

AN ANALYSIS OF THE EFFECTIVENESS OF DIVERSIFICATION AS A  
MEANS OF OVERCOMING THE INSTABILITY CHARACTERISTIC OF  
FARM INCOME IN MANITOBA

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An Abstract  
Submitted to  
The Faculty of Post Graduate Studies  
The University of Manitoba

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In Partial Fulfillment  
of the Requirements for the Degree  
of Master of Science in Agriculture

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by  
Vernon E. Nelson

May, 1959

This study or analysis consisted of a measurement of the effectiveness of the diversification practice in overcoming instability in farm income in Manitoba. A correlation analysis was made of the yields, prices and cash incomes of the major farm products produced in the Province. Correlation of course, is a measurement of the extent to which prices, yields, or cash incomes of one product tend to vary in a pattern similar to that of the prices, yields, or cash incomes of another product. If products are closely correlated, that is they tend to be affected by the same factors, their value as substitutes for diversification purposes is limited. This is because when the price, for example, of one product is low, the other or others will command a low price as well.

It was found that prices of all farm products tended to be highly correlated. Cash incomes received from these same products were also fairly highly correlated. Yields or marketings showed somewhat less correlation, and in some cases none at all. The lower correlation in yields was largely offset by the higher values for prices and cash incomes. It was therefore concluded that because correlation was relatively high, the value of substitution between products was relatively low, hence there was little to be gained by "intensive" diversification to overcome instability in farm income. There were also two factors, year to year variability, and sporadic instability that were found to modify this conclusion to some extent.

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## CHAPTER I

### INTRODUCTION

The many factors impinging upon the agricultural sector of our economy combine to produce extreme variability in farm income from year to year. Fluctuations in farm income arise out of highly variable farm commodity prices and the uncertainties of weather conditions, diseases and insects, which have their effect on yield. Many different practices have been tried by farm managers in an effort to overcome this instability in farm income. One of the most common methods has been the adoption of some degree of diversification. The word "diversification" may have several meanings dependent upon the degree to which the practice is followed. These different meanings or levels of diversification will be discussed in detail later. It should be noted, however, that the word will be used in this analysis in reference to a very high level of diversification. This level will be referred to as "intensive diversification" in the following discussion.

The problem then, is one of a highly variable annual agricultural income in Manitoba. The objective is to make an examination of the practice of "intensive diversification" as a means of overcoming or ameliorating the effects of fluctuating farm incomes.

In the succeeding analysis an examination of the farm industry will be made and the reasons for, or the causes of instability in farm



income will be discussed. This will be followed by an explanation of risk and uncertainty which arise out of the factors causing instability. The practice of "diversification" will then be described in detail. This will prepare the way for a statistical analysis of the usefulness or effectiveness of the practice in overcoming uncertainty, which will be found in Chapter VIII of the thesis. The succeeding chapters will then be devoted to an examination of the observations recorded together with the conclusions reached. Lastly an interpretation will be made of some of the implications toward farm management policy indicated in the analysis.

It should be noted that in the title and in the following discussion the word "farm income" is meant to include both the variables of yield and price which are the factors determining the level of income. Intra-year variations in income and price are not analyzed because the year is commonly accepted as the unit of time for calculating income in agriculture. Variations in annual income are also much more significant for the purpose of this thesis.

## CHAPTER II

### INSTABILITY: THE NATURE OF THE FARM INDUSTRY

A brief description of the nature of the farm industry in Manitoba is absolutely essential before beginning a discussion of the value and effectiveness of diversification, in overcoming the extreme fluctuations in income to which the individual farm entrepreneur is subjected. The entrepreneur is faced with all or most of the variables affecting other primary industries as well as a number common only to the farm industry. It is these variables or uncertainties that are at the root of the many problems that have plagued the farm industry. They are much more a cause of concern to the modern farmer, however, who must turn to the market to obtain most of the factors of production which he must have. This is quite different from the period 50 to 60 years ago and less when a farm entrepreneur was comparatively self-sufficient.

Agriculture is particularly vulnerable to business fluctuations in the rest of economy. It is one of the major problems of a primary industry, that the income accruing to it is subject to violent fluctuations in the course of changes in the general level of business activity and national income. Farm income falls substantially during depression periods as the prices of farm commodities drop to very low levels. Even when the rest of the economy is enjoying prosperity, farm income may be quite low. The period from 1951 to 1957 is a good

example. National income was at an all time high, yet farm income and prices tended to decline and remained relatively low throughout much of this period.

