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Spatial Impact of Factor Payments: A Case Study of Turkey Production and Processing in Utah

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SPATIAL IMPACT OF FACTOR PAYMENTS:

A CASE STUDY OF TURKEY PRODUCTION AND PROCESSING IN UTAH

by

Chesley T. Blackham

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Chesley T. Blackham

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Spatial Impact of Factor Payments: A Case Study of
Turkey Production and Processing in Utah

by

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The purpose of this paper is to examine the importance of the spatial origin of capital or investment funds and its influence on local community incomes within the context of agricultural production and processing in a rural area in Utah.

A careful identification of the sources of capital investment can be used to determine the spatial source and flow of returns from it, and, hence, provides some indication of the extent to which local community income could be expected to change with changes in the level and mix of factors employed locally.

(65 pages)

CHAPTER I

INTRODUCTION

During the past thirty years, the United States agricultural industry has demonstrated a remarkable capacity to absorb new technology and to respond to changes in product demand. In most important respects, the industry continues to be a healthy one. However, the same cannot be said for individual firms and for certain rural communities where resource readjustments have occurred at rates which result in under- and unemployment of the labor force and the companion problem of depopulation of the rural community.

In some small communities, it is possible that no serious policy can be introduced which would reverse or significantly mitigate these problems except to focus on the maintenance and improvement of labor force quality and to encourage the rate at which labor can be absorbed into urban labor markets. In other communities, it is possible that problems of this sort may be successfully treated by making public investments and/or by the selective encouragement of industries to locate within labor market areas which include the problem communities.

Numerous policy pronouncements and public and private expenditures are being directed at increasing incomes in rural communities. Many of these investments are being directed at enlargement of the rural area recreational base as the answer to the problem, while examination of alternative solutions is not being considered. It appears that not all types of investments, public or private, recreational or non-recreational

can be expected to have similar impact on community incomes and subsequently on employment and population. Currently, much emphasis is being placed on investments by the public sector and on recreational developments as the answers to rural area's sagging economy. However, there is very limited evidence to suggest that these are the only or the best answers to the problem. Further, it has been evidenced that certain types of development in rural communities have a more significant impact on community income because of their complementary nature and the source of investment funds. Of significance is whether the capital investment is locally supplied or comes from external sources, and the resulting impact on the development of the community. If investment is restricted to local sources, this may curtail investment in other areas that could be just as profitable or more profitable than the intended investment. A careful identification of the source of capital investment would determine the spatial sources and flow of returns from it, and hence, would provide some indication of the extent to which local community income could be expected to change with changes in the level and mix of factors employed locally. In this study, the importance of the spatial origin of capital or investment funds and its influence on local community incomes will be examined. The focus will be within the context of agricultural production and processing in a rural area in Utah rather than attempting to examine the entire gamut of investment alternatives that are available to any given area. In this study, a detailed analysis will be made of the Sanpete County turkey production-processing industry and the extent of its economic impact on the Sanpete County area. Special emphasis will be placed on the role of capital accumulation and formulation within the Moroni Feed Company.

Objectives

The objectives of this study are as follows:

(1) To identify the sources of capital investment thereby determining the spatial sources of these funds.

(2) To examine the marginal factor shares of turkey production and processing by empirically estimating specific production functions for them, and thereby determine returns to the various factors of production.

(3) To examine the magnitude of locally vs. externally supplied investment and its resulting impact on community income.

Historical sketch

Sanpete County is the most concentrated area of turkey production in Utah. This county's relative share has increased from 26 percent of the state's production in 1939 to an estimated 52 percent in 1972.[1] An important reason for this growth is a completely integrated producer's cooperative located at Moroni in Sanpete County. The efficient operation of this cooperative has resulted in the elimination of other feed producers, turkey processors and poult suppliers who formerly operated in the area in past years. In a strict economic sense, this could be explained by substantial economies of scale present in the Moroni Feed Company.

As a vocational project -- during the late 1920's -- turkey raising supplemented family incomes. With the advent of the depression, the sideline turkey businesses were instrumental in reviving the economy of the Sanpete County area.

From this loose beginning in the late 1920's emerged the Moroni Feed Company. Growth of this company has been steady and upward since that time. As of 1970, the annual volume of business had grown to $28,000,000 with $2,000,000 being paid out in wages and salaries. As such, the company is a major contributor to the economic base of the Sanpete County area.

[1] Ralph S. Blackham, General Manager, Moroni Feed Company, Moroni, Utah, 1973.

Presently the Moroni Feed Company has approximately 105 turkey producers engaged in growing turkeys. The 1972 crop of live turkeys was in excess of two million birds and estimates for 1973 indicate a singular size drop. Many of these turkeys are sold in whole bird form while others are sold as various further-processed items such as steaks, breast roasts, turkey burger and hind-quarter roasts. The enlargement of marketing further processed items appears to be an area that holds potential for growth in the company.

The most notable feature distinguishing this cooperative from other similar cooperatives is that it has paid out any overages over cost on a five-year revolving basis by department since its organization, thereby instilling confidence in the management and assuring continued growth.

CHAPTER II

REVIEW OF LITERATURE

Implicit in any review of literature is a study of the relevant material concerning the problem to be researched. Hence, a careful, selective review was made of the literature in reference to the spatial impact of factor payments, and to turkey production and processing in Utah. This review was by no means exhaustive but those pieces of literature which were deemed most relevant to the study were reviewed.

Basically, there were five areas of general concern that were reviewed. They were: (1) turkey production benchmark studies, (2) literature relating to production functions and the factor share arguments, (3) the export-base theory of regional growth economics, (4) articles concerning multiplier analysis, and (5) a study of timber harvesting and reforestation and regional income distribution.

Turkey production studies

Several benchmark studies have been made concerning the Utah turkey industry. These were conducted by the Agricultural Experiment Station, Utah State University, Logan, Utah, and published in 1945, 1954, and 1964. Generally, the analysis consisted of analyzing the trends in costs and returns from turkey production in Utah. The 1964 report was based on 36 flocks in Sanpete County in 1961. It showed that the cost of turkey production was about 25 cents per pound eviscerated. Feed amounted to nearly two-thirds of total cost, poults 16 percent, labor 6 percent, and other costs 12 percent.

The study indicated that over the period 1949-1961 average net return from turkey production was near zero. This implies that returns to labor and capital have been paid at market rates and that on the average no management income was provided.

It was concluded in the study that Utah's disadvantage in transfer costs for both feed and finished product, would likely proclude any increase in her relative position among states in turkey production.[2]

These benchmark studies provided a method of procedure used in this study in analyzing turkey production in Sanpete County. Estimates of costs and returns to producers were found to be similar to those in the benchmark studies.

Production functions and the factor share arguments

A considerable amount of research concerning the various forms of the production function has been done. The specific form of the production function deemed most useful for this study was the Cobb-Douglas production function. The question of most significance is whether or not the Cobb-Douglas function would represent the conditions of turkey production and processing correctly. According to Zarembka and Chernicoff, that for most empirical purposes the elasticity should be assumed equal to unity and Cobb-Douglas function employed rather than the CES function.[3] Sidhu also cites similar studies that indicate the elasticity not to be significantly

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[2]Roice H. Anderson, The Utah Turkey Industry: An Economic Appraisal, Agricultural Experiment Station, Utah State University, Logan, Utah, Bulletin 445, April 1964.

