, indicating a set of possible payoffs $a_1, a_2, \ldots a_n$, with corresponding probabilities of $p_1, p_2, \ldots p_n$ summing to 1.0. For example, the CE elicitation for the format of (0, 1000; 0.5, 0.5)~(450;1) means that decision maker is indifferent between choosing risky prospect that has payoff zero and 1000 with the equal probability of 0.5 and choosing sure prospect that has sure return of 450.

In ELCE method, each decision maker is asked to make a decision about actions he/she should take against nature of following type. There is a once-only choice to be made between action I (a_1) and action II (a_2), with consequences depending on which of two equally likely uncertain events S_1 and S_2 occurs (Table 1)

Table 1. Elicitation of Certainty Equivalents (CE) Levels

State of Nature	Probability	Action I (a_1) Payoff	Action II (a_2) Payoff
S_1	0.5	z($1000)	y($450)
S_2	0.5	f ($0)	y($450)
Expected Monetary Value	1.0	z/2	y($450)

In this setting, agent is asked to specify the monetary value of the outcome "y" (say \$ 450) given value of "z" (say \$ 1000 as maximum level among all outcomes) such that he/she would be indifferent between action a_1 and a_2. It can be written in the format of (0, 1000; 0.5, 0.5)~(450;1). It means that decision maker is indifferent between choosing risky prospect that has payoff zero and 1000 with the equal probability of 0.5 and choosing sure prospect that has sure return of 450.
Thus, we can say that utility of risky prospect a_1 is equal to utility of the y for this agent. By using mathematical notation:

$$u(a_1) = 0.5u(z) + 0.5u(0) = u(a_2) = u(y) \qquad (13)$$

It can be imposed an ordinal scale by assigning utility values of $u(0) = 0$ and $u(z) = 1$. Then equation (13) can be written as follows:

$$0.5(1) + 0.5(0) = u(y) = u(450) = 0.5 \qquad (14)$$

In a second stage, agent is asked to specify the monetary value of the outcome "h" (lets say \$215) given value of "y" (in this case \$ 450) such that he/she would be indifferent between action a_1 and a_2.. It can be written more compactly in the form of (0, 450; 0.5, 0.5)~(215;1). Fourth value is obtained as follows:

$$u(h) = 0.5u(450) + 0.5(0) = 0.5(0.5) + 0 = u(215) \qquad (15)$$

In a third stage, agent is asked to specify the monetary value of the outcome "g" given value of "h" (\$ 215) such that he/she would be indifferent between action a_1 and a_2 and so on. Until now, we obtained the data between minimum value (\$ 0) and medium CE (\$450). To obtained data between maximum value and medium value of CE, agent is asked to specify the monetary value of the outcome "j" given value of "y" (\$ 450) and "z" (\$1000) such that he/she would be indifferent between choosing action a_1 which has payoffs "y" and "z" with equal probability of 0.5 and action a_2 which gives sure payoffs of "j". By obtaining "j" (lets say \$ 700) value, agent is asked to specify the monetary value of the outcome "k" given value of "j" (\$ 700) and "z" (\$1000) such that he/she would be indifferent between choosing action a_1 which has payoffs "j" and "z" with equal probability of 0.5 and action a_2 which gives sure payoffs of "k"
By iterating same procedure, we can get enough data to derive agent's utility function.
Table 2. summarizes the procedure for eliciting a utility function.

Table 2. Sequence of Elicitation of CEs For The ELCE method of Estimating a Utility Function

Step	Elicited CE	Utility Calculation
	Setting a scale	U(f) = 0; U(z)= 1
1	(y;1.0)~(f,z;0.5,0.5)	U(y) = 0.5U(f)+0.5u(z)=0.5
2	(h;1.0)~(f,y;0.5,0.5)	U(h)= 0.5U(f)+0.5u(y)=0.25
3	(g;1.0)~(f,h;0.5,0.5)	U(g) = 0.5U(f)+0.5u(h)=0.125
4	(j;1.0)~(z,y;0.5,0.5)	U(j) = 0.5U(z)+0.5u(y)=0.75
5	(k;1.0)~(j,y;0.5,0.5)	U(k) = 0.5U(z)+0.5u(j)=0.875

In this example, a sequence of seven CE points (f, z, y, h, g, j, and k) and corresponding utility values (0, 1, 0.5, 0.25, 0.125, 0.75, and 0.875) are obtained. To determine the most appropriate functional form given the possible functional form of utility such as quadratic, cubic, negative exponential or expo-power, series of utility values are regressed on the corresponding value of CE.

