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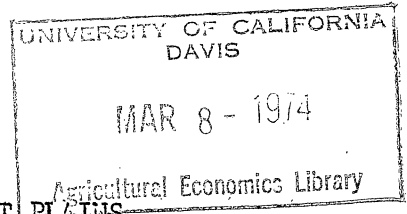
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1973

*Farm
Size*



ECONOMIES OF SIZE IN WHEAT FARMING IN THE GREAT PLAINS

by
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Farms in the United States continue to grow in size. This change has been going on since the 1930's and will probably continue for some time. In this paper we present some highlights from a study of large scale wheat farms in the northern and central Great Plains States. The study was undertaken to answer the question, "Are there economic incentives for expanding farm size?" or, "Are large wheat farms more efficient than average size farms?"

Methodology. -- Most studies relating to the size of farm have assumed constant input and product prices regardless of size of farm. In this study a special effort was made to determine if large farmers were obtaining volume discounts on inputs or receiving premiums on volume wheat sales.

Data were gathered from 80 large wheat farms on production practices, machinery inventories, labor costs, and other cost items needed to estimate production costs. The method used to determine production costs could be described as a combination of farm records and synthetic firm approach. 1/

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1/ For a survey of several techniques of economies of size studies and a summary of a wide variety of such studies, see J. Patrick Madden, "Economies of Size in Farms," Agr. Econ. Rpt. No. 107, ERS-USDA, February 1967.

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Because complete cost data were not always available, the survey data obtained were used as input to a budget-generator system at Montana State University which produced the final budgets.

Area of Study and Sample

Personal interviews were conducted in the summer and fall of 1971 of 80 large scale wheat producers in North Dakota, South Dakota, Montana, Colorado and Kansas. All interviews were conducted by professional economists. A large study area was needed because these large farms represent a small percentage of the farm population. The smallest size of farm interviewed had gross receipts in 1970 of \$50,000 from crop production and crop-related government payments. The largest farm interviewed had about 50,000 acres of cropland.

The sample farms were classified into three size categories (see table 1).

Table 1. Number of farms enumerated by size and by area

| Area | Gross value of crop production ^{1/} | | |
|----------------------|--|-------------------|------------------|
| | \$50,000-99,000 | \$100,000-199,999 | \$200,000 & over |
| Montana | 5 | 21 | 9 |
| North & South Dakota | 10 | 14 | 4 |
| Colorado & Kansas | 9 | 4 | 4 |
| Total | 24 | 39 | 17 |

^{1/} Includes gross sales from crops and value of government payments under wheat and feed grain programs on 1970 crop.

Survey Results

Incorporation. -- We found that 20 percent of these large wheat farms were incorporated. ^{2/} In all of the seven Northern Great Plains States only one percent of the farms were incorporated. However, all of the corporations were closely held family operations and none could be classified as "corporate farms owned by outside interests."

Outside Business Interests. -- Thirty-one of the sample farms had ownership and management interests in other businesses besides farming. However, about 2/3 of these outside business interests were related to farming, including primarily grain elevators, machinery and other dealerships. Generally these business interests had been purchased with farm profits and not vice versa. The fact that most of these outside businesses were incorporated gave these large farms some of the advantages of incorporation even though their farming business was not incorporated. Hence, on about 1/4 of the farms studied, the farmer was either buying some of his inputs from his own business or selling his grain to himself.

Production Practices. -- Production techniques differed little between the smaller and the larger of these farms in terms of types of equipment or operations performed. One difference noted was that larger farmers used more fertilizer and got about two bushels per acre higher wheat yields.

Size of Equipment. -- The average size of tractor on 12,000 acre farms was about 110 drawbar horsepower compared to an average of 100 DBHP on farms with 3,000 crop acres, -- a negligible difference. Hence, over the range of 3,000 to 12,000 acres of cropland, the size of equipment was about the same. The trend to bigger tractors is expected to continue as old tractors

^{2/} This, despite the fact that incorporation for agricultural purposes is prohibited in North Dakota and restricted in Kansas.

are replaced so in the future we may see more difference in machinery technology on those very large farms but very little exists at present.

Custom Hiring. -- One of the major differences in production practices found was the use of custom combines. On the smaller of these farms about 37 percent of the crops were harvested by custom machines. In the middle size group this figure was about 51 percent and at the large end it was about 87 percent. Part of this difference can perhaps be explained by the need for more hired labor as farm size increases. Perhaps it's easier to hire a job custom done than to hire and supervise the labor and own the machines.

The large farmers apparently pay the same custom rates as the smaller farmers but their size makes them preferred customers for the custom operator.