[3]Paul Zarembka and Helen B. Chernicoff, "Further Results on the Empirical Relevance of the CES Function," The Review of Economics and Statistics, Vol. LII, February 1970, pp. 47-53.

different from one.[4] This function then satisfies the three properties of linear homogeneity.[5]

In using the Cobb-Douglas production function in analysis of factor shares it must be assumed that each input factor is paid the amount of its marginal product and thereby enables the determination of returns to the various factors. For example, if each input is assumed to be paid by the amount of its marginal product, then the relative share of total product accruing to capital will be

$$\frac{X_2 \ (\partial X_0 / \partial X_2)}{X_0} = \alpha_2$$

and to labor

$$\frac{X_1 \ (\partial X_0 / \partial X_1)}{X_0} = \alpha_1$$

where $X_0 = aX_1^{\alpha_1} X_2^{\alpha_2}$

Thus α_1 and α_2 represent, respectively, the relative shares of labor and capital in the total product. The fact that $\alpha_1 + \alpha_2 = 1$ serves then to ensure the exhaustion of product.

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[4] Sidhu, Surjet Singh, unpublished mimeograph memo, University of Minnesota, Department of Agricultural Economics, 1972.

[5] The three properties are as follows:

1. The average physical product of labor and of capital can be expressed as functions of the capital-labor ratio alone.
2. The marginal physical product of labor and of capital can be expressed as functions of the capital-labor ratio alone.
3. If each input factor is paid the amount of its marginal product, the total product will be exhausted exactly by the distributive shares for all input factors.

Regional economics and the export-base theory

One of the basic theories of regional economics is the so-called "export-base" theory. In essence, it implies that export-base theory is primarily demand-oriented, that is, the fundamental source of growth for a region is brought about by changes in the regions export demand. It is assumed that these changes are exogenous to the particular region in question.

Many studies have been conducted which indicate that the "export-base" theory is inadequate as a growth theory and should not be considered as such. In these studies, the longer-run growth process is viewed as being supply-oriented and that factor and product price adjustments are made quickly enough such that full employment may alsways be assumed. This yields an inconsistency between the studies and the previous definition of the "export-base" theory.

After a careful critique of the "export-base" theory, Lewis concludes that it is overly simplistic, difficult to implement empirically, and theoretically deficient and as such should be discarded as a basis for regional growth models.[6]

However, it appears from further investigation that the "export-base" theory could be utilized in certain specific areas as long as it was not used as a full comprehensive growth model and its limitations were recognized and understood. For example, the "export-base" theory could be applied in this study to the Moroni Feed Company as representing a rural export industry where demand is determined outside the area where the company is located.

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[6]William Cris Lewis, "A Critical Examination of the Export-Base Theory of Urban-Regional Growth," The Annals of Regional Science, December 1972, pp. 15-25.

Multiplier analysis

To compensate for the inherent weaknesses in the "export-base" theory, more sophisticated means of analyses have been developed. One of these was the inter-regional multiplier analysis. This was done by a construction of a simplified model of income determination in a closed system of n regions, quite similar to comparative static national income models that take account of international trade. In this type model, exports are assumed to be a function of income in the n-1 regions. It is then shown given a disturbance (increase in investment) in the system, that inter-regional trade spreads the benefits of a rise in investment in one region over the whole system. The magnitude of the change in economic activity is measured by the inter-regional multiplier that takes into account feedback effects which the "export-base" theory fails to do. This concept of inter-regional multipliers analysis could be applied to even smaller study areas such as a county or multi-county region. Such a multiplier would be of considerable benefit in the present study of Utah turkey production and processing in measuring the benefit accrued to the multi-county area under consideration.

Timber harvesting and regional income distribution

A study of timber harvesting and regional income distribution recently completed at Utah State University was reviewed. This study included an attempt to assess the impact of local vs. non-local capital investment. Relative magnitudes of capital investment were estimated by source, as well as the relative magnitudes of benefit leakage outside of each study area.*

*Timber Harvesting and Regional Income Distribution, Dissertation by A. Allen Dyer, U.S.U., Logan, Utah, April, 1973.

The study approached timber harvesting with both regression analysis and estimation of direct factor payments. From these approaches, the impact on local community income was estimated. The analysis used in the present study of turkey production and processing was of the same general format as the one used in the timber harvesting study. Similar efforts were made to estimate the impact of turkey production and processing on social community income.

As stated previously, the three major objectives of this study were (1) to identify the sources of capital investment, (2) to examine the marginal factor share arguments, and (3) to examine the magnitude of investment whether it be local or non-local.

As a basis for adquately treating these objectives the literature reviewed have provided several useful precedents. The turkey production benchmark studies aid in the estimation of relevant production functions for the present study, while the study by the factor share arguments provides useful possibilities for analyzing returns to the various factors of production including capital.

The remaining items of review suggest means for estimating the magnitude of the investment and determining its economic activity for the area. It was not intended that this review of literature provide an exhaustive review of all the material remotely related to this study. For this reason, limited reviews and references may occur at other places within the thesis.

CHAPTER III

PROCEDURE

Three-phase problem

The structure of agricultural production and processing firms examined in this study were found to be vertically integrated to a great extent. Because of this high degree of vertical integration, there was a significant degree of correlation between inputs and outputs. That is, some end products or outputs within the agricultural production-processing function become major inputs into subsequent phases of the process. For example, the finished turkey feed ration becomes a major input into the production process of the local turkey producer. The turkey producer subsequently has his final product processed and marketed through the centrally-located producers cooperative processing plant.

Because of the high degree of vertical integration and input-output correlation, the study was approached in a series of steps or phases. Each phase encompasses one specific part of the agricultural production-processing function and hence provides a more suitable framework for analyzing the problems and achieving the objectives of the study.

Phase I entails the production of turkey feed and related feed inputs available to the turkey producer. Phase II is the turkey production process and phase III, the turkey processing and marketing function.

By using the three-phase process outlined, it was possible to identify the sources of capital investment within each of the phases and subsequently

the magnitude of that investment. Further analysis of the data shed considerable light on the resulting impact on community income and the extent to which income was influenced by the source of the capital investment.

Production function

The form of the production function chosen for use in this study was the Cobb-Douglas production function. From all indications, the Cobb-Douglas production function appeared to represent the conditions of turkey production and processing most adequately in that it described what would be expected to happen given the nature of the data.

By using non-experimental data from the real world in estimation of the Cobb-Douglas production function, turkey producers, the feed processing plant and the turkey processing plant were expected to be operating within stage II of the production function. This is consistent with economic theory because a rational firm manager will seek to be in the second stage, where none of the inputs are being used in so large of quantities as to reduce the level of output.

Further analysis of production functions indicated that for most empirical purposes the elasticity could be assumed or constrained equal to unity and the Cobb-Douglas production function employed. Under these conditions the function would satisfy the three properties of linear homogeneity.*

Satisfaction of these three properties of linear homogeneity makes it possible for identification and analyses of marginal factor shares and subsequent returns to the factors of production.

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*See source footnote (5), page 7.

For example, let X_0 represent the product of a firm

X_1 = labor input

X_2 = capital input

t = time

then $X_{0_t} = aX_{1_t}^{\alpha_1} X_{2_t}^{\alpha_2}$

In the context of the example, attention is restricted to a given production period, hence the subscript t may be dropped.

Assuming conditions of perfect competition in both factor and product markets, let π be profit and P_0, P_1, and P_2 be the price of the products, the wage of labor, and the cost of using one unit of capital services, respectively.

