RISK & DIVERSIFICATION

in Arizona Crop Farm Planning

Part I: The Principle of Increasing Risk and Individual Crop Net Income Variability Estimates

Farm size increases, technological change, a tight money supply, and government program changes are only a few of the factors increasing the complexity of the decision-making process for Arizona farmers and agribusinessmen.

Farmers face a number of problems when deciding how to adjust their operations in light of these developments. For example, if land is diverted from cotton production, lack of experience in producing alternative crops may limit the range of alternatives the farmer has open to him or make it very difficult for him to rationally evaluate the potential consequences of a given crop rotation or farm plan. Now, more than ever before, farmers and other businessmen need reliable statistics and an adequate procedure for analyzing alternative courses of action in order to make sound decisions.

The purpose of this article, the first of three installments, is two-fold; (1) to illustrate vis a vis the "Principle of Increasing Risk" the importance of allowing for risk and uncertainty in crop farm planning, and (2) to present estimates of the net income variability associated with selected crops grown in Arizona. Parts II and III, forthcoming in the November-December and January-February issues respectively, will serve to document the additional data and decision making steps that are required for an individual farmer to systematically evaluate the potential consequences of his existing or anticipated farming situation.

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The Principle of Increasing Risk

The principle of increasing risk states that as a business is expanded through the use of borrowed capital, the chance of the owner losing his own capital (i.e., going out of business) increases. Consider the case of a farmer who with $250,000 of equity capital borrows an additional $100,000 in order to increase the size of his business and/or invest in new equipment which will enable him to grow a high-value vegetable crop and thereby decrease his dependence on cotton production. Further assume that this decision was based on the knowledge that on the average, such a plan would lead to an after taxes return of 25 percent on invested capital as opposed to the 15% now being earned. The farmer's position before and after the acquisition of the borrowed capital is summarized below:

Before Reorganization: 83.3 percent Equity

Assets	– Liabilities	= Net Worth
$300,000	– $50,000	= $250,000

After Reorganization: 62.5 percent Equity

Assets	– Liabilities	= Net Worth
$400,000	– $150,000	= $250,000

The reorganized plan would indeed result in a substantial gain under the anticipated 25 percent increase in asset value. Assuming the 15 and 25 percent return under the old and new plan respectively, the reorganized plan would lead to a $100,000 increase in net worth whereas the old plan would increase net worth by only $45,000.

Before Reorganization (15% Return)

Assets	– Liabilities	= Net Worth
$345,000	– $50,000	= $295,000

After Reorganization (25% Return)

Assets	– Liabilities	= Net Worth
$500,000	– $150,000	= $350,000

The example appropriately illustrates the benefits that can be captured through the sound use of credit. However, now let's assume as frequently happens in a farming situation involving capital intensive high value crops, that a combination of forces largely beyond the farmer's control, i.e., bad local weather, depressed market prices, etc., results in a bad year during the first year following reorganization. The effect of a decrease in asset value comparable to the expected return under each of the two cases is given below:

Before Reorganization (Assuming a 15% Loss)

Assets	– Liabilities	= Net Worth
$255,000	– $50,000	= $205,000

After Reorganization (Assuming a 25% Loss)

Assets	– Liabilities	= Net Worth
$300,000	– $150,000	= $150,000

A farmer having experienced a bad year as in the "before reorganization" example would still have slightly over 80 percent equity and could probably persevere without liquidating any of his assets. Conversely, a farmer having experienced a bad year as in the "after reorganization" example would have assets valued at $300,000, liabilities of $150,000 and consequently only 50 percent equity. A farmer in this position would undoubtedly find it difficult to obtain adequate financing to continue with the reorganized plan. If the worst occurred and the farmer was forced to liquidate a portion of his assets, his financial position would likely deteriorate even further as forced liquidations rarely lead to a "fair market" sales price.

Net Income Variability Estimates for Selected Arizona Crops[1]

The above discussion dramatizes the need for considering year to year income fluctuations in farm planning. For a couple of reasons, the net income variability measures which will be presented here do not in and of themselves take account of all of the factors which can cause year to year income fluctuations. First, the study on which this article is based assumes that farmers generally recognize long-run physical and economic trends such as technological advances, inflation, and price cycles. Recognizing these long-run trends, the farmer planning crop production for the year ahead is more likely to view the "random" element as a deviation from the "current level" (i.e. of prices or yields over the last five years) rather than as deviation from the long-run mean. Thus, our variability estimates are measures of only the unpredictable portion of total variability.

The second limitation results from the nature of the data base used to derive the variability estimates. Arizona state price and yield data were used to derive a historical per acre

[1] Net Income as used here refers to the net returns above direct growing and harvesting costs (variable costs) for each crop. Fixed costs such as depreciation, taxes, and interest on the investment have not been subtracted as it is inappropriate to assign them to an individual crop. Fixed costs will be introduced in the whole farm analyses, Part III, in this series of articles.

