MEASURING SCOPE AND SCALE EFFICIENCY GAINS DUE TO SPECIALIZATION

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Abstract

Using the non-parametric linear programming approach, this study examines overall efficiency gains due to diversification between crop and livestock enterprises for a sample of Kansas farms. Overall efficiency gains were decomposed into scope efficiency gains and scale efficiency gains. Farms with both crops and livestock were found to be less efficient than farms with just crops or just livestock. Operator age, profit margin, and farm size were significantly related to overall efficiency.

Keywords: Non-Parametric Linear Programming Approach, Efficiency Gains, Economies of Scale, Economies of Scope.

MEASURING SCOPE AND SCALE EFFICIENCY GAINS DUE TO DIVERSIFICATION

Though not as prevalent as they once were, diversified crop/livestock farms are still very common in the United States. For instance, in 2004, approximately 70% of the farms participating in the Kansas Farm Management Association had both crop and livestock enterprises. In addition to possible reductions in risk, farms may diversify to take advantage of economies of scope and/or economies of scale. Economies of scope exist if it is less costly to produce more than one output in a single entity than it is to produce these same outputs in several separate entities (Panzar and Willig, Eaton and Lemche, and Pulley and Braunstein). Using cost functions, economies of scope exist if $C(y_1, y_2) < C(y_1, 0) + C(0, y_2)$ where $C(y_1, y_2)$ represents the cost of producing two outputs, and $C(y_1, 0)$ representing the cost of producer output, y_1 and $C(0, y_2)$ representing the cost of producer output, y_2. Economies of scope between crop and livestock enterprises may be garnered from a more efficient use of labor and capital. Labor, particularly unpaid operator and family labor, and machinery can often be more effectively utilized if the farm has both crop and livestock enterprises. In addition, producing both types of enterprises may reduce the handling and transportation costs of raised feed as well as provide for a more efficient utilization of livestock waste products. Similarly, scope economies may be realized from multiple cropping on crop-only farms or in association with farms that are specialized in one livestock enterprise.

Adding a livestock enterprise to a crop farm or adding a crop enterprise to a livestock farm may also be an effective method of expanding or taking advantage of economies of scale. For instance, if a farm faces a tight land market in the area surrounding the farm, expanding

through the addition or expansion of a livestock enterprise may be more feasible than renting or buying additional land. Spatial diseconomies may accompany crop expansion in this case. Scale advantages may also arise from crop diversification on crop-only farms or under increased diversification on livestock-only farms or crop-livestock farms. Using a cost function, economies of scale exist if $C(y_1, y_2) / \sum_i y_i MC_i(y_1, y_2)$ is greater than one, where $MC_i(y_1, y_2)$ is the marginal cost of producing the ith output. The magnitude of economies of scope and scale can be estimated using dual functions. Examples of econometric studies that have used dual functions include Kim, Lawrence, and Cohn et al.

Using efficiency and distance function theory,[2] scale and scope efficiency estimates could be translated into economies of scope and scale efficiency gains. In this paper, a non-parametric linear programming approach[3], which utilizes distance functions, is used to estimate the economies of scope and scale efficiency gains due to diversification. With the non-parametric linear programming approach, efficiency gains are estimated using input requirement sets and distance functions. Following Fare, and Fare and Primont, efficiency gains can be computed by invoking the duality equivalency between the subadditivity of the cost function and the superadditivity of the input requirement set. As explained more fully in the next section, with the non-parametric linear programming approach, efficiency gains due to diversification can be

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[2] The introduction of the efficiency concept by Farrell and distance functions by Shephard (1973 and 1990) has led to numerous applications including efficiency and productivity measures of various sectors of the economy. Farrell discussed the empirical estimation of efficiency using multiple agricultural outputs and inputs. Farrell and Fieldhouse published another analysis using farm survey data. In 1966 at the Western Farm Management Association meeting, four papers related to efficiency measurement were presented (Boles, Bressler, Seitz, and Sitorus). Recent applications to U.S. agriculture include Chavas and Aliber, and Featherstone et al.

