LABOR AND MANAGEMENT TIME ALLOCATIONS IN ECONOMIES OF FARM SIZE STUDIES

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Economies of farm size continue to be one of the most important questions facing agricultural economists. The extent of farm size economies is not only important to farmers, but also to rural communities as they adjust to ever larger farms.

Madden examined alternative analytical procedures for studying farm size economies and concluded that the synthetic-firm or economic-engineering approach provides the most reliable results. The reliability of this approach, however, depends upon the accuracy of the input-output coefficients, particularly those that change with farm size. For example, reductions in per unit labor requirements with increases in enterprise size have often been difficult to validate.

An advantage of the economic-engineering approach is that pure size economies can be obtained by holding the quality of management constant. The management time requirements must be increased with farm size to hold management quality constant. Unfortunately little research has been done to determine changes in management time requirements with farm size increases. With the notable exception of a study by Hughes and Stanton of New York dairy farms, the authors were unable to find empirical verification of how management time requirements change with size of farm. Some economies of farm size studies reviewed simply assumed a fixed per acre management time requirement (Krause and Kyle, Faris and Armstrong), but gave no empirical support of their estimates. Other studies (Davis and Madden, Van Arsdal and Elder) based their estimates of management time needs on the number of workers. The source of their data was interviews with professional farm managers or progressive farmers. However, no evidence of the reliability of these estimates was given.

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Data Needs

Economic-engineering studies of crop or crop-livestock farms require information concerning the labor contribution of each worker by season of the year. The labor input of the farm operator presents a more difficult problem than for hired workers. Not only must the researcher specify the total hours per day the operator is willing and able to work during each season, but also the allocation of his time between labor and management. Most importantly, information is needed on how the farmer's time allocation changes with size of farm.

Farm Survey

Farmers in eight counties in central North Dakota were interviewed in 1975 concerning the amount of time spent on labor and management activities. Information was obtained from 97 farmers randomly selected from four farm size groups (Table 1). The farmers operated farms ranging in size from 850 to 5,600 acres. The sample was limited to farmers receiving two-thirds or more of their gross income from grain production.

TABLE 1. FARM SIZE GROUPS BY CROPLAND ACRES AND NUMBER OF FARMERS INTERVIEWED, CENTRAL NORTH DAKOTA GRAIN FARMS, 1975

Farm Size Group	Cropland Acres	Farmers Interviewed
Small	800-1,399	22
Medium	1,400-1,999	26
Large	2,000-2,599	23
Very Large	2,600+	26
TOTAL		97

Each farmer was given a description of activities considered as management and labor to help assure uniformity of responses. Management activities included purchasing inputs, acquisition of land, keeping and using records, information gathering and consultation, marketing of products, supervising labor, and planning. Activities, such as livestock chores, driving tractor, repairing machinery, and others, involving a large proportion of manual labor were classified as labor. This division of activities into labor or

management is arbitrary since the distinction between labor and management is difficult to define in terms of specific activities (Johnson). Some activities classified as management, such as record keeping or purchasing of inputs, also involve labor-type activities. The labor management classification used has two advantages. First, it was easily understood by the farmers interviewed. Second, it fits the data needs of linear programming studies. Labor time is restricted to that which could be drawn upon by an enterprise, leaving overhead activities in the management category.

Labor and management time estimates were obtained from the farmer for "typical" spring fieldwork, spring nonfieldwork, summer, harvest, wet harvest, postharvest, and winter days. "Typical" days were examined throughout the year since the time spent on labor and management varies by season. The labor or management time could occur in the evening or night, as well as during the day. The daily operator labor time for partnerships included time spent on labor by the "dominant" partner, while the daily management time included the management time contributions of all partners.

Labor and Management Time Equations

Farm size studies using the economic-engineering approach typically use linear programming techniques to develop a series of short-run cost curves for plants of increasing sizes. The fixed resources (plant) for a crop farm are usually the number of workers and the size of the machinery complement. When more than two workers are considered, the largest machinery available is typically assumed. More units of the largest equipment are used to complement additional workers.

However, as the number of workers needing supervision increases, the farmer must devote greater time to management activities (especially to supervise and coordinate labor). The farmer's labor contribution must necessarily decrease since he is willing to work only so many hours a day.

The farm survey data were used to develop linear regression equations relating daily operator labor and management time with annual man-months of labor needing

supervision.[1] The results for each season of the year are presented in Table 2. The spring and harvest seasons have been divided into those days when fieldwork is possible and those when it is not due to field conditions.

TABLE 2. SEASONAL BIVARIATE REGRESSION EQUATIONS RELATING DAILY OPERATOR LABOR AND MANAGEMENT TIME WITH THE ANNUAL AMOUNT OF LABOR NEEDING SUPERVISION (MAN-MONTHS), CENTRAL NORTH DAKOTA GRAIN FARMS, 1975

Season	Item	Equation[a]	r^2	Sig. Level
Spring Fieldwork	Labor	L = 13.9-.073X	.07	1%
	Management	M = .9+.090X	.09	1%
Spring Nonfieldwork	Labor	L = 8.4-.105X	.10	1%
	Management	M = 1.8+.145X	.22	1%
Summer	Labor	L = 10.5-.188X	.26	1%
	Management	M = .8+.207X	.40	1%
Harvest	Labor	L = 13.9-.074X	.04	10%
	Management	M = .4+.098X	.19	1%
Wet Harvest	Labor	L = 8.4-.118X	.11	1%
	Management	M = 1.4+.144X	.29	1%
Postharvest	Labor	L = 10.3-.086X	.07	1%
	Management	M = 1.0+.085X	.20	1%
Winter	Labor	L = 3.9-.058X	.04	5%
	Management	M = 2.2+.061X	.08	1%

[a] L = labor hours per day, M = management hours per day, and X = man-months of labor needing supervision.

