

ECONOMIC REPORT

Economic Report ER92-1

January 1992

A COMPARISON OF MINNESOTA'S FARM BUSINESS MANAGEMENT ASSOCIATION MEMBERS AND THE USDA'S FARM COSTS AND RETURNS SURVEY

by

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ABSTRACT

Many states have farm record associations which collect individual farm data. This data are used for research, extension, and teaching purposes. However, since membership in the associations is voluntary, the question arises whether the members are representative of the population of all farmers in that area. This study compares farm record data collected through the Southeastern and Southwestern Minnesota Farm Business Management Associations (FBMA) and data obtained through the USDA's Farm Costs and Returns Survey (FCRS). Both data sets were for 1987. By design, the FCRS survey is not subject to the self-selection bias that may occur in the FBMA data. The objectives of this study are to: (1) determine which farm characteristics are statistically the same in the FBMA and FCRS data, and (2) determine the farm size ranges in which FBMA farms are statistically representative of FCRS farms.

FBMA farms were not representative of all farms in their area. FBMA farms do not include small operations. Major differences exist in total tillable acreage, rented land and livestock production, especially hogs. These combined differences result in a substantial difference in net farm income between the two farm categories. However, the FBMA farms reflect FCRS farms' solvency conditions relatively well.

FBMA farms were more similar to farms with sales exceeding \$60,000 per year but differences still existed. Total acreage, total sales (especially sales of hogs), total expenses, and net farm income were significantly ($p < .01$) higher for FBMA farms. Even at higher sales levels, FBMA farms were characterized by a higher level of livestock production and a slightly larger tillable acreage mainly due to renting additional land. Economic performance measured by net farm income and returns to total assets and family labor also was significantly ($p < .01$) better for FBMA farms. So even though differences in assets, liabilities, and thus solvency positions were insignificant ($p > .10$), the economic performance of the FBMA farms appears to be better than FCRS farms even in larger sizes.

On the basis of these findings, the FBMA data cannot be used to represent all farms or even all commercial farms. It does appear that FBMA farms can be used to represent larger farms with livestock. Thus, the FBMA data is not well-suited for estimation of economic relationships to be used in aggregate economic analyses of the agricultural sector.

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INTRODUCTION

Many states¹ have farm record associations which collect individual farm data and prepare annual summaries (e.g., Justus, 1989; Olson et al., 1990). The data from these associations are used for research, extension, and teaching purposes (e.g., Schurle and Tholstrup, 1989; Sonka et al., 1989; Scott, 1984; Tvedt et al., 1989). The association data are a combination of cross-sectional and time-series data of individual farms. Many of the farms have been included for 5-15 years or longer. The data are an excellent source of teaching and extension examples and other uses, such as policy impact analysis, intertemporal managerial behavior research, or monitoring of farm financial conditions.

Studies using this farm data usually contain a comment or disclaimer about whether, or to what degree, the conclusions can be extended to the general farm population because the associations are not considered to be a random sample of all farms for several reasons. Participation in the Associations is voluntary; hence, the question arises whether the farmers in the associations are different due to self-selection bias from the population of farmers in the respective area. As measured in either

¹The National Association of Farm Business Analysis Specialists (NAFBAS) includes members in Alabama, Colorado, Illinois, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, New Mexico, North Carolina, South Carolina, and Wisconsin.

physical or financial terms, the very small and very large farms in census surveys are not represented in association data. Also, it is sometimes argued that, on average, association members have managerial and professional talent exceeding their fellow farmers. The argument continues in that participants in the associations benefit as receivers of a farm management service that further enhances their opportunities to develop and prosper on a well-managed farm operation.

To clarify the representativeness question, this study focuses on whether farms in one of these associations are "the same" as other farms in the same geographic area. Previously, only a few studies have addressed this question. Mueller (1954) found that, compared to a random sample of farms, a set of record-keeping farms in Illinois were larger in terms of acreage, had a higher soil quality, used more inputs per acre, and had better management as measured by financial performance. Mueller also paired the sample farms and record-keeping farms on the basis of land size and soil quality and found that managerial ability was positively related to size but not related to membership in a record-keeping group. In 1939, Hopkins (as quoted in Mueller) found that record-keeping farms in Iowa used more short-term capital and had higher earnings than comparably sized survey farms.

More recently, Olson and Tvedt (1987) found that association farms in southwest Minnesota were larger than the 1982 U.S. Agricultural Census averages in terms of acreage, livestock numbers, sales, expenses, and investment. They also found association farms to be better managed when compared on the basis of yields and the rate of return to assets. However, Olson and Tvedt used published averages for both the associations

and the census and did not have the individual farm observations. Thus, they could not perform statistical comparison nor could they compare the Association farms exclusively with Census farms in larger sales classes. Gustafson et al. (1990) compared a sample of record-keeping farms with a random sample of all farms in North Dakota in 1986. Like Olson and Tvedt, Gustafson et al. found differences between the two groups even after adjusting for farm size.

This paper uses an approach similar to Gustafson et al. to compare farm record data collected through the Southeastern and Southwestern Minnesota Farm Business Management Associations (FBMA) and data obtained through the USDA's Farm Costs and Returns Survey (FCRS). Both data sets were for 1987. The FCRS survey is based upon random sampling within specified strata reflecting the size of farms as well as geographical area. By design, it is not subject to the self-selection bias that may occur in the FBMA data. This comparison updates those by Mueller and Hopkins, improves on Olson and Tvedt by using individual farm data for both the FBMA and FCRS, and expands the procedure used by Gustafson et al. by testing the distribution functions of farm characteristics. The two objectives of this study are to: (1) determine which farm characteristic variables collected through FBMA are statistically the same as data collected through the FCRS, and (2) determine the farm size ranges in which FBMA farms are statistically representative of farms in the FCRS.

This is done in three ways: (1) a visual comparison of group averages by three measures of farm size, (2) a statistical comparison of the equality of the sample means, and (3) a statistical comparison of the distribution functions between the samples. The first comparison was done

with farms grouped according to total tillable acreage, total assets, and total cash sales. The second comparison used a Welch t-test to test whether the means of the farm characteristic variables are the same in the FBMA and FCRS samples. This comparison was done for all farms and for those with sales greater than \$40,000. Finally, a Kolmogorov-Smirnov test (Lindgren, 1968) was performed for some of the more important variables to test for statistical differences of the distribution functions.

Several variables were identified to represent farm characteristics. The size comparison was based on acreage, total assets and cash sales. Revenue was described by the major sources of cash income: cash sales of products (such as grain, livestock, and milk) and cash income from other sources (such as government payments). Costs were identified in terms of variable and fixed costs. Variable costs were grouped into total variable costs, total repairs, and total cash expenditures for leasing, custom work, etc. Fixed costs were represented by depreciation of buildings and machinery and the total cost of capital services regardless of machinery ownership arrangements. Financial measures were total assets, total liabilities, the debt/asset ratio, and total cash interest expenditures. Comparisons of farm profitability and relative economic efficiency were made through operating margin, net farm income, and rate of return to total assets and operator's labor.

DATA ADJUSTMENTS

Several measures used in the analyses are defined differently in the two samples. The FBMA and FCRS data were adjusted so the respective variables would correspond as closely as possible. The changes and

adjustments that were made were due to discrepancies in measurements of acreage of owned and rented land, valuation of land, definition of net farm income, and accounting procedures.

In some cases, the amount of owned land required adjustment because information concerning total owned acreage was not available or contradictory to the information regarding total owned tillable land for some FBMA farms. The latter figure was usually available with greater accuracy since it measures actual land use and cropping patterns. Thus, the total adjusted acreage of land owned was defined as the maximum of reported owned land and reported owned tillable acreage. This adjustment increased the owned acreage from 234 acres to 254 acres for the FBMA farms.

The FCRS valuation of land is the total market value of buildings and land as perceived by the respondent during the interview. The FBMA data is somewhat more ambiguous. The Southeastern Association has always used cost basis valuation of land, while the Southwestern Association has used a market value approach since 1979. To change the Southeast data to market value, the average estimated values for land in farms on a per county basis (Schwab and Raup, 1988) were used to obtain an adjusted value of total assets for all the farms. Since these values reflect farms with average quality of land and buildings within the county, the value was adjusted also by the cost-basis value of buildings as reported for each farm. The estimated value per acre was then multiplied by the total adjusted acreage of land owned for the FBMA farms. After these adjustments, the average value of land and buildings increased from \$178,664 to \$237,997 for FBMA farms. The resulting implied value of assets per acre of land is \$936 per acre for FBMA farms and \$969 per acre for FCRS - a difference of 3.5%.