Then,

π = total revenue - total cost or in expanded form:

$$\pi = P_0X_0 - P_1X_1 - P_2X_2$$

Thus, the firm maximizes π subject to the constraint implied by the production function. The first order conditions for a maximum are:

$$\frac{\partial \pi^*}{\partial \lambda} = -X_0 + aX_1^{\alpha_1} X_2^{\alpha_2} = 0$$

$$\frac{\partial \pi^*}{\partial X_0} = P_0 - \lambda = 0$$

$$\frac{\partial \pi^*}{\partial X_1} = -P_1 + \lambda\alpha_1 \frac{aX_1^{\alpha_1} X_2^{\alpha_2}}{X_1} = 0$$

$$\frac{\partial \pi}{\partial X_2} = -P_2 + \lambda\alpha_1 \frac{aX_1^{\alpha_1} X_2^{\alpha_2}}{X_2} = 0$$

where $\pi^* = \pi - \lambda (X_0 - aX_1^{\alpha_1} X_2^{\alpha_2})$

These equations then imply:

$$X_0 = aX_1^{\alpha_1} X_2^{\alpha_2}, \quad \alpha_1 = \frac{P_1X_1}{P_0X_0}, \quad \alpha_2 = \frac{P_2X_2}{P_0X_0} \quad [7]$$

which determine the output which will be produced and the inputs of factors to be employed once the price of the product and factors are given. This implicitly assumes that second-order conditions are also met.

Treatment of technical change*

Empirical evidence of the rate of technical change during the period 1909-1949 taken from American data indicates that the upward shift in the production function was at a rate of about one percent per year for the first half of the period and two percent per year for the last half. It also indicated that gross ouput per man hour doubled over the interval, with 87½ percent of the increase due to technical change and the remaining 12½ percent due to increased use of capital.[8]

It is self-evident that any study which involves changes in the amounts of investment and its relationship to the specific production function in question must include some way of handling or treating technical change. One method of treating technical change has been suggested by Solow and a summary of that method is as follows:

Assumptions (1) linear homogeneous in L,K.

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[7] Marc Nerlove, Estimation and Identification of Cobb-Douglas Production Functions, Chicago, Illinois: Rand McNalley & Co., 1965.

[8] Robert M. Solow, "Technical Change and the Aggregate Production Function," The Review of Economics and Statistics, August, 1957, pp. 312-320.

* See appendix for further discussion on the treatment of technical change.

Theoretical formulation:

(1) $Q = F(L,K,t) = A(t)\ f(K,L)$ Production function (Labor, Capital, time) multiply through by 1/L Q - output A(t) - technical change

(2) Per capita output $\frac{Q}{L} = A(t)\ [1/L\ f(K,L)]$ treat 1/L as $\lambda, \lambda = 1/L$

a) $\lambda = 1/L\ f(\lambda K, \lambda L) = \lambda F(L,K)$

(3) $Q/L = A(t) = f(K/L,1)$

(4) $Q/L = A(t)\ \bar{f}(k) \quad \bar{f}(k) = 1/L\ f(K,L)$

(5) $\ln Q = \ln A(t) + \ln \bar{f}\ (k) \quad \frac{d\dot{q}}{dt} = \dot{q} \quad \frac{dA}{dt} = \dot{A}$

(6) marginal / total $\quad \frac{\dot{q}}{q} = \frac{\dot{A}}{A} + \frac{f_k \dot{k}}{\bar{f}\ (k)}$

Then to estimate the rate of technological change

$$A = \frac{\dot{A}}{A} = \frac{\dot{q}}{q} - W_K \frac{\dot{k}}{k}$$ [9]

Solow demonstrates a way of segregating shifts of the aggregate production function from movements along it. The method used rests on the assumption that factors are paid their marginal products. This is precisely the approach taken in this study. The form of production functions employed by Solow was the Cobb-Douglas with elasticity assumed to be equal to unity and the factor shares being paid their marginal product. It was for these reasons that the Solow model was selected as a positive menas for treating the problem of technical change in this study.

As shown in the theoretical formulation, production consists of labor, capital and a time variable. This specifies the special case of neutral technical change. That is, marginal rates of substitution are not affected by shifts in the production function while output is either increased or

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[9] Ibid.

decreased. A(t) measures the cummulated effect of shifts over time. Solow then shows that Euler's theorem having been assumed implies that the function is homogeneous of degree one. Consequently, manipulation of equation 7 then indicates how an estimate of technical change can be found.

Another method of treating technical change[10] is to incorporate a time variable raised to a power. The degree of the change in technology is reflected in the power of the term. For example, the term could be included in the production function equation to take care of the technical change. However, a basic problem arises with this approach and its application to time series data. That is, if the number of observations is extensive, these observations may tend to swap the effect of the other variables in the estimation.

Both methods of treating technical change were employed in the study. Regressions were run using the Solow time variable for one run and using a dummy variable for the other run. Results are presented later in the paper.

The form used for the Solow treatment of technical change was of the general form:

$$X_0 = A(t) \; X_1^{\alpha_1} \; X_2^{\alpha_2} \; X_3^{\alpha_3}$$

where X_0 = output or the dependent variable

$A(t)$ = rate of technical change

X_1 = land input

X_2 = labor input

X_3 = capital input

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[10] Murray Brown, On the Theory and Measurement of Technological Change, Cambridge University Press, pp. 125-26.

The form used for the inclusion of a dummy variable incorporating time was of the general form:

$$X_0 = aX_1^{\alpha_1} X_2^{\alpha_2} X_3^{\alpha_3} X_4^{\alpha_4}$$

where X_0 = output on the dependent variable

a = constant

X_1 = land input

X_2 = labor input

X_3 = capital input

X_4 = dummy time variable

In order to employ the Solow technique of accounting for technical change, the first year of data availability was set equal to one and subsequent years were listed in numerical order.

1961 = 1
1962 = 2
. .
. .
. .
1972 = 12

Employing a dummy variable to account for technical change was based on the isolation of technological epochs. These are periods of time in which substantial investments indicative of technical change were made. Analysis of the data revealed these periods as 1964, 1967, and 1971. The time variable was then listed as follows:[11]

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[11] See source footnote (9), page 15.

1961 = 1
.
.
.
1964 = 1
1965 = 2
.
.
.
1967 = 2
1968 = 3
.
.
.
1971 = 3
1972 = 4

Data collection*

Within each of the three phases of production and processing, data were gathered that would indicate the magnitude and source of the inputs and outputs of each respective phase. The data entailed also estimation of the extent of external and internal sources of capital for all phases. Following is a brief description of the data collection process for each phase of the production-processing function.

Phase I (feed production). The value of land used in the feed processing function was determined by referring to the audit reports of the Moroni Feed Company for the years 1961-1972. Labor requirements and wage and salary payouts were also determined in large measure by reference to these reports. The number of employed persons was determined by interview with the personnel manager of the Moroni Feed Company. These data were transposed into man-month equivalents in order to facilitate their aggregation into a single variable for the regression analysis. Capital investment and related rates of depreciation were taken from the capital

*See appendix for further discussion on data collection.

equipment ledger and broken down into office equipment and industrial equipment by year. The extent of internal and external sources of capital was determined by analysis of the audit reports which indicated relative magnitudes of capital available from outside borrowings and internal (net worth) sources. A similar procedure was followed in phase III for determining internal and external sources of capital funds. Management and supervisory salaries were given as an overall average by year. The magnitude and dollar value of feed grains and finished feed product were taken from the audit reports and by direct interview with the general manager of the Moroni Feed Company.

Phase II (turkey production). Inputs and outputs for the turkey production process were determined by direct interview with producers in the Sanpete County area. Those interviewed were determined by a random sample of 40 taken from a total population of 105 within three separate strata of turkey producers.* The three separate strata were based on the relative size of the producers output in the number of pounds of eviscerated turkey produced.

Strata one: 0 to 200,000 pounds
Strata two: 200,000 to 400,000 pounds
Strata three: over 400,000 pounds

Phase III (turkey processing and marketing). Land, labor, and capital data were taken from the audit reports and capital equipment ledger as indicated under phase I. Output of finished turkey product was obtained by interview with the general manager of the company. The value of the output was compiled on a per pound basis with average turkey prices per year obtained from the Statistical Reporting Service.

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*See Appendix C for interview schedule.