[3] The non-parametric linear programming approach has several advantages. First, it does not impose, a priori, a specific functional form. Second, it can effectively handle multiple outputs and multiple inputs. Third, efficiency can be computed without information pertaining to input and output prices for each observation. Finally, efficiency measures can be easily decomposed into several components.

effectively decomposed into economies of scale efficiency gains and economies of scope efficiency gains. These efficiency gains can be estimated for individual farms and compared across farm types.

The objective of this study is to examine the economies of scope and scale efficiency gains due to diversification between crop and livestock enterprises. Specifically, the non-parametric linear programming approach is used to estimate economies of scope and scale efficiency gains for a sample of Kansas farms. Because farms differ widely in a number of characteristics, the isolation of diversification or multiple product economies must account for the efficiency impacts of these other characteristics. Thus, the independent efficiency impacts of diversification as well as other characteristics are analyzed.

NON-PARAMETRIC LINEAR PROGRAMMING APPROACH

Suppose that the input requirement set that transforms inputs $\left(x=(x_1, x_2, ..., x_i) \in \Re_+^I\right)$ into outputs $\left(y=(y_1, y_2, ..., y_j) \in \Re_+^J\right)$ can be represented by an input requirement set $L(y)$. Let $L_S(y_1)$ and $L_D(y)$ represent the input requirement sets for a specialized (S) and a diversified (D) farm, respectively. Overall efficiency gains can be represented as follows:

(1) $$Overall\ Efficiency\ Gains = \frac{L_D(y)}{L_S(y_1)}$$

where a ratio greater than (equal to) one indicates efficiency (no efficiency) gains due to diversification between specialized and diversified farms.

The input requirement set for the specialized farm under constant returns to scale and strong input disposability can be defined as:

(2) $$L_S(y_1|_{CRS}) = \{x\colon y_1 \text{ produced by } x;\}$$

Using (2), relative efficiency for a specialized farm in year *t* can be evaluated with the following input distance function:

(3) $$D_S^T(y_1^t,\ x^t\,|_{CRS})^{-1} = \min_{\lambda,z}\{\lambda : (y_1^t, \lambda\, x^t) \in L_S^T(y_1^t)\ \}$$

or

$$\min_{\lambda,z} \lambda \quad s.t. \quad y_1^t \le Y_1\, z \qquad \text{where } Y_1 = (y_1^1, y_1^2, ..., y_1^T)$$

$$\lambda\, x^t \ge X\, z \qquad X = (x^1, x^2, ..., x^T)$$

$$z \ge 0$$

In (3), *z* is a {*Tx1*} vector of intensity variables with $z \ge 0$ identifying the constant returns to scale (CRS) boundaries of the reference set. The greater (less) than sign represents the strong disposability of inputs (outputs).

Similarly, an input distance function can be used to evaluate relative efficiency for a specialized farm under variable returns to scale technology:

(4) $$D_S^T(y_1^t,\ x^t\,|_{VRS})^{-1} = \min_{\lambda,z} \lambda \quad s.t. \quad y_1^t \le Y_1\, z \qquad \text{where } Y_1 = (y_1^1, y_1^2, ..., y_1^T)$$

$$\lambda\, x^t \ge X\, z \qquad X = (x^1, x^2, ..., x^T)$$

$$z = 1$$

In (4), *z* is a {*Tx1*} vector of intensity variables with $z = 1$ identifying variable returns to scale (VRS) boundaries of the reference set (Fare et al.).