Machinery Investment. -- Machinery investments per acre were found to be about \$20 per acre of cropland on the group of smaller farms compared to about \$16 on the medium sized and \$12 on the large sized group. Part of this difference is due to the practice of hiring more custom combining on the larger farms. Even though tractor size was found to be similar for all sizes of farms, the larger farms apparently used their machinery over more acres or more hours and thus were able to reduce per acre investment.

Hired Labor. -- The operators were asked to identify all labor used for crops. Total labor use on crops was found to be 1.58 hours per acre on the small farms, 1.61 on the medium size farms and 1.22 on the large farms (table 2).

Table 2. Labor use on sample farms

| Size of Farm | Operator | Family | Total Hired | Total all Labor | Hours per acre of cropland |
|---------------------------|----------|--------|-------------|-----------------|----------------------------|
| --Man-month equivalents-- | | | | | |
| Small | 14.5 | 3.6 | 10.6 | 28.7 | 1.58 |
| Medium | 14.1 | 4.7 | 19.1 | 37.8 | 1.61 |
| Large | 14.6 | 4.9 | 38.9 | 58.4 | 1.22 |

It appears that total labor use per acre is considerably less on the larger farms. Part of this difference is due to the greater use of custom combining. Adjusting for the additional labor hired through custom combining gives labor estimates of 1.67 hours per acre on small farms, 1.75 on medium size and 1.45 for large farms which still indicates less labor per acre on the largest farm. 3/

Wage rates increased with farm size. Monthly wage rates averaged \$375 on the small farms and \$600 on the large farms (table 3). The higher wage rates on the large farms is attributed at least in part to the fact that large farms employed some workers that were expected to provide some supervision, such as foremen, or skilled workers such as mechanics. 4/

The combination of a higher proportion of hired labor and higher wage rates produced a rising cost of hired labor per acre as size increased (\$.94 per acre on small farms, \$1.45 on medium and \$1.92 on large farms.).

Not only were per acre costs of hired labor greater on large farms but it was found that per acre costs of hired machine services and bookkeeping and legal costs also tend to increase with size. For instance, the expense of keeping farm records was about \$200 on the smaller farms and about \$3,200 on the largest farms.

Discounts on Purchased Inputs. -- The inputs purchased on wheat farms include machinery, machinery repairs, fuel, fertilizer, herbicide and seed. Special attempts were made in the survey to determine where these farmers usually purchase their inputs and the extent, if any, to which they received reductions in prices due to volume purchases. Herbicides were usually supplied by the custom operator and only about 20 percent of seed needs were purchased. Hence, machinery, fuel, and fertilizer are the major purchased inputs.

3/ Based on an estimate of .5 man hours of hired labor obtained for each acre custom hired.

4/ These data still do not give the entire picture because many more perquisites or fringe benefits were generally received by the workers on the larger farms and these costs are not included.

Table 3. Hired labor use and costs for crops on sample farms

| | Size of Farm | | |
|--|--------------|------------|--------------|
| | Small | Medium | Large |
| Average rates (wage) | | | |
| Monthly (dol.) | 375.00 | 425.00 | 600.00 |
| Daily (dol.) | 12.00 | 13.50 | 16.00 |
| Average time worked: | | | |
| Non-family: Full time (mos.) | 5.4 | 12.1 | 30.7 |
| Part time (mos.) ^{1/} | 5.3 | 7.0 | 8.2 |
| Family: Part time (mos.) ^{2/} | <u>1.8</u> | <u>2.3</u> | <u>2.4</u> |
| Total | 12.5 | 21.4 | 41.3 |
| Cost of hired help: | | | |
| Non-family: Full time (dol.) | 2,018 | 5,121 | 18,414 |
| Part time (dol.) | 1,578 | 2,373 | 3,086 |
| Family: Part time (dol.) ^{2/} | <u>668</u> | <u>994</u> | <u>1,458</u> |
| Total | 4,264 | 8,488 | 22,958 |
| Hired labor cost per acre of cropland: | | | |
| | \$.94 | \$1.45 | \$1.92 |

^{1/} Assuming 25 days per month and daily wage rates.

^{2/} Assuming one-half family labor hired at monthly rates.

We found that a fairly sizable share of these large farmers bypass their local dealer when purchasing major inputs (table 4). Of the sample farmers, about 40 percent bypassed their local dealer in purchasing machines and repairs, 20 percent in purchasing fuel and about half of those who used fertilizer.

A sizable portion of the 80 sample farmers obtained volume discounts on their major inputs. About 60 percent obtained volume discounts on machinery purchased, 45 percent on fuels and 41 percent on herbicides (table 5).

