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# A NOTE ON DECREASING ABSOLUTE RISK AVERSION AMONG FARMERS IN NEPAL

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**Attitudes toward risk are explored for a sample of rice growers on small farms in Nepal, in the context of the subjective expected utility maximisation model. Farmers are found to be generally averse to risk, with diverse levels of absolute risk aversion that tend to diminish as wealth increases, both for individuals and in a cross-sectional sense. Relative risk aversion is argued to be the most comparable measure for contrasts of attitudes toward risk.**

## *Introduction*

Intuitively, farmers are likely to be averse to risk. The documentary evidence is limited but this intuition is broadly supported by studies (albeit featuring very diverse risk attitudes) such as those in Australia (Officer and Halter 1968; Bond and Wonder 1980), Brazil (Dillon and Scandizzo 1978), India (Binswanger 1980), Mexico (O'Mara 1971) and Sri Lanka (Herath 1980). Risk is likely to be involved in decisions about new technology and resource use in farming (Anderson, Dillon and Hardaker 1977; Hazell 1982). Several investigators have shown that the adoption of new technology is influenced strongly by the prevalence of perceived uncertainty (Schluter 1974; Wolgin 1975; Moscardi and de Janvry 1977; Brink and McCarl 1978). Such is the context of the present study of rice farmers in Nepal.

Farmers' attitudes toward risk doubtless depend on many things, ranging from cultural background to individual psyche. Investigators have attempted to relate measures of risk aversion to a wide variety of socio-economic characteristics, albeit in the absence of any clear theoretical model as to the nature of causality. The only relationship to have been the subject of significant theoretical argument has been the connection between risk attitude and wealth. Pratt (1964) and Arrow (1965) argued that, for an individual, absolute risk aversion should be a decreasing function of wealth, and Arrow (1965), somewhat more tentatively, hypothesised that relative risk aversion should be an increasing function of wealth.[1] Some of the investigators of farmers' attitudes to risk have explored associations between risk aversion and wealth, although, seemingly, there has been no overt theorising on the relationship between in-

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[1] These two measures of risk aversion are those that have received the greatest attention in the theoretical literature. The coefficient of absolute risk aversion is defined as $RA(W) = -U''(W)/U'(W)$, where $U(W)$ is utility of wealth and the primes denote derivatives (Pratt 1964; Arrow 1965). Relative risk aversion (Arrow 1965; 1971, pp. 97-8) is the product of wealth and absolute risk aversion; that is $RR(W) = W \times RA(W)$. Another measure that has received some attenton both theoretically (Zeckhauser and Keeler 1970) and empirically (Binswanger 1980) is size-of-risk aversion, $RS(x, W) = x[-U'(W+x)/U(W+x)]$, where $x$ is the size of risk measured as a gain or loss. For recent reviews of the field, see Harvey (1981) and Ross (1981).

dividual decreasing absolute risk aversion (DARA) and analogous phenomena observed across individuals. For instance, Binswanger (1980) found that wealth appeared to have little influence on risk-taking behaviour, as measured by partial risk aversion and Bond and Wonder (1980) came to the same conclusion using several measures of risk aversion. O'Mara (1971) attempted to test the DARA hypothesis across individuals, but he found no clear cross-sectional association in his study of 72 Mexican peasants. In spite of the sparsity of empirical evidence, the assumption of DARA for individuals is routinely made in theoretical work in the economics of uncertainty (e.g. Sandmo 1971; Batra 1975).

Confirmation (or rejection!) of such an association between wealth and absolute risk aversion would also be useful, particularly in the context of developing-country agriculture. If, indeed, farmers are less averse to risk as they become wealthier, there are clear implications for a diminishing impact of risk aversion on adoption of techniques perceived to be risky, when wealth in such communities increases through economic growth, land reform or improved techniques themselves.

## *Method*

The study was conducted in two adjoining districts of Nepal (Dhanusha and Mahottary) with 30 farm households being interviewed in each district (Hamal 1981). Wealth was measured in terms of total assets (including arable land, livestock, fruit trees, house, cattle shed, storage, agricultural implements, radio, bicycles etc.) all valued at 1980-81 market prices. Farmers' risk preferences were elicited using an interview technique, with choices being made among pairs of hypothetical, equally-likely, two-point risky prospects (Anderson et al. 1977, pp. 75-6). There are obvious problems with using responses to hypothetical gambles, but there are also difficulties of a practical, financial and moral nature with using responses to gambles involving significant real sums of money. The hypothetical or 'mind experiment' approach is judged to be the only feasible approach for this study.