Scale efficiency for each specialized farm can be computed as the ratio of input distance functions under the assumption of constant returns to scale and variable returns to scale technology:

(5) $$S_S^T(y_1^t,\ x^t) = \frac{D_S^T(y_1^t,\ x^t\,|_{CRS})^{-1}}{D_S^T(y_1^t,\ x^t\,|_{VRS})^{-1}}$$

Now let's examine a diversified farm. The input requirement set for a diversified farm under constant returns to scale and strong input disposability can be defined as:

(6) $L_D(y|_{CRS}) = \{x\colon y \text{ produced by } x;\}$

The input requirement set in (6) can be used to examine the relative efficiency of a diversified farm under constant returns to scale technology in year *t*:

(7) $$D_D^T(y^t,\ x^t|_{CRS})^{-1} = \min_{\lambda,z}\{\lambda\colon (y^t, \lambda x^t) \in L_D^T(y^t)\}$$

or

$$\min_{\lambda,z} \lambda \quad s.t. \quad y^t \le Yz \qquad \text{where } Y_1 = (y^1, y^2, \ldots, y^T)$$
$$\lambda x^t \ge X z \qquad X = (x^1, x^2, \ldots, x^T)$$
$$z \ge 0$$

In (7), *z* is a {*Tx1*} vector of intensity variables with $z \ge 0$ identifying the constant returns to scale (CRS) boundaries of the reference set.

The input distance function for a diversified farm under variable returns to scale technology in year *t* can be depicted as follows:

(8) $$D_D^T(y^t,\ x^t|_{VRS})^{-1} = \min_{\lambda,z} \lambda \quad s.t. \quad y^t \le Yz \qquad \text{where } Y = (y^1, y^2, \ldots, y^T)$$
$$\lambda x^t \ge X z \qquad X = (x^1, x^2, \ldots, x^T)$$
$$z = 1$$

Scale efficiency for each diversified farm can be computed as the ratio of input distance functions under the constant returns to scale and variable returns to scale technology:

(9) $$S_D^T(y^t,\ x^t) = \frac{D_D^T(y^t,\ x^t|_{CRS})^{-1}}{D_D^T(y^t,\ x^t|_{VRS})^{-1}}$$

The efficiency estimates computed in equations (3), (4), (7), and (8) above can be used to explore efficiency gains. Before doing this, it is important to note that technical efficiency computed under constant returns to scale technology can be decomposed into pure technical efficiency computed under variable returns to scale technology and scale efficiency. This decomposition can be translated into efficiency gains. Specifically, overall efficiency gains can

be defined as the product of economies of scope efficiency gains and economies of scale efficiency gains. Using input requirements sets and distance functions, this decomposition can be depicted as:

$$(10)\quad \frac{L_D(y)}{L_S(y_1)} \equiv \frac{D_D^T(y^t,\, x^t\,|_{CRS})^{-1}}{D_S^T(y_1^t,\, x^t\,|_{CRS})^{-1}} = \frac{D_D^T(y^t,\, x^t\,|_{VRS})^{-1}}{D_S^T(y_1^t,\, x^t\,|_{VRS})^{-1}} * \frac{S_D^T(y^t,\, x^t)}{S_S^T(y_1^t,\, x^t)}$$

Overall efficiency gains = Scope efficiency gains $*$ Scale efficiency gains

The first part on the right hand side of (10) represents efficiency gains due to scope. The second part represents efficiency gains due to scale.

Overall efficiency gains, scope efficiency gains, and scale efficiency gains are graphically represented in figure 1. Constant returns to scale and variable returns to scale technology for the specialized farm are represented as CRS^S *and* VRS^S respectively, and for the diversified farm as CRS^D *and* VRS^D respectively. Based on figure 1, scope efficiency gains [first part of right hand side of (10)] due to diversification between specialized and diversified firms can be represented as:

$$(11)\quad \text{Scope Efficiency gains} = \frac{D_D^T(y^t,\, x^t\,|_{VRS})^{-1}}{D_S^T(y_1^t,\, x^t\,|_{VRS})^{-1}} = \frac{OX/OX_S}{OX/OX_D} = \frac{OX_D}{OX_S}$$

Scale efficiency gains [second part of right hand side of (10)] due to diversification between specialized and diversified farms can be represented as:

$$(12)\quad \text{Scale Efficiency gains} = \frac{S_D^T(y^t,\, x^t)}{S_S^T(y_1^t,\, x^t)} = \frac{\dfrac{OX/OX^{F_S}}{OX/OX_S}}{\dfrac{OX/OX^{F_D}}{OX/OX_D}} = \frac{OX_S/OX^{F_S}}{OX_D/OX^{F_D}}$$