The rate of discount was highly variable. On purchases of machinery and repairs the discounts ranged from 5 to 25 percent, on fuels the discounts ranged from 2 to 36 percent, on fertilizer the range was 2 to 30 percent and on herbicides it was 1 to 25 percent. The effect of such discounts on production costs was estimated by determining the average discount for all farms in each size group and applying this percentage to the actual average expenditures on these farms by type of input (table 6). The net

Table 4. Summary of input purchasing practices of sample farms

| | Size of Farm | | |
|--------------------------------------|--------------|----------|---------|
| | : Small | : Medium | : Large |
| | (Pct.) | | |
| Machinery: | | | |
| Have ownership in business <u>1/</u> | 8.3 | 5.1 | 5.9 |
| Shop around <u>1/</u> | 75.0 | 69.2 | 52.9 |
| Bypass local dealer <u>1/</u> | 37.5 | 48.7 | 29.4 |
| Fuel: | | | |
| Have ownership in business | 0 | 2.6 | 5.9 |
| Shop around | 58.3 | 38.5 | 47.1 |
| Bypass local dealer | 16.7 | 20.5 | 23.5 |
| Fertilizer: | | | |
| Use fertilizer | 58.3 | 71.8 | 64.7 |
| Have ownership in business | 0 | 10.3 | 23.5 |
| Shop around <u>2/</u> | 50.0 | 57.1 | 72.7 |
| Bypass local dealer <u>2/</u> | 28.6 | 46.4 | 72.7 |

1/ These categories are not mutually exclusive. Those who have ownership in a business may also "shop around." They likely will "bypass local dealer." Others who "shop around" may or may not "bypass local dealer." (This applies to all three inputs.)

2/ Percentage of those using fertilizer.

savings due to all discounts received amounted to \$.68 per acre of cropland on the small farms in our sample, \$.87 on the medium size and \$.98 on the large farms. About 2/3 of these savings result from the discounts on machinery and machinery repairs.

Selling Wheat. -- Wheat is a fairly homogeneous product and the opportunities for selling wheat at a price premium due to quality differences are quite limited. The major things a farmer can do to get a better wheat price include timing of sale, delivery closer to a terminal to reduce freight costs, or bypassing the local dealer.

It appeared from our study that the large scale wheat farmer has more grain storage capacity as a percent of normal annual production than does the average farmer. This varied considerably by location but in all areas it was higher than average for the area. The 80 farms studied had average storage capacity of 152 percent of one year's normal crop. This gives them some flexibility in time of marketing. Many farmers actually carry some grain in storage for several years.

Table 5. Percent of farmers reporting some volume discounts on purchased inputs

| Input | Size of Farm | | | | Avg. |
|------------------------|--------------|--------|-------|------|------|
| | Small | Medium | Large | | |
| Machinery purchased | 67.0 | 56.0 | 59.0 | 60.0 | |
| Machinery repairs | 58.3 | 64.1 | 41.2 | 57.5 | |
| Gasoline & diesel fuel | 29.0 | 49.0 | 59.0 | 45.0 | |
| Fertilizer | 21.0 | 46.0 | 72.7 | 45.3 | |
| Herbicides | 21.0 | 49.0 | 53.0 | 41.0 | |

Table 6. Summary of discounts received on input purchases on sample farms

| Item | Size of Farm | | | | | |
|--|--------------|-------------------|--------|-------------------|-------|-------------------|
| | Small | | Medium | | Large | |
| | Pct. | Dol./A of crop | Pct. | Dol./A of crop | Pct. | Dol./A of crop |
| Discounts received by farmers reporting savings: | | | | | | |
| Machinery purchases | 11.4 | .54 | 13.3 | .72 | 16.1 | .66 |
| Machinery repairs | 15.2 | .27 | 20.7 | .52 | 22.7 | .66 |
| Gasoline | 5.4 | .06 | 12.6 | .12 | 11.6 | .12 |
| Diesel | 10.2 | .06 | 18.3 | .11 | 24.5 | .22 |
| Fertilizer | 5.0 | .06 | 6.1 | .04 | 10.2 | .11 |
| Herbicides | 6.2 | .06 | 7.1 | .06 | 8.2 | .07 |
| Total | | 1.05 | | 1.57 | | 1.84 |
| Avg. discount adj. to all farmers: | | | | | | |
| Machinery purchases | 6.6 | .47 | 7.4 | .36 | 9.5 | .39 |
| Machinery repairs | 8.9 | .16 | 13.3 | .34 | 9.4 | .27 |
| Gasoline | 1.2 | .01 | 6.2 | .06 | 6.8 | .07 |
| Diesel | 3.0 | .02 | 9.0 | .06 | 14.5 | .13 |
| Fertilizer | 1.0 | .01 | 2.8 | .02 | 7.1 | .08 |
| Herbicides | 1.3 | .01 | 3.5 | .03 | 4.3 | .04 |
| Total | | .68 | | .87 | | .98 |

Several of the large wheat farmers we interviewed had large trucks that were used during off-season to haul grain long distances to or toward terminal markets. This practice utilized both labor and investment that would have been temporarily idle to get a better price on grain.