A range of wealth was fixed from a lower bound of the range of elicitation (LBRE) to an upper bound of the range of elicitation (UBRE). Farmers were assumed to be unfavourably disposed (even hypothetically) to participating in a gamble resulting in an outcome below the LBRE. The LBRE indicates a 'subsistence level' for farmers below which survival is thought to be difficult and degrading, if not impossible. A 'subsistence' farmer in this study has been defined as one who holds two katha (0.0089 ha) of paddy land, a few traditional implements and a small house. All these factors together just permit the farmer to meet minimum daily requirements to support himself and his family (the average family size being six). At current prices, the estimated LBRE is Rs 2200 ($A155).

Similarly, the concept of the UBRE was used because it was thought that farmers would not be able to form a good conception of a level of wealth that is beyond their imagination. The UBRE was defined as that level above which farmers' present life styles could be completely changed. Therefore, the UBRE was estimated according to the Nepalese Land Act and general observation among Nepalese large farmers. The Act forbids an individual from holding more than 22.25 ha of land. Farmers

having more than this area are considered to be rich and are expected to be in non-farm businesses. That is, their attitudes and behaviour are rather different from those of the 'average' farmer. Therefore, the UBRE was estimated on the basis of the typical wealth of this rich class. The estimated UBRE was Rs 340 000 ($A24 000).

All the elicited utility functions were found to be concave and (as a result of employing the practice of plotting the functions and checking consistency as the inverview progressed) smooth. Absolute risk aversion over different segments of the utility functions was calculated to determine the nature of any change with wealth.

The calculation procedure developed was as follows. The seven data points for each function were used directly by taking them in contiguous groups of three (making five triplets), fitting (Schlaifer 1971) a negative exponential utility function to each set of three points (a two-point risk and associated certainty equivalent), thus yielding five segments, each with an assumed constant absolute risk aversion coefficient ($RA$). This procedure seems to quantify the data in a convenient form for hypothesis testing, yet without imposing any presumptive functional forms for the overall utility function.[2]

## *Results*

An analytical summary of the estimates of risk aversion was undertaken by means of simple linear regression. For each set of farm preference data, the fitted coefficients of local risk aversion for the five segments were regressed on the respective expected wealth levels ($W$) associated with each of the two-point risks. Similarly, the analogous relative risk aversion coefficients ($RA \times W$) were also regressed as a dependent variable to test whether each empirical utility function exhibited decreasing, constant or increasing relative risk aversion.

With the level of significance for the $t$-test on the slope set arbitrarily at 0.20, 58 per cent of sample farmers show utility functions exhibiting decreasing risk aversion, only 2 per cent are increasing, whereas utility functions of 40 per cent of the sample fall into the residual (non-significant) category of 'constant' risk aversion (Table 1). It is thus concluded that individual farmers' absolute risk aversion tends to be

TABLE 1

*Percentage of Sample[a] Risk Aversion Changes with Wealth*

| Type of risk aversion | Absolute risk aversion | Relative risk aversion |
|---|---|---|
| Decreasing and significant at 0.2 level[b] | 58 | 25 |
| Constant (that is, not significantly decreasing or increasing) | 40 | 64 |
| Increasing and significant at 0.2 level[b] | 2 | 11 |

[a] Sample size = 60 farmers.
[b] $t(0.1, 3) = 1.64$. The unconventionally-high level of 0.2 was chosen in view of the few (5) observations and (3) degrees of freedom.

[2] Most functional forms imply a particular pattern of changing absolute risk aversion (e.g. logarithmic decreasing; quadratic increasing) and testing via goodness of fit of alternative functional forms thus devolves to a curve-fitting exercise plagued by specification bias and invariably a very similar measure of goodness of fit.

negatively related to wealth. The situation of relative risk aversion is more scattered, with the main tendency to be 'constant'.

By way of a concise summary of the farmers' risk attitudes, a cumulative probability distribution of absolute risk aversion (predicted from the individual regressions at current wealth) is presented as a smooth distribution function in Figure 1. This representation indicates that risk aversion varies markedly between individuals.

It is tempting to endeavour to make comparisons between this set of data and data reported by other investigators. However, such comparison is spurious (even for statistics like mean and range or for standardised measures such as the coefficient of variation) because the coefficient of absolute risk aversion depends on the units and currency values used to measure wealth. On the other hand, relative risk aversion is not so unit-dependent and, accordingly, the distribution of this measure is also summarised in Figure 1. This latter distribution could be compared with distributions of measures assessed similarly in other studies, if such were available. Most reported values are much higher than Arrow's (1965) speculated typical value of unity, but about two-thirds lie within the intuitively-likely range of zero to four speculated by Little and Mirrlees (1974. p. 330).