Net farm income on the accrual basis was defined as cash operating income minus the operator's share of cash operating expenditures, depreciation of capital assets, and inventory changes. Capital purchases and sales are not included in the calculation of net farm income. In order to enhance the comparability between the FBMA and FCRS data sets, an imputed rent for operators dwelling was added to the net farm income of the FBMA farms. Average dwelling rent was estimated from FCRS data by sales class for Minnesota.

Since information concerning unpaid labor was not available for the FBMA farms (while it is available for the FCRS farms), the imputed cost of labor and then the returns to assets alone was not calculated. To overcome this data deficiency, overall economic performance is measured by the traditional rate of return to assets but interpreted as the return to both operator's labor and assets.

Several differences in accounting procedures were the basis for further adjustments. The FCRS data is based strictly on cash accounting, but the FBMA data includes accounts payable and accounts receivable. All variables in the FBMA data were adjusted to reflect cash accounting practices. Instead of using depreciation calculated under IRS rules, depreciation of buildings and equipment was measured on a cost accounting basis in both FCRS and FBMA which should minimize differences due to varying measurement techniques. In evaluating the debt/asset ratio, the adjusted asset values were used for the FBMA data in order to obtain greater compatibility with the FCRS data. A comparison was also made with the original asset values reported in FBMA irrespective of their potential

deficiencies. Nonfarm assets and nonfarm debt were not included in the FCRS survey; consequently, they were excluded from the FBMA data set.

A tenancy ratio was calculated as the proportion of all tillable land which was rented. Tillable land was used for this ratio instead of all owned land because the FBMA reporting of rented land includes tillable land only and does not include nontillable land such as permanent pasture, meadows, forest land, swamps, roads, and farmstead land. Owned land includes both tillable and nontillable land; thus, to use all owned land would introduce a downward bias in the tenancy ratio.

A VISUAL COMPARISON BY FARM SIZE

The first comparison between the FCRS and FBMA samples was made on the basis of farm size. Farm size was measured in three ways: total tillable acreage, total adjusted assets, and total cash sales. Each of the size classifications have advantages and disadvantages; the results and interpretations vary somewhat depending upon the choice of size variable. To make some comparisons, the farms were classified by both farm size and livestock intensity.² Livestock intensity was measured by total livestock sales as a proportion of total cash sales for each farm. Farms with more than 50% of total cash sales being livestock sales were classified as having a high level of livestock intensity. Low livestock intensity was defined as having livestock sales which accounted for 50% or less of total cash sales.

²These crosstabulations are reported in Appendix A and referred to as needed.

Classification by total tillable acreage

The first variable selected as a measure of size was total tillable acreage farmed, owned plus rented. In all of the variables compared, FBMA farms were larger on average but that does not hold for all acreage sizes (Table 1). Since 76.6% of the FCRS farms have less than 300 tillable acres while only 29.6% of the FBMA farms have less than 300 tillable acres, we would expect that a higher proportion of the farms included in the FCRS survey would be operations where farming may be a secondary occupation. This is supported by the observation of an FBMA fieldman that very few FBMA farmers have jobs off the farm (Weness).

While the average FBMA farm has a total adjusted asset level 50% larger than the FCRS average, this is not true in all size classes. Below 600 acres, FBMA farms have more assets per farm. Above 600 acres, FCRS farms have more assets when classified by acreage. This holds true even when divided by livestock intensity (Appendix Table A1). Even though larger FCRS farms have higher asset values, FBMA farms have more debt than FCRS farms in all acreage classes.

FBMA farms are larger in terms of total sales, total expenses, operating margin, and net farm income in all classes. One notable exception is that FCRS farms with more than 600 acres have more milk sales. The comparison of total sales of livestock reveals that the FBMA farms are characterized by a substantially higher level of livestock sales in all size categories except for farms with more than 900 acres and with high livestock intensity. On the other hand this category contains relatively few observations which complicates statistical inference. Overall, the observations suggest that the FBMA farms are characterized by a

Table 1. Comparison of FCRS and FBMA farm record data sets for 1987 with classification based on total tillable acres

a. Number of Farms and Relative Frequency

Acres	Number of Farms		Relative Frequency	
	FCRS	FBMA	FCRS	FBMA
Below 300	120	71	76.6	29.6
300-600	46	104	15.5	43.3
600-900	20	43	3.7	17.9
900 and above	29	22	4.2	9.2
All farms	215	240	100.0	100.0

b. Total Assets and Debt

Acres	Total Assets		Debt	
	FCRS	FBMA	FCRS	FBMA
Below 300	219,003	269,065	70,943	103,375
300-600	292,302	428,293	106,827	172,006
600-900	674,863	547,532	234,280	253,202
900 and above	1,115,257	1,008,242	337,116	363,560
All farms	300,576	455,722	93,800	183,810

c. Total Sales and Livestock Sales

Acres	Total Sales		Livestock Sales	
	FCRS	FBMA	FCRS	FBMA
Below 300	44,240	145,032	26,821	92,011
300-600	129,292	214,442	66,408	111,722
600-900	208,261	296,914	89,669	127,483
900 and above	412,939	529,816	175,961	261,866
All farms	79,050	237,594	41,572	122,499

d. Hog Sales and Cattle Sales

Acres	Hog Sales		Cattle Sales	
	FCRS	FBMA	FCRS	FBMA
Below 300	5,908	39,136	5,738	15,520
300-600	21,740	49,485	20,424	32,649
600-900	28,111	56,926	23,160	40,479
900 and above	60,967	124,329	84,488	123,120
All farms	11,463	54,617	11,981	37,278

Table 1. (Continued)

e. Milk Sales and Inventory Change

Acres	Milk Sales		Inventory Change	
	FCRS	FBMA	FCRS	FBMA
Below 300	14,884	26,169	4,758	9,680
300-600	24,456	26,536	12,517	19,117
600-900	38,354	17,705	13,789	31,530
900 and above	19,480	14,075	60,211	49,317
All farms	17,429	23,703	8,635	21,318

f. Total Expenses and Depreciation

Acres	Total Expenses		Depreciation	
	FCRS	FBMA	FCRS	FBMA
Below 300	37,527	108,777	7,174	14,914
300-600	96,788	165,350	14,996	21,665
600-900	158,634	229,895	24,134	28,911
900 and above	313,967	417,573	45,156	47,873
All farms	62,860	183,299	10,617	23,369

g. Operating Margin and Net Farm Income

Acres	Operating Margin		Net Farm Income	
	FCRS	FBMA	FCRS	FBMA
Below 300	6,713	36,255	7,256	36,337
300-600	32,505	49,092	29,848	52,545
600-900	49,627	67,019	38,165	76,386
900 and above	98,973	112,243	69,896	122,333
All farms	16,190	54,295	14,747	54,819

h. Debt to Asset Percentage and Rented Land Percentage

Acres	Debt/Asset %		Rented Land %	
	FCRS	FBMA	FCRS	FBMA
Below 300	32	38	28	51
300-600	27	40	59	57
600-900	35	46	64	67
900 and above	30	36	63	63
All farms	31	40	48	60

substantially higher level of livestock production. Forty-eight percent of FBMA farms were classified as livestock intensive; 44% of FCRS farms were so classified. This relatively minor difference, combined with a greater difference in total sales, suggests that farms that actually produce livestock among the FBMA farms are far more livestock intensive than their counterparts in the FCRS group.

An analysis of solvency measures and tenancy levels do not indicate any clear patterns distinguishing the two groups except for the debt/asset ratio which is lower for the FCRS farms relative to the FBMA farms for all sizes and livestock intensities. The overall tenancy ratio is higher for the FBMA farms versus FCRS farms. However, no clear pattern of tenancy ratios evolves across the size and livestock intensity classes.

To summarize, the division of farms based upon total acreage indicates that the FBMA farms are (1) larger in terms of total sales, and total operating expenditures, (2) characterized by a higher level of debt, operating margin, and net farm income, and (3) more livestock intensive. Also, FBMA farms with less than 900 acres held more assets than FCRS farms, but FCRS farms larger than 900 acres held slightly more assets than their FBMA counterparts. FBMA farms had higher tenancy ratios except for the largest size in which the ratios are equal.