Of the 80 sample farms, 9 had sole or part ownership of a country grain elevator. Ownership of an elevator provides several possible advantages. In many cases the storage space involved was acquired at a very reasonable price. In all 9 cases observed, the elevator was incorporated. In some situations this provides the possibilities for reduction of income tax liabilities.

Some elevator owners also had dealerships in fertilizer, seed or herbicide along with the elevator business. But the main reason for owning an elevator is that it gives the farmer a chance to bypass a local dealer and possibly save some handling costs. Most of the farmers who owned an elevator claimed to have saved 3-5 cents per bushel in handling costs.

A distinct impression gained from this study was that the large farmer spends considerably more time, effort and money in marketing his wheat than does the average farmer. This is as expected since the larger farmer may be negotiating the sale of 50,000 bushels instead of 5,000.

The 80 farmers interviewed were asked the direct question, "Do you think you get a better price through large volume sales? If so, how much?" Volume price premiums were reported by 30 percent of the operators of the small size group compared to 67 percent in the medium size group and 86 percent in the large size group. The volume premiums ranged from 2 to 10 cents per bushel. Multiplying average premiums by the number of farms in each group gives the following estimate, small size = 0.6¢ per bushel; medium size = 2.4¢ per bushel; and large size = 4.4¢ per bushel. With a 30 bushel yield this would amount to \$.18 per acre for the small size group, \$.72 for the medium size and \$1.32 for the large size group.

Rates of Return. -- Farm budgets were prepared to estimate the effects of after-tax rates of return to equity of such variables as size of farm, incorporation versus individual ownership, level of equity, volume discounts, price premiums and land appreciation.

Budgets were prepared for 1,500, 3,000, 6,000 and 12,000 acre cash grain farms with annual yields and production practices representing the wheat-fallow areas of eastern Montana or western North Dakota. Net taxable income, based on 1970 average prices and government payments, ranged from about \$12,000 to \$125,000. Hence, income taxes become an important item and were estimated and subtracted.

Equity levels of sample farms averaged about 80 percent but varied from 25 to 100 percent. Hence, four equity levels -- 25, 50, 75, and 100 percent -- were budgeted.

With 1970 farm prices, 100 percent equity, no land appreciation and no quantity discounts on inputs or volume price premiums, net income per acre before taxes would rise slightly as size increases. The progressive nature of income taxes would, however, about offset size effects so that under these conditions after-tax rates of return were about 5 percent or less for all four sizes of farms (table 7). At lower equity levels, rates of return were generally lower due to the interest costs. However, on the 12,000 acre farm the rate of return was slightly higher at 75 and 50 percent equity levels than at 100 percent equity. This occurred because added interest costs were offset considerably by lower taxes and total net after-tax income was reduced proportionately less than the reduction in equity.

With average reported volume discounts and price premiums, after tax rates of return are slightly higher, between 5 and 5½ percent, but still no definite size advantage is indicated at high equity levels. At lower equity levels, large farms show some advantages. On the 12,000 acre farm, rates of return to equity rise as equity drops due again to tax savings. The highest rate of return estimated was 6.86 percent which would still not look particularly attractive to off-farm investors. Hence, one would not expect off-farm interests to be investing in large wheat farms if they want a competitive rate of return.

Substantial savings in income taxes through incorporation were found to be possible only on the 12,000 acre farm and above 25 percent equity. In those cases rates of return were raised by .2 to .3 percent.

