Turk J Agric For
27 (2003) 305-312

Risk Attitudes of Farmers in Terms of Risk Aversion: A Case Study of Lower Seyhan Plain Farmers in Adana Province, Turkey

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Received: 06.03.2003

Abstract: Exploring the attitude of farmers toward risk is important in understanding their managerial decisions, especially given the exposure of farmers to risky events such as drought. However, a survey of the literature finds no study of the risk attitudes of farmers in Turkey. Therefore, this study examines the risk attitudes of farmers in the Lower Seyhan Plain of Turkey. While some variation by utility function exists in the classification of the sampled farmers into risk averse and risk preferring categories, the overwhelming evidence is that the sampled farmers are risk averse. One hundred eighty-two out of 200 estimated Arrow-Pratt risk coefficients imply a risk averse attitude. Thus, these farmers are likely to make managerial decisions that reduce risk, even if the decisions translate into lower income. A policy implication of this finding is that producers are likely to be interested in crop insurance.

Key Words: Risk management in agriculture, Farmers' risk attitudes in Turkey

Üreticilerin Mutlak Risk Katsayıları: Adana İli Aşağı Seyahan Ovası Çifçileri Örneği

Özet: Üreticilerin riske karşı gösterdikleri davranışı bilmek, onların özellikle kuraklık gibi riskle ilgili yönetsel kararlarını anlamda önemli bir yere sahiptir. Yapılan literatür çalışmasında, Türkiye'de üreticilerin riske karşı duyarlılıklarının bir göstergesi olan mutlak risk katsayıları ile ilgili herhangi bir çalışmaya rastlanmamıştır. Bu çalışma ile, Adana ili, Aşağı Seyhan Ovasında faaliyet gösteren üreticilerin mutlak risk katsayıları belirlenmeye çalışılmıştır. Üreticilerin kullanılan fonksiyonun tipine bağlı olarak mutlak risk katsayılarının derecesi değişmekle birlikte, büyük çoğunluğunun riske karşı duyarlı olduğu saptanmıştır. Hesaplanan 200 mutlak risk katsayısının 182'sinin risk-sevmeyen, geriye kalan 18'inin ise risk-seven bir yapı gösterdiği elde edilmiştir. Risk seven yapı gösteren 18 durumun 15'i Kübik fonksiyondan kaynaklanmıştır. Böylelikle, üreticilerin işletmelerinde riski azaltıcı yöndeki uygulamalara eğilimli olacakları ve iyi bir şekilde dizayn edilmiş bir sigorata programına ilgi duyacakları sonucuna varabiliriz.

Anahtar Sözcükler: Tarımda risk yönetimi, Türkiyedeki üreticilerin risk davranışları

Introduction

Given that farming is a business activity subject to risky events such as drought, an important factor in understanding the behavior and managerial decisions of farmers is their attitude toward risk. For example, the more risk averse a farmer, the more likely he or she is to make managerial decisions that emphasize the goal of reducing variation in income rather than the goal of maximizing income.

Since Pratt (1964), the most commonly accepted characteristic of people's attitude toward risk has been decreasing absolute risk aversion (DARA). DARA implies that people are adverse to risk and that their aversion decreases as wealth or income increases. In contrast to

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this well-accepted conceptual argument, the empirical evidence regarding the risk attitude of farmers is ambiguous. Evidence has been found for decreasing, increasing, and constant risk aversion (Pope, 1982).

Empirical determination of an individual's attitude toward risk begins with the specification of a utility function. A utility function relates the well being (i.e. level of utility) of the individual to his or her income or wealth. Previous research has documented that the attitude toward risk identified via empirical analysis is sensitive to the utility function used during the analysis. For example, a study of 12 graduate students found that all 12 were classified as risk averse when a semi-log utility function was used, whereas all 12 were classified as risk neutral when a non-linear utility function was used (Musser et al., 1984). Another study of 40 farmers from Sri Lanka found that the number classified as risk averse varied from 20 for the cubic utility function, to 27 for the quadratic utility function, to 40 for the negative exponential utility function (Zuhair et al., 1992). Given the sensitivity of the determination of risk attitude to the choice of the utility function, a variety of utility functions are examined in this study.

Despite the importance of risk attitudes in understanding farmer behavior and managerial decisions, a review of the literature finds no empirical study of the risk attitudes of farmers in Turkey. To fill this void, this article reports on a study of the risk preference of producers in the Lower Seyhan Plain in Adana Province, Turkey. A total of 50 farmers participated in the survey.