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gross income estimate for each of the thirteen crops analyzed for each year in the study, 1960-70.[2] Similarly, secondary data was used to derive yearly estimates of the corresponding per acre production and harvest cost and thereby the per acre returns above variable cost for each crop.[3] Assuming that future variability for these crops is closely related to past variability, these estimates will serve as realistic measures of the relative riskiness of each crop. It must be remembered that for certain farms or areas within the state, the absolute variability for any given crop may be higher or lower depending upon specific climatic resource and economic conditions.

Table 1. Ranking of Arizona Crops by Net Income Variability Coefficients

Rank	Crop	Average Net Income	Variability Coefficient	(% of Time) Net Income Greater Than 60%	70%	80%	90%
1	**Cotton**	210	16	201	192	181	166
2	**Barley**	21	18	20	19	18	16
3	**Sugar Beets**	97	29	90	82	73	61
4	**Milo**	27	34	25	22	19	15
5	**Alfalfa**	34	43	31	27	22	15
6	**Carrots**	506	47	445	380	304	198
7	**Wheat**	15	65	13	10	7	3
8	**Onions**	700	66	584	458	310	106
9	**Spring Lettuce**	473	68	392	304	200	58
10	**Cantaloupes**	258	71	212	162	103	22
11	**Fall Lettuce**	381	73	311	236	147	25
12	**Watermelons**	128	83	102	73	39	– 8
13	**Potatoes**	159	87	124	87	43	–18

The Variability Coefficients

The variability coefficient shows in percentage terms the degree of random or unpredictable variability relative to the current level of the item in question. For example, the random variation (variation other than long-term trends) in the per acre net income for Arizona upland cotton over the past 10 years has been about $34, while the current level (average over the last 5 years) averages about $210 per acre. The net income variability coefficient for Arizona upland cotton is ($\$34 \div \$210) \times 100\% = 16$ percent. Accordingly the average per acre net income (1966-70 estimated average returns above variable costs) and the corresponding variability coefficients are presented in data columns one and two of Table 1.

The thirteen crops, selected on the basis of current economic importance and the availability of data, are ranked according to the magnitude of the variability coefficient. The rankings in general correspond closely with common knowledge concerning the relative degree of risk of Arizona crops, i.e. the vegetable crops are bunched near the bottom of the table. Thus, we state with some confidence that the data does correctly portray the degree of risk inherent in the production of these individual crops.

A better understanding of how the information presented relates to the principle of increasing risk can be gained through study of data columns three through six, Table 1. These data show the net income level that can be anticipated with varying degrees of probability. For example, based on previous years, the net income from cotton can be expected to exceed $201/acre only six years out of ten, $192 seven years out of ten, etc. Stated conversely, at least one year out of ten the net income from cotton will be $166 or less.

The significance of the variability measures in terms of allowing for risk in farm planning should now be apparent. With the exception of cotton, the crops with a high income potential will lead to large year to year income fluctuations. A farmer must decide whether to produce: (a) high income crops having a correspondingly high risk of losses, (b) lower risk crops having lower average income, or (c) a combination of high and low risk crops. New farmers who have limited capital, or who prefer not to gamble on high risk crops, can choose crop combinations which minimize risk and thus avoid the short-run possibility of bankruptcy. Established farmers, or those who have high risk preference, may wish to concentrate on high risk crops because they believe that high possible incomes may offset greater probabilities of large losses.

Obviously, what has been presented here is only part of the picture. The selection of a cropping plan should also involve the consideration of agronomic and resource limitations as they relate to crop interrelationships. Further, as has already been established the debt burden and farm fixed costs should be of major concern. In Part II, "Diversification and Control of Income Variability," (forthcoming in the November-December issue) we will present data (comparable to the individual crop data in this article) for various crop diversification schemes. Subsequently, in Part III, "Allowing for Risk in Arizona Crop Farm Planning," (forthcoming in the January-February issue), we will complete the process of illustrating the practical application of the "Principle of Increasing Risk" by introducing debt retirement and farm fixed cost considerations.

[2] The data is taken from Arizona Agricultural Statistics, 1966 through 1970. This yearly publication is compiled by the Arizona Crop and Livestock Reporting Service, U.S. Department of Agriculture, Statistical Reporting Service and published in cooperation with Department of Agricultural Economics, University of Arizona.

[3] The cost estimates assume a "benchmark" 800 acre farm and were based on Mack, Lawrence E., "Supplementary Material in Support of Ph.D. Dissertation Entitled: Economic Implications of a Dynamic Land and Water Base for Agriculture in Central Arizona," File Report 68-2, Department of Agricultural Economics, The University of Arizona, October 4, 1968 and Wildermuth, John, et al., "Updated Data for Arizona Crop Farm Planning," File Report 69-12, Department of Agricultural Economics, The University of Arizona, December, 1970.