5. Results and Discussion

5.1 Utility Elicitation for Study Area

In this study we followed same ELCE procedure to elicit farmers utility function explained above. The range of income levels chosen for the questionnaire was \$ 0 and \$ 50 billion. This range was based on the preliminary analysis and previous studies. Then farmer is asked to specify the value monetary value of the sure outcome given payoffs of TL 50 billion and zero with equal probability such that he/she would be indifferent between action sure outcome and risky outcome, and so on. Following Dillon and Anderson (1971), the sequence of elicited CE and corresponding utility values setting $u(0) = 0$ and $u(50) = 1$ with income measured in billion, for farmer 1is shown in Table 3.

Table 3. Sequence of Elicitation of CEs and Utility values for Farmer 1

Step	Elicited CE	Utility Calculation
	Setting a scale	U(0) = 0; U(50)= 1
1	(23;1.0)~(0,50; 0.5,0.5)	U(23) = 0.5U(0)+0.5u(50)=0.5
2	(11;1.0)~(0,23; 0.5,0.5)	U(11)= 0.5U(0)+0.5u(23)=0.25
3	(5;1.0)~(0,11; 0.5,0.5)	U(5) = 0.5U(0)+0.5u(11)=0.125
4	(2;1.0)~(0,5; 0.5,0.5)	U(2) = 0.5U(0)+0.5u(5)=0.0625
5	(35;1.0)~(50,23; 0.5,0.5)	U(35) = 0.5U(50)+0.5u(23)=0.75
6	(41;1.0)~(50,35; 0.5,0.5)	U(41) = 0.5U(50)+0.5u(35)=0.875
7	(44;1.0)~(50,41; 0.5,0.5)	U(44) = 0.5U(50)+0.5u(41)=0.9375

After determining farmers' CE equivalent points by an iterative process between interviewer and respondent, utility points were regressed on corresponding CE values by using quadratic, cubic, power, negative exponential, and expo-power utility functions.

5.2 Farmers' Absolute Risk Aversion Coefficient

Since Arrow-Parat risk aversion coefficient is directly related farmer's risk attitude, hence risk premium who willing to pay, it computed and compared for each utility function Table 4. It can be seen that, though farmers' risk aversion coefficient differs with underlying utility function, all farmers exhibit risk-averse behavior in all utility functions except in the quadratic utility function. With this utility function, farmers exhibit risk preference attitudes.

Table 4. Absolute Risk Aversion Coefficients Using Different Utility Functions

Number of Farmer	Negative Exponential Utility Function	Expo-Power Utility Function	Power Utility Function	Quadratic Utility Function	Cubic Utility Function
1	0.0589	0.0476	0.0261	-0.0334	0.0311
2	0.0406	0.0155	0.0038	-0.0074	0.0037
3	0.1079	0.0367	0.0185	-0.0326	0.0097
4	0.0509	0.0371	0.0126	-0.0288	0.0184
5	0.0444	0.0160	0.0095	-0.0146	0.0057
6	0.0439	0.0264	0.0097	-0.0145	0.0148
7	0.0412	0.0107	0.0043	-0.0078	0.0022
8	0.0428	0.0181	0.0071	-0.0117	0.0067
9	0.0446	0.0270	0.0105	-0.0138	0.0168
10	0.0425	0.0181	0.0067	-0.0099	0.0073
11	0.0442	0.0175	0.0094	-0.0153	0.0057
12	0.0419	0.0146	0.0053	-0.0073	0.0051
13	0.0433	0.0163	0.0079	-0.0115	0.0072
14	0.0439	0.0133	0.0086	-0.0140	0.0032
15	0.0432	0.0204	0.0081	-0.0116	0.0101
16	0.0426	0.0181	0.0067	-0.0099	0.0073
17	0.0504	0.0181	0.0178	-0.0263	0.0005
18	0.0464	0.0123	0.0118	-0.0180	0.0007
19	0.0585	0.0235	0.0298	-0.0329	-0.0109
20	0.0523	0.0157	0.0202	-0.0274	-0.0032
21	0.0534	0.0099	0.0216	-0.0276	-0.0076
22	0.0394	0.0015	0.0035	-0.0117	-0.0036
23	0.0461	0.0239	0.0118	-0.0187	0.0100
24	0.0650	0.0444	0.0332	-0.0339	0.0197
25	0.0558	-0.0085	0.0259	-0.0318	-0.0185
26	0.0528	0.0229	0.0206	-0.0264	0.0037
27	0.0474	0.0245	0.0137	-0.0202	0.0109
28	0.0496	0.0191	0.0162	-0.0225	0.0023
29	0.0591	0.0110	0.0293	-0.0328	-0.0158
30	0.0493	0.0206	0.0159	-0.0231	0.0034
31	0.0518	0.0174	0.0196	-0.0278	-0.0023
32	0.0463	0.0189	0.0118	-0.0194	0.0039
33	0.0647	0.0363	0.0341	-0.0332	0.0135
34	0.0490	0.0156	0.0161	-0.0258	-0.0017
35	0.2614	0.2481	0.1007	-0.1463	0.3053
36	0.3389	0.2503	0.1816	-0.1721	0.1447
37	0.0546	0.0120	0.0126	-0.0255	-0.0033
38	0.1029	0.0423	0.0423	-0.0542	-0.0023
39	0.1124	0.0758	0.0478	-0.0586	0.0347
40	0.3797	0.1068	-0.0061	0.0066	-0.0081
41	0.5062	0.4160	0.1780	-0.2661	0.3016
42	0.1897	0.0539	-0.0028	0.0029	-0.0037
43	0.3894	0.0700	0.0066	-0.0315	-0.0041
44	0.2375	0.1568	0.0740	-0.1210	0.0850
45	0.1231	0.0788	0.0415	-0.0623	0.0437
46	0.2253	0.1169	0.0546	-0.0991	0.0385
47	0.2203	0.0463	0.0536	-0.1060	-0.0147
48	0.2096	0.0741	0.0737	-0.1098	-0.0015
49	0.4270	0.3028	0.0962	-0.1913	0.1488
50	0.2554	0.2075	0.0906	-0.1345	0.1413