Survey design and data collection are described in the next section. The most commonly used utility functions and their associated measures of risk aversion are explained, followed by a discussion of the methodology used to elicit a farmer's utility function. The results and discussion of the analysis are presented. The article ends with conclusions and implications.

Materials and Methods

Survey Design and Data Collection

The data used in this study were collected from a sample of farmers in the Lower Seyhan Plain in Adana Province, Turkey. This study area was selected because it contains a variety of wealth situations ranging from smaller, traditional farmers to larger, commercial farmers.

A 2-stage process was used to select the sample of farmers to be interviewed within the study area. First, 4 villages were selected based on the recommendation of extension service agents that the villages were typical of the study area and that their farmers were willing to participate in this study. Second, 50 farmers were chosen at random from these 4 villages for personal interview. Previous studies suggest that a sample size of 25 to 30 is sufficient when variation within the micro-area is not large (Officer and Halter, 1968; Hamal and Anderson, 1982). However, this study used a sample size of 50 to improve the probability that sufficient variation existed in the wealth of the survey participants.

Using number of hectares as a proxy for wealth, the population of farmers was stratified into 4 groups: 0.1-5, 5.1-10, 10.1-25, and 25.1+ ha. A random sample was drawn from each stratum. The number of farmers drawn totaled 19, 14, 10, and 7 for the 0.1-5, 5.1-10, 10.1-25, and 25.1+ ha strata, respectively.

The survey was conducted during the spring of 2001. Data collected included farm revenue, the primary operator's age and education, hectares of planted crops, number of livestock, output level for each commodity produced, amount of labor (on-farm, off-farm, hired), land holdings and machinery.

Utility Functions and Measures of Risk Aversion

The most commonly used utility functions when assessing risk preferences are the negative exponential, power, expo-power and cubic functions*. Each starts with the assumption that an economic agent's utility function has a positive slope over the entire range of payoffs. This assumption can be stated mathematically as $u'(w)>0$, where $u'(w)$ is the first derivative of the utility function with respect to w, which is usually either income or wealth.

The second derivative of a utility function, or the change in marginal utility as the level of income or weath increases, is a commonly used measure of risk aversion.

* The quadratic utility function was commonly used in early studies. However, it is not examined in this study because it has the conceptually undesirable property that risk aversion increases as wealth or income increases.

Its sign is used to classify a decision maker's attitude toward risk. Specifically, $u''(w) < 0$ implies risk aversion, $u''(w) = 0$ implies risk indifference, and $u''(w) > 0$ implies risk preferrence.

Utility generally is measured on an ordinal scale. Transforming the shape of the utility function on an ordinal scale into a quantitative measure of risk aversion is not a trival problem. It is solved by using a measure that is constant for any positive linear transformation of a utility function. This measure is known as the coefficient of absolute risk aversion, $r_a(w)$. It was defined by Pratt (1964) and Arrow (1964) as

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

$r_a(w)$ can be interpreted as the change in marginal utility per unit of outcome space (Raskin and Cochran, 1986). It is positive if the individual is averse to risk, zero if the individual is indifferent to risk, and negative if the individual prefers risk.

Given this general background discussion, the cubic utility function can be written as

$$u(w) = a_1 + a_2w + a_3w^2 + a_4w^3 \quad (2)$$

where u(w) refers to utility with respect to w.

The absolute risk aversion coefficient, A(w), of the cubic utility function is

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

This coefficient can be positive or negative depending on the sign of the numerator, i.e., the second derivative of the utility function. Thus, the cubic utility function is consistent with risk aversion, risk indifference, and risk preferring attitudes.

The negative exponential utility function can be written as

$$u(w) = 1 - \exp(-\alpha w) \quad (4)$$

where exp is the exponential function.

The absolute risk aversion coefficient equals

$$A(w) = -u''(w)/u'(w) = \alpha \quad (5)$$

The absolute risk aversion coefficient, i.e. α, is constant and positive over all levels of wealth and income. Thus, the negative exponential function exhibits constant absolute risk aversion (CARA). CARA implies that changes in initial wealth do not alter a decision (Pope and Just, 1991). Although Arrow (1964) criticized the CARA property, this function has been widely used in empirical analyses (Hardaker et al., 1997). In addition, the Freundian (1956) mean-variance approach relies on a negative exponential utility function.