Farm prices are subject to wide variation throughout the course of the business cycle and tend to fluctuate much more than the general level of prices in the economy. While the prices of farm produced commodities are very flexible, the prices of farm machinery, equipment and supplies are not nearly so variable. Thus when farm prices are declining, the prices of the factors of production required by farmers do not decline as quickly, if at all, thus squeezing the entrepreneur between falling income on the one hand and steady or rising costs on the other hand. This situation is aggravated by the large proportion of relatively fixed to total costs of agricultural production. Fluctuations in gross income accruing to agriculture are therefore reflected almost entirely in net income.

Control of resource administration in agriculture is vested in the hands of thousands of individual farm managers. This large group makes all the ultimate decisions on how farm resources will be allocated between alternative uses, both at a given point in time, and also over time. In terms of numbers, or as a percent of total labor requirements, management is nowhere nearly so important in non-agricultural industries. Management makes up the bulk of the labor force in agriculture, while in industry, management accounts for only a small fraction of the total labor requirements. All consumer

preferences and choices, national programs, and economic influences must thread through the management of the individual farm firm, in order to make any impact on farm production, income and resource use. This is undoubtedly one of the reasons why farmers are notoriously slow in adapting production patterns to changes in price relationships between different farm products.

The time involved in agricultural production in most cases precludes perfect knowledge of the future. Decision making thus takes place in an environment of uncertainty. The need for farm management, co-ordination and supervision grows out of these constantly changing conditions and the incomplete knowledge and information available to predict the future within acceptable limits, let alone certainty.

The preceding discussion serves to point out the dominant characteristic of farm income, that of instability. This again, is the problem that forms the basis for this thesis. The main causes of instability will now be discussed, followed by a more detailed review of the way in which it affects farm income.

#### 1. CAUSES OF INSTABILITY IN FARM INCOME

The main causes of instability of farm income may be classified into two general groups: (1) those originating in the demand for agricultural products through changes in business conditions, and (2) those arising out of the supply of agricultural products. These two cases of instability will now be discussed.

Instability of Business Conditions. The rise and fall of the demand for farm products is directly associated with fluctuations in business conditions of the economy outside agriculture. As agriculture has grown more dependent upon the exchange system for the necessary factors of production, it has become increasingly vulnerable to these business fluctuations. The prices received by farmers move in close sympathy with those in business, rising when industrial production and employment expand, and falling when they contract. However, the amplitude of farm price fluctuations is considerably greater than those of prices generally. This is because of the inability of the farm industry to equate the supply with the demand for individual farm commodities. When demand exceeds supply for a commodity such as flax, the price will be bid up as buyers compete for the limited supply. Conversely, when supply exceeds demand, the price of flax will decline to the level at which buyers will be willing to purchase all the production, (this is assuming ordinary free market conditions.)

The effect on price of even small changes in supply (production) in agriculture may be seen in Figure I, page 8. In the diagram, the curve D D represents the relatively inelastic demand curve for all farm products taken together. The inelastic nature of this demand curve indicates that the total requirements of all farm products is relatively stable or fixed for any particular period. In other words, demand changes very little in spite of changes in quantity marketed and prices. Assume in the diagram that the normal quantity of production is  $Q_1$ ,

with the level of farm prices at  $P_1$ . A small increase in supply to  $Q_2$ , causes prices to fall substantially to  $P_2$ . This happens because the demand changes very little with any change in price. Therefore, a substantial decline in prices was necessary before demand was sufficient to consume the small additional production. Similarly, a small decrease in supply ( $Q_3$ ) is reflected in a large increase in prices ( $P_3$ ). This comes about because demand is relatively fixed or inelastic, so that a decrease in production causes prices to rise as consumers compete or bid against each other for the smaller supply. Prices rise much more than in proportion to the decrease in production because the demand curve is relatively inelastic. That is, consumers wants in terms of total farm products changes very little with changes in prices. It should be noted that although the total demand for farm products is relatively inelastic, the demand for individual farm products may not be nearly so inelastic. For example, the demand for meat may be relatively stable or inelastic, but consumer choices between beef, pork, poultry, mutton etc. may change substantially in relation to the relative prices of these products at any time.