Table 7. After-tax rates of return to equity for four sizes of farms and four equity levels 1/

| Equity level | Size of Farm (acres of cropland) | | | |
|--|-------------------------------------|--------------|--------------|---------------|
| | 1,500 (%) | 3,000 (%) | 6,000 (%) | 12,000 (%) |
| With no volume discounts on inputs or price premiums and individual ownership | | | | |
| 100% | 5.14 | 4.55 | 4.87 | 4.53 |
| 75% | 4.74 | 4.23 | 4.64 | 4.78 |
| 50% | 3.30 | 3.01 | 3.98 | 4.84 |
| 25% | -1.37 | -1.89 | .13 | 3.59 |
| With average reported volume discounts and price premiums and individual ownership | | | | |
| 100% | 5.14 | 4.77 | 5.29 | 4.96 |
| 75% | 4.74 | 4.55 | 5.31 | 5.43 |
| 50% | 3.30 | 3.66 | 5.04 | 6.04 |
| 25% | -1.37 | - .53 | 2.76 | 6.86 |
| With average reported volume discounts and price premiums for corporations 2/ | | | | |
| 100% | 5.07 | 4.84 | 5.41 | 5.25 |
| 75% | 4.62 | 4.55 | 5.33 | 5.73 |
| 50% | 3.18 | 3.61 | 4.94 | 6.26 |
| 25% | -1.37 | - .53 | 2.57 | 6.79 |

1/ No allowance made for operators labor or management in estimation of net returns.

2/ Taxes on corporation estimated assuming reasonable salaries paid to operators. Corporation assumed to be allowed to retain earnings without payment of retained earnings tax if exhibit reinvestment of earnings.

However, land appreciation possibilities coupled with minimal equity levels to get leverage provides some good rates of return to equity. When a 5 percent annual rate of appreciation on real estate, which was about the average in the Northern Great Plains between 1967 and 1972, is added to the current returns from farming, total rates of return to equity become quite attractive (table 8).

The high rates of return here illustrated, however, are before taxes on capital gains from appreciation. This tax was not estimated due to the difficulty of determining the proper tax rate. These rates of return are high primarily due to leverage or a multiplier effect due to low equity

Table 8. Rates of return to equity with 5 percent annual appreciation in land values 1/

| Equity level | Size of Farm (acres of cropland) | | | |
|--------------|-------------------------------------|-------|-------|--------|
| | 1,500 | 3,000 | 6,000 | 12,000 |
| | (%) | (%) | (%) | (%) |
| 100% | 9.34 | 9.12 | 9.74 | 9.51 |
| 75% | 10.34 | 10.35 | 11.21 | 11.53 |
| 50% | 11.75 | 12.36 | 13.89 | 15.19 |
| 25% | 15.48 | 16.92 | 20.51 | 25.11 |

1/ Returns from appreciation (not taxed) added to after-tax rates of return from current income. Assume average volume discounts and price premiums.

financing. With 25 percent equity, a 5 percent rate of appreciation of an asset will give the owner a 20 percent rate of return to equity. Hence, if land appreciation is expected, it is usually best to own more land at a low equity. Even with the high rate of appreciation in land values the difference in rates of return by size of farm are not large unless equity levels are 50% or less.

Summary and Conclusions. -- Operators of large farms make more money than operators of small farms primarily because they are larger. Rates of return are about equal except at low equity levels for the sizes studied. Discounts on purchased inputs can reduce costs by about \$1.00 per acre and premiums on grain sales can increase income by \$1.32 per acre. However, progressive income taxes and higher costs on some other items offset some of this gain.

Land appreciation raises rates of return on all sizes but slightly more on the larger farms. The main determinant of rate of return is the leverage one gains from low equity. With any land appreciation, operators would likely be better off to own 50 percent equity in a 12,000 acre farm than 100 percent equity in a 6,000 acre farm. Gains from land appreciation were found to be far more significant than gains due to size.

We predict that large wheat farms will continue increasing in numbers and that management rather than capital or other inputs may be the main limitation on rate and extent of growth of large farms.

In passing laws against farming corporations, some states and groups hope to keep off-farm money interests out of farming. On one hand, this is probably not necessary at least in regard to wheat farming because wheat farming, not counting land appreciation, does not appear to be that profitable. On the other hand, laws that keep bona fide farmers from incorporating their businesses, result in raising their federal income taxes under current tax laws.

Due to the changing composition of costs as size of farm increases, good weather and good prices probably help large farms more than they help small farms. Hence, good times will probably promote the growth of large farms at the expense of small farms. Bad times, such as low prices, low government payments or bad weather, will probably slow down the rate of growth of large farms.

A major impact of the growth of large farms will be an adverse impact on small towns in the Great Plains. Large farmers bypass local dealers in purchases and sales. Hence, small town merchants will tend to decline in numbers as large farms increase. This will threaten the viability of many small towns.

The growth in numbers of large farms will promote more use of custom combines, hired bookkeepers, hired tax accountants, the use of fertilizer and the production of wheat. In contrast, more large farms will result in a decrease in total investment in machinery and the percentage of the farm population that are owner-operators. Whether all these changes in our rural economy are desirable are matters that need further study.