The power utility function has the form

$$u(w) = \alpha + \beta w^{\gamma} \quad (6)$$

where α, β and γ are parameters. A parameter restriction is $0 < \gamma < 1$.

The absolute risk aversion coefficient is

$$A(w) = -u''(w)/u'(w) = -(\gamma - 1)w^{-1} \quad (7)$$

A(w) is positive and decreases while wealth increases. Thus, the power function exhibits DARA. This feature makes the power function attractive because conceptually, as income or wealth increases, the willingness to take on risk is expected to increase (Pratt, 1964; Arrow, 1964).

The expo-power utility function is

$$u(w) = \gamma - \exp(-\phi w^{\alpha}) \quad (8)$$

Parameter restrictions are $\gamma > 1$, $\phi \neq 0$, $\alpha \neq 0$, and $\phi\alpha > 0$.

The absolute risk aversion coefficient is

$$A(w) = -u''(w) / u'(w) = (1 - \alpha + \alpha\phi w^{\alpha}) / w \quad (9)$$

The expo-power utility function is free of restrictions regarding risk aversion type (Saha, 1993). Given the parameter restrictions, absolute risk aversion can be decreasing, constant or increasing depending on whether $\alpha < 1$, $\alpha = 1$, $\alpha > 1$, respectively.

Procedures Used to Elicit a Farmer's Utility

The method most commonly used to empirically elicit utility from an economic agent is the equally likely certainty equivalent (ELCE) model (Hardarker et al., 1997). The ELCE derives certainty equivalents (CE) for a sequence of risky outcomes and matches them with utility values. An ordinal scale is imposed by assigning utility values of 1 to the best outcome and 0 to the worst outcome (Hardarker et al., 1997). Based on the results of a preliminary analysis and field study, the range of income levels selected for this study was 0 to 50 billion Turkish lira (TL).

Table 1 presents an example of the sequential steps used to elicit a farmer's CEs and corresponding utility values. The farmer is asked to specify the monetary value of a sure outcome that makes him indifferent between

Table 1. An Example of sequential elicitation of certainty equivalents and calculation of Utility values.

Step	Elicited Certainty Equivalents	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)=0.500
2	(11;1.0)~(0,23; 0.5,0.5)	U(11) = 0.5U(0) + 0.5u(23)=0.250
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)=0.750
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)=0.937

the 2 risky outcomes of TL 50 billion and TL 0 with equal probability. In this example, the farmer's answer is TL 23 billion. Thus, the farmer has a CE of TL 23 billion for uncertain payouts of TL 50 billion and TL 0, each with a probability of 0.5. By convention, this decision choice is written in the format (0, 50; 0.5, 0.5)~(23;1). Given the initial response of TL 23 billion, the farmer is then asked to specify the monetary value of the sure outcome that makes him indifferent between having uncertain payouts of TL 23 billion and TL 0 with equal probability. The response is TL 11 billion. Next, the farmer is asked to specify the monetary value of the sure outcome that makes him indifferent between the uncertain payouts of TL 11 billion and TL 0 with equal probability. This iterative process continues until the farmer's sure income or CE reaches TL 1 billion. The process is stopped at this point because a sufficient number of data points have been obtained.

To obtain data for the other half of the income distribution, the farmer is asked to specify the monetary value of the sure outcome that makes him indifferent between having uncertain payouts of TL 50 billion and TL 23 billion with equal probability. The iterative procedure described above continues until the CE reaches TL 49 billion.

To calculate the associated utilities, utility values of 0 and 1 are assigned to TL 0 and TL 50 billion, respectively. Given these values, the utility associated with the CE value of TL 23 billion is computed as

$$u(23) = 0.5u(0) + 0.5u(50) = 0.5(0) + 0.5(1) = 0.500 \quad (11)$$

Next, the utility associated with the CE value of TL 11 billion is computed as

$$u(11) = 0.5u(0) + 0.5u(23) = 0.5(0) + 0.5(0.500) = 0.250 \quad (12)$$

This procedure is repeated for the other elicited CEs (see column 2 of Table 1).

Results and Discussion

A sequence of 9 CE points and 9 corresponding utility values were obtained for each of the 50 farmer participants in the survey. The CE values were regressed on the farmer's utility values for each functional form (cubic, power, negative exponential, and expo-power utility functions). The nonlinear least square (NLS) computational method was used. In total, 200 equations were estimated (4 equations for each of the 50 farmer observations).