Overall efficiency gains due to diversification between specialized and diversified farms can be represented as:

(13) $$\frac{D_D^T(y^t,\, x^t|_{CRS})^{-1}}{D_S^T(y_1^t,\, x^t|_{CRS})^{-1}} = \frac{OX_D}{OX_S} * \frac{OX_S / OX^{F_S}}{OX_D / OX^{F_D}} \equiv \frac{OX^{F_D}}{OX^{F_S}}$$

To summarize, the first step in the non-parametric linear programming approach is to compute efficiency measures for each farm using equations (3), (4), (7), and (8). The second step is to compute the mean efficiency for each farm type by year. The third step is to use equation (10) to compute overall efficiency gains, scope efficiency gains, and scale efficiency gains. Farm types analyzed included nine systems which had been in existence for the time period of the study. These included four crop-only farms involving wheat and different combinations of feedgrains, soybeans, and hay. Four farm types involved beef plus the same crop combinations of the crop-only farms. Last, one farm was beef-only.

FARM CHARACTERISTICS EXPLAINING EFFICIENCY MEASURES

To further analyze the efficiency gains due to diversification, Tobit regression analysis is conducted to examine the relationship between efficiency and farm characteristics.

Due to the lower and upper censored nature of the efficiency measures, y^*_{ft}, a Tobit model is appropriate. Following Maddala, the Tobit model can be represented as:

(17) $$y_{ft} = \alpha + \sum_{k=1}^{K} x_{fk}\beta_k + \varepsilon_f \qquad f = 1,....,F; \quad k = 1,....,K$$
$$\varepsilon_f \sim \mathrm{N}(0, \sigma_\varepsilon^2)$$

where F and K is the number of farms and number of independent variables respectively. Efficiency is used as dependent variable in the Tobit models. The independent variables (x_{fk}) measure farm characteristics and include operator age, percent of acres irrigated, risk, risk aversion, profit margin, farm size, and diversification which is analyzed using dummy variables

for each farm type. The error terms e_f follow a standard normal distribution with mean zero and variance σ_ε^2. Risk is measured using the 10-year standard deviation of income. Risk aversion is proxied with the debt to asset ratio. Profit margin is included as an explanatory variable to explore the relationship between financial efficiency and technical efficiency. Farm size is measured using gross farm income.

KANSAS FARM INPUT AND OUTPUT DATA

A sample of 570 Kansas Farm Management Association (KFMA) farms with continuous data from 1994 to 2003 is used in the analysis. Inputs include labor, purchased inputs, and capital. The number of workers on the farm (operator and hired labor) is used as the labor input variable. Purchased inputs include seed, fertilizer, herbicide and insecticide, feed, repairs, insurance, chemicals, veterinarian expenses, fuel, oil, and utilities. The purchased input index is created by dividing real purchased input expenses by the real USDA prices paid index for items used for production. Capital includes cash farm rent, depreciation, and an interest charge on assets. The capital input index is created by dividing real capital expense by an index of real interest rates. The index of real interest rates uses the real interest rate in 2003 as the base (1.00), nominal interest rates from the Federal Reserve Bank of Kansas City, and the implicit price deflator for personal consumption expenditures (Federal Reserve Bank of St. Louis).

Outputs include wheat, feedgrains, soybeans, hay, beef, and miscellaneous income. Hay includes alfalfa, other hay, and silage. Beef is measured on a value added basis. Specifically, pounds of beef purchased are subtracted from pounds of beef sold to derive value added quantities. Miscellaneous income includes government payments, crop insurance proceeds, patronage dividends, and custom work.

Outputs produced by the farms differ among the farms. These differences in outputs produced are used to compare relative efficiency differences among the farms. Specifically, efficiency gain comparisons involve four crop-only farms all involving wheat. These include wheat only, wheat-feedgrains, wheat- feedgrains-soybeans, and wheat-feedgrains-soybeans-hay. Four farm types include the same crop combinations but also include beef. Finally, a beef-only group of farms was analayzed. Miscellaneous income is not used to categorize farms. However, it is important to note that this output is included in the efficiency analysis. The two most common farm types are the beef-wheat-feedgrains-soybeans-hay and wheat-feedgrains-soybeans-hay farm types.