5.3 Choosing Best Utility Function For Study Area

Best functional form is chosen based on the economic theory such as the type and degree of risk, violation of parameters restriction and statistical criteria such as t-statistics. The negative exponential, expo-power, power, quadratic, and cubic utility functions were fitted to farmer's elicited utility values by using nonlinear least square (NLS) method for fifty farmers. Negative-exponential and expo-power utility functions perform best among other utility functions (Table.5).

Table 5. The Number of Farmers Violating Parameter Restriction and Statistical Significance Level Given Possible Utility Functions.

Utility Functions	Number of farmers who have violation in parameters restrictions	Number of farmers who have violation in statistical significance at 10 % level	Total number of farmers who violate restriction and significance level
Negative-exponential	0	0	0
Expo-Power	0	15	15
Power	0	50	50
Quadratic	50	50	50
Cubic	0	45	45

There is no parameter restriction and statistical significance violation for negative exponential utility function. This was followed by expo-power utility function that it violates parameter restriction in 15 farmers out of 50. Other three utility functions did not perform well in terms of parameter restriction violation and statistical significance level for parameters value.

Based on this analysis and given that the expo-power utility function has not yet been studied in sufficient detail to understand desirables parameters magnitudes (Hennessy, 1998), we can conclude that negative-exponential function represents studied farmers utility function best.

5. The Relationship Between Risk Aversion and Personal Characteristics of Individual

There is no empirical method that show how personal characteristic are correlated to risk aversion (Binswanger, 1980). In this section, however, we look at personal characteristics that may be determined jointly with risk aversion given the fact the causal nature of the relationship between these is unknown.

Farmers' negative exponential risk aversion was regressed by using different types of models such as linear, logarithmic, semi-logarithmic, and non-linear (Box-Cox) on farmers' personal characteristic such as education, age, and capital value to determine possible relationship between risk aversion and personal characteristic. However, no significant relationship between risk aversion and personal characteristics could be found using regular regression analysis.

It is well known that economic theory purports existence of some relationship between risk aversion and personal characteristics of human beings. After carefully examining data, it came into our attention that there is an accumulation of farmers' risk aversion coefficient around certain values. Of the total farmers interviewed, 21 farmers' risk aversion coefficient was less than 0.05 and 29 farmers that a coefficient higher or equal to 0.05. Next, risk aversion coefficient was treated as a dichotomous variable given that the farmer either has risk aversion coefficient less than 0.05 or not.

To handle models involving dichotomous dependent variables, the logit model is suggested (Gujarati, 1995). Thus, following Gujarati, we used a logit model to determine the relationship between risk aversion and personal characteristic. The model can be written as follows:

$$L_i = \ln\left(\frac{A_i}{1-A_i}\right) = \alpha_0 + \alpha_{1i}EDU + \alpha_{2i}AGE + \alpha_{3i}CAP + u_i \quad (16)$$

where L_i refers to logit, A_i is absolute risk aversion coefficient for farmer i, EDU is education level, AGE is farmer's age, CAP refers to capital value farmers possess, and u_i is the disturbance term. A_i takes two values; zero if farmers have risk aversion coefficient less than 0.05 otherwise one. Parameter estimations have been estimated by using equation (16) and results are summarized in Table.6.