Space limitations preclude presentation of the parameters obtained for each of the 200 estimated utility functions. Table 2 contains a summary of the estimated parameters, and the complete set of estimates can be obtained from the authors upon request.

Because a curve is being fitted, the significance of the equation, i.e. R^2, has more statistical importance than the significance of the individual coefficients. R^2 was statistically significant at the 10% test level for all 200 equations. However, it should be remembered that the number of observations used to estimate each equation was small (9). Furthermore, as Hardeker et al. (1997) pointed out, "... the propose of the curve fitting is to find the equation of curve that is already partly defined by the

Table 2. Summary[1] of regression equations estimated for utility functions using data obtained from farmers in Adana province, Turkey, 2001.

Parameter by Utility Function	Mean Estimate[2]	High Estimate[2]	Low Estimate[2]	Percent That Are Significant[3]
Negative Exponential				
α	0.110	0.4920	0.0375	100
R^2	94	99	83	100
Expo-Power				
γ	1.0622	1.12390.0929	100	
$\varnothing$	0.0334	0.3555	0.0001	80
α	1.8487	2.8936	1.0265	100
R^2	98	99	88	100
Power				
α	0.0031	0.0826	-0.2651	86
β	0.0841	0.4998	0.0044	88
γ	0.9924	1.6213	0.3972	100
R^2	98	99	88	100
Cubic				
α_1	0.0314	0.1480	-0.0318	44
α_2	0.0625	0.4490	-0.0410	70
α_2	-0.0012	0.0510	-0.0891	42
α_3	0.0005	0.0090	-0.0061	48
R^2	98	99	88	100

1. The complete set of results is available from the authors upon request.
2. An equation was estimated for each farmer observation. Thus, 50 equations were estimated for each utility function.
3. A 10% test level is used on the t-statistic for the coefficients and F-statistic for R^2.

Source: Original Calculations

elicited utility points, not to fit a curve to a scatter of points representing random deviations from some underlying but unknown relationship." Consequently, care should be taken in interpreting R^2.

The parameter estimates obtained from the fitted equations are used to determine the Arrow-Pratt coefficient of absolute risk aversion, the variable of primary interest in this study. The coefficient is computed using equations 3, 5, 7 and 9 for the cubic, negative exponential, power and expo-power utility function, respectively. Table 3 contains the absolute risk aversion coefficients derived for each farmer for each utility function.

As expected from previous studies (Musser et al., 1984; Zuhair et al., 1992), the Arrow-Pratt coefficient for a farmer differs with the underlying utility function. Furthermore, a farmer may be classified as risk averse by one utility function and risk preferring by another utility function.

For the negative exponential utility function, all 50 farmers are classified as risk averse, i.e. . Almost all farmers are classified as risk averse by the expo-power utility function (farmer 25 is an exception) and by the power utility function (farmers 41 and 42 are exceptions). The major discrepancy in the results is the cubic utility function, for which 15 farmers are classified as having risk preferring attitudes.

The finding that more farmers are classified as risk preferring by the cubic utility function is consistent with Zuhair et al.'s (1992) study of farmers in Sri Lanka. All farmers in their study were classified as risk averse by the negative exponential utility function.

Table 3. Absolute risk aversion coefficient by utility function, Adana province, Turkey, 2001.

