ESTIMATION OF MULTICROP PRODUCTION FUNCTIONS FOR SOUTHWEST KANSAS

by

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INTRODUCTION

Agriculture on the High Plains of Southwest Kansas has been undergoing changes during the past decade. Agriculture there, since WW II, had become increasingly more dependent upon irrigation, until recently when the trend reversed. Crops that have been irrigated are corn, grain sorghum, wheat, alfalfa and, more recently, soybeans. With declining groundwater supplies in the Ogallala aquifer and rising input prices--particularly for energy sensitive inputs such as fuel, fertilizer, and chemicals--profit margins have been squeezed some certain irrigated production practices have declined in profitability as compared with alternative practices.

In the past decade farmers in Southwest Kansas have reduced their acreage in irrigated corn by changing to crops requiring less irrigation and by returning to dryland production. The reduction in irrigation is also occurring in the panhandle of Oklahoma, which is just south of the study area. Harris and Mapp, using a stochastic dominance model, studied which irrigation strategy is most efficient for the panhandle of Oklahoma. They concluded that intensive irrigation of 24 acre-inches is inefficient for grain sorghum production and propose using an alternative irrigation strategy that irrigates when available soil water is depleted to 45% of maximum available. This is just one example of transitions away from intensive irrigation.

The main objectives of this thesis are to study the transitions that are occurring in Southwest Kansas crop production and to estimate a management variable which measures the productive efficiency of the producers. Those objectives are accomplished by estimating production functions for the seven major crops produced in the study area, which are; irrigated wheat, dryland wheat, irrigated corn, irrigated grain sorghum, dryland grain sorghum, irrigated alfalfa, and irrigated soybean production. Then the estimated parameters from those production functions are used to study the transitions between crops and are used to create a weighted average management variable. By estimating production functions and estimating a management variable the hypothesis that constant returns to scale in the production of crops and economies to size in the output market exists will also be tested.

CHAPTER II

DESCRIPTION OF THE STUDY AREA

The study area is that part of Southwest Kansas which is the territory for Association III of the Kansas Farm Management Associations. Geographically, it ranges from the eastern edge of Barber County west to the Colorado border and from the northern edge of Lane County south to the Oklahoma border (Figure 1).

The average annual precipitation ranges from less than 18 inches on the west to more than 24 inches in Barber County on the southeast (Figure 2). Average precipitation during the summer growing season ranges from 12 inches at the western edge to 18 inches at the eastern edge of the study area. Such precipitation is less than the amount of moisture required to successfully produce corn, soybeans, and alfalfa. For that reason those crops are irrigated when raised in this area. The other crops--wheat and grain sorghum--can be produced with little or no irrigation, but respond to irrigation. Those two crops consume less water and are more drought tolerant, while dryland wheat production remains the dominant crop in Southwest Kansas.

The percentage of total crop acres irrigated has been decreasing since 1975 (Figure 3). Prior to 1975, the percentage of total crop acres irrigated was increasing. The heavy pumping of groundwater from the Ogallala aquifer has been lowering the water table in the aquifer. During 1974, the price of petroleum rose drastically, resulting in the price of petroleum related inputs to increase. Those two events caused the pumping costs of irrigating to increase substantially, initiating the

Figure 1

KANSAS FARM MANAGEMENT ASSOCIATIONS

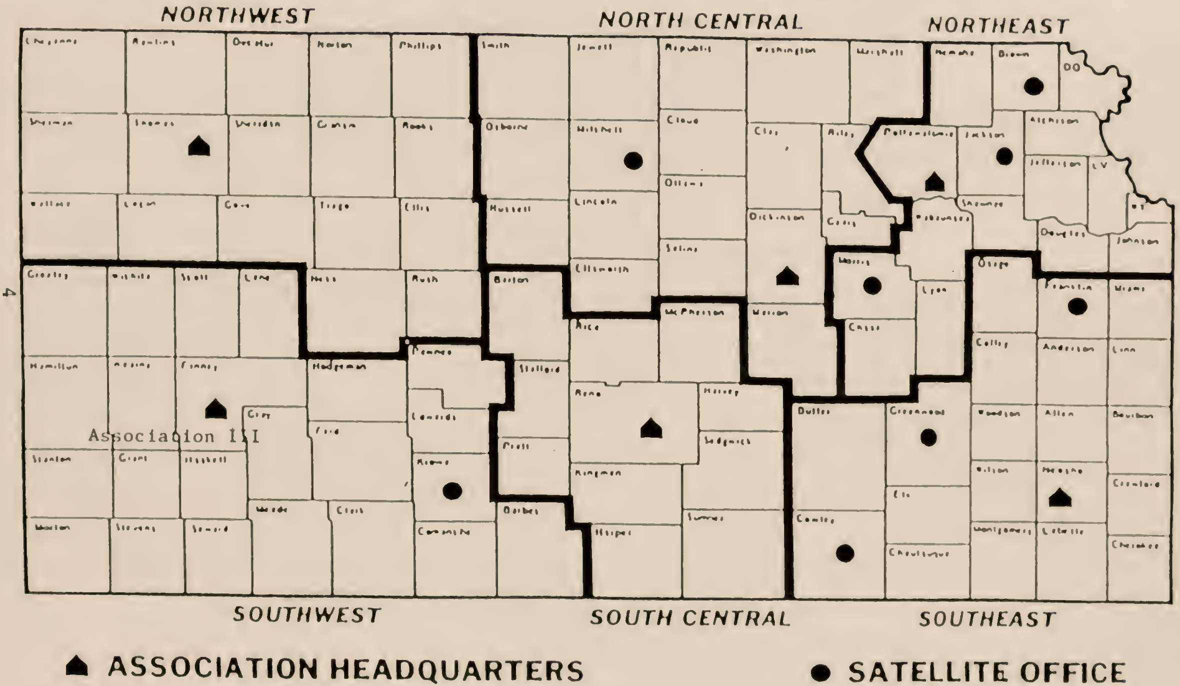


Figure 2

Average Precipitation in Kansas

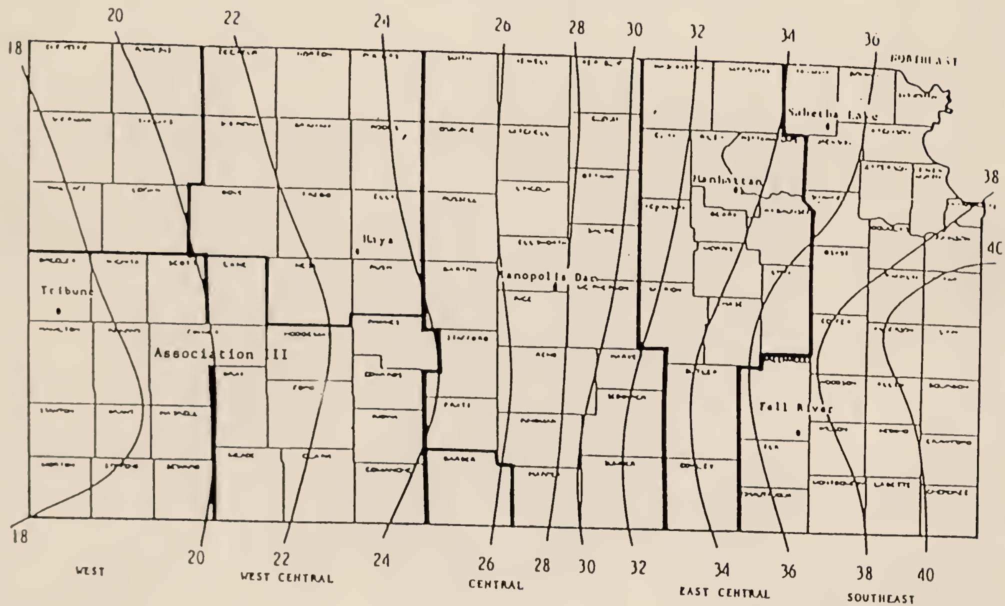
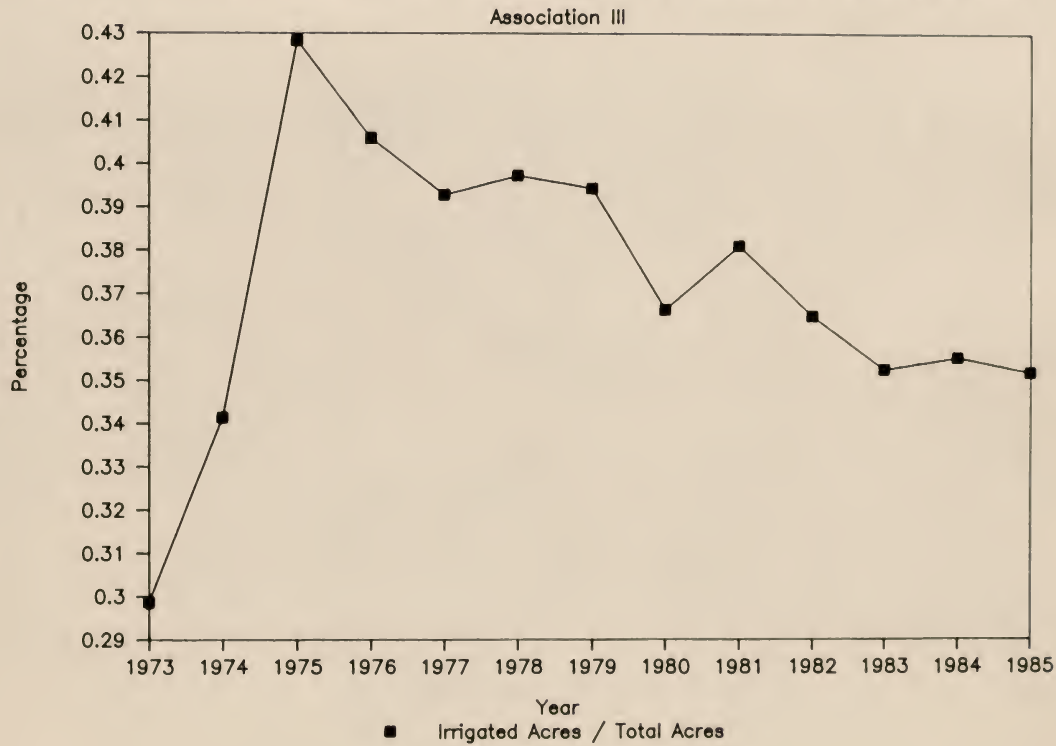


Figure 3

Percent of Total Crop Acres Irrigated



beginning of the downward trend in cropland acres irrigated. From 1975 to 1985 the percent of total crop acres irrigated decreased by about 19%.

Irrigated corn production has been the crop most affected. In 1984 only 8% of the cropland was devoted to irrigated corn production compared to 21% in 1976. Some of the land taken out of irrigated corn production was converted to irrigated grain sorghum and irrigated wheat production, crops requiring less water (refer to Figures 4 - 10 for production trends).

Relative to the price of feed grains--corn and grain sorghum--the price for wheat in Southwest Kansas has been decreasing since 1980. For that reason acres in dryland grain sorghum has been increasing since 1980, while dryland wheat production has been decreasing. Between 1980 and 1985 dryland wheat production has decreased from about 54% to 47% of total crop acres while dryland grain sorghum increased from 7% to 17% of total crop acres.

Irrigated alfalfa and irrigated soybean production have been in a general upward trend since 1976. The price for alfalfa hay in Southwest Kansas has also been trending upward during the same time period. Soybeans are a relatively new crop for the study area with the percentage of total crop acres steadily rising. From 1976 to 1985 irrigated alfalfa production increased from 1.4% to 2.7% of total crop acres, while irrigated soybean production increased from 0.5% to 2.3% of total crop acres.

At the same time the average farm size in Southwest Kansas has been increasing steadily since 1973 (Figure 11). The average farm size rose from 588 acres in 1973 to 667 acres in 1985. With the average farm size

Figure 4

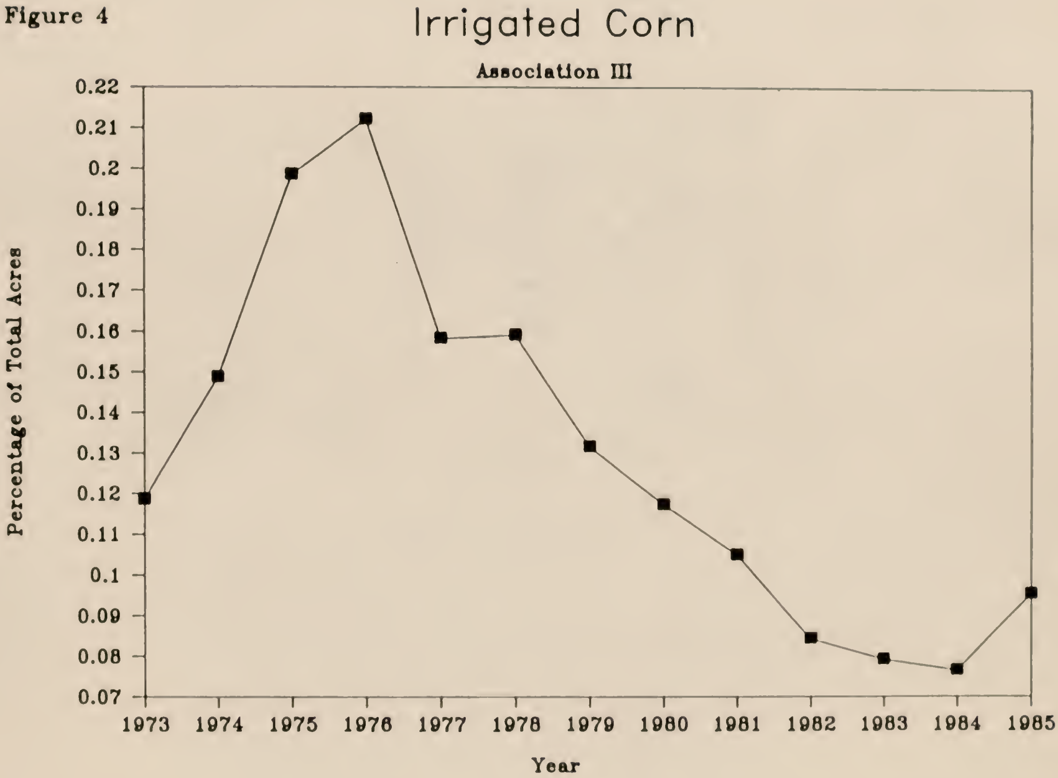

Irrigated Corn
Association III
Percentage of Total Acres
0.22
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
Year

Figure 5 Dryland Grain Sorghum

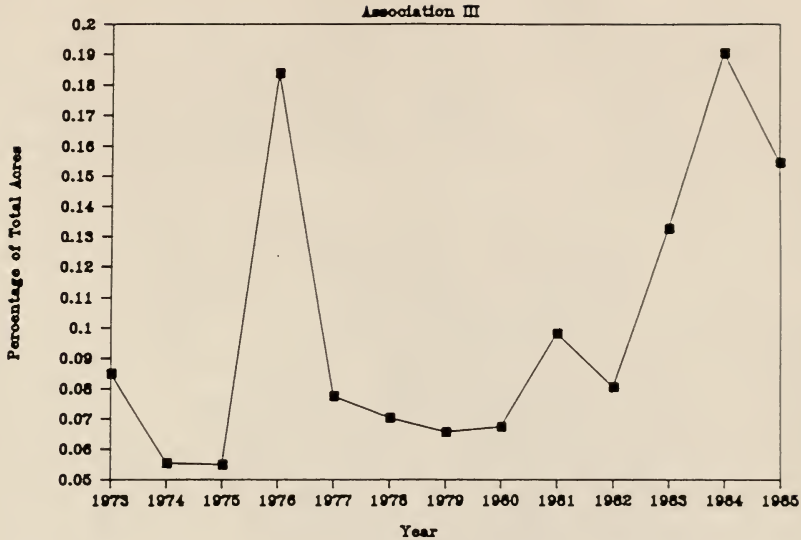


Figure 6 Irrigated Grain Sorghum

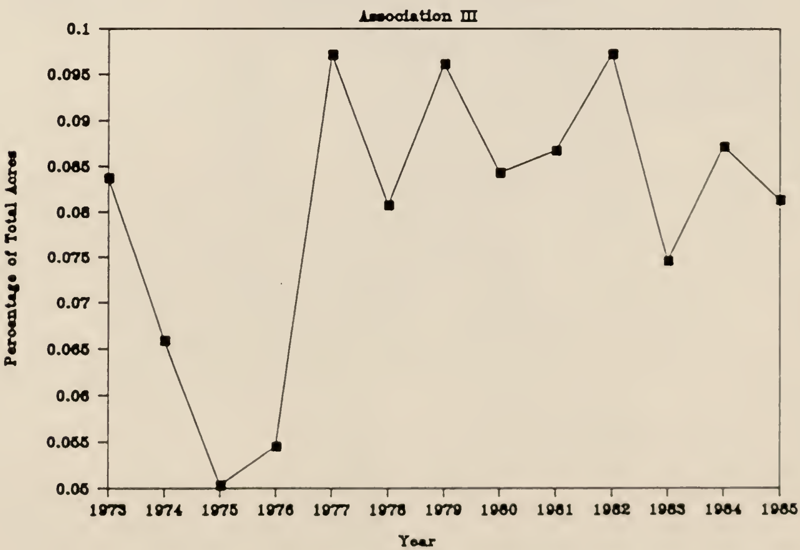


Figure 7

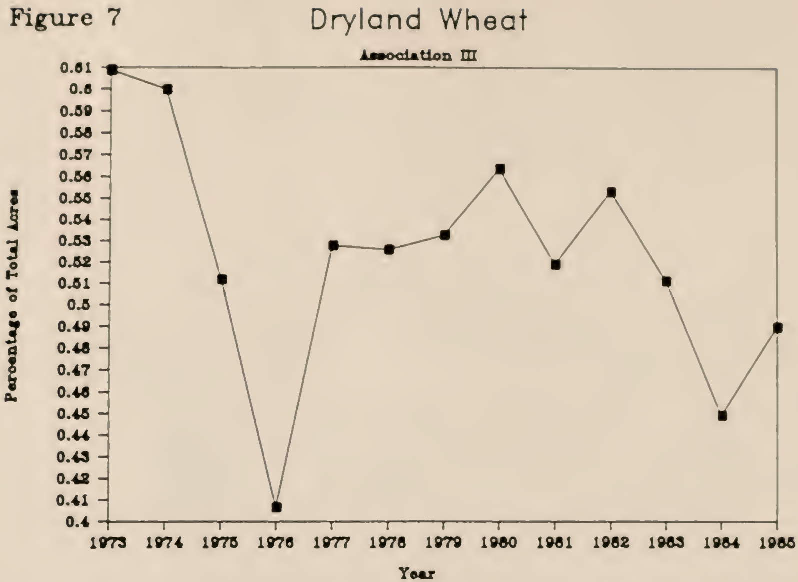


Figure 8

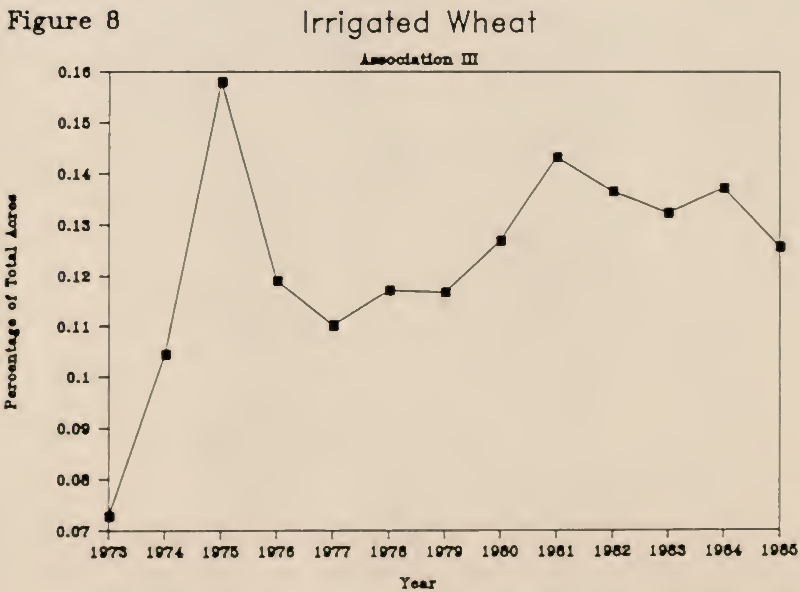


Figure 9

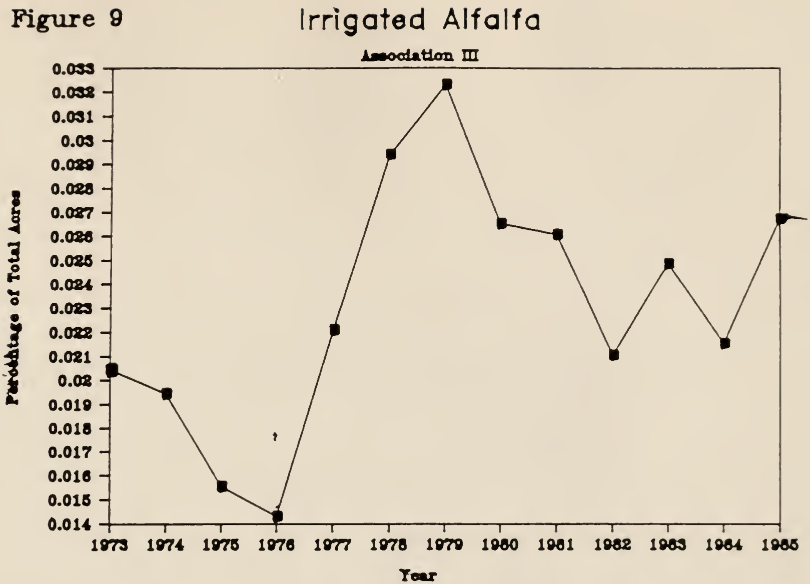


Figure 10

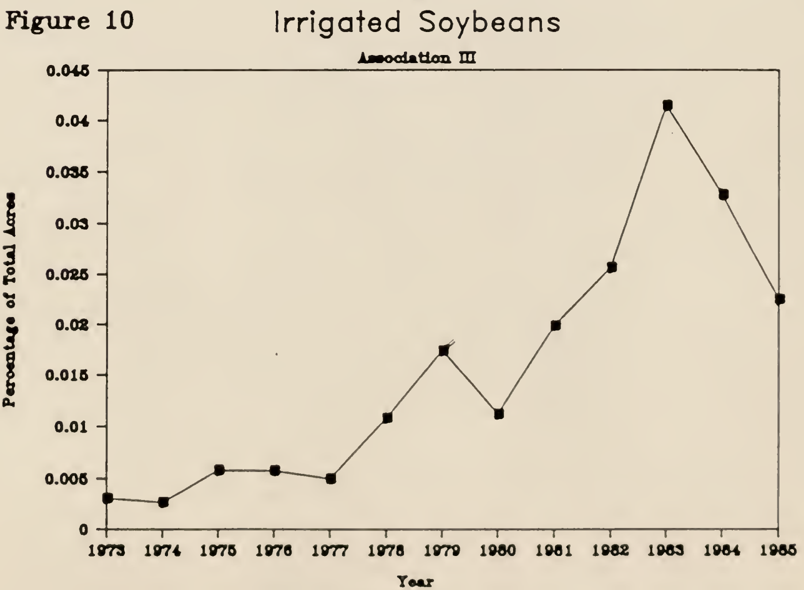
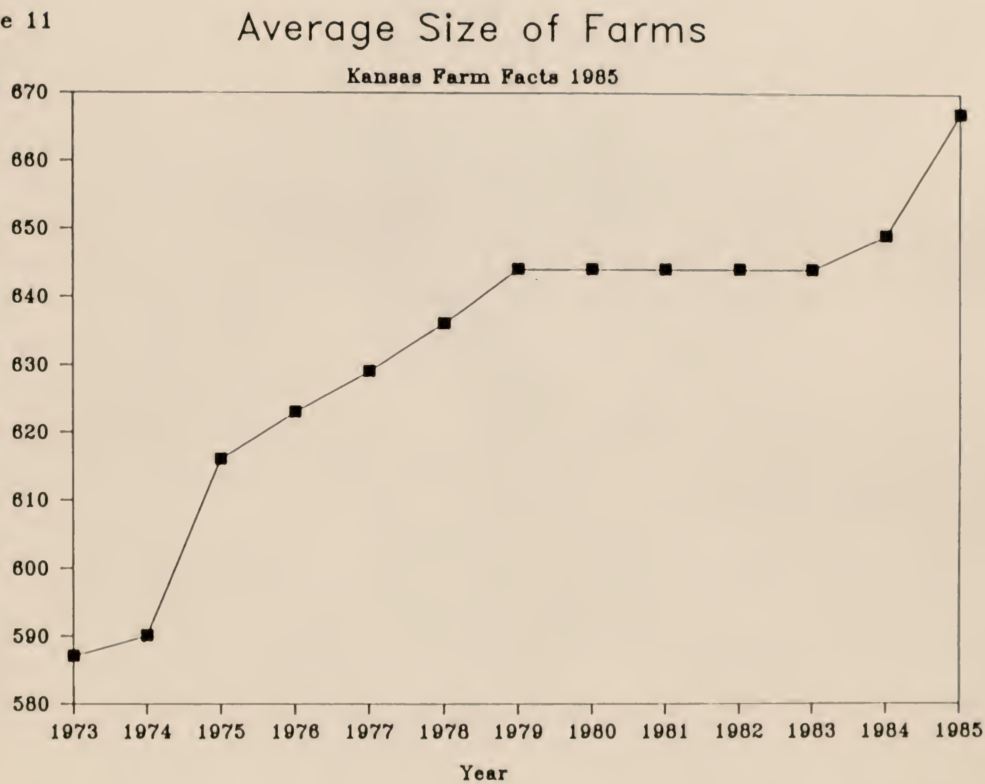


Figure 11



Average Size of Farms
Kansas Farm Facts 1985
670
660
650
640
630
620
610
600
590
580
Acres per Farm
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
Year

increasing the total number of producers has been decreasing. This upward trend in farm size indicates increasing economies to size in either Kansas farm production or marketing.