Classification by total adjusted assets

The second classification scheme used was based upon the value of total adjusted assets in the farming operation. This involves all assets including inventories, farm machinery, equipment, etc. The valuation of land and buildings is based upon the assumptions and procedures previously

described. The classification based on total assets provides approximately the same picture as the classification based on total tillable acreage. The similarity is not surprising since total assets and total acreage are expected to be strongly correlated. As in the classification scheme based on total tillable acres, the FCRS data set contains a higher proportion of smaller farms (assets below \$250000, Table 2). However, the disparity is less obvious. As expected, the differences between total assets in respective size categories are relatively minor. The difference in farm size between the FCRS and FBMA data, as measured by total sales and total expenses, is still quite substantial. In terms of income measures, FBMA farms had consistently larger levels of total sales, sales of livestock, total expenses, operating margin and net farm income than FCRS farms in all size classes. When classified by total adjusted assets (Table 2), the smallest size class of both FCRS and FBMA farms had higher debt/asset ratios and percentages of rented land compared to the classification by tillable acreage (Table 1).

Overall, the classification by total adjusted assets shows differences in size and economic performance between the FCRS and FBMA farms. A higher proportion of FBMA farms are in the larger classes. When compared on the basis of all the income measures, FBMA farms are producing more income than their FCRS counterparts in each size class. That is, FBMA farms are making more efficient use of a similar asset base.

Table 2. Comparison of FCRS and FBMA farm record data sets for 1987 with classification based on total assets

a. Number of Farms and Relative Frequency

Assets (\$1000)	Number of Farms		Relative Frequency	
	FCRS	FBMA	FCRS	FBMA
Below 250	80	90	55.0	37.5
250-500	70	86	29.4	35.8
500-750	25	36	8.8	15.0
Above 750	40	28	6.8	11.7
All farms	215	240	100.0	100.0

b. Total Assets and Debt

Assets (\$1000)	Total Assets		Debt	
	FCRS	FBMA	FCRS	FBMA
Below 250	126,250	183,291	46,544	84,869
250-500	337,045	434,709	95,753	198,270
500-750	586,318	681,152	213,753	268,316
Above 750	1,180,025	1,106,095	311,939	348,770
All farms	300,576	455,722	93,800	183,810

c. Total Sales and Livestock Sales

Assets (\$1000)	Total Sales		Livestock Sales	
	FCRS	FBMA	FCRS	FBMA
Below 250	29,287	137,659	9,674	60,112
250-500	94,221	218,763	53,999	112,508
500-750	129,265	284,105	70,710	132,821
Above 750	349,745	556,847	207,368	340,448
All farms	79,050	237,594	41,572	122,499

d. Hog Sales and Cattle Sales

Assets (\$1000)	Hog Sales		Cattle Sales	
	FCRS	FBMA	FCRS	FBMA
Below 250	1,848	31,327	2,405	10,978
250-500	19,542	54,036	14,225	21,263
500-750	9,752	43,256	20,172	53,210
Above 750	56,229	145,872	68,864	150,517
All farms	11,463	54,617	62,860	37,278

Table 2. (Continued)

e. Milk Sales and Inventory Change

Assets (\$1000)	Milk Sales		Inventory Change	
	FCRS	FBMA	FCRS	FBMA
Below 250	5,220	15,687	3,486	13,281
250-500	19,844	26,513	11,902	21,803
500-750	40,700	35,827	8,214	19,816
Above 750	75,450	25,248	36,540	47,589
All farms	17,429	23,703	8,635	21,318

f. Total Expenses and Depreciation

Assets (\$1000)	Total Expenses		Depreciation	
	FCRS	FBMA	FCRS	FBMA
Below 250	29,611	106,144	4,334	10,761
250-500	69,367	172,458	11,974	23,557
500-750	100,098	204,223	22,362	32,740
Above 750	254,626	437,687	40,285	51,267
All farms	62,860	183,299	10,617	23,369

g. Operating Margin and Net Farm Income

Assets	Operating Margin		Net Farm Income	
	FCRS	FBMA	FCRS	FBMA
Below 250	-324	31,515	1,567	39,272
250-500	24,854	46,305	24,804	50,569
500-750	29,167	79,882	12,992	73,630
Above 750	95,120	119,160	79,733	124,517
All farms	16,190	54,295	14,747	58,419

h. Debt to Asset Percentage and Rented Land Percentage

Assets (\$1000)	Debt/Asset %		Rented Land %	
	FCRS	FBMA	FCRS	FBMA
Below 250	37	46	59	86
250-500	28	46	46	57
500-750	36	39	33	46
Above 750	26	32	45	46
All farms	31	40	48	60

Classification by total cash sales

The third classification scheme categorizes the farms according to total cash income including government payments. Cash income, which is a measure of gross output, is also a measure of size which is less affected by differences in tenancy structure and livestock intensity. Government payments are included because they can be regarded as cash compensation for a reduction in output (e.g., reducing planted acreage) which is a reflection of the size of the operation. Cash renting and share renting are treated the same in the two data sets.

Once again it is evident that the FCRS data base contains a substantial number of small farms (Table 3). Under this classification by total sales, the similarities for variables measuring economic performance, such as net farm income, operating margin, total sales, sales of livestock and operating expenditures, are stronger than with the first two classification schemes. As expected, differences exist between FBMA and FCRS data for farms with sales below \$40,000. These differences are less accentuated for farms with sales exceeding \$80,000. In other words, both FCRS and FBMA farms with sales above \$80,000 do not exhibit remarkably different properties when comparing the average values of some important farm characteristic variables--except FBMA farms have higher debt/asset ratios and higher tenancy ratios. Similar to the previous two classifications, FCRS farms have a slightly lower sales volume of livestock when classified by livestock intensity (Appendix Table A3).

In conclusion, differences between FCRS and FBMA farms across these three classifications appear to exist in economic efficiency shown by higher operating margin and net farm income for FBMA farms in every size

Table 3. Comparison of FCRS and FBMA farm record data sets for 1987 with classification based on total cash sales

a. Number of Farms and Relative Frequency

Total sales (\$1000)	Number of farms		Relative frequency	
	FCRS	FBMA	FCRS	FBMA
Below 40	66	7	49.5	2.9
40-80	34	13	18.3	5.4
80-160	41	63	18.2	26.3
Above 160	74	157	14.1	65.4
All farms	215	240	100.0	100.0

b. Total Assets and Debt

Total sales (\$1000)	Total assets		Debt	
	FCRS	FBMA	FCRS	FBMA
Below 40	156,063	140,182	31,330	76,359
40-80	276,797	185,348	113,308	26,050
80-160	341,767	275,821	128,879	114,724
Above 160	787,200	564,368	244,387	229,386
All farms	300,576	455,722	93,800	183,810

c. Total Sales and Livestock Sales

Total sales (\$1000)	Total sales		Livestock Sales	
	FCRS	FBMA	FCRS	FBMA
Below 40	14,336	30,230	3,581	12,727
40-80	56,950	59,652	20,271	18,681
80-160	106,789	119,656	60,349	47,543
Above 160	299,787	308,899	178,745	166,068
All farms	79,050	237,594	41,572	122,499

d. Hog Sales and Cattle Sales

Total sales (\$1000)	Hog Sales		Cattle Sales	
	FCRS	FBMA	FCRS	FBMA
Below 40	702	2,142	1,314	5,224
40-80	2,482	1,757	8,327	5,027
80-160	14,257	20,158	12,670	8,773
Above 160	57,416	75,161	53,414	52,816
All farms	11,463	54,617	11,981	37,278

Table 3. (Continued)

e. Milk Sales and Inventory Change

Total sales (\$1000)	Milk Sales		Inventory change	
	F CRS	FBMA	F CRS	FBMA
Below 40	1,392	3,171	2,699	4,677
40-80	9,269	10,698	6,650	9,949
80-160	32,813	17,633	9,913	9,654
Above 160	64,587	28,131	30,470	27,681
All farms	17,429	23,703	8,635	21,318

f. Total Expenses and Depreciation

Total sales (\$1000)	Total expenses		Depreciation	
	F CRS	FBMA	F CRS	FBMA
Below 40	18,442	26,856	2,437	4,605
40-80	48,995	43,053	9,495	6,134
80-160	76,340	86,175	15,636	13,211
Above 160	219,883	240,859	34,389	29,708
All farms	62,860	183,299	10,617	23,369

g. Operating Margin and Net Farm Income

Total sales (\$1000)	Operating margin		Net farm income	
	F CRS	FBMA	F CRS	FBMA
Below 40	-4,105	3,373	480	8,040
40-80	7,955	16,599	3,816	23,957
80-160	30,449	33,480	26,522	35,167
Above 160	79,904	68,039	63,947	72,849
All farms	16,190	54,295	14,747	58,419

h. Debt to Asset Percentage and Rented Land Percentage

Total sales (\$1000)	Debt/asset %		Rented land %	
	F CRS	FBMA	F CRS	FBMA
Below 40	20	54	26	45
40-80	41	14	47	58
80-160	37	42	50	63
Above 160	31	41	57	60
All farms	31	40	48	60

class except one: FCRS farms with sales above \$160,000 have a higher operating margin. Differences are also present in size (larger FBMA farms) and tenancy structure (more rented land on FBMA farms). FBMA farms had higher total sales of livestock and livestock intensity than FCRS farms. FCRS and FBMA farms have similar solvency levels.