Farmer Number	Negative Exponential Utility Function	Expo-Power Utility Function	Power Utility Function	Cubic Utility Function
1	0.0589	0.0476	0.0261	0.0311
2	0.0406	0.0155	0.0038	0.0037
3	0.1079	0.0367	0.0185	0.0097
4	0.0509	0.0371	0.0126	0.0184
5	0.0444	0.0160	0.0095	0.0057
6	0.0439	0.0264	0.0097	0.0148
7	0.0412	0.0107	0.0043	0.0022
8	0.0428	0.0181	0.0071	0.0067
9	0.0446	0.0270	0.0105	0.0168
10	0.0425	0.0181	0.0067	0.0073
11	0.0442	0.0175	0.0094	0.0057
12	0.0419	0.0146	0.0053	0.0051
13	0.0433	0.0163	0.0079	0.0072
14	0.0439	0.0133	0.0086	0.0032
15	0.0432	0.0204	0.0081	0.0101
16	0.0426	0.0181	0.0067	0.0073
17	0.0504	0.0181	0.0178	0.0005
18	0.0464	0.0123	0.0118	0.0007
19	0.0585	0.0235	0.0298	-0.0109
20	0.0523	0.0157	0.0202	-0.0032
21	0.0534	0.0099	0.0216	-0.0076
22	0.0394	0.0015	0.0035	-0.0036
23	0.0461	0.0239	0.0118	0.0100
24	0.0650	0.0444	0.0332	0.0197
25	0.0558	-0.0085	0.0259	-0.0185
26	0.0528	0.0229	0.0206	0.0037
27	0.0474	0.0245	0.0137	0.0109
28	0.0496	0.0191	0.0162	0.0023
29	0.0591	0.0110	0.0293	-0.0158
30	0.0493	0.0206	0.0159	0.0034
31	0.0518	0.0174	0.0196	-0.0023
32	0.0463	0.0189	0.0118	0.0039
33	0.0647	0.0363	0.0341	0.0135
34	0.0490	0.0156	0.0161	-0.0017
35	0.2614	0.2481	0.1007	0.3053
36	0.0389	0.2503	0.1816	0.1447
37	0.0546	0.0120	0.0126	-0.0033
38	0.1029	0.0423	0.0423	-0.0023
39	0.1124	0.0758	0.0478	0.0347
40	0.3797	0.1068	-0.0061	-0.0081
41	0.5062	0.4160	0.1780	0.3016
42	0.1897	0.0539	-0.0028	-0.0037
43	0.3894	0.0700	0.0066	-0.0041
44	0.2375	0.1568	0.0740	0.0850
45	0.1231	0.0788	0.0415	0.0437
46	0.2253	0.1169	0.0546	0.0385
47	0.2203	0.0463	0.0536	-0.0147
48	0.2096	0.0741	0.0737	-0.0015
49	0.4270	0.3028	0.0962	0.1488
50	0.2554	0.2075	0.0906	0.1413

Source: Original Calculation

Little consistency exists regarding the magnitude of the absolute risk aversion coefficient in previous studies. Raskin and Cochran (1986) reported that absolute risk coefficients obtained by studies ranged from -0.00001 to ∞. In addition, Musser et al. (1984), Zuhair et al. (1992) and Raskin and Cochran (1986) reported that the coefficients differed for a broad range of factors, including study area, utility function and the procedure used to derive the risk coefficient.

Conclusions

Understanding the attitude of farmers toward risk is important in understanding their managerial decisions. However, a survey of the literature found no study of the risk attitudes of farmers in Turkey. The objective of this study was to evaluate the risk preference attitudes of farmers in Adana province of Turkey.

A sample of 50 farmers was surveyed in the Lower Seyhan Plain of Adana Province. The commonly-used ELCE model was employed to elicit information that was used to determine the farmers' risk preference. Because previous studies have documented that the utility function assumed for the analysis can affect the determination of risk attitude, 4 utility functions were used in this analysis: the cubic, negative exponential, power and expo-power utility functions.

The overwhelming evidence is that the sampled farmers are risk averse. One hundred eighty-two out of 200 estimated Arrow-Pratt risk coefficients implied a risk averse attitude.

A risk averse attitude is associated with managerial decisions that tradeoff a lower risk or variation in income for higher income. Managerial strategies consistent with risk aversion include diversifying the commodities produced, storing crops between years, adopting farming practices that reduce the potential for crop failure, earning off-farm income and accumulating savings in the form of cash rather than investing in capital improvements.

The finding of risk aversion suggests that Turkey's government should focus on developing farm policies that help farmers reduce risk. For example, the feasibility of crop insurance is currently being investigated. Because insurance is a mechanism for exchanging risk between buyers and sellers, it is important to know the demand for such a trade (Mishra, 1996). Attitude toward risk is an important factor influencing a farmer's demand for crop insurance. This study implies that this policy effort of Turkey's government should continue.

The study is limited in scope. It involves only 50 farmers in 1 part of a single province. Additional studies are needed to corroborate or counter the results of this study, as well as to develop a map of risk preference attitudes across the wide variety of agricultural systems and geographical terrains that abound in Turkey. A better understanding of the risk attitudes of Turkish farmers will yield substantial payouts in terms of the development of higher quality farm management education programs, the provision of more appropriate inputs by agribusiness firms and the design of more effective government policies.

Acknowledgments

The authors are grateful to the Agricultural Economics Research Institute for funding this research and thank 3 anonymous reviewers for their helpful comments.

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