In summary, there is a definite transition away from production of crops that require large amounts of water, such as corn, to crops that require less water and are more drought tolerant such as grain sorghum and wheat. Acreage in irrigated alfalfa and irrigated soybean production have increased, but those additional acres are small when compared with total crop acres.

CHAPTER III

REVIEW OF THE LITERATURE

In this chapter I review some of the literature on estimation of production functions and on input and output economies to size. A previous study by Orlan Buller, "Ogallala Aquifer Study in Kansas Linear Programming Model", used a linear programming model to project what changes in production practices would occur under different scenarios. That study does not look at what is actually occurring in production today--with changing prices and technology--which is what I am studying in this thesis. For this reason the topic of transitions towards dryland or limited irrigation production is not included in this chapter.

Estimation of production functions

Earl O. Heady and John L. Dillon argued that when formulating an economic model the three main tasks facing the researcher are 1) to decide whether a single equation or a system of equations is appropriate, 2) to choose the set of variables that are relevant to the model, and 3) to form hypotheses to be tested concerning the functional form of the equation(s).

To decide whether to use a single equation or a system of equations, one needs to determine if the production process can be satisfactorily represented by a single unilateral causal relationship between inputs and output if a system of equations is needed. Ideally, all variables that affect the production process should be included in the model, but this is never the case. A variable may be excluded because it is an unobservable variable for which no good proxy is available or because the number of variables used must be restricted in order to assure a reasonable level of degrees of freedom. Lastly, when choosing a functional form for the production function the researcher must attempt to take account of whatever is known about the production process. Also the function must be computationally manageable, both for estimation and testing. When choosing a functional form, sometimes the data will show the shape of the function, such as linear or quadratic, for the relevant range.

Just, Zilberman, and Hockman reported on evaluated different functional forms for estimating multicrop production functions. Functional forms considered were the general Cobb-Douglas, the constant elasticity of transformation, and the constraint structure of a programming model. Equations (1), (2), and (3) show these functional forms respectively.

1) $y_1 y_2^{\delta} = \alpha 0 x1^{\alpha 1} x2^{\alpha 2} x3^{\alpha 3}$ where α is a constant

2) $(\delta_1 y_1^c + \delta_2 y_2^c)^{1/c} = g(x_1, x_2, x_3)$

3) $Ay \leq x$

Equations (1) and (2) have some undesirable properties. Both of these equations suggest that if one input is increased on one crop, then the quantity of either crop can be increased. An example of this unrealistic condition is that of a farmer producing both corn and grain sorghum who by increasing the acres in corn production could increase either corn or grain sorghum output.

Just et al. noted that to use the programming model, in the form of equation (3), one needs to know the amount of each input is used to produce that crop. This poses some limitations when using non-experimental data, since the variable inputs may not be observed by crop.

When estimating multicrop production functions, one needs to determine if jointness exists between the crops production processes. Frisch argues that there are basically three different types of jointness in production: 1) direct jointness in products such as production of wool and mutton, 2) indirect jointness in where the quantity of product x is a technically given function of the quantity of product y and the quantity of product y is a technically given function of the quantity of product z, and 3) jointness due to use of allocatable fixed inputs when producing several products, such as producing several crops with a fixed amount of land. In this thesis I am estimating production functions for seven crops that all compete with each other for the variable inputs such as fertilizer, fuel, and pesticides and for one allocatable fixed input--land. Jointness does exist between the production functions in this thesis since all the crops are competing for an allocatable fixed input--land--by definition 3. Shumway, Pope, and Nash examined the question of jointness and the problems when estimating production functions if jointness exists. They suggest that if jointness exists, then separate production functions cannot be written. With jointness between production processes a multiple-product structure must be used, because of cross-equation restrictions and correlation. Shumway et al. propose using a seemingly unrelated (SUR) multiple-product system incorporating those restrictions to estimate the production functions.

Just et al. addressed the same problem and suggested using a system of simultaneous equations to estimate the variable inputs used by each crop and the multicrop production functions. They used a Cobb-Douglas production function. Their model can be derived as follows.

NOTATION:

a) y_{ikt} = Output crop k, farmer i, in time t.
b) x_{ijkt} = Input, j,for crop, k, of producer, i, in time ,t.
c) α_{jk} = Production elasticities for input, i, on crop, k.
d) β_{kt} = Technology/weather effect for crop, k, at time, t.
e) γ_k = Effect of human capital on producing crop, k.
f) m_i = Management variable for producer, i.
g) $\epsilon_{ijkt}^{x \text{ or } y}$ = This is a stochastic error term for output/input, whichever is denoted by superscripts. Subscripts define if for i, j, k, t or a combination of them.
h) r_{ikt} = Gross returns of crop, k, for producer, i, in time, t.
i) w_{ijt} = The price of input, i, for crop, j, in time, t.
j) P_{ikt} = The price of crop, k, for producer, i, in time, t.

Equation (1) demonstrates the generalized production function.

$$(1)\quad y_{ikt} = \prod_{j=1}^{J} x_{ijkt}^{\alpha_{jk}} \, e^{\beta_{kt} + \gamma_k m_i + \epsilon_{ikt}^{y}}$$

The production function, (1), is placed into a Lagrangean function as shown in Equation (2).

$$(2)\quad L = \max \sum_{k=1}^{K} P_{ikt}\, y_{ikt} - \sum_{j=1}^{J} w_{ijt}\, x_{ijt}$$

$$- \sum_{k=1}^{K} \lambda_{ikt} \left\{ y_{ikt} - \prod_{j=1}^{J} x_{ijkt}^{\alpha_{jk}} \, e^{\beta_{kt} + \gamma_k m_i + \epsilon_{ikt}^{y}} \right\}$$

$$- \sum_{j=1}^{J} \phi_{ijt} \left(\sum_{k=1}^{K} x_{ijkt} - x_{ijt} \right)$$

Now the first order conditions (FOC) are derived for equation (2) and set equal to zero. They are as follows:

FIRST ORDER CONDITIONS:

FOC1: $\partial L/\partial y_{ikt} = P_{ikt} - \lambda_{ikt} = 0$

FOC2: $\partial L/\partial x_{ijt} = - w_{ijt} + \phi_{ijt} = 0$

FOC3: $\partial L/\partial x_{ijkt} = \lambda_{ikt}\, \partial f/\partial x_{ijkt} - \phi_{ijt} = 0$

FOC4: $$\partial L/\partial \lambda_{ikt} = \prod_{j=1}^{J} x_{ijkt}^{\alpha_{jk}}\, e^{\beta_{kt} + \gamma_k m_i + \epsilon_{ikt}^{y}} - y_{ikt} = 0$$

FOC5: $$\partial L/\partial \phi_{ijt} = x_{ijt} - \sum_{k=1}^{K} x_{ijkt} = 0$$

NOTE1: $\partial f/\partial x_{ijkt} = MPPx_{ijkt}$

$$\partial f/\partial x_{ijkt} = \alpha_{jk}\, x_{ijkt}^{\alpha_{jk-1}}\, e^{\beta_{kt} + \gamma_k m_i + \epsilon_{ikt}^{y}}$$

$$= \alpha_{jk} \frac{x_{ijkt}^{\alpha_{jk}}\, e^{\beta_{kt} + \gamma_k m_i + \epsilon_{ikt}^{y}}}{x_{ijkt}}$$

[N1] $$\partial f/\partial x_{ijkt} = \alpha_{jk} \frac{y_{ikt}}{x_{ijkt}} = MPPx_{ijkt}$$

FOC1 shows that $P_{ikt} = \lambda_{ikt}$.

FOC2 shows that $w_{ijt} = \phi_{ijt}$.

By substituting [N1] and the previous two findings into equation FOC3, they derive the following equation.

$$P_{ikt}\, \alpha_{jk} \frac{y_{ikt}}{x_{ijkt}} - w_{ijt} = 0$$

Where $P_{ikt}\, y_{ikt} = r_{ikt}$ (gross returns)

By rearranging and substitution, equation (3) is obtained.

$$(3)\quad \alpha_{jk} \frac{r_{ikt}}{x_{ijkt}} = w_{ijt}$$

$$(4)\quad x_{ijkt} = \alpha_{jk} \frac{r_{ikt}}{w_{ijkt}}$$

Equation (4) gives the profit maximizing values for the variable inputs. Next, the inputs are summed for all crops, since x_{ijkt} is unobserved, to derive equation (5).

$$(5)\quad \sum_{k=1}^{K} x_{ijkt} = \sum_{k=1}^{K} \alpha_{jk} \frac{r_{ikt}}{w_{ijt}}$$

By substituting equation (5) into FOC5 , equation (I) is derived. This is the first equation of the system of equations developed by Just et al..

$$(I)\quad x_{ijt} = \sum_{k=1}^{K} \alpha_{jk} \frac{r_{ikt}}{w_{ijt}} + \epsilon_{ijt}{}^{x}$$

Now, by using the MRS for an input used for two different crops, the second equation, (equation II), in the system of equations is derived. By rearranging equation (3) the following is produced.

$$w_{ijt}\, x_{ijkt} = \alpha_{jk}\, r_{ikt}$$

Consider substitution between crops k and κ, using equations (6) and (7).

$$(6)\quad w_{ijt}\, x_{ijkt} = \alpha_{jk}\, r_{ikt}$$

$$(7)\quad w_{ijt}\, x_{ij\kappa t} = \alpha_{j\kappa}\, r_{i\kappa t}$$

To calculate the MRS they divide equation (6) by equation (7).

$$MRS = \frac{w_{ijt}\, x_{ijkt}}{w_{ijt}\, x_{ij\kappa t}} = \frac{\alpha_{jk}\, r_{ikt}}{\alpha_{j\kappa}\, r_{i\kappa t}}$$

By rearranging terms and canceling the following is found.

$$x_{ijkt} = \frac{\alpha_{jk}\, r_{ikt}\, x_{ij\kappa t}}{\alpha_{j\kappa}\, r_{i\kappa t}}$$

Take the natural log of the preceding equation to generate equation (II) of the system of equations.

$$\text{(II)} \qquad \ln x_{ijkt} = \ln \alpha_{jk} - \ln \alpha_{j\kappa} + \ln \left\{ \frac{r_{ikt}\, x_{ij\kappa t}}{r_{i\kappa t}} \right\} + \epsilon_{ijkt}{}^{x}$$

To solve for the third equation (equation III) in the system of equations, they take the natural log of equation (1). This transformation changes equation (1) into an functional form that can be estimated.

$$\ln y_{ikt} = \sum_{j=1}^{J} \alpha_{jk} \ln x_{ijkt} + \beta_{kt} + \gamma_k m_i + \epsilon_{ikt}{}^{y}$$

Next the variable and fixed inputs are separated into two different categories.

$$\text{(8a)} \qquad \ln y_{ikt} = \underbrace{\sum_{j=1}^{f} \alpha_{jk} \ln x_{ijkt}}_{\text{fixed inputs}} + \underbrace{\sum_{j=f+1}^{J} \alpha_{jk} \ln x_{ijkt}}_{\text{variable inputs}} + \beta_{kt} + \gamma_k m_i + \epsilon_{ikt}{}^{y}$$

From equation (4), the profit maximizing values of the variable inputs are known. By taking the natural log of equation (4) the following equation is generated.

$$\ln x_{ijkt} = \ln \alpha_{jk} + \ln \left\{\frac{r_{ikt}}{w_{ijt}}\right\}$$

By substituting this result into equation (8a), (8b) is derived.

$$\text{(8b)} \qquad \ln y_{ikt} = \sum_{j=1}^{f} \alpha_{jk} \ln x_{ijkt} + \sum_{j=f+1}^{J} \alpha_{jk} \left\{\ln \alpha_{jk} + \ln \left(\frac{r_{ikt}}{w_{ijt}}\right)\right\} + \beta_{kt} + \gamma_k m_i + \epsilon_{ikt}^{y}$$

By setting $\hat{\beta}_{kt} = \beta_{kt} + \Sigma\, \alpha_{jk} \ln \alpha_{jk}$ and substituting $\hat{\beta}_{kt}$ into equation (8b), the third equation (equation III) of the system of equations is derived.

$$\text{(III)} \qquad \ln y_{ikt} = \sum_{j=1}^{f} \alpha_{jk} \ln x_{ijkt} + \sum_{j=f+1}^{J} \alpha_{jk} \ln \left\{\frac{r_{ikt}}{w_{ijt}}\right\} + \hat{\beta}_{kt} + \gamma_k m_i + \epsilon_{ikt}^{y}$$

The final equation (equation IV) of the system of equations is obtained by rearranging FOC5.

$$\text{(IV)} \qquad x_{ijt} = \sum_{k=1}^{K} x_{ijkt}$$

The four equations derived by Just et al., equations (I) through (IV), are shown below as a system of equations.

$$\text{(I)} \quad x_{ijt} = \sum_{k=1}^{K} \alpha_{jk} \frac{r_{ikt}}{w_{ijt}} + \epsilon_{ijt}^{x}$$

$$\text{(II)} \qquad \ln x_{ijkt} = \ln \alpha_{jk} - \ln \alpha_{j\kappa} + \ln \left\{ \frac{r_{ikt}\, x_{ij\kappa t}}{r_{i\kappa t}}\right\} + \epsilon_{ijkt}^{x}$$

$$\text{(III)} \quad \ln y_{ikt} = \sum_{j=1}^{f} \alpha_{jk} \ln x_{ijkt} + \sum_{j=f+1}^{J} \alpha_{jk} \ln \left\{ \frac{r_{ikt}}{w_{ijt}} \right\} + \hat{\beta}_{kt}$$

$$+ \gamma_k m_i + \epsilon_{ikt}{}^{y}$$

$$\text{(IV)} \quad x_{ijt} = \sum_{k=1}^{K} x_{ijkt}$$

Just et al. applied this system of multicrop production functions to non-experimental data from farms in Israel. The data consisted of seventy small family farms for a time period of 1977 to 1980. They conclude that this method of estimating multicrop production functions is practical and generates reasonable estimates.

For the management variable in equation III Just et al. used the farm advisor panel rating of each producer. Earl O. Heady and John L. Dillon found three major disadvantages to using such a management variable. They are 1) such a variable may not distinguish between knowledge and entrepreneurial logic, 2) it may measure the management potential or capability but not the actual management input over the production period being analyzed, and 3) it suffers from the fact it incorporates subjective elements. Heady et al. suggested using the residuals from the estimated production function. If the residual is positive then management is above average and if the residuals are negative then management is below average.

Input and Output Economies to Size

Another objective was to determine if economies to size exists for the whole farm operation even if there are no economies to scale in production. Are there economies to size in the purchase of inputs and the sale of outputs? Past studies have found evidence of such economies.

Smith, Knutson, and Richardson found that although discounts for purchasing large quantities of inputs may exist, in reality only 38% of the suppliers of fuel, seed, herbicide, fertilizer, and machinery offer such discounts and the quantity that is needed to be eligible for those discounts is so small that few farmers are not eligible for the discounts. Suppliers recognize that it costs less to sell to a few large operations rather than selling to a large number of small operations, but those suppliers indicated that if they were to give discounts to the large farms, discontent would arise among farmers not eligible. For those reasons, Smith, et al. conclude that there are no economies to size in the purchase of inputs.

Another possible economy of the large operation would be having an advantage in marketing the output. Feder and Slade found that the larger farms allocate more resources to gathering market information which should give the larger farms a marketing advantage. More information will generate better expectations and reduce risk. Krause and Kyle conclude that, in 1969, the larger corn farmers could receive up to $5.00 per acre more for their crop. Another study by Krenz, Heid, and Sitler showed that, in 1970, the larger wheat farmers received about 4.5 cents per bushel more than the smaller scale farmers. Smith, Knutson, and Richardson found that in Texas, cotton producers with more than 1600 acres were able to market their 1979-80 cotton lint for significantly higher prices than producers with less than 1600 acres. The farms with 2,561 to 4,000 acres of production, received nearly 7% higher prices than those with less than 640 acres.

Smith et al. conclude that economies to size do exist, even though they seem quite small on a per unit basis. They went on to study why the larger farms received higher prices for their products. They reported that there is a premium of only 0.25 to 0.50 cents per pound for marketing over 100 bales of cotton in one lot. Farmers that sold directly to the shipper received premiums of up to 0.50 cents per pound. Only 14.7% of the 1979-80 cotton crop was contracted, but 41% of the cotton produced by farms of size over 4,400 acres was contracted. It was concluded that they could not determine why the larger farms received higher prices. One hypothesis is that the larger farmers had more time to spend on the marketing aspect of the operation. In 1981, the cotton farms with over 4,400 acres increased net revenue from integration and marketing economies by an estimate of $65,000 and for the mid sized farms with 1,601 to 2,560 acres was increased by $17,000.

CHAPTER IV

METHOD OF ANALYSIS

One of the most common problems encountered when estimating multicrop production functions from non-experimental data is the missing data on variable inputs used by each crop. Few if any of the farms in Association III do enterprise accounting. Because of that the only cost information available is the total cost of each major category of inputs used on the farm. The solutions to this and other problems are explained in the following sections of this chapter.

This chapter is divided into two sections. The first section, Description of the Data Set, describes in detail the data and its collection. The second section, Derivation of the Model, derives the model and demonstrates how the parameters generated from the model are used to measure the productive efficiency of each operator and how they are used to study transitions in production practices in Southwest Kansas.

Description of the Data Set:

The data used in this thesis are the crop production data recorded by the farmer-members of Kansas Farm Management Association III. The territory of Association III covers twenty-three counties in Southwest Kansas. The data are compiled on a yearly basis by the Department of Agricultural Economics, Kansas State University and stored on the Kansas Farm Management Data Bank. The farms used in the analysis are those for which crop production data were recorded for each of the thirteen years from 1973 to 1985.

The data obtained from the Kansas Farm Management Data Bank for each farm for each of the thirteen years were 1) acres in each crop, 2) production of each crop, 3a) total farm crop expenses on fertilizer, 3b) on fuel, 3c) on pesticides, and 3d) on other purchased inputs. Because I am interested in the transition from irrigated to dryland production, I treated dryland production as a separate crop from irrigated production of the same crop. Seven different crops--when distinguishing between irrigated and dryland production--are grown by the farms in the sample, but few farms raise all seven crops. The crops are: irrigated wheat, dryland wheat, irrigated corn, irrigated grain sorghum, dryland grain sorghum, irrigated alfalfa hay, and irrigated soybeans.

Crop prices were obtained from the Kansas Crop and Livestock Reporting Service. The prices received for a crop produced using irrigation is no different than the price received if produced without irrigation. Crop prices used were seasonal average prices for Southwest Kansas. The prices for fertilizer and fuel were collected from the U.S.D.A. "Agricultural Prices". Those were average prices paid by producers in Kansas. Fertilizer prices are in dollars per ton and fuel prices are in dollars per gallon. Because prices for pesticides could not be obtained for the whole time period of 1973-1985, I used the producers price index for agricultural chemicals as published in the "Wholesale Price Indexes". All of the prices were deflated to 1982 dollar values.

The Kansas Farm Management Data Bank has a variable for the farm cash operating expense for machinery repairs and irrigation expense. An input price could not be estimated for irrigation expense and machinery repairs combined, thus the variable, fuel, was used to measure the differences in costs between dryland and irrigated production. In doing so I assumed that there is positive correlation between fuel consumption and water applied.

Time dummy variables were used to measure technology and weather changes over the years. Time dummy variables shift the regression plane in parallel shifts upward or downward to compensate for weather and/or technological changes over time. In year t, T_t is equal to one, else T_t is equal to zero.

Dummy variables are included to measure differences in production function response among farmers. I attributed those differences to differences in management on the farms. I-1 dummy variables were used, one variable for each farm except for the one farm against which all differences were measured. For the I-1 management variables, the variable M_i was set equal to one when the observation was for farmer i and to zero otherwise. The coefficient on each dummy variable measures how much, on average, output of that farm differed from the output of the base farm after all other factors in the production function had been accounted for. The use of dummy variables to measure management effects overcomes the three major problems identified by Heady et al. when using as a management variable some rating of each producer.

Derivation of the Model:

The model used in this study is a modified version of the Just et al. model presented the Review of the Literature. The following shows the system of equations used in this study to estimate the production functions.

$$\text{(V)} \qquad x_{ijt} = \sum_{k=1}^{K} \alpha_{jk} \frac{r_{ikt}}{w_{ijt}} + \epsilon_{ijt}^{x}$$

$$\text{(VI)} \qquad \ln y_{ikt} = \sum_{j=1}^{f} \alpha_{jk} \ln x_{ijkt} + \sum_{j=f+1}^{J} \alpha_{jk} \ln \left\{ \frac{r_{ikt}}{w_{ijt}} \right\} + \hat{\beta}_{kt} + \gamma_k m_i + \epsilon_{ikt}^{y}$$

Note: The means, standard deviations, and coefficient of variations for the variables in this system of equations are reported in appendix A. Equation (V) and (VI) consist of four and seven equations respectively. The notation is defined in Chapter III.

All variable input parameters in equations (VI) also appear in at least one of the equations in set (V). To estimate the system of equations it is necessary to constrain the parameters in (VI) to equal the value of the same parameters in (V).

The Just et al. model estimated the system of equations using two and three stage non-linear least squares. In my model I used dummy variables to measure the management effects, which increased the number of variables in the model to 703. The model has eleven equations and 703 variables which makes it difficult and expensive to estimate using two and three stage non-linear least squares. The main-frame at Kansas State University does not have the capacity to estimate a model of that magnitude. Just et al. had to use two stage or three stage least squares because they used current price times current production as the proxy variable for expected returns and current production is contemporaneously correlated with the errors in the production functions. I avoided that problem by choosing an alternative measure for expected production. Expected returns can be defined as expected output times expected price. I factored expected output into two components, yield per acre and acres in production. Acres in production are known at the beginning of the production process, but yield is not and the producer makes decisions based on expected yields.

To form an instrumental variable for expected yield, I estimated yield as a function of exogenous variables. Assuming profit maximization for one acre of land, a producer will use an input up to the point where value marginal product (VMP) is equal to the input price, i.e.,

$$VMP \equiv P_{ikt} * MPP_{ikt} = w_{ijt}$$

So the amount of x_{ijkt} used and hence the resulting yield is a function of the input to output price ratio, i.e.,

$$\text{Yield} = f(w_{ijt}/P_{ikt})$$

Based on that I estimated expected yield for each crop as a function of input--for each variable input--to output price ratio, year effects, and farm effects. Equation (VII) shows that function.