Table.6 The Relationship Between Risk Aversion Coefficient and Farmer's Personal Characteristics

Variable	Coefficient	Standard Error	t-value	P-value
Constant	3.0434	1.5912	1.913	0.0558
Age	0.0432	0.0272	-1.588	0.1122
Education	-1.6809	0.9383	-1.791	0.0733
Capital	-0.0162	0.2273	-0.713	0.4761

Age has a positive sign, meaning when farmers get older they become more risk averse and it is significant at the 5 percent level. Education has, also, has meaningful sign which indicates that the higher the level of education farmers get, the less risk averse they become. In the model, capital value is used as proxy for farmer's annual income. It would have been better to use annual income but farmers, usually, don't reveal their annual income truthfully. Though the capital variable has a meaningful sign, it is not significant. The negative sign implies that there is a negative relationship between capital value and risk aversion. The wealthier people are less risk averse than poor people. This finding is consistent with Binswanger's (1980) finding of existence of a weak relationship between risk aversion coefficient and wealth.

6. Conclusion

Negative exponential utility function is the best representative function for farmers in the study area. With this function, all interviewed farmers have risk aversion attitudes toward risk. This finding is consistent with both, economic theory and previous studies.

Though there is a no significant relationship between capital value and farmers' risk aversion coefficient, there is a significant relationship with farmers' personal characteristics such as age and education.

Reference Lists

Arrow, K. J. "The Role of Securities in the Optimal Allocation of Risk Bearing." *Rev. Econ. Stud.* 31(April 1964):91-96.

Binswanger, H. P. "Attitudes Toward Risk: Experimental Measurement in Rural India." *American Journal of Agricultural Economics.* 62(1980):395-407

Bond, G., and B. Wonder. "Risk Attitudes Amongst Australian Farmers." *Australian Journal of Agricultural Economics.* April (1980): 17-34.

Buccola, S.T. "Specification of Bernoulian Utility Function in Decision Analysis: Comment." *Agricultural Economic Research.* 34(19-21).

Dillon, J.L., J.R. Anderson. "Allocative Efficiency, Traditional Agriculture, and Risk." *American Journal of Agricultural Economics.* 53(February 1971):26-32.

Friedrich, K.H. "Farm Management Data Collection, Analysis, Storage and Retrieval System." In Keral, B., S. Gafsi, M. Mbilinyi, J. Nabila, D. Norman, D.S.C. Spencer. *Field Data Collection in The Social Sciences: Experiences in Africa and Middle East.* Agricultural Development Council, Inc. New York. 1976.

Freund, R. "The Introduction of Risk into Programming Models." Econometrica 24(July1956):253-63.

Gujarati, D.N. "*Basic Econometrics*" McGraw-Hill, Inc. Third Edition, 1995.

Hamal, K. B., and J. R. Anderson. "A Note on Decreasing Absolute Risk Aversion Among Farmers in Nepal." *Australian Journal of Agricultural Economics.*26(1982): 220-25.

Hardeker, J. B., R. B. M., Huirane, and J. R. Anderson. "*Copping With Risk.*" CAB International (1997).

Hennessy, D.A. "The Production Effects of Agricultural Income Support Policies Under Uncertainty." *American Journal of Agricultural Economics.* 80(1998):46-57.

Lin, W., and H. S. Chang. "Specification of Bernoulian Utility Function in Decision Analysis" *Agricultural Economic Research.* 30(1978): 30-36

Officer, R. R., A.N. Halter. "Utility Analysis in a Practical Setting." *American Journal of Agricultural Economics.* 50(May 1968):257-77

Pope, R.D., and R.E. Just. "On Testing the Structure of Risk Preferences in Agricultural Supply Analysis." *American Journal of Agricultural Economics.* 73(August 1991):743-48.

Pope, R. D. "Empirical Estimation and Use of Risk Preferences: An Appraisal of Estimation Methods that Use Actual Economic Decisions." *American Journal of Agricultural Economics.* 4(1982):376-83

Pratt, J. "Risk Aversion in the Small and in the Large." *Econometrica* 32(1964): 122-36

Raskin, R., and M.J. Cochran. "Interpretations and Transformations of Scale for the Pratt-Arrow Absolute Risk Aversion Coefficient: Implications for Generalized Stochastic Dominance." *Western Journal of Agricultural Economics.* 11(February 1986):204-10

Saha, A. "Expo-power utility: A Flexible Form For Absolute and Relative Risk Aversion." *American Journal of Agricultural Economics.* 75(1993): 905-13.

Zuhair, S.M.M., D.B. Taylor, and D.B. Kramer. "Choice of Utility Form: Its effect on Classification of Risk Preferences and the Prediction of Farmer Decisions." *Agricultural Economics.* 6(1992):333-344