Spatial source of funds

The spatial sources of investment funds from external sources were determined by consulting the audit reports. These reports showed the magnitude of external borrowings. External borrowings were defined as borrowings from financial institutions outside of the area of the company. The magnitude of investment funds from internal sources was defined as returns to management and are illustrated in Table 6. Determination of these funds helped to estimate the impact on community income explained in the following section.

Impact on income

To adequately account for the impact on community income, the income generated from the three phases of production was summed and multiplied by an area multiplier. The specific multiplier used was developed by Nureddin A. Taqieddin in his Ph.D. dissertation.[12] It was used to estimate area economic activity generated by the three phases of the turkey industry in terms of wages and salaries, interest, rents, and returns to management.

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[12]Nureddin A. Taqieddin and B. Delworth Gardner, "Impact on Federal Employment on the Distribution of Economic Activity and Population in Utah," pp. 11-14.

CHAPTER IV

DISCUSSION AND INTERPRETATION OF RESULTS

Introduction

The basic format for analyzing the data was of a two-fold nature consisting of (1) a production function estimation employing ordinary least-squares regression and (2) an alternative approach dealing directly with payments to factors of production.

In the estimation of production functions, computer runs were made for phases I and III which employ four combinations of two alternative formulations of the technical change and capital variables. This is illustrated in Figure 1.

The computer program used in this statistical analysis was an ordinary least-squares regression package adapted for use on the Burroughs 6700 by Drs. Reed Willis and Allen LeBaron of Utah State University.

The twelve-year time series for the feed production and turkey processing phases were run with the capital variable disaggregated into three specific types of capital for one run and aggregated into one lump sum for the other run. The data were also run using the two different methods of accounting for technical change discussed earlier. This treatment of the data resulted in four separate runs for both the feed production and turkey processing functions.

The land variable was not included in the regression analysis because the available data listed land at a constant value over the twelve-year period. Subsequently, the land variable would not have had any measurable effect on the regression results. It was recognized, however, that land

Figure 1. Variable combinations by run

Production Phase \ Variables	Land	Labor	Office	Industrial	Building	Solow	Dummy	Feed and Poult
I								
Run 1		X		X		X		
Run 2		X		X			X	
Run 3		X	X	X	X	X		
Run 4		X	X	X	X		X	
II								
Run 1	X	X		X				X
III								
Run 1		X		X		X		
Run 2		X		X			X	
Run 3		X	X	X	X	X		
Run 4		X	X	X	X		X	

did provide a flow of services over the twelve-year period and as such must be accounted for in the analysis. Subsequently, an interest rate was selected that would reflect a return to land in its next best use. This was uniformly assumed to be agricultural use. It is recognized that this selection is somewhat arbitrary, but was rationalized on the basis that it would reflect the opportunity value for that type of land.

A study of land values of other similar agricultural production and processing industries could indicate the relative market value of the land in use. However, it is recognized that the market for land is generally a local market, hence the value of such a study may be limited. For this study, it was considered sufficient to assign a rate of 4½ percent as a fair return to land and deduct this from gross revenue.

All dollar figures in the time series data were adjusted to the common base year (1967), using the following formula:

$$\frac{\text{Raw Data}}{\text{Price Index}} \times 100 = \text{adjusted value}$$

the price index used was the U.S. Wholesale Price Index for the years 1961 to 1972.

The results of the three regression analyses are presented in tabular form with further explanations given by phase.

Phase I (feed production function)

The results of the feed production regression analysis are presented in Tables 1 and 2 as follows:

Table 1. Feed production with aggregated capital

Variable Name	Solow			Dummy		
	b value	S_b	t	b value	S_b	t
Labor	0.02088	0.1097	0.1902	0.04076	0.1355	0.3009
Capital	0.1164	0.1866	0.6240	-0.1074	0.1945	-0.5519
Solow	0.1095	0.06341	1.727			
Dummy				0.03960	0.09197	0.4306
		R^2 = .5781			R^2 = .4339	
	a)	$\sum_{i=1}^{6} bi$ = 0.29178		a)	$\sum_{i=1}^{6} bi$ = 0.01796	
Degrees of freedom = 8	b)	DWT = 1.689		b)	DWT = 1.617	
	c)	t = 1.057		c)	t = -0.111	

a) b value for the land variable not included in the regression analysis was entered in the summation of the bi values at 0.045. The bi's were significantly different from 1 in the Solow treatment and were significantly different in the dummy variable treatment.

b) No significant auto correlation of inputs existed at α = .05 for either case.

c) No interpretation given on t values.

Table 2. Feed production with disaggregated capital

Variable Name	Solow			Dummy		
	b value	S_b	t	b value	S_b	t
Labor	0.4184	0.08638	4.843**	0.2408	0.1629	1.479
Office	0.02188	0.004557	4.801**	0.01419	0.009068	1.565
Industrial	0.008238	0.001796	4.587**	0.01105	0.003667	3.014*
Building	-0.0009812	0.001154	-0.8501	-0.003098	0.002397	-1.292
Solow	0.1237	0.01654	7.479**			
Dummy				0.1292	0.04588	2.816*
		R^2 = .9541			R^2 = .7958	
	a)	$\sum_{i=1}^{6} bi$ = .6162		a)	$\sum_{i=1}^{6} bi$ = 0.437142	
Degrees of freedom = 6	b)	DWT = 2.208		b)	DWT = 1.307	
	c)	t = 5.461		c)	t = 1.878	
ALL t values show significance except for buildings at α = .05. And, α = .01.				Industrial and the dummy variable showed significance at α = .05.		

a) b value for land was 0.045.

b) No auto correlation using the Solow treatment. The test failed using the dummy variable treatment and no statement can be made concerning auto correlation of inputs.

c) t values do not appear to be consistent. No interpretation is therefore attempted.

* significant at α = .05.

** significant at α = .01.

Phase I--Runs 1 and 2. The coefficient, R^2, was larger at .5781 for the Solow treatment as compared with .4339 for the dummy time variable treatment of technical change. The summation of the beta coefficients was higher, .29178 as compared to .01796, for the Solow treatment as well. In both, they differed significantly from one. None of the calculated t values on the beta coefficients were statistically significant at the $\alpha = .05$ level.

Phase I--Runs 3 and 4. The coefficients of determination, R^2, were .9541 and .7958 for runs 3 and 4 respectively. Again, the highest R^2 was obtained using the Solow treatment of technical change. The sum of the beta coefficients was .6162 for run 3 as compared with .437142 for run 4. However, in both, they differed significantly from one. The calculated t values on the beta coefficients showed significance at the $\alpha = .05$ and $\alpha = .01$ level in run 3 for the variables labor, office, industrial, and Solow. In run 4, only the industrial and dummy variables showed significance on the calculated t values at $\alpha = .05$ level.

Phase II (turkey production function)

The results of the turkey production regression analysis are presented in Table 3 as follows:

The negative value on land could be attributable to land being treated as a fixed cost by the turkey producers. As such, they would not be sensitive to the flow of services from it. Also, in many cases, the land used in turkey production was marginal land or land that could not be utilized for crops.

The negative sign on labor could be explained by the substantial use of family labor in turkey production. Most producers used what help was available and not necessarily what help was needed.

Table 3. Turkey production

Variable Name & Code	b value	S_b	t
Land X_1	-0.03172	0.02017	-1.573
Labor X_2	-0.03749	0.04733	-0.7921
Capital X_3	-0.01319	0.04441	-0.2971
Feed and Poults X_4	1.040	0.05517	18.85*
a) $\sum_{i=1}^{4} bi$	R^2 = .9769 = .9576 t = 29.8627		Degrees of freedom = 34 t = 2.0336 18.85 > 2.0336 at α = .05

a) Implies the bi's are not significantly different from 1.

* Significant at α = .05.