Equation (VII):

$$\text{yield}_{ikt} = \Sigma\, \phi_{ijkt} * \frac{w_{ijt}}{P_{ikt-1}} + \phi_t \text{trend} + \phi_i M_i + \epsilon$$

Equation (VII) is estimated using the ordinary least square method (OLS) and the predicted values for the yield of each crop are used to calculate the proxy for expected returns,

$$\hat{yield}_{ikt} * Acres * P_{ikt-1} = \hat{r}_{ikt}$$

where

$\hat{yield}_{ikt}$ = predicted yield from equation (VII),

Acres = Acres in production, known at time of the production process,

P_{ikt-1} = Output price during time period t-1,

w_{ijt} = Input price during time t, and

$\hat{r}_{ikt}$ = Proxy for expected returns.

With my proxy variable for expected returns, the system of equations can be estimated using a seemingly unrelated method (SUR). This method of estimating the model assumes that the error terms are contemporaneously correlated and uses this additional information while estimating the model. Seemingly unrelated (SUR) allows restrictions to be placed across the equations. Restrictions can also be placed within each equation, so constant returns to scale can be forced upon the model, i.e., the summation of the parameters in each equation can be forced to equal one. Because of the size of the model, I chose to not include equation (II) from the Just et al. model. By dropping this equation I will also be discarding some information and the estimates will not be as efficient.

Most of the producers do not produce all seven crops each year, and some do not produce some of the crops at all. That causes estimation problems with the production function equations where the log of values are used because the log of zero is minus infinity. Those zero observations cannot be dropped because the model must have the same number of observations for each equation in the system. If each equation in the system does not have the same number of observations the model could not be estimated using seemingly unrelated, or any other method that uses the error terms as additional information. This is due to the fact that the error terms from equations (V) would not match up with the error terms from equations (VI).

When estimating any model, the estimated regression line always passes through the variable means. For those reasons the means of the log variables in equations (VI) are calculated when production is not equal to zero and when production is equal to zero those mean values are substituted in place of the log of zero values in equations (VI). The means are not substituted in place of the zeros in equations (V), since that set of equations estimates the variable input usage for each crop and there are no log variables. Using the mean values in equations (VI) the slope coefficients will not be affected, but the variances will be understated and hence the t statistics will be artificially high.

The model is first estimated with all of the variables included and a restriction placed across the equations, equations (V) and (VI). Next, an additional restriction is placed on the parameters, in equations (VI), to force constant returns to scale. This is done by forcing the parameters of the variable inputs and the acres variable in equations

(VI) to sum to one for each equation. Those results will be compared to the previous to see if constant returns to scale exists.

When estimating production functions over time periods the model might not be able to show large shifts in production due to large changes in technology. For this reason the data is split into two different time periods, 1974-1980 and 1981-1985. The model is then run on both of these two separate time periods to see if the parameters changed. If the parameters change considerably then the original model had smoothed over those changes in technology. The results from these models are compared with each other to determine which model estimates the production functions best.

When using the Cobb-Douglas functional form the estimated parameters are equal to the input elasticities for the respective inputs. The input elasticity is defined as percent change in output divided by percent change in the input. For a Cobb-Douglas type function, i.e.,

$$Y = \alpha X^b,$$

the input elasticity is given by

$$\frac{\partial Y/Y}{\partial X/X} = \frac{b\alpha X^b}{X} \cdot \frac{X}{Y} = \frac{bY}{X} \cdot \frac{X}{Y} = b.$$

By using the elasticities for acres and summing the elasticities for the purchased inputs the transitions between intensively irrigated crops, i.e. irrigated corn production, and the other crops is studied. All of the purchased inputs in this model are positively correlated with the price of energy. So when the price of energy increases, producers should move out of crops that have large elasticities for purchased inputs and into crops that have larger elasticities for acres in production. By comparing the elasticities for acres, and ranking the crops by size of their acres elasticities, one will be able to conclude that movement should occur out of the crops with relatively small elasticities on land and into crops with relatively larger elasticities on land.

After all of the previous models are estimated, the model that generates the most reasonable results is chosen. The estimated parameters for the management dummy variables from that model are used to derive a single management measure for each farm. The management measure for each farm is a weighted average of that farms' dummy variable coefficients where the weights are the fraction of total crop acres devoted to each crop, i.e.,

$$F_i = \frac{\sum_{k=1}^{7}(A_{ik} * \alpha_{ik})}{T_i}$$

where

A_{ik} = Average acres in production of crop k, for farm i,

T_i = Total average acres in production for farm i,

α_{ik} = Management dummy variable parameter for crop k, farm i, and

F_i = Management variable for farm i.

This management variable is used to measure the productive efficiency of each producer in the following function.

RRCM = f(F_i, TA, RENT, CLCM, LTLCM, MACHINE) where

RRCM - Rate of Return to Capital Managed, percentage,

F_i - The management variable derived previously,

TA - Total Acres in production,

RENT - Percentage of total acres that are rented,

CLCM - Current loans to capital managed ratio,

LTLCM - Long term loans to capital managed ratio, and

MACHINE - Dollars per acre spent on machinery.

The parameter for total acres in production will measure economies to size. If the parameter is positive, the larger producers will receive a higher rate of return to capital managed than the smaller producers. The parameter for RENT determines if the rate of return to capital managed can be increased by renting additional acreage.

The variables CLCM and LTLCM are included to determine whether rate of return to capital managed is affected by borrowing money. The current loan to capital managed variable is to measure short term loans, such as to cover production costs, while the long term loan to capital managed measures the effect of borrowing money to expand. The variable MACHINE measures return on investment in machinery, i.e., how rate of return to capital managed is affected by replacing older equipment with new or buying larger new equipment when the producer expands.

This regression was also run without the management variable to examine how the model estimates rate of return to capital managed when the management variable is excluded. The results from this model and the previous model, which includes management, are compared to check the significance of the management variable for affecting the rate of return to capital managed.

CHAPTER V

RESULTS AND DISCUSSION

The variable input variables included in the model are fertilizer, fuel, and pesticides. When examining the data set I found problems with the variable other purchased inputs. For this reason other purchased inputs was left out of the model. When the model was first estimated all of the coefficients were of expected sign, with the exception of the coefficients for Pesticides on both irrigated and dryland wheat production (Table 5.1).

The model was next restricted to demonstrate constant returns to scale. The restriction forces the summation of input parameters to equal one. This did not change the results significantly (refer to Table 5.1). Before this restriction was placed on the model, the parameters were nearly equal to one. With the restriction placed on the model the variable, Acres, became considerably more significant, except for alfalfa production.

Table 5.1

Results From Indicated Models

Estimated Model: dependant variable = indicated production

Equation/Coeff.	SUR Estimate/T-ratio[1]	SUR Forced Constant Returns to Scale Estimate/T-ratio
Irrigated Wheat		
Acres	0.3257	0.3014
	(11.35)	(78.70)
Fertilizer	0.0008	0.0008
	(1.83)	(1.88)

[1]T-Ratios in parenthesis.

Table 5.1 cont.

Results From Indicated Models

Estimated Model: dependant variable = indicated production

Equation/Coeff.	SUR Estimate/T-ratio[2]	SUR Forced Constant Returns to Scale Estimate/T-ratio
Irrigated Wheat cont.		
Fuel	1.1469	1.1475
	(14.40)	(14.42)
Pesticides	-0.4607	-0.4497
	(-5.98)	(-5.90)
Dryland Wheat		
Acres	0.2741	0.3209
	(7.08)	(52.95)
Fertilizer	0.0017	0.0016
	(6.93)	(6.86)
Fuel	0.9649	0.9582
	(24.08)	(24.14)
Pesticides	-0.2631	-0.2507
	(-6.45)	(-7.36)
Irrigated Corn		
Acres	0.0839	0.2210
	(3.13)	(64.38)
Fertilizer	0.0022	0.0022
	(21.26)	(20.94)
Fuel	0.3905	0.3725
	(20.38)	(19.78)

[2] T-Ratios in parenthesis.

Table 5.1 cont.

Results From Indicated Models

Estimated Model: dependant variable - indicated production		
	SUR	SUR Forced Constant Returns to Scale
Equation/Coeff.	Estimate/T-ratio[3]	Estimate/T-ratio
Irrigated Corn cont.		
Pesticides	0.4509	0.4044
	(22.06)	(22.04)
Irrigated Grain Sorghum		
Acres	0.2448	0.2386
	(8.51)	(101.80)
Fertilizer	0.0025	0.0025
	(10.29)	(10.30)
Fuel	0.7707	0.7736
	(17.93)	(18.04)
Pesticides	-0.0146	-0.0147
	(-0.35)	(-0.36)
Dryland Grain Sorghum		
Acres	0.2150	0.2984
	(6.24)	(67.38)
Fertilizer	0.0015	0.0015
	(3.17)	(3.09)
Fuel	0.4782	0.4643
	(6.10)	(5.94)
Pesticides	0.2637	0.2358
	(3.47)	(3.15)
Irrigated Soybeans		
Acres	0.4247	0.3258
	(13.33)	(39.28)
Fertilizer	0.0344	0.0342
	(12.87)	(12.82)
Fuel	0.5775	0.5781
	(1.97)	(1.97)
Pesticides	0.0177	0.0619
	(0.06)	(0.22)
Irrigated Alfalfa		
Acres	0.7835	0.4569
	(5.67)	(3.42)

[3] T-Ratios in parenthesis.

Table 5.1 cont.

Results From Indicated Models

Estimated Model: dependant variable = indicated production

Equation/Coeff.	SUR Estimate/T-ratio[4]	SUR Forced Constant Returns to Scale Estimate/T-ratio
Irrigated Alfalfa cont.		
Fertilizer	0.2979	0.3050
	(2.14)	(2.19)
Fuel	-0.2487	0.0732
	(-0.89)	(0.26)
Pesticides	0.3534	0.1649
	(1.31)	(0.61)

When the time series was separated into two time periods, 1974-1980 and 1981-1985, the parameter for fuel increased in the later time period. The acres parameter for corn production changed to a negative coefficient. The acres parameter for all of the other crops also decreased, except for irrigated wheat, but remained positive (see Table 5.2).

[4]T-Ratios in parenthesis.

Table 5.2

Results From Indicated Models

Estimated Model: dependant variable - indicated production

Equation/Coeff.	SUR 1974-1980 Estimate/T-ratio[5]	SUR 1981-1985 Estimate/T-ratio
Irrigated Wheat		
Acres	0.2817	0.3575
	(7.19)	(6.75)
Fertilizer	-0.0008	0.0049
	(-1.56)	(7.47)
Fuel	1.1207	1.1937
	(16.16)	(9.15)
Pesticides	-0.4168	-0.5183
	(-6.30)	(-4.08)
Dryland Wheat		
Acres	0.3031	0.1419
	(5.51)	(2.07)
Fertilizer	0.0009	0.0014
	(2.94)	(4.21)
Fuel	0.8771	0.9236
	(23.99)	(13.94)
Pesticides	-0.1916	-0.1521
	(-5.62)	(-2.20)
Irrigated Corn		
Acres	0.1705	-0.4575
	(6.16)	(-6.29)
Fertilizer	0.0021	0.0034
	(17.58)	(20.99)
Fuel	0.3391	0.5327
	(20.42)	(16.11)
Pesticides	0.4744	0.5605
	(32.08)	(13.37)
Irrigated Grain Sorghum		
Acres	0.2813	0.1344
	(7.74)	(2.54)
Fertilizer	0.0024	0.0014
	(9.63)	(3.47)

[5] T-Ratios in parenthesis.

Table 5.2 cont.

Results From Indicated Models

Estimated Model: dependant variable = indicated production

Equation/Coeff.	SUR 1974-1980 Estimate/T-ratio[6]	SUR 1981-1985 Estimate/T-ratio
Irrigated Grain Sorghum cont.		
Fuel	0.4670	0.9657
	(15.90)	(12.18)
Pesticides	0.2641	-0.1522
	(9.55)	(-1.94)
Dryland Grain Sorghum		
Acres	0.2133	0.1600
	(4.63)	(2.58)
Fertilizer	-0.0001	0.0026
	(-0.16)	(4.31)
Fuel	0.3349	0.5380
	(4.09)	(4.37)
Pesticides	0.4065	0.2301
	(5.20)	(1.91)
Irrigated Soybeans		
Acres	0.7132	0.4325
	(17.54)	(7.65)
Fertilizer	0.0320	0.0248
	(6.57)	(8.07)
Fuel	0.4927	0.3673
	(2.01)	(0.70)
Pesticides	-0.0294	0.2276
	(-0.12)	(0.45)
Irrigated Alfalfa		
Acres	0.7908	0.3302
	(4.52)	(1.73)
Fertilizer	0.2716	0.4039
	(1.61)	(1.99)
Fuel	-0.1140	1.1482
	(-0.41)	(1.45)
Pesticides	0.2300	-0.8902
	(0.85)	(-1.16)

After estimating the production functions, the estimates from the

[6]T-Ratios in parenthesis.

farm effect dummy variables were used to create a management measure for each farm. This management measure, along with the other variables in this model, was used to estimate the rate of return to capital managed. Table 5.3 shows the results from the first regression which estimates the Rate of Return to Capital Managed. The management variable is positively correlated to Rate of Return to Capital Managed.

Table 5.3

Results From Rate of Return to Capital Managed Model

Estimated Model: dependant variable = Rate of Return to Capital Managed

Coefficient	OLS Estimate/T-ratio[7] Adjusted R^2 = 0.4348
Management	0.6074 (2.329)
Total Acres in Production	0.0004 (3.859)
Current Loans/Capital Managed	-4.6295 (-2.151)
Long Term Loans/Capital Managed	5.4855 (3.286)
Percentage Rented Acreage	0.2643 (1.074)
Machine Expense per Acre	-0.0059 (-0.686)

When the management variable is omitted from the model the R^2 value decreases. The estimated coefficients for current loans to capital managed and long term loans to capital managed are the only two coefficients that change significantly. Current loans to capital managed decreased by 1.22, while long term loans to capital managed increased by

[7]T-Ratios in parenthesis.

0.6217 (see Table 5.4).

Table 5.4

Results From Rate of Return to Capital Managed Model without Management

Estimated Model: dependant variable = Rate of Return to Capital Managed

Adjusted R^2 = 0.4136

Coefficient	OLS Estimate/T-ratio[8]
Total Acres in Production	0.0004 (4.172)
Current Loans/Capital Managed	-5.8520 (-2.753)
Long Term Loans/Capital Managed	6.1072 (3.639)
Percentage Rented Acreage	0.3609 (1.351)
Machine Expense per Acre	-0.0059 (-0.686)

One might suspect that the age of the operator will have a greater effect on rate of return to capital managed than the management variable. For this reason the variable, age of operator, was added to the model. Table 5.5 shows the results from that model.

Table 5.5

Rate of Return to Capital Managed Model with Operators Age

Estimated Model: dependant variable = Rate of Return to Capital Managed

Adjusted R^2 = 0.4300

Coefficient	OLS Estimate/T-ratio[9]
Management	0.6093 (2.324)

[8]T-Ratios in parenthesis.

[9]T-Ratios in parenthesis.

Table 5.5 cont.

Rate of Return to Capital Managed Model with Operators Age

Estimated Model: dependant variable = Rate of Return to Capital Managed

Coefficient	OLS Estimate/T-ratio[10]
	Adjusted R^2 = 0.4300
Total Acres in Production	0.0004
	(3.260)
Current Loans/Capital Managed	-4.5643
	(-2.073)
Long Term Loans/Capital Managed	5.4048
	(3.078)
Percentage Rented Acreage	0.2570
	(0.811)
Machine Expense per Acre	-0.0065
	(-0.691)
Operators Age	0.0010
	(0.154)

Discussion of the Results

Estimation of the Production Model (refer to tables 5.1 and 5.2)

The yield values were first estimated to create the instrumental variables. Those yield values were estimated as a function of the input to output price ratios, year-effects, and a farm effects. Those regressions had good R^2 values, which ranged from 0.30 to 0.62.

The input elasticities for acres range from 0.7835 for irrigated alfalfa, to 0.0839 for irrigated corn production and all estimated parameters for acres are statistically significant to a 99% significance level. Irrigated wheat acres input elasticity is slightly greater than that of dryland wheat acres. This is expected, because one can obtain

[10] T-Ratios in parenthesis.

higher yields with irrigated production than with dryland. The input elasticity for irrigated grain sorghum acres is also slightly greater than dryland grain sorghum acres for the same reason as for wheat production. The input elasticity for acres in irrigated corn production is the smallest estimated input elasticity of all of the crops. There has been a considerable amount of transition out of irrigated corn production since 1976 and the model has troubles showing these transitions over the full twelve year time period. The input elasticities for both irrigated alfalfa and irrigated soybeans acres are large in comparison with the other crops. Those estimates are less reliable because irrigated alfalfa and irrigated soybeans acres make up a small percentage of total acres in crop production. Recall, if the crop is not grown on a farm then the mean values of the variables are used in the equation for that crop in equations (VI). This could cause some of the coefficients not to be of the expected magnitude if there exist a small number of non-zero observations, which is the case with irrigated soybean and irrigated alfalfa production.

The estimated coefficients show that dryland wheat production is more responsive to fertilizer than irrigated wheat production. This is opposite of what is expected if there is a positive interaction between irrigation and fertilizer. For this reason I would have expected the irrigated wheat fertilizer elasticity to be greater than the dryland wheat fertilizer elasticity. The fertilizer elasticity for irrigated grain sorghum production is greater than the fertilizer elasticity for dryland grain sorghum production. Both of those elasticities are positive and significant, which demonstrates positive interaction between irrigation and fertilizer. The fertilizer elasticity for irrigated corn production is larger than any of the fertilizer elasticities for dryland production, but is smaller than the fertilizer elasticity for irrigated grain sorghum production. I would have expected the fertilizer elasticity for irrigated corn production to be greater than for irrigated grain sorghum production. The difference in fertilizer elasticities for irrigated grain sorghum production and irrigated corn production is only 0.0003; this is a small difference and the elasticity for irrigated corn production is more significant. Irrigated soybean fertilizer elasticity is greater than all of the crops, except for irrigated alfalfa, which is inconsistent with what would be expected. Both fertilizer elasticities for irrigated soybeans and irrigated alfalfa are greater than they should be. This is probably due to the small number of farms producing those crops, which causes the estimated parameters to be artificially high and less reliable, since the mean values are substituted in place of the zero values in equations (VI).

The estimated fuel elasticities show that irrigated production is more responsive to additional fuel than that of dryland production. The fuel elasticity for irrigated grain sorghum is greater than the fuel elasticity for dryland grain sorghum production which shows that irrigated production is more responsive to fuel use. This also holds true for irrigated wheat versus dryland wheat production. This means that to increase irrigated production by one unit it takes more fuel than to increase dryland production. This is demonstrating the positive correlation between irrigation and fuel consumption. The fuel elasticity for irrigated corn production is less than irrigated grain sorghum or irrigated wheat production, which is not what I had expected. Irrigated corn production requires more water than irrigated wheat or irrigated grain sorghum production, which makes me believe that the elasticity for irrigated corn production should be greater. Irrigated corn production requires more of the other inputs, such as pesticides and fertilizer, so the model is probably placing more weight on the other variable inputs for corn to compensate for this low fuel elasticity. The fuel elasticity for irrigated soybean is smaller than what was expected, while the fuel elasticity for irrigated alfalfa production is negative, but insignificant. Again, this is caused by the small number of production observations that are non-zero, giving less reliable estimates.

The pesticide elasticities for irrigated wheat and dryland wheat production are negative and significant. If it were negative it should have at least been insignificant, saying that it is likely not to be different from zero. Wheat production in southwest Kansas requires small amounts of pesticides when compared to the other crops considered in this thesis, see Appendix C for Kansas Farm Management Budgets. The pesticide elasticity for irrigated corn production is positive and significant. Irrigated corn production is more responsive to pesticides than any of the other crops in the model. The pesticide elasticity for irrigated grain sorghum is negative, but insignificant, while the pesticide elasticity for dryland grain sorghum production is positive and significant. This shows that dryland production is more responsive to pesticide applications and irrigated production is more dependant on the other inputs in the model. Irrigated alfalfa is almost as responsive to pesticides as irrigated corn production. This is a reasonable result, because alfalfa production relies heavily on pesticides. The pesticide elasticity for irrigated soybean production is quite small, but is insignificant. This could be caused by the fact that only forty seven of the one hundred and twenty three farms produce soybeans at least one year.

The estimated parameters for the time dummy variables were included to show for technological and weather shifts (see Appendix B for results). The estimates for those coefficients are decreasing over time, that is the estimate for 1974 is greater than the estimate for 1985. This is opposite of what is theoretically expected for technological changes. But, during the eighties producers suffered two years that were abnormally hot and dry. This could of caused some of the downward shifts.

When the model was next restricted to production functions with constant returns to scale--the estimates on each production function were restricted to sum to one--the parameters did not change appreciably. The parameters were close to equaling one before the restriction was placed on the model. This shows that there are constant returns to scale in production. In other words, when producers expand they do not increase their yields per acre. Note that this is not returns to acre in a monetary value, but only in production of the commodity.

Next, the data is divided into two different time series, 1974-1980 and 1981-1985, and the model is estimated for both time periods. The results from these regressions show that the elasticity for acres decreased in the latter years for all crops, except for irrigated wheat. This is probably due to new technologies such as the introduction of more productive seeds, and the substitution of other inputs for land. The fertilizer elasticity estimates were larger for the latter time period for all of the crops except for irrigated grain sorghum and irrigated soybeans. That shows that land is being substituted for with increased fertilizer use. The rising price of fuel since 1974 has caused the elasticity for fuel to increase for all of the crops, except for irrigated soybean production, due to the increased usage of large machinery that is more efficient. The elasticity for pesticides has decreased in the latter time period for all of the crops, except for irrigated corn and irrigated soybean production. Some of this decrease in the pesticide elasticity could be due to the increasing restrictions placed on pesticide usage for environmental reasons--such as the use of DDT--which caused the producers to use more refined and higher priced pesticides. When the time series was divided into two time periods, some of the estimated parameters become negative and some become insignificant. The results from the previous model, when the time series was not divided into two time periods and the model is not restricted to constant returns to scale, seems to generate better results than when the time series is divided into two time periods.

Tables 5.6 and 5.7 are used to examine the transitions that would occur when the price of energy increases, which happened during the mid seventies. Those tables consist of the estimated elasticities for acres and ordering of the seven crops in descending order by their estimated acres elasticities. Since I have found that constant returns to scale exists in crop production in Southwest Kansas, the estimated elasticities for purchased inputs is equal to one minus the estimated elasticity for acres in production. So when the price of energy increases, which causes the prices of the purchased inputs to increase, producers should move out of crops with relatively low elasticities for land and into crops with relatively higher land elasticities.

Table 5.6

Estimated Parameters for Acres in Production

	SUR Whole Time Period	SUR 1974-1980	SUR 1981-1985
Irrigated Wheat	0.32	0.28	0.35
Dryland Wheat	0.27	0.30	0.14
Irrigated Corn	0.08	0.17	-0.45
Irrigated G.S.	0.24	0.28	0.13
Dryland G.S.	0.21	0.21	0.16
Irrigated Alfalfa	0.78	0.79	0.33
Irrigated Soybeans	0.42	0.71	0.43

Table 5.7 shows that when the price of energy increases then producers should move out of irrigated corn production and into crops that are higher on the list. Note that in all of the models, irrigated corn production has the lowest acres elasticity. Which shows that there should be movement out of irrigated corn production and into the other crops, which agrees with the historical data in Chapter 2.

Table 5.7

Crops Ordered by Estimated Acre Parameters

	SUR Whole Time Period	SUR 1974-1980	SUR 1981-1985
Largest	IALF	IALF	ISB
	ISB	ISB	IWHT
	IWHT	DWHT	IALF
	DWHT	IWHT	DGS
	IGS	IGS	DWHT
	DGS	DGS	IGS
Smallest	IC	IC	IC

The model did not do a very good job estimating the parameters for irrigated soybean and irrigated alfalfa production, due to the small number of instances that farmers raised alfalfa and soybeans. Still irrigated alfalfa and irrigated soybeans must be left in the model because the fertilizer, fuel, and pesticide cash operating expense variables include expenses for irrigated alfalfa and irrigated soybean production.

Management and Returns to Capital Managed (see tables 5.3, 5.4 and 5.5)

The results show that the management variable I created is positively correlated with the rate of return to capital managed and is significant. The total acres in production variable has a small, positive effect on rate of return to capital managed. This shows that economies to size do exist, but are small. The percentage of total acres rented has a larger effect on rate of return to capital managed, but is less significant than total acres in production.