Because of the very nature of the farm industry it is virtually impossible to regulate the supply of any product coming on the market in any one year. This is the opposite to industry, especially large monopoly or semi-monopoly industries where production can be, and is regulated fairly closely to the existing level of demand. These are the most important reasons why farm prices tend to fluctuate much more than prices generally.

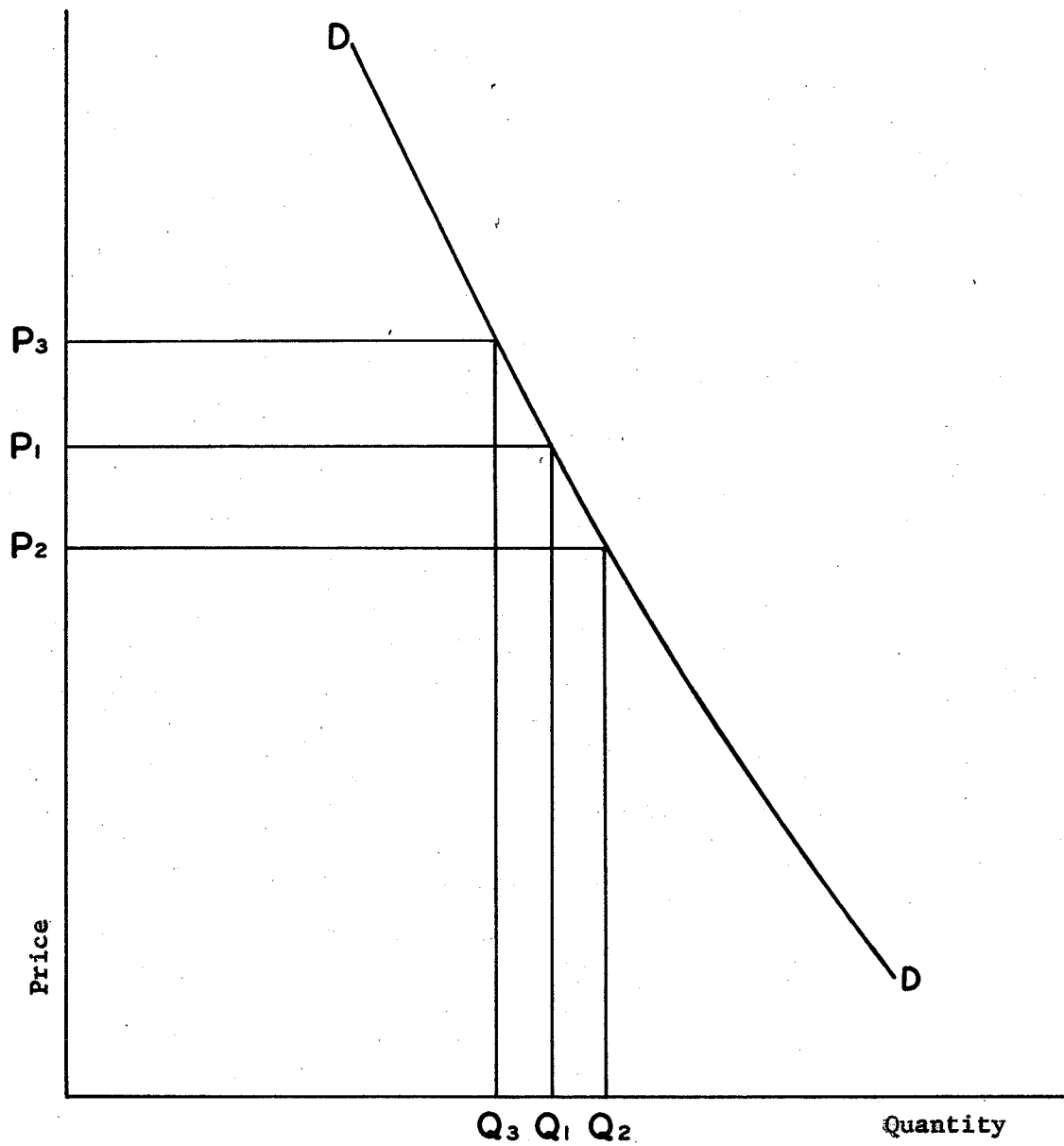


FIGURE I

ILLUSTRATION OF THE EFFECT OF A CHANGE IN SUPPLY ON  
PRICE WITH AN INELASTIC DEMAND CURVE

Instability of Agricultural Production. Agricultural production is subject to many risks and uncertainties that are a major factor in the income instability of the individual entrepreneur. Rain, drought, frost, flood, hail, wind storms, insects and rodents, plus a wide variety of animal and plant diseases, all affect the level of production from an individual farm. These factors determine in no small degree whether yields are large or small, and whether flocks and herds thrive or fail to respond to feeding practices. The individual farmer has relatively little control over these vagaries of nature, so that even in the better situated and more suitable farming areas, the fortunes and failures of farm entrepreneurs are determined to a considerable degree by these production uncertainties.<sup>1</sup>