The negative sign on capital is questionable and a plausible explanation is not available. It would indicate that producers were not receiving positive values from increases in capital and would be over-capitalized.

The positive sign associated with the feed and poult variable was expected and it was significant at the $\alpha = .05$ level.

Again the summation of the beta coefficients differed significantly from one and exhaustion of product is not obtained. Therefore, no attempt was made to analyze the marginal factor shares with respect to turkey production.

Phase III (turkey processing function)

The results of the turkey processing regression analysis are presented in Tables 4 and 5 as follows:

Phase III--Runs 1 and 2. The coefficients of determination, R^2, were .5736 for the Solow treatment and .3417 for the dummy variable treatment of technical change. Summation of the beta coefficients for both runs was negative and significantly different from one. None of the calculated t values in the beta coefficients were statistically significant at the $\alpha = .05$ level.

Phase III--Runs 3 and 4. The coefficients of determination, R^2, were .5453 for the Solow treatment and .3836 for the dummy variable treatment of technical change. Summation of the beta coefficients in both runs was negative and significantly different from one. None of the calculated t values were statistically significant at the $\alpha = .05$ level.

Economic Interpretation of Phases I and III

Phase I: The more plausible statistical results for phase I were

Table 4. Processing function with aggregated capital

Variable Name	Solow b value	Solow S_b	Solow t	Dummy b value	Dummy S_b	Dummy t
Labor	-0.6266	0.2282	-2.745	-0.3485	0.3902	-0.8932
Capital	-0.09221	0.1171	-0.7877	-0.01149	0.1374	-0.08369
Solow	0.13900	0.06619	2.101			
Dummy				0.02983	0.1478	0.2018
	R^2 = .5736			R^2 = .3417		
	a) $\sum_{i=1}^{6} bi$ = -0.53481			a) $\sum_{i=1}^{6} bi$ = -0.29516		
Degrees of freedom = 8	b) DWT = 3.148			b) DWT = 1.905		
	c) t = -3.2307			c) t = -1.3842		
None of the t values showed significance at α = .05.				None of the t values showed significance at α = .05.		

a) b value for land was 0.045.

b) No auto correlation existed between inputs in either case.

c) No interpretation given on t values.

Table 5. Processing function with disaggregated capital

Variable Name	Solow b value	Solow S_b	Solow t	Dummy b value	Dummy S_b	Dummy t
Labor	-0.6542	0.2963	-2.208	-0.3024	0.4537	-0.6665
Office	0.0005644	0.006177	0.09136	0.00379	0.006928	0.5471
Industrial	-0.002017	0.02624	-0.07688	0.0147	0.02888	0.3626
Building	-0.001062	0.007319	-0.1451	-0.003475	0.008541	-0.4069
Solow	0.1213	0.08306	1.461			
Dummy				0.001438	0.1750	0.008218
		R^2 = .5453			R^2 = .3836	
	a) $\sum_{i=1}^{6}$ bi = -0.4904			a) $\sum_{i=1}^{6}$ bi = -0.245177		
Degrees of freedom = 6	b) DWT = 2.892			b) DWT = 1.963		
	c) t = -2.283			c) t = -0.9653		
None of the t values showed significance at α = .05.				None of the t values showed significance at α = .05.		

a) b value for land was 0.045

b) No auto correlation existed in the Solow treatment. No statement can be made concerning auto correlation in the dummy variable case. The test failed.

c) No interpretation given on t values.

obtained in run three. However, one of the capital variables (buildings) which was assumed a priori to be of importance had a negative sign on its beta coefficient indicating that it was not correlated with output as expected. All four runs failed to show the feed production function to be homogeneous of degree one. Application of Euler's theorem on product exhaustion breaks down and economic interpretation is not possible. However, one possible explanation of the negative sign of the beta coefficient for buildings could be due to two reasons: (1) distance of the feed department from the supply of feed ingredients. To properly insure an adequate supply of feed for producers, management indicated it was necessary to store substantial quantities of feed ingredients, thereby necessitating a larger investment in buildings, (2) to provide some latitude in the purchasing of feed ingredient. Storage facilities make it possible to hedge on the market and possibly attain feed ingredients at reduced rates.

Phase III. As in phase I, phase III exhibited unexpected and inconsistent results according to the a priori specification of the model in relationship to identification of the variables. The negative signs on the beta coefficients would indicate negative correlation between the inputs and outputs and would imply over-capitalization and an oversupply of labor. This appears to negate further use of the model since a positive correlation between inputs and outputs was expected. However, there does exist the possibility of an oversupply of labor in the processing facility because of the seasonal nature of the process. Many workers are hired to insure adequate help and to overcome the absenteeism that exists.

The negative signs on the capital variables cannot be explained. Purchase of new capital equipment has reduced costs and increased quality

of the product according to management and as such should have shown a positive sign.

Because of the generally unacceptable statistical results and these inconsistencies, marginal factor share analysis was not attempted. However, an alternative mode of analysis was used in which payments to factors were estimated directly. This alternative approach is discussed in the section which follows.

Alternative approach

An alternative means for developing estimates of the factor shares was to address the problem directly with analysis of the payments to factors of production. This approach places a limit on the applicability of the study to a general population. By reducing the observations from twelve years data to two years data, causes it to resemble a case study. The results are presented in Tables 6 and 7.

The same three-phase framework was used in the alternative approach, that of (1) feed production, (2) turkey production, and (3) turkey processing.

Phases I and III. These two phases are treated together because of the similarity of factors and factor payments. Gross revenue was determined by examination of the audit report and is defined as follows:

net margin
minus 20% allocations
plus wages and salaries

Factor payments were subsequently netted out from this figure.

Payments to land were determined in the same manner as under the regression analysis. That is, an interest rate was chosen that reflected what investors would invest in that type of land in its next best use being

agricultural use. This interest rate was applied against the value of the land shown in the audit report and that amount was netted out of gross revenue.

Payments to labor were determined by analysis of the audit report. These figures were also netted out of gross revenue.

Payments to capital were of two types, external and internal. External interest payments were payments made for the use of funds obtained from sources outside of the company. Internal interest payments were implied payments not actually made for use of revolving fund credits held within the company itself. The rates of interest were determined as follows in Tables 6 and 7.

The interest rate for external funds was calculated by taking the average seasonal operating loan rate for two periods of time in 1971, [February and August]. In addition to this, the company is required to pay 15 percent of interest in stock which is revolved every eight years. Also, they receive a cooperative refund from the Berkeley Bank for Cooperatives. The general manager indicated to properly account for these two items, it was necessary to add .45 of 1 percent to the already established rate. This resulted in an external interest rate of .0578 percent.

The internal interest rate was determined by taking an average of interest rates on time certificates of deposit available at local banking institutions in the area. These were the most comparable to the nature of the revolving fund credits of the company in that the time certificates of deposit are not available for some specified length of time. In comparison, the revolving fund credits are allocated five years after

Table 6. Determination of returns to management phases I and III, (1972)

	Feed Production		Turkey Processing	
Net margin	$898,747.00		$799,599.00	
Minus 20% allocations	174,055.00		150,209.00	
	724,692.00		629,571.00	
Plus wages & salaries	352,230.11		1,578,658.00	
Adj. Net Margin (gross revenue)	1,076,922.11		2,208,229.00	
		Percentage		Percentage
*Internal interest expenses	174,408.68		159,893.72	
**External interest expenses	52,020.00		46,240.00	
Rents	788.18		1,080.86	
Wages & salaries	352,230.11		1,578,658.00	
	579,446.97		1,785,872.58	
Return to management	497,475.14	.4619	422,356.42	.1913

*internal interest rate - .0542

**external interest rate - .0578

Change in return to management 1971 to 1972

Feed production	Turkey processing
+ 16,338.51	+ 446,734.28

Table 7. Determination of returns to management phase III

ALL figures are presented on a per pound of eviscerated turkey basis.