The two types of loans that are included in this model are current and long term loans to capital managed. The current loans to capital managed are used for operating loans, while the long term loans are more for expanding and starting new operations. The results show that if the current loans to capital managed ratio is increased then the rate of return to capital managed will decrease, but if the long term loans to capital managed ratio is increased then the rate of return to capital managed will increase. This means that if producers increases their current loans to capital managed ratio by borrowing money for operating expenses then their rate of return to capital managed will decrease. On the other hand, the model shows that if they expand their operation by taking out long term loans and increase their long term loans to capital managed ratio, their rate of return to capital managed will increase. I do not think that increasing the long term loans to capital managed ratio will increase the rate of return to capital managed with current economic conditions. I suspect that most of the long term loans were acquired when the interest rates were low, and this model is over estimating the impact of the long term loans to capital managed ratio on rate of return to capital managed.

The final variable in this model is machinery expense per acre, which shows the result of buying new machinery. This variable has a negative, but insignificant, coefficient. This demonstrates that buying new equipment, or investing heavily in equipment, might be inversely related to rate of return to capital managed.

When the model was run without the management variable, the current and long term loans to capital managed coefficients change. The current loan coefficient becomes a larger negative value and the long term loan coefficient becomes a larger positive value. The rest of the coefficients do not change significantly. This suggests that the management variable measures the financial efficiency of the producers also.

There was suspicion that the operators age might have a greater effect on rate of return to capital managed and might even make the management variable insignificant. Table 5.5 shows that the operators age is insignificant and small. The management variable is still significant when the operators age is included in the model.

CHAPTER VI

SUMMARY

By studying the production data, one can see that there is movement away from irrigated corn production towards crops that require less water and can tolerate soil moisture stress, such as grain sorghum and wheat. Soybean production is a relatively new crop for Southwest Kansas and has been increasing in popularity in the past five years. The production of Irrigated Alfalfa has also been increasing in the past few years, probably due to the increases in alfalfa prices.

One of the first problems encountered when estimating the model is the fact that not all of the producers produced all seven of the crops which meant zero values for some of the production data. Because I used the Cobb-Douglas functional form, the log of the zero values could not be calculated. Instead I substituted the means of the non-zero log values in place of the log of zero values. The only effect this had on the model is that t statistics that are calculated with the residuals are artificially high and the variance will be lower than actual. The estimated coefficients are not affected by this procedure.

When the model was first estimated the estimated coefficients on most of the variables were of the correct sign. The model did have problems estimating the coefficients for pesticide usage for irrigated and dryland wheat production, they had negative signs and were significant at a 99% significance level. The estimated coefficients for the time dummy variables decreased over time. I would have expected them to have increased since better technology, such as hybrid seeds, fertilizers, and more efficient practices, have been introduced since 1974, but during the eighties Southwest Kansas experienced two years that were abnormally hot and dry. This could have caused the time dummy variables to decrease during the eighties.

Next the model was forced to demonstrate constant returns to scale. This did not change the results appreciably, because the summation of the estimated input parameters was previously almost equal to one. This shows that constant returns to scale do exist in crop production of Southwest Kansas.

The last manipulation of the model was to split the time series into two different time series, for 1974 to 1980 and 1981 to 1985. This was to see if there were any great technological shifts that the earlier model could not detect. The results from this showed that the elasticity for land for most of the crops decreased due to the increase in the elasticity for fertilizer. This means that in the latter years producers are using more fertilizer to increase the yields since the newer varieties of seeds are more responsive to fertilizers.

By studying the estimated parameters for acres and grouping the estimated parameters for the variable inputs into one estimated parameter called purchased inputs the models can be used to show what transitions should occur when the price of energy increases. The results from this show that when the price of energy increases then producers should move out of crops that have high elasticities for purchased inputs, such as irrigated corn production, and into crops with relatively higher elasticities for land in production. This is consistent with what occurred in the past when energy prices increased in the mid seventies.

The original model seems to produce the best results. For this reason the estimated parameters for the management dummy variables were used from this model to calculate a whole farm management variable. This whole farm management variable was used to estimate the rate of return to capital managed, along with; current loans to capital managed, long term loans to capital managed, total acres, percent rented acres, and machine expense per acre. The estimated coefficient for the management variable was quite large and significant at a 99% significance level. Current loans to capital managed seem to hurt the rate of return to capital managed, while long term loans to capital managed increase the rate of return to capital managed. The estimated coefficient for total acres is positive and the estimated coefficient for percent rented acres was also positive. This suggests that economies to size do exist Southwest Kansas crop production. The estimated coefficient for machinery expense per acre was negative and insignificant, which means that it probably has no effect on the rate of return to capital managed. There was suspicion that the operators age might be correlated with the management variable, but when the age variable was added the estimated coefficient for it was small and insignificant. A correlation matrix was calculated for operators age and management variable, which showed a small negative correlation between the two.

This thesis shows one way that the Kansas Farm Management Data Bank can be used. It also shows some of the limitations that were encountered due to the lack of information, such as the total production cost data for the earlier years in the time series. If enterprise accounting would be done in Southwest Kansas more precise production functions could be estimated and the transitions that are occurring could be studied with more certainty.

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APPENDICES

APPENDIX A

STATISTICAL DESCRIPTION OF THE DATA SET

MEAN, STANDARD DEVIATION, AND COEFFICIENT OF VARIATION FOR THE DATA SET

Statistical Description of the Data Set

Variable	Mean	S.D.[1]	C.V.[2]
Farm Cash Operating Expense for Fertilizer	10585.46	14441.53	136.43
Farm Cash Operating Expense for Pesticides	13194.04	12906.88	97.82
Farm Cash Operating Expense for Pesticides	5131.20	16131.28	314.38
Farm Cash Operating Expense for Other Inputs	7782104.27	9611803.99	123.99
Price of Wheat	4.33	1.42	32.63
Price of Corn	3.46	0.87	25.05
Price of G.S.	3.06	0.79	25.88
Price of Soybeans	7.72	2.03	26.27
Price of Alfalfa	75.23	11.37	15.12
Price of Fert	249.48	59.96	24.03
Price of Pest	0.73	0.21	29.04
Price of Fuel	0.89	0.21	23.57
Price of Other	80.23	20.17	25.14
LNIWP	8.84	0.75	8.46
LNDWP	9.34	1.00	10.66
LNICP	10.24	0.65	6.32
LNIGSP	9.14	0.69	7.55
LNDGSP	8.27	0.79	9.55
LNIAP	5.81	0.53	9.08
LNISBP	7.96	0.40	5.01
LNIWA	5.12	0.68	13.18
LNDWA	5.95	0.89	14.98
LNICA	5.49	0.57	10.29
LNIGSA	4.82	0.57	11.83
LNDGSA	4.87	0.70	14.38
LNIAA	4.32	0.46	10.55
LNISBA	4.53	0.30	6.70
LNIWFT	8.72	4.22	48.47

[1]S.D. - standard deviation

[2]C.V. - coefficient of variation

Variable	Mean	S.D.[3]	C.V.[4]
LNDWFT	12.77	2.61	20.40
LNICFT	8.85	4.16	47.00
LNIGSFT	8.55	4.48	52.38
LNDGSFT	8.04	4.54	56.45
LNIAFT	5.12	1.10	21.55
LNISBFT	5.22	2.35	44.92
LNIWFL	8.94	1.66	18.61
LNDWFL	8.21	1.32	16.08
LNICFL	10.69	1.44	13.45
LNIGSFL	9.34	1.34	14.34
LNDGSFL	8.45	1.37	16.18
LNIAFL	8.42	3.59	42.60
LNISBFL	9.42	1.25	13.27
LNIWOT	8.76	3.13	35.71
LNDWOT	11.85	2.05	17.32
LNICOT	9.25	3.03	32.77
LNIGSOT	8.71	3.41	39.15
LNDGSOT	8.12	3.50	43.15
LNIAOT	5.78	0.55	9.56
LNISBOT	5.92	1.78	30.11
LNIWPT	8.95	1.86	20.79
LNDWPT	8.05	1.44	17.84
LNICPT	10.76	1.64	15.25
LNIGSPT	9.36	1.52	16.28
LNDGSPT	8.46	1.53	18.07
LNIAPT	8.55	3.76	43.99
LNISBPT	9.52	1.33	13.99
Rate of Return to Capital Managed	1.97	1.65	83.91
Management Variable	0.49	0.62	126.05
Current Loans to Capital Managed	0.09	0.08	83.17
Long Term Loans to Capital Managed	0.09	0.08	94.00
Total Acres in Production	1706.18	1121.08	65.71
Percent Acres Rented	0.82	0.44	54.56

[3]S.D. - standard deviation

[4]C.V. - coefficient of variation

Variable	Mean	S.D.[5]	C.V.[6]
Operators			
Age	51.65	9.57	18.54

[5]S.D. - standard deviation

[6]C.V. - coefficient of variation

APPENDIX B

Estimated Parameters for Time and Management Dummy Variables

Time and Management Dummy Variables Results

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Irrigated Wheat				
1985 shift	1.7398	24.0763	1.7573	25.3596
1984 shift	1.9337	26.2347	1.9544	28.0085
1983 shift	1.9339	25.9168	1.9529	27.4530
1982 shift	1.8580	24.2223	1.8828	26.4507
1981 shift	1.2311	15.1802	1.2584	16.8145
1980 shift	1.8052	20.8895	1.8357	23.2017
1979 shift	2.2414	27.9296	2.2697	30.9881
1978 shift	2.0067	25.9589	2.0337	28.8199
1977 shift	1.8332	22.6773	1.8600	24.8905
1976 shift	2.2530	30.0640	2.2804	33.5789
1975 shift	2.3963	30.4640	2.4289	35.1940
1974 shift	2.2266	22.7702	2.2649	25.8758
MANAGEMENT (1) shift	0.1494	1.6456	0.1547	1.7083
MANAGEMENT (2) shift	0.0749	0.8673	0.0807	0.9368
MANAGEMENT (3) shift	-0.0331	-0.3742	-0.0104	-0.1225
MANAGEMENT (4) shift	0.1287	1.4846	0.1469	1.7451
MANAGEMENT (5) shift	0.0700	0.8156	0.0859	1.0247
MANAGEMENT (6) shift	0.0078	0.0871	0.0325	0.3854
MANAGEMENT (7) shift	0.0607	0.6997	0.0785	0.9306
MANAGEMENT (8) shift	0.0742	0.8417	0.0966	1.1483
MANAGEMENT (9) shift	0.0666	0.7729	0.0864	1.0376
MANAGEMENT (10) shift	0.0413	0.4500	0.0529	0.5807
MANAGEMENT (11) shift	0.0332	0.3856	0.0483	0.5723
MANAGEMENT (12) shift	-0.0112	-0.1221	0.0213	0.2522
MANAGEMENT (13) shift	-0.0402	-0.4405	-0.0105	-0.1248
MANAGEMENT (14) shift	-0.0961	-1.1071	-0.0879	-1.0190
MANAGEMENT (15) shift	0.0263	0.2555	0.0355	0.3481
MANAGEMENT (16) shift	-0.0170	-0.1947	-0.0077	-0.0893
MANAGEMENT (17) shift	0.0181	0.2029	0.0277	0.3130
MANAGEMENT (18) shift	-0.0490	-0.5572	-0.0357	-0.4121
MANAGEMENT (19) shift	0.0965	0.6318	0.0999	0.6540
MANAGEMENT (20) shift	-0.1350	-1.5228	-0.1288	-1.4566
MANAGEMENT (21) shift	0.2461	1.5990	0.2286	1.4964
MANAGEMENT (22) shift	-0.1046	-0.8027	-0.1144	-0.8821
MANAGEMENT (23) shift	0.0086	0.0966	0.0152	0.1721
MANAGEMENT (24) shift	0.1451	0.9395	0.1611	1.0523
MANAGEMENT (25) shift	-0.0999	-0.8511	-0.0896	-0.7673
MANAGEMENT (26) shift	0.0055	0.0604	0.0075	0.0831
MANAGEMENT (27) shift	0.1356	1.5507	0.1374	1.5718

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Irrigated Wheat (cont.)				
MANAGEMENT (28) shift	0.0417	0.4766	0.0635	0.7571
MANAGEMENT (29) shift	0.1257	1.4710	0.1430	1.7218
MANAGEMENT (30) shift	0.0838	0.6447	0.0887	0.6836
MANAGEMENT (31) shift	0.0210	0.2324	0.0487	0.5771
MANAGEMENT (32) shift	0.0331	0.3745	0.0551	0.6576
MANAGEMENT (33) shift	0.0127	0.1538	0.0385	0.4567
MANAGEMENT (34) shift	0.1593	1.7715	0.1852	2.1816
MANAGEMENT (35) shift	0.0525	0.5975	0.0666	0.7711
MANAGEMENT (36) shift	0.0364	0.3299	0.0561	0.5913
MANAGEMENT (37) shift	0.0608	0.6820	0.0718	0.8134
MANAGEMENT (38) shift	0.0960	0.9725	0.1115	1.1461
MANAGEMENT (39) shift	-0.1155	-0.8802	-0.1009	-0.7756
MANAGEMENT (40) shift	-0.2955	-2.2564	-0.2806	-2.1608
MANAGEMENT (41) shift	0.0097	0.1138	0.0206	0.2445
MANAGEMENT (42) shift	0.0595	0.6990	0.0753	0.9047
MANAGEMENT (43) shift	0.0466	0.5422	0.0602	0.7122
MANAGEMENT (44) shift	0.0003	0.0030	0.0185	0.2154
MANAGEMENT (45) shift	0.0603	0.6825	0.0828	0.9802
MANAGEMENT (46) shift	0.0282	0.3268	0.0430	0.5088
MANAGEMENT (47) shift	-0.0223	-0.2262	-0.0087	-0.0893
MANAGEMENT (48) shift	0.0135	0.1538	0.0334	0.3951
MANAGEMENT (49) shift	-0.0310	-0.2389	-0.0358	-0.2759
MANAGEMENT (50) shift	0.0209	0.1933	0.0239	0.2208
MANAGEMENT (51) shift	0.0120	0.1179	0.0084	0.0826
MANAGEMENT (52) shift	0.1303	0.8501	0.1167	0.7647
MANAGEMENT (53) shift	-0.1054	-1.0912	-0.0859	-0.9154
MANAGEMENT (54) shift	0.0867	0.6690	0.0848	0.6544
MANAGEMENT (55) shift	-0.0391	-0.3816	-0.0482	-0.4735
MANAGEMENT (56) shift	0.0383	0.4483	0.0279	0.3300
MANAGEMENT (57) shift	0.0792	0.8729	0.0781	0.8609
MANAGEMENT (58) shift	0.0068	0.0725	0.0394	0.4556
MANAGEMENT (59) shift	0.0388	0.4374	0.0298	0.3384
MANAGEMENT (60) shift	0.0288	0.3327	0.0328	0.3797
MANAGEMENT (61) shift	0.0626	0.7405	0.0717	0.8550
MANAGEMENT (62) shift	0.0203	0.2309	0.0355	0.4121
MANAGEMENT (63) shift	-0.0808	-0.9067	-0.0715	-0.8084
MANAGEMENT (64) shift	0.0302	0.3422	0.0523	0.6186
MANAGEMENT (65) shift	-0.0143	-0.1640	-0.0055	-0.0636
MANAGEMENT (66) shift	0.1440	1.7330	0.1466	1.7662
MANAGEMENT (67) shift	0.0802	0.9026	0.1050	1.2468
MANAGEMENT (68) shift	0.1244	1.1223	0.1458	1.3456
MANAGEMENT (69) shift	0.0033	0.0216	0.0004	0.0025
MANAGEMENT (70) shift	0.0760	0.6960	0.0621	0.5754

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Irrigated Wheat (cont.)				
MANAGEMENT (71) shift	-0.1635	-1.6113	-0.1557	-1.5417
MANAGEMENT (72) shift	0.1157	0.5578	0.1238	0.5985
MANAGEMENT (73) shift	0.0851	0.9712	0.1050	1.2433
MANAGEMENT (74) shift	-0.0003	-0.0037	0.0194	0.2252
MANAGEMENT (75) shift	-0.0579	-0.6532	-0.0489	-0.5566
MANAGEMENT (76) shift	-0.0829	-0.9443	-0.0643	-0.7559
MANAGEMENT (77) shift	0.0551	0.5832	0.0921	1.0905
MANAGEMENT (78) shift	0.2021	1.5488	0.1908	1.4717
Dryland Wheat				
1985 shift	1.7751	13.9675	1.6841	16.1961
1984 shift	1.9623	15.2562	1.8676	18.0132
1983 shift	2.0386	15.9052	1.9449	18.7596
1982 shift	1.9384	14.4550	1.8322	17.7594
1981 shift	1.2263	9.1183	1.1202	10.8100
1980 shift	1.9184	13.7959	1.8039	17.3677
1979 shift	2.3461	17.0273	2.2322	21.7696
1978 shift	2.0374	14.8321	1.9237	18.8396
1977 shift	1.9610	13.9585	1.8426	17.9141
1976 shift	2.1314	15.5412	2.0178	19.7617
1975 shift	2.4780	16.8918	2.3466	23.2456
1974 shift	2.4429	15.7811	2.3010	22.2181
MANAGEMENT (1) shift	0.1068	0.8067	0.0940	0.7124
MANAGEMENT (2) shift	0.0650	0.4498	0.1236	0.9041
MANAGEMENT (3) shift	-0.0488	-0.3581	-0.0218	-0.1585
MANAGEMENT (4) shift	0.0680	0.4669	-0.0203	-0.1512
MANAGEMENT (5) shift	0.0897	0.5653	0.1305	0.9539
MANAGEMENT (6) shift	-0.0618	-0.4415	0.1339	0.8645
MANAGEMENT (7) shift	0.0016	0.0114	-0.0275	-0.2001
MANAGEMENT (8) shift	-0.1563	-1.0671	0.0358	0.2613
MANAGEMENT (9) shift	0.1013	0.3003	-0.1049	-0.7459
MANAGEMENT (10) shift	0.0460	0.3254	0.1620	0.4849
MANAGEMENT (11) shift	0.0352	0.2555	0.0622	0.4421
MANAGEMENT (12) shift	0.0071	0.0512	0.0738	0.5502
MANAGEMENT (13) shift	-0.1589	-1.1484	0.0306	0.2235
MANAGEMENT (14) shift	-0.0330	-0.2400	-0.1357	-0.9893
MANAGEMENT (15) shift	0.1481	1.1020	0.1636	1.2226
MANAGEMENT (16) shift	0.0267	0.1902	0.0833	0.6260
MANAGEMENT (17) shift	0.1228	0.9040	0.1520	1.1356
MANAGEMENT (18) shift	0.1272	0.9487	0.1408	1.0528
MANAGEMENT (19) shift	-0.0194	-0.1386	0.0132	0.0960
MANAGEMENT (20) shift	0.0853	0.6414	0.1035	0.7826
MANAGEMENT (21) shift	0.0585	0.4368	0.0652	0.4869

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Dryland Wheat (cont.)				
MANAGEMENT (22) shift	-0.0312	-0.2299	-0.0144	-0.1061
MANAGEMENT (23) shift	0.0558	0.4167	0.0814	0.6147
MANAGEMENT (24) shift	0.1065	0.7917	0.1248	0.9329
MANAGEMENT (25) shift	0.1078	0.8135	0.1171	0.8856
MANAGEMENT (26) shift	0.1754	1.3198	0.1984	1.5077
MANAGEMENT (27) shift	0.1521	1.1427	0.1686	1.2721
MANAGEMENT (28) shift	0.0080	0.0588	0.0441	0.3296
MANAGEMENT (29) shift	0.1647	1.2362	0.1909	1.4511
MANAGEMENT (30) shift	0.1384	1.0067	0.1733	1.2874
MANAGEMENT (31) shift	-0.0158	-0.0921	0.0542	0.3336
MANAGEMENT (32) shift	-0.0921	-0.5297	-0.0153	-0.0939
MANAGEMENT (33) shift	-0.0943	-0.7073	-0.0753	-0.5684
MANAGEMENT (34) shift	0.0259	0.1807	0.0782	0.5709
MANAGEMENT (35) shift	-0.2601	-1.7695	-0.1953	-1.4215
MANAGEMENT (36) shift	-0.0388	-0.2556	0.0328	0.2341
MANAGEMENT (37) shift	0.1121	0.3248	0.2234	0.6694
MANAGEMENT (38) shift	-0.1010	-0.7000	-0.0461	-0.3355
MANAGEMENT (39) shift	0.0831	0.6217	0.1095	0.8301
MANAGEMENT (40) shift	0.0640	0.4758	0.0897	0.6744
MANAGEMENT (41) shift	0.1215	0.9064	0.1351	1.0104
MANAGEMENT (42) shift	-0.0365	-0.2746	-0.0188	- 0.1426
MANAGEMENT (43) shift	0.0606	0.4503	0.0847	0.6353
MANAGEMENT (44) shift	0.0970	0.7207	0.1269	0.9580
MANAGEMENT (45) shift	-0.0150	-0.1123	0.0077	0.5840
MANAGEMENT (46) shift	0.0681	0.4914	0.1122	0.8367
MANAGEMENT (47) shift	0.1079	0.8193	0.1130	0.8576
MANAGEMENT (48) shift	-0.0942	-0.2768	-0.0177	-0.0529
MANAGEMENT (49) shift	0.0952	0.7071	0.1086	0.8095
MANAGEMENT (50) shift	-0.0715	-0.4652	-0.0232	-0.1559
MANAGEMENT (51) shift	0.1157	0.8765	0.1088	0.8254
MANAGEMENT (52) shift	0.0938	0.6969	0.1086	0.8099
MANAGEMENT (53) shift	0.1145	0.8390	0.1468	1.0954
MANAGEMENT (54) shift	-0.0219	-0.1632	-0.0042	-0.0314
MANAGEMENT (55) shift	-0.0148	-0.1069	0.0279	0.2080
MANAGEMENT (56) shift	0.0672	0.4988	0.0988	0.7461
MANAGEMENT (57) shift	-0.1317	-0.9957	-0.1280	-0.9684
MANAGEMENT (58) shift	0.0202	0.1494	0.0516	0.3883
MANAGEMENT (59) shift	0.0422	0.3173	0.0638	0.4837
MANAGEMENT (60) shift	0.0743	0.5584	0.1200	0.9025
MANAGEMENT (61) shift	0.0939	0.7036	0.1197	0.9080
MANAGEMENT (62) shift	0.1289	0.9696	0.1477	1.1176
MANAGEMENT (63) shift	0.1399	1.0422	0.1598	1.1990
MANAGEMENT (64) shift	0.0277	0.2092	0.0358	0.2705