RESULTS

EFFICIENCY ESTIMATES

Table 1 presents the overall, scope, and scale efficiency estimates for all farms averaged by farm type. These efficiency estimates should be viewed as tentative or gross in that the impacts of age, profit margin, farm size, etc. have not been removed from the estimates. For example, one particular farm type group may happen to have younger age operators on average compared to another farm type. Farms having only wheat are found to have the highest efficiency followed by beef-only farms. These results suggest that specialized farms have clear efficiency advantages over diversified farms. Again, however, these groups of farms differ not only in enterprise mix but in other previously described characteristics as well.

Scope economy differences among groups are the major determining force impacting overall efficiency rather than scale. Both wheat-only and beef-only farms clearly have no scope

disadvantages relative to the other multiple product firms. The often hypothesized scope advantages of multiple enterprise farms is not evident in this farm sample.

Relative to beef-only farms, slight to moderately increased scale efficiencies are realized when crop enterprises are included. This is most obvious for beef-wheat farms relative to beef-only farms. However, the same phenomena is not observed among the crop-only farms. Additional crops added to wheat farms do not yield scale advantages.

Tables 2, 3, 4 and 5 present overall, scope, and scale efficiency gains for four types of comparisons. Wheat-only farms are compared in Table 2 to each of the three other farm types containing wheat. Consistently higher overall efficiency gains for specialized wheat farms are observed relative to greater diversified farm types. Scale gains are observed to be a negligible part of these differences while scope losses from multiple products is seen to be the cause of the overall efficiency differences.

In Table 3 comparisons of efficiency gains are shown for beef-wheat farms relative to other beef-wheat-other crop farm combinations. Again, greater crop diversification results in increased efficiency gains for beef-wheat farms relative to beef-wheat farms which also include other crops. Again it is scope disadvantages for multiple product farms causing the efficiency gains with scale gains to be nearly nonexistent.

The efficiency gains of beef-only farms relative to beef farms involving various crop enterprises are shown in Table 4. Overall efficiency gains are only slight (1.007) in favor of beef-only farms compared to beef-wheat farms. However, the differences widen when additional crops are included. Again it is scope gain differences which largely account for the differences in overall efficiency gains, not scale gain changes.

Last, the addition of beef to each of the four crop-only farms results in the efficiency gains presented in Table 5. Overall efficiencies are decreased through the addition of beef. The often hypothesized scale advantages of adding beef when crop expansion opportunities may be limited is not observed in this analysis. Further, the scope disadvantages of adding any crop combination to beef-only farms is evident.

The slight scale advantage resulting from adding crops to beef-only farms and the small scale disadvantage of adding crops to beef farms is somewhat opposite to the usual perspective that efficiencies derived from expanded farm size are limited by difficulties in expanding acreage while adding beef enables expanded farm size to be more easily achieved.

FARM TYPE AND CHARACTERISTIC DIFFERENCES

The "gross" efficiencies examined in the previous section averaged for each farm type do not conclusively demonstrate group differences because other factors influencing efficiency are not constant across groups. Hence, a simultaneous analysis of all factors were used to accurately determine differences from diversification among farm types. This was completed using a Tobit model. Dummy variables were included with the base being farms having wheat, feedgrains, soybeans, and hay as enterprises. For a particular time period it is conceivable that financial variables may differ widely among farm types due to crop yield phenomenon. This sampling issue related to the time frame may also influence the benefits from irrigation which would also not be expected to be important in the long run. Size, as represented by farm income, operator age, and risk would not be expected to be affected by the choice of analysis time period.

In Table 6, all hypothesized explanatory variables are presented. Irrigation and the debt/asset ratio demonstrate insignificant influences. Gross farm income or farm size is seen to be significant and positively related to efficiency. As expected, farms with higher profit margins

are relatively more efficient. Operator age is significant and negatively related to efficiency. Although not significant, risk is negatively related to efficiency. The implication of a negative risk result is that efficiency increases as risk declines which is expected theoretically.