STRATA I (-0- pounds to 200,000 pounds)

Gross Revenue 0.2824

Less factor payments:

		percentage
Land	0.0015	.0060
Labor	0.0176	.0713
Capital	0.0085	.0345
Feed & Poults	0.2191	.8882
TOTAL	0.2467	

Net Revenue (Return to management) 0.0356

STRATA II (200,000 pounds to 400,000 pounds)

Gross Revenue 0.2839

Less factor payments:

		percentage
Land	0.0004	.0016
Labor	0.0135	.0556
Capital	0.0069	.0284
Feed & Poults	0.2221	.9144
TOTAL	0.2429	

Net Revenue (Return to management) 0.0412

STRATA III (over 400,000 pounds)

Gross Revenue 0.2918

Less factor payments:

		percentage
Land	0.0004	.0016
Labor	0.0108	.0435
Capital	0.0077	.0510
Feed & Poults	0.2296	.9239
TOTAL	0.2485	

Net Revenue (Return to management) 0.0434

being left within the company's capital reserves. It appeared reasonable to assume that patrons would demand a rate of return that would be comparable to investment in other alternatives outside the company. The final internal interest rate was .0542 percent. However, this rate somewhat understates the opportunity costs of these internal funds to the feed and processing departments. It is quite reasonable to assume that the company management could receive a higher return than .0542 by investing these funds in other areas rather than within the company itself.

The external interest rate was applied against outside borrowing and netted out of gross revenue. The internal interest rate was applied against net worth minus allocations for 5 years previous of each department and then netted out of gross revenue. This resulted in a net revenue figure as a return to management.* As shown in Table 6, the returns to managements were 46 percent and 19 percent for the feed production and turkey processing function respectively.

The return to management of the feed production process is somewhat understated for 2 reasons. (1) The feed department acts as clearing house for the other departments and some portion of external interest payments would actually belong to one of the other departments within the company. (2) Allocations deducted out of net worth were assumed to be paid up. However, not all of the allocations are paid up, thereby understating the net return to management figure. It could safely then be assumed that the return to management in the processing function is overstated in that this department receives most of the operating funds and funds for improvement of existing facilities and purchase of new capital equipment.

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*Technically there are no returns to management in a cooperative. They are distributed to the patrons on a year-revolving basis.

As shown, the return to management of the feed production process is very high, nearly two and one-half times the return in the processing function which is also very favorable. The existence of such favorable margins is contingent upon two conditions set forth by the membership of the company. They are: (1) What period of time members desire to have the margin revolved. For example, if members desired to revolve every ten years instead of five, as funds are presently revolved, the margin would be considerably less. And if they wanted to revolve in less than five years the margin would be considerably higher. (2) To what extent members desire to borrow from external sources. The more they desire to borrow from external sources, the lower would be the margin.

One further reason for a higher margin in the feed production process is in the nature of the operation. Historically, the processing facility has required a larger investment than that required by the feed production process.

Hence, the impact of income generated by the two facilities is largely dependent upon the membership of the company.

Phase II. The results of the factor payment analysis for the turkey production process are presented in Table 7. All figures are calculated on a per pound of eviscerated turkey produced and are representative of three levels or strata of growers. These three strata are divided as follows:

Strata one: 0 to 200,000 pounds
Strata two: 200,000 to 400,000 pounds
Strata three: over 400,000 pounds

The figures indicate that for all three strata, feed and poult costs are the most important factors of production comprising an average of

.9088 percent of all costs. It also appeared that larger net revenues per pound were realized by producers in strata three. This is explained by a larger gross revenue received by these producers and relatively lower costs. These costs were lower in all categories except feed and poults than for the other two strata. It appears that those larger producers had more total pounds in cold storage and profited by price increases that occurred after producers in the other strata had sold all of their product.

Spatial source of funds

From the preceding analysis, it is now possible to identify the source of capital investment in the three phases of the study.

Phase I. After netting out of the gross revenue all factor payments as indicated in Table 6, local resources for investment plus that amount available from external sources are shown as follows.

external sources	$847,980.00	.64%
internal sources	$497,475.14	.36%

where external sources are defined as borrowings from the Berkeley Bank for cooperatives minus the interest payment and internal sources are defined as the return to management as calculated on Table 6. This holds for phase III as well as phase I.

It is evident the larger portion of investment and operating funds are generated from sources external to the area in which the feed production process is located.

Phase II. According to the data collected from individual turkey producers, a substantial portion of operating capital was obtained from external sources,[13] illustrated as follows.

[13]External sources are those sources outside the Sanpete County area while internal sources are those within the Sanpete County area.

external sources .5897 percent

internal sources .4103 percent

Those producers classified in stratas two and three were generally obtaining their operating capital from external sources while the smaller producers were obtaining their operating capital from internal sources.

Phase III. This phase was handled in the same manner as phase I, in that all factors payments were netted out of gross revenue. Local resources for investment plus that amount from external sources are as follows.

external sources $753,760.00 .64 percent

internal sources $422,356.42 .36 percent

Again the larger protion of investment and operating funds are provided by external sources.*

Impact on income

To determine the impact on income within the area served by the Moroni Feed Company, a simple economic base type multiplier was used. Multipliers used in this study were originally estimated by Taqieddin in a study of the impact of federal employment on economic activity and population in Utah.[14] He calculated yearly estimates for all years between 1960 and 1970 and also showed the time trend of multipliers by county. Using this information, the multiplier for 1972 was computed as follows. Multiplier 1972 - 2.1569 + 0.0214(13).[15] This resulted in a multiplier

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*See data refinement for determination of funds available.

[14]See source footnote (12), page 20.

[15]Ibid. page 16.

Table 8. Impact on area income, 1972*

Payments \ Phase	I		II		III	
	Internal	External	Internal	External	Internal	External
Wages and salaries	352,230.11	--	495,656.28	--	1,459,469.32	119,188.68
Interest	174,408.68	52,020.00	121,306.75	174,347.05**	159,893.72	46,240.00
Rents	788.18		22,914.01		1,080.86	
Profits	497,475.14		1,609,925.08		422,356.42	
Σ (Summation)	Internal: 1,024,902.11 External: 52,020.00		Internal: 2,249,802.12 External: 174,347.05		Internal: 2,042,800.32 External: 165,428.68	

The internal impact of the multiplier of the three phases would be then:

$5,317,504.55 X 2.4351 = $12,948,655.32

*See appendix for further explanations of Table 8.

**External borrowings rate .5897
Internal borrowings rate .4103

of 2.4351 for the area (Sanpete County) served by the company. The results are presented in Table 8.

The internal impact on income of the multiplier of the three phases would be then: $5,317,504.55 X 2.4351 = $12,948,655.32

This figure is somewhat overstated for two reasons. (1) Much of the activity is internalized within the company thereby overstating the value of the multiplier, and (2) returns to producers were calculated employing the present value of revolving fund credits to be received in five years, thereby overstating returns to producers and understating returns to management.

Taking the figure of $12,948,655.32 determination of the impact on the income of Sanpete County area can be calculated. By comparison with the total personal income figure of $28,900,000 for 1972,[16] the three-phase process accounts for approximately .4480 percent of all income within the Sanpete County area.

If all the capital were supplied internally the impact on income would be $13,902,717.11 on the Sanpete County area, an increase of nearly one million dollars in added benefits.

Demonstration of the proportionate increase from 1971 to 1972 attributable to the feed and processing departments is as follows.

$ 16,338.51	(change in feed production)*
446,734.28	(change in turkey processing)
336,768.11	(change in wage payments)
$ 799,840.90	

[16] Utah Economic and Business Review, Vol. 33, Number 3, March 1973, University of Utah, page 6.