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Dryland Wheat (cont.)				
MANAGEMENT (65) shift	0.0042	0.0316	0.0270	0.2029
MANAGEMENT (66) shift	0.1260	0.9378	0.1379	1.0285
MANAGEMENT (67) shift	0.0829	0.5991	0.1288	0.9644
MANAGEMENT (68) shift	0.1479	1.1143	0.1694	1.2864
MANAGEMENT (69) shift	0.0736	0.5544	0.0938	0.7109
MANAGEMENT (70) shift	0.1140	0.8633	0.1253	0.9510
MANAGEMENT (71) shift	0.1162	0.8622	0.1521	1.1553
MANAGEMENT (72) shift	0.0515	0.3872	0.0720	0.5456
MANAGEMENT (73) shift	-0.1033	-0.7513	-0.1020	-0.7419
MANAGEMENT (74) shift	-0.0393	-0.2871	-0.0458	-0.3347
MANAGEMENT (75) shift	-0.0531	-0.3933	-0.0551	-0.4078
MANAGEMENT (76) shift	0.0729	0.5291	0.0907	0.6613
MANAGEMENT (77) shift	0.0227	0.1346	0.0771	0.4735
MANAGEMENT (78) shift	0.1447	1.0671	0.1728	1.2920
MANAGEMENT (79) shift	0.1036	0.7739	0.1119	0.8364
MANAGEMENT (80) shift	0.0817	0.6003	0.1067	0.7925
MANAGEMENT (81) shift	0.1728	1.2781	0.1898	1.4107
MANAGEMENT (82) shift	-0.0608	-0.4601	-0.0454	-0.3449
MANAGEMENT (83) shift	0.1066	0.7986	0.1342	1.0185
MANAGEMENT (84) shift	0.1262	0.9447	0.1541	1.1699
MANAGEMENT (85) shift	0.0666	0.4957	0.0614	0.4570
MANAGEMENT (86) shift	0.0192	0.1424	0.0362	0.2702
MANAGEMENT (87) shift	0.0594	0.4248	0.0945	0.6902
MANAGEMENT (88) shift	-0.0137	-0.1040	-0.0153	-0.1155
MANAGEMENT (89) shift	0.0949	0.6994	0.1168	0.8673
MANAGEMENT (90) shift	0.0515	0.3854	0.0793	0.6016
MANAGEMENT (91) shift	0.0579	0.4395	0.0603	0.4581
MANAGEMENT (92) shift	-0.0012	-0.0089	-0.0028	-0.0211
MANAGEMENT (93) shift	0.0999	0.7513	0.0810	0.6134
MANAGEMENT (94) shift	0.0271	0.2050	0.0315	0.2386
MANAGEMENT (95) shift	-0.0128	-0.0963	-0.0215	-0.1623
MANAGEMENT (96) shift	-0.0516	-0.3895	-0.0330	-0.2506
MANAGEMENT (97) shift	-0.0994	-0.6657	-0.0493	-0.3428
MANAGEMENT (98) shift	0.0267	0.2014	0.0452	0.3428
MANAGEMENT (99) shift	0.0435	0.3207	0.0602	0.4464
MANAGEMENT (100) shift	-0.0379	-0.2845	-0.0207	-0.1564
MANAGEMENT (101) shift	0.0692	0.5198	0.0800	0.6026
MANAGEMENT (102) shift	0.0755	0.5720	0.0854	0.6481
MANAGEMENT (103) shift	0.0963	0.7295	0.0882	0.6688
MANAGEMENT (104) shift	0.0780	0.4646	0.1374	0.8537
MANAGEMENT (105) shift	0.0702	0.5275	0.0493	0.3737
MANAGEMENT (106) shift	0.0236	0.1784	0.0127	0.0965
MANAGEMENT (107) shift	0.1383	0.9982	0.1920	1.4578

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Dryland Wheat (cont.)				
MANAGEMENT (108) shift	0.1017	0.7491	0.1429	1.0854
MANAGEMENT (109) shift	0.0962	0.7172	0.1271	0.9642
MANAGEMENT (110) shift	0.1459	1.0441	0.1952	1.4573
MANAGEMENT (111) shift	0.1234	0.9184	0.1536	1.1615
MANAGEMENT (112) shift	0.0639	0.4716	0.0899	0.6706
MANAGEMENT (113) shift	-0.0046	-0.0345	0.0152	0.1148
MANAGEMENT (114) shift	-0.0889	-0.6694	-0.0734	-0.5552
MANAGEMENT (115) shift	0.0113	0.0836	0.0178	0.1319
MANAGEMENT (116) shift	0.1029	0.6469	0.1491	0.9627
MANAGEMENT (117) shift	0.0473	0.3528	0.0781	0.5928
MANAGEMENT (118) shift	-0.0098	-0.0726	0.0047	0.0347
MANAGEMENT (119) shift	0.0371	0.2714	0.0699	0.5210
Irrigated Corn				
1985 shift	-1.7561	-6.6058	-1.6102	-6.0926
1984 shift	-1.6240	-6.1004	-1.4673	-5.5494
1983 shift	-1.7714	-6.6948	-1.6255	-6.1800
1982 shift	-1.5500	-5.8681	-1.4196	-5.4003
1981 shift	-1.5870	-6.0152	-1.4450	-5.5083
1980 shift	-1.4208	-5.4570	-1.3291	-5.1175
1979 shift	-1.1563	-4.4434	-1.0621	-4.0917
1978 shift	-1.1537	-4.4527	-1.0810	-4.1784
1977 shift	-1.2734	-4.9166	-1.2049	-4.6587
1976 shift	-1.1173	-4.3180	-1.0487	-4.0586
1975 shift	-0.9579	-3.7182	-0.9085	-3.5290
1974 shift	-0.5034	-1.9723	-0.4849	-1.9001
MANAGEMENT (1) shift	3.5099	13.4691	3.2154	12.6509
MANAGEMENT (2) shift	3.6822	14.0900	3.3497	13.2335
MANAGEMENT (3) shift	3.6196	13.9721	3.3272	13.1686
MANAGEMENT (4) shift	3.7001	14.1954	3.3741	13.3501
MANAGEMENT (5) shift	3.6001	13.7363	3.3237	12.9609
MANAGEMENT (6) shift	3.5743	13.8105	3.2991	13.0324
MANAGEMENT (7) shift	3.5666	13.3501	3.3706	12.7490
MANAGEMENT (8) shift	3.4960	12.8899	3.2389	12.1534
MANAGEMENT (9) shift	3.6891	14.0961	3.3429	13.2228
MANAGEMENT (10) shift	3.7762	14.3042	3.3762	13.3883
MANAGEMENT (11) shift	3.5434	13.7020	3.2720	12.9282
MANAGEMENT (12) shift	3.7268	14.1882	3.3553	13.2913
MANAGEMENT (13) shift	3.5955	13.7476	3.3128	12.9597
MANAGEMENT (14) shift	3.6024	13.9178	3.3210	13.1314
MANAGEMENT (15) shift	3.4712	13.2380	3.2195	12.5003
MANAGEMENT (16) shift	3.5679	13.4885	3.3396	12.8099
MANAGEMENT (17) shift	3.6155	13.6373	3.3186	12 8451

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Irrigated Corn (cont.)				
MANAGEMENT (18) shift	3.5189	13.6800	3.2955	13.0013
MANAGEMENT (19) shift	3.5292	13.6225	3.2933	12.9191
MANAGEMENT (20) shift	3.4666	12.4282	3.2302	11.7451
MANAGEMENT (21) shift	3.5879	13.8846	3.3395	13.1592
MANAGEMENT (22) shift	3.4872	13.0391	3.3149	12.4955
MANAGEMENT (23) shift	3.5763	13.8953	3.3456	13.2035
MANAGEMENT (24) shift	3.5426	13.3419	3.2983	12.6287
MANAGEMENT (25) shift	3.6515	14.1306	3.3685	13.3452
MANAGEMENT (26) shift	3.6098	13.9033	3.3153	13.0954
MANAGEMENT (27) shift	3.5832	13.8361	3.3078	13.0587
MANAGEMENT (28) shift	3.6910	14.1828	3.3739	13.3490
MANAGEMENT (29) shift	3.5688	13.8423	3.3181	13.1098
MANAGEMENT (30) shift	3.4234	12.3276	3.2138	11.7011
MANAGEMENT (31) shift	3.6343	14.0669	3.3900	13.3522
MANAGEMENT (32) shift	3.6585	13.9910	3.3196	13.1228
MANAGEMENT (33) shift	3.6078	11.9112	3.3901	11.3049
MANAGEMENT (34) shift	3.5271	11.6859	3.2916	11.0356
MANAGEMENT (35) shift	3.6993	14.2781	3.3843	13.4627
MANAGEMENT (36) shift	3.6896	14.1755	3.3659	13.3321
MANAGEMENT (37) shift	3.6027	13.9085	3.3472	13.1702
MANAGEMENT (38) shift	3.6105	13.8607	3.3120	13.0476
MANAGEMENT (39) shift	3.6801	14.1749	3.3761	13.3589
MANAGEMENT (40) shift	3.6567	14.1660	3.3777	13.3881
MANAGEMENT (41) shift	3.6972	14.1666	3.3589	13.3045
MANAGEMENT (42) shift	3.6131	14.0673	3.3692	13.3511
MANAGEMENT (43) shift	3.2495	10.5156	2.9458	9.7150
MANAGEMENT (44) shift	3.4004	13.3094	3.2914	12.9288
MANAGEMENT (45) shift	3.4751	13.2324	3.3699	12.8724
MANAGEMENT (46) shift	3.5829	13.8317	3.3037	13.0474
MANAGEMENT (47) shift	3.4251	12.7020	3.1092	11.8451
MANAGEMENT (48) shift	3.5114	13.6439	3.3320	13.0699
MANAGEMENT (49) shift	3.4874	13.4827	3.2433	12.7588
MANAGEMENT (50) shift	3.6202	13.9534	3.3432	13.1763
MANAGEMENT (51) shift	3.5479	13.7020	3.3009	12.9766
MANAGEMENT (52) shift	3.5029	13.5797	3.2769	12.8950
MANAGEMENT (53) shift	3.6817	14.1562	3.3638	13.3199
MANAGEMENT (54) shift	3.5929	13.3535	3.3484	12.6465
MANAGEMENT (55) shift	3.1098	10.0357	2.8156	9.2463
MANAGEMENT (56) shift	3.5047	13.3991	3.2962	12.7587
MANAGEMENT (57) shift	3.2942	12.6426	2.9850	11.7773
MANAGEMENT (58) shift	3.4845	13.5523	3.3255	13.0307
MANAGEMENT (59) shift	3.4649	13.1283	3.2250	12.4178
MANAGEMENT (60) shift	3.3874	12.6920	3.2710	12.3015

	SUR		SUR Forced to Constant Returns to Scale	
Equation/Coefficient	Estimate	T-Ratio	Estimate	T-Ratio
Irrigated Corn (cont.)				
MANAGEMENT (61) shift	3.4420	12.8629	3.2912	12.3748
MANAGEMENT (62) shift	3.7055	14.0397	3.3389	13.1416
Irrigated Grain Sorghum				
1985 shift	1.6170	24.9784	1.6205	25.9942
1984 shift	1.5899	24.6985	1.5934	25.7402
1983 shift	1.4453	21.9972	1.4490	22.9133
1982 shift	1.6530	24.9312	1.6571	26.3057
1981 shift	1.6245	24.1044	1.6282	25.4735
1980 shift	1.6834	23.7369	1.6878	25.5392
1979 shift	1.9766	28.7961	1.9813	31.1819
1978 shift	2.0681	31.3855	2.0725	33.7675
1977 shift	1.9454	28.0087	1.9501	30.1765
1976 shift	2.0272	30.7131	2.0316	32.6180
1975 shift	2.1124	30.7635	2.1178	33.6276
1974 shift	2.2407	28.3219	2.2472	32.2437
MANAGEMENT (1) shift	0.0671	0.8037	0.0677	0.8109
MANAGEMENT (2) shift	-0.0178	-0.2045	-0.0159	-0.1845
MANAGEMENT (3) shift	0.0664	0.7533	0.0701	0.8135
MANAGEMENT (4) shift	0.0434	0.4998	0.0454	0.5262
MANAGEMENT (5) shift	-0.0353	-0.4229	-0.0313	-0.3854
MANAGEMENT (6) shift	0.0735	0.8629	0.0802	1.0139
MANAGEMENT (7) shift	0.0059	0.0626	0.0087	0.0931
MANAGEMENT (8) shift	-0.1260	-1.4176	-0.1216	-1.4083
MANAGEMENT (9) shift	0.0837	0.5375	0.0797	0.5144
MANAGEMENT (10) shift	-0.0021	-0.0179	-0.0013	-0.0114
MANAGEMENT (11) shift	-0.1245	-1.4912	-0.1206	-1.4837
MANAGEMENT (12) shift	0.0084	0.0999	0.0140	0.1774
MANAGEMENT (13) shift	0.0883	1.0585	0.0889	1.0663
MANAGEMENT (14) shift	0.0410	0.4872	0.0429	0.5140
MANAGEMENT (15) shift	0.0038	0.4080	0.0049	0.0616
MANAGEMENT (16) shift	0.1082	1.3040	0.1119	1.3818
MANAGEMENT (17) shift	0.0707	0.7129	0.0721	0.7289
MANAGEMENT (18) shift	0.0722	0.6238	0.0723	0.6249
MANAGEMENT (19) shift	0.1350	0.6345	0.1352	0.6354
MANAGEMENT (20) shift	0.0507	0.4381	0.0495	0.4282
MANAGEMENT (21) shift	-0.0045	-0.0428	-0.0059	-0.0556
MANAGEMENT (22) shift	-0.0221	-0.2685	-0.0193	-0.2381
MANAGEMENT (23) shift	-0.0498	-0.5015	-0.0490	-0.4947
MANAGEMENT (24) shift	0.0421	0.5092	0.0456	0.5618
MANAGEMENT (25) shift	0.0767	0.9053	0.0798	0.9564
MANAGEMENT (26) shift	0.1258	1.5607	0.1291	1.6367
MANAGEMENT (27) shift	-0.0559	-0.6652	-0.0499	-0.6299

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Irrigated Grain Sorghum (cont.)				
MANAGEMENT (28) shift	0.0809	0.9902	0.0846	1.0713
MANAGEMENT (29) shift	-0.1496	-1.5002	-0.1484	-1.4960
MANAGEMENT (30) shift	0.0787	0.9614	0.0831	1.0523
MANAGEMENT (31) shift	-0.0144	-0.1763	-0.0125	-0.1544
MANAGEMENT (32) shift	-0.0316	-0.3850	-0.0295	-0.3627
MANAGEMENT (33) shift	0.0868	1.0096	0.0867	1.0081
MANAGEMENT (34) shift	-0.0011	-0.0133	0.0004	0.0049
MANAGEMENT (35) shift	-0.0154	-0.1832	-0.0108	-0.1333
MANAGEMENT (36) shift	0.0879	0.9146	0.0894	0.9549
MANAGEMENT (37) shift	0.0366	0.2805	0.0392	0.3016
MANAGEMENT (38) shift	0.0638	0.7851	0.0677	0.8561
MANAGEMENT (39) shift	0.1765	1.3570	0.1785	1.3766
MANAGEMENT (40) shift	0.1329	1.1427	0.1347	1.1666
MANAGEMENT (41) shift	0.0861	0.9837	0.0898	1.0426
MANAGEMENT (42) shift	0.0054	0.0570	0.0061	0.0656
MANAGEMENT (43) shift	-0.0623	-0.4763	-0.0601	-0.4626
MANAGEMENT (44) shift	0.1144	1.2606	0.1172	1.3096
MANAGEMENT (45) shift	0.1161	1.2712	0.1195	1.3351
MANAGEMENT (46) shift	0.0032	0.0299	0.0049	0.0461
MANAGEMENT (47) shift	0.0309	0.3703	0.0350	0.4311
MANAGEMENT (48) shift	-0.0856	-0.4030	-0.0883	-0.4154
MANAGEMENT (49) shift	-0.3107	-0.0246	-0.3210	-0.0254
MANAGEMENT (50) shift	0.0578	0.6395	0.0550	0.6152
MANAGEMENT (51) shift	0.0441	0.5117	0.0433	0.5025
MANAGEMENT (52) shift	0.0319	0.2450	0.0324	0.2488
MANAGEMENT (53) shift	0.0693	0.7542	0.0728	0.8124
MANAGEMENT (54) shift	0.0699	0.7473	0.0690	0.7381
MANAGEMENT (55) shift	-0.0110	-0.1106	-0.0136	-0.1376
MANAGEMENT (56) shift	0.1301	1.5934	0.1281	1.5801
MANAGEMENT (57) shift	0.0536	0.5978	0.0528	0.5896
MANAGEMENT (58) shift	0.0050	0.0237	0.0033	0.0157
MANAGEMENT (59) shift	-0.0140	-0.1556	-0.0051	-0.0640
MANAGEMENT (60) shift	0.0695	0.8551	0.0709	0.8750
MANAGEMENT (61) shift	0.0655	0.8209	0.0675	0.8534
MANAGEMENT (62) shift	-0.0811	-1.0099	-0.0784	-0.9891
MANAGEMENT (63) shift	0.0224	0.1923	0.0262	0.2269
MANAGEMENT (64) shift	-0.2195	-2.6526	-0.2166	-2.6585
MANAGEMENT (65) shift	-0.1179	-1.4707	-0.1154	-1.4562
MANAGEMENT (66) shift	-0.1387	-1.3076	-0.1376	-1.2978
MANAGEMENT (67) shift	-0.1334	-1.2587	-0.1337	-1.2622
MANAGEMENT (68) shift	0.1266	1.6037	0.1271	1.6120
MANAGEMENT (69) shift	-0.1262	-0.5931	-0.1257	-0.5919
MANAGEMENT (70) shift	-0.0563	-0.2626	-0.0509	-0.2402

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Irrigated Grain Sorghum (cont.)				
MANAGEMENT (71) shift	-0.1185	-0.5569	-0.1186	-0.5574
MANAGEMENT (72) shift	0.1203	0.9175	0.1238	0.9519
MANAGEMENT (73) shift	-0.3857	-2.4865	-0.3855	-2.4871
MANAGEMENT (74) shift	-0.2710	-1.7450	-0.2697	-1.7379
MANAGEMENT (75) shift	-0.0836	-0.7878	-0.0828	-0.7809
MANAGEMENT (76) shift	0.0263	0.2273	0.0280	0.2427
MANAGEMENT (77) shift	0.1605	1.9743	0.1647	2.0894
MANAGEMENT (78) shift	0.0776	0.9769	0.0792	1.0025
MANAGEMENT (79) shift	-0.0728	-0.7785	-0.0674	-0.7504
MANAGEMENT (80) shift	-0.1518	-1.8505	-0.1495	-1.8395
MANAGEMENT (81) shift	-0.6235	-5.3256	-0.6208	-5.3544
MANAGEMENT (82) shift	0.0390	0.3323	0.0425	0.3676
Dryland Grain Sorghum				
1985 shift	1.8305	17.3144	1.7707	17.2220
1984 shift	1.4898	14.0184	1.4265	13.8445
1983 shift	1.1709	10.9776	1.1080	10.7071
1982 shift	1.6558	15.1284	1.6074	14.9371
1981 shift	1.8734	16.7499	1.8225	16.5931
1980 shift	1.7464	15.2856	1.6953	15.1048
1979 shift	2.1892	19.9248	2.1316	19.8682
1978 shift	1.9018	17.4461	1.8337	17.3988
1977 shift	2.1916	19.6325	2.1312	19.5873
1976 shift	2.0083	18.2376	1.9041	18.7546
1975 shift	1.9551	17.6129	1.8757	17.6835
1974 shift	2.4315	19.3627	2.3369	19.6043
MANAGEMENT (1) shift	0.0130	0.0973	-0.0992	-0.7903
MANAGEMENT (2) shift	-0.0144	-0.0626	-0.0085	-0.0371
MANAGEMENT (3) shift	0.0917	0.7182	0.0897	0.7027
MANAGEMENT (4) shift	-0.1641	-0.8449	-0.1786	-0.9200
MANAGEMENT (5) shift	-0.0506	-0.1630	-0.0635	-0.2045
MANAGEMENT (6) shift	0.1434	0.6209	0.2331	1.0219
MANAGEMENT (7) shift	-0.1699	-1.1866	-0.2410	-1.7186
MANAGEMENT (8) shift	-0.0884	-0.6344	-0.0841	-0.6038
MANAGEMENT (9) shift	-0.3905	-2.6366	-0.4551	-3.1249
MANAGEMENT (10) shift	-0.0513	-0.2228	-0.0874	-0.3807
MANAGEMENT (11) shift	0.1184	0.8335	0.0424	0.3058
MANAGEMENT (12) shift	-0.0223	-0.1679	-0.0745	-0.5681
MANAGEMENT (13) shift	-0.1441	-0.9875	-0.1798	-1.2386
MANAGEMENT (14) shift	0.0607	0.2643	0.0038	0.0167
MANAGEMENT (15) shift	0.0601	0.3955	0.0442	0.2910
MANAGEMENT (16) shift	0.0819	0.6078	0.0658	0.4888
MANAGEMENT (17) shift	0.0207	0.0667	0.0646	0.2089

Equation/Coefficient	SUR		SUR Forced to Constant Returns to Scale	
	Estimate	T-Ratio	Estimate	T-Ratio
Dryland Grain Sorghum (cont.)				
MANAGEMENT (18) shift	0.1278	0.8813	0.1002	0.6931
MANAGEMENT (19) shift	0.0974	0.7598	0.0927	0.7237
MANAGEMENT (20) shift	0.1444	0.8919	0.1072	0.6651
MANAGEMENT (21) shift	0.2316	1.4350	0.2051	1.2742
MANAGEMENT (22) shift	0.0550	0.3922	0.0163	0.1174
MANAGEMENT (23) shift	0.2214	1.3754	0.2348	1.4595
MANAGEMENT (24) shift	0.1660	1.0891	0.1292	0.8522
MANAGEMENT (25) shift	0.1823	1.3520	0.1655	1.2296
MANAGEMENT (26) shift	0.2014	1.5014	0.2103	1.5689
MANAGEMENT (27) shift	0.1523	0.9445	0.1322	0.8212
MANAGEMENT (28) shift	0.0245	0.1957	0.0339	0.2708
MANAGEMENT (29) shift	0.0661	0.4352	0.0437	0.2887
MANAGEMENT (30) shift	-0.0736	-0.4226	-0.0609	-0.3501
MANAGEMENT (31) shift	0.0996	0.7788	0.0362	0.2893
MANAGEMENT (32) shift	0.0961	0.4196	0.0891	0.3891
MANAGEMENT (33) shift	-0.1004	-0.5165	-0.1083	-0.5573
MANAGEMENT (34) shift	-0.2157	-1.8070	-0.3322	-1.9029
MANAGEMENT (35) shift	-0.1121	-0.5819	-0.1207	-0.6212
MANAGEMENT (36) shift	0.1433	1.1357	0.1027	0.8215
MANAGEMENT (37) shift	0.0692	0.5326	0.0157	0.1225
MANAGEMENT (38) shift	0.1757	1.3617	0.1308	1.0249
MANAGEMENT (39) shift	-0.0057	-0.0452	-0.0357	-0.2843
MANAGEMENT (40) shift	0.0678	0.5404	0.0474	0.3787
MANAGEMENT (41) shift	0.2490	1.9597	0.1935	1.5479
MANAGEMENT (42) shift	0.1323	1.0118	0.1247	0.9541
MANAGEMENT (43) shift	0.1076	0.5539	0.1007	0.5187
MANAGEMENT (44) shift	-0.2118	-1.0899	-0.2291	-1.1802
MANAGEMENT (45) shift	-0.3667	-1.1796	-0.4095	-1.3198
MANAGEMENT (46) shift	-0.0764	-0.5968	-0.0830	-0.6478
MANAGEMENT (47) shift	0.1104	0.7809	0.0491	0.3530
MANAGEMENT (48) shift	0.0328	0.2357	0.0268	0.1922
MANAGEMENT (49) shift	0.0054	0.0172	-0.0368	-0.1188
MANAGEMENT (50) shift	0.0302	0.1308	-0.0340	-0.1483
MANAGEMENT (51) shift	0.1411	0.8755	0.1460	0.9059
MANAGEMENT (52) shift	-0.0901	-0.5536	-0.1319	-0.8151
MANAGEMENT (53) shift	0.0324	0.2129	0.0207	0.1362
MANAGEMENT (54) shift	-0.1140	-0.4986	-0.1168	-0.5110
MANAGEMENT (55) shift	-0.0397	-0.2929	-0.0709	-0.5259
MANAGEMENT (56) shift	-0.1532	-1.0973	-0.1307	-0.9384
MANAGEMENT (57) shift	0.1351	1.0205	0.0303	0.2421
MANAGEMENT (58) shift	0.0634	0.4899	0.0132	0.1036
MANAGEMENT (59) shift	0.2005	1.4686	0.1446	1.0749
MANAGEMENT (60) shift	0.0607	0.4766	0.0068	0.0546