After taking into account the farm characteristics described above, the independent differences among farm types can be more accurately assessed. The comparison base is the wheat-feedgrains-soybean-hay farm type. Wheat-only farms (DM 4), the completely diversified beef-crop farms (DM 5), beef-wheat farms (DM 8), and beef farms (DM 9) show significant differences from the comparison base. These results narrow but do not contradict the earlier conclusions of 1) the efficiency disadvantages (relative to wheat-only) of crop diversification, 2) the efficiency disadvantages of including beef in crop-only farms, and 3) the efficiency advantages of beef-only and beef-wheat farms.

SUMMARY AND CONCLUSIONS

Farms diversify for various reasons. In addition to reducing risk, farms may diversify to take advantage of scope efficiency or scale efficiency. This paper used the non-parametric linear programming approach to examine efficiency gains due to diversification between crop and livestock enterprises.

Specialized farms were found to be relatively more efficient than diversified farms. In addition to being more specialized, farms with higher levels of efficiency tended to be larger, have younger operators, and have a higher profit margin.

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FIGURE 1. ECONOMIES OF SCOPE AND SCALE EFFICIENCY GAINS DUE TO DIVERSIFICATION

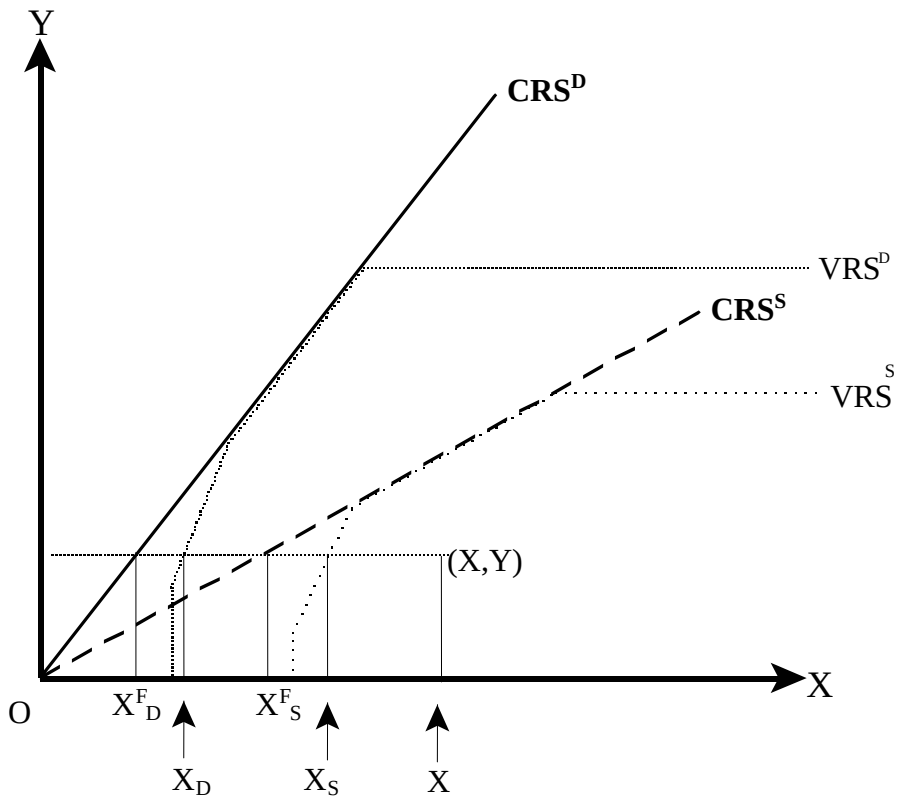

TABLE 1. AVERAGE, OVERALL, SCOPE, AND SCALE EFFICIENCY BY FARM TYPE.