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<sup>1</sup>For further discussion, see T. W. Schultz, Agriculture in an Unstable Economy (New York and London: McGraw-Hill Book Company, 1945), pp. 211 to 216.



## CHAPTER III

### RISK AS A FACTOR AFFECTING FARM INCOME

At this stage in the discussion, it is necessary to point out a distinction which exists between two different forms or conditions of uncertainty. In his quest to overcome or protect himself against instability of income, the farm entrepreneur is forced to make estimates of future conditions (comparative prices and yields of different commodities as well as general market levels) of which he has limited information. These future conditions may take either of two forms, which will be designated as "risks" on the one hand or "uncertainties" on the other. Risk will be explained and defined in the following discussion, while Chapter IV will be devoted to a discussion of Uncertainty.

#### RISK

Estimates about any future event which is not regarded as certain, may involve either uncertainty or risk.<sup>1</sup> The future event viewed as it exists on an individual basis is always uncertain. Viewed as a member of a group of events so related that their joint outcome is more certain than the individual events in the group, it may be called risk. Both to a fire insurance company and to the owner, the

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<sup>1</sup>See E. O. Heady, Economics of Agricultural Production and Resource Use (New York: Prentice-Hall Inc., 1952), pp. 439-441.

future of a particular building is uncertain, but to the company which insures it, assuming that it also insures many comparable buildings, the burning of the building is a risk. There is therefore an actuarial basis for risk taking which is not the case for uncertainty.

The practical difference between risk and uncertainty is that in the former the distribution of the outcome over a group of instances is known, either through "a priori" calculation or from statistics of past experience.<sup>2</sup> For example, it is known that in throwing a perfect dice the chance of turning up a six will be once in every six throws, if the dice is thrown often enough. Uncertainty cannot be measured in this way because it is impossible to form a group of closely related instances or outcomes, as the situation is highly unique. The price of hogs is uncertain because there are no two years in which the combination of factors affecting the demand and supply of pork and the level of business conditions and prices generally in the economy are the same. It is therefore impossible to measure with any degree of accuracy what the price of pork at any particular time in the future will be, because neither the range of possibilities or the relative effects of each of the factors mentioned previously can be measured accurately. This discussion may be sum-

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<sup>2</sup>F. H. Knight, Risk, Uncertainty and Profit (Boston and New York: Houghton Mifflin Company, 1921), p. 233.

marized by saying that risk is characterized by a known or measurable probability distribution, while uncertainty has no known or measurable probability distribution, or has a myriad of probability distributions too numerous to be of any value.

Risk does not or need not have any impact of a nature to affect decision making and resource use in agriculture.<sup>3</sup> Since risk involves knowledge of the mean, as well as the range and dispersion of outcome, all of which can be estimated statistically, losses and gains which grow out of risk phenomena may be incorporated into the entrepreneur's cost schedule. This may be done even where the number of cases is not great enough to allow prediction of loss on the individual farm. Agencies have arisen which specialize in risk taking in such familiar forms as fire and hail insurance.

This overall distinction between risk and uncertainty was set out by Frank H Knight before 1921.<sup>4</sup> He stated that a risk is "an uncertainty which can by any method be reduced to an objective, quantitatively determinate probability" and thereby "can be reduced to complete certainty by grouping cases". "Pure" uncertainty was referred to as "not susceptible to measurement", and hence cannot be eliminated by inclusion in the firms cost schedule.

Risk then relates to variability phenomena which can be incor-

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<sup>3</sup>Heady, op. cit., p. 442.

<sup>4</sup>Knight, op. cit., p. 197.

porated into costs. It is uncertainty which gives rise to the need for an entirely different framework for decision making and resource administration. It is also the presence of uncertainty which has given rise to the concept of "intensive diversification" mentioned previously, which developed as a means of lessening the effects on the farm entrepreneur. Uncertainty is therefore a much more significant factor of decision making in agricultural production.