STATISTICAL COMPARISONS OF THE MEANS

The comparison of the means in the previous section was informative and illustrative but did not show that the differences were significant. In this section, the Welch t-test was used to test for statistical differences between the means of the two populations (Best and Rayner, 1987). This comparison was designed to test the null hypothesis that there was no statistical difference between the means for the two data sets. The Welch t-test was chosen because its performance was found to be equivalent or better than the Wald test in Monte Carlo simulations (Best and Rayner). The test statistic is defined as follows:

$$V = (\bar{X}_1 - \bar{X}_2) / (S_1^2/m + S_2^2/n)^{1/2} \quad (1)$$

Where \bar{X}_1 and \bar{X}_2 are the sample means and S_1^2 and S_2^2 are the sample variances of the variable being investigated in the FCRS and FBMA data sets, respectively. Hence, S_1^2/m and S_2^2/n are the variances of the estimated population means for the FCRS and FBMA data sets. The test requires that the sampling distributions for X_1 and X_2 be normally distributed with equal variance. This requirement may not be met due to the voluntary membership of the FBMA. However, since the sample sizes, m and n , were 215 and 240, respectively, the Central Limit Theorem was invoked which states that the distributions for the estimated means will be approximately

normally distributed when m and n are sufficiently large. Following Best and Rayner, the distribution of V was approximated by a t_f distribution in which the degrees of freedom were data dependent:

$$t_f = (S_1^2/m + S_2^2/n)^2 / (S_1^4/(m^3 - m^2) + S_2^4/(n^3 - n^2)) \quad (2)$$

The FCRS sample data set is a complex sample where individual farmers are sampled to ensure that farms of different size and production categories are represented in the sample (Morehart, 1986; Kish and Franko, 1974; Fuller, 1984). From the complex sample the variance of the mean S_1^2/m is estimated for each of the farm characteristic variables as described in detail in Appendix B.

In order to evaluate the data dependent degrees of freedom according to equation (2), the value for m was set to the actual number of observations which is 215 for the FCRS data set. This value for m was also used to calculate S_1^4 . It is not clear from Best and Rayner what the theoretically correct procedure is when the variance of the mean is based upon an "expanded data set" as is used in the FCRS survey. An evaluation of the f-value based upon the expanded number of farms provided degrees of freedom that were substantially higher than the more conservative approach taken in this study. The resulting f-values were greater than 5 (as Best and Rayner recommend) for all the examined variables.

Testing means with all farms

A comparison of the means of the variables showed FBMA farms to be quite different from the entire population of farms in the Southeastern and Southwestern regions of Minnesota, as represented by the FCRS sample (Table 4). This result was consistent with the crosstabulations in the previous

Table 4. Comparison of means for all and FBMA farms for 1987. Statistical tests are conducted for differences in means using Welch t-test.

Variable ¹	FCRS		FBMA		t-stat ²
	Mean	Std.err.	Mean	Std.err.	
oprage	47.1	1.2	44.1	.8	-2.0 **
albownd	160.3	13.2	234.1	14.4	3.77***
totac	231.7	18.8	479.8	17.6	9.61***
tcropac	118.2	10.6	191.7	12.0	4.57***
tcshac	90.4	12.2	203.3	13.7	6.15***
tshac	20.7	4.9	84.9	10.3	5.59***
trac	111.1	13.7	288.1	16.0	8.39***
tenure	.5	.03	.6	.02	2.93***
aidle	39.7	3.6	81.1	3.4	8.38***
pasac	38.4	5.0	13.1	1.7	-4.7 ***
aownrnt	14.1	3.9	2.6	1.4	-2.7 ***
adjassr	300,048	21,768	455,722	20,845	5.16***
vinlv	27,353	3,518	63,308	4,752	6.08***
vfmeq	52,785	4,354	36,075	2,266	-3.4 ***
vlbown2	155,359	12,802	193,501	11,898	2.18**
debt	93,800	9,860	183,809	10,574	6.22***
da	.3	.03	.4	.02	2.75***
incshfm	79,050	7,469	237,593	11,493	11.5 ***
ingov	14,206	1,398	29,210	1,577	7.11***
vsallv	41,572	5,350	122,449	9,245	7.57***
lvsint	.5	.03	.5	.02	-.27
vsalmilk	17,429	3,494	23,702	3,558	1.25
vsalhogs	11,463	2,367	54,617	6,490	6.24***
vsalcatt	11,981	1,723	37,277	7,033	3.49***
chginv	8,635	1,433	21,317	2,626	4.23***
texopb	62,860	5,585	183,298	9,993	10.5 ***
exint	9,316	1,122	16,134	1,089	4.36***
exrntcsh	6,059	838.0	14,322	1,012	6.28***
exhirl	2,123	373.3	6,255	823.5	4.57***
totrep	6,028	542.2	13,314	604.2	8.97***
capex	4,676	430.9	11,096	594.8	8.73***
capexinr	10,705	888.4	24,410	1,020	10.1 ***
exdepr	10,617	1,184	23,368	1,146	7.73***
tcapinr	21,322	1,904	47,779	1,831	10.0 ***
opr marg	16,190	3,235	54,295	3,366	8.16***
ninfrml	14,747	3,211	58,418	3,039	9.87***
ninfrm	14,747	3,211	58,628	3,132	9.78***
roasslab	.1	0	.2	.01	7.84***
albownd	160.3	13.2	254.8	14.3	4.85***
assets	300,576	21,785	396,389	18,728	3.33***
vlbown	155,359	12,802	178,664	11,247	1.36
vlbownl	155,359	12,802	237,997	13,675	4.41***
exallopr	62,860	5,585	180,741	9,864	10.3 ***

¹The variables are described in Table 5.

²Significance levels are as follows: *** = .01; ** = .05; * = .10

Table 5. Description of variables defined and analyzed in Tables 4 and 6 through 9

Variable	Definition
Oprage	Operators age
Albown	Total acreage owned by operator
Totac	Total tillable acreage farmed by operator including land harvested for hay
Tcropac	Total owned tillable acreage
Tcshac	Total cash rented tillable acres
Tshac	Total share rented tillable acreage
Trac	Total tillable rented acreage (tcshac+tshac)
Tenure	A tenancy ratio (trac/totac)
Aidle	Idle tillable land in fallow or set aside land
Pasac	Total acreage of pasture land
Aownrnt	Owned land rented out by operator
Adjassr	Adjusted total value of assets with landvalues represented by vlbownl instead of vlbown
Vinvlv	Value of livestock inventory
Vfmeq	Value of farm machinery and equipment
Vlbown2	Adjusted landvalue, Albownl* estimated value per acre of of farmland on a per county basis
Debt	Total farm debt
Da	Debt/asset ratio (debt/adjassr)
Incshfm	Total cash sales including government payments and other forms of income
Ingov	Total cash income from government payments
Vsallv	Total cash sales of livestock products including milk
Lvsint	Livestock intensity (vsallv/incshfm)
Vsalmilk	Total cash sales of milk
Vsalhogs	Total cash sales of hogs
Vsalcatt	Total cash sales of cattle
Chginv	Change in inventory of livestock and grain
Texopb	Total operating expenditures according to FCRS definition
Exint	Total cash interest expenses
Exrntcsh	Total cash rent expenses
Exhirl	Total cash expenses for hired labor
Totrep	Total cash expenses for repairs of capital and equipment (includes farm machinery, buildings, dwellings and livestock equipment)
Capex	Expenses for capital equipment services such as custom work hired, equipment leases, etc.
Capexinr	Total cash expenditures for capital services excluding purchases of machinery and building equipment (totrep+capex)
Exdepr	Depreciation of farm machinery, equipment and buildings
Tcapinr	Total value of capital services (exdepr+capexinr)
Oprmarg	Operator margin (total cash sales - cash expenses)
Ninfrml	Net farm income adjusted to reflect definition in FCRS
Ninfrm	Net farm income as defined in FBMA reports.
Roasslab	Rate of return to total assets and operator labor in order to facilitate comparison between FCRS and FBMA = (ninfrml+exint)/adjassr
Albownl	Adjusted owned acreage in FBMA data set to reflect non reported values for Albown and adjustment for land rented out (aownrnt)
Assets	Total farm related assets (unadjusted for FBMA)
Vlbown	Value of owned land (unadjusted for FBMA)
Vlbownl	Vlbownl + value of buildings according to balance sheet statement for FBMA farms

section of this study. The FBMA farms were substantially larger in total acreage farmed and the divergence seemed mainly due to a larger acreage of rented land versus the FCRS farms in the area. The difference in size was also quite pronounced when size was measured in total sales; total assets; or total operating expenditures. Overall, the size variables are characterized by high t-statistics. The main exception is the value of farm machinery and equipment which is actually higher for the FCRS than for the FBMA farms. This result is not surprising since the FBMA data set reflects the cost basis value of machinery in accordance with the balance sheet statement while the FCRS data set reflects an estimated market value.