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Dryland Grain Sorghum (cont.)				
MANAGEMENT (61) shift	0.0919	0.7166	0.0670	0.5242
MANAGEMENT (62) shift	-0.0369	-0.1189	-0.0664	-0.2141
MANAGEMENT (63) shift	0.0149	0.0976	-0.0155	-0.1021
MANAGEMENT (64) shift	0.0869	0.5318	0.0258	0.1599
MANAGEMENT (65) shift	0.0696	0.4299	0.0341	0.2113
MANAGEMENT (66) shift	0.0639	0.2799	0.0649	0.2843
MANAGEMENT (67) shift	-0.0289	-0.1647	-0.0690	-0.3954
MANAGEMENT (68) shift	-0.0360	-0.2561	-0.1729	-1.3412
MANAGEMENT (69) shift	0.0469	0.3204	-0.0072	-0.0498
MANAGEMENT (70) shift	0.1415	1.0612	0.0319	0.2545
MANAGEMENT (71) shift	0.0768	0.5968	0.0405	0.3171
MANAGEMENT (72) shift	-0.1085	-0.6202	-0.1356	-0.7765
MANAGEMENT (73) shift	-0.0903	-0.6447	-0.1812	-1.3418
MANAGEMENT (74) shift	0.0063	0.0489	-0.0470	-0.3679
MANAGEMENT (75) shift	-0.1683	-1.1980	-0.2124	-1.5247
MANAGEMENT (76) shift	0.2035	1.3358	0.1733	1.1416
MANAGEMENT (77) shift	0.0471	0.3079	0.0030	0.0195
MANAGEMENT (78) shift	-0.0547	-0.3686	-0.1287	-0.8863
MANAGEMENT (79) shift	-0.3608	-1.8554	-0.3614	-1.8581
MANAGEMENT (80) shift	0.2707	0.8706	0.2291	0.7380
MANAGEMENT (81) shift	-0.3057	-1.5645	-0.3380	-1.8432
MANAGEMENT (82) shift	0.0402	0.1758	0.0066	0.0287
MANAGEMENT (83) shift	0.0733	0.3180	0.0114	0.0497
MANAGEMENT (84) shift	0.1466	0.7435	0.0622	0.3206
MANAGEMENT (85) shift	-0.2475	-1.5178	-0.3074	-1.9075
MANAGEMENT (86) shift	-0.0803	-0.5559	-0.2043	-1.5135
MANAGEMENT (87) shift	-0.3391	-1.9245	-0.4033	-2.3151
MANAGEMENT (88) shift	-0.1991	-1.1374	-0.2266	-1.2978
MANAGEMENT (89) shift	-0.0665	-0.2142	-0.0890	-0.2867
MANAGEMENT (90) shift	-0.2882	-0.9237	-0.3561	-1.1460
MANAGEMENT (91) shift	0.0298	0.4771	0.0169	0.1171
MANAGEMENT (92) shift	-0.0831	-0.4264	-0.1271	-0.6549
MANAGEMENT (93) shift	-0.1172	-0.7230	-0.1562	-0.9684
MANAGEMENT (94) shift	0.3409	1.7464	0.2873	1.4813
MANAGEMENT (95) shift	0.1792	0.5745	0.1141	0.3671
MANAGEMENT (96) shift	0.0871	0.5370	0.0401	0.2487
MANAGEMENT (97) shift	0.1128	0.3615	0.1922	0.6194
MANAGEMENT (98) shift	0.0604	0.4588	-0.0157	-0.1224
MANAGEMENT (99) shift	0.0014	0.0081	-0.0431	-0.2472
MANAGEMENT (100) shift	-0.0236	-0.0756	0.0815	0.2629
MANAGEMENT (101) shift	0.0199	0.0869	-0.0195	-0.0852
MANAGEMENT (102) shift	0.0342	0.2254	0.0258	0.1703
MANAGEMENT (103) shift	0.1062	0.6103	0.1095	0.6292

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Dryland Grain Sorghum (cont.)				
MANAGEMENT (104) shift	0.2582	1.7745	0.2134	1.4789
MANAGEMENT (105) shift	0.0681	0.2965	0.0433	0.1887
MANAGEMENT (106) shift	-0.1789	-1.3526	-0.2123	-1.6142
MANAGEMENT (107) shift	-0.1852	-1.4121	-0.2720	-2.1560
MANAGEMENT (108) shift	0.0859	-0.5505	-0.1724	-1.1349
MANAGEMENT (109) shift	-0.1525	-0.7835	-0.1819	-0.9364
MANAGEMENT (110) shift	0.2121	1.2182	0.1923	1.1057
MANAGEMENT (111) shift	-0.0427	-0.1839	-0.1275	-0.5559
MANAGEMENT (112) shift	0.4280	1.3750	0.3732	1.2023
Irrigated Soybeans				
1985 shift	0.0828	1.4750	0.0806	1.4333
1984 shift	0.1323	2.3176	0.1508	2.6531
1983 shift	0.2113	3.6188	0.2510	4.3941
1982 shift	0.1779	2.6534	0.1872	2.7938
1981 shift	-0.0809	-0.7853	-0.0541	-0.5265
1980 shift	0.0913	0.6787	0.1175	0.8747
1979 shift	0.6267	6.5581	0.6742	7.1383
1978 shift	0.4817	5.9382	0.5283	6.6157
1977 shift	0.2847	2.6192	0.3022	2.7840
1976 shift	-0.2567	-2.8694	-0.1784	-2.0700
1975 shift	0.0879	1.0698	0.1367	1.6920
1974 shift	1.2906	6.3704	1.3568	6.7303
MANAGEMENT (1) shift	1.7963	19.5764	1.9349	23.8429
MANAGEMENT (2) shift	1.7316	17.8282	1.8649	21.3072
MANAGEMENT (3) shift	1.6161	16.7925	1.7839	22.0482
MANAGEMENT (4) shift	1.9111	22.2125	2.0441	27.0548
MANAGEMENT (5) shift	1.9026	13.5777	1.9731	14.2490
MANAGEMENT (6) shift	1.8822	17.1455	2.0178	19.8869
MANAGEMENT (7) shift	1.7154	16.5452	1.8931	21.5406
MANAGEMENT (8) shift	1.5471	10.6921	1.6953	12.3538
MANAGEMENT (9) shift	1.7920	19.1874	1.8907	21.4363
MANAGEMENT (10) shift	1.7195	14.8807	1.9070	19.0628
MANAGEMENT (11) shift	1.6557	11.2269	1.8596	13.9805
MANAGEMENT (12) shift	1.8259	20.4129	1.9690	25.3309
MANAGEMENT (13) shift	1.7585	18.5232	1.8758	21.3869
MANAGEMENT (14) shift	1.8040	20.9675	1.9364	25.5955
MANAGEMENT (15) shift	1.8100	12.5996	1.9822	14.8569
MANAGEMENT (16) shift	1.3217	9.3938	1.5028	11.6636
MANAGEMENT (17) shift	1.9945	18.1167	2.1407	21.3315
MANAGEMENT (18) shift	1.7903	18.9788	1.9407	23.6658
MANAGEMENT (19) shift	1.6051	16.6174	1.7693	21.5480
MANAGEMENT (20) shift	1.8067	18.7940	1.9632	23.6834

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Irrigated Soybeans (cont.)				
MANAGEMENT (21) shift	2.0244	12.3032	2.2796	15.7983
MANAGEMENT (22) shift	1.6282	12.3043	1.7160	13.2467
MANAGEMENT (23) shift	1.6763	16.7949	1.8111	19.9976
MANAGEMENT (24) shift	1.7264	18.7854	1.9121	26.6851
MANAGEMENT (25) shift	1.9847	21.4894	2.1645	29.3405
MANAGEMENT (26) shift	1.7808	17.3915	2.0209	28.7266
MANAGEMENT (27) shift	1.8401	19.3599	2.0041	24.9435
MANAGEMENT (28) shift	1.9275	20.6915	2.0650	24.9327
MANAGEMENT (29) shift	1.7041	16.3453	1.8813	21.1890
MANAGEMENT (30) shift	1.7873	18.5911	1.9677	25.1638
MANAGEMENT (31) shift	1.9999	17.0320	2.2283	23.8033
MANAGEMENT (32) shift	1.9649	19.8263	2.1096	23.8782
MANAGEMENT (33) shift	1.8670	22.0065	1.9877	26.1074
MANAGEMENT (34) shift	1.9064	21.3996	2.0201	24.7057
MANAGEMENT (35) shift	1.8063	18.7055	1.9740	24.2489
MANAGEMENT (36) shift	1.9922	23.8500	2.0831	26.4643
MANAGEMENT (37) shift	2.0785	18.4002	2.1792	20.0581
MANAGEMENT (38) shift	1.7936	22.8780	1.9013	26.7820
MANAGEMENT (39) shift	1.6483	17.4189	1.7701	20.4197
MANAGEMENT (40) shift	1.8708	13.7034	2.0133	15.5828
MANAGEMENT (41) shift	0.9603	9.4923	1.1707	15.2023
MANAGEMENT (42) shift	0.6966	4.8206	0.8578	6.3270
MANAGEMENT (43) shift	1.9367	18.1534	2.0553	20.5165
MANAGEMENT (44) shift	1.2534	7.7531	1.3855	8.8550
MANAGEMENT (45) shift	1.9548	20.1882	2.0843	23.6413
MANAGEMENT (46) shift	1.1245	7.6176	1.3094	9.6229
MANAGEMENT (47) shift	1.6384	18.2004	1.7946	23.6559
Irrigated Afalfa				
1985 shift	-1.4648	-3.3904	-0.7960	-1.8664
1984 shift	-1.1559	-3.0116	-0.4425	-1.1750
1983 shift	-1.2873	-3.6760	-0.6080	-1.7725
1982 shift	-1.2470	-3.3348	-0.6227	-1.6907
1981 shift	-1.2037	-3.2593	-0.5959	-1.6376
1980 shift	-1.1291	-3.2136	-0.5208	-1.5068
1979 shift	-1.1647	-3.3001	-0.1955	-1.4320
1978 shift	-1.1719	-3.3356	-0.4697	-1.3667
1977 shift	-1.1528	-3.1888	-0.5180	-1.4572
1976 shift	-1.1003	-2.9684	-0.3771	-1.0388
1975 shift	-1.2868	-3.1705	-0.5825	-1.4589
1974 shift	-1.0755	-3.0047	-0.4277	-1.2166
MANAGEMENT (1) shift	1.6886	12.2185	1.9770	14.6552
MANAGEMENT (2) shift	1.3405	9.8930	1.8324	14.6181

Equation/Coefficient	SUR Estimate	SUR T-Ratio	SUR Forced to Constant Returns to Scale Estimate	SUR Forced to Constant Returns to Scale T-Ratio
Irrigated Alfalfa (cont.)				
MANAGEMENT (3) shift	1.1676	8.1045	1.6516	12.2485
MANAGEMENT (4) shift	1.7625	12.7221	1.9955	14.6300
MANAGEMENT (5) shift	1.6582	9.2169	2.2687	13.4673
MANAGEMENT (6) shift	1.5736	8.9088	1.7780	10.1383
MANAGEMENT (7) shift	1.4133	9.5489	1.9405	14.1228
MANAGEMENT (8) shift	1.3226	9.3358	1.6696	12.1904
MANAGEMENT (9) shift	1.3684	10.2180	1.7556	13.7520
MANAGEMENT (10) shift	1.5486	10.7111	1.9476	14.0674
MANAGEMENT (11) shift	1.2744	8.5141	1.9546	14.8381
MANAGEMENT (12) shift	2.7640	8.7749	2.7044	8.5875
MANAGEMENT (13) shift	1.3948	9.9696	1.9352	15.1188
MANAGEMENT (14) shift	1.2067	8.6822	1.7870	14.2926
MANAGEMENT (15) shift	1.1657	7.3510	1.2827	8.1140
MANAGEMENT (16) shift	1.1924	8.2608	1.8847	15.0921
MANAGEMENT (17) shift	1.2706	9.1214	1.8284	14.4555
MANAGEMENT (18) shift	1.3906	9.6816	1.9300	14.6090
MANAGEMENT (19) shift	1.3866	10.0801	1.8857	14.8146
MANAGEMENT (20) shift	1.8661	9.5681	2.1750	11.3049
MANAGEMENT (21) shift	1.6348	10.5742	2.0510	13.8199
MANAGEMENT (22) shift	1.3692	9.4884	1.9099	14.3835
MANAGEMENT (23) shift	1.4971	9.4870	2.0599	14.0638
MANAGEMENT (24) shift	1.8706	12.4377	2.0257	13.5459
MANAGEMENT (25) shift	1.5613	11.4173	1.9305	14.7134
MANAGEMENT (26) shift	1.6058	10.8250	1.7739	12.0426
MANAGEMENT (27) shift	1.0949	7.4783	1.7838	13.9959
MANAGEMENT (28) shift	2.0354	13.2147	2.0538	13.3348
MANAGEMENT (29) shift	1.6876	12.4897	1.9392	14.6289
MANAGEMENT (30) shift	0.7869	3.3533	1.5044	6.7697
MANAGEMENT (31) shift	1.2775	9.2109	1.8401	14.6517
MANAGEMENT (32) shift	1.5828	11.7763	1.8617	14.1902
MANAGEMENT (33) shift	1.4593	9.3074	1.9447	15.0566
MANAGEMENT (34) shift	1.3176	9.2020	1.9565	15.4469
MANAGEMENT (35) shift	1.3104	9.6878	1.7917	14.2718
MANAGEMENT (36) shift	0.8323	3.8712	1.4094	6.8328
MANAGEMENT (37) shift	1.3674	9.7491	1.8796	14.4974
MANAGEMENT (38) shift	1.4407	8.0160	1.8367	10.5007
MANAGEMENT (39) shift	1.7259	8.9026	2.0275	10.5974
MANAGEMENT (40) shift	1.1354	7.8509	1.8383	14.7605
MANAGEMENT (41) shift	1.7953	13.4102	1.8353	13.7156
MANAGEMENT (42) shift	1.3061	9.5235	1.8314	14.5732

Equation/Coefficient	SUR Other Excluded 1974-1980 Estimate	SUR Other Excluded 1974-1980 T-Ratio	SUR Other Excluded 1981-1985 Estimate	SUR Other Excluded 1981-1985 T-Ratio
Irrigated Wheat				
1985 shift	------		1.2432	11.4827
1984 shift	------		1.4274	12.8356
1983 shift	------		1.4283	12.7489
1982 shift	------		1.3447	11.5634
1981 shift	------		0.7256	5.8242
1980 shift	2.1388	21.8583	------	
1979 shift	2.5753	27.4308	------	
1978 shift	2.3371	25.4495	------	
1977 shift	2.1703	23.2758	------	
1976 shitt	2.5820	28.4531	------	
1975 shift	2.7417	28.7801	------	
1974 shift	2.5910	24.0359	------	
MANAGEMENT (1) shift	-0.1229	-1.1513	0.6462	4.3634
MANAGEMENT (2) shift	-0.3231	-3.0280	0.6666	5.0515
MANAGEMENT (3) shift	-0.2634	-2.4418	0.3969	2.8125
MANAGEMENT (4) shift	-0.0689	-0.6624	0.4888	3.4835
MANAGEMENT (5) shift	-0.1177	-1.1279	0.4330	3.2496
MANAGEMENT (6) shift	-0.2626	-2.4408	0.4625	3.1778
MANAGEMENT (7) shift	-0.2433	-2.3014	0.5631	4.1440
MANAGEMENT (8) shift	-0.1330	-1.2584	0.4415	3.0388
MANAGEMENT (9) shift	-0.1981	-1.9214	0.4907	3.4545
MANAGEMENT (10) shift	-0.2064	-1.7722	0.5110	3.7449
MANAGEMENT (11) shift	-0.1774	-1.6940	0.4173	3.0939
MANAGEMENT (12) shift	-0.3015	-2.7427	0.4268	2.7267
MANAGEMENT (13) shift	-0.3042	-2.7035	0.4207	2.8897
MANAGEMENT (14) shift	-0.2548	-2.4633	0.2308	1.6741
MANAGEMENT (15) shift	0.4407	0.2900	0.2663	1.9141
MANAGEMENT (16) shift	-0.1158	-1.1175	0.1688	1.2153
MANAGEMENT (17) shift	-0.1276	-1.1326	0.3157	2.3905
MANAGEMENT (18) shift	-0.4105	-3.8244	0.4729	3.3778
MANAGEMENT (19) shift	-1.8535	-0.0711	0.4803	2.8813
MANAGEMENT (20) shift	-0.1005	-0.8981	-0.0504	-0.3761
MANAGEMENT (21) shift	-0.0316	-0.2055	-1.2262	-0.0395
MANAGEMENT (22) shift	0.0091	0.0455	0.1310	0.7863
MANAGEMENT (23) shift	-0.2040	-1.9148	0.3644	2.6118
MANAGEMENT (24) shift	-2.0946	-0.0802	0.4894	2 8250
MANAGEMENT (25) shift	-0.2834	-2.1340	0.2445	1.1342
MANAGEMENT (26) shift	-0.2624	-2.1989	0.4332	3.3393
MANAGEMENT (27) shift	-0.1615	-1.4567	0.6079	4 7207
MANAGEMENT (28) shift	-0.1248	-1.1768	0.3515	2.4633
MANAGEMENT (29) shift	-0 0869	-0.8388	0 5139	3 8053

Equation/Coefficient	SUR Other Excluded 1974-1980		SUR Other Excluded 1981-1985	
	Estimate	T-Ratio	Estimate	T-Ratio
Irrigated Wheat (cont.)				
MANAGEMENT (30) shift	-0.1311	-1.0045	-0.0973	-0.0047
MANAGEMENT (31) shift	-0.1884	-1.7015	0.4032	2.7930
MANAGEMENT (32) shift	-0.1127	-1.0359	0.3481	2.5145
MANAGEMENT (33) shift	-0.1888	-1.7364	0.3906	2.7318
MANAGEMENT (34) shift	-0.0134	-0.1256	0.4780	3.1486
MANAGEMENT (35) shift	-0.2023	-1.8704	0.4677	3.4385
MANAGEMENT (36) shift	-0.1518	-1.2345	0.3381	1.6562
MANAGEMENT (37) shift	-0.2161	-1.9029	0.5162	3.9398
MANAGEMENT (38) shift	-0.1098	-0.7197	0.4369	3.2492
MANAGEMENT (39) shift	-0.3342	-2.5233	-0.3528	-0.0170
MANAGEMENT (40) shift	-0.5096	-3.8604	0.6572	0.0317
MANAGEMENT (41) shift	-0.3223	-3.1245	0.5473	4.0740
MANAGEMENT (42) shift	-0.2275	-2.1995	0.5062	3.6133
MANAGEMENT (43) shift	-0.1299	-1.2505	0.3720	2.7337
MANAGEMENT (44) shift	-0.1258	-1.1482	0.2743	2.0138
MANAGEMENT (45) shift	-0.1577	-1.4771	0.4563	3.1972
MANAGEMENT (46) shift	-0.2493	-2.3858	0.4939	3.6512
MANAGEMENT (47) shift	-0.1369	-0.9033	0.3416	2.5321
MANAGEMENT (48) shift	-0.1183	-1.1069	0.2882	2.0804
MANAGEMENT (49) shift	-0.2915	-2.2322	0.6340	0.0306
MANAGEMENT (50) shift	-0.0879	-0.4407	0.4233	3.0975
MANAGEMENT (51) shift	-0.2075	-1.7362	0.3777	2.2608
MANAGEMENT (52) shift	-0.1350	-0.8877	2.6745	0.0861
MANAGEMENT (53) shift	-0.2241	-1.6454	0.2156	1.5800
MANAGEMENT (54) shift	-0.0735	-0.4877	0.3169	1.4795
MANAGEMENT (55) shift	-0.1616	-1.4253	-0.3090	-1.4431
MANAGEMENT (56) shift	-0.3138	-3.0125	0.5793	4.4327
MANAGEMENT (57) shift	-0.1543	-1.2920	0.4543	3.5079
MANAGEMENT (58) shift	-0.2729	-2.3253	0.4803	3.1834
MANAGEMENT (59) shift	-0.2066	-1.8271	0.4220	3.2646
MANAGEMENT (60) shift	-0.1091	-1.0623	0.2618	1.9037
MANAGEMENT (61) shift	0.2087	-2.0379	0.5133	3.9166
MANAGEMENT (62) shift	-0.2756	-2.6160	0.5779	4.1136
MANAGEMENT (63) shift	-0.0403	-0.3563	0.0592	0.4491
MANAGEMENT (64) shift	-0.0454	-0.4180	0.2562	1.8566
MANAGEMENT (65) shift	-0.0981	-0.9425	0.1495	1.0902
MANAGEMENT (66) shift	-0.0840	-0.8377	0.5241	4.0499
MANAGEMENT (67) shift	-0.0513	-0.4775	0.3590	2.4895
MANAGEMENT (68) shift	-0.0942	-0.8170	-0.1306	-0.0107
MANAGEMENT (69) shift	-2.5516	-0.0978	0.4066	2.4390
MANAGEMENT (70) shift	-0.2072	-1.8091	0.5182	0.0423
MANAGEMENT (71) shift	-0.6030	-5.1060	0.6805	4.0582
MANAGEMENT (72) shift	-0.1217	-0.6079	8.7318	0.1404

Equation/Coefficient	SUR Other Excluded 1974-1980 Estimate	T-Ratio	SUR Other Excluded 1981-1985 Estimate	T-Ratio
Irrigated Wheat (cont.)				
MANAGEMENT (73) shift	-0.1249	-1.1603	0.4728	3.4621
MANAGEMENT (74) shift	-0.1999	-1.8282	0.3547	2.5044
MANAGEMENT (75) shift	-0.2170	-1.9318	0.2421	1.8061
MANAGEMENT (76) shift	-0.2215	-2.1205	0.1917	1.3441
MANAGEMENT (77) shift	-0.0971	-0.8189	0.3793	2.5154
MANAGEMENT (78) shift	-0.0554	-0.4190	-0.4801	-0.0232
Dryland Wheat				
1985 shift	------		1.9321	9.8157
1984 shift	------		2.1255	10.6479
1983 shift	------		2.2072	11.1191
1982 shift	------		2.1376	10.1742
1981 shift	------		1.4468	6.8521
1980 shift	1.9629	10.5160	------	
1979 shift	2.3706	12.7261	------	
1978 shift	2.0572	11.0301	------	
1977 shift	1.9845	10.4450	------	
1976 shift	2.1395	11.4600	------	
1975 shift	2.4898	12.3685	------	
1974 shift	2.4903	11.9702	------	
MANAGEMENT (1) shift	0.0306	0.1800	0.2767	1.3331
MANAGEMENT (2) shift	0.0402	0.2085	-0.0021	-0.0097
MANAGEMENT (3) shift	-0.2584	-1.4196	0.2824	1.3669
MANAGEMENT (4) shift	-0.0992	-0.5608	-0.0064	-0.0302
MANAGEMENT (5) shift	0.0048	0.0244	0.0612	0.2778
MANAGEMENT (6) shift	-0.1339	-0.4994	0.1836	0.8785
MANAGEMENT (7) shift	-0.0992	-0.5362	-0.0711	-0.3349
MANAGEMENT (8) shift	-0.0713	-0.3841	0.0442	0.2103
MANAGEMENT (9) shift	-0.2471	-1.2873	-0.0952	-0.4197
MANAGEMENT (10) shift	0.0480	0.1394	-34.6637	-0.1578
MANAGEMENT (11) shift	0.1105	0.5697	0.0117	0.0566
MANAGEMENT (12) shift	-0.0402	-0.2219	0.0990	0.4699
MANAGEMENT (13) shift	-0.1235	-0.6698	0.1241	0.5997
MANAGEMENT (14) shift	-0.2402	-1.2989	-0.0576	-0.2779
MANAGEMENT (15) shift	0.1542	0.8801	0.1519	0.7362
MANAGEMENT (16) shift	0.0554	0.3079	-0.1756	-0.7702
MANAGEMENT (17) shift	0.1443	0.8110	0.0655	0.3148
MANAGEMENT (18) shift	0.0694	0.3997	0.1821	0.8805
MANAGEMENT (19) shift	-0.1051	-0.5687	0.0275	0.1301
MANAGEMENT (20) shift	-0.0026	-0.0150	0.1816	0.8803
MANAGEMENT (21) shift	0.0686	0.3965	0.0589	0.2850
MANAGEMENT (22) shift	-0.2082	-1 1649	0.1874	0.9055
MANAGEMENT (23) shift	0.0351	0.2020	0.0562	0.2714