The sign of the b values indicates that the time used for labor activities decreases while management requirements increase with the amount of labor supervised. The decrease in labor time with man-months of labor supervised is not exactly offset by increased management time since the total time spent per day increased slightly with size of farm. During the two most critical labor periods--spring fieldwork and harvest--long hours are

[1] Labor needing supervision includes hired labor and family labor other than the farm operator or his partner.

worked per day with most of the time devoted to labor; while, in less pressing periods, hours worked per day declined and a larger portion is devoted to management.

The farm operator's labor and management contribution can be easily estimated by substituting the amount of labor supervised into the equations and multiplying by the number of days in each period. The coefficients of determination indicate that a great deal of the variance of operator labor and management contribution is unexplained by the amount of labor supervised. However, all but two of the regression coefficients are significantly different from zero at the 1 percent level. The wide confidence interval indicates that it would be unwise to extend the equations beyond the range of the data from which they were developed. The number of man-months of labor supervised on the survey farms ranged from zero to 50.

Including other variables in multiple regression equations explained more of the variance in labor and management time (Hvinden). Labor time in one or more seasons was inversely related to amount of hired labor, operator's age, and machinery size and directly related to amount of livestock. Management time in one or more seasons was directly related to gross farm sales, amount of labor, farmer's age, years of education, farmland dispersion, and partnerships. The multiple regression equations explained 7 to 38 percent of the variance in daily operator labor time and 21 to 43 percent of daily operator management time depending upon the season.

Annual Management Requirements and Farm Size

The annual time each farmer spent on management was obtained by multiplying the daily management time for each season by the length of the season and summing for all seasons. The relation between annual management time used and farm size measured in man-months of labor supervised is shown in Figure 1.

A large part of total management time was not associated with the amount of labor supervised. Even farmers with no labor to supervise needed to spend time purchasing

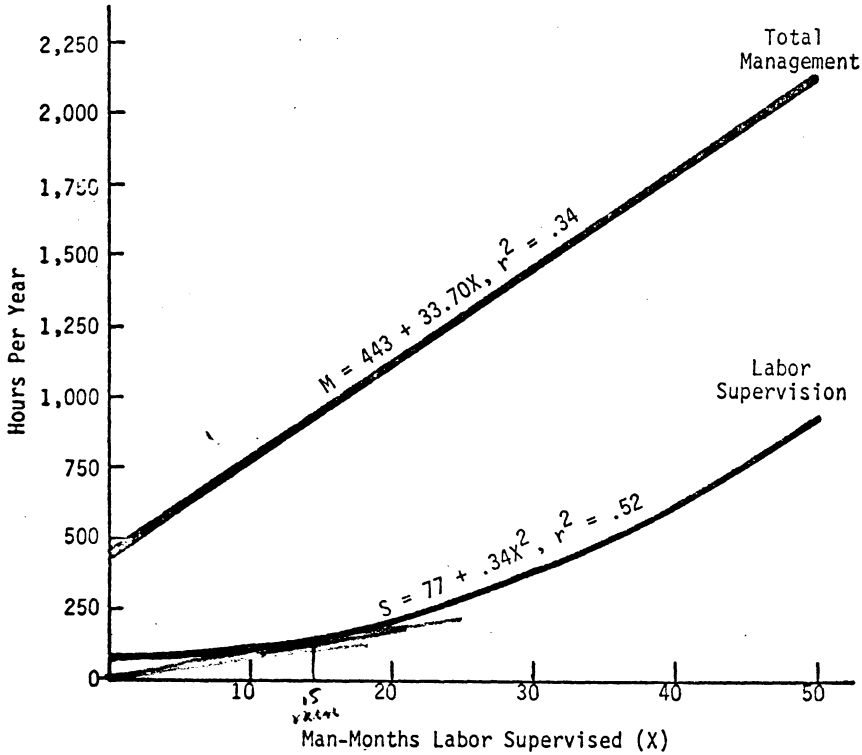

Figure 1. Annual Labor Supervision and Management Time for Varying Amounts of Labor Needing Supervision

inputs, marketing products, record keeping, planning, and gathering information.[2] Due to the fixed time, average management requirements per man-month of labor supervised decline with size of farm. When farm size was measured in gross sales, management time per dollar of gross sales also declined with farm size.

The farmers interviewed estimated the percentage of management time used for labor supervision during each season. This information was converted to annual labor supervision

[2]Much of what is defined as management time in this study represents time used for what is often referred to as farm overhead tasks.

time. The regression equation relating annual labor supervision time to man-months of labor supervised is shown in Figure 1.

The regression equation indicates that the time needed to supervise and coordinate labor increases at an increasing rate with the amount of labor supervised. The data lend support to the argument that diseconomies of size exist in the supervision and coordination of labor. These diseconomies appeared for North Dakota grain farms ranging in size from a one-man farm to one with up to four additional workers. The range of the data was insufficient to determine whether total management time would also increase at an increasing rate with the number of workers supervised.

Conclusions

Specification of how the farm operator's management time requirements change with size of farm has been a serious data void hampering economies of size studies using the economic-engineering approach. Equations derived in this study provide this information for grain farms in central North Dakota. Although time needed to supervise and coordinate labor increased at an increasing rate with labor supervised, total management time increased linearly with this measure of farm size. To evaluate whether management requirements per unit of product eventually increase with farm size requires information from larger farms than included in this study. Studies of labor and management time allocations are needed in other types of farming areas to improve the accuracy of economies of size studies.

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