Livestock sales and inventory of livestock are significantly larger for FBMA farms. The major divergence between FBMA farms and the area in general appears to be the level of hog production. The distinction between the two groups is somewhat less accentuated for sales of cattle. Neither the sales of milk nor livestock intensity are statistically different ($p > .10$) between the two groups.

The observed dissimilarities in livestock production and farm size quite clearly affect economic performance as measured by operating margin and net farm income. Net farm income is substantially higher for the FBMA farms. The rate of return to both operator's labor and assets is significantly ($p < .01$) larger for FBMA farms. The standard error for the rate of return to assets and labor is much lower for the FBMA farms. This may be due to a higher degree of homogeneity with respect to managerial skills within the FBMA farmers relative to the FCRS farms.

The solvency and debt situation was characterized by a higher debt load for the FBMA farms. When the overall debt/asset ratio is estimated,

based upon adjusted asset values, there is a statistically significant difference between the FCRS and FBMA data sets. The relative debt load is significantly ($p < .01$) higher among the FBMA farms.

The statistical tests for differences in average value of assets per farm indicates that a significant ($< .01$) difference in the adjusted value of land and in adjusted total assets. Finally, the tenancy ratio exhibits a statistically significant difference with a higher proportion of rented land among the FBMA farms. This result is consistent with the observations from previous crosstabulations.

FBMA operators were also significantly ($p < .05$) younger than all FCRS operators.

TEST FOR DIFFERENCES IN DISTRIBUTION FUNCTIONS

The Welch test used in the previous section assumed that the variance is equal between the two groups of sampling distributions. In order to examine the robustness of the results, a Kolmogorov-Smirnov (KS) test (Lindgren, 1968) was conducted to test for statistical differences between the two distribution functions for some of the more important farm characteristic variables. The test statistic D (according to Lindgren, 1968) is computed as follows:

$$D = \sup_x |F_1(x) - F_2(x)| \quad (7)$$

where F_1 and F_2 are the cumulative distribution functions for the FCRS and FBMA samples.

The null hypothesis is that the sample distribution functions are the same. Critical values for the D-statistic can be found in a statistical theory text (e.g., Lindgren). If the computed D-value exceeds the

critical value, the null hypothesis is rejected, and we can conclude that a difference exists between the distribution functions. For practical purposes, the test requires that the cumulative distribution functions are obtained for both samples. The cumulative distribution function for the FCRS was weighted by USDA's expansion factor for each individual sample record. The FCRS and FBMA data were grouped into a grid of 250-400 intervals between the maximum and minimum values. The D-statistic was computed using a simple spreadsheet program.

For the variables tested, the KS test shows that the differences between the FBMA and FCRS farms were significant ($p < .01$) except for two variables (Table 6). The first variable was operator age. The average age of FCRS farmers was 47.1; for FBMA farmers, 44.1; the KS test showed the difference in age distributions was significant at the 5% level, not the 1% level. The second variable was the value of milk sales; the KS test showed the FCRS and FBMA distributions to be not significantly ($p > .10$) different. The KS test also shows that FBMA farms are larger than FCRS farms; the D-statistic for total acreage is 0.515 and significant ($p < .01$). Since the D-statistic for rented acreage (0.443) is larger than for owned acreage (0.258), it appears that most of the difference is due to a larger rented acreage. These results support the results of the Welch t-test which is used again in the next section to make comparisons of larger farms.

COMPARISONS FOR LARGER FARMS

In the previous two sections, the null hypothesis of equal means was rejected for most of the variables when comparing all farms (Tables 4 and 6). In this part of the analysis, the Welch t-test is repeated for those

Table 6. Kolmagarov-Smirnov test for differences between distribution functions for FBMA and FCRS data 1987¹

Variable ²	D-value ³	Variable	D-value	Variable	D-value
Albown	0.200***	Exint	0.299***	Ninfrml	0.548***
Albownl	0.258***	Exallopr	0.583***	Adjassr	0.307***
Totac	0.515***	Assets	0.212***	Da	0.164***
Trac	0.443***	Debt	0.352***	Roasslab	0.563***
Oprage	0.132**	Vsallv	0.430***	Lvsint	0.218***
Oprmarg	0.547***	Vsalmilk	0.064	Tenure	0.392***
Chginv	0.286***	Vsalhogs	0.318***		
Incshfm	0.632***	Vsalcatt	0.161***		
Vfmeq	0.173***	Exhirl	0.391***		
Vinvlv	0.364***	Capexinr	0.513***		
Vlborn	0.172***	Tcapinr	0.494***		

¹Based upon a sample of 240 and 215 farms in FBMA and FCRS, respectively.

²Variables are defined in Table 5.

³Critical value for D:

	α	D
*	10%	0.115
**	5%	0.128
***	1%	0.153

FCRS and FBMA farms with total sales greater than \$40,000, \$50,000 and \$60,000.

This analysis indicated that the differences between the two groups of farms decreased with increasing farm size (Tables 7, 8, and 9). These results were consistent with the results from the crosstabulations. The differences in size variables such as owned acreage and total assets were insignificant ($p > .10$) for all three sizes. However, there was a tendency towards the FBMA farms having larger acreage acquired through renting land, especially through share rental arrangements even in the larger sales classification (Table 9). The difference in total adjusted assets is insignificant but the FCRS farms did have a significantly ($p < .01$) higher valuation of farm machinery and equipment in all three sizes.

In the two larger sales classifications, the total debt load, total interest expenditures, and the debt/asset ratios did not exhibit a significant ($p > .10$) difference between the two groups of farms. Thus, there is no statistically significant ($p > .10$) difference in solvency between the two groups. This finding suggests that FBMA farm data could be used as a data source for financial analysis of larger farms in the region.

Although several of the variables were becoming increasingly similar with increasing cash sales, FBMA farms with sales greater than \$60,000 still had a statistically significant ($p < .01$) greater net farm income than FCRS farms (Table 9). This difference is partly explained by the significant ($p < .01$) difference in total sales even though FBMA farms had higher operating expenses. Hog sales were significantly ($p < .01$) larger on FBMA farms while milk sales were significantly ($p < .05$) larger on FCRS farms.

Table 7. Comparison of means for FCRS and FBMA data set for 1987. The comparison is conducted for farms with cash sales exceeding \$40000. Statistical tests are conducted for difference in means evaluated by Welch t-test.

Variable ¹	FCRS		FBMA		t-stat ²
	Mean	Std.err	Mean	Std.err	
oprage	43.9	1.4	43.9	.8	.05
albown	213.2	17.0	236.8	14.8	1.04
totac	376.9	19.7	490.6	17.7	4.30***
tcropac	177.3	13.9	195.4	12.3	.97
tcshac	165.9	19.2	209.3	13.9	1.82*
tshac	32.4	7.2	85.7	10.6	4.15***
trac	198.3	20.3	295.1	16.2	3.72***
tenure	0.5	0.03	0.6	0.02	1.71*
aidle	63.7	4.5	83.0	3.4	3.09***
pasac	40.0	7.6	143.3	1.8	13.2 ***
aownrnt	9.8	4.4	2.7	1.5	-1.5
adjassr	441,171	28,951	465,202	21,152	.67
vinlv	46,420	5,593	64,981	4,852	2.50**
vfmeq	84,375	4,630	37,004	2,306	-9.1 ***
vlbown2	215,208	19,872	196,600	12,181	-.79
debt	155,027	14,901	187,037	10,750	1.74*
da	0.4	0.03	0.4	0.02	1.35
incshfm	142,476	9,108	243,823	11,594	6.87***
ingov	24,806	1,863	29,940	1,599	2.09**
vsallv	78,808	8,098	125,797	9,438	3.77***
lvsint	0.6	0.03	0.5	0.02	-.96
vsalmilk	33,147	6,033	24,320	3,657	-1.2
vsalhogs	22,010	4,340	56,194	6,658	4.30***
vsalcatt	22,436	3,003	38,241	7,235	2.01**
chginv	14,453	2,577	21,817	2,697	1.97**
texopb	106,395	7,063	187,998	10,133	6.60***
exint	15,709	1,805	16,526	1,110	.39
exrntcsh	11,249	1,358	14,753	1,030	2.05**
exhirl	3,938	684.6	6,410	846.0	2.27**
totrep	9,654	762.9	13,598	612.6	4.03***
capex	7,420	579.7	11,340	605.4	4.67***
capexinr	17,074	1,134	24,937	1,031	5.12***
exdepr	18,634	1,686	23,932	1,433	2.39***
tcapinr	35,709	2,357	48,869	1,838	4.40***
oprmarg	36,081	4,712	55,825	3,414	3.39***
ninfrml	28,731	5,282	59,932	3,073	5.10***
roasslab	0.1	0.01	0.2	0.01	5.49***
albownl	213.2	17.0	258.1	14.6	2.00**
assets	442,215	28,944	405,457	18,967	-1.0
vlbown	215,208	19,872	182,511	11,481	-1.4
vlbownl	215,208	19,872	242,256	13,976	1.11
exallopr	106,395	7,063	185,366	10,003	6.44***
ninfrm	28,731	5,282	60,312	3,158	5.13***

¹Variables are defined in Table 5.