Equation/Coefficient	SUR Other Excluded 1974-1980 Estimate	SUR Other Excluded 1974-1980 T-Ratio	SUR Other Excluded 1981-1985 Estimate	SUR Other Excluded 1981-1985 T-Ratio
Dryland Wheat (cont.)				
MANAGEMENT (24) shift	0.0413	0.2365	0.1745	0.8422
MANAGEMENT (25) shift	0.0657	0.3769	0.1603	0.7802
MANAGEMENT (26) shift	0.1392	0.8087	0.1996	0.9691
MANAGEMENT (27) shift	0.0952	0.5522	0.2030	0.9850
MANAGEMENT (28) shift	-0.0911	-0.5143	0.0694	0.3261
MANAGEMENT (29) shift	0.1648	0.9555	0.1242	0.6002
MANAGEMENT (30) shift	0.0232	0.1318	0.2915	1.3309
MANAGEMENT (31) shift	-0.2287	-1.0592	0.2106	0.7247
MANAGEMENT (32) shift	-0.0882	-0.4362	-5.2100	-0.1517
MANAGEMENT (33) shift	0.0056	0.0325	-0.2379	-1.1476
MANAGEMENT (34) shift	-0.0137	-0.0712	-0.0025	-0.0116
MANAGEMENT (35) shift	-0.1604	-0.8555	-0.5889	-2.4256
MANAGEMENT (36) shift	-0.1623	-0.8124	0.0370	0.1558
MANAGEMENT (37) shift	0.1559	0.4325	-8.2974	-0.0380
MANAGEMENT (38) shift	-0.1292	-0.6683	-0.1498	-0.6883
MANAGEMENT (39) shift	0.0521	0.3028	0.0674	0.3227
MANAGEMENT (40) shift	-0.0047	-0.0263	0.1524	0.7392
MANAGEMENT (41) shift	0.0950	0.5445	0.1806	0.8750
MANAGEMENT (42) shift	-0.1166	-0.6746	0.0814	0.3962
MANAGEMENT (43) shift	0.0500	0.2891	0.0110	0.0525
MANAGEMENT (44) shift	0.0245	0.1391	0.1618	0.7757
MANAGEMENT (45) shift	-0.1082	-0.6181	0.1041	0.5017
MANAGEMENT (46) shift	-0.0329	-0.1822	0.1303	0.6034
MANAGEMENT (47) shift	0.1093	0.6432	0.1205	0.5883
MANAGEMENT (48) shift	-78.9971	-0.4398	-0.1675	-0.4544
MANAGEMENT (49) shift	0.0501	0.2964	0.1615	0.7813
MANAGEMENT (50) shift	-0.0592	-0.3190	-0.3089	-1.0624
MANAGEMENT (51) shift	0.0513	0.3022	0.2532	1.2332
MANAGEMENT (52) shift	0.0547	0.3121	0.1552	0.7509
MANAGEMENT (53) shift	0.0897	0.5020	0.1178	0.5633
MANAGEMENT (54) shift	-0.1155	-0.6689	0.1147	0.5520
MANAGEMENT (55) shift	0.0337	0.1865	-0.1597	-0.7449
MANAGEMENT (56) shift	-0.0164	-0.0924	0.1635	0.7872
MANAGEMENT (57) shift	-0.2334	-1.3689	0.0154	0.0753
MANAGEMENT (58) shift	-0.1400	-0.7979	0.2271	1.0903
MANAGEMENT (59) shift	0.0728	0.4199	-0.0047	-0.0230
MANAGEMENT (60) shift	0.0796	0.4411	-0.0044	-0.0204
MANAGEMENT (61) shift	0.0413	0.2394	0.1293	0.6239
MANAGEMENT (62) shift	0.1141	0.6588	0.1542	0.7461
MANAGEMENT (63) shift	0.1599	0.9239	0.0731	0.3518
MANAGEMENT (64) shift	0.0398	0.2322	0.0126	0.0611
MANAGEMENT (65) shift	0.0893	0.5114	-0.1546	-0.7439
MANAGEMENT (66) shift	0.1002	0.5735	0.1584	0.7670

Equation/Coefficient	SUR Other Excluded 1974-1980		SUR Other Excluded 1981-1985	
	Estimate	T-Ratio	Estimate	T-Ratio
Dryland Wheat (cont.)				
MANAGEMENT (67) shift	0.0728	0.4026	0.0094	0.0438
MANAGEMENT (68) shift	0.1751	1.0147	0.1035	0.5048
MANAGEMENT (69) shift	0.1366	0.7956	-0.0454	-0.2198
MANAGEMENT (70) shift	0.1001	0.5868	0.1342	0.6549
MANAGEMENT (71) shift	0.1463	0.8354	0.0151	0.0721
MANAGEMENT (72) shift	-0.0586	-0.3416	0.1672	0.8088
MANAGEMENT (73) shift	-0.3465	-1.9099	0.2100	1.0146
MANAGEMENT (74) shift	-0.0824	-0.4596	0.0491	0.2369
MANAGEMENT (75) shift	-0.0903	-0.5105	0.0263	0.1278
MANAGEMENT (76) shift	0.1557	0.8891	-0.0927	-0.4216
MANAGEMENT (77) shift	0.0640	0.3031	-0.1878	-0.6675
MANAGEMENT (78) shift	0.1173	0.6559	0.1994	0.9661
MANAGEMENT (79) shift	0.0378	0.2182	0.2052	0.9932
MANAGEMENT (80) shift	0.1625	0.9133	-0.0714	-0.3415
MANAGEMENT (81) shift	0.1261	0.7358	0.2349	1.0861
MANAGEMENT (82) shift	0.1713	0.9996	-0.3863	-1.8853
MANAGEMENT (83) shift	0.0738	0.4279	0.1000	0.4810
MANAGEMENT (84) shift	0.0625	0.3557	0.2180	1.0625
MANAGEMENT (85) shift	-0.0595	-0.3419	0.2985	1.4408
MANAGEMENT (86) shift	0.1451	0.8283	-0.1827	-0.8825
MANAGEMENT (87) shift	0.1067	0.5693	-0.0137	-0.0655
MANAGEMENT (88) shift	-0.1094	-0.6430	0.1383	0.6742
MANAGEMENT (89) shift	-0.0392	-0.2198	0.2381	1.1588
MANAGEMENT (90) shift	-0.1016	-0.5885	0.2130	1.0227
MANAGEMENT (91) shift	-0.1452	-0.8550	0.3678	1.8013
MANAGEMENT (92) shift	-0.1905	-1.1197	0.3164	1.5363
MANAGEMENT (93) shift	0.0289	0.1691	0.2558	1.2274
MANAGEMENT (94) shift	-0.1085	-0.6369	0.2323	1.1335
MANAGEMENT (95) shift	-0.0274	-0.1609	0.0528	0.2560
MANAGEMENT (96) shift	0.2823	1.6444	-0.5327	-2.5931
MANAGEMENT (97) shift	-0.2702	-1.4811	0.3031	1.0741
MANAGEMENT (98) shift	-0.1612	-0.9405	0.2650	1.2863
MANAGEMENT (99) shift	-0.0283	-0.1650	0.1325	0.6098
MANAGEMENT (100) shift	-0.1863	-1.0600	0.1557	0.7554
MANAGEMENT (101) shift	-0.0406	-0.2342	0.2206	1.0699
MANAGEMENT (102) shift	-0.0143	-0.0839	0.2171	1.0594
MANAGEMENT (103) shift	0.0008	0.0047	0.2765	1.3452
MANAGEMENT (104) shift	-0.0600	-0.2821	0.2681	0.9645
MANAGEMENT (105) shift	0.0567	0.3316	0.1656	0.7901
MANAGEMENT (106) shift	-0.0606	-0.3564	0.1946	0.9430
MANAGEMENT (107) shift	0.0069	0.0374	0.2534	1.1858
MANAGEMENT (108) shift	0.0882	0.4940	0.0775	0.3706
MANAGEMENT (109) shift	0.1111	0.6345	0.0476	0.2299

Equation/Coefficient	SUR Other Excluded 1974-1980 Estimate	T-Ratio	SUR Other Excluded 1981-1985 Estimate	T-Ratio
Dryland Wheat (cont.)				
MANAGEMENT (110) shift	0.1335	0.7185	0 0992	0 4669
MANAGEMENT (111) shift	0.1593	0.9052	0.0501	0.2408
MANAGEMENT (112) shift	0.1510	0.8559	-0 0853	-0.4094
MANAGEMENT (113) shift	0.0199	0.1153	-0.0465	-0.2256
MANAGEMENT (114) shift	-0.2578	-1.4983	0.1461	0.7103
MANAGEMENT (115) shift	-0.1736	-0.9822	0.2338	1.1447
MANAGEMENT (116) shift	0.1213	0.6524	-0.1793	-0.4752
MANAGEMENT (117) shift	-0.0591	-0.3391	0.1554	0 7499
MANAGEMENT (118) shift	0.1258	0.7076	-0.1718	-0.8352
MANAGEMENT (119) shift	-0.0935	-0.5184	0.1856	0.8944
Irrigated Corn				
1985 shift	------		-1.5395	-1.4781
1984 shift	------		-1.4658	-1.4073
1983 shift	------		-1.5301	-1.4738
1982 shift	------		-1.2513	-1.2054
1981 shift	------		-1.2825	-1.2373
1980 shift	-2.9643	-4.8828	------	
1979 shift	-2.6969	-4.4478	------	
1978 shift	-2.7192	-4.5015	------	
1977 shift	-2.8359	-4.6896	------	
1976 shift	-2.6915	-4.4620	------	
1975 shift	-2.5367	-4.2200	------	
1974 shift	-2.0683	-3.4674	------	
MANAGEMENT (1) shift	4.8125	8.3503	4.0007	3.9728
MANAGEMENT (2) shift	5.0016	8.6925	4.2037	4 1922
MANAGEMENT (3) shift	4.9136	8.5446	3.8680	3.8611
MANAGEMENT (4) shift	5.0048	8.7158	4.0661	4.0613
MANAGEMENT (5) shift	4.9416	8.5867	0.4943	0.0708
MANAGEMENT (6) shift	4.9033	8.5069	3.8809	3.8686
MANAGEMENT (7) shift	4.9475	8.6011	0.2316	0.0166
MANAGEMENT (8) shift	4.8175	8.2779	3.7422	3.6742
MANAGEMENT (9) shift	4.9721	8.6365	4.2759	4 2606
MANAGEMENT (10) shift	5.0432	8.7870	4 5656	4.5459
MANAGEMENT (11) shift	4 8105	8.3603	3.8407	3 8304
MANAGEMENT (12) shift	4 9248	8.5705	4.5801	4 5612
MANAGEMENT (13) shift	4 9293	8.5502	3.4159	3.3688
MANAGEMENT (14) shift	4 8539	8 4319	4 0704	4 0598
MANAGEMENT (15) shift	4 8340	8.3542	0 3249	0 0465
MANAGEMENT (16) shift	4 9510	8 5965	0 3532	0.0337
MANAGEMENT (17) shift	4 9366	8 5639	0 5511	0 0658
MANAGEMENT (18) shift	4 7629	8 2666	3 6382	3.6270
MANAGEMENT (19) shift	4 7902	8 2912	3 8154	3.7880

Equation/Coefficient	SUR Other Excluded 1974-1980		SUR Other Excluded 1981-1985	
	Estimate	T-Ratio	Estimate	T-Ratio
Irrigated Corn (cont.)				
MANAGEMENT (20) shift	4.8542	8.3087	2.2412	0.1070
MANAGEMENT (21) shift	4.9659	8.6356	3.6120	3.5922
MANAGEMENT (22) shift	4.9111	8.4963	1.3371	0.0958
MANAGEMENT (23) shift	4.9392	8.6070	3.5043	3.4874
MANAGEMENT (24) shift	4.8940	8.4739	0.9834	0.0939
MANAGEMENT (25) shift	4.9497	8.6208	3.9763	3.9719
MANAGEMENT (26) shift	4.9840	8.6445	3.8956	3.8825
MANAGEMENT (27) shift	4.9079	8.5080	3.9876	3.9725
MANAGEMENT (28) shift	4.9678	8.6496	4.2792	4.2665
MANAGEMENT (29) shift	4.9263	8.5493	3.6984	3.6872
MANAGEMENT (30) shift	4.7903	8.2172	1.5579	0.0744
MANAGEMENT (31) shift	4.8866	8.5083	4.1634	4.1551
MANAGEMENT (32) shift	4.8876	8.4970	4.3536	4.3374
MANAGEMENT (33) shift	4.6398	0.1833	3.6823	3.6295
MANAGEMENT (34) shift	4.8993	8.3217	4.5973	0.1098
MANAGEMENT (35) shift	4.9775	8.6813	4.0732	4.0714
MANAGEMENT (36) shift	5.0009	8.7060	4.1978	4.1882
MANAGEMENT (37) shift	4.9275	8.5767	3.6392	3.5944
MANAGEMENT (38) shift	4.9791	8.6342	3.9026	3.8824
MANAGEMENT (39) shift	4.9656	8.6467	4.1049	4.0963
MANAGEMENT (40) shift	4.9468	8.6216	3.9065	3.9038
MANAGEMENT (41) shift	4.9828	8.6710	4.1672	4.1590
MANAGEMENT (42) shift	4.9391	8.6204	3.9685	3.9659
MANAGEMENT (43) shift	4.5990	7.5948	2.8068	0.0670
MANAGEMENT (44) shift	4.8072	8.3299	3.2623	3.2349
MANAGEMENT (45) shift	4.9718	8.5717	3.0501	3.0171
MANAGEMENT (46) shift	4.8868	8.4758	3.9961	3.9821
MANAGEMENT (47) shift	4.7478	8.1594	0.9133	0.0872
MANAGEMENT (48) shift	4.9291	8.5819	0.3390	0.0567
MANAGEMENT (49) shift	4.8836	8.4538	3.3279	3.3065
MANAGEMENT (50) shift	5.0029	8.6818	3.8645	3.8463
MANAGEMENT (51) shift	4.9198	8.5284	3.1757	3.1461
MANAGEMENT (52) shift	4.9283	8.5547	3.2112	3.1882
MANAGEMENT (53) shift	5.0513	8.7906	4.1445	4.1342
MANAGEMENT (54) shift	4.9450	8.5800	1.4718	0.1054
MANAGEMENT (55) shift	4.4829	7.3467	2.1772	0.0520
MANAGEMENT (56) shift	4.8905	8.4864	0.9321	0.1113
MANAGEMENT (57) shift	5.0611	8.7624	2.9943	2.9819
MANAGEMENT (58) shift	4.9142	8.5429	0.1050	0.0175
MANAGEMENT (59) shift	4.8482	8.3549	0.3518	0.0420
MANAGEMENT (60) shift	4.9410	8.5011	2.6703	2.6220
MANAGEMENT (61) shift	4.8798	8.4161	1.0295	0.0738
MANAGEMENT (62) shift	4.9648	8.6382	4.0082	3.9617

Equation/Coefficient	SUR Other Excluded 1974-1980		SUR Other Excluded 1981-1985	
	Estimate	T-Ratio	Estimate	T-Ratio
Irrigated Grain Sorghum				
1985 shift	------		1.5127	16.9680
1984 shift	------		1.4471	16.2287
1983 shift	------		1.2902	14.3759
1982 shift	------		1.5087	16.2091
1981 shift	------		1.4658	15.2624
1980 shift	1.9422	25.3106	------	
1979 shift	2.1787	28.6159	------	
1978 shift	2.2365	30.3289	------	
1977 shift	2.1329	28.0986	------	
1976 shift	2.1551	29.3073	------	
1975 shift	2.2419	29.3689	------	
1974 shift	2.5559	30.4770	------	
MANAGEMENT (1) shift	0.1011	0.9862	0.1562	1.3721
MANAGEMENT (2) shift	-0.3712	-3.3541	0.3969	3.4701
MANAGEMENT (3) shift	-0.1255	-1.1253	0.3681	3.0911
MANAGEMENT (4) shift	-0.1451	-1.3072	0.3067	2.7177
MANAGEMENT (5) shift	0.0030	0.0313	-0.0921	-0.7427
MANAGEMENT (6) shift	-0.0671	-0.6663	0.3604	2.8735
MANAGEMENT (7) shift	-0.0847	-0.8101	0.1509	0.9924
MANAGEMENT (8) shift	0.0811	0.7213	-0.1427	-1.1806
MANAGEMENT (9) shift	-5.8024	-0.2571	0.2737	1.7781
MANAGEMENT (10) shift	-0.0816	-0.7386	-0.0827	-0.0063
MANAGEMENT (11) shift	-0.3913	-4.0721	0.3395	2.7562
MANAGEMENT (12) shift	-0.1929	-1.9693	0.3695	2.9938
MANAGEMENT (13) shift	-0.0032	-0.0316	0.2590	2.3040
MANAGEMENT (14) shift	-0.0210	-0.2025	0.1824	1.6190
MANAGEMENT (15) shift	-0.1255	-1.3560	0.2370	2.1074
MANAGEMENT (16) shift	-0.0170	-0.1744	0.3741	3.0961
MANAGEMENT (17) shift	-0.1412	-0.9833	0.3038	2.5392
MANAGEMENT (18) shift	-0.1787	-0.9223	0.3009	2.2958
MANAGEMENT (19) shift	0.0402	0.2075	-1.1857	-0.0228
MANAGEMENT (20) shift	-0.0453	-0.4095	-0.3926	-0.0297
MANAGEMENT (21) shift	-0.0776	-0.7057	0.0744	0.3708
MANAGEMENT (22) shift	-0.0001	-0.0005	-0.0155	-0.1389
MANAGEMENT (23) shift	0.3101	2.1585	-0.0757	-0.6263
MANAGEMENT (24) shift	-0.1796	-1.9155	0.4715	3.7666
MANAGEMENT (25) shift	-0.0636	-0.6183	0.3310	2.8277
MANAGEMENT (26) shift	-0.0338	-0.3555	0.3878	3.4155
MANAGEMENT (27) shift	-0.0750	-0.7681	0.0779	0.6134
MANAGEMENT (28) shift	0.0035	0.0369	0.2656	2.2368
MANAGEMENT (29) shift	-0.1826	-1.7718	-0.2386	-1.1717
MANAGEMENT (30) shift	-0.0919	-0.9607	0.3839	3.2139
MANAGEMENT (31) shift	-0 2083	-2.1983	0.2788	2.3355

Equation/Coefficient	SUR Other Excluded 1974-1980 Estimate	T-Ratio	SUR Other Excluded 1981-1985 Estimate	T-Ratio
Irrigated Grain Sorghum (cont.)				
MANAGEMENT (32) shift	-0.1787	-1.8931	0.2016	1.6851
MANAGEMENT (33) shift	0.0886	0.9206	0.0303	0.2325
MANAGEMENT (34) shift	-1.1311	-1.3455	0.2008	1.6750
MANAGEMENT (35) shift	-0.2667	-2.6874	0.4006	3.3120
MANAGEMENT (36) shift	0.0538	0.5533	-0.1770	-0.8839
MANAGEMENT (37) shift	-0.1207	-0.8328	0.1977	0.9848
MANAGEMENT (38) shift	-0.1188	-1.2478	0.3927	3.3492
MANAGEMENT (39) shift	-0.0756	-0.3912	0.4472	2.9355
MANAGEMENT (40) shift	0.3312	0.0299	0.3592	2.9360
MANAGEMENT (41) shift	-0.0754	-0.6809	0.3628	3.0480
MANAGEMENT (42) shift	-0.4760	-3.8873	0.5077	4.1749
MANAGEMENT (43) shift	-0.6998	-3.5923	0.3835	2.4979
MANAGEMENT (44) shift	-0.1579	-1.2929	0.4474	3.7826
MANAGEMENT (45) shift	-0.0483	-0.3918	0.3874	3.2772
MANAGEMENT (46) shift	-0.2654	-2.1650	0.4892	3.1874
MANAGEMENT (47) shift	-0.1525	-1.5165	0.3255	2.8236
MANAGEMENT (48) shift	-0.1380	-0.7120	-1.5185	-0.0292
MANAGEMENT (49) shift	0.0027	0.0019	-0.5798	-0.0328
MANAGEMENT (50) shift	0.0900	0.8010	0.0775	0.6477
MANAGEMENT (51) shift	0.0154	0.1400	0.1502	1.3471
MANAGEMENT (52) shift	0.1581	0.8096	0.0607	0.3999
MANAGEMENT (53) shift	-0.0420	-0.3415	0.3232	2.6508
MANAGEMENT (54) shift	-0.0049	-0.0504	0.0856	0.4260
MANAGEMENT (55) shift	-0.0810	-0.8326	-0.3347	-0.0378
MANAGEMENT (56) shift	0.0434	0.4450	0.2533	2.2535
MANAGEMENT (57) shift	0.0178	0.1457	0.1546	1.3850
MANAGEMENT (58) shift	-0.1308	-0.6742	-2.0051	-0.0386
MANAGEMENT (59) shift	-0.0805	-0.7618	0.2124	1.5304
MANAGEMENT (60) shift	0.1230	1.3276	-0.0436	-0.3658
MANAGEMENT (61) shift	0.0223	0.2416	0.2083	1.7871
MANAGEMENT (62) shift	-0.3292	-3.5197	0.3111	2.7104
MANAGEMENT (63) shift	-0.1308	-0.6703	0.2680	1.9977
MANAGEMENT (64) shift	-0.5230	-5.3218	0.2279	1.9542
MANAGEMENT (65) shift	-0.1240	-1.3203	-0.0756	-0.6657
MANAGEMENT (66) shift	-0.4167	-3.4042	0.3466	2.2694
MANAGEMENT (67) shift	-0.1265	-0.6530	-0.0273	-0.2289
MANAGEMENT (68) shift	0.0229	0.2490	0.3007	2.6964
MANAGEMENT (69) shift	-4.1504	-0.0952	0.0768	0.3794
MANAGEMENT (70) shift	-0.1733	-0.8816	-1.5749	-0.0303
MANAGEMENT (71) shift	-0.1963	-1.0102	-2.1522	-0.0414
MANAGEMENT (72) shift	0.0059	0.0478	-0.5855	-0.0330
MANAGEMENT (73) shift	-0 5062	-3.5113	-1.3098	-0.0488
MANAGEMENT (74) shift	-0.4103	-2.8519	-0.5936	-0 0221

Equation/Coefficient	SUR Other Excluded 1974-1980 Estimate	T-Ratio	SUR Other Excluded 1981-1985 Estimate	T-Ratio
Irrigated Grain Sorghum (cont.)				
MANAGEMENT (75) shift	-0.1875	-1.8333	-0.1082	-0.0103
MANAGEMENT (76) shift	-0 1047	-0.8491	0 2487	1 2384
MANAGEMENT (77) shift	0.0837	0 8816	0.3310	2 8119
MANAGEMENT (78) shift	-0.0860	-0.9317	0.3725	3 2866
MANAGEMENT (79) shift	0.0232	0.1811	0.0431	0.3577
MANAGEMENT (80) shift	-0.0195	-0.2085	-0.3886	-3.2119
MANAGEMENT (81) shift	-0.2309	-1 8597	-1.8729	-9.1709
MANAGEMENT (82) shift	0.1192	0.0107	0.2580	2.0547
Dryland Grein Sorghum				
1985 shift	------		2.0773	10 5179
1984 shift	------		1.7033	8.5267
1983 shift	------		1.4083	7.1030
1982 shift	------		1.8859	9.4398
1981 shift	------		2.1651	10.5819
1980 shift	1.8029	15.8743	------	
1979 shift	2.2234	20.4075	------	
1978 shift	1.8718	17.2265	------	
1977 shift	2.1663	19.6347	------	
1976 shift	1.9828	17.7981	------	
1975 shift	1.9175	17.5259	------	
1974 shift	2.4939	19.9934	------	
MANAGEMENT (1) shift	0.1796	1.1686	-0.2558	-1 2008
MANAGEMENT (2) shift	-1.9728	-0.0597	-0.2828	-1.0613
MANAGEMENT (3) shift	0.1318	0.9387	-0.0820	-0.3895
MANAGEMENT (4) shift	-0.6134	-0.0280	-0.3588	-1.5283
MANAGEMENT (5) shift	0.0533	0.1964	-15.3915	-0.1778
MANAGEMENT (6) shift	2.2600	0.0682	0.1108	-0.3961
MANAGEMENT (7) shift	0.1603	0.9675	-0.6122	-2.7721
MANAGEMENT (8) shift	0.0615	0.3493	-0.3687	-1.7121
MANAGEMENT (9) shift	-0.4206	-2 4812	-0.4872	-2.0733
MANAGEMENT (10) shift	-1.7330	-0.0522	-0.2963	-1.1277
MANAGEMENT (11) shift	0.0821	0 5137	0.2528	1 0902
MANAGEMENT (12) shift	0 2231	1.5536	-0.6680	-2 8428
MANAGEMENT (13) shift	-0 0361	-0 2206	-0 4065	-1 7244
MANAGEMENT (14) shift	0.0968	0 4664	4 4127	-0.0987
MANAGEMENT (15) shift	0 1398	0 5146	-0 1512	-0 7194
MANAGEMENT (16) shift	-0.0565	-0 3504	0.0418	0.1976
MANAGEMENT (17) shift	-4.3847	-0 0681	-0 1673	-0 4984
MANAGEMENT (18) shift	0.1601	0 7861	-0 0460	-0 2208
MANAGEMENT (19) shift	0 2550	1 8107	-0.2320	-1 0980
MANAGEMENT (20) shift	-0 0884	-0 3246	0 0634	0 2913
MANAGEMENT (21) shift	0 0613	0 2249	0.1292	0 5919