*See appendix for determination of 1971 returns to management.

The figures are indicative of changes in the return to management of the feed and turkey processing departments. The change in wage figure includes both departments.

Applying this figure against the multiplier yields $1,947,692.58. Comparing this amount with the total change of incomes within Sanpete County[17] shows that the company accounts for approximately 34 percent of the change between 1971 and 1972.

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[17] Ibid., page 6.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

The objective of the thesis was examination of factors of production involved within the turkey production and processing industry in Utah. The study was site specific in that all the data were taken from the Sanpete County area. In this respect, it then approaches the form of a case study rather than a more generalized study that could be applicable to other turkey producing areas. In short, the objectives of the study were threefold:

(1) identification of capital inputs and their source

(2) marginal factor share analysis of returns to production factors

(3) impacts of investment and community incomes

The study focused on a three-phase process because of the nature of the agricultural firm under study. These three phases entailed, (1) feed production, (2) turkey production, and (3) turkey processing. The analysis then focused on two methods of reaching the objectives of the study. They were:

(1) production function (estimation) analysis of factor shares

(2) alternative approach

Production function estimation and analysis of factor shares

The form of production function assumed for the study was a Cobb-Douglas function, homogeneous of degree one. Independent variables were identified by interview and analysis of records of the Moroni Feed Company. Four separate computer runs were made for phases I and III

and one run was made for phase II. The runs in phases I and III involved the use of two methods of accounting for technical changes. They were:

(1) Solow treatment of technical change via time trend analysis

(2) Inclusion of a dummy time variable for each technological epoch

Also within phases I and III the capital variable was run in both aggregated and disaggregated forms. The statistical results obtained from phases I and III prompted caution in further use of estimated functions and the marginal factor shares which could be derived from them. Of greater cause for concern were the inconsistent results obtained from those expected based on a priori specification of the model. Many of the beta coefficients expected to be positively associated with value of production had negative signs. Tests to determine homogeneity of degree one and subsequent discussion of factor shares was considered to be somewhat meaningless. Some suggestions are offered later which could prove useful in similar analyses in the future.

The results obtained from phase II production function estimation were much closer to what was expected. The feed and drug variable was by far the most important variable and had been expected to be so. The beta coefficients were summed to .9576 which was not significantly different from one. A more realistic form of the variables would probably have reduced the R^2 for the model, but would provide a means of obtaining closer conformity to the assumptions of interdependence among the "independent" variables in the regression analysis.

Alternative approach

An alternative method was used which approached the problem of estimating factor shares by direct payments to factors of production.

These payments were determined from available data and split out between internal payments to the Sanpete County area and external payments outside the county area. The internal area payments were summed and applied against the county multiplier to show the impact of the income generated. The incremental change in income from 1971 to 1972 was estimated to provide a qualified estimate of the proportion of total change on economic activity which could be attributable to phases I and III.

It is recognized that by going from a production function estimation procedure to estimation of direct factor payments, implies a loss of generality of the study. By approaching the problem using only two years of data, it takes on the appearance of a case study applicable only to the area of the study rather than a more generalized study that could be applied in other turkey production and processing areas in the country.

Recommendations

Within the scope of the study, recommendations will be made in two areas. They are: (1) Specific recommendations to the area of the study in conjunction with phases I, II, III. (2) General recommendations for improvement of the regression analysis to improve any subsequent work in the area.

Area recommendations

Phases I and III: It is recommended that the feed production department expand their capital base. The existence of the large margin or return to management indicates that they could take greater risks in using new capital equipment without endangering the financial structure of the company. Basic in this recommendation is the assumption that increased output realized could and would be purchased by local turkey producers.

The feed department could also take much of the risk associated with new capital equipment used by the processing facility.

Phase II. To the turkey producer, two recommendations are made as follows.

1) Increase herd size. From the data and its results, it appears that higher net revenues are captured by those producers who produce in excess of 200,000 pounds with the highest net revenues captured by those producers who produce more than 400,000 pounds.

2) Increase the capital base of the operation. This would enable more effective utilization of existing labor and coincides with the increase in herd size.

Suggestions for improvement of the regression analysis

A more "general" study of the complete operation of the Moroni Feed Company could possibly have produced more plausible statistical results. This would have greatly enlarged the scope of the problem to be analyzed and a sufficiently longer time period would have been necessary to complete the study.

Phases I and III. Data for phases I and III were obtained from many of the same sources, therefore, suggestions for improvement of both will be included in the same section. A listing of suggestions for improvement with some discussion of each follows.

1) An in-depth study of land values in order that a more realistic value could be placed on the land variable.

2) A more adequate treatment of the labor variable. For example, labor could be broken down by category (management, blue collar, technical, etc.) and estimates of the contribution of each category to output could

be made. This would entail a more complete picture of wages paid out and a sufficient number of observations to provide for statistical analysis.

3) An improved treatment of the capital variable might be assured by a more in-depth study of technical change. Also a more detailed analysis of the depreciation schedule and the varying rates of depreciation could have produced a more accurate measure of the capital input.

4) A statistical estimation of the effect of the time lag between installation of capital equipment and effective realization of returns from that capital.

Phase II: To achieve more significant results in the turkey production analysis, several alternatives are available. To account for the fixed nature of the land variable, land could be approached by using a minimum requirements approach. That is, land usage could be arrayed per bird over the sample and a minimum space requirement determined per bird and a minimum cost requirement determined simultaneously. Then for each operation, a charge could be levied against the operation or any other operation that would more adequately reflect the value of the land variable.

To improve the reliability of the labor variable, a determination of an average wage for a typical turkey producer could be assigned to each producer so that his labor estimates would not be understated.

The main problem with the capital variable and the resulting negative sign was the lack of sufficient data concerning the cost of the capital expenditures. The reliability of the data depends entirely upon the records kept by the individual producers and perhaps if more time had been allowed for the field survey, more accurate data would have been obtained.

It is possible that better results could have been obtained if the feed and poult costs had been separated rather than aggregated.

Finally, a last suggestion would be to run the regression on a per bird basis rather than on a total value basis as was done in this study.

As indicated previously, these are suggestions for further research which could improve the statistical analysis of any further work done in this area.

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APPENDICES

APPENDIX A

Data Refinement

Phase I

Land values were listed at cost without any adjustment being made for inflationary pressures on prices over the period of time covered by the study. Further research showed that additional information was unavailable on the relative increase in value of the land. However, because of the relatively small magnitude of the land variable, it was not deemed relevant to pursue the matter further.

The labor input was determined from the audit reports and by interview with the personnel manager. According to management personnel, it was possible to assume that both seasonal and full time labor were employed on the average of 8 hours per day. These labor figures were then transposed to man-month equivalents by quarter.

The capital investment input was determined by inspection of the capital equipment ledger for the period 1961 to 1972. Each item was listed at cost and summed for each particular year. The original cost of the buildings was also determined from the capital equipment ledger in the same manner.

The magnitude and cost of feed grains used in producing the finished feed product were determined from the audit reports. Figures indicating the total amount of feed produced were obtained from the general manager.

Phase II

An *a priori* determination of the relative size of turkey production operations was necessary in order to conduct the farmer survey. This

information was obtained from hatchery records of the number of poults delivered to each grower during 1972. From this information, a stratification of the growers was constructed, as indicated in the body of this thesis, from which the sample was taken.