²Significance levels are as follows: *** = .01; ** = .05; * = .10

Table 8. Comparison of means for FCRS and FBMA data set for 1987. The comparison is conducted for farms with cash sales exceeding \$50000. Statistical tests are conducted for difference in means evaluated by Welch t-test.

Variable ¹	FCRS		FBMA		t-stat ²
	Mean	Std.err	Mean	Std.err	
oprage	43.3	1.4	44.0	0.8	.44
albown	224.9	19.0	238.7	14.9	.57
totac	395.1	21.5	494.4	17.7	3.56***
tcropac	185.6	15.7	195.9	12.5	.52
tcshac	174.9	20.6	211.9	14.1	1.48
tshac	33.2	7.4	86.6	10.7	4.10***
trac	208.1	21.9	298.5	16.3	3.31***
tenure	0.5	0.03	0.6	0.02	1.70*
aidle	65.2	4.9	83.6	3.5	3.09***
pasac	45.4	8.2	13.4	1.8	-3.79***
aownrnt	10.7	5.0	2.8	1.5	-1.52
adjassr	473,665	32,159	468,545	21,330	-.13
vinlv	51,800	6,147	65,079	4,909	1.69*
vfmeq	90,788	4,887	37,419	2,323	-9.86***
vlbown2	230,158	22,263	197,776	12,319	-1.27
debt	167,799	16,423	189,472	10,797	1.10
da	0.4	0.03	0.4	0.02	1.40
incshfm	156,844	9,980	246,372	11,651	5.84***
ingov	26,153	2,088	30,275	1,608	1.56
vsallv	87,716	8,929	126,951	9,537	3.00***
lvsint	0.6	0.03	0.5	0.02	-1.12
vsalmilk	37,666	6,669	24,414	3,702	-1.73*
vsalhogs	24,530	4,947	56,927	6,731	3.88***
vsalcatt	24,195	3,436	38,475	7,328	1.76*
chginv	16,371	2,768	22,087	2,728	1.47
texopb	115,411	7,851	189,975	10,201	5.79***
exint	16,867	2,022	16,741	1,117	-.05
exrntcsh	11,910	1,483	14,939	1,037	1.67*
exhirl	4,501	779.5	6,486	855.9	1.71*
totrep	10,411	840.4	13,657	619.3	3.11***
capex	7,772	658.9	11,441	610.5	4.08***
capexinr	18,184	1,260	25,098	1,040	4.23***
exdepr	20,552	1,839	24,189	1,166	1.67*
tcapinr	38,736	2,550	49,287	1,846	3.35***
opr marg	41,433	5,054	56,397	3,442	2.45**
ninfrml	33,729	5,684	60,552	3,092	4.15***
roasslab	0.1	0.01	0.2	0.01	5.12***
albownl	224.9	18.98	259.1	14.77	1.42
assets	474,863	32,150	408,985	19,100	-1.76*
vlbown	230,158	22,263	184,378	11,577	-1.82*
vlbownl	230,158	22,263	243,938	1,412	.52
exallopr	115,411	7,851	187,316	10,070	5.63***
ninfrm	33,729	5,684	60,930	3,179	4.18***

¹Variables are defined in Table 5.

²Significance levels are as follows: *** = .01; ** = .05; * = .10

Table 9. Comparison of means for FCRS and FBMA data set for 1987. The comparison is made for farms with cash sales exceeding \$60000. Statistical tests are conducted for difference in means evaluated by Welch t-test.

Variable ¹	FCRS		FBMA		t-stat ²
	Mean	Std. err	Mean	Std. err	
oprage	43.5	1.4	44.0	0.8	.33
albown	221.9	20.5	239.9	15.1	.71
totac	417.4	24.6	497.9	17.8	2.64***
tcropac	186.2	16.7	197.7	12.6	.55
tcshac	192.3	23.1	214.6	14.4	.82
tshac	37.1	8.4	85.6	10.8	3.53***
trac	229.4	24.5	300.2	16.5	2.39***
tenure	0.5	0.04	0.6	0.02	1.16
aidle	68.2	5.7	84.2	3.5	2.40***
pasac	43.3	8.0	13.3	1.9	-3.6 ***
aownrnt	10.3	5.4	2.8	1.5	-1.3
adjassr	493,436	36,081	472,755	21,465	-.49
vinlv	57,439	6,749	65,763	4,957	.99
vfmeq	92,997	5,260	37,729	2,347	-9.5 ***
vlbown2	236,887	25,046	199,025	12,446	-1.3
debt	168,538	16,830	191,811	10,855	1.16
da	0.3	0.03	0.4	0.02	1.62
incshfm	172,846	11,042	248,944	11,710	4.72***
ingov	26,827	2,326	30,611	1,617	1.33
vsallv	98,867	9,705	128,275	9,632	2.15**
lvsint	0.6	0.03	0.5	0.02	-1.4
vsalmilk	42,266	7,401	24,556	3,747	-2.1 **
vsalhogs	28,374	5,644	57,578	6,810	3.30***
vsalcatt	26,693	3,970	38,980	7,419	1.46
chginv	18,151	3,110	22,224	2,762	.98
texopb	125,558	8,928	191,963	10,270	4.87***
exint	17,954	2,277	16,956	1,125	-.39
exrntcsh	13,054	1,659	15,129	1,045	1.05
exhirl	5,029	896.8	6,550	866.4	1.21
totrep	11,123	926.7	13,757	624.7	2.35**
capex	8,232	735.1	1,528	616.0	-8.5 ***
capexinr	19,355	1,402	25,285	1,047	3.38***
exdepr	22,253	2,047	24,425	1,173	.92
tcapinr	41,608	2,824	49,710	1,854	2.39**
opr marg	47,288	5,535	56,981	3,470	1.48
ninfrml	38,636	6,317	61,073	3,118	3.18***
roasslab	0.1	0.01	0.2	0.01	4.22***
albown1	221.9	20	260.5	15	1.52
assets	494,822	36,075	413,485	19,173	-1.9 *
vlbown	236,887	25,046	186,476	11,664	-1.8 *
vlbown1	236,887	25,046	245,745	14,256	.31
exallopr	125,558	8,928	189,290	10,138	4.71***
ninfrm	38,636	6,317	61,477	3,205	3.22***

¹Variables are defined in Table 5.

²Significance levels are as follows: *** = .01; ** = .05; * = .10

When the economic performance, measured by either net farm income or the rate of returns to labor and assets, was analyzed there was a significant ($p < .01$) difference even for farms with sales greater than \$60,000. If we wish to use FBMA farms to analyze impacts on the population of farms, this is a disturbing result. The difference may be due to a larger acreage of total tillable land, which was mostly rented, together with a more intensive hog production. It was also thought important to recognize that 1986 and 1987 were especially favorable years for hog producers. An analysis of FBMA records reveals that "returns to overhead per cwt. produced" (i.e., total sales of hogs minus direct costs divided by production) were 55-100% higher for 1986 and 1987 compared to 1984 and 1985. Hence, if there was a tendency towards excess representation of hog producers in the FBMA farm record data system, the economic conditions that prevailed during 1987 would have further enhanced the observed differences in net farm income. Whether differences in income were due to differences in managerial capacity, or due to more favorable production conditions on the FBMA farms, was not addressed within the framework of this study. This issue could be explored by estimating production functions for the two categories of farms and testing for statistical differences of parameter estimates.