Equation/Coefficient	SUR Other Excluded 1974-1980 Estimate	T-Ratio	SUR Other Excluded 1981-1985 Estimate	T-Ratio
Dryland Grain Sorghum (cont.)				
MANAGEMENT (22) shift	-0.1054	-0.5883	-0.0151	-0.0724
MANAGEMENT (23) shift	0.1578	0.7778	0.0957	0.4048
MANAGEMENT (24) shift	-0.0100	-0.3623	0.0242	0.1164
MANAGEMENT (25) shift	0.1668	1.1252	0.0938	0.4296
MANAGEMENT (26) shift	0.1428	0.9716	0.1605	0.7294
MANAGEMENT (27) shift	0.0910	0.3327	0.0156	0.0710
MANAGEMENT (28) shift	-0.0878	-0.6524	0.0576	0.2712
MANAGEMENT (29) shift	0.2431	1.1969	-0.1747	-0.8034
MANAGEMENT (30) shift	0.0112	0.0711	-1.7707	-0.0791
MANAGEMENT (31) shift	0.4833	3.3871	-0.5089	-2.4445
MANAGEMENT (32) shift	0.4243	1.5650	-0.3755	-1.1365
MANAGEMENT (33) shift	-0.2429	-1.1879	0.0270	0.0813
MANAGEMENT (34) shift	0.4244	2.4054	-2.6433	-7.9334
MANAGEMENT (35) shift	-0.2451	-1.1995	0.0632	0.1901
MANAGEMENT (36) shift	0.3389	2.4166	-0.2398	-1.1476
MANAGEMENT (37) shift	-0.0031	-0.0212	0.0861	0.4134
MANAGEMENT (38) shift	0.1018	0.6953	0.1643	0.7885
MANAGEMENT (39) shift	0.1033	0.7560	-0.2562	-1.2265
MANAGEMENT (40) shift	0.0578	0.4139	-0.0325	-0.1511
MANAGEMENT (41) shift	0.2621	1.8554	0.1515	0.7303
MANAGEMENT (42) shift	0.0465	0.3145	0.0743	0.3537
MANAGEMENT (43) shift	-0.3039	-1.1161	0.1502	0.5701
MANAGEMENT (44) shift	-0.1762	-1.0022	-0.8096	-0.0275
MANAGEMENT (45) shift	-1.9459	-0.0303	-0.5495	-1.6646
MANAGEMENT (46) shift	0.0018	0.0135	0.3014	-1.3589
MANAGEMENT (47) shift	-0.0613	-0.3428	0.0892	0.4287
MANAGEMENT (48) shift	-0.1316	-0.7511	-0.0517	-0.2447
MANAGEMENT (49) shift	0.0311	0.1140	-13.8188	-0.1597
MANAGEMENT (50) shift	0.2345	0.8475	-0.3010	-0.9069
MANAGEMENT (51) shift	0.0398	0.1468	-0.0248	-0.1122
MANAGEMENT (52) shift	0.0495	0.3037	-0.5515	-1.6613
MANAGEMENT (53) shift	0.2376	1.3634	-0.3140	-1.3397
MANAGEMENT (54) shift	0.1295	0.4762	-0.4907	-1.4713
MANAGEMENT (55) shift	0.0566	0.3943	-0.3063	-1.3062
MANAGEMENT (56) shift	-0.3337	-1.9130	-0.2561	-1.1790
MANAGEMENT (57) shift	0.1415	0.9360	0.0981	0.4640
MANAGEMENT (58) shift	0.0883	0.6221	-0.0455	-0.2083
MANAGEMENT (59) shift	0.2668	1.6684	0.0403	0.1930
MANAGEMENT (60) shift	0.2688	1.9288	-0.3015	-1.4438
MANAGEMENT (61) shift	-0.0492	-0.3502	0.1815	0.8728
MANAGEMENT (62) shift	-0.3218	-0.0050	-0.2154	-0.6508
MANAGEMENT (63) shift	0.1937	0.9539	-0.2195	-1.0069
MANAGEMENT (64) shift	-0.4553	-0.0347	-0.0911	-0.4366

Equation/Coefficient	SUR Other Excluded 1974-1980		SUR Other Excluded 1981-1985	
	Estimate	T-Ratio	Estimate	T-Ratio
Dryland Grain Sorghum (cont.)				
MANAGEMENT (65) shift	-0.6360	-0.0485	-0.1191	-0.5712
MANAGEMENT (66) shift	-1.2102	-0.0366	-0.1152	-0.4382
MANAGEMENT (67) shift	-0.5461	-0.0331	-0.2123	-0.9720
MANAGEMENT (68) shift	0.3692	2.2070	-0.5384	-2.4689
MANAGEMENT (69) shift	0.1303	0.7981	-0.1491	-0.6408
MANAGEMENT (70) shift	0.3225	2.0687	-0.1647	-0.7812
MANAGEMENT (71) shift	0.0449	0.3144	0.0118	0.0570
MANAGEMENT (72) shift	0.5889	2.1552	-0.5294	-2.2537
MANAGEMENT (73) shift	0.1150	0.6891	-0.3352	-1.5799
MANAGEMENT (74) shift	0.0076	0.0538	-0.0549	-0.2527
MANAGEMENT (75) shift	-0.3689	-2.0680	-0.2020	-0.9680
MANAGEMENT (76) shift	0.2600	1.5778	0.0264	0.0986
MANAGEMENT (77) shift	-0.0068	-0.0328	-0.0710	-0.3261
MANAGEMENT (78) shift	0.0714	0.4234	-0.2981	-1.2747
MANAGEMENT (79) shift	0.2605	0.9604	-0.8879	-3.3802
MANAGEMENT (80) shift	0.2942	1.0772	-10.7984	-0.1249
MANAGEMENT (81) shift	-1.0924	-3.9413	-0.1132	-0.4340
MANAGEMENT (82) shift	-0.0952	-0.3503	0.0751	0.2283
MANAGEMENT (83) shift	0.1031	0.4952	-1.6320	-0.0365
MANAGEMENT (84) shift	-0.0144	-0.0680	0.3768	1.1436
MANAGEMENT (85) shift	-0.8309	-4.0391	0.0201	0.0863
MANAGEMENT (86) shift	0.1767	1.0656	-0.4034	-1.7753
MANAGEMENT (87) shift	-0.4145	-1.5159	-0.4390	-1.8844
MANAGEMENT (88) shift	-0.5478	-2.6516	-0.0530	-0.2006
MANAGEMENT (89) shift	0.0420	0.1546	-2.4099	-0.0279
MANAGEMENT (90) shift	-0.2771	-1.0044	-2.3276	-0.0270
MANAGEMENT (91) shift	0.1298	0.9218	-0.4815	-0.0379
MANAGEMENT (92) shift	-0.6070	-2.2299	0.0806	0.3104
MANAGEMENT (93) shift	0.2320	0.8526	-0.3657	-1.6766
MANAGEMENT (94) shift	0.0118	0.0433	0.3842	1.4785
MANAGEMENT (95) shift	0.2816	1.0231	-3.2138	-0.0372
MANAGEMENT (96) shift	0.1735	1.0645	-0.0822	-0.2498
MANAGEMENT (97) shift	0.1290	0.4741	-5.6871	-0.0662
MANAGEMENT (98) shift	0.1950	1.2822	-0.1820	-0.8724
MANAGEMENT (99) shift	-0.0275	-0.1523	0.1022	0.3075
MANAGEMENT (100) shift	0.0590	0.2153	-1.9090	-0.0221
MANAGEMENT (101) shift	0.1148	0.5592	-2.2066	-0.0494
MANAGEMENT (102) shift	0.4680	1.7317	-0.2450	-1.1672
MANAGEMENT (103) shift	0.0051	0.0253	0.1294	0.4971
MANAGEMENT (104) shift	0.2840	1.7231	0.1494	0.6411
MANAGEMENT (105) shift	-0.7633	-0.0230	-0.1849	-0.7044
MANAGEMENT (106) shift	-0.1424	-0.9490	-0.2467	-1.6545
MANAGEMENT (107) shift	0.4135	2.7165	-1.1022	-5.2460

Equation/Coefficient	SUR Other Excluded 1974-1980 Estimate	T-Ratio	SUR Other Excluded 1981-1985 Estimate	T-Ratio
Dryland Grain Sorghum (cont.)				
MANAGEMENT (108) shift	-0.0766	-0.4774	-0.0052	-0.0159
MANAGEMENT (109) shift	0.0352	0.1677	-0.6787	-1.9874
MANAGEMENT (110) shift	0.4211	1.5514	-0.0338	-0.1447
MANAGEMENT (111) shift	0.0284	0.1341	-2.1045	-0.0471
MANAGEMENT (112) shift	3.7756	0.0587	0.1677	0.5079
Irrigated Soybeans				
1985 shift	------		-0.0746	-0.3692
1984 shift	------		0.0155	0.0730
1983 shift	------		0.0727	0.3400
1982 shift	------		0.0668	0.2788
1981 shift	------		-0.1288	-0.4185
1980 shift	0.2765	2.3745	------	
1979 shift	0.6823	6.7821	------	
1978 shift	0.7536	7.1359	------	
1977 shift	0.6416	6.0308	------	
1976 shift	0.2992	2.6024	------	
1975 shift	0.3340	3.1194	------	
1974 shift	1.5575	10.1254	------	
MANAGEMENT (1) shift	-0.0745	-0.1105	2.0306	9.5441
MANAGEMENT (2) shift	-0.5332	-0.5254	1.9521	8.9216
MANAGEMENT (3) shift	-0.0601	-0.0792	1.8501	8.4036
MANAGEMENT (4) shift	1.6087	13.1069	2.0985	9.8819
MANAGEMENT (5) shift	1.5623	12.7815	1.7044	0.1460
MANAGEMENT (6) shift	0.2764	0.1828	2.0730	8.8766
MANAGEMENT (7) shift	-0.0915	-0.0902	1.9363	8.5678
MANAGEMENT (8) shift	0.9447	7.3114	-0.6513	-0.0557
MANAGEMENT (9) shift	0.1908	0.1880	2.0205	9.6230
MANAGEMENT (10) shift	-0.5584	-0.3689	1.9381	8.1829
MANAGEMENT (11) shift	0.4319	0.1428	1.8593	6.5761
MANAGEMENT (12) shift	0.0277	0.0456	2.0483	9.6203
MANAGEMENT (13) shift	-0.0068	-0.0067	1.9755	9.2022
MANAGEMENT (14) shift	1.1431	9.4604	2.0847	9.8147
MANAGEMENT (15) shift	0.1991	0.0659	1.9972	7.3135
MANAGEMENT (16) shift	0.5621	0.1860	1.5296	5.7213
MANAGEMENT (17) shift	0.4945	0.3273	2.2406	9.9517
MANAGEMENT (18) shift	0.1611	0.2120	1.9997	9.1329
MANAGEMENT (19) shift	0.6859	5.4596	1.9077	8.2837
MANAGEMENT (20) shift	0.4256	2.7588	2.0599	9.3401
MANAGEMENT (21) shift	0.5244	3.0567	1.1685	0.0999
MANAGEMENT (22) shift	0.0568	0.0188	1.8568	7.5029
MANAGEMENT (23) shift	-0 1321	-0.8341	2.1484	9 6642
MANAGEMENT (24) shift	0.7474	5.5431	2.0514	9.5878

Equation/Coefficient	SUR Other Excluded 1974-1980 Estimate	T-Ratio	SUR Other Excluded 1981-1985 Estimate	T-Ratio
Irrigated Soybeans (cont.)				
MANAGEMENT (25) shift	1.3541	10.7081	2.1772	9.8619
MANAGEMENT (26) shift	0 7705	5.4002	1.9502	8.1558
MANAGEMENT (27) shift	1.0197	7.9353	2.1668	9.6319
MANAGEMENT (28) shift	1.2215	9.8288	2.1814	10.0015
MANAGEMENT (29) shift	-0.2215	-0.2183	1.9090	8.2341
MANAGEMENT (30) shift	0.4450	3.3507	2.1259	9.6024
MANAGEMENT (31) shift	0.9670	6.3869	1.8106	6.6765
MANAGEMENT (32) shift	-0.0066	-0.0065	2.1968	10.1618
MANAGEMENT (33) shift	0.6744	5.4413	2.2071	10.5657
MANAGEMENT (34) shift	0.0387	0.0510	2.1400	10.3731
MANAGEMENT (35) shift	0.0797	0.1051	2.0301	9.3124
MANAGEMENT (36) shift	1.5827	13.0251	2.1988	10.7802
MANAGEMENT (37) shift	1.4317	11.9415	0.4379	0.0749
MANAGEMENT (38) shift	1.2647	10.8009	1.9356	9.3391
MANAGEMENT (39) shift	0.1863	0.1837	1.8631	8.4834
MANAGEMENT (40) shift	-0.2073	-0.0685	2.0860	8 2517
MANAGEMENT (41) shift	1.0453	7.4660	0.9479	3.9490
MANAGEMENT (42) shift	0.0720	0.5659	1.2144	0.1039
MANAGEMENT (43) shift	-0.2736	-0.1809	2.1570	9.7429
MANAGEMENT (44) shift	0.4982	3.6325	1.0700	0.0916
MANAGEMENT (45) shift	0.5099	0.5036	2.1828	10.2101
MANAGEMENT (46) shift	0.4219	3.1568	1.1592	0.0992
MANAGEMENT (47) shift	1.2049	9.5249	1.7086	7.7460
Irrigated Afalfa				
1985 shift	------		0.8230	0.9645
1984 shift	------		1.0596	1.3629
1983 shift	------		0.9931	1.3634
1982 shift	------		0.9343	1.3119
1981 shift	------		0.7258	1.1494
1980 shift	-1.1502	-2.6450	------	
1979 shift	-1.1830	-2.7768	------	
1978 shift	-1.1759	-2.8264	------	
1977 shift	-1 1421	-2.6000	------	
1976 shift	-1.0723	-2.4943	------	
1975 shift	-1.2465	-2.5930	------	
1974 shift	-1.1026	-2.4395	------	
MANAGEMENT (1) shift	1.7002	12.7107	0.2017	0.3831
MANAGEMENT (2) shift	1.3509	9.7921	0.0783	0.1508
MANAGEMENT (3) shift	1.2092	7.4051	-0.1104	-0.2133
MANAGEMENT (4) shift	1.8621	13.8997	0.2116	0.4018
MANAGEMENT (5) shift	3.5709	0 5644	0.4076	0.7532
MANAGEMENT (6) shift	1.3994	7 6767	1.6172	2.9169

	SUR Other Excluded 1974-1980		SUR Other Excluded 1981-1985	
Equation/Coefficient	Estimate	T-Ratio	Estimate	T-Ratio
Irrigated Alfalfa (cont.)				
MANAGEMENT (7) shift	1.8220	11.9432	-0.0666	-0.1260
MANAGEMENT (8) shift	1.8484	13.7665	-1.4754	-2.8034
MANAGEMENT (9) shift	1.3473	10.3268	0.1260	0.2424
MANAGEMENT (10) shift	1.6474	12.0531	0.2117	0.1071
MANAGEMENT (11) shift	1.3748	8.8474	0.1499	0.2939
MANAGEMENT (12) shift	0.2414	0.0191	0.7611	1.1608
MANAGEMENT (13) shift	1.5416	10.9220	0.0231	0.0441
MANAGEMENT (14) shift	1.1858	8.5529	0.2383	0.4572
MANAGEMENT (15) shift	1.2377	7.2648	0.4775	0.2006
MANAGEMENT (16) shift	1.3074	8.7415	0.0580	0.1107
MANAGEMENT (17) shift	1.4909	10.4023	0.00004	0.0001
MANAGEMENT (18) shift	1.4306	9.9679	0.2147	0.4090
MANAGEMENT (19) shift	1.5890	11.9894	0.0148	0.0284
MANAGEMENT (20) shift	1.4523	6.3768	0.5228	0.9301
MANAGEMENT (21) shift	1.7556	11.5065	0.2848	0.5304
MANAGEMENT (22) shift	1.5196	10.8234	-0.2128	-0.4011
MANAGEMENT (23) shift	1.6529	10.4887	0.2755	0.5122
MANAGEMENT (24) shift	1.9604	13.7265	-0.8169	-0.3427
MANAGEMENT (25) shift	1.5357	11.6600	0.2862	0.5462
MANAGEMENT (26) shift	1.6814	12.3943	-0.7946	-0.1332
MANAGEMENT (27) shift	1.0912	6.5985	0.0438	0.0840
MANAGEMENT (28) shift	2.1342	13.5951	0.1189	0.2210
MANAGEMENT (29) shift	1.8187	14.3175	-0.0156	-0.0296
MANAGEMENT (30) shift	0.9500	0.0673	-0.2487	-0.4523
MANAGEMENT (31) shift	1.3417	9.8176	0.1435	0.2747
MANAGEMENT (32) shift	0.3306	0.1319	0.0651	0.1260
MANAGEMENT (33) shift	1.4971	10.2478	0.0183	0.0348
MANAGEMENT (34) shift	1.4499	9.9264	0.0024	0.0047
MANAGEMENT (35) shift	1.3597	10.1943	0.1356	0.2608
MANAGEMENT (36) shift	0.9025	3.8817	-2.2504	-0.1891
MANAGEMENT (37) shift	1.5341	11.1905	-0.2402	-0.4579
MANAGEMENT (38) shift	1.5570	9.5073	1.8295	0.1528
MANAGEMENT (39) shift	1.8471	10.1871	0.0411	0.0034
MANAGEMENT (40) shift	1.3329	8.8045	-0.1409	-0.2696
MANAGEMENT (41) shift	1.8689	15.6121	-0.1043	-0.0353
MANAGEMENT (42) shift	1.5940	11.5064	-0.2448	-0.4699

APPENDIX C

Kansas Farm Management Budgets

Variable Input Costs per Acre (Year = 1985)

	Irrigated Wheat (flood)	Irrigated Wheat (pivot)	Dryland Wheat*	Irrigated Corn (flood)	Irrigated Corn (pivot)	Irrigated G.S. (flood)
INPUT:						
Labor	15.00	12.00	10.80	19.20	16.20	18.00
Seed	4.80	4.80	4.80	23.00	23.00	3.60
Pesticides	6.75	6.75	8.30	45.00	45.00	27.75
Fertilizer	17.30	17.30	16.00	45.00	45.00	32.40
Fuel and Oil	22.12	28.50	11.50	32.24	49.00	29.53
Crop Mach. Repairs	12.00	12.00	11.50	14.00	14.00	14.00
Irr. Equip. Repairs	9.00	21.30	------	9.00	21.30	9.00
Crop Insurance	------	------	------	------	------	------
Drying	------	------	------	13.00	13.00	11.00
Custom Hire	------	------	5.50	------	------	------
Miscellaneous	3.00	3.00	6.00	3.00	3.00	3.00
Interest on 1/2 Var. Costs @ 14%	6.30	7.40	5.21	14.31	9.19	10.38
Expected Yield per Acre	50 bu.	50 bu.	32 bu.	140 bu.	140 bu.	110 bu.

	Irrigated G.S. (pivot)	Dryland G.S.*	Irrigated Soybeans (flood)	Irrigated Soybeans (pivot)	Irrigated Alfalfa (pivot)
INPUT:					
Labor	13.80	13.80	16.20	13.80	7.20
Seed	3.60	3.15	12.00	12.00	5.00
Pesticides	27.75	10.30	10.50	10.50	12.00
Fertilizer	32.40	17.80	11.20	11.20	16.10
Fuel and Oil	41.60	13.50	27.68	38.75	48.40
Crop Mach. Repairs	14.00	13.00	13.00	13.00	6.00
Irr. Equip. Repairs	21.30	------	9.00	21.30	21.30
Crop Insurance	------	------	------	------	------
Drying	11.00	5.50	------	------	------
Custom Hire	------	3.00	------	------	129.00
Miscellaneous	3.00	6.00	3.00	3.00	3.00
Interest on 1/2 Var. Costs @ 14%	11.79	6.02	7.18	8.65	17.36
Expected Yield per Acre	115 bu.	55 bu.	45 bu.	45 bu.	7 ton

* Note these production costs are for central Kansas, the budgets for western Kansas could not be obtained

Source: Kansas State University, Kansas Farm Management Guides

Variable Input Costs per Acre (Year = 1979)

	Irrigated Wheat (flood)	Irrigated Wheat (pivot)	Dryland Wheat*	Irrigated Corn (flood)	Irrigated Corn (pivot)	Irrrigated G.S. (flood)
INPUT:						
Labor	10.40	8.40	7.20	14.40	11.60	12.80
Seed	4.80	4.80	4.00	18.00	18.00	3.00
Pesticides	0.00	0.00	0.00	32.50	32.50	4.50
Fertilizer	15.60	15.60	12.00	29.70	29.70	24.15
Fuel and Oil	17.13	21.83	7.30	22.19	28.18	20.29
Machinery and Equipment Repairs	14.00	14.00	9.50	14.00	14.00	14.00
Drying	------	------	------	12.50	12.50	2.50
Crop Insurance	3.00	3.00	------	------	------	------
Custom Hire	10.00	10.00	5.00	10.00	10.00	10.00
Miscellaneous	2.50	2.50	2.50	2.50	2.50	2.50
Interest on 1/2 Var. Costs @ 10%	3.87	4.01	2.38	7.79	7.95	4.69
Expected Yield per Acre	50 bu.	50 bu.	32 bu.	125 bu.	125 bu.	100 bu.

	Irrigated G.S. (pivot)	Dryland G.S.*	Irrigated Soybeans (flood)	Irrigated Soybeans (pivot)	Irrigated Alfalfa (pivot)
INPUT:					
Labor	10.40	9.15	12.40	9.60	4.00
Seed	3.00	1.50	12.48	12.48	6.56
Pesticides	4.50	6.00	6.00	6.00	5.50
Fertilizer	24.15	13.50	6.00	6.00	7.95
Fuel and Oil	25.00	8.30	28.18	23.94	38.77
Machinery and Equipment Repairs	14.00	10.50	14.00	14.00	14.00
Crop Insurance	------	------	------	------	------
Drying	2.50	5.50	------	------	------
Custom Hire	10.00	------	10.00	10.00	70.00
Miscellaneous	2.50	2.50	2.50	2.50	2.50
Interest on 1/2 Var. Costs @ 10%	4.80	2.85	4.58	4.23	7.46
Expected Yield per Acre	100 bu.	55 bu.	35 bu.	45 bu.	5 ton

* Note these production costs are for central Kansas, the budgets for western Kansas could not be obtained.

Source: Kansas State University, Kansas Farm Management Guides

ESTIMATION OF MULTICROP PRODUCTION FUNCTIONS FOR SOUTHWEST KANSAS

by

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B.S., Kansas State University, 1984

AN ABSTRACT OF A MASTER'S THESIS

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Multicrop production functions were estimated for the seven major crops produced in Southwest Kansas which are; irrigated wheat, dryland wheat, irrigated corn, irrigated grain sorghum, dryland grain sorghum, irrigated alfalfa, and irrigated soybeans. The method of Seemingly Unrelated regressions was used to estimate the system of equations. Except for pesticide usage on irrigated and dryland wheat production, the estimated parameters produced by the model for the variable and fixed inputs were reasonable and consistent. The results show that constant returns to scale exists in Southwest Kansas crop production.

Dummy variables were included in the production functions to capture individual farm effects on the production of each crop. A whole farm management variable for each farm was obtained as a weighted average of each farm effects for each crop. That variable along with; total acres in production, current loans to capital managed ratio, long term to capital managed ratio, percentage rented acres, machine expense per acre, and operators age were regressed on rate of return to capital managed. The results showed that the whole farm management variable explains a large amount of the variation in rate of return to capital managed. They also showed that economies to size exist in Southwest Kansas crop production.