So far, the hypothesis of DARA has been tested on the basis of each individual's utility function. However, an extension of the hypothesis to a cross-sectional relationship is tested across farmers by regressing their absolute risk aversion, predicted at their current wealth level ($RA^*$), on their current level of wealth.[3] The results are (with standard errors in parentheses):

$$RA^* = 216 - 21.2\ W^*$$
$$(19)\ (5.1)$$
$$n = 60 \quad \bar{R}^2 = 0.21$$

where $RA^*$ = absolute risk aversion $\times 10^{-5}$; and
$W^*$ = current wealth level (Rs $10^3$).

Absolute risk aversion is strongly and negatively related to wealth. Taken together with the individual analyses, it is concluded that farmers indeed exhibit DARA utility functions that show decreasing absolute risk aversion. Thus, the DARA hypothesis is again not rejected. This is what the theorists would suggest, but contrasts markedly with the null findings of O'Mara (1971, p. 218).

## *Conclusion*

It is concluded that risk aversion is the prevalent risk attitude among small Nepalese rice farmers. Farmers' levels of absolute risk aversion are negatively related to their present wealth which, in turn, is obviously related closely to such things as area of arable land and average annual income. Partly because of the prevalence of risk aversion, these rice farmers may be unwilling to adopt new technologies perceived to be risky. However, as they manage to increase their wealth, their potentially

[3] As noted above, the only effect about which there has been explicit theorising is that of wealth and, accordingly, this is the only variable included in the present parsimonious specification. The temptation of including a number of additional 'socio-economic' explanatory variables has been resisted on the grounds of the arbitrariness and lack of *a priori* causation inherent in such *ad hoc* specifications.

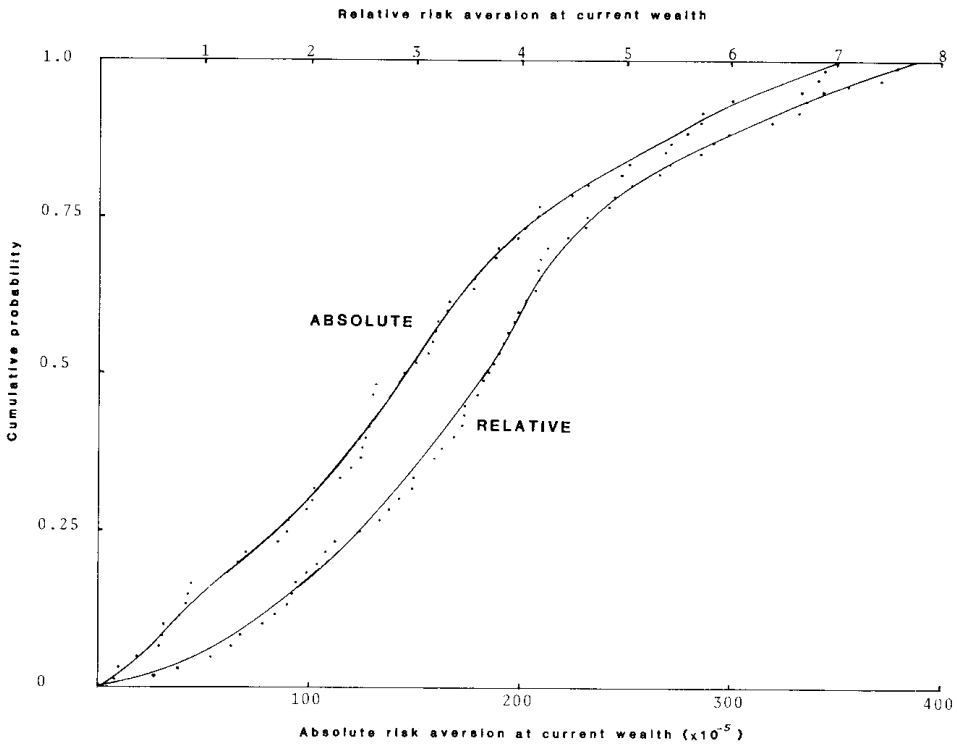


FIGURE 1—Sample CDFs of Predicted Present Levels of Risk Aversion.

impeding aversion to risk will tend to diminish, according to the empirically supported hypothesis of individual DARA, and any risk-constrained adoption may increase.

Our data support the frequently-made assumption of DARA. The DARA hypothesis would be founded on much firmer ground if studies analogous to the present one could be conducted among diverse groups of decision makers. We speculate that our data may be representative of those for small farmers generally in Nepal, and perhaps of other developing countries. It would be of particular interest in further investigation to sample farmers across a much wider range of prevailing wealth.[4]

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[4] One such recent sample of wealthier farmers is the group of 13 Minnesota farmers among whom Hildreth and Knowles (1982) found strong evidence of DARA.

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