CONCLUSION

The comparison of the FCRS and FBMA data sets focused on some of the more important variables that are of relevance for empirical research. While only the data for 1987 were compared, the following conclusions were of particular interest. First, the FBMA farms are not representative of

all farms in their area (i.e., Southern Minnesota as measured by the FCRS sample). The FBMA farms do not include small farming operations. Major differences exist in total tillable acreage, rented land and livestock production, especially hogs. These combined differences result in a substantial difference in net farm income between the two farm categories. However, the FBMA farms reflect the area's farm solvency conditions relatively well.

When the data was classified by total cash sales, the analysis suggests that the FBMA farms were more similar to all farms with sales exceeding \$60,000 per year but differences still existed. Most of the prior differences between all FCRS and FBMA farms were insignificant ($p > .10$). However, total acreage, total sales (especially sales of hogs), total expenses, and net farm income were significantly ($p < .01$) higher for FBMA farms. This analysis suggests that, even at higher sales levels, the FBMA farms were characterized by a higher level of livestock production and a slightly larger tillable acreage mainly due to renting additional land. Economic performance measured by net farm income and returns to total assets and family labor also was significantly ($p < .01$) better for FBMA farms. So even though differences in assets, liabilities, and thus solvency positions were insignificant ($p > .10$), the economic performance of the FBMA farms appears to be better than FCRS farms even in larger sizes.

On the basis of these findings, the FBMA data can not be used to represent all farms or all commercial farms. It does appear that FBMA farms can be used to represent larger farms with livestock. The noticeable difference in net farm income may be partly attributable to differences in work load between FBMA and FCRS farms. Since the work load is not measured

on the FBMA farms, this potential difference cannot be tested. Hence, the FBMA data is less well-suited for estimation of economic relationships that are subsequently used in aggregate economic analyses of input demand and supply conditions in the agricultural sector.

Gustafson et al. found the record-keeping farms to have a larger equity but lower profitability than the average in 1986. Using 1987 data, this study found record-keeping farms to have both larger equity and higher profitability. This difference in results may be due to both different years and differences in the two samples of record-keeping farms.

Besides the need to test more than one year's data, further research may be done in two areas. Cluster analysis can identify what types of farms are in the FBMA and FCRS data when clustered on the basis of measures such as acreage, livestock sales, debt load, etc. This would identify what types of farms the FBMA farms do represent and thus where and how research on FBMA farms could be extrapolated to the whole population. A second area of research is estimation of frontier production functions for each data set. If FBMA farms do not represent the average FCRS farm, they may represent the frontier technology and thus can be used for studies of the economic effects of adoption of new/improved technologies.

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APPENDIX A

Crosstabulations of Farms by Size and Livestock Intensity¹

Table A1. Characteristics of FCRS and FBMA farms for 1987 classified by total tillable acreage and livestock intensity

a. Number of Farms and Relative Frequency

Acres	Livestock Intensity	Number of Farms		Relative Frequency	
		FCRS	FBMA	FCRS ²	FBMA
Below 300	low	62	25	42.2	10.0
	high	57	47	33.6	19.6
300-600	low	18	54	7.9	22.5
	high	28	50	7.6	20.8
600-900	low	11	32	2.5	13.3
	high	9	11	1.2	4.6
900 and above	low	17	13	2.9	5.4
	high	12	9	1.3	3.8
All farms		215	240	100.0	100.0

b. Total Assets and Total Sales

Acres	Livestock Intensity	Total Assets		Total Sales	
		FCRS	FBMA	FCRS	FBMA
Below 300	low	191,720	200,295	26,652	105,775
	high	256,588	304,226	67,355	165,078
300-600	low	286,336	409,139	87,261	161,360
	high	501,966	448,979	172,790	271,771
600-900	low	448,499	472,716	150,699	232,878
	high	1,127,905	765,179	323,465	483,200
900 and above	low	888,937	766,155	288,251	383,609
	high	1,603,478	1,357,923	681,919	741,003
All farms		300,576	455,722	79,050	237,594

¹Livestock intensity was measured by total livestock sales as a proportion of total cash sales for each farm. Farms with more than 50% of total cash sales being livestock sales were classified as having a high level of livestock intensity. Low livestock intensity was defined as having livestock sales which accounted for 50% or less of total cash sales.

²The relative frequency for FCRS is based on the entire population not just the sample.

Table A1. (Continued)

c. Livestock Sales and Inventory Change

Acres	Livestock Intensity	Sales of Livestock		Inventory Change	
		F CRS	FBMA	F CRS	FBMA
Below 300	low	3,051	24,284	5,624	-666
	high	57,286	126,595	3,774	14,964
300-600	low	9,677	39,350	13,526	16,392
	high	125,119	189,987	11,473	22,061
600-900	low	12,463	56,688	4,502	29,821
	high	244,188	333,430	32,377	36,500
900 and above	low	31,864	106,229	70,092	35,345
	high	486,809	486,676	38,896	69,499
All farms		41,572	122,499	8,635	21,318

d. Total Expenses and Depreciation

Acres	Livestock Intensity	Total Expenses		Depreciation	
		F CRS	FBMA	F CRS	FBMA
Below 300	low	26,306	69,267	4,199	10,837
	high	52,284	128,952	11,069	16,997
300-600	low	64,523	118,916	12,213	19,077
	high	130,179	215,499	17,877	24,461
600-900	low	110,212	176,009	16,468	25,569
	high	255,546	386,655	39,477	38,635
900 and above	low	226,455	296,599	35,665	40,356
	high	502,747	592,314	65,629	58,730
All farms		62,860	183,299	10,617	23,369

Table A1. (Continued)

e. Operating Margin and Net Farm Income

Acres	Livestock Intensity	Operating Margin		Net Farm Income	
		F CRS	FBMA	F CRS	FBMA
Below 300	low	347	36,508	3,448	29,703
	high	15,071	36,126	12,854	39,724
300-600	low	22,738	42,444	22,237	45,274
	high	42,612	56,272	37,724	60,399
600-900	low	40,487	56,870	23,262	67,218
	high	67,919	96,544	67,992	103,055
900 and above	low	61,796	87,010	52,026	89,341
	high	179,172	148,689	108,446	169,988
All farms		16,190	54,295	14,747	58,419

f. Debt to Asset Percentage and Rented Land Percentage

Acres	Livestock Intensity	Debt/Asset %		Rented Land %	
		F CRS	FBMA	F CRS	FBMA
Below 300	low	27	35	36	63
	high	37	40	18	46
300-600	low	36	38	69	55
	high	22	42	48	59
600-900	low	34	52	73	68
	high	35	36	47	63
900 and above	low	36	37	72	71
	high	23	36	43	52
All farms		31	40	48	60

Table A2. Comparison of FCRS and FBMA farms for 1987 when the classification is based upon total assets and livestock intensity

a. Number of Farms and Relative Frequency

Total Assets (\$1000)	Livestock Intensity	Number of Farms		Relative Frequency	
		FCRS	FBMA	FCRS	FBMA
Below 250	low	53	39	37.1	16.3
	high	52	34	17.9	14.2
250-500	low	27	41	13.8	17.1
	high	31	41	15.6	17.1
500-750	low	39	30	3.1	12.5
	high	11	22	5.7	9.2
750 and above	low	14	13	2.2	5.4
	high	14	20	4.6	8.3
All farms		215	240	100.0	100.0

b. Total Assets and Total Sales

Total Assets (\$1000)	Livestock Intensity	Total Assets		Total Sales	
		FCRS	FBMA	FCRS	FBMA
Below 250	low	135,073	145,772	29,305	117,299
	high	110,461	171,523	30,549	146,376
250-500	low	347,644	364,716	69,028	188,050
	high	327,673	388,010	116,494	217,515
500-750	low	606,471	610,771	114,604	232,034
	high	575,540	606,483	137,105	328,735
750 and above	low	1,111,381	1,001,994	292,954	341,943
	high	1,212,850	1,115,151	376,902	610,220
All farms		300,576	455,722	79,050	237,594

Table A2. (Continued)

c. Livestock Sales and Inventory Change

Total Assets	Livestock Intensity	Sales of Livestock		Inventory Change	
		FCRS	FBMA	FCRS	FBMA
(\$1000)					
Below 250	low	2,426	20,041	4,758	13,956
	high	24,866	99,601	1,030	14,313
250-500	low	10,432	47,272	18,458	20,335
	high	92,517	155,401	6,105	16,907
500-750	low	6,398	63,175	6,217	19,942
	high	105,104	247,765	9,283	22,779
750 and above	low	34,314	99,054	49,892	23,591
	high	290,120	414,421	30,156	57,617
All farms		41,572	122,499	8,635	21,318

d. Total Expenses and Depreciation

Total Assets	Livestock Intensity	Total Expenses		Depreciation	
		FCRS	FBMA	FCRS	FBMA
(\$1000)					
Below 250	low	31,554	91,579	4,198	9,161
	high	26,574	114,262	4,788	10,827
250-500	low	46,845	144,710	10,283	19,942
	high	89,278	169,836	13,469	20,872
500-750	low	72,704	163,123	11,115	27,759
	high	114,748	271,736	28,377	32,404
750 and above	low	238,840	244,118	39,987	48,109
	high	262,175	479,667	40,428	51,935
All farms		62,860	183,299	10,617	23,369