Land values were extremely volatile in that most of the growers indicated what they considered to be the present market value of their land. Because of this difficulty, another method of reaching the true value of the land was used. Growers were asked to indicate on a general soils map the approximate location of their farm. From this indicated location, an approximate market price was suggested for each soil type by the Soil Conservation Service, Then this present value of the land was transformed into an annual rental rate per acre and applied against the number of acres the farmer used in his production process. This process is demonstrated as follows.

$$(1) \quad PV = \frac{AR}{i}$$

where PV = present value of the land without water

AR = annual rental

i = interest rate

The interest rate used was determined by consulting bank officials in the area as to the typical loan rates used on land at that period of time. Then solving (1) for AR, we have

$$AR = (PV) \quad (i)$$

Labor costs were also determined by interview with the turkey producers. These costs were reported as numbers of hours per day spent on the production process. Most farmers also employed family labor to a great extent in their operation. In any operation where the wife was employed, it was

assumed she was as effective as the man, and would be paid the same as the man. Children employed were converted into man equivalents using the following.

16 year old = man
15 year old = 7/8
14 year old = 6/8
. . .. . .
. . . . .
. . . . .

The value of the labor then was computed by multiplying the number of hours by $1.83/hour. This figure was the 1972 average per hour farm wage for Utah, according to the Utah Crop and Livestock Reporting Service.

Depreciated value of the capital investment was determined by weighting the original cost of the capital by two different interest rates. One rate reflected the depreciation rate on buildings and equipment while the other, the depreciation rate on tractors, trucks and similar equipment. They were weighted as follows.

.0875 on .84 percent of total capital
.12955 on .16 percent of total capital

Interest rates were again determined by interview with local funding sources.

Feed and drug costs and poult costs were also determined by interview with the turkey producers.

Final output and gross revenue realized by turkey producers was determined by interview and by consultation with processing plant management personnel. The figures used in the analysis were total number of pounds of turkey processed and gross revenue in dollars. It was necessary to add on .15¢ per pound in the case where some of the processed turkey had not been sold and no revenue realized. The fifteen cent figure was determined in conjunction with the processing plant manager who handles the

marketing for the growers. It was assigned on February 15, 1973 in order to process the data on that date. It was also necessary to account for revolving fund credits allocated to the growers on the total poundage of turkeys processed. The Board of Directors declared the dividend to be .0494 cents per pound. Twenty percent of this dividend was allocated out in cash and the remaining 80 percent was assigned to be allocated out in five years. This was handled in the analysis by discounting the remaining 80 percent at the going rate. The grower then is credited with the discounted sum being 55 percent of the allocated value.

Phase III

The only difference between phase I and phase III, data refinement, is the input of live turkeys into phase III is not included in phase I. The number of turkeys processed was obtained from the processing plant manager for the years 1964-1972. Figures previous to 1964 were estimated by the following method.

For example: $\frac{24,787,466}{X} = 20,669$

$X = 1,199,258$

where 24,787,466 = total pounds processed in 1964

20,669 = average pound per turkey over the 1964-1972 period

X = number of turkeys processed in 1964

Figures for 1961-1963 were obtained in similar fashion.

Total value of the output of the processing function consisted of finished turkey and processed by-products. The value of the by-products was obtained from the audit reports in conjunction with interviewing the general manager. The value of the finished turkey product was determined by the following formula obtained from the Statistical Reporting Service.

$$E = L/.81 + \text{processing charge}$$

where

E = eviscerated weight price

L = live weight price

.81 = average grade yield

Eviscerated weight prices were estimated from this formula and applied to the total tonnage of finished turkey product by year. The live weight prices were obtained from the Statistical Reporting Service and the average grade yield by interview with the processing plant manager.

Determination of funds available for investment

To determine the amount of funds available for investment and operation, the external interest was deducted from the amount of the loan outstanding and the remaining amount was added to the return to management determined in Table 6 as follows.

Phase I		Phase III	
$900,000.00 - 52,020.00 =	847,980.00	$800,000.00 - 46,240.00 =	753,560.00
479,475.14		422,356.42	
1,345,455.14		1,176,116.42	

Determination of returns to management phases I and III, 1971

	Feed Production		Turkey Processing	
Net margin	$940,971.00		$246,487.00	
minus 20% allocations	181,556.00		47,636.00	
	759,415.00		198,851.00	
plus wages & salaries	229,644.00		1,364,476.00	
Gross Revenue	989,059.00		$1,563,327.00	
*Internal interest expense	155,084.07		153,890.13	
**External interest expense	122,406.12		68,238.00	
Rents	788.18		1,080.86	
Wages & salaries	229,644.00		1,364,476.00	
	$507,922.37		$1,587,684.86	
Return to management	$481,136.63	.4856	-$24,377.86	-.0156

*internal interest rate = .0542 **external interest rate = .0612

Further explanation of Table 8

Phase II. To determine net profits to all growers in the Sanpete County area, total tonnage produced by those sampled was summed and each strata's proportion of total product was calculated. The resulting percentage was applied against the total production of all growers and that figure multiplied by the net profit figure for the respective strata.

	Strata I	Strata II	Strata III
Pounds on sample	2,483,428	4,164,657	7,759,098
Percentage	.1723	.2891	.5386
Total pounds produced by all growers		38,868,265	
Pounds	6,697,002.06	11,236,815.41	20,934,447.53
Net profit/lb.	.0356/lb.	.0412/lb.	.0434/lb.
Total net profit	$238,413.27	$462,956.79	$908,555.02
Summed	$1,609,925.08		

Phase II. Wages and salaries, interest and rent payments were determined by using the cost figures per strata from Table 7 and applying these figures against the total tonnage produced by each strata and expanded to include the entire population.

Phase III. Determination of external wages and salaries was obtained by interview with the personnel manager of Moroni Feed Company. It was estimated that .0755 percent of wage and salaries of the processing department left the area.

APPENDIX B

Further explanations on Solow's treatment of technical change

$$k = K/L$$

$$\bar{f}(k) = 1/L\ f(K,L)$$

$$f_k = \frac{\partial f(k)}{\partial k} = \frac{\partial f(K/L,\ 1)}{\partial k} = \frac{\partial f}{\partial K} = f_k \quad \therefore \bar{f}_k = f_K$$

(8) substituting into 6 $\quad \frac{\dot{q}}{q} = \frac{\dot{A}}{A} + \frac{f_K \dot{k}}{1/L f(K,L)}$

then define $W_k = \frac{\partial Q}{\partial K} \cdot \frac{K}{Q}$

$$W_k = AfK \cdot \frac{K}{A\ f(K,L)} = \frac{f_K K}{f(K,L)}$$

$$\frac{W_k}{K} = \frac{f_k}{f(K,L)}$$

substituting into 8

$$\dot{q}/q = \frac{\dot{A}}{A} + \frac{W_k}{K} \quad \frac{\dot{k}}{1/L}$$

by manipulation

$$W_K \frac{\dot{k}}{K/L} = W_K \frac{\dot{k}}{k}$$

leads to $\quad \dot{q}/q = \frac{\dot{A}}{A} + W_K \frac{\dot{k}}{k} \equiv (7)$

APPENDIX C

Turkey producer questionnaire

Name _____

Address _____

Operational Data

1. Size and location of operation--average # turkeys _____, farm location _____

   a. Type of bird and number
      Broad white tom _____ Heavy white tom _____
      Broad white hen _____ Heavy white hen _____
      Brooding period _____

2. Inputs

   a. Land - acreage used for turkey production _____
      approximate value of land $ _____

   b. Labor

	Number of Days	Amount Paid	Month
Own	#		
Family	#		
Hired	#		
Extra	#		

   c. Capital (initial cost) $ _____, Source of borrowed capital _____
      _____ Designate that proportion of total capital allocated to the turkey enterprise _____ %

   d. Feed and drug cost $ _____

   e. Poult cost $ _____

3. Output - total production, past two years, and proposed production, 1973.

	1971	1972	1973	pounds storage (1972)
a. Number of pounds produced				
b. Gross revenue/lb. (includes revolving fund credits)				

All information will be held in confidence.

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