## CHAPTER IV

### UNCERTAINTY AS A FACTOR AFFECTING FARM INCOME

The term "uncertainty" is used throughout this analysis in reference to all circumstances in which decisions must be made without complete knowledge of significant future events. (Significant future events are all occurrences, which if foreseen correctly, would have influenced the particular decision). Uncertainty will exist if expectations of future prices, yields, or capital allowances are indeterminate, and if it is not even possible to calculate with any accuracy a predictable range of results.

Uncertainty then, involves the making of decisions without perfect knowledge. It is always present when knowledge of the future is less than perfect in the sense that the parameters of the probability distribution (the mean yield or price, the variance, range or dispersion and the skewness or shape of the distribution) cannot be predetermined.<sup>1</sup> Uncertainty refers simply to anticipations of the future which are peculiar to the mind of each individual producer. It arises because the entrepreneur must formulate an image of the future in his mind but has no quantitative means by which these predictions may be verified. Anticipations of the future may be made, but not enough observations under similar conditions can be made to predict the

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<sup>1</sup>E. O. Heady, Economics of Agricultural Production and Resource Use (New York: Prentice-Hall Inc., 1952), p.443.

relevant probability distribution.

The existence of uncertainty not only influences the process of decision making, but also has an effect upon the objectives or goals of the entrepreneur<sup>2</sup>. If expectations are uncertain, it no longer seems realistic to assume that the entrepreneur is interested solely in maximizing net income over some period of time. It may also be important or even a definite necessity to maintain a certain minimum level of income throughout the life of the firm in order to protect the capital invested against uncertainties which may force liquidation of assets in the short run. For example, an entrepreneur must receive a minimum annual income sufficient to maintain the existence of his family and himself, and also to retain the existence of his farm as an economic unit. It will be of little value if his average yearly income is more than sufficient to meet his requirements if he is faced with periods when his income is so small that he is forced to liquidate his assets and go out of operation.

A firm is thus confronted not only with the necessity of considering the expected value of the income stream but also with the desirability or necessity of maintaining within limits the capital value of the firm as a going concern. If the future is uncertain, the entrepreneur is influenced not only by the mean or most probable value

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<sup>2</sup>D. G. Johnson, Forward Prices for Agriculture (Chicago: University of Chicago Press, 1947), Chap. IV.

of future income but also by the distribution of income over time. The time involved in the production process is significant because the greater the period over which the production cycle extends, the more likely that uncertainty will affect the outcome.

### I. TYPES OF UNCERTAINTY

Uncertainty may be broken down into four main types or classes:<sup>3</sup>

- (1) price uncertainty for products or factors,
- (2) technical or yield uncertainty,
- (3) technological uncertainty,
- (4) the sociological and legal framework in which the firm operates.

Each of these four will be discussed briefly.

Price Uncertainty. Prices to be realized vary in accordance with a number of factors, the following four of which are among the most important.

(a) The actions of other producers. If many entrepreneurs produce a product with only a limited demand, an oversupply may develop which will suppress the price. Similarly, the action of many producers bidding for a factor of production which is limited in quantity, such as a new variety of seed wheat, will tend to bid up the price of that factor thus increasing its cost to each individual producer.

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<sup>3</sup>Heady, op. cit., pp. 453 - 454.

(b) The degree of national prosperity. Agricultural prices when allowed to fluctuate without government interference tend to follow a pattern similar to other prices and the general prosperity of the economy. Characteristically, however, they show much greater extremes of fluctuation than the general level of prices over the length of the business cycle.

(c) Changes in consumer tastes. A change in consumer taste between say beef and pork, or between beef and veal, to the extent that the change is reflected in the relative demand schedules for these products will also result in a change in their price relationships.

(d) The vagaries of the weather. Favorable weather conditions resulting in a bumper crop in any one year may flood the market for a particular commodity such as wheat, and its price will tend to be suppressed. On the other hand the opposite condition may result in low production but in higher prices because of the short supply. As an "exogenous" or outside variable, price instability or unpredictability is never quite as great in other industries as it is in agriculture because most other industries are not so greatly affected by weather-generated price variations.

The outstanding characteristic of these four sources of price uncertainty is the unpredictable nature of each one. Certainly no one can predict the weather over the length of a crop production period. It is also difficult to predict the actions of other producers and the effect of these actions on the production of different products and



their prices. The same applies to the gradual changes that take place in consumer tastes as well as the fluctuations that occur in national prosperity.