Farm Type[1]	Efficiency		
	Overall	**Scope**	**Scale**
1. WH-FG-SB-HY	.9277	.9447	.9816
2. WH-FG-SB	.9487	.9621	.9846
3. WH-FG	.9590	.9751	.9836
4. WH	.9845	1.000	.9845
5. BF-WH-FG-SB-HY	.9143	.9352	.9773
6. BF-WH-FG-SB	.9403	.9522	.9872
7. BF-WH-FG	.9210	.9401	.9785
8. BF-WH	.9653	.9824	.9827
9. BF	.9721	1.000	.9721

[1] Types refer to farms having wheat (WH), feedgrains (FG), soybeans (SB), hay (HY), and beef (BF).

TABLE 2. OVERALL, SCOPE, AND SCALE EFFICIENCY GAINS OF WHEAT FARMS RELATIVE TO OTHER CROP-ONLY FARMS.

	Efficiency Gains		
Farm Type[1]	**Overall**	**Scope**	**Scale**
WH-FG-SB-HY	1.061	1.059	1.003
WH-FG-SB	1.038	1.039	1.000
WH-FG	1.027	1.025	1.001

[1] Types refer to farms having wheat (WH), feedgrains (FG), soybeans (SB), and hay (HY).

TABLE 3. OVERALL, SCOPE, AND SCALE EFFICIENCY GAINS OF BEEF-WHEAT FARMS RELATIVE TO OTHER BEEF-CROP FARMS.

	Efficiency Gains		
Farm Type[1]	**Overall**	**Scope**	**Scale**
BF-WH-FG-SB-HY	1.056	1.051	1.005
BF-WH-FG-SB	1.027	1.032	.995
BF-WH-FG	1.048	1.045	1.004

[1] Types refer to farms having wheat (WH), feedgrains (FG), soybeans (SB), hay (HY), and beef (BF)

TABLE 4. OVERALL, SCOPE, AND SCALE EFFICIENCY GAINS OF BEEF-ONLY FARMS RELATIVE TO BEEF-CROP FARMS.

	Efficiency		
Farm Type[1]	**Overall**	**Scope**	**Scale**
BF-WH-FG-SB-HY	1.063	1.069	.995
BF-WH-FG-SB	1.034	1.050	.985
BF-WH-FG	1.055	1.064	.993
BF-WH	1.007	1.018	.989

[1] Types refer to farms having wheat (WH), feedgrains (FG), soybeans (SB), hay (HY), and beef (BF).

TABLE 5. OVERALL, SCOPE, AND EFFICIENCY GAINS OF INCLUDING BEEF IN FOUR CROP-ONLY FARMS.

	Efficiency		
Farm Type[1]	**Overall**	**Scope**	**Scale**
WH-FG-SB-HY	.9856	.9900	.9960
WH-FG-SB	.9911	.9897	1.0026
WH-FG	.9604	.9641	.9948
WH	.9805	.9824	.9982

[1] Types refer to farms having wheat (WH), feedgrains (FG), soybeans (SB), hay (HY), and beef (BF).

TABLE 6. TOBIT REGRESSION OF OVERALL EFFICIENCY FOR SIX FARM CHARACTERISTICS AND EACH FARM TYPE (RELATIVE TO WH-FG-SB-HY).

Variable	Estimate	t-Value
Intercept	1.042	23.16
Farm Income	.243	4.53
Percent Irrigation	.020	.44
Debt/Asset Ratio	-.001	.04
Operator Age	-.002	2.68
Profit Margin	.104	4.29
Risk	-1.44	1.15
DM 2 (Wheat-Feedgrains-soybeans farms)	.024	.69
DM 3 (Wheat-Feedgrains farms)	.052	1.45
DM 4 (Wheat farms)	.259	3.27
DM 5 (Beef- Wheat-Feedgrains-soybeans-Hay farms)	-.049	-2.20
DM 6 (Beef- Wheat-Feedgrains-soybeans farms)	.016	.41
DM 7 (Beef- Wheat-Feedgrains- farms)	.011	.39
DM 8 (Beef- Wheat farms)	.107	2.69
DM 9 (Beef farms)	.284	3.04