Table A2. (Continued)

e. Operating Margin and Net Farm Income

Total Assets (\$1000)	Livestock Intensity	Operating Margin		Net Farm Income	
		FCRS	FBMA	FCRS	FBMA
Below 250	low	-2,249	25,720	344	35,393
	high	3,975	32,114	4,191	41,036
250-500	low	22,183	43,340	25,320	49,385
	high	27,216	47,679	24,348	49,831
500-750	low	41,899	68,912	28,945	67,421
	high	22,357	56,998	4,460	54,204
750 and above	low	54,114	97,826	35,125	80,180
	high	114,728	130,553	101,064	145,984
All farms		16,190	54,295	14,747	58,419

f. Debt to Asset Percentage and Rented Land Percentage

Total Assets (\$1000)	Livestock Intensity	Debt/Asset %		Rented Land %	
		FCRS	FBMA	FCRS	FBMA
Below 250	low	39	51	64	92
	high	31	45	35	88
250-500	low	17	52	52	71
	high	39	44	41	46
500-750	low	36	39	50	43
	high	37	40	18	46
750 and above	low	38	29	56	40
	high	21	34	36	52
All farms		31	40	48	60

Table A3. Comparison of FCRS and FBMA farms for 1987 when the classification is based upon total cash sales (including government payments) and livestock intensity

a. Number of Farms and Relative Frequency

Total Sales (\$1000)	Livestock Intensity	Number of Farms		Relative Frequency	
		FCRS	FBMA	FCRS	FBMA
Below 40	low	46	3	34.6	1.3
	high	20	4	14.9	1.7
40-80	low	20	9	10.8	3.8
	high	14	4	7.4	1.7
80-160	low	17	36	6.5	15.0
	high	24	27	11.7	11.3
Above 160	low	26	75	4.3	31.3
	high	48	82	9.8	34.2
All farms		215	240	100.0	100.0

b. Total Assets and Total Sales

Total Sales (\$1000)	Livestock Intensity	Total Assets		Total Sales	
		FCRS	FBMA	FCRS	FBMA
Below 40	low	177,606	110,848	16,396	34,889
	high	111,365	162,182	10,424	26,735
40-80	low	263,996	166,950	56,353	62,326
	high	295,396	226,744	57,819	53,637
80-160	low	306,406	292,115	102,403	114,936
	high	361,584	254,096	109,247	125,948
Above 160	low	740,334	528,484	277,483	251,836
	high	807,608	597,190	309,500	361,090
All farms		300,576	455,722	79,050	237,594

Table A3. (continued)

c. Livestock Sales and Inventory Change

Total Sales (\$1000)	Livestock Intensity	Sales of Livestock		Inventory Change	
		F CRS	FBMA	F CRS	FBMA
Below 40	low	1,190	3,395	2,652	4,497
	high	9,201	19,726	2,927	4,813
40-80	low	5,296	6,485	11,827	14,066
	high	42,031	46,121	-872	685
80-160	low	14,875	17,273	18,958	7,785
	high	85,834	87,902	4,845	12,147
Above 160	low	31,181	69,497	50,589	24,835
	high	243,003	254,395	21,709	30,285
All farms		41,572	122,499	8,635	21,318

d. Total Expenses and Depreciation

Total Sales (\$1000)	Livestock Intensity	Total Expenses		Depreciation	
		F CRS	FBMA	F CRS	FBMA
Below 40	low	20,015	22,983	2,775	4,876
	high	15,378	29,762	1,783	4,403
40-80	low	50,775	45,843	10,049	6,325
	high	46,410	36,776	8,689	5,704
80-160	low	74,708	79,564	13,121	12,688
	high	77,255	94,991	17,046	13,910
Above 160	low	194,678	189,681	30,189	28,064
	high	230,859	287,669	36,218	31,213
All farms		62,860	183,299	10,617	23,369

Table A3. (continued)

e. Operating Margin and Net Farm Income

Total Sales (\$1000)	Livestock Intensity	Operating Margin		Net Farm Income	
		F CRS	FBMA	F CRS	FBMA
Below 40	low	-3,619	11,906	470	16,122
	high	-4,955	-3,027	605	1,979
40-80	low	5,578	16,483	2,009	27,767
	high	11,409	16,861	6,441	15,384
80-160	low	27,695	35,372	30,436	35,501
	high	31,992	30,958	24,329	34,723
Above 160	low	82,805	62,155	68,367	65,251
	high	78,641	73,421	62,022	79,799
All farms		16,190	54,295	14,747	58,419

f. Debt to Asset Percentage and Rented Land Percentage

Total Sales (\$1000)	Livestock Intensity	Debt/Asset %		Rented Land %	
		F CRS	FBMA	F CRS	FBMA
Below 40	low	22	91	29	73
	high	15	36	12	10
40-80	low	46	16	58	70
	high	34	11	23	17
80-160	low	26	38	70	63
	high	43	47	28	63
Above 160	low	38	43	72	63
	high	28	39	44	56
All farms		31	40	48	60

APPENDIX B

Computation of Variances and Standard Errors for Observations in the FCRS Data Set

The general idea is that a total sum for the farm characteristic variables are created for the study area such as:

$$X_r^T = \sum_{j=1}^r \left| \begin{array}{c|c} n_{ij} & x'_{ijk} \\ \hline \sum_{k=1} & \frac{x'_{ijk}}{n_{ij}} \end{array} \right| \quad (B1)$$

where:

$$x'_{ijk} = x_{ijk} * p_{ijk} * f_{ijk} \quad \text{and}$$

x_{ijk} - the observed value of item x for farmer k in stratum j in observed state i ;

n_{ij} - number of responding farmers included in stratum j in observed state i ;

p_{ijk} - a population count for the record k which is the same within stratum; and

f_{ijk} - a proration factor for the record.

From (B1) the total sum of the "expanded data" in the region is obtained as X_r^T which can be seen since "the expansion factor" e_{ijk} is defined as $p_{ijk} * f_{ijk} / n_{ij}$ for each individual record. Notice that for the purpose of the comparison with the FBMA data, index i is always the same since FBMA data is collected solely from southern Minnesota. The estimated mean for the region is thus a weighted mean where the sum of e_{ijk} 's in the region is the expanded number of farms that is actually estimated from the survey. Therefore, the estimated mean for variable X in the region is a ratio:

$$\frac{X_r^T}{\sum_{j=1}^r \sum_{k=1}^{n_{ij}} e_{ijk}} = \bar{X} \quad (B2)$$

To estimate the variance of \bar{X} (i.e., S_1^2/m), a statistical procedure has been implemented for the FCRS data (Morehart, 1986) which uses a Taylor series expansion to estimate the standard error of the mean and hence consequently also the variance of the mean.

The following description is based upon notation previously used in the report and applied in the FCRS survey. First, define

$$X_{ij}^T = \frac{\sum_{k=1}^{n_{ij}} x'_{ijk}}{n_{ij}} \quad (B3)$$

X_{ij}^T is the average for the adjusted data in strata j for state i . The variance of X_{ij}^T is then:

$$V(X_{ij}^T) = \frac{\sum_{k=1}^{n_{ij}} \left(X'_{ijk} - X_{ij}^T \right)^2}{n_{ij} (n_{ij} - 1)} * (P_{ijk} - n_{ij}) / P_{ijk} \quad (B4)$$

The variance of X_{ij}^T 's for the whole region or state, i.e., $V(X_r^T)$ is then obtained as a summation over j 's for the variances within each strata i.e., $V(X_{ij}^T)$. Hence:

$$V(X_r^T) = \sum_{j=1}^r (V(X_{ij}^T)) \quad (B5)$$

The standard error for an estimated mean of an variable or a ratio of two variables x and y are then:

$$SE(x_r^T/y_r^T) = (x_r^T/y_r^T) [V(x_r^T)/(x_r^T)^2 + V(y_r^T)/(y_r^T)^2 - 2COV(x_r^T, y_r^T)/x_r^T y_r^T] \quad (B6)$$

In (A6), x_r^I/y_r^I is a ratio of the two variables or an estimated mean where the estimated number of farms y_r^I is considered a stochastic variable since it is estimated by the survey design.