Technical or Yield Uncertainty. Technical uncertainty refers to variation in the production coefficients (yields) for a given technique or practice. It is absent in most non-agricultural industries to the extent that output is usually the result of exact quantities of productive factors in constant proportions, and manufactured under fixed predetermined conditions. For example, if ten pounds of copper plus two pounds of nickel-steel alloy are necessary to produce 100 feet of a certain grade of wire, then this is a fixed and definite production function (with constant production coefficients for each factor) which can be repeated at will to produce the same output. However, in farming there is considerable variation in the year to year output of a fixed quantity of resources. This of course is largely because of the vagaries of nature to which the farm production processes are so closely dependent. In other words, the environment of the production processes can be controlled in the manufacturing industries, which is not usually the situation in the agricultural industry. An entrepreneur may follow a fixed rotation, apply constant cultivation practices, fertilizer etc., but due to the effects of weather the resulting yields will show considerable variation. The extent of this yield variation is shown in Table III page 52. It will be noted in this table that the average year-to-year yield variation between 1926 and 1955 has

ranged from 16 percent for rye to 33 percent for oats. Wheat and barley have both varied over twenty-five percent each year on the average. Compare this with an ordinary manufacturing process where the average variation in product is usually quite small.

Even in the non-farm industries where technological uncertainty is present, its magnitude is not nearly as large as for particular agricultural crops or for the agricultural industry as a whole. The farm manager is thus faced with a complex task in formulating plans for the use of resources as he must reckon in terms of uncertain yields as well as uncertain prices. On the other hand, the non-farm producer since he is not so pressed on the side of technical uncertainty, often can devote a greater portion of his entrepreneurial efforts to formulating price expectations and planning.

Technological Uncertainty. Technological uncertainty arises from advances in scientific knowledge, and improvement in the methods of application of technical processes which increase the productivity of given resources. It is particularly important in industry where trade names and processes can be patented. Farm and non-farm firms alike are faced with uncertainties from technological change, when investment questions call for the consideration of whether the form of resources or the technique adopted will give costs as low as a new technique which may come on the market in the near future.

The fourth source of uncertainty is the sociological and legal framework in which the firm exists. This category includes problems

of tenure, purchasing contracts and related types of uncertainty. The character of individuals is also a phenomena which must be predicted and which could lead to errors of decision in employer-employee relationships and in successful loan transactions. Uncertainty and lack of predictability which attach to government programs might also be placed in this category.<sup>4</sup>

## II. THE EFFECTS OF UNCERTAINTY

One of the chief functions of market prices is that of guiding resources into lines of production which conform with the choices of consumers. The great variability of farm commodity prices and the lack of any simple and effective system which farmers can use in forming price expectations, causes market prices to serve inefficiently in this respect. The expectations are subject to such great errors that production may be guided into the wrong alternatives and resources organized inefficiently as a precaution against uncertainty. For example, a farmer may be so uncertain of the outcome of his seasonal crop pattern, that rather than take a chance on specializing in the enterprise or enterprises in which his efficiency is greatest, he may introduce several other crops on the assumption that at least one of them will be successful. Under highly uncertain and hazardous conditions this practice could result in a lower average income, but a more

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<sup>4</sup>For further discussion of the types of uncertainty, see Heady, op. cit., p.453.

stable income than under a more specialized system. This practice is inefficient to the extent that farm resources are not always used in those enterprises in which they are most productive.

Precautions to meet uncertainty almost always necessitate a sacrifice, which either results in less than maximum production from given resources or conversely, does not allow for a minimum cost for a given output. Both the farmer and the consuming society suffer when production is geared to inaccurate expectations. It is in these ways that price and technological uncertainty have important undesirable effects upon allocative efficiency and income distribution in agriculture.

Short-run effects of uncertainty. The farm entrepreneur is faced with two types of judgments which must be made in the short run.<sup>5</sup>

(1) What will be the prices of factors and products in alternative lines of output when decisions made now materialize in marketable products?

(2) What will be the physical products forthcoming from the combination of inputs used?

The defects in resource allocation with uncertain expectations are of two types. First, if the mean or most probable expected price proves to be correct, the allocation of resources will not be the same as with single-valued expectations. Second, the mean or most probable

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<sup>5</sup>Johnson, op. cit